

CHAPTER IX - RECOMMENDATION

1. PROJECT IMPLEMENTATION

It has been identified that both Nong Pla Lai and Ban Bung Sub-Projects are technically feasible and economically viable, at the Internal Rate of Return (IRR) of 11.3% and 8.2%, respectively. The area has suffered serious shortage of water, and the industrial demand is expected to grow rapidly due to the Fifth Social and Economic Development Plan. It is therefore, recommended that both sub-project be carried forward to the next stage with least lapse of time in due consideration of an enhancement of the national economy, an advancement of the regional development and the promotion of the inhabitants' welfare.

2. CONSTRUCTION PERIOD

Construction period proposed for the projects is extremely tight so that the urgent demand for water in the project area may be satisfied. It is needed, therefore, to forward without delay preparation and procedure required for the implementation of the project.

3. WATER SUPPLY IN LAEM CHABANG AREA

The pipeline route of Dok Krai - Mab Ta Pud, Mab Ta Pud - Sattahip and Dok Krai - Laem Chabang is proposed in the project. However, since the route of Dok Krai - Laem Chabang is extremely costly, it is recommended to make a further study on the potential of water resources development in its vicinity.

4. PURIFICATION AND DISTRIBUTION SYSTEM

Purification and distribution system are not included in the scope of the project in question. Construction of the purification and distribution system is to be shouldered by the local government. Especially for municipal water supply, it is indispensable to construct a purification plant and also important to stabilize potable water supply.

Construction of the above-mentioned purification plant and distribution system will have to be completed at the same time of completion of the project.

5. HOUSE EVACUATION

There are a number of houses which need to be evacuated or moved for implementation of the proposed project, thus causing some social problems. Utmost care should be taken in carrying out the house evacuation program in accordance with the applicable laws and regulations in force.

6. WATER CONTAMINATION

When the possible water contamination in the reservoirs and rivers is anticipated, structural countermeasures as well as enforcement of legal regulations will be necessary.

7. IRRIGATION

This Project covers only a portion of existing as well as possible water demand for irrigation in consideration of the prospect that a huge amount of irrigation water, not only for paddy but also for vegetables and fruits, will be required when the regional development project is realized. Therefore, it is desirable to formulate the master-plan for agricultural development, as a part of the regional development project.

8. HYDROLOGICAL OBSERVATION

To carry out an effective operation of the project and to study further a potential of water resources development, the existing hydrological stations are to be kept in good working order, and it is recommended that at least one station be established in the basins above each dam site.

9. OPERATION AND MAINTENANCE

RID is now in charge of operation and maintenance for the dams and irrigation facilities. However, it has not yet been decided which agency will be in charge of operation and maintenance for the pipeline system. It is urgently required to set up an agency in its charge.

Operation and maintenance rules for the proposed facilities should be studied before the completion of the project to assure orderly distribution of the water developed by the proposed dam.

10. FURTHER STUDY FOR PROJECT IMPLEMENTATION

The study on the following items should be conducted for the next engineering study stage to facilitate successful implementation of the project.

- Topographical maps of the proposed dam site, the proposed pipeline course, the irrigation area and the riparian structure sites.
- Cross levelling and longitudinal survey along the proposed dam axis and the proposed main structure sites and along the proposed pipeline and irrigation canal.
- Geological investigation including boring at the proposed dam site and at its main structure sites, sounding, soil survey and test at the proposed borrow pit sites of the dam construction as well as along the pipeline and the irrigation facilities.
- Test for the embankment materials and concrete strength for dam construction.

Table 2-1 Change of Population of Changwat Chon Buri and Rayong

Unit: Person					
Changwat Rayong	1976	1977	1978	1979	1980
Rayong Municipality	26,250	26,761	27,060	27,516	37,305
A. Muang Rayong	84,582	87,298	89,521	91,433	83,693
A. Klaeng	98,823	92,449	95,242	97,620	100,484
A. Ban Khai	68,941	69,768	70,526	71,049	71,190
K.A. Pluak Daeng	23,910	24,642	24,842	25,648	25,791
K.A. Ban Chang	27,218	27,289	27,181	27,247	27,594
K.A. Wang Chang	-	10,374	11,469	12,391	12,839
Total	329,724	338,481	345,841	352,904	358,896

Unit: Person					
Changwat Chon Buri	1976	1977	1978	1979	1980
Chon Buri Municipality	49,017	49,529	49,855	50,063	50,106
Panat Nikhon M.	13,014	13,130	13,262	13,334	13,411
Tambon Si Racha M.	17,491	18,601	19,773	21,099	21,632
A. Muang Chon Buri	107,454	110,665	114,567	117,384	119,281
A. Panat Nikhon	123,321	126,410	107,000	108,923	110,203
A. Pan Thong	36,739	36,946	37,279	37,779	38,289
A. Ban Bung	76,104	76,284	77,199	77,714	78,262
A. Si Racha	77,993	78,615	80,665	82,062	84,516
A. Ban La Mung	68,870	70,699	43,392	43,925	43,789
A. Sattahip	80,355	80,887	81,963	84,639	85,112
K.A. Ko Si Chang	2,697	2,792	2,815	2,884	2,955
K.A. Nong Yai	16,158	16,674	16,930	17,247	17,386
K.A. Bo Thong	-	-	22,409	23,594	24,779
Muang Pattaya	-	-	29,726	31,777	34,706
Total	669,213	681,232	696,835	712,426	724,427

(Source ; Changwat Registration Office)

Table 2-2 Per Capita Gross Provincial Products in the Eastern Region

Province	Capita in Baht		
	GPP/1972	GPP/1976	Average Growth Rate (Annual)
Chantaburi	3,634	4,140	3.5 %
Chachoengsao	3,395	3,493	0.7 %
Chon Buri	8,049	9,486	4.5 %
Trat	5,097	3,636	-7.2 %
Nakhon Nayok	2,689	3,332	6.0 %
Prachin Buri	2,450	2,820	3.8 %
Rayong	4,869	5,097	1.2 %
Eastern Region Average	4,625	5,145	

Note : GPP-Gross Provincial Products

Source : Dpet. of Town & Country Planning
Ministry of Interior

Table 2-3 Gross Provincial Products in Changwat Chon Buri

Sector	Unit : Million Baht										
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	
Agriculture and Fisheries	1177.4	1384.1	1259.2	1288.7	1322.5	1380.7	1444.9	1517.3	1597.3	1689.1	
Mining & Manufacturing	1464.9	1628.4	1792.2	2013.1	2242.8	2458.5	2682.4	2911.6	3148.6	3386.6	
Services	2209.7	2355.4	2433.5	2602.1	2783.2	2977.5	3185.6	3409.2	3649.5	3907.2	
Total	4852.0	5367.9	5484.9	5903.9	6348.5	6816.7	7312.9	7838.1	8395.4	8982.9	

Note: 1972 - 1976 Actual on 1972 Price
 1977 - 1981 Projection

Source: Dept. of Town & Country
 Planning
 Ministry of Interior

Table 2-4 Existing Water Supply Systems in Chon Buri & Rayong (1980)

Changwat	Water Supply Location	Service Area	Source of Water	Capacity CM/day	Population	Percentage Water Users	Water Supply Record CM/Year			Fare Baht/CM		
							1977	1978	1979		1980	
Chon Buri	Chon Buri	A. Muang A. Si Racha	Bang Phra Res.	48,000	164,300	55.1%	10,858,727	11,478,293	11,610,306	12,033,720	2	
	Panut Nikhom	A. Panut Nikhom	Huayserica	1,440	15,200	44.76%	390,264	414,566	263,677	264,019	2	
	Ban Bung	A. Ban Bung	Changnam Luor Huay Mai Fai	480	6,690	39.73%	141,593	105,129	120,603	85,367	2	
	Nu Klua	Pattaya	Marptra Chan Res.	1,920 24,000	33,600	17.25%	219,170	302,699	226,975	295,010	2	
	Ao Udon	Ao Udon	N.A.	N.A.	N.A.	N.A.	--	195,128	117,849	194,400	2	
	Nong Yai	Nong Yai	N.A.	N.A.	N.A.	N.A.	--	13,811	14,734	22,000	3	
	Pan Thong	Pan Thong	N.A.	N.A.	N.A.	N.A.	--	55,869	36,716	43,200	3	
	Tanbon Mie	Tanbon Mie	N.A.	N.A.	N.A.	N.A.	--	--	30,940	36,000	3	
	Rayong	Rayong	A. Muang	Bung Taseipete to Fai San Khai	6,720	28,900	66.02%	1,297,580	1,548,695	1,337,485	N.A.	2
		Preese	A. Kiang	Klong Plo	2,400	6,340	24.73%	--	--	39,125	155,594	2
Pluak Daeng		A. Pluak Daeng	N.A.	N.A.	N.A.	N.A.	--	11,614	15,082	14,680	3	
Ban Khai		A. Ban Khai	Irrigation Canal	N.A.	N.A.	N.A.	--	23,873	25,495	27,153	3	
Ban Chang		K.A. Ban Chang	N.A.	N.A.	N.A.	N.A.	--	61,249	51,267	61,883	4	
Ban Khuen		Ban Khuen	N.A.	N.A.	N.A.	N.A.	--	124,637	134,861	142,723	2	

Note: N.A. ; Not available

-- ; Before operation of water supply.

Table 2-5 Existing Reservoirs for Water Supply

	Ban Phra	Ban Bung	Map Prachan	Dok Krai	Nong Kho* (Under Construction)
Changwat	Chon Buri	Chon Buri	Chon Buri	Rayong	Chon Buri
River	Huai Skuhrid	Huai Khlong, Yai tributary of Ban Pakong River	Huai Nong	Khlong Dok Krai in the watershed of the Rayong River	Khoong Nong Kho
Year of Completion	1974	1958	1979	1975	1983
Catchment Area (km ²)	130	53	32	291	51
Annual Rainfall (mm)	1,306	1,150	1,258	1,500	1,224
Annual Inflow (MCM)	31.4	13	14	101	16
Water Utilization Capacity (MCM)	(106)	(1.5)	(13)	49	18
Gross Storage Capacity (MCM)	110	1.9	14.8	71	20
Main Purposes & Consumption	Tapioca factory: 0.3 MCM/Y Veneer: 0.1 MCM/Y Oil Refinery: 3.2 MCM/Y	Sugar Refinery: 1.8 MCM/Y	City water: (Pattaya) 8 MCM/Y Irrigation: 80 ha	Irrigation: 4,800 ha	Irrigation and Industrial use

Note : Figure in parenthesis shows estimated capacity.

* Under construction

Table 3-1 Future Population Based on Current Trend

Unit: Person

Changwat Rayong	Future Population			Population Increase	
	1980	1990	2000	1980-1990	1980-2000
Rayong Municipality <u>1/</u>	37,305	56,629	79,773	19,324	42,468
A. Muang <u>1/</u>	83,693	90,474	93,065	6,781	9,372
A. Klaeng	100,484	127,383	154,338	26,899	53,854
A. Ban Khai	71,190	77,522	83,524	6,332	12,334
K.A. Pluak Daeng	25,791	30,804	35,676	5,013	9,885
K.A. Ban Chang <u>1/</u>	27,594	28,264	29,047	670	1,453
K.A. Wang Chang	12,839	21,414	29,834	8,575	16,995
Total	358,896	432,490	505,257	73,594	146,361

Unit: Person

Changwat Chon Buri	Future Population			Population Increase	
	1980	1990	2000	1980-1980	1980-2000
Chon Buri Municipality	50,106	52,897	55,557	2,791	5,451
Panat Nihon M.	13,411	14,408	15,392	997	1,981
Tambon Si Racha M. <u>1/</u>	21,632	32,611	43,339	10,979	21,707
A. Muang Chon Buri	119,281	150,115	180,290	30,834	61,009
A. Panat Nihon	110,203	126,154	142,024	15,951	31,821
A. Pan Thong	38,289	42,069	45,957	3,780	7,668
A. Ban Bung <u>2/</u>	78,262	83,894	89,555	5,632	11,293
A. Si Racha <u>1/</u>	84,516	100,426	116,795	15,910	32,279
A. Ban La Mung	43,789	45,824	47,765	2,035	3,976
A. Sattahip	85,112	98,377	111,528	13,265	26,416
K.A. Ko Si Chang	2,955	3,553	4,157	598	1,202
K.A. Nong Yai	17,386	20,486	23,491	3,100	6,105
K.A. Bo Thong	24,779	36,579	48,372	11,800	23,593
Muang Pattaya	34,706	59,380	84,173	24,674	49,467
Total	724,427	866,773	1,008,395	142,346	283,968

1/: Nong Pla Lai Sub-Project

2/: Ban Bung Sub-Project

Table 3-2 Projection of Induced Population and Labor Force by Area (1990)

Area	Projects	Unit: Person						
		direct workers	indirect workers	induced workers	local workers	1980-1990 net natural growth ^{4/}	expected work force (40%)	net induced population (50%)
Sattahip	Soda Ash ^{1/}	800	400	640	560	13,265		
	Sea port ^{2/}	5,280	1,186	1,056	5,410	335		
	SUB TOTAL	6,080	1,586	1,696	5,970	13,600	5,440 -	6,800
Laem Chabang	Sea port ^{3/}	-	-	-	-	10,979		
	Industrial Estate ^{2/}	7,500	3,750	6,000	5,250	15,910		
	SUB TOTAL	7,500	3,750	6,000	5,250	26,889	10,756 -	13,445
Rayong	Sponge Iron ^{1/}					335		
	Natural Gas Separation					19,324		
	Petro Chemical	9,464	4,732	7,571	6,625	6,781		
	Chemical Fert. Industrial Estate	12,500	6,250	10,000	8,750	6,332		
	SUB TOTAL	21,964	10,982	10,571	15,375	32,772	13,109 -	16,386
	SUB TOTAL							70,284

Note: ^{1/} 100% operation ; ^{2/} 50% operation ; ^{3/} 0%

^{4/} Sattahip .. A. Sattahip + 1/2 K.A. Ban Chang, Laem Chabang .. Si Racha M. + A. Si Racha Rayong-Sattahip.. 1/2 K.A. Ban Chang + Rayong M. + A. Muang + A. Ban Khai

^{5/} The long term plan of Chonburi states that the labor force is 46% of the population and employment is 16% of the total population. Population & Housing Census-1970 indicates that employment population for Chonburi and Rayong are 41.9%, 43.6% of the population respectively.

Table 3-3 Projection of Induced Population and Labor Force by Area (2000)

		Unit: Person						
Area	Projects	direct workers	indirect workers	induced workers	local workers	1980-2000 net natural growth	expected work force	net induced population
Sattahip	Soda Ash	800	400	640	560	26,416		
	Sea port	10,560	2,371	2,112	10,819	726		
	SUB TOTAL	11,360	2,771	2,752	11,379	27,142	10,857 - 13,571	11,008
Laem Chabang	Sea port / <u>1</u>	2,112	474	422	2,164	21,707		
	Industrial Estate	15,000	7,500	12,000	10,500	32,279		
	SUB TOTAL	17,112	7,974	12,422	12,664	53,986	21,594 - 26,993	49,688
Rayong	Sponge Iron					726		
	Natural Gas Separation					42,468		
	Petro Chemical	9,464	4,732	7,571	6,625	9,372		
	Chemical Fert. Industrial Estate	25,000	12,500	20,000	17,500	12,334		
SUB TOTAL	34,464	17,232	27,571	24,125	64,910	25,964 - 32,455	110,284	

/1 20% operation

Table 3-4 Water Demand for Industrial Use (Nong Pla Lai Sub-Project)

Unit: MCM/Year

Year	Rayong Area		Sattahip Area		Sub-total		Laem Chabang Area		Total			
	Plant Demand	Increase Demand	Plant Demand	Increase Demand	Demand	Increase Demand	Plant Demand	Increase Demand	Demand	Increase Demand		
1984	Gas Separation Petrochemical	7.8	7.8			7.8	7.8			7.8	7.8	
1985	Sponge Iron	1.0	8.8			1.0	8.8			1.0	8.8	
	Chemical Fertilizer	9.5	18.3	Soda Ash	10.2	10.2	19.7	28.5	Industrial Estate	3.3	23.0	31.8
1986	Industrial Estate	2.4	20.7	Sattahip Port	2.1	12.3	4.5	33.0			4.5	36.3
1990	Industrial Estate	2.4	23.1	Sattahip Port	1.4	13.7	3.8	36.8	Industrial Estate	3.3	6.6	43.4
1995									Industrial Estate	3.6	10.2	47.0
				Sattahip Port	0.6	14.3	0.6	37.4	Laem Chabang Port	1.8	12.0	49.4
1996			Sattahip Port	1.2	15.5	1.2	38.6	Industrial Estate	3.0	15.0	53.6	
2000	Industrial Estate	4.8	27.9	Sattahip Area	1.7	17.2	6.5	45.1	Laem Chabang Port	1.8	16.8	61.9

Table 3-5 Water Demand for Industrial and Municipal Use (Nong Pla Lai Sub-Project)

Year	Rayong						Sattahip						Laem Chabang						Total	Unit: MCM/Year		
	Industry-related municipal		Other municipal		Total		Industry-related municipal		Other municipal		Total		Industry-related municipal		Other municipal		Total					
	Industry-related municipal	Other municipal	Industry	Total	Industry-related municipal	Other municipal	Industry	Total	Industry-related municipal	Other municipal	Industry	Total	Industry-related municipal	Other municipal	Industry	Total	Industry-related municipal	Other municipal			Industry	Total
1980	-	1.5	-	1.5	-	0.3	0.3	-	1.8	-	1.8	-	0.3	-	-	0.3	-	-	-	-	2.1	1980
1981	-	1.8	-	1.8	-	0.6	0.6	-	2.4	-	2.4	-	0.5	-	-	0.5	-	-	-	-	2.9	1981
1982	-	2.1	-	2.1	-	0.9	0.9	-	3.0	-	3.0	-	0.7	-	-	0.7	-	-	-	-	3.7	1982
1983	-	2.4	-	2.4	-	1.1	1.1	-	3.5	-	3.5	-	1.0	-	-	1.0	-	-	-	-	4.5	1983
1984	7.8	2.7	-	10.5	-	1.4	1.4	7.8	4.1	11.9	-	1.3	-	-	1.3	-	-	-	-	-	5.4	1984
1985	18.3	3.0	-	21.3	10.2	1.7	12.2	28.5	4.7	33.5	3.3	7.8	1.7	1.6	6.6	6.6	31.8	2.0	6.3	40.1	1985	
1986	20.7	3.2	-	27.6	12.3	2.0	14.9	33.0	5.2	42.5	3.3	1.7	1.8	1.8	6.8	6.8	36.3	6.0	7.0	49.3	1986	
1987	20.7	3.5	-	27.9	12.3	2.3	15.2	33.0	5.8	43.1	3.3	1.7	2.1	2.1	7.1	7.1	36.3	6.0	7.9	50.2	1987	
1988	20.7	3.8	-	28.2	12.3	2.5	15.4	33.0	6.3	43.6	3.3	1.7	2.4	2.4	7.4	7.4	36.3	6.0	8.7	51.8	1988	
1989	20.7	4.1	-	28.5	12.3	2.8	15.7	33.0	6.9	44.2	3.3	1.7	2.6	2.6	7.6	7.6	36.3	6.0	9.5	51.8	1989	
1990	23.1	4.4	-	36.0	13.7	3.1	17.6	36.8	7.5	53.6	6.6	3.4	3.4	3.4	12.9	12.9	43.4	12.7	10.4	66.5	1990	
1991	23.1	4.9	-	36.5	13.7	3.3	17.8	36.8	8.2	54.3	6.6	3.4	3.2	2.9	13.2	13.2	43.4	12.7	11.4	67.5	1991	
1992	23.1	5.3	-	36.9	13.7	3.5	18.0	36.8	8.8	54.9	6.6	3.4	3.4	3.4	13.4	13.4	43.4	12.7	12.2	68.3	1992	
1993	23.1	5.8	-	37.4	13.7	3.8	18.3	36.8	9.6	55.7	6.6	3.4	3.7	3.7	13.7	13.7	43.4	12.7	13.3	69.4	1993	
1994	23.1	6.3	-	37.9	13.7	4.0	18.5	36.8	10.3	56.4	6.6	3.4	3.9	3.9	13.9	13.9	43.4	12.7	14.2	70.3	1994	
1995	23.1	6.8	-	38.4	14.3	4.2	19.4	37.4	11.0	57.8	12.0	6.0	4.2	4.2	22.2	22.2	49.4	15.4	15.2	80.0	1995	
1996	23.1	8.0	-	39.6	15.5	4.4	21.1	38.6	12.4	60.7	15.0	7.0	4.5	4.5	26.5	26.5	53.6	16.7	16.9	87.2	1996	
1997	23.1	9.2	-	40.8	15.5	4.6	21.3	38.6	13.8	62.1	15.0	7.0	4.7	4.7	26.7	26.7	53.6	16.7	18.5	88.8	1997	
1998	23.1	10.4	-	42.0	15.5	4.9	21.6	38.6	15.3	63.6	15.0	7.0	5.0	5.0	27.0	27.0	53.6	16.7	20.3	90.6	1998	
1999	23.1	11.6	-	43.2	15.5	5.1	21.8	38.6	16.7	65.0	15.0	7.0	5.2	5.2	27.2	27.2	53.6	16.7	21.9	92.2	1999	
2000	27.9	15.5	-	56.0	17.2	5.3	24.0	45.1	17.9	80.0	16.8	7.0	5.5	5.5	29.3	29.3	61.9	24.0	23.4	109.3	2000	

Note: Rayong includes Rayong Municipality, Amphoe Muang Rayong, King Amphoe Ban Chang, Amphoe Ban Khai.
Sattahip includes Amphoe Sattahip.
Laem Chabang includes Amphoe Si Racha, Si Racha Municipality.

**Table 3-6 Water Demand for Industrial and
Municipal Use (Ban Bung Sub-Project)**

Unit: MCM

Year	Industry	Municipality	Total
1980	1.8	1.3	3.1
1981	1.8	1.4	3.2
1982	1.8	1.5	3.3
1983	1.8	1.6	3.4
1984	1.8	1.7	3.5
1985	1.8	1.8	3.6
1986	1.8	2.0	3.8
1987	2.0	2.1	4.1
1988	2.3	2.3	4.6
1989	2.6	2.4	5.0
1990	2.9	2.5	5.4
1991	3.0	2.6	5.6
1992	3.2	2.7	5.9
1993	3.4	2.9	6.3
1994	3.6	3.0	6.6
1995	3.8	3.2	7.0
1996	4.0	3.4	7.4
1997	4.2	3.6	7.8
1998	4.4	3.8	8.2
1999	4.6	4.0	8.6
2000	4.8	4.2	9.0

Table 3-7 Water Demand of Nong Pla Lai Irrigation Area (Cropping Intensity 180%)

Unit: MCM

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	ANNUAL
1968	6.68	1.13	0.00	12.35	11.59	9.38	9.48	6.63	0.00	0.67	7.16	6.01	71.14
1969	5.33	0.88	0.51	10.33	8.56	5.92	5.72	5.55	0.00	1.45	2.30	6.98	53.59
1970	2.81	0.95	0.27	12.89	8.67	7.19	9.48	5.21	0.00	4.47	8.15	8.79	60.93
1971	4.87	1.01	0.56	14.92	8.26	5.57	6.96	7.40	0.00	4.47	8.84	9.67	72.58
1972	2.85	1.93	0.29	15.83	14.77	3.21	10.46	4.86	0.00	3.47	8.84	6.77	73.34
1973	5.72	0.74	0.29	12.58	10.22	4.72	7.26	5.10	0.00	4.47	7.42	8.77	67.33
1974	2.83	0.91	0.46	14.56	9.49	4.19	0.00	5.87	0.00	1.31	8.84	7.31	55.80
1975	5.10	0.90	0.43	12.80	10.02	6.37	3.53	6.35	0.00	4.47	6.80	8.25	65.09
1976	4.50	0.98	0.61	17.24	6.47	7.21	5.19	6.41	0.00	3.45	8.84	9.68	70.61
1977	5.00	1.18	0.49	5.23	12.70	7.25	6.35	7.14	0.00	1.27	4.70	10.05	61.43
1978	4.90	1.21	0.28	8.21	11.29	6.44	9.54	6.91	0.00	4.47	6.46	9.66	69.41
1979	4.53	1.84	0.25	12.84	14.97	6.26	10.12	7.40	0.00	4.47	8.84	7.13	78.69
1980	4.20	1.76	0.28	10.16	8.12	8.37	6.82	6.10	0.00	4.47	8.04	8.56	66.88

Table 3-8 Water Demand of Thap Ma Irrigation Area (Cropping Intensity 180%)

Unit: MCM

	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	ANNUAL
1968	11.71	1.98	0.00	21.65	20.32	16.45	16.62	11.62	0.00	1.17	12.55	10.70	124.74
1969	9.35	1.54	0.89	18.11	15.01	10.38	10.03	9.73	0.00	2.54	4.03	12.24	93.97
1970	4.93	1.67	0.47	22.08	15.20	12.61	16.62	9.14	0.00	7.84	14.29	15.41	106.84
1971	8.54	1.77	0.98	26.16	14.48	9.76	12.20	12.96	0.00	7.84	15.50	16.96	127.26
1972	5.00	3.38	0.51	27.76	25.90	5.63	18.34	8.52	0.00	6.08	15.50	11.87	128.60
1973	10.03	1.30	0.51	22.06	17.92	8.28	12.73	8.94	0.00	7.84	13.01	15.38	118.06
1974	4.96	1.60	0.81	25.53	16.64	7.35	0.00	10.29	0.00	2.30	15.50	12.82	97.84
1975	8.94	1.58	0.75	22.44	17.57	11.17	6.19	11.13	0.00	7.84	11.92	14.47	114.13
1976	7.89	1.72	1.07	30.23	11.34	12.64	9.10	11.24	0.00	6.05	15.50	16.97	123.81
1977	8.77	2.07	0.86	9.17	22.27	12.71	11.13	12.52	0.00	2.23	8.24	17.62	107.71
1978	8.59	2.12	0.49	14.40	19.80	11.29	16.73	12.12	0.00	7.84	11.33	16.94	121.71
1979	7.94	3.23	0.44	22.51	26.25	10.98	17.74	12.98	0.00	7.84	15.50	12.50	137.98
1980	7.36	3.09	0.49	17.81	14.24	14.68	11.96	10.70	0.00	7.84	14.10	15.01	117.27

Table 3-9 Water Balance of Supply and Demand

Unit: MCM/Year

Year	Nong Pla Lai Sub-Project Area				Ban Bung Sub-Project Area			
	Water Demand		Water Supply	Water Balance	Water Demand		Water Supply	Water Balance
	Ind.&Mun.	Irrigation			Ind.&Mun.			
1980	2.1	-	2.1	- 2.1	3.1	(2.3)	- 0.8	
81	2.9	-	2.9	- 2.9	3.2	(2.3)	- 0.9	
82	3.7	-	3.7	- 3.7	3.3	(2.3)	- 1.0	
83	4.5	-	4.5	- 4.5	3.4	(2.3)	- 1.1	
/1 84	13.2	-	13.2	9.6	3.5	(2.3)	- 1.2	
85	40.1	-	40.1	-17.3	3.6	(2.3)	- 1.3	
/2 86	49.3	69.4	118.7	30.7	3.8	9.0	5.2	
87	50.2	69.4	119.6	69.4	4.1	9.0	5.9	
88	51.0	69.4	120.4	29.0	4.6	9.0	5.4	
89	51.8	69.4	121.2	28.2	5.0	9.0	4.0	
90	66.5	69.4	135.9	13.5	5.4	9.0	4.6	
91	67.5	69.4	136.9	12.5	5.6	9.0	4.4	
92	68.3	69.4	137.7	11.7	5.9	9.0	4.1	
93	69.4	69.4	138.8	10.6	6.3	9.0	3.7	
94	70.3	69.4	139.7	9.7	6.6	9.0	3.4	
/3 95	80.0	128.1	208.1	22.2	7.0	9.0	2.0	
96	87.2	128.1	215.3	15.0	7.4	9.0	1.6	
97	88.8	128.1	216.9	13.4	7.8	9.0	1.2	
/4 98	90.6	194.7	285.3	11.6	8.2	9.0	0.8	
99	92.2	194.7	286.9	10.0	8.6	9.0	0.4	
2000	109.3	194.7	304.0	- 7.1	9.0	9.0	0	

/1 Completion of Water Transmission System between Dok Krai Dam and Mab Ta Fud.

/2 Completion of Khlong Yai Dam /4 Completion of Thap Ma Dam

*Figure in parenthesis shows vested right water of the existing Ban Bung.

Table 4-1 Area and Discharge of Turnout in Irrigation Blocks

Block No.	Area (ha)	Turnout No.	Discharge (m ³ /sec)	Lateral Canal No.
B-1	92	T-1	0.247	
B-2	86	T-2	0.230	
B-3	21	T-3	0.056	
B-4	20	T-4	0.054	
B-5	218	T-5	0.584	L-1
B-6	87	T-6	0.233	L-2
B-7	125	T-7	0.335	
B-8	166	T-8	0.445	
B-9	92	T-9	0.247	
B-10	122	T-10	0.327	
B-11	163	T-11	0.437	
B-12	115	T-12	0.308	
B-13	63	T-13	0.169	L-3
B-14	30	T-14	0.080	L-4
B-15	185	T-15	0.496	L-5
B-16	150	T-16	0.402	
B-17	148	T-17	0.397	L-6
B-18	83	T-18	0.222	L-7
B-19	137	T-19	0.367	
B-20	116	T-20	0.311	
B-21	749	T-21	2.007	L-8
B-22	68	T-22	0.182	L-9
B-23	194	T-23	0.520	L-10
B-24	165	T-24	0.442	L-11
B-25	260	T-25	0.697	L-12

Note: Refer Fig. 4-7.

Table 6-1 Construction Cost of the Project

Unit : million US\$

Item	Grand Total			Nong Pla Lai Sub-Project			Ban Bung Sub-Project		
	L.C.	F.C.	Total	L.C	F.C	Total	L.C.	F.C.	Total
1. Direct Construction Cost	44.82	75.74	120.56	40.09	70.15	110.24	4.73	5.59	10.32
Civil Works	37.73	46.81	84.54	33.08	41.50	74.58	4.65	5.31	9.96
Equipment & materials	7.09	28.93	36.02	7.01	28.65	35.66	0.08	0.28	0.36
2. Road Relocation	0.98	1.60	2.58	0.78	1.30	2.08	0.20	0.30	0.50
3. Compensation	11.12	-	11.12	9.86	-	9.86	1.26	-	1.26
4. Engineering Cost	1.59	14.20	15.79	1.45	11.95	13.40	0.14	2.25	2.39
Sub-total (1-4)	58.51	91.54	150.05	52.18	83.40	135.58	6.33	8.14	14.47
5. Contingencies	45.36	41.44	86.80	40.57	37.59	78.16	4.79	3.85	8.64
Physical Price	7.48	10.75	18.23	6.52	9.52	16.04	0.96	1.23	2.19
Interest during Construction	37.88	30.69	68.57	34.05	28.07	62.12	3.83	2.62	6.45
6. Interest during Construction	-	4.72	4.72	-	4.24	4.24	-	0.48	0.48
Total Project Cost (1-6)	103.87	137.70	241.57	92.75	125.23	217.98	11.12	12.47	23.59

Table 6-2 Construction Cost of Nong Pla Lai Sub-Project

Unit : million US\$

Item	Grand Total			Nong Pla Lai Dam			Water Transmission System						Irrigation and Drainage System					
	L.C.	F.C.	Total	L.C.	F.C.	Total	Dok Krai-Mab Ta Pud		Mab Ta Pud-Sattahp		Dok Krai - Leem Chabang		L.C.	F.C.	Total			
							L.C.	F.C.	Total	L.C.	F.C.	Total				L.C.	F.C.	Total
1. Direct Construction Cost	40.09	70.15	110.24	10.78	14.77	25.55	9.31	24.29	33.60	4.80	10.98	15.78	11.04	17.20	28.24	4.16	2.91	7.07
Civil Works	33.08	41.50	74.58	10.55	14.07	24.62	6.17	10.37	16.54	3.51	5.86	9.37	8.69	8.31	17.00	4.16	2.89	7.05
Equipment & materials	7.01	28.65	35.66	0.23	0.70	0.93	3.14	13.92	17.06	1.29	5.12	6.41	2.35	8.89	11.24	-	0.02	0.02
2. Road Relocation	0.78	1.30	2.08	0.78	1.30	2.08	-	-	-	-	-	-	-	-	-	-	-	-
3. Compensation	9.86	-	9.86	9.37	-	9.37	0.04	-	0.04	0.04	-	0.04	-	-	-	0.41	-	0.41
4. Engineering Cost	1.45	11.95	13.40	0.13	3.02	3.15	0.31	2.11	2.42	0.27	1.80	2.07	0.51	3.46	3.97	0.23	1.56	1.79
Sub-total	52.18	83.40	135.58	21.06	19.09	40.15	9.66	26.40	36.06	5.11	12.78	17.89	11.55	20.66	32.21	4.80	4.47	9.27
5. Contingencies	40.57	37.59	78.16	15.64	9.62	25.26	4.12	7.49	11.61	4.47	6.40	10.87	12.10	11.80	23.90	4.24	2.28	6.52
Physical Price	6.52	9.52	16.04	3.17	2.87	6.04	0.97	2.64	3.61	0.51	1.28	1.79	1.16	2.06	3.22	0.71	0.67	1.38
Interest during Construction	34.05	28.07	62.12	12.47	6.75	19.22	3.15	4.85	8.00	3.96	5.12	9.08	10.94	9.74	20.68	3.53	1.61	5.14
Total (1-6)	92.75	125.23	217.98	36.70	29.85	66.55	13.78	34.94	48.72	9.58	19.72	29.30	23.65	33.71	57.36	9.04	7.01	16.05

Table 7-1 Personnel Required for Operation and Maintenance

	Before completion	After completion	Remark
<u>Dok Krai Dan</u>			
Civil Engr.	2	3	Additional to the existing staff
Mechanical Engr.	4	6	
Operation and Monitor	4	6	
Driver	2	2	
<u>Nong Pla Lai Dan</u>			
Chief	-	1	
Asst. Chief	-	2	
Civil Engr.	-	5	
Mechanical Engr.	-	5	
Operation and Monitor	-	10	
Driver	-	2	
<u>Pipeline System</u>			
Chief	1	1	
Asst. Chief	1	2	
Civil Engr.	2	6	
Mechanical Engr.	4	10	
Operation and Monitor	10	20	
Patrol	4	8	
Driver	2	4	
<u>Irrigation System</u>			
Chief	-	1	Additional to the existing staff
Operation and Monitor	-	4	
Driver	-	2	
<u>Ban Bung Dan</u>			
Civil Engr.	-	2	Additional to the existing staff
Mechanical Engr.	-	2	
Operation and Monitor	-	2	
Driver	-	1	

Table 8-1 Annual Disbursement of Economic Project Cost

Unit : million US\$

Item	Total			1982		1983		1984		1985		1986	
	Total			L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.
	L.C.	F.C.	Total										
I. Nong Pla Lai Sub-Project													
1. Nong Pla Lai Dam	13.62	21.96	35.58	-	-	1.28	2.19	3.90	3.05	6.24	10.84	2.20	5.88
2. Water Transmission System*	27.55	65.24	92.79	0.21	1.42	7.45	21.29	4.58	14.59	8.42	16.70	6.89	11.24
3. Irrigation and Drainage System	3.26	5.14	8.40	-	-	0.10	0.75	0.24	0.64	1.25	1.63	1.67	2.21
Sub-Total (1-3)	44.43	92.34	136.77	0.21	1.42	8.83	24.23	8.72	18.28	15.91	29.17	10.76	19.24
II. Ban Bung Sub-Project	4.86	9.37	14.23	-	-	0.55	1.81	1.31	1.51	2.25	4.50	0.75	1.55
Total	49.29	101.71	151.00	0.21	1.42	9.38	26.04	10.03	19.79	18.16	33.67	11.51	20.79

NOTE * : This cost covers the pipeline route of Dok Krai - Mab Ta Pud, Mab Ta Pud - Sattahip and Dok Krai - Laem Chabang

Table 8-2 Economic Cost of Land Consolidation of
Nong Pla Lai Irrigation Area

	Unit in million US\$				
	Total	1985	1986	1987	1988
1. Base Cost	3.00	0.35	1.00	1.00	0.65
2. Engineering Service	0.12	0.01	0.04	0.04	0.03
3. Compensation	-	-	-	-	-
4. Contingency	0.47	0.04	0.17	0.17	0.09
5. Total	3.59	0.40	1.21	1.21	0.77

Table 8-3 Water Supply and Benefit
(Nong Pla Lai Sub-Project)

Year	Water Supply (MCM)	Benefit (1,000 US\$)
1984	6.2	1,345
1985	16.7	3,624
1986	22.8	4,948
1987	50.2	10,893
1988	51.0	11,067
1989	51.8	11,241
1990	66.5	14,431
1991	67.5	14,648
1992	68.3	14,821
1993	69.4	15,060
1994	70.3	15,255
1995	80.0	17,360
1996		
1997		
1998		
1999		
2000		
2031	80.0	17,360

Table 8-4 Agricultural Production by Crop

	Production Volume (T/ha)	Economic Price (β/T)	Production (β/ha)	Cost (β/ha)	Net Production (β/ha)
Without Project					
Wet Season					
Paddy (L.V.)					
Present (1981)	1.44	5,500	7,700	2,278	5,422
Future (1992)	2.00	6,700	13,400	2,639	10,761
With Project (1992)					
Wet Season					
Paddy (H.Y.V.)	4.00	6,700	26,800	7,342	19,458
Dry Season					
Paddy (H.Y.V.)	4.50	6,700	30,150	8,671	21,479
Groundnuts	1.90	13,020	24,738	10,146	14,592

Table 8-5 Agricultural Net Production by Crop
(Cropping Intensity 180%)

	Plant Area (ha)	NP per ha (β/ha)	Gross Production (1,000β)
Without Project			
Wet Season			
Paddy (L.V.)			
Present (1981)	3,840	5,422	20,820
Future (1992)	3,840	10,761	41,322
With Project (1992)			
Wet Season			
Paddy (H.Y.V.)	3,650	19,458	71,022
Dry Season			
Paddy (H.Y.V.)	975	21,497	20,960
Groundnuts	1,945	14,592	28,381

Table 8-6 Price Structure of Rice/Paddy at Constant 1981 Prices

	1981		1990	
	Financial	Economic	Financial	Economic
Export price, 5% br.				
FOB Bangkok (US\$/ton) /1	510	510	622	622
(B/ton)	10,200	10,200	12,444	12,444
Grade differential (86%) /2	8,770	8,770	10,700	10,700
Rice premium	1,000		1,220	
Export duty	440		540	
Municipal tax	15		18	
Reserve requirement loss	845		1,030	
Exporter's margin /3	440	305	536	370
Wholesaler's margin /3	210	145	256	177
Ex-mill price of rice	5,820	8,320	7,100	10,153
Ex-mill price of paddy	4,190	5,990	5,110	7,310
Tax	90		110	
Miller's margin /4	350	250	430	310
Input price of paddy at mill	3,750	5,740	4,570	7,000
Middleman's margin /3	350	240	430	300
Farm gate price of paddy	3,400	5,500	4,140	6,700

/1 : The World Bank prospect.

/2 : Average of exported white rice excluding parboiled rice over previous five years.

/3 : Conversion factor 0.69 is applied.

/4 : Conversion factor 0.72 is applied.

Table 8-7 Water Supply and Benefit
(Ban Bung)

	Water Supply (MCM)	Benefit (1,000 US\$)
1987	1.8	547
88	2.3	699
89	2.7	821
90	3.1	942
91	3.3	1,003
92	3.6	1,094
93	4.0	1,216
94	4.3	1,307
95	4.7	1,429
96	5.1	1,550
97	5.5	1,672
98	5.9	1,794
99	6.3	1,915
2000	6.7	2,037
2031	6.7	2,037

**Table 8-8 Sensitivity Analysis of Industrial and Municipal Water
for Nong Pla Lai Sub-Project (Economic)**

	Construction cost	Delay of Water Demand	IRR (%)
Base case			10.5
Case 1	10% up		9.5
Case 2	20% up		8.7
Case 3		10 years	8.6

**Table 8-9 Sensitivity Analysis of Industrial and Municipal Water
for Ban Bung Sub-Project (Economic)**

	Construction cost	Delay of Water Demand	IRR (%)
Base case			8.2
Case 1	10% up		7.6
Case 2	20% up		7.0
Case 3		10 years	7.0

Table 8-10 Annual Disbursement of Financial Project Cost

Unit : million US\$

Item	Total		1982		1983		1984		1985		1986	
	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.
I. Nong Pla Lai Sub-Project												
1. Nong Pla Lai Dam	36.70	29.85	-	-	3.42	2.54	10.43	3.83	16.37	14.56	6.48	8.92
2. Water Transmission System*	47.01	88.37	0.24	1.54	9.84	25.25	7.73	19.36	15.17	24.21	14.03	18.01
3. Irrigation and Drainage System	9.04	7.01	-	-	0.13	0.87	0.77	0.81	3.54	2.21	4.60	3.12
Sub-Total (1-3)	92.75	125.23	0.24	1.54	13.39	28.66	18.93	24.00	35.08	40.98	25.11	30.05
II. Ban Bung Sub-Project	11.12	12.47	-	-	1.02	2.09	2.55	1.92	5.52	6.08	2.03	2.38
Total	103.87	137.70	0.24	1.54	14.41	30.75	21.48	25.92	40.60	47.06	27.14	32.43

NOTE * : This cost covers the pipeline route of Dok Krai - Mab Ta Pud, Mab Ta Pud - Sattahip and Dok Krai - Laem Chabang

Table 8-11 Income Statement for Industrial and Municipal Use (Nong Pla Lai Sub-Project) (1)

(UNIT: 1000 DOLLAR)

<<< I N C O M E S T A T E M E N T >>>

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1. REVENUE	0.0	0.0	942.4	2538.4	3404.8	7630.4	7752.0	7873.6	10108.0	10260.0
WATER CONSUMPTION (1)	0.0	0.0	6.2	16.7	22.4	50.2	51.0	51.8	66.5	67.5
WATER CONSUMPTION (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RATE (1)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST	0.0	0.0	140.0	650.0	1040.0	1230.0	1240.0	1250.0	1550.0	1560.0
1) OPERATING & MAINTENANCE	0.0	0.0	140.0	650.0	1040.0	1230.0	1240.0	1250.0	1550.0	1560.0
2) INTEREST	0.0	0.0	0.0	0.0	0.0	0.0	2862.6	2862.6	2862.6	2862.6
ON LONG TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	2862.6	2862.6	2862.6	2862.6
ON SHORT TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3) DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	3363.3	3363.3	3363.3	3363.3
4) OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. PROFIT	0.0	0.0	802.4	1888.4	2364.8	6400.4	286.2	397.8	2332.2	2474.2
1. REVENUE	10381.6	10548.8	10685.6	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0
WATER CONSUMPTION (1)	80.0	69.4	70.3	80.0	80.0	80.0	80.0	80.0	80.0	80.0
WATER CONSUMPTION (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RATE (1)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST	7815.8	7805.8	7813.8	7780.3	7723.2	7637.6	7531.6	7425.6	7319.5	7213.5
1) OPERATING & MAINTENANCE	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0
2) INTEREST	2862.6	2862.6	2860.6	2827.0	2770.0	2684.4	2578.3	2472.3	2366.3	2260.3
ON LONG TERM DEPOSIT	2862.6	2862.6	2860.6	2827.0	2770.0	2684.4	2578.3	2472.3	2366.3	2260.3
ON SHORT TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3) DEPRECIATION	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3
4) OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. PROFIT	2565.8	2743.0	2871.8	4379.7	4436.8	4522.4	4628.4	4734.4	4840.5	4946.5
1. REVENUE	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0
WATER CONSUMPTION (1)	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
WATER CONSUMPTION (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RATE (1)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST	7107.5	7001.5	6895.5	6789.4	6683.4	6577.4	6471.4	6365.4	6259.3	6153.3
1) OPERATING & MAINTENANCE	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0
2) INTEREST	2154.3	2048.2	1942.2	1836.2	1730.2	1624.2	1518.1	1412.1	1306.1	1200.1
ON LONG TERM DEPOSIT	2154.3	2048.2	1942.2	1836.2	1730.2	1624.2	1518.1	1412.1	1306.1	1200.1
ON SHORT TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3) DEPRECIATION	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3
4) OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. PROFIT	5052.5	5158.5	5264.5	5370.6	5476.6	5582.6	5688.6	5794.6	5900.7	6006.7

Table 8-11 Income Statement for Industrial and Municipal Use (Nong Pla Lai Sub-Project) (2)

(UNIT: 1000 DOLLAR)

<<< INCOME STATEMENT >>>

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1. REVENUE	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0
WATER CONSUMPTION (1)	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
WATER CONSUMPTION (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RATE (1)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST	6047.3	5941.3	5835.2	5729.2	5623.2	5517.2	5411.2	5305.1	5199.1	5095.1
1) OPERATING & MAINTENANCE	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0
2) INTEREST	1094.0	988.0	882.0	776.0	670.0	563.9	457.9	351.9	245.9	141.8
ON LONG TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ON SHORT TERM DEPOSIT	1094.0	988.0	882.0	776.0	670.0	563.9	457.9	351.9	245.9	141.8
3) DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4) OTHERS	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3
3. PROFIT	6112.7	6218.7	6324.8	6430.8	6536.8	6642.8	6748.8	6854.9	6960.9	7064.9

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
1. REVENUE	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0
WATER CONSUMPTION (1)	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
WATER CONSUMPTION (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RATE (1)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST	5022.0	4973.7	4953.2	4953.2	4953.2	4953.2	4953.2	4953.2	4953.2	4953.2
1) OPERATING & MAINTENANCE	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0	1590.0
2) INTEREST	69.4	20.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ON LONG TERM DEPOSIT	69.4	20.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ON SHORT TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3) DEPRECIATION	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3	3363.3
4) OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. PROFIT	7137.4	7186.3	7206.7	7206.7	7206.7	7206.7	7206.7	7206.7	7206.7	7206.7

Table 8-12 Cash Flow of Nong Pla Lai Sub-Project

Unit : 1000 US\$

YEAR	CAPITAL COST	REVENUE	OPE. & TAX	BENEFIT
1982	1752.4	0.0	0.0	0.0
1983	37980.4	0.0	0.0	0.0
1984	33811.6	942.4	140.0	802.4
1985	53986.1	2538.4	650.0	1888.4
1986	37281.4	3404.8	1040.0	2364.8
1987	0.0	7630.4	1230.0	6400.4
1988	0.0	7752.0	1240.0	6512.0
1989	0.0	7873.6	1250.0	6623.6
1990	0.0	10108.0	1550.0	8558.0
1991	0.0	10260.0	1560.0	8700.0
1992	0.0	10381.6	1590.0	8791.6
1993	0.0	10548.8	1580.0	8968.8
1994	0.0	10685.6	1590.0	9095.6
1995	0.0	12160.0	1590.0	10570.0
2031	0.0	12160.0	1590.0	10570.0

Table 8-13 Income Statement for Industrial and Municipal Use (Ban Bung Sub-Project) (F)

(UNIT: 1000 DOLLAR)

<<< INCOME STATEMENT >>>

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1. REVENUE	0.0	0.0	0.0	0.0	0.0	273.6	349.6	410.4	471.2	501.6
1) WATER CONSUMPTION (1)	0.0	0.0	0.0	0.0	0.0	1.8	2.3	2.7	3.1	3.3
2) WATER CONSUMPTION (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RATE (1)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST	0.0	0.0	0.0	0.0	0.0	100.0	100.0	100.0	1162.0	1162.0
1) OPERATING & MAINTENANCE	0.0	0.0	0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0
2) INTEREST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	425.0	425.0
ON LONG TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	425.0	425.0
ON SHORT TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3) DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	637.1	637.1
4) OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. PROFIT	0.0	0.0	0.0	0.0	0.0	173.6	249.6	310.4	-690.8	-660.4

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1. REVENUE	547.2	608.0	653.6	714.4	775.2	836.0	896.8	957.6	1018.4	1018.4
1) WATER CONSUMPTION (1)	3.6	4.0	4.3	4.7	5.1	5.5	5.9	6.3	6.7	6.7
2) WATER CONSUMPTION (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RATE (1)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST	1162.0	1162.0	1162.0	1158.3	1151.2	1133.9	1112.6	1091.4	1070.1	1048.9
1) OPERATING & MAINTENANCE	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2) INTEREST	425.0	425.0	425.0	421.2	414.1	396.8	375.3	354.3	333.0	311.8
ON LONG TERM DEPOSIT	425.0	425.0	425.0	421.2	414.1	396.8	375.3	354.3	333.0	311.8
ON SHORT TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3) DEPRECIATION	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1
4) OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. PROFIT	-614.8	-554.0	-508.4	-443.9	-376.0	-297.9	-215.8	-133.8	-51.7	-30.5

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1. REVENUE	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4
1) WATER CONSUMPTION (1)	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
2) WATER CONSUMPTION (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RATE (1)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST	1027.6	1006.4	985.1	963.9	942.6	921.4	900.1	878.9	857.7	836.4
1) OPERATING & MAINTENANCE	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2) INTEREST	290.5	269.3	248.0	226.8	205.6	184.3	163.1	141.8	120.6	99.3
ON LONG TERM DEPOSIT	290.5	269.3	248.0	226.8	205.6	184.3	163.1	141.8	120.6	99.3
ON SHORT TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3) DEPRECIATION	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1
4) OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. PROFIT	-9.2	12.0	33.3	54.5	75.8	97.0	118.3	139.5	160.7	182.0

Table 8-13 Income Statement for Industrial and Municipal Use (Ban Bung Sub-Project) (Z)
(UNIT: 1000 DOLLAR)

		I N C O M E S T A T E M E N T											
		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	
1. REVENUE		1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4
WATER CONSUMPTION (1)		6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
WATER CONSUMPTION (2)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RATE (1)		152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)		152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST		815.2	793.9	772.7	755.2	741.0	737.1	737.1	737.1	737.1	737.1	737.1	737.1
1) OPERATING & MAINTENANCE		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2) INTEREST		78.1	56.8	35.6	18.1	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ON LONG TERM DEPOSIT		78.1	56.8	35.6	18.1	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ON SHURT TERM DEPOSIT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3) DEPRECIATION		637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1
4) OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. PROFIT		203.2	224.5	245.7	263.2	277.4	281.3	281.3	281.3	281.3	281.3	281.3	281.3
1. REVENUE		1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4	1018.4
WATER CONSUMPTION (1)		6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
WATER CONSUMPTION (2)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RATE (1)		152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)		152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST		737.1	737.1	737.1	737.1	737.1	737.1	737.1	737.1	737.1	737.1	737.1	737.1
1) OPERATING & MAINTENANCE		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2) INTEREST		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ON LONG TERM DEPOSIT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ON SHURT TERM DEPOSIT		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3) DEPRECIATION		637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1	637.1
4) OTHERS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. PROFIT		281.3	281.3	281.3	281.3	281.3	281.3	281.3	281.3	281.3	281.3	281.3	281.3

Table 8-14 Cash Flow of Ban Bung Sub-Project

Unit : 1000 US\$

YEAR	CAPITAL COST	REVENUE	OPE. & TAX	BENEFIT
1982	0.0	0.0	0.0	0.0
1983	3076.9	0.0	0.0	0.0
1984	4398.3	0.0	0.0	0.0
1985	11413.1	0.0	0.0	0.0
1986	4204.1	0.0	0.0	0.0
1987	0.0	273.6	100.0	173.6
1988	0.0	349.6	100.0	249.6
1989	0.0	410.4	100.0	310.4
1990	0.0	471.2	100.0	371.2
1991	0.0	501.6	100.0	401.6
1992	0.0	547.2	100.0	447.2
1993	0.0	608.0	100.0	508.0
1994	0.0	653.6	100.0	553.6
1995	0.0	714.4	100.0	614.4
1996	0.0	775.2	100.0	675.2
1997	0.0	836.0	100.0	736.0
1998	0.0	896.8	100.0	796.8
1999	0.0	957.6	100.0	857.6
2000	0.0	1018.4	100.0	918.4
2031	0.0	1018.4	100.0	918.4

Table 8-15 Sensitivity Analysis of Industrial and Municipal Water for Nong Pla Lai Sub-Project (Financial)

	Water tariff (US\$/m ³)	Construction cost	Delay of Water Demand	IRR (%)
Base case	0.152			4.9
Case 1-1	0.066			-
1-2	0.130			3.7
1-3	0.218			7.2
Case 2-1		10% up		4.3
2-2		20% up		3.5
Case 3-1			10 years	3.8

Table 8-16 Sensitivity Analysis of Industrial and Municipal Water for Ban Bung Sub-Project (Financial)

	Water tariff (US\$/m ³)	Construction cost	Delay of Water Demand	IRR (%)
Base case	0.152			1.8
Case 1-1	0.174			2.3
1-2	0.218			3.3
1-3	0.304			5.4
Case 2-1		10% up		1.4
2-2		20% up		1.0
Case 3-1			10 years	1.2

Table 8-17 Result of Water Quality Test

Unit: ppm

Item	Location		
	Ban Bung	Hong Pla Lai	Dok Krai
Cadmium	unfound	unfound	unfound
Cyanide	unfound	unfound	unfound
Phosphorus	0.29	0.04	0.03
Chromium	unfound	unfound	unfound
Arsenic	0.001	0.001	0.001

Table 8-18 Mineral Constituent

(Sample, 16 Aug. 1981)

Item		Item	
PH	7.1	Ec x 10 ⁶	100
Ca (ppm)	10	SSP	23
Mg (ppm)	4	SAR	0.4
Na (ppm)	5	RSC	0.01
Total (ppm)	0.1	TS (ppm)	93
Fe		TDS (ppm)	68
Diss (ppm)	0	SS (ppm)	25
Mn	0	Alkalinity as CaCO ₃ (ppm)	40
CO ₃	0	Total hardness as CaCO ₃ (ppm)	40
HCO ₃ (ppm)	49		
Cl (ppm)	8		
SO ₄ (ppm)	2		

PH by glass electrode

Ec x 10⁶ = Electrical conductivity Micromhos/cm

RSC = Residual sodium carbonate

SSP = Solube sodium percentage

SAR = Sodium adsorption ratio

TS = Total solid

TDS = Total dissolved solid

SS = Suspended solid

Table 8-19 Water Analysis at Dok Krai

(Jan. 1979 - Jun. 1981)

Item	Upstream				Downstream			
	Count	Mean	Max.	Min.	Count	Mean	Max.	Min.
PH	25	7.1	7.9	6.4	25	7.1	7.7	6.3
ECX10 ⁶ at 25°C	27	116	130	100	27	145	410	110
SAR	18	0.5	0.6	0.4	18	0.5	0.9	0.2
SSP	18	28	32	25	18	25	36	7
RSC meq/l	18	0.08	0.25	0	18	0.08	0.32	0
Ca(ppm)	18	10.3	11.9	7.5	18	17.3	60.6	8.7
Mg(ppm)	18	3.2	5.1	1.7	18	3.7	10.7	2.4
Na(ppm)	18	6.9	8.1	6.0	18	7.8	17.3	6.0
K (ppm)	-	-	-	-	-	-	-	-
Fe	Total	-	-	-	-	-	-	-
	Diss.	-	-	-	-	-	-	-
CO ₃	0	0	0	0	0	0	0	0
HCO ₃ (ppm)	18	62	237	42	18	71	257	42
Cl (ppm)	18	7.1	8.2	5.7	18	7.1	8.2	5.7
SO ₄ (ppm)	18	1.0	2.9	0	18	6.7	40.3	0
NO ₃ (ppm)	-	-	-	-	-	-	-	-
PO ₄	-	-	-	-	-	-	-	-
B (ppm)	-	-	-	-	-	-	-	-

Table 8-20 Potable Water Quality Standard (WHO)

Item	Standard	Item	Standard
PH	7.0 - 8.5	Cyanide (CN)	0.01 ppm
Iron (Fe)	0.3 ppm	Lead (Pb)	0.1 ppm
Manganese (Mn)	0.1 ppm	Calcium (Ca)	75 ppm
Copper (Cu)	1.0 ppm	Cl ⁻	200 ppm
Zinc (Zn)	5.0 ppm	NH ₄ - N	0.5 ppm
Fluoride	1.0 ppm	NO ₃ - N	40 ppm
Phenols	0.001 ppm	SO ₄ ⁻	200 ppm
Arsenic (As)	0.2 ppm		

Table 8-21 Irrigation Water Quality Standard

Item	Standard
PH	6 - 7
COD	below 6 ppm
T-N	below 1 ppm
Ec	500 $\mu\text{V}/\text{cm}$
Cu	below 0.01 ppm
Zn	below 1 ppm
As	below 0.01 ppm
Mn	below 7 ppm

Table 8-22 Industrial Water Quality Standard

Item	PH	Evaporation Residue (ppm)	Turbidity	Fe + Mn (ppm)	Hardness (CaCO ₃ ppm)
Usage					
Cooling Water	6 - 8	50 - 200	5 - 20	0.1 - 1.0	30 - 100
Boiler Use	6.5 - 7.5	10 - 100	2 - 6	0.05 - 0.5	10 - 60
Washing	6 - 8	80 - 150	2 - 6	0.1 - 1.0	30 - 50
Processing	6.5 - 7.5	50 - 90	1 - 5	0.2 - 0.3	20 - 80
Material	6.5 - 7.5	50 - 80	1 - 5	0.05 - 1.0	30 - 50
Temperature Control	6.5 - 7.5	50 - 100	3 - 10	0.1 - 0.3	20 - 80

Fig. 2-1 Isohyetal Annual Mean Rainfall Map of Thailand

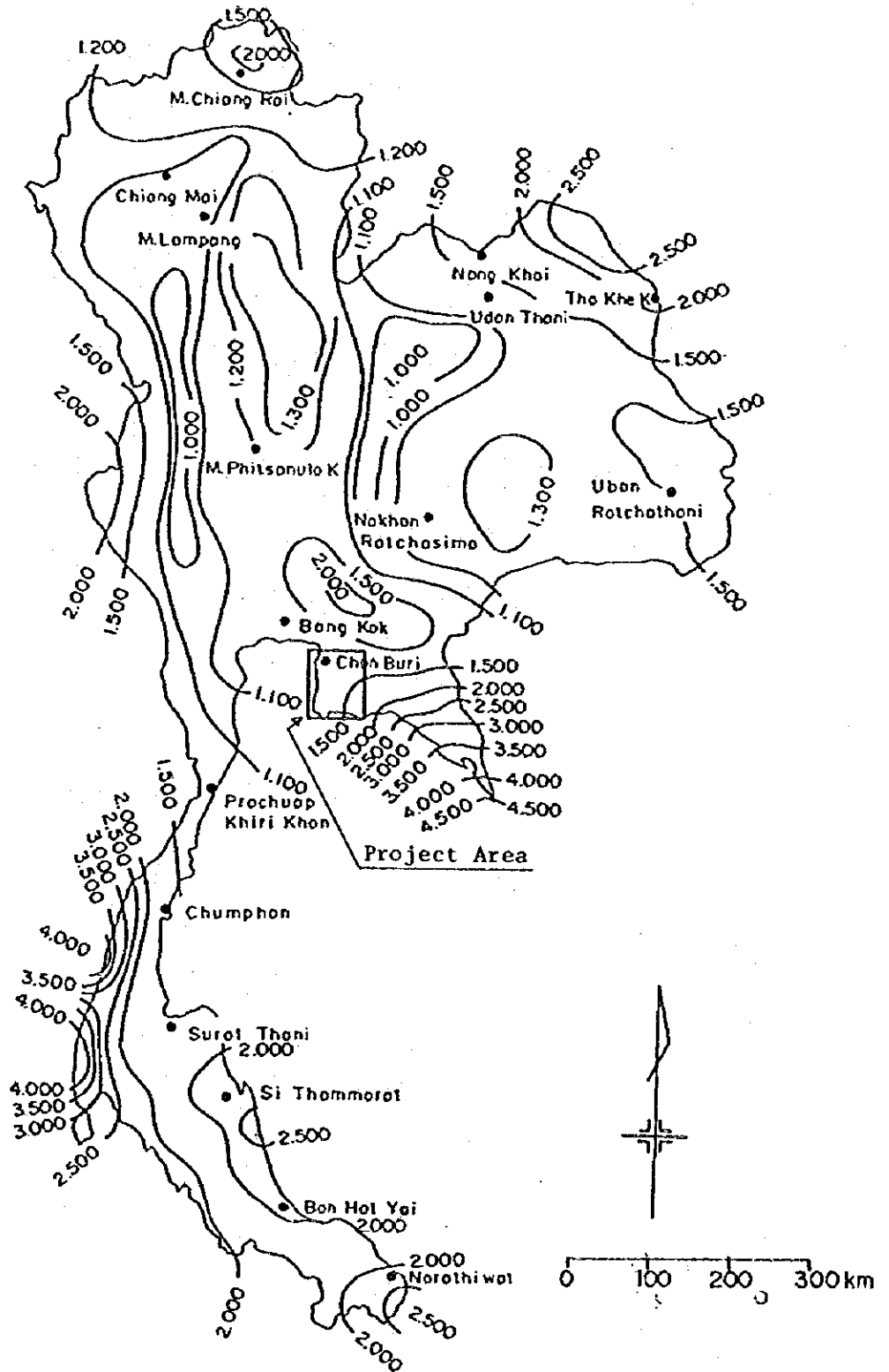


Fig. 2-2 Monthly Mean Rainfall Distribution

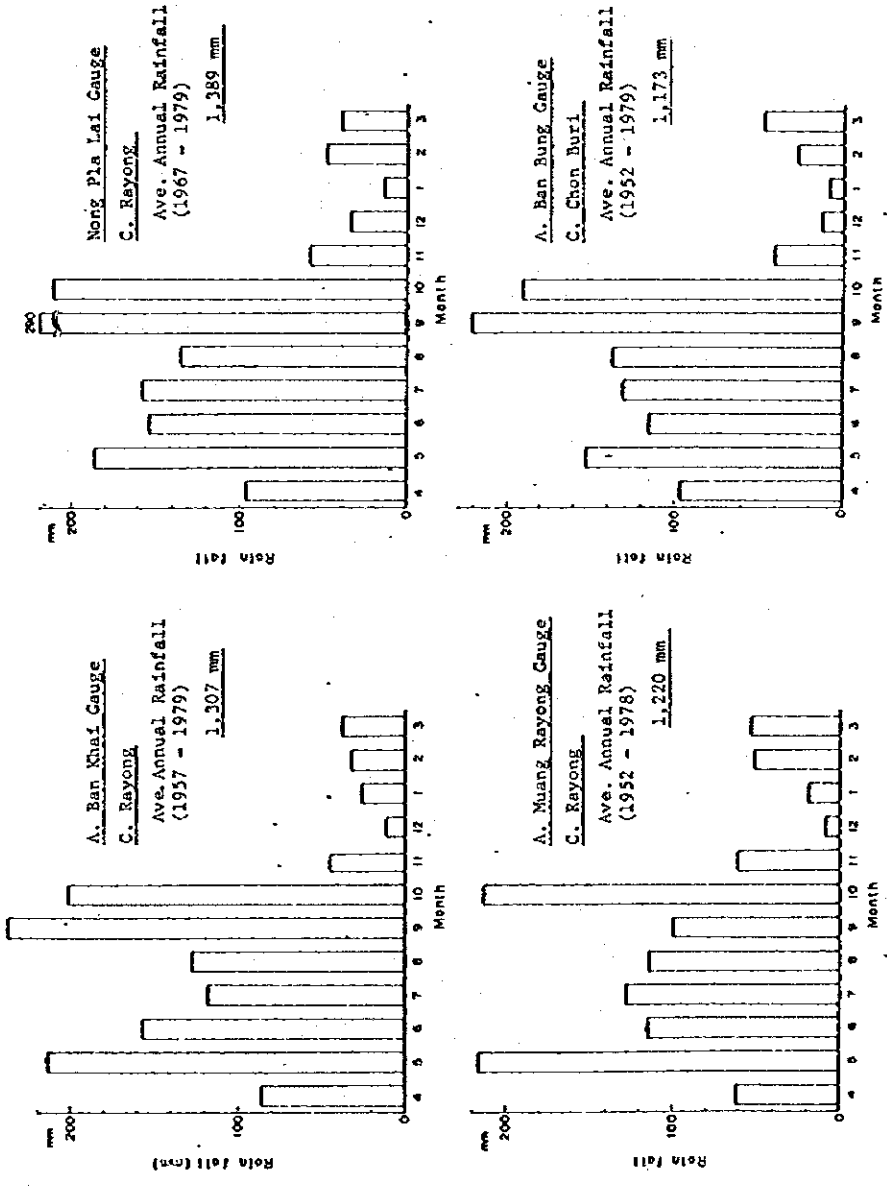


Fig. 2-3 Monthly Mean Evaporation

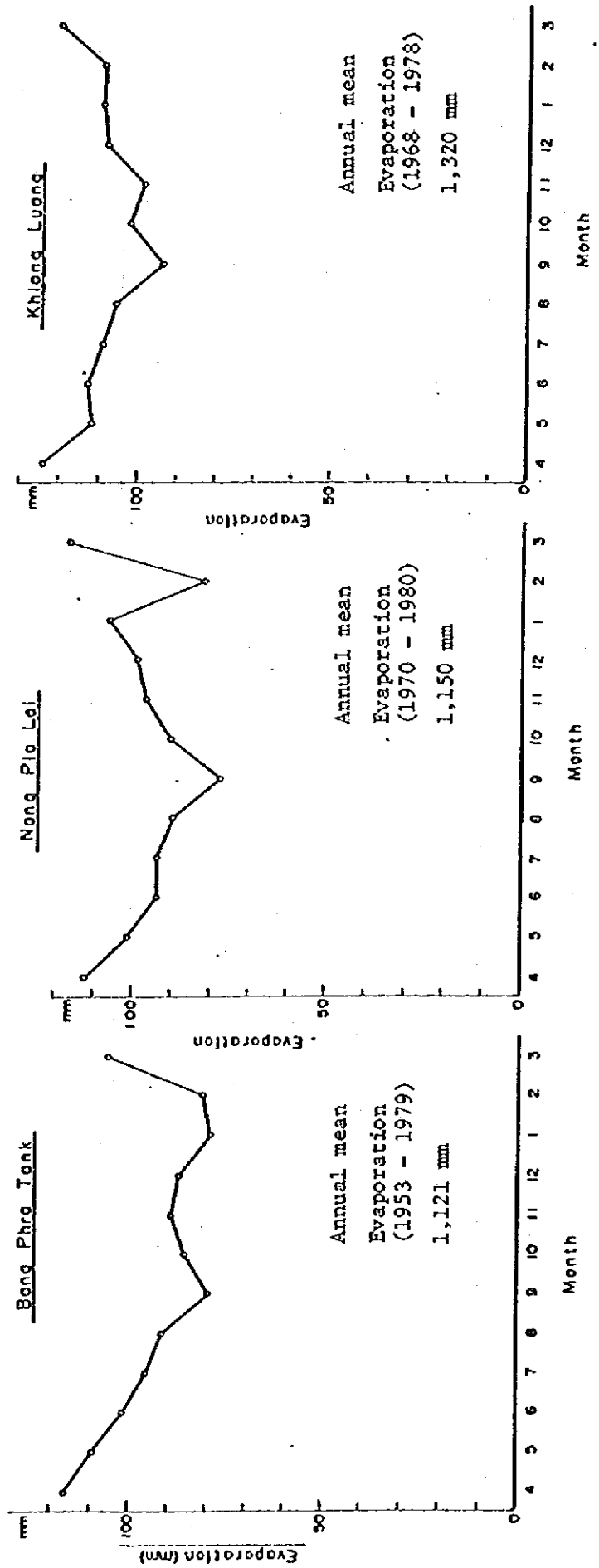


Fig. 2-4 Specific Discharge of Main Flood in Thailand

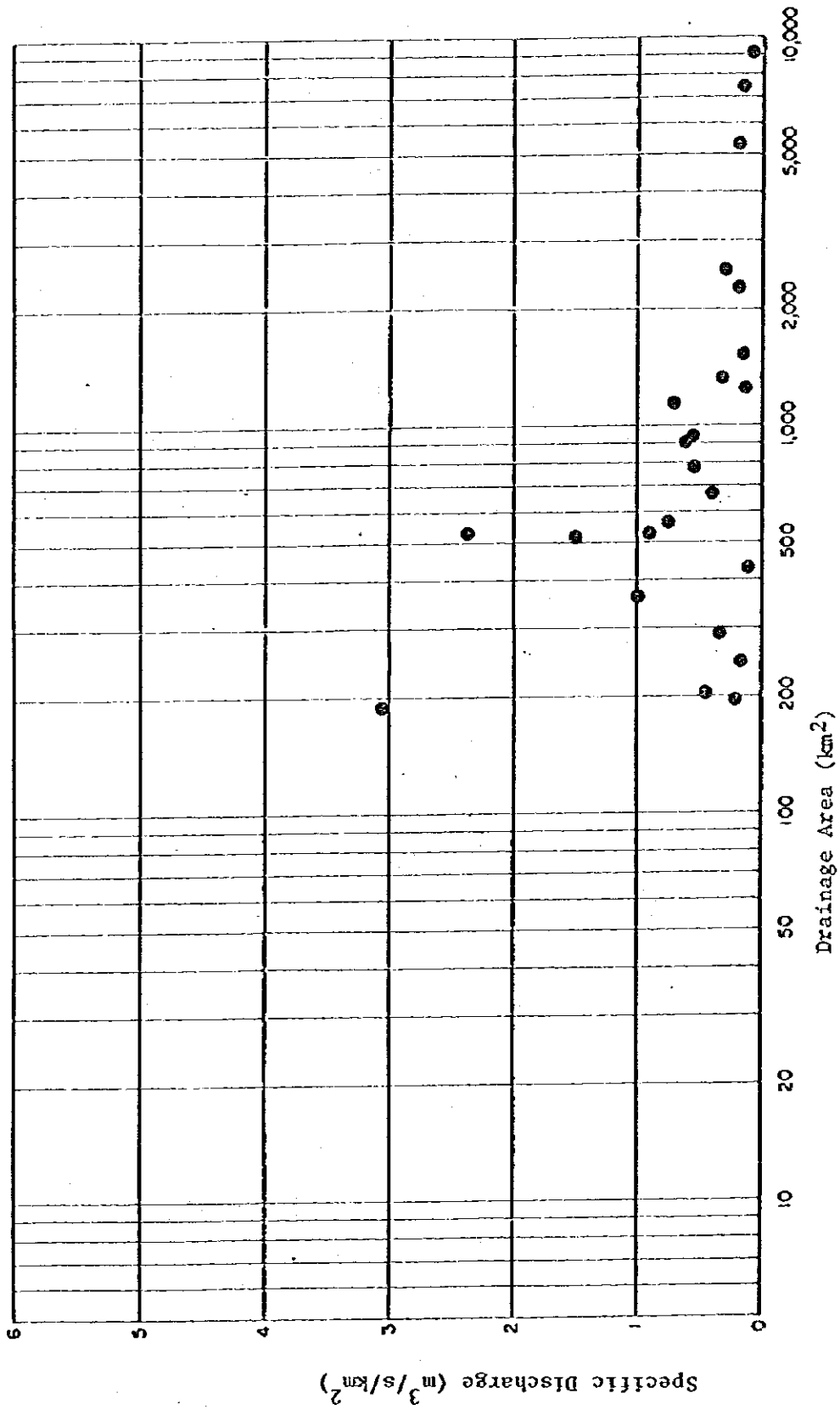


Fig. 2-5 General Map of Rayong River

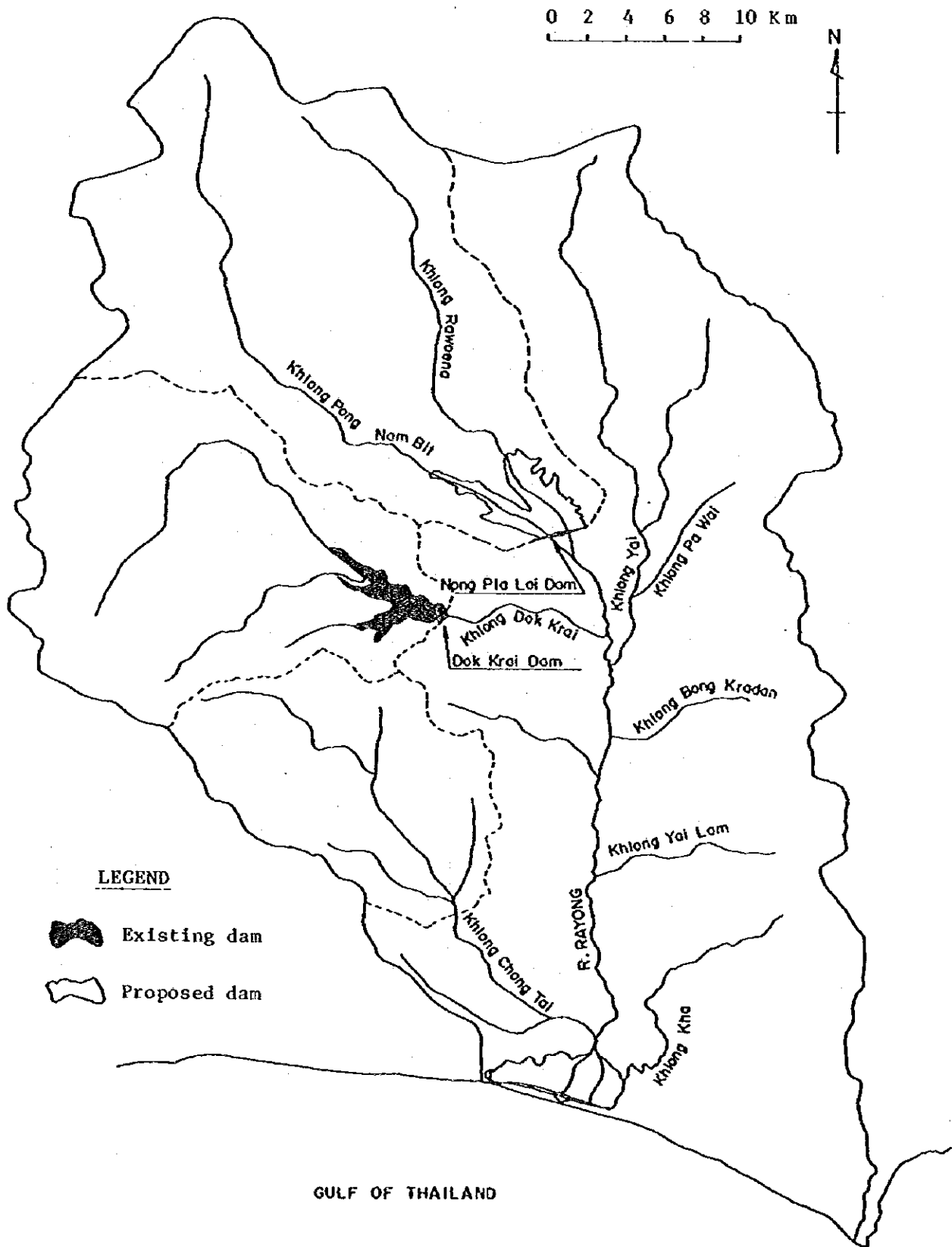


Fig. 2-6 Longitudinal Profile and Stream Flow Capacity (Rayong River)

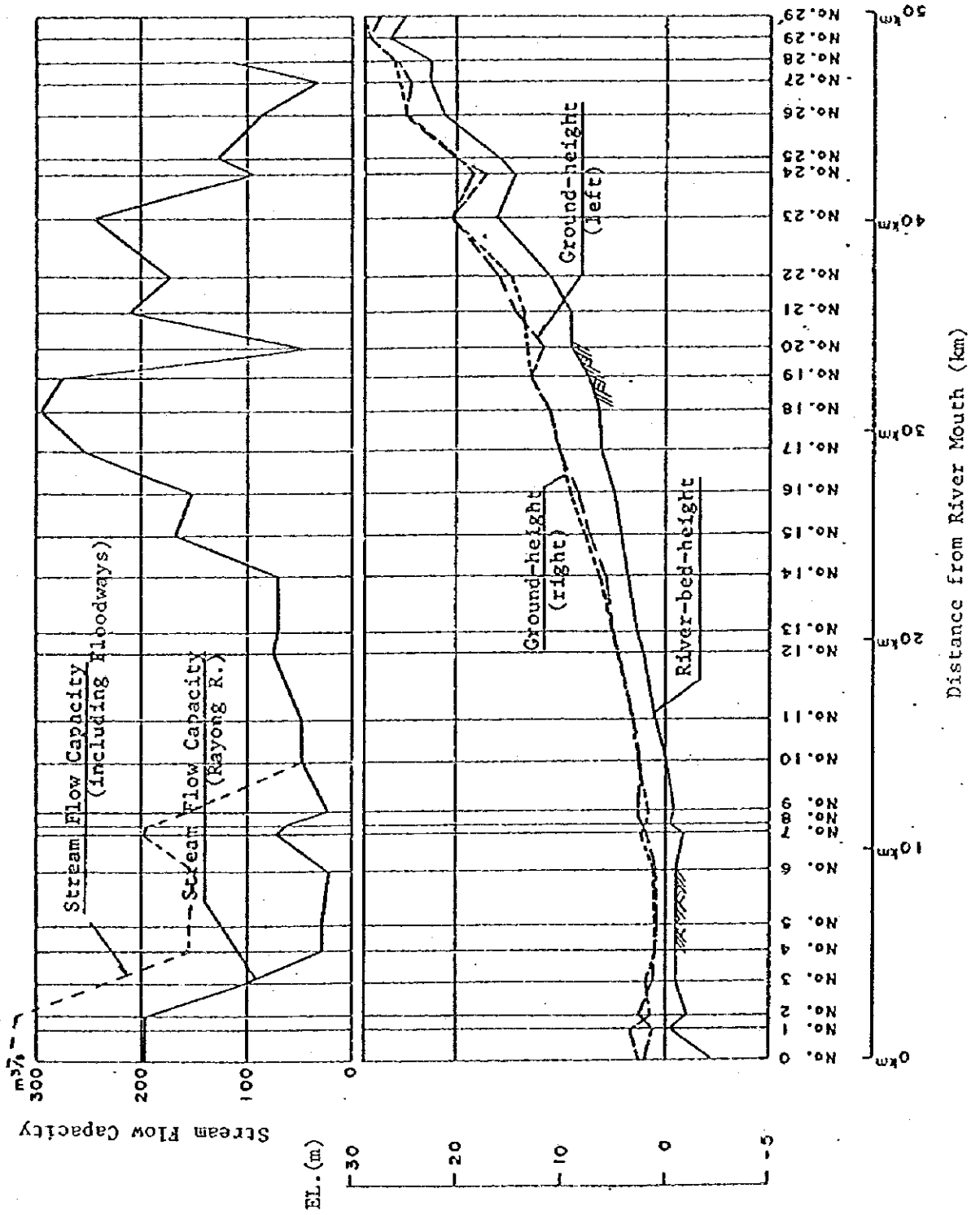


Fig. 2-7 General Map of Ban Bung River

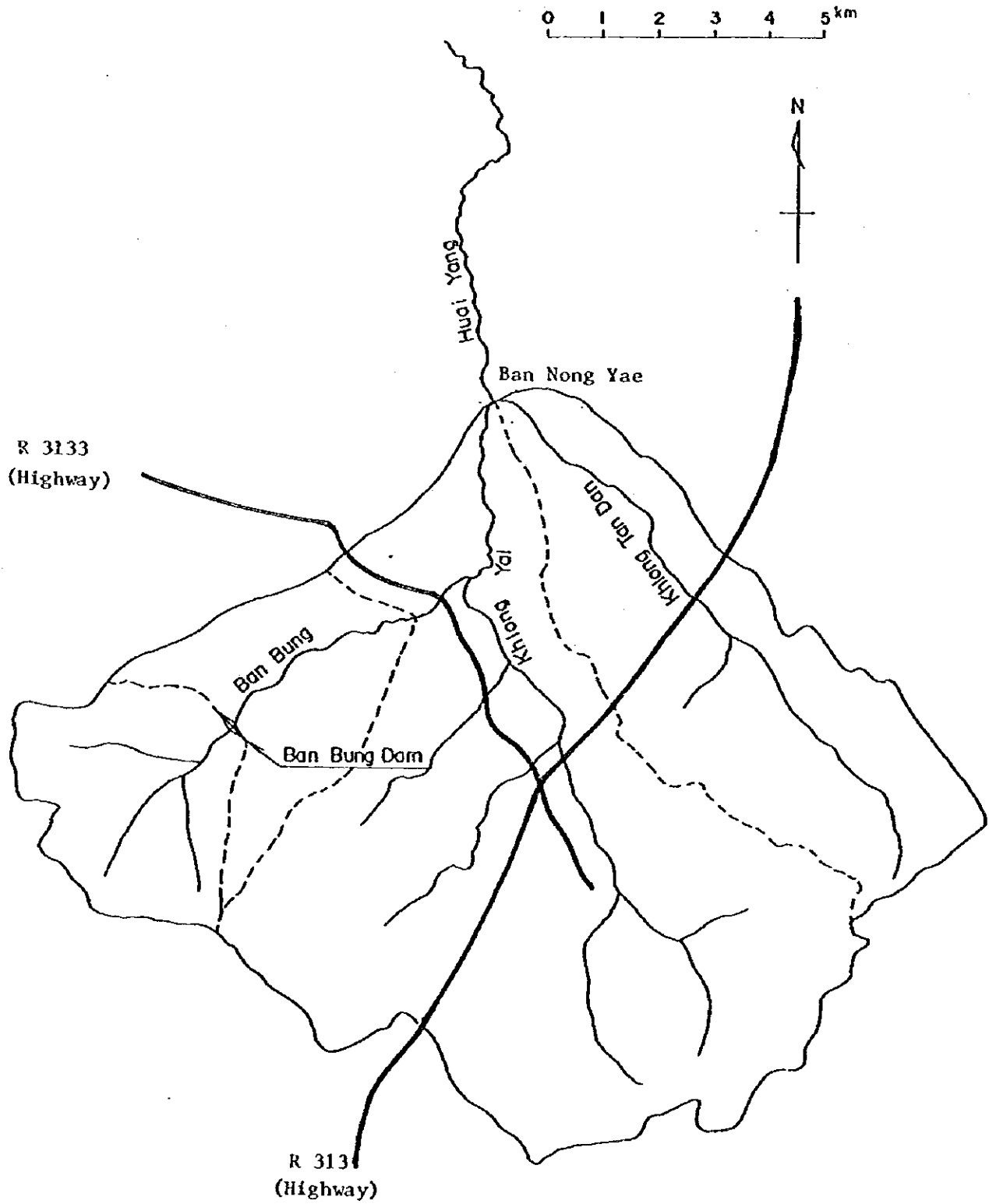


Fig. 2-8 Longitudinal Profile and Stream Flow Capacity (Ban Bung River)

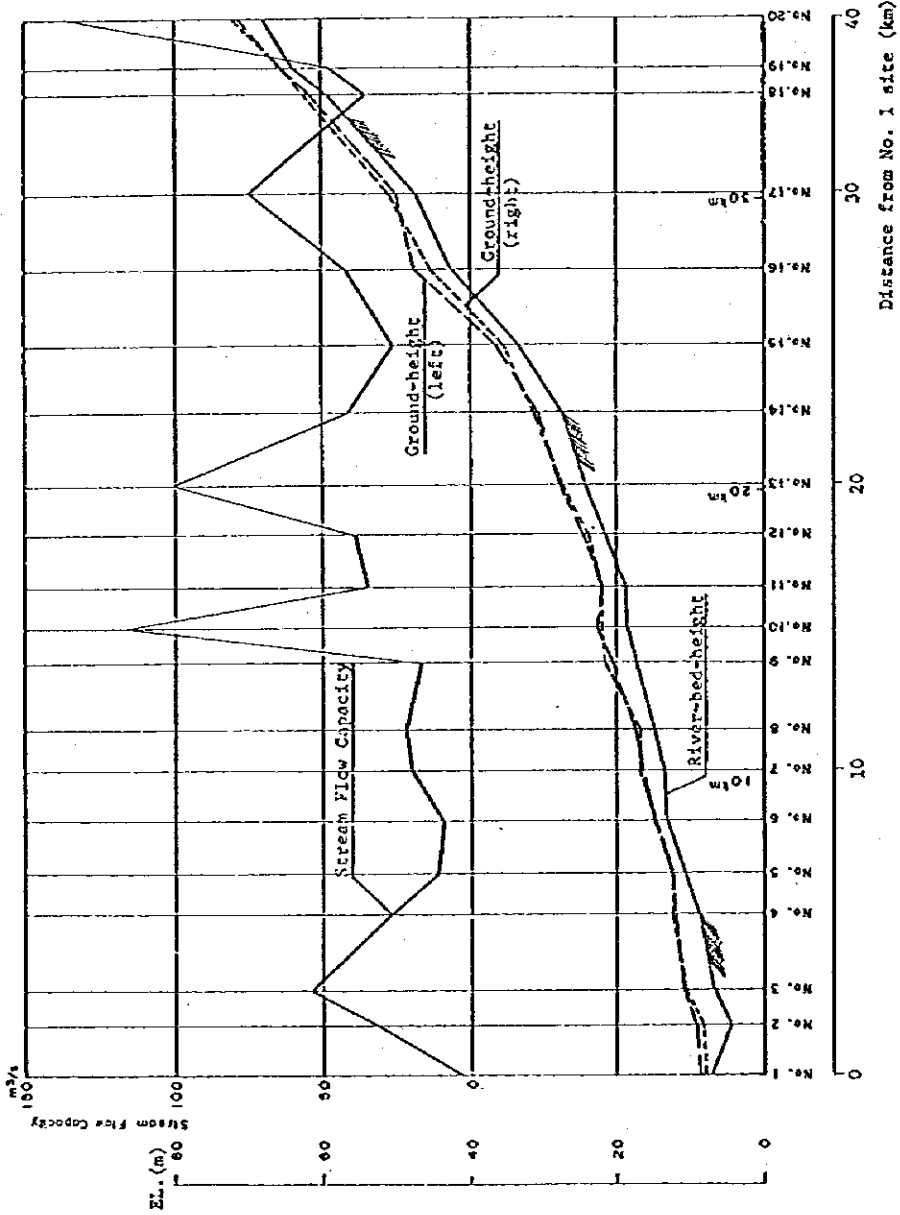


Fig. 2-9 Land Use Map

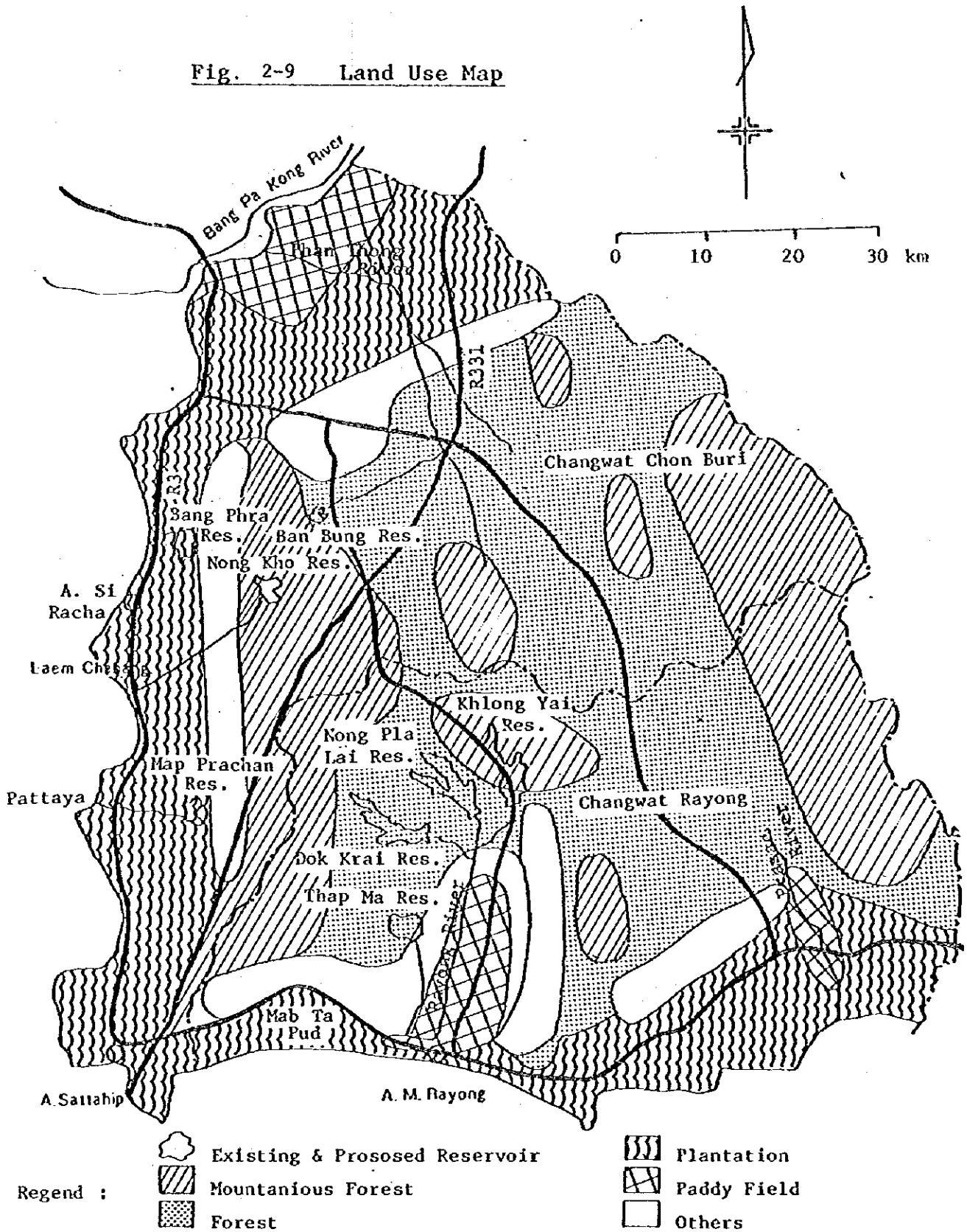


Fig. 3-1 Proposed Cropping Pattern

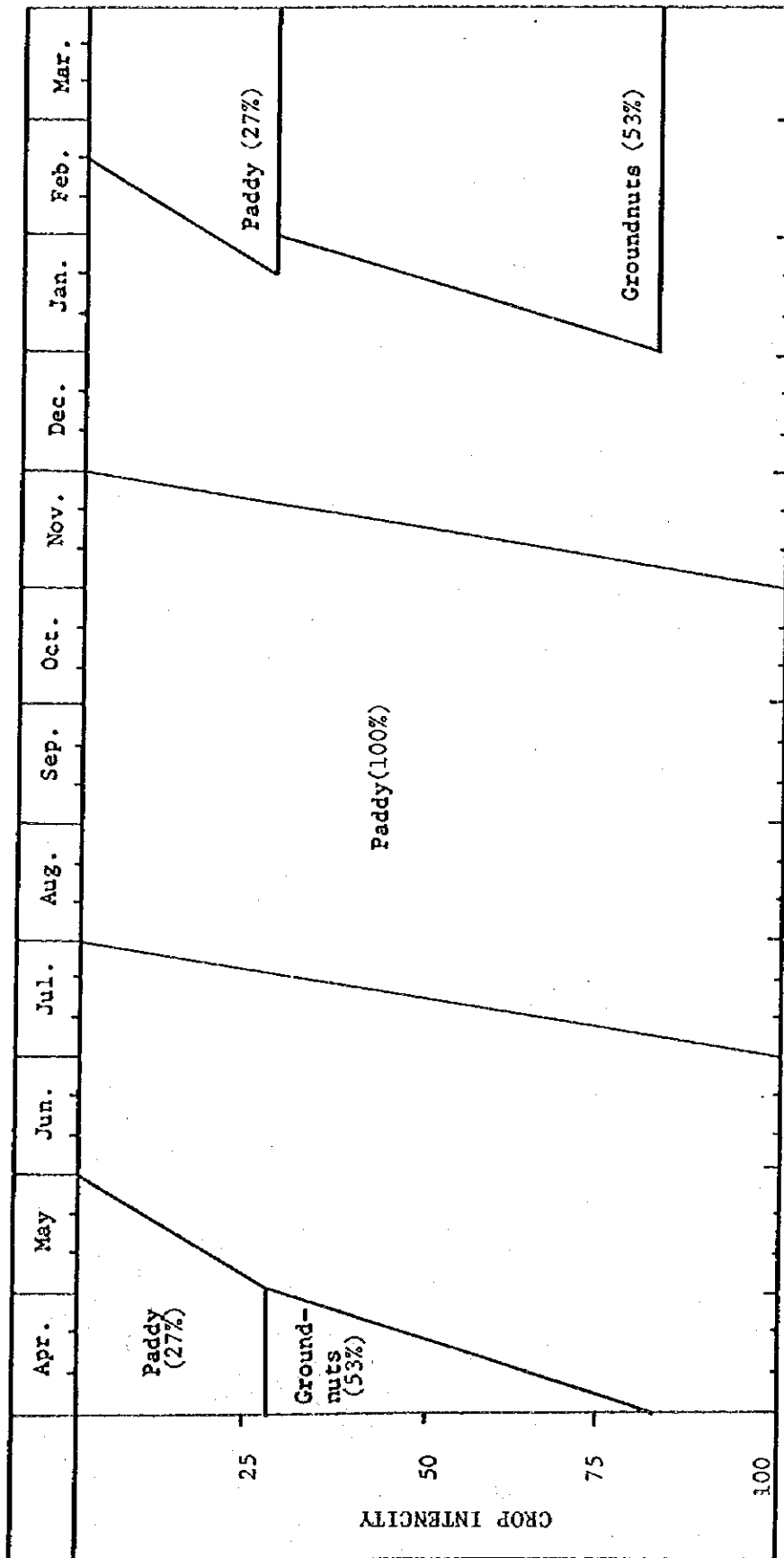


Fig. 3-2 Industrial & Municipal Water Demand

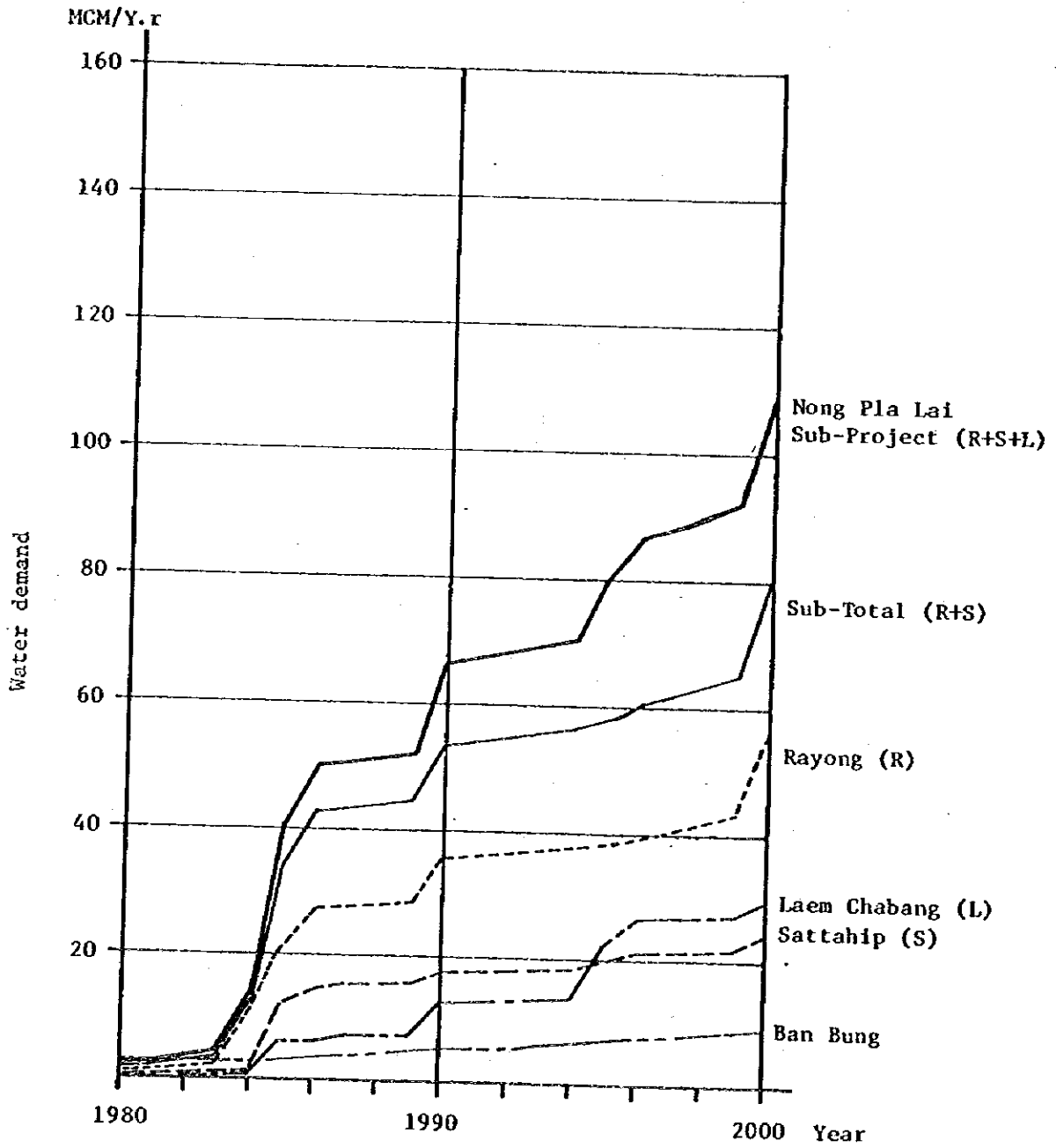


Fig 3-3 Location of Existing and Proposed Reservoir

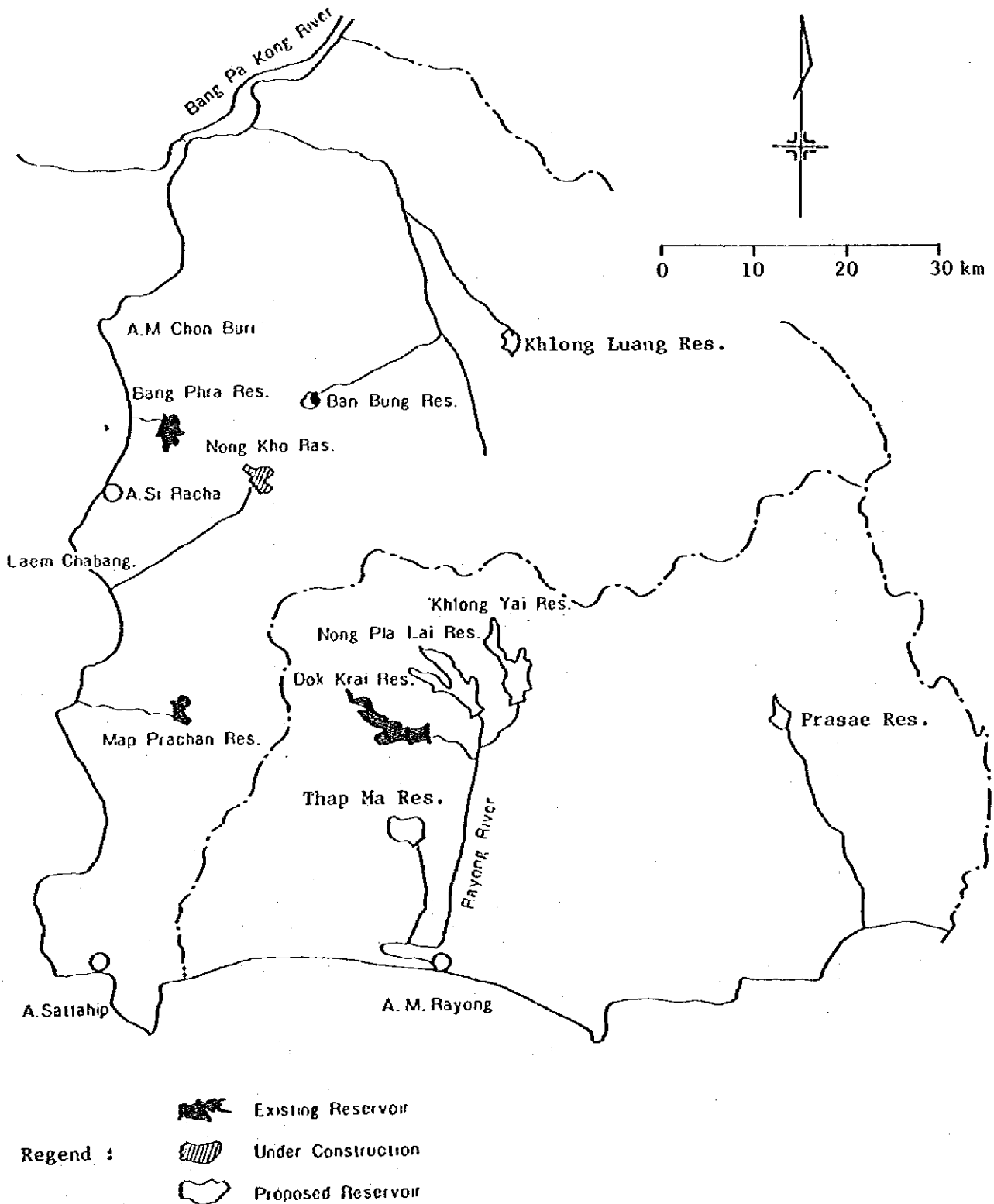


Fig. 3-4 Water Supply and Demand

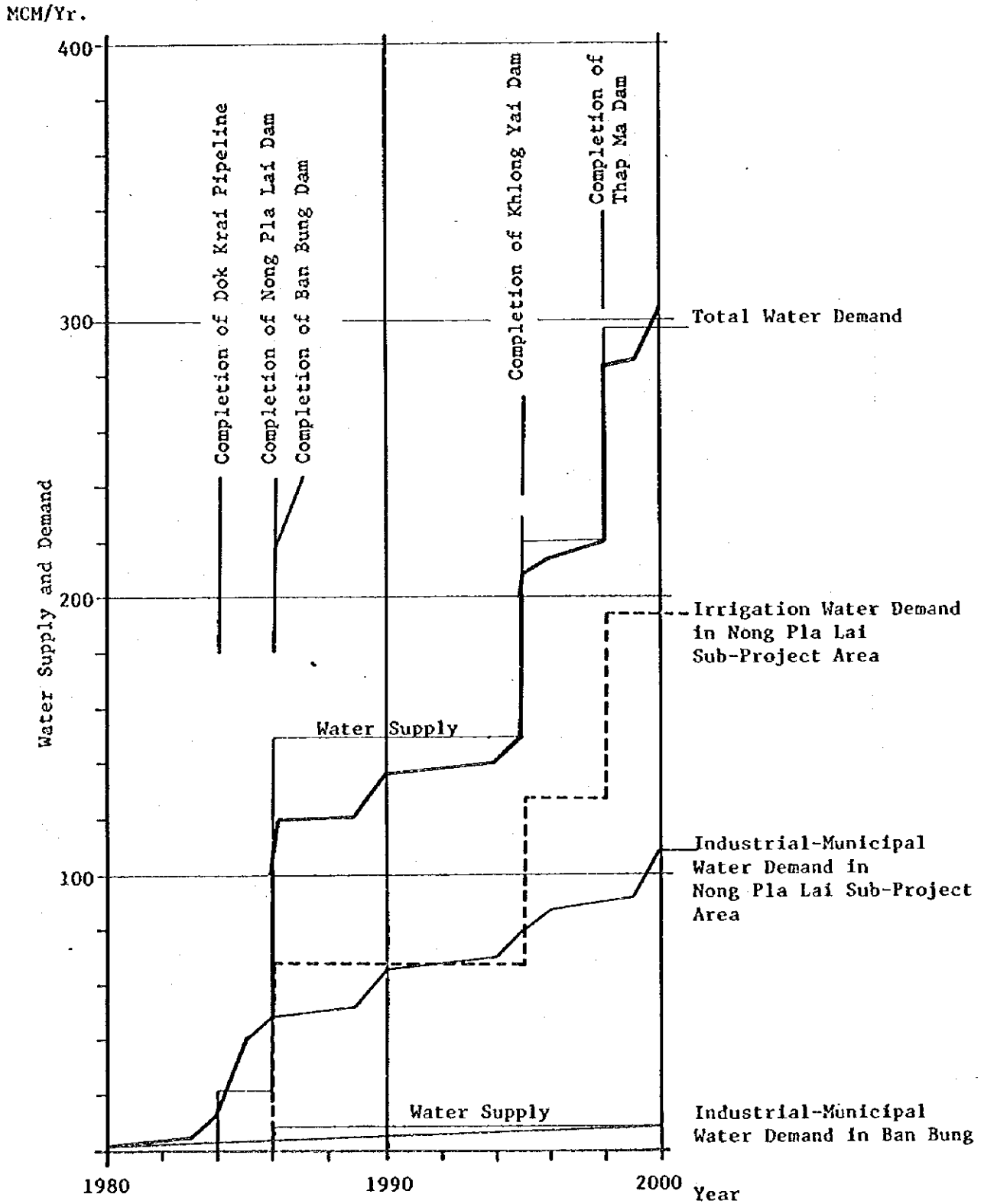


Fig. 4-1 Water Balance in Dok Krai Reservoir (First Stage)

Reservoir Storage Capacity: 49.0 MCM

Water Supply: Ban Khai Irrigation Area: 94.0 MCM/year
 Nab To Pud In Rayong Area: 25.1 MCM/year

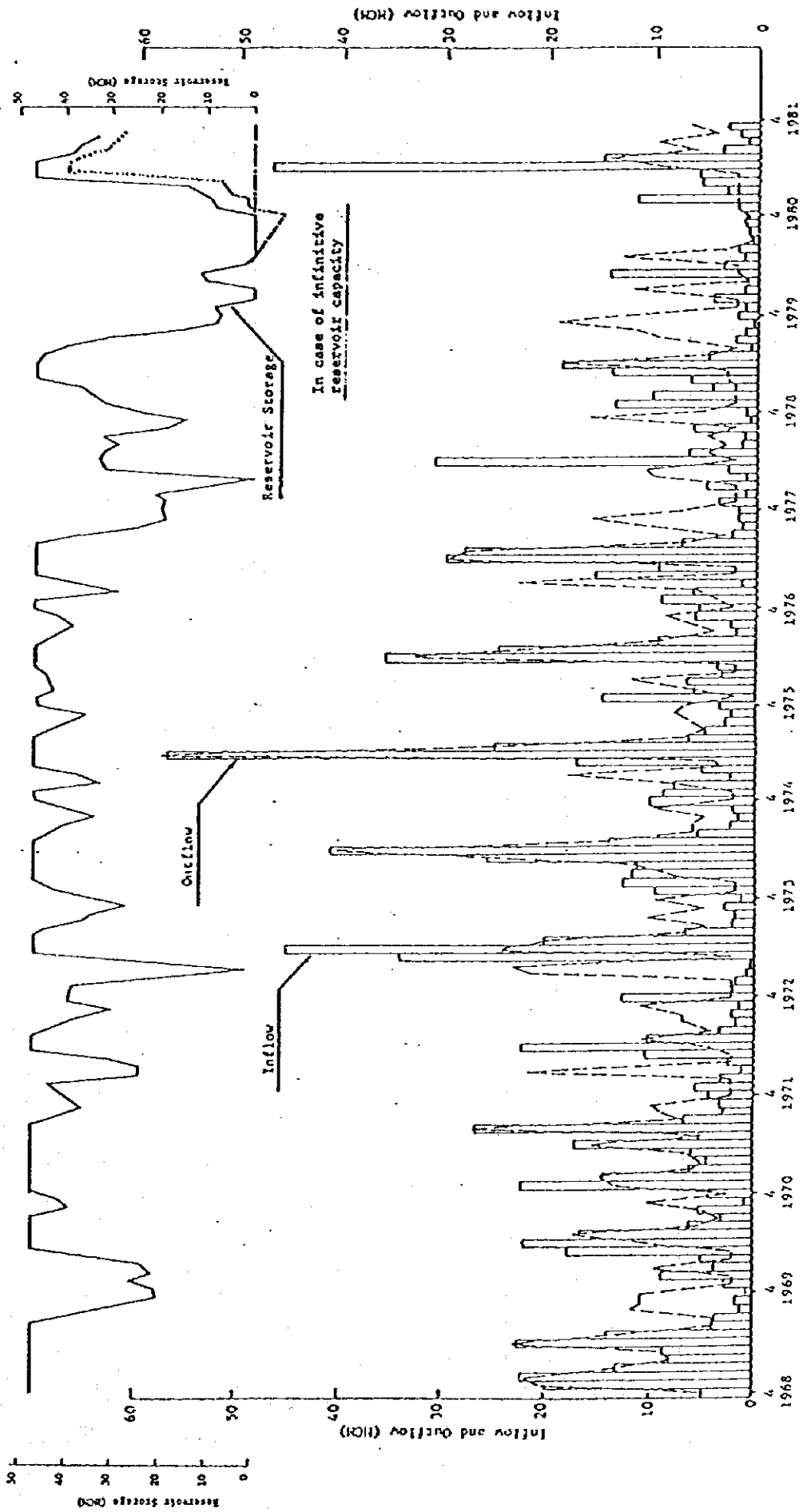


Fig. 4-2 Water Balance in Dok Krai Reservoir (Second Stage)

Reservoir Storage Capacity: 49.0 MCM
 Water Supply: Rayong Area : 42.2 MCM/year
 Sattahip Area : 21.3 MCM/year
 Lam Chabang Area: 24.6 MCM/year

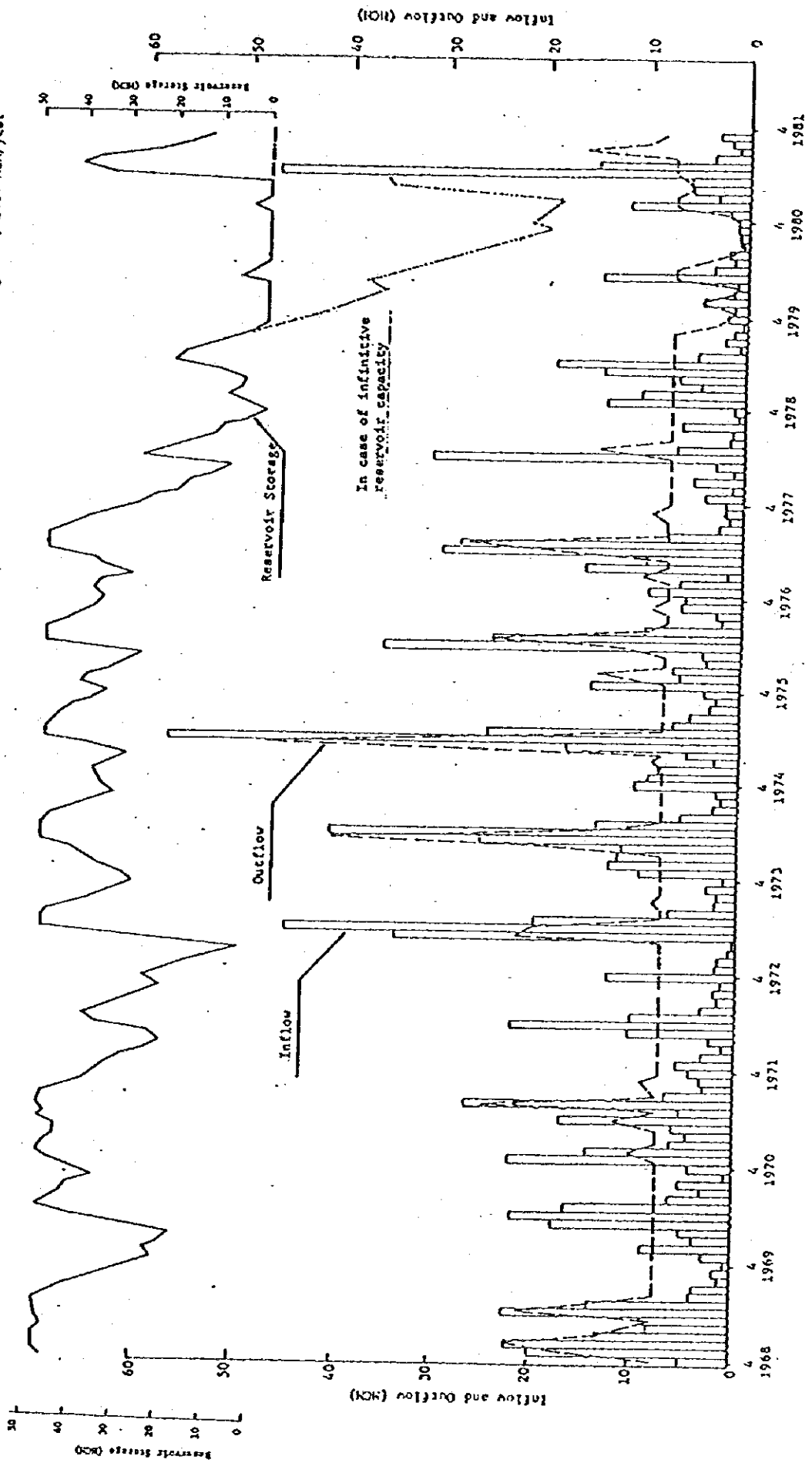


Fig. 4-3 Water Balance in Nong Pla Lai Reservoir

Reservoir Storage Capacity: 144.6 MCM
 Water Supply: Ban Khai Irrigation Area : 94.0 MCM/year
 Nong Pla Lai Irrigation Area: 71.5 MCM/year

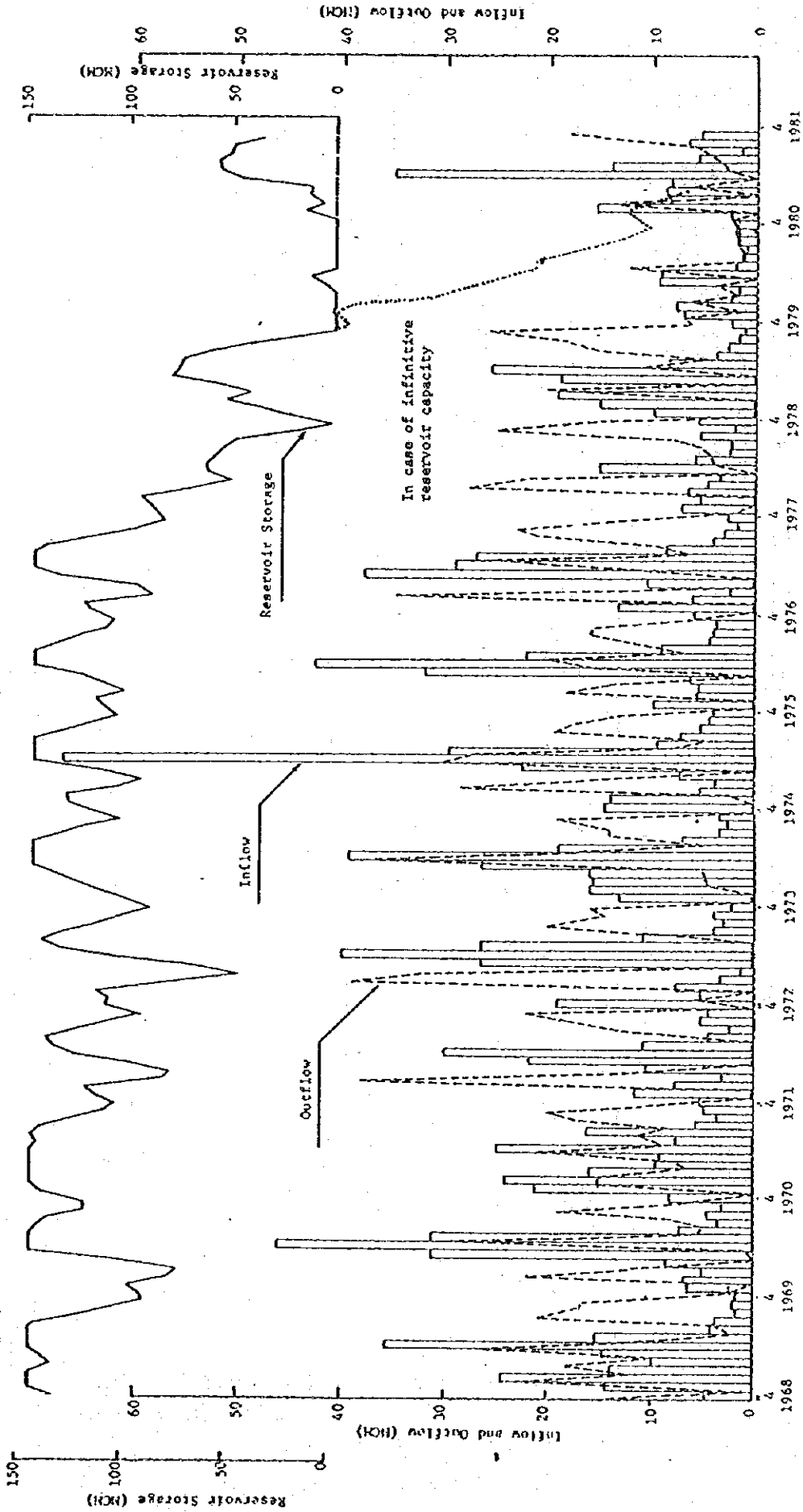
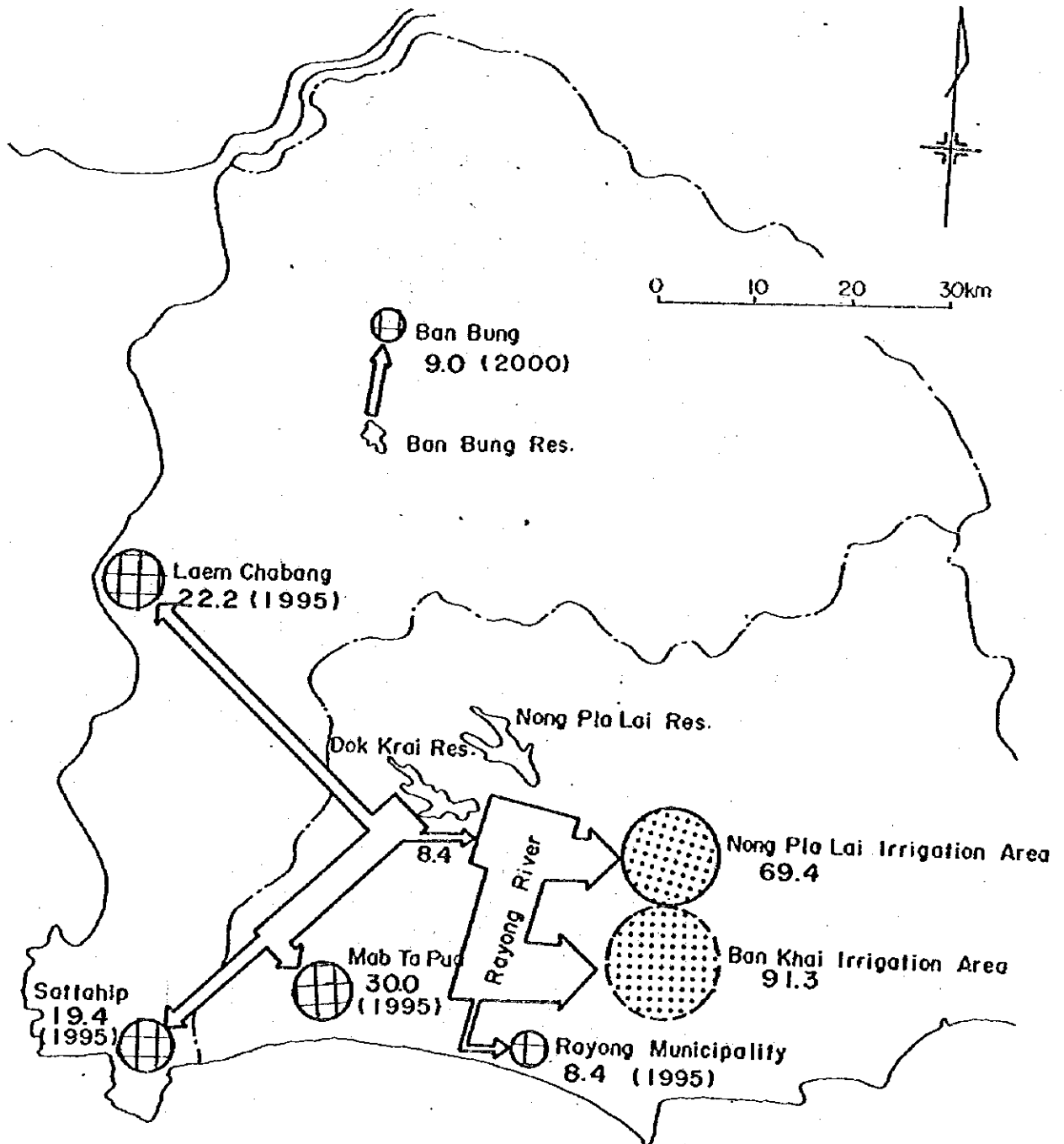


Fig. 4-4 Water Supply by Dok Krai, Nong Pla Lai and Ban Bung Reservoirs



LEGEND

- ⊕ Municipal-industrial water.
- ⊙ Irrigation water. --- Newly developed water by the project.
- ⊙ Irrigation water. --- Vested right water.

Figure is water demand in MCM/year and (Design Year)

Fig. 4-5 Storage Capacity Curves of Nong Pla Lai Reservoir

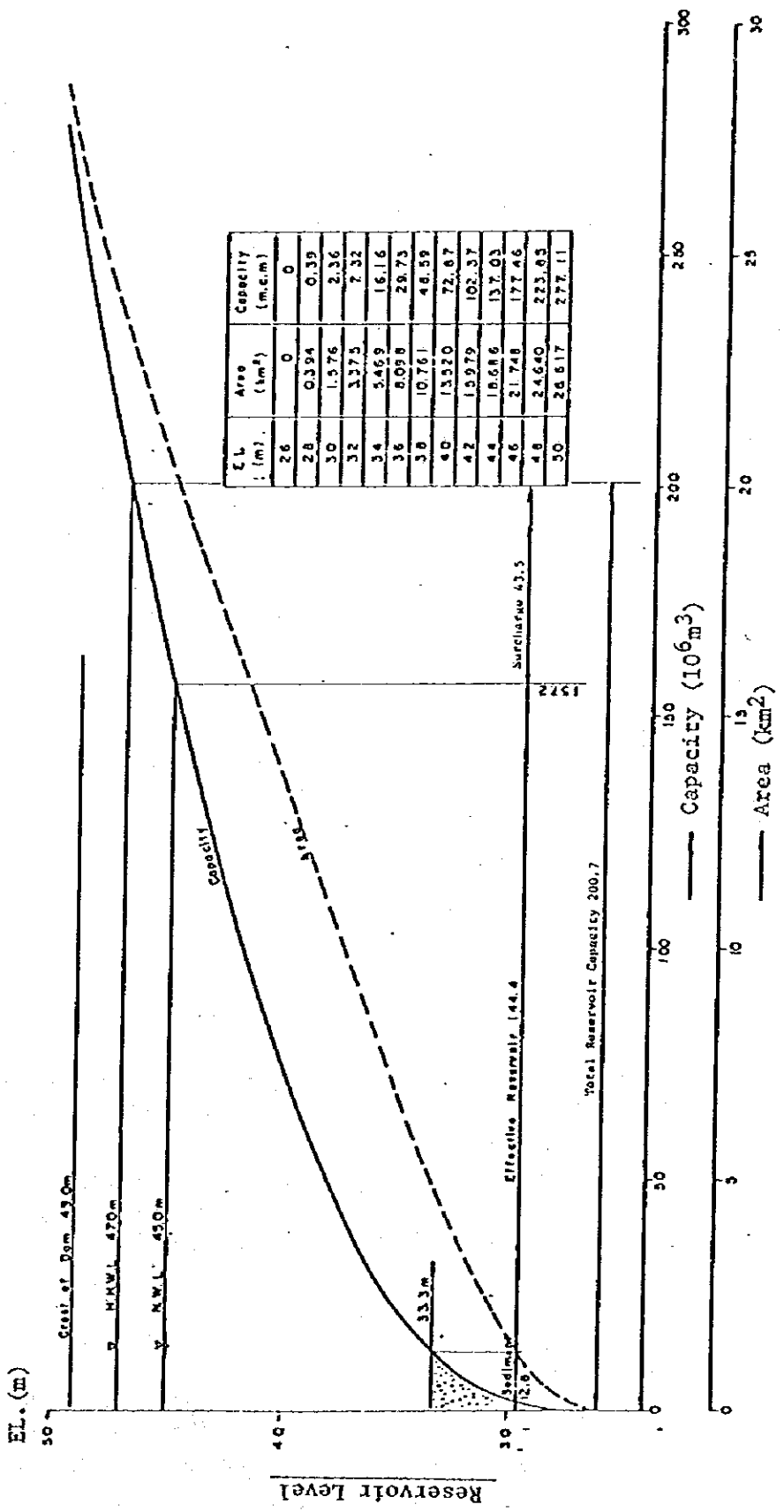
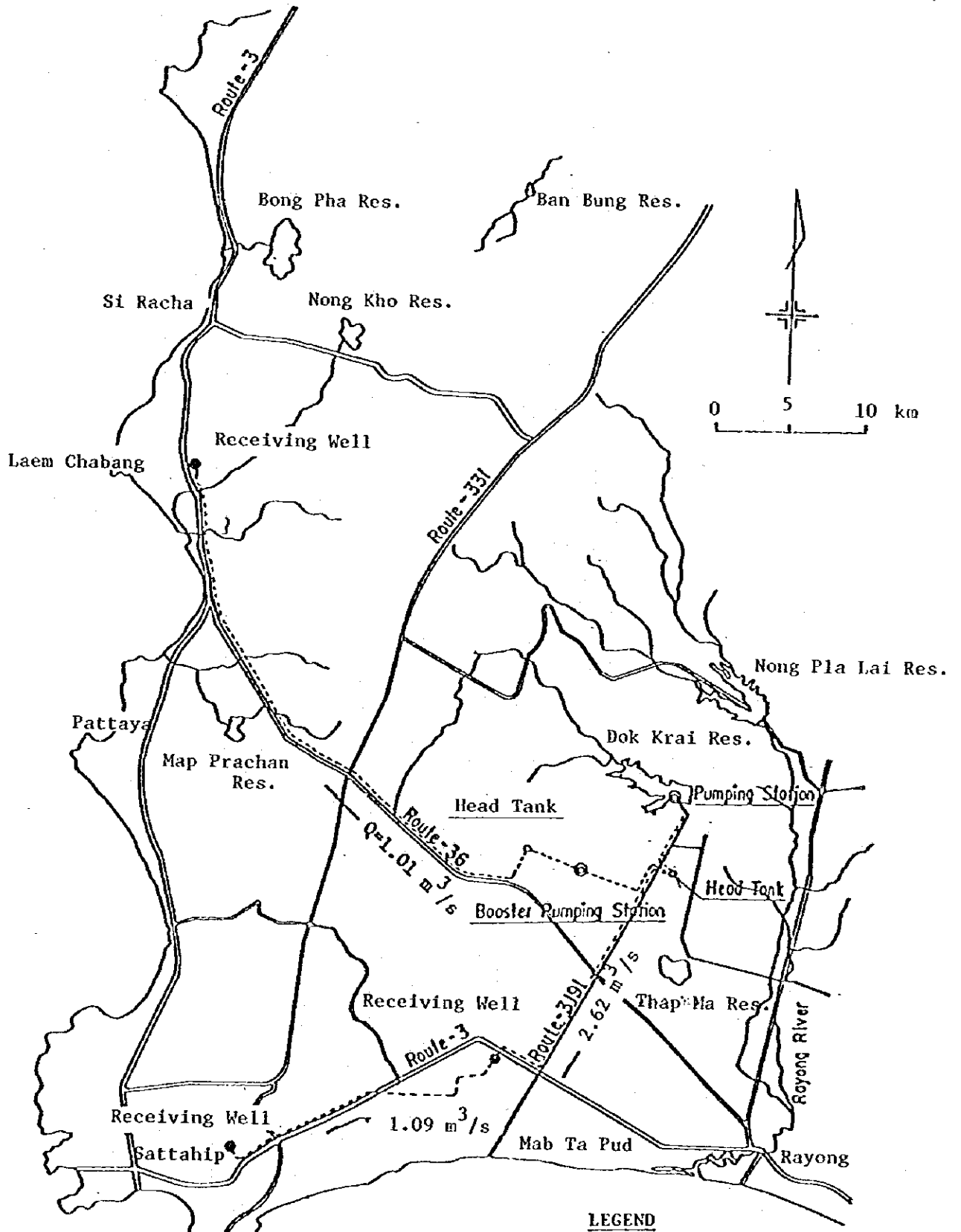


Fig. 4-6 General Plan of Water Transmission System



- LEGEND**
- ⊙ Pumping Station
 - Head Tank
 - Receiving Well.
 - Pipeline

Fig. 4-7 General Plan of Irrigation and Drainage System

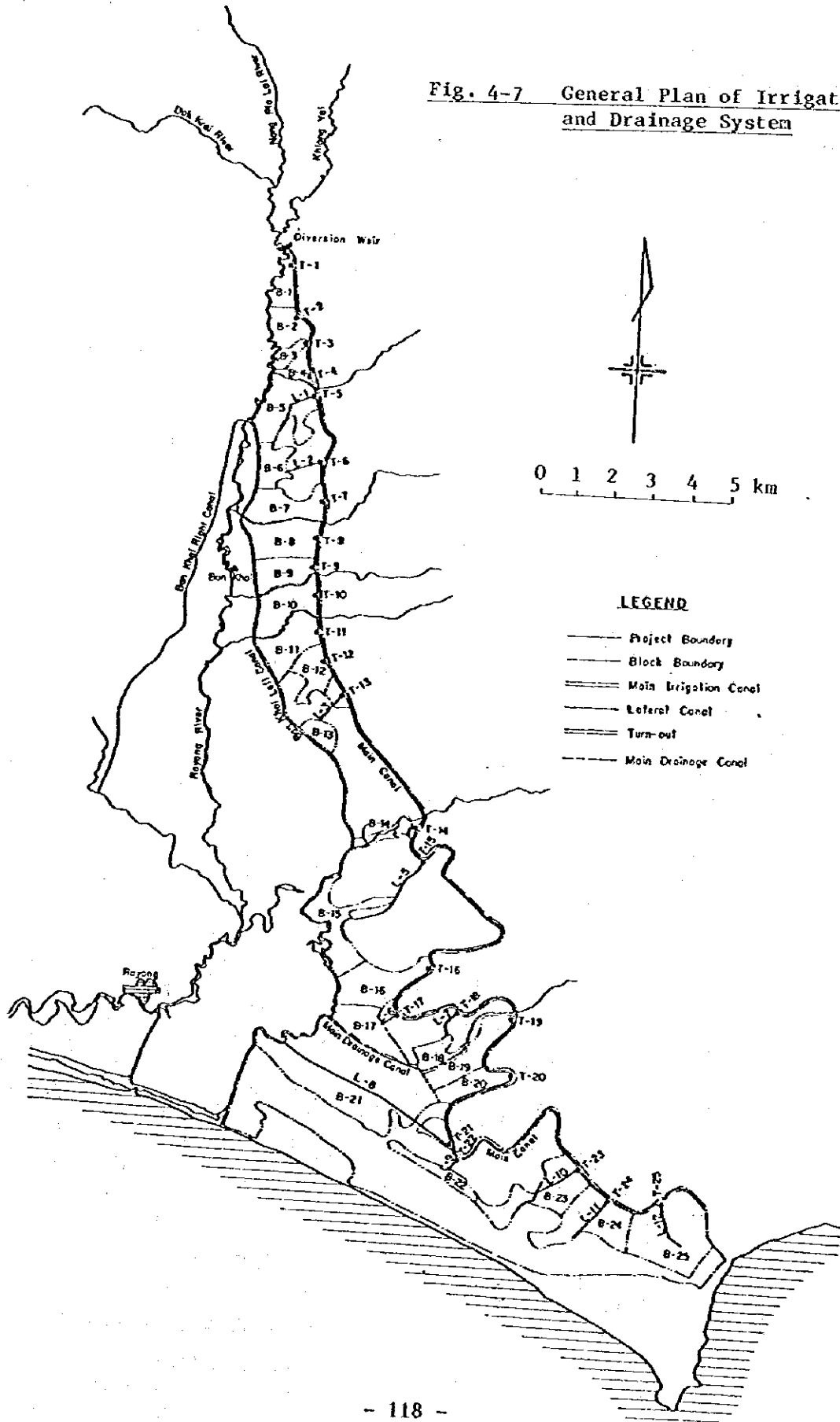


Fig. 4-8 Water Balance in Ban Bung Reservoir

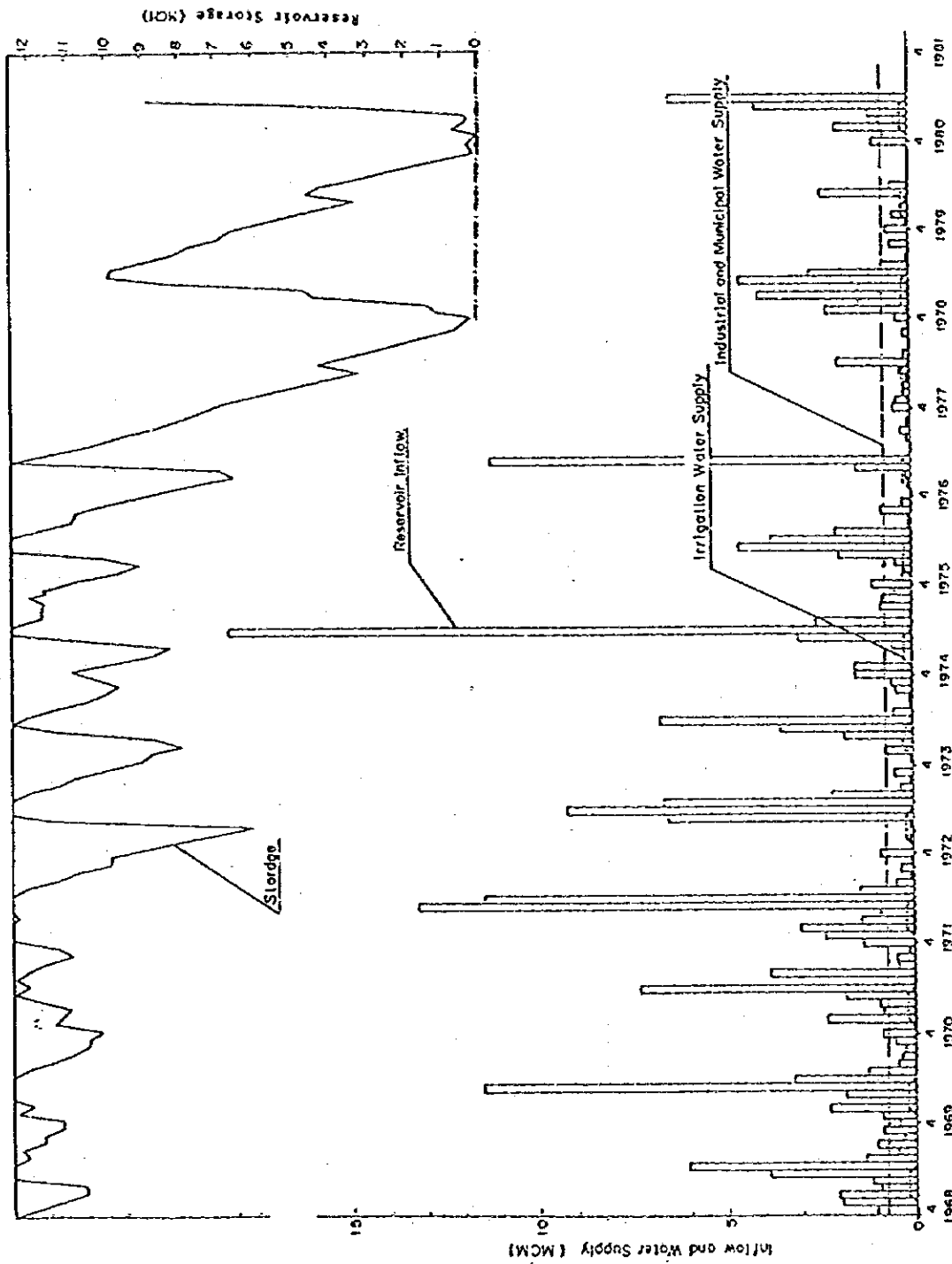


Fig. 4-9 Storage Capacity Curve of Ban Bung Reservoir

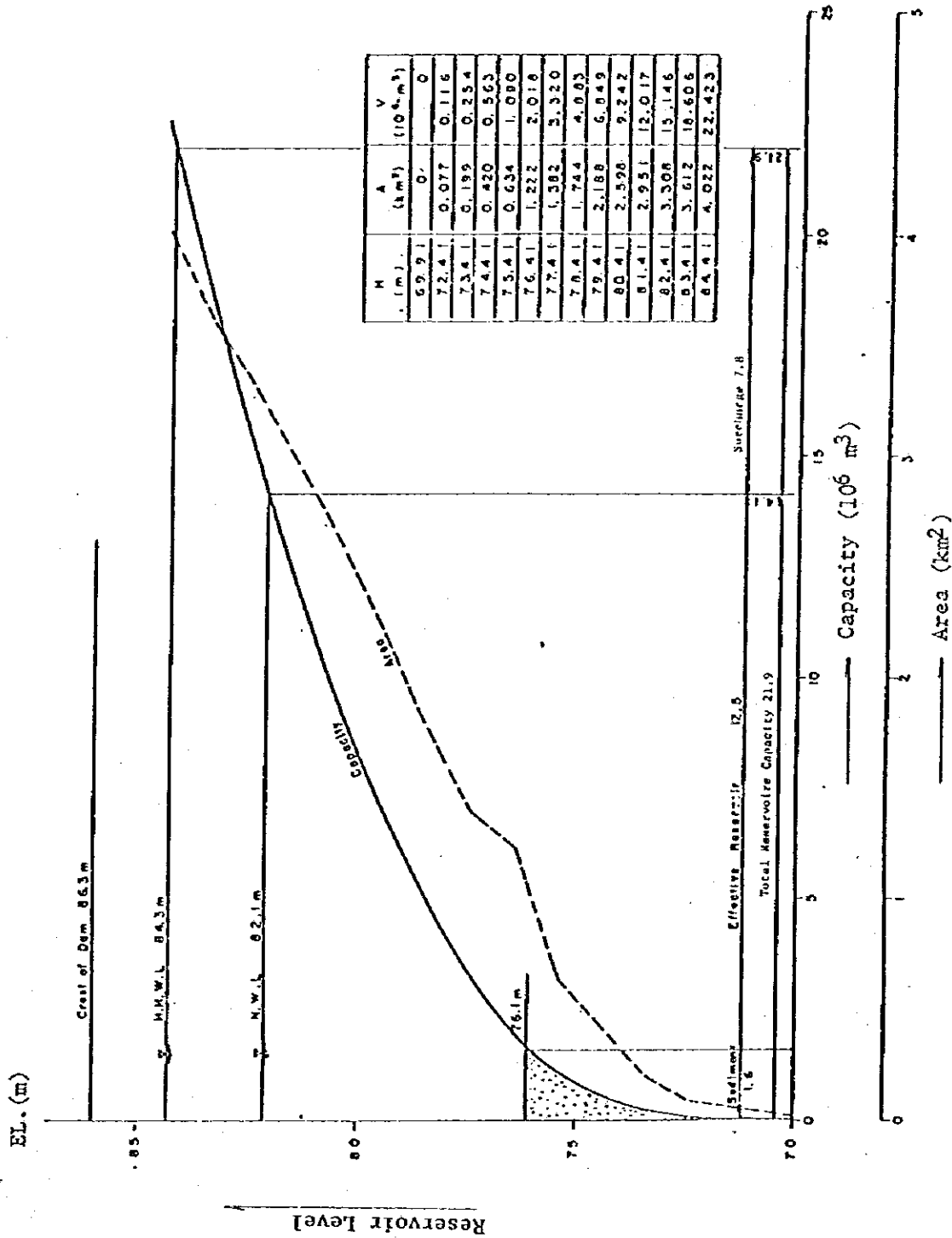


Fig. 5-1 Geological Map Of Nong Pla Lai Dam Axis

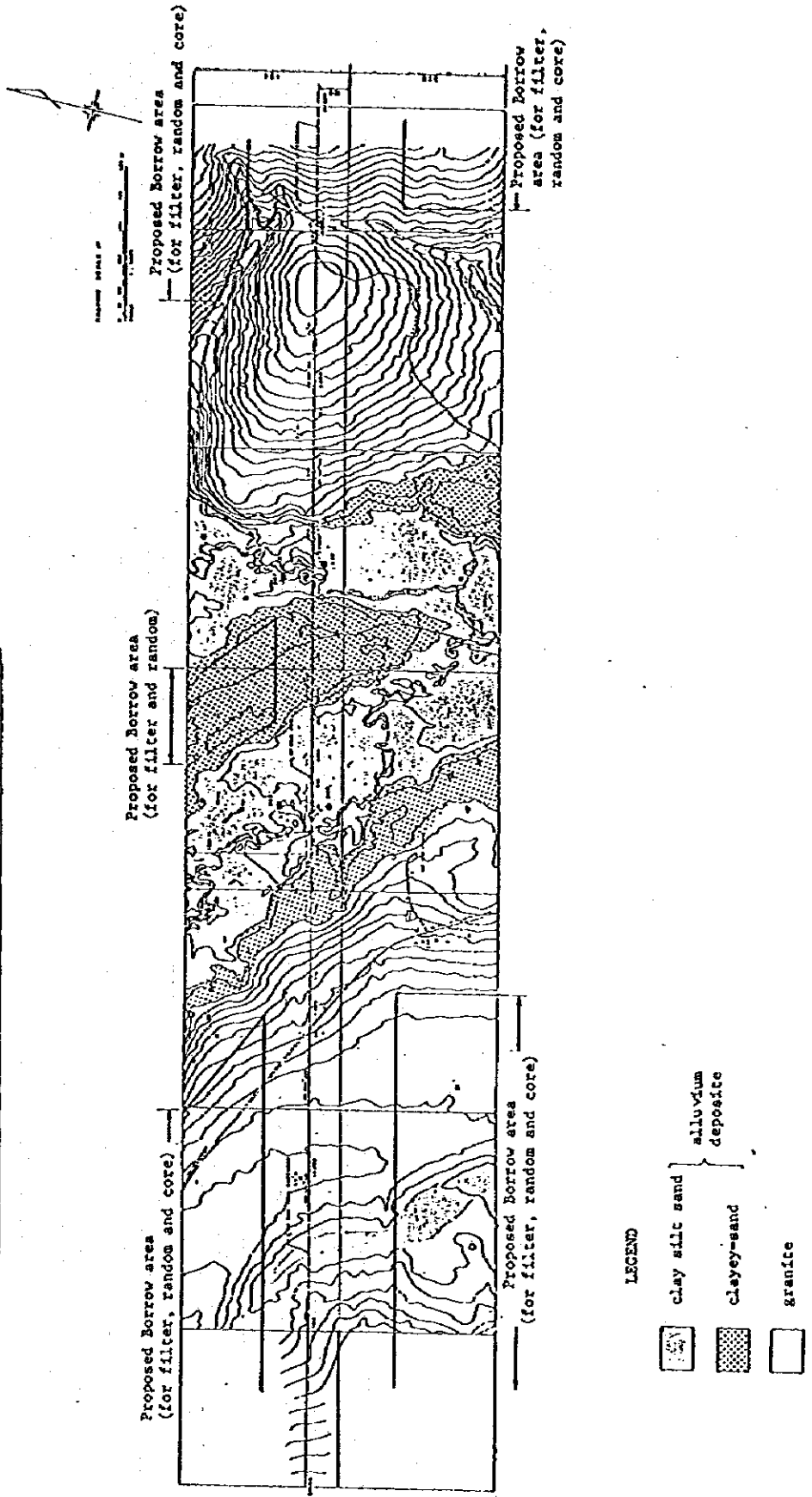


Fig. 5-2 General Plan of Nong Pla Lai Dam

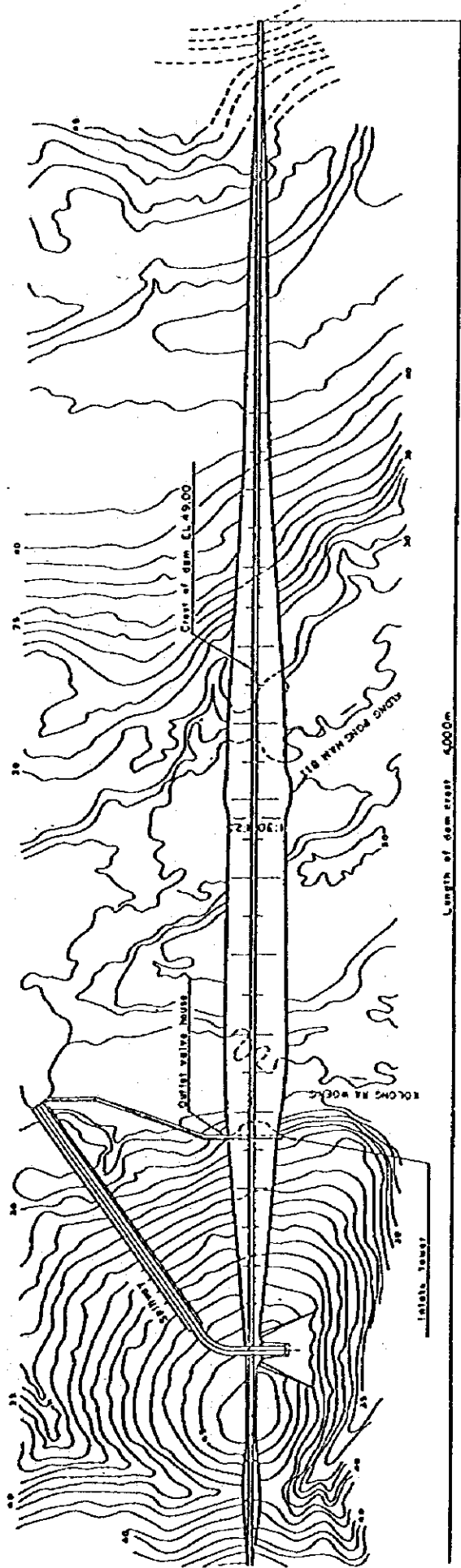


Fig. 5-3 Longitudinal Profile of Nong Pla Lai Dam

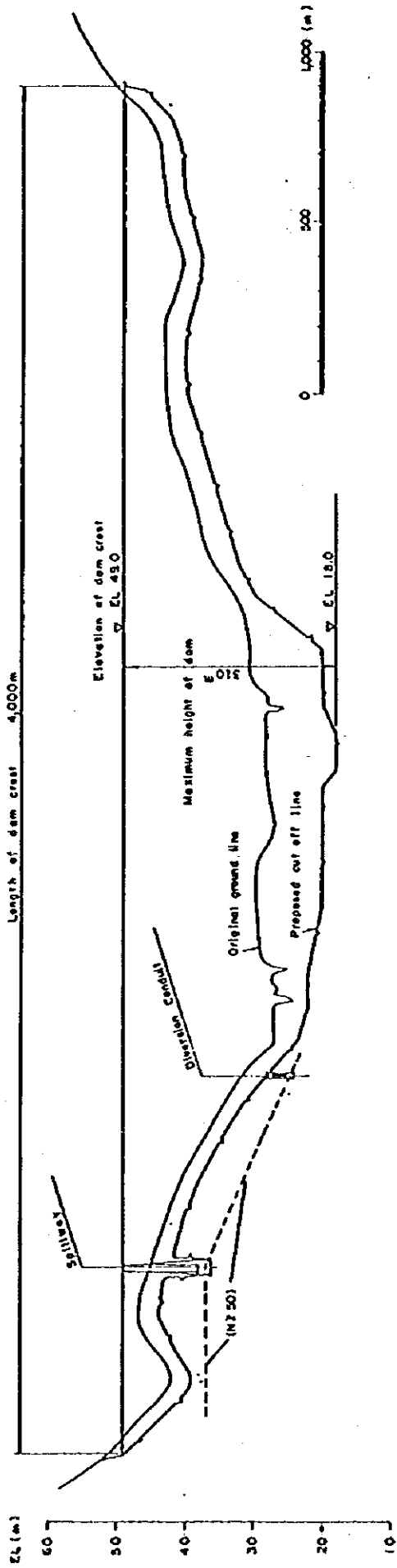


Fig. 5-4 Standard Cross-Section of Nong Pla Lai Dam

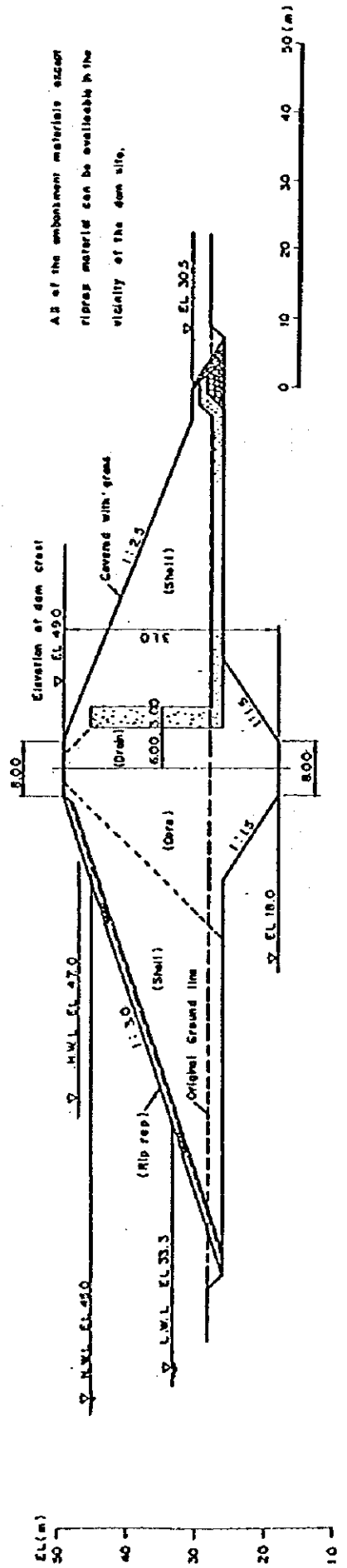


Fig. 5-5 Inflow and Outflow Hydrograph of Design Flood for Spillway

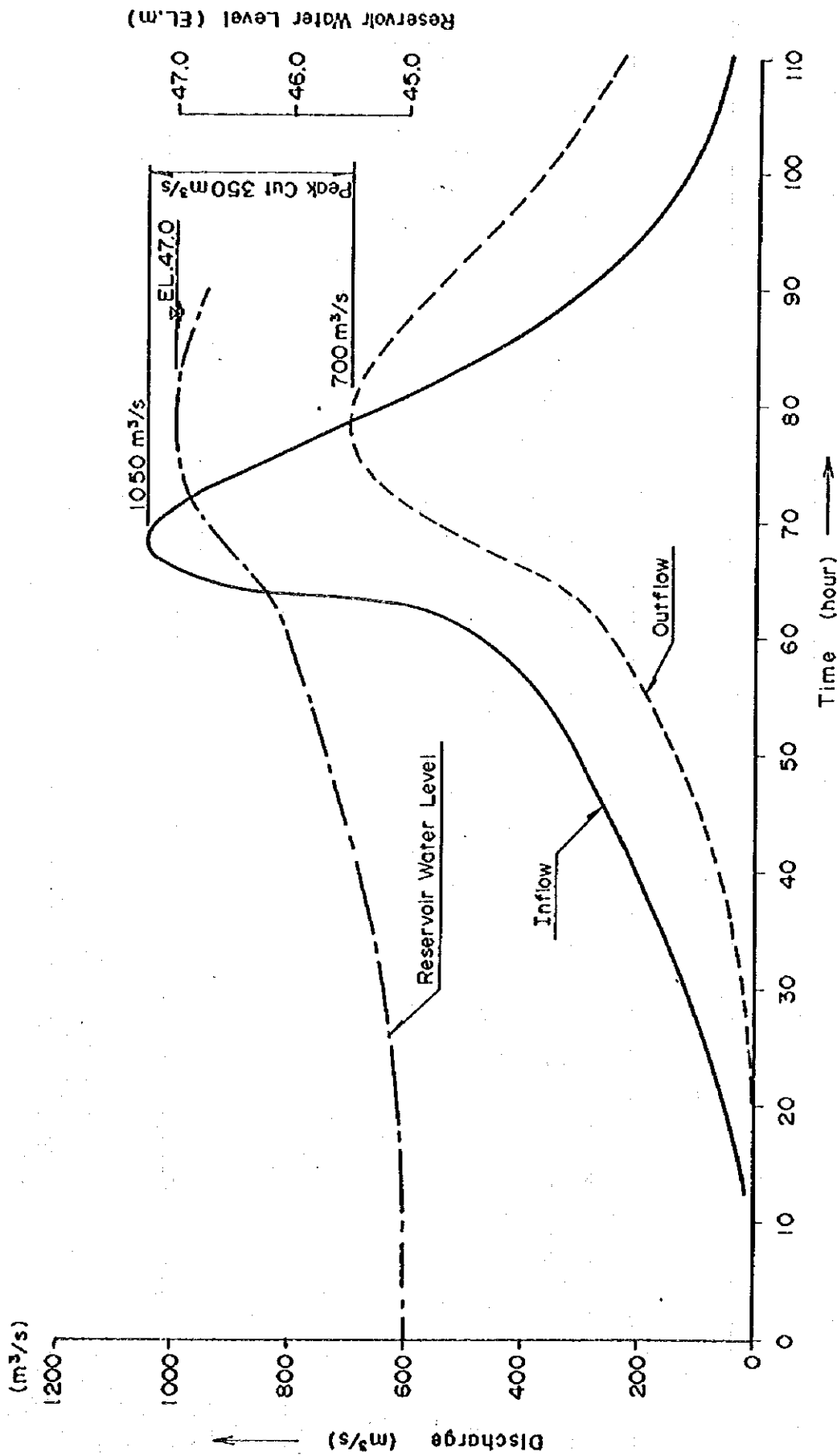


Fig. 5-6. Plan of Spillway of Nong Pla Lai Dam

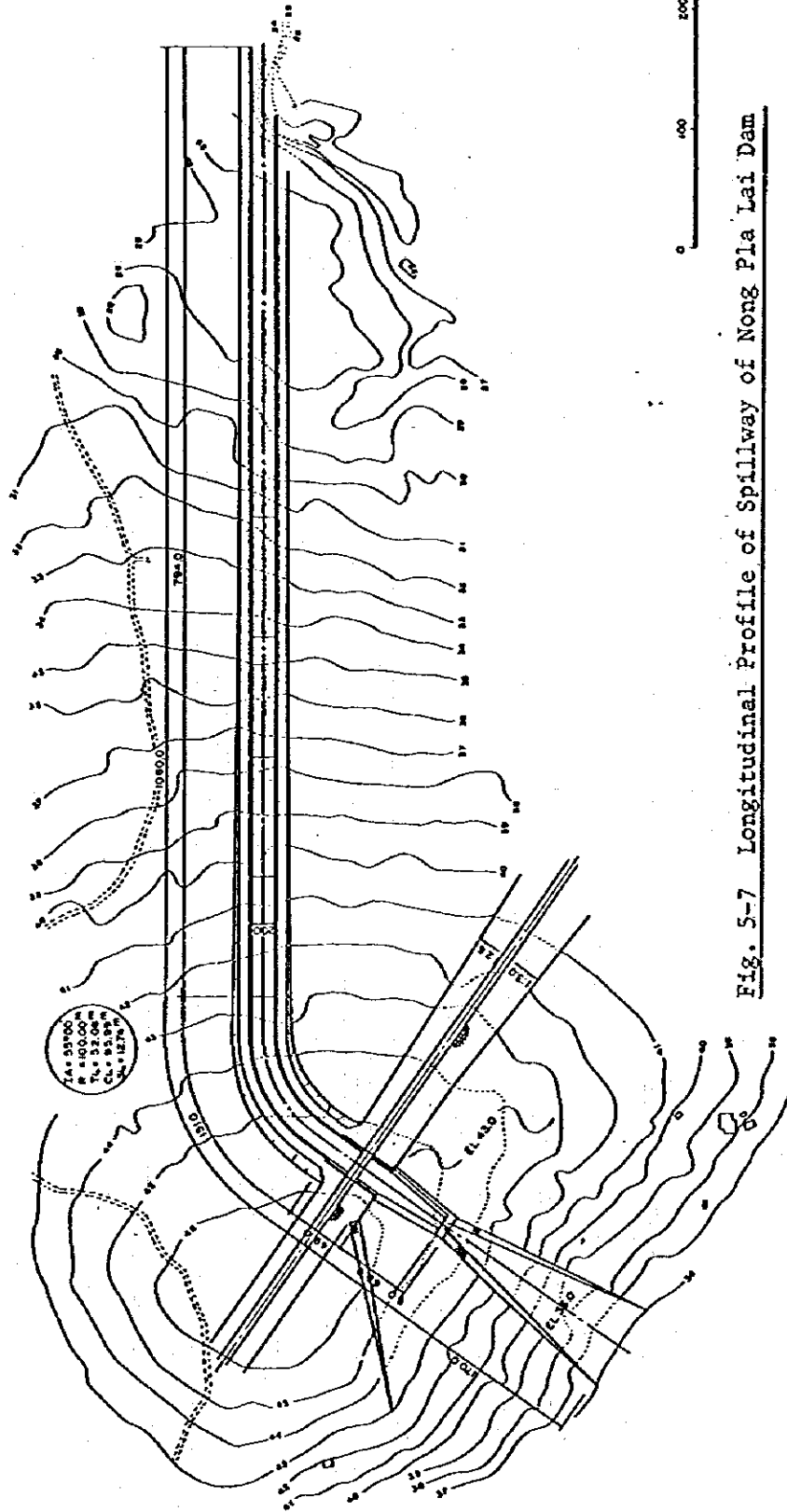


Fig. 5-7 Longitudinal Profile of Spillway of Nong Pla Lai Dam

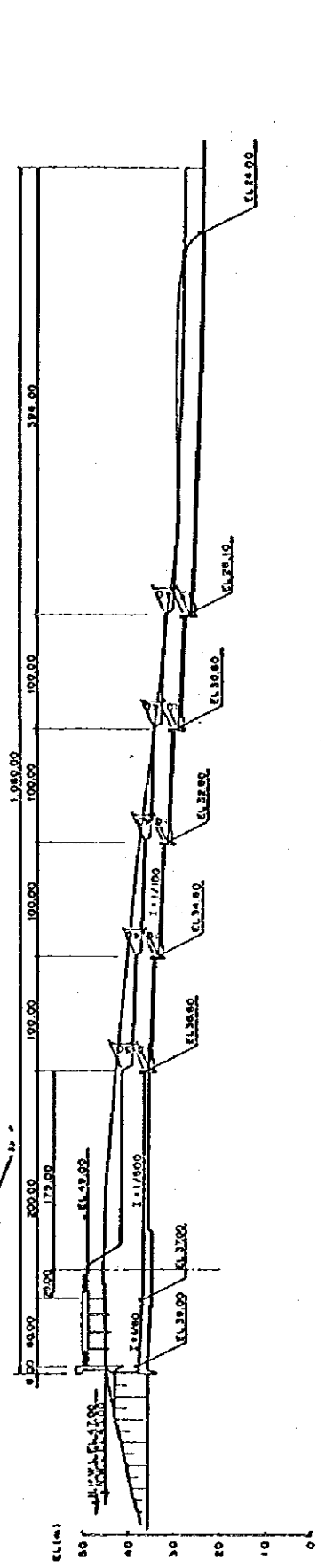


Fig. 5-8 Details of Spillway of Nong Pla Lai Dam

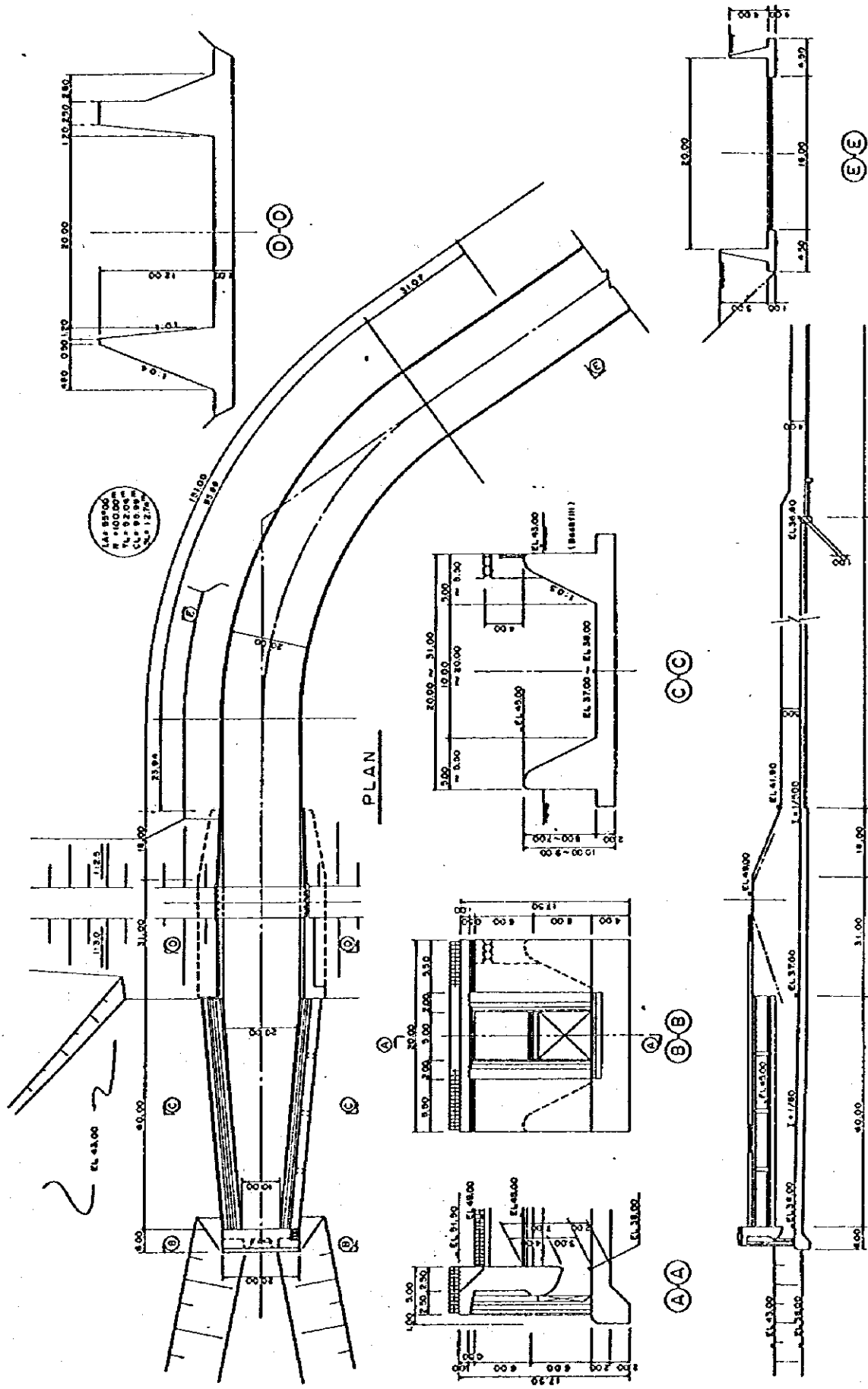


Fig. 5-10 Road Relocation

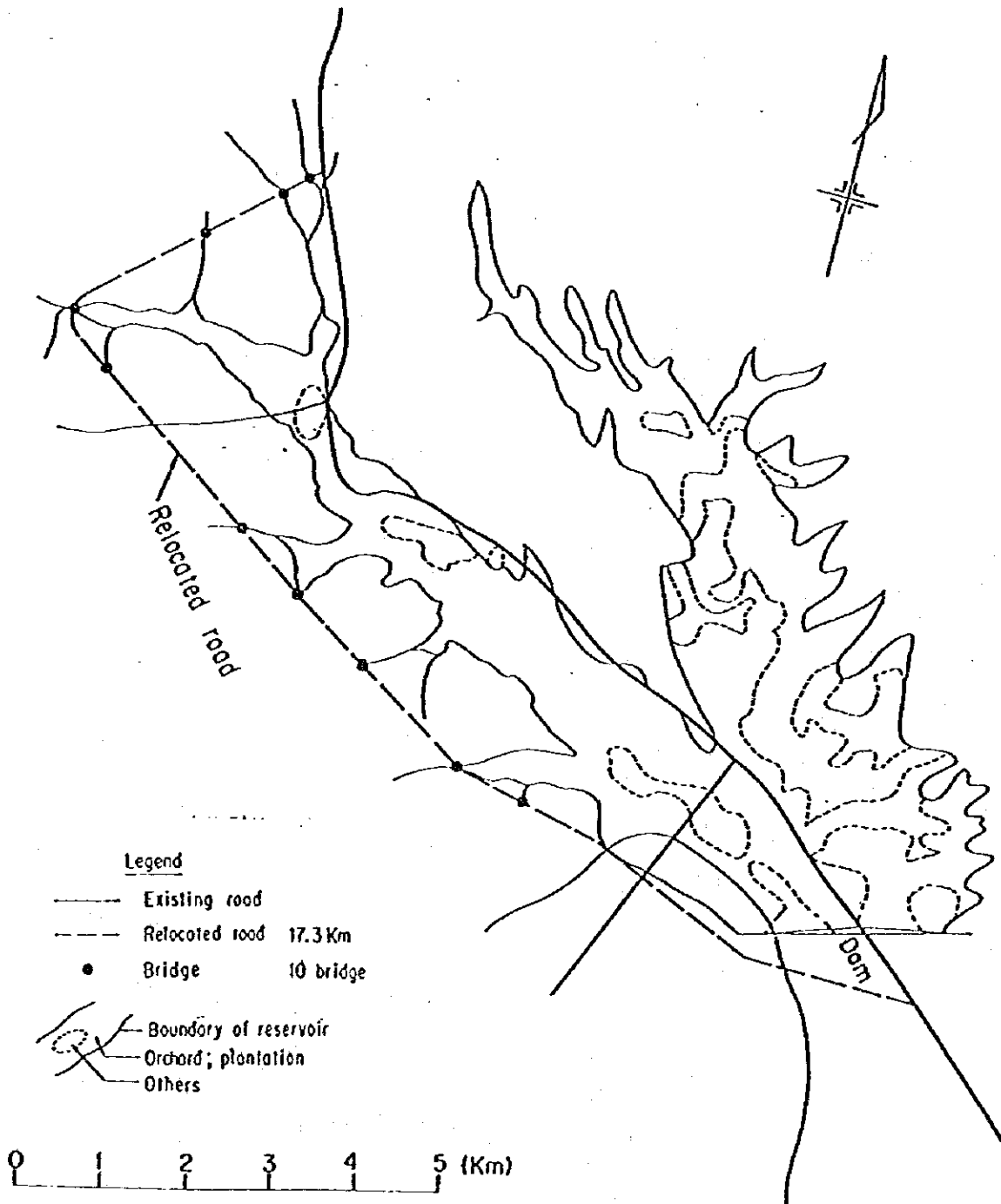
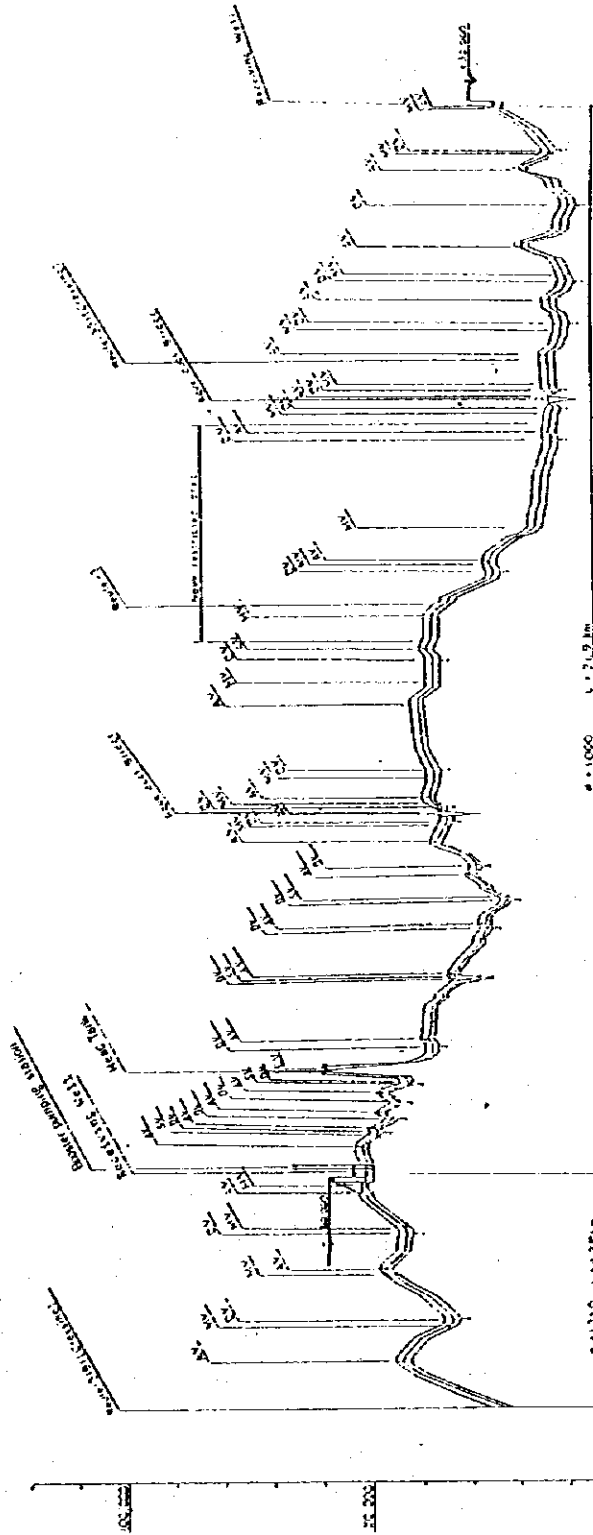
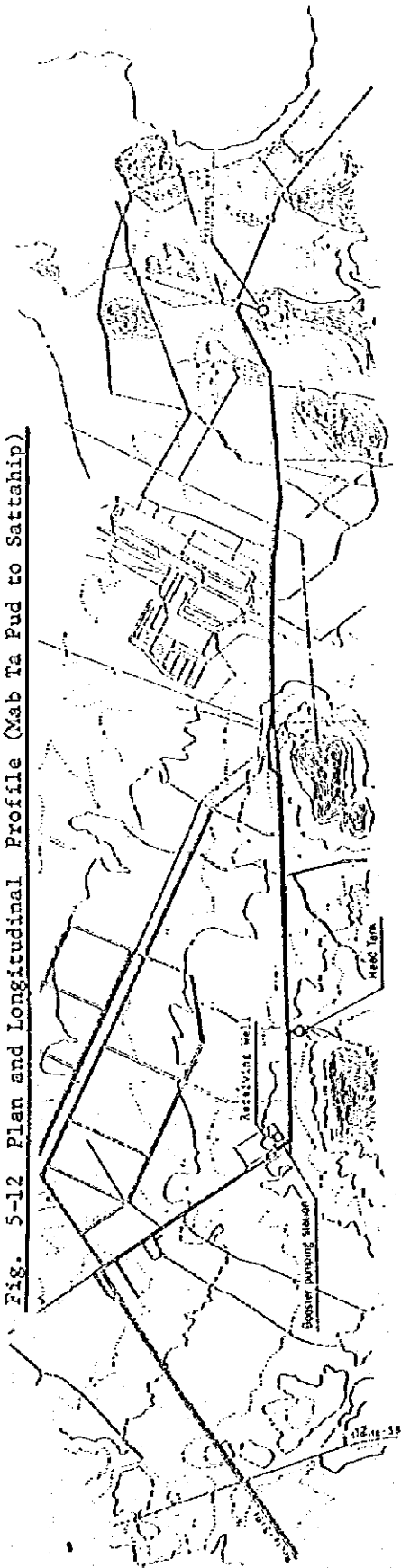


Fig. 5-12 Plan and Longitudinal Profile (Mab Ta Pud to Sattaship)



LEGEND

- AV: Air Valve
- DV: Drain Valve
- MV: Main Valve
- EV: Emergency Valve

Stationing	Elevation (m)
0+00	100.00
0+10	105.00
0+20	110.00
0+30	115.00
0+40	120.00
0+50	125.00
0+60	130.00
0+70	135.00
0+80	140.00
0+90	145.00
1+00	150.00
1+10	155.00
1+20	160.00
1+30	165.00
1+40	170.00
1+50	175.00
1+60	180.00
1+70	185.00
1+80	190.00
1+90	195.00
2+00	200.00
2+10	205.00
2+20	210.00
2+30	215.00
2+40	220.00
2+50	225.00
2+60	230.00
2+70	235.00
2+80	240.00
2+90	245.00
3+00	250.00
3+10	255.00
3+20	260.00
3+30	265.00
3+40	270.00
3+50	275.00
3+60	280.00
3+70	285.00
3+80	290.00
3+90	295.00
4+00	300.00
4+10	305.00
4+20	310.00
4+30	315.00
4+40	320.00
4+50	325.00
4+60	330.00
4+70	335.00
4+80	340.00
4+90	345.00
5+00	350.00
5+10	355.00
5+20	360.00
5+30	365.00
5+40	370.00
5+50	375.00
5+60	380.00
5+70	385.00
5+80	390.00
5+90	395.00
6+00	400.00
6+10	405.00
6+20	410.00
6+30	415.00
6+40	420.00
6+50	425.00
6+60	430.00
6+70	435.00
6+80	440.00
6+90	445.00
7+00	450.00
7+10	455.00
7+20	460.00
7+30	465.00
7+40	470.00
7+50	475.00
7+60	480.00
7+70	485.00
7+80	490.00
7+90	495.00
8+00	500.00
8+10	505.00
8+20	510.00
8+30	515.00
8+40	520.00
8+50	525.00
8+60	530.00
8+70	535.00
8+80	540.00
8+90	545.00
9+00	550.00
9+10	555.00
9+20	560.00
9+30	565.00
9+40	570.00
9+50	575.00
9+60	580.00
9+70	585.00
9+80	590.00
9+90	595.00
10+00	600.00
10+10	605.00
10+20	610.00
10+30	615.00
10+40	620.00
10+50	625.00
10+60	630.00
10+70	635.00
10+80	640.00
10+90	645.00
11+00	650.00
11+10	655.00
11+20	660.00
11+30	665.00
11+40	670.00
11+50	675.00
11+60	680.00
11+70	685.00
11+80	690.00
11+90	695.00
12+00	700.00
12+10	705.00
12+20	710.00
12+30	715.00
12+40	720.00
12+50	725.00
12+60	730.00
12+70	735.00
12+80	740.00
12+90	745.00
13+00	750.00
13+10	755.00
13+20	760.00
13+30	765.00
13+40	770.00
13+50	775.00
13+60	780.00
13+70	785.00
13+80	790.00
13+90	795.00
14+00	800.00
14+10	805.00
14+20	810.00
14+30	815.00
14+40	820.00
14+50	825.00
14+60	830.00
14+70	835.00
14+80	840.00
14+90	845.00
15+00	850.00
15+10	855.00
15+20	860.00
15+30	865.00
15+40	870.00
15+50	875.00
15+60	880.00
15+70	885.00
15+80	890.00
15+90	895.00
16+00	900.00
16+10	905.00
16+20	910.00
16+30	915.00
16+40	920.00
16+50	925.00
16+60	930.00
16+70	935.00
16+80	940.00
16+90	945.00
17+00	950.00
17+10	955.00
17+20	960.00
17+30	965.00
17+40	970.00
17+50	975.00
17+60	980.00
17+70	985.00
17+80	990.00
17+90	995.00
18+00	1000.00
18+10	1005.00
18+20	1010.00
18+30	1015.00
18+40	1020.00
18+50	1025.00
18+60	1030.00
18+70	1035.00
18+80	1040.00
18+90	1045.00
19+00	1050.00
19+10	1055.00
19+20	1060.00
19+30	1065.00
19+40	1070.00
19+50	1075.00
19+60	1080.00
19+70	1085.00
19+80	1090.00
19+90	1095.00
20+00	1100.00
20+10	1105.00
20+20	1110.00
20+30	1115.00
20+40	1120.00
20+50	1125.00
20+60	1130.00
20+70	1135.00
20+80	1140.00
20+90	1145.00
21+00	1150.00
21+10	1155.00
21+20	1160.00
21+30	1165.00
21+40	1170.00
21+50	1175.00
21+60	1180.00
21+70	1185.00
21+80	1190.00
21+90	1195.00
22+00	1200.00
22+10	1205.00
22+20	1210.00
22+30	1215.00
22+40	1220.00
22+50	1225.00
22+60	1230.00
22+70	1235.00
22+80	1240.00
22+90	1245.00
23+00	1250.00
23+10	1255.00
23+20	1260.00
23+30	1265.00
23+40	1270.00
23+50	1275.00
23+60	1280.00
23+70	1285.00
23+80	1290.00
23+90	1295.00
24+00	1300.00
24+10	1305.00
24+20	1310.00
24+30	1315.00
24+40	1320.00
24+50	1325.00
24+60	1330.00
24+70	1335.00
24+80	1340.00
24+90	1345.00
25+00	1350.00
25+10	1355.00
25+20	1360.00
25+30	1365.00
25+40	1370.00
25+50	1375.00
25+60	1380.00
25+70	1385.00
25+80	1390.00
25+90	1395.00
26+00	1400.00
26+10	1405.00
26+20	1410.00
26+30	1415.00
26+40	1420.00
26+50	1425.00
26+60	1430.00
26+70	1435.00
26+80	1440.00
26+90	1445.00
27+00	1450.00
27+10	1455.00
27+20	1460.00
27+30	1465.00
27+40	1470.00
27+50	1475.00
27+60	1480.00
27+70	1485.00
27+80	1490.00
27+90	1495.00
28+00	1500.00
28+10	1505.00
28+20	1510.00
28+30	1515.00
28+40	1520.00
28+50	1525.00
28+60	1530.00
28+70	1535.00
28+80	1540.00
28+90	1545.00
29+00	1550.00
29+10	1555.00
29+20	1560.00
29+30	1565.00
29+40	1570.00
29+50	1575.00
29+60	1580.00
29+70	1585.00
29+80	1590.00
29+90	1595.00
30+00	1600.00
30+10	1605.00
30+20	1610.00
30+30	1615.00
30+40	1620.00
30+50	1625.00
30+60	1630.00
30+70	1635.00
30+80	1640.00
30+90	1645.00
31+00	1650.00
31+10	1655.00
31+20	1660.00
31+30	1665.00
31+40	1670.00
31+50	1675.00
31+60	1680.00
31+70	1685.00
31+80	1690.00
31+90	1695.00
32+00	1700.00
32+10	1705.00
32+20	1710.00
32+30	1715.00
32+40	1720.00
32+50	1725.00
32+60	1730.00
32+70	1735.00
32+80	1740.00
32+90	1745.00
33+00	1750.00
33+10	1755.00
33+20	1760.00
33+30	1765.00
33+40	1770.00
33+50	1775.00
33+60	1780.00
33+70	1785.00
33+80	1790.00
33+90	1795.00
34+00	1800.00
34+10	1805.00
34+20	1810.00
34+30	1815.00
34+40	1820.00
34+50	1825.00
34+60	1830.00
34+70	1835.00
34+80	1840.00
34+90	1845.00
35+00	1850.00
35+10	1855.00
35+20	1860.00
35+30	1865.00
35+40	1870.00
35+50	1875.00
35+60	1880.00
35+70	1885.00
35+80	1890.00
35+90	1895.00
36+00	1900.00
36+10	1905.00
36+20	1910.00
36+30	191

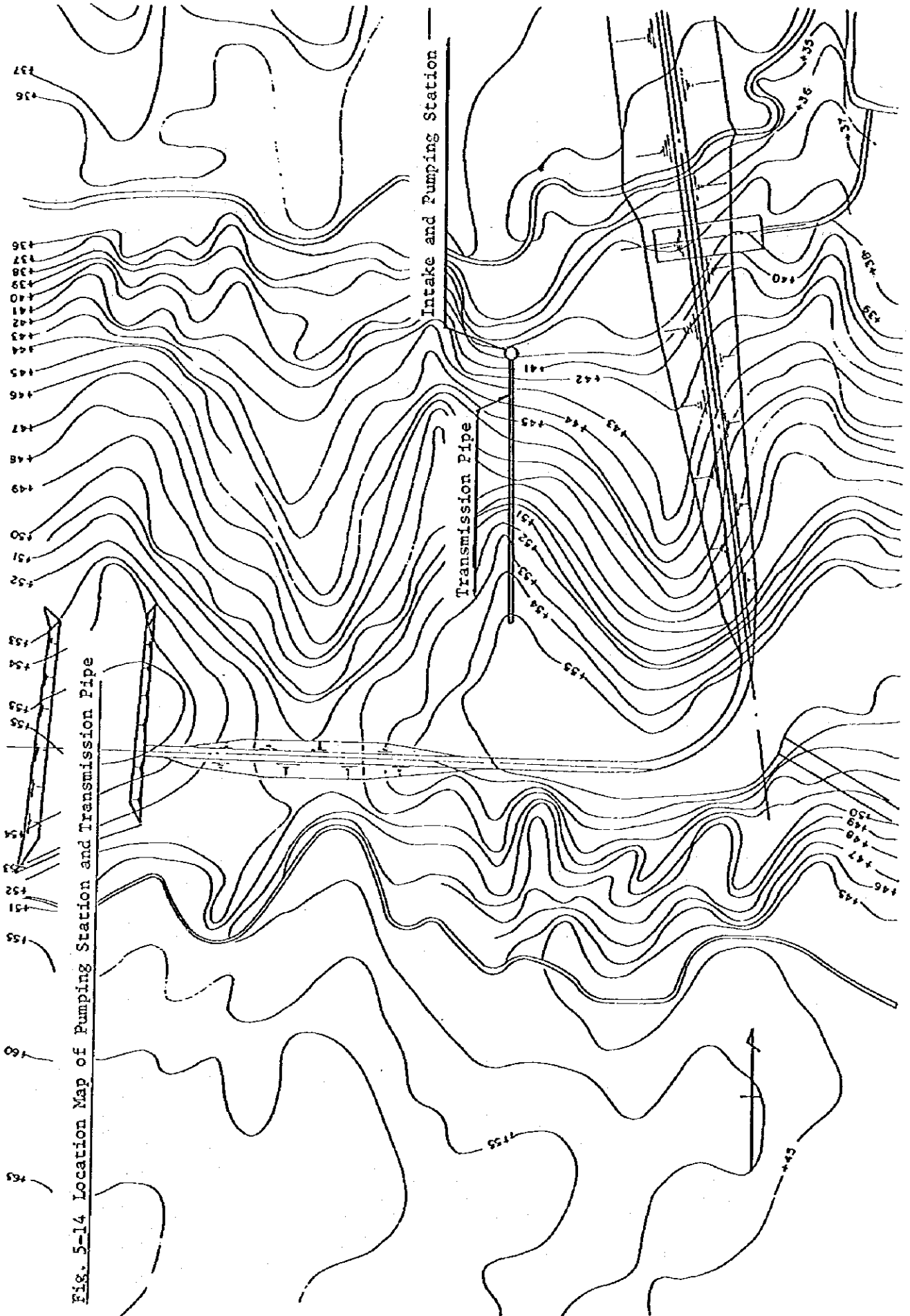


Fig. 5-14 Location Map of Pumping Station and Transmission Pipe

EL. (m)

Fig. 5-15 Profile of Pumping Station and Transmission Pipe

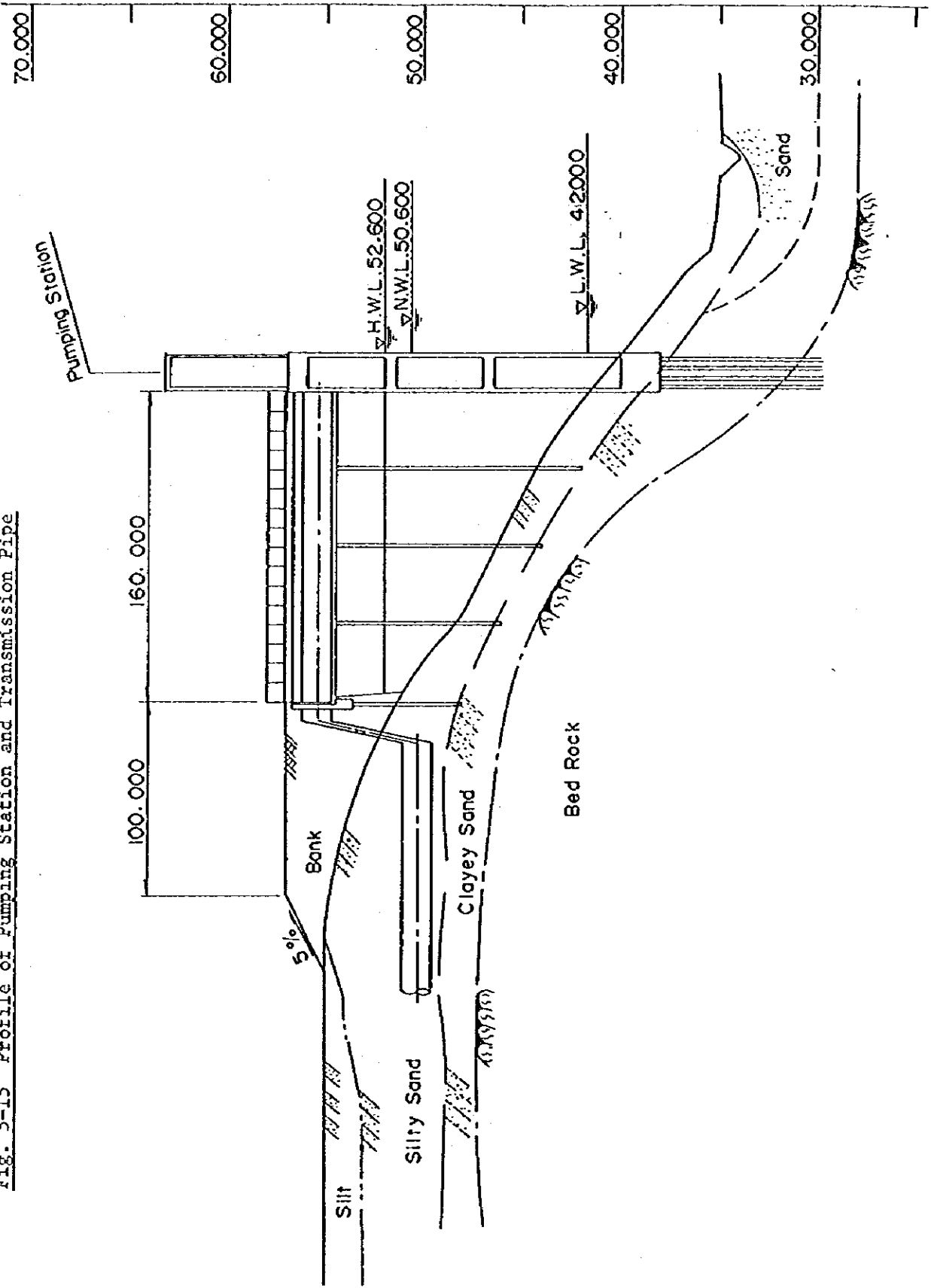


Fig. 5-16 General Plan of Pumping Station

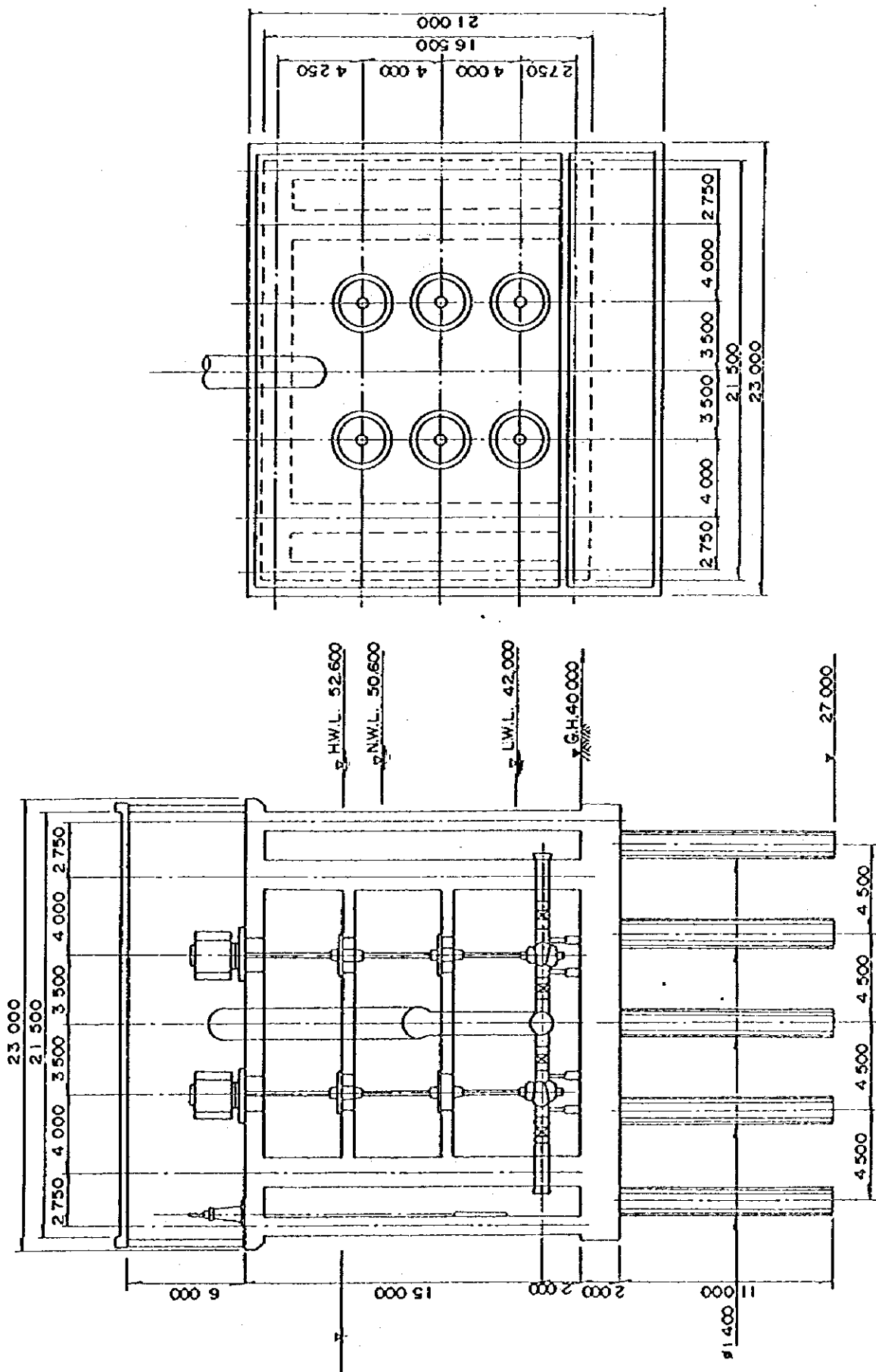


Fig. 5-17 General Plan of Air Chamber

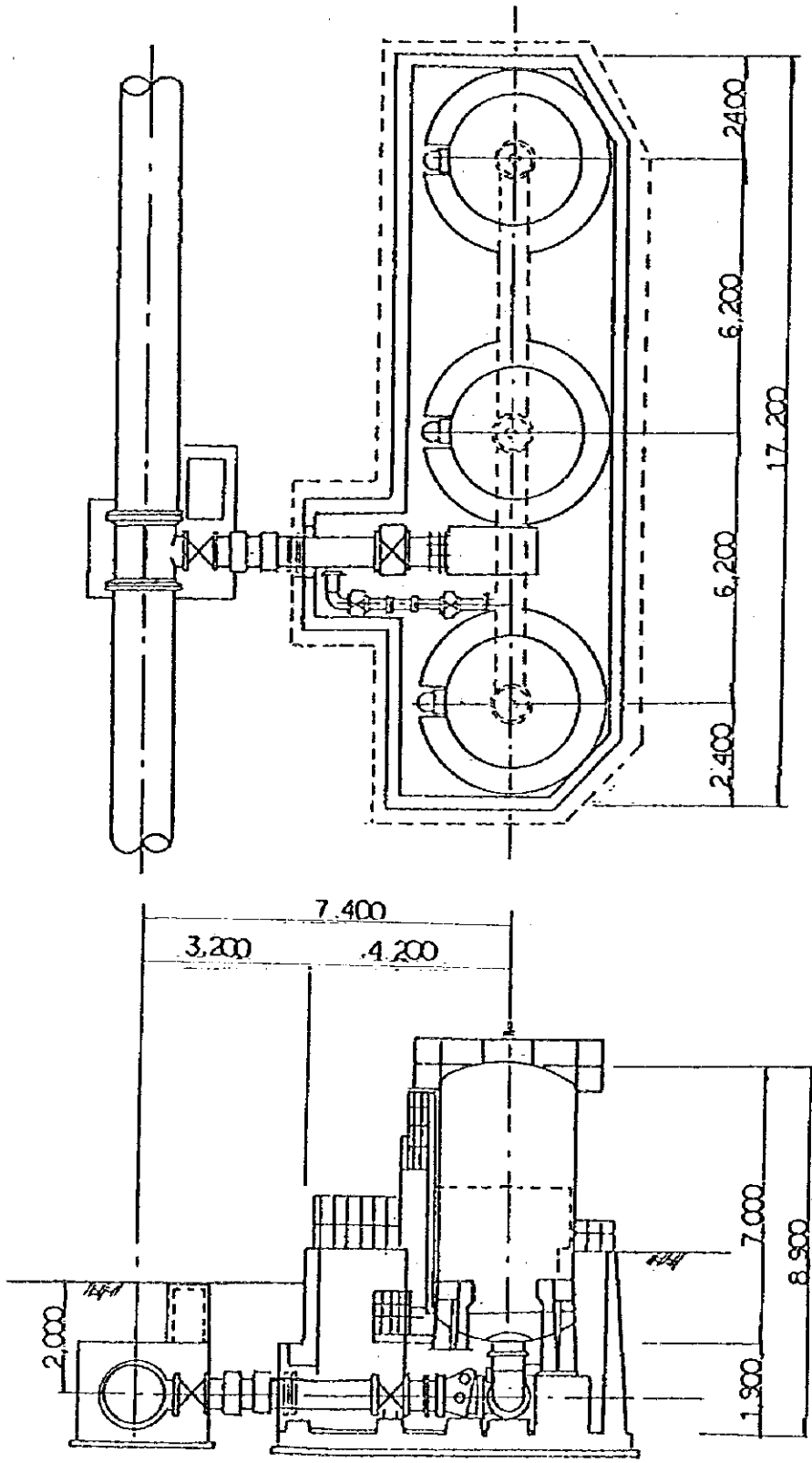


Fig. 5-18 Standard Dimension of Head Tank

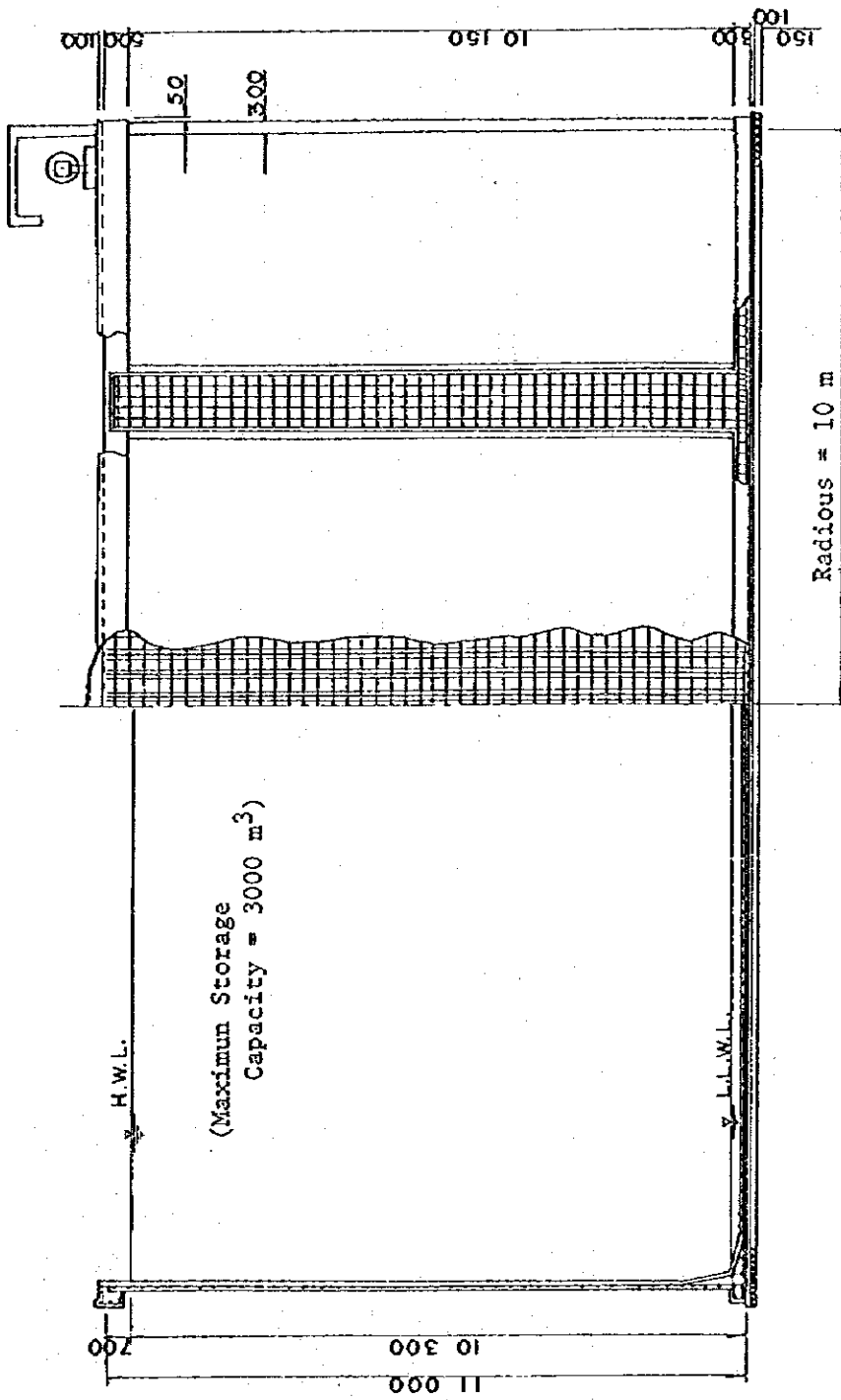


Fig. 5-19 General Plan of Receiving Well

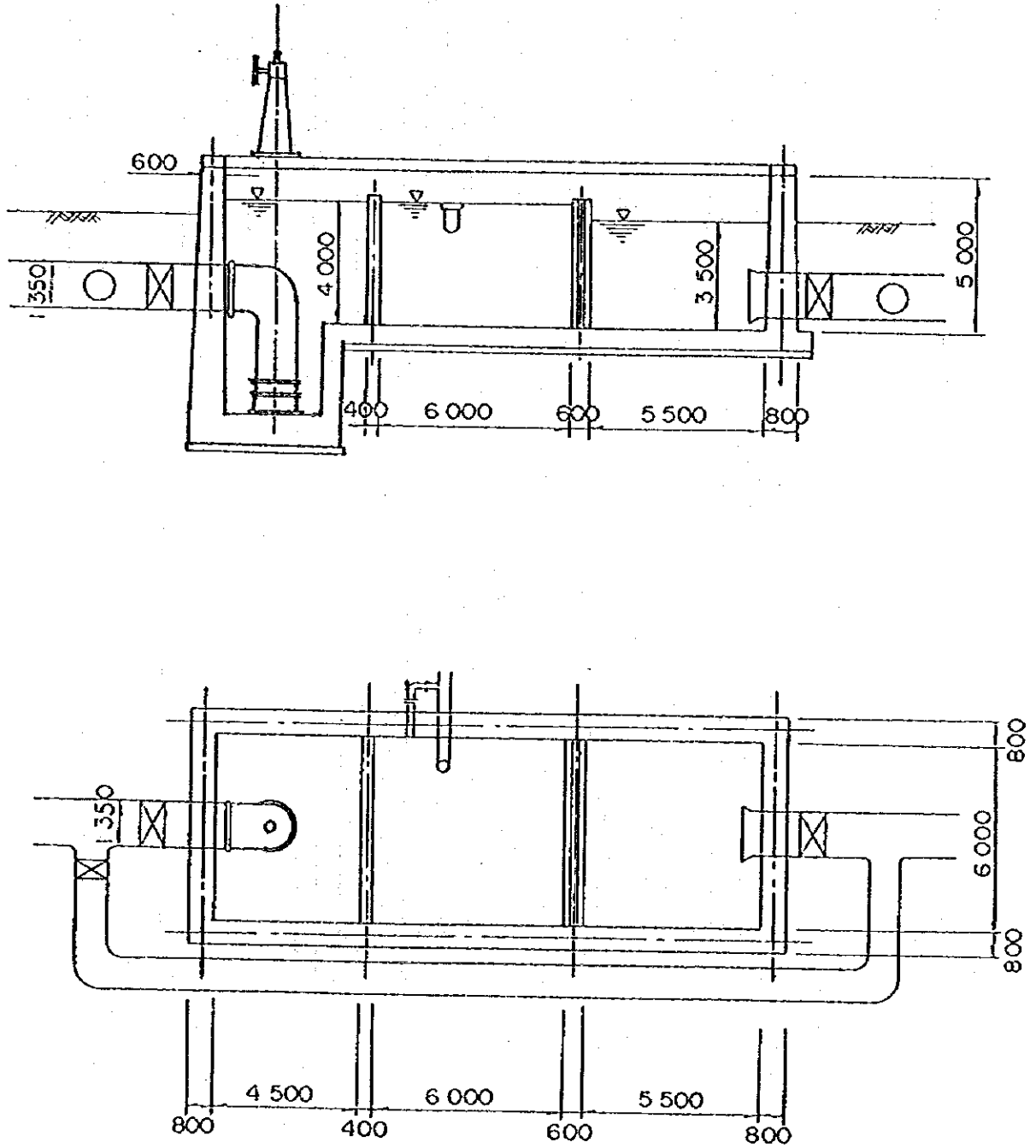
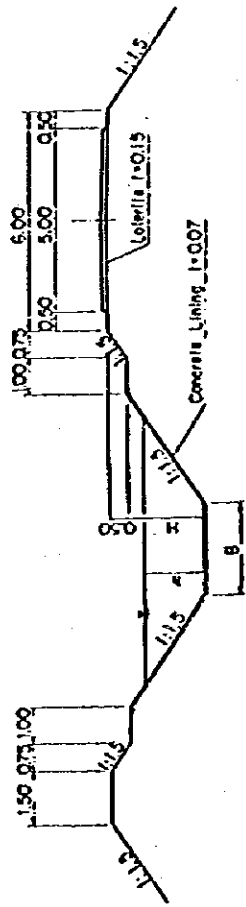


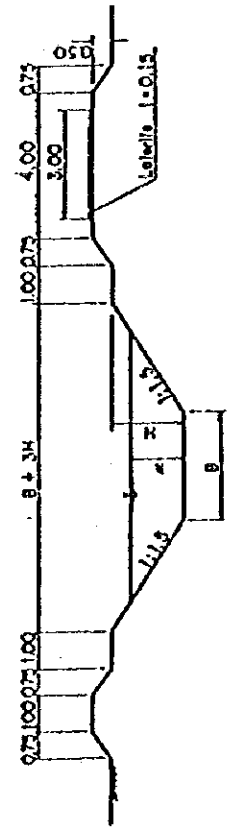
Fig. 5-20 Standard Cross-Section and Dimension of Irrigation and Drainage Canal



Standard Cross-Section of Main Canal

Dimension Table of Main Canal

Length (km)	Discharge (m ³ /sec)	Slope	A (m)	B (m)	H (m)
7.9	9.795	1/5,000	1.75	2.60	2.15
5.9	6.056	1/5,000	1.59	2.80	1.99
20.8	6.123	1/5,000	1.59	2.80	1.79
3.1	3.846	1/5,000	1.23	2.00	1.53
6.5	1.841	1/3,000	0.81	1.60	1.11

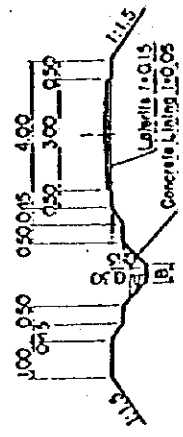


Standard Cross-Section of Drainage Canal

Dimension Table of Drainage Canal

Length (km)	Discharge (m ³ /sec)	Slope	A (m)	B (m)	H (m)
3.40	14.2	1/700	1.80	4.0	2.20
3.05	20.4	1/1000	2.03	4.0	2.50

Standard Cross-Section of Lateral Canal



Dimension Table of Lateral Canal

Lateral No.	Length (km)	Discharge (m ³ /sec)	Slope	A (m)	B (m)	H (m)
L-1	1.75	0.384	1/800	0.43	0.50	0.50
L-2	0.90	0.233	1/800	0.40	0.40	0.40
L-3	1.05	0.189	1/500	0.30	0.40	0.40
L-4	0.40	0.090	1/600	0.25	0.30	0.30
L-5	3.35	0.496	1/600	0.40	0.50	0.50
L-6	6.60	0.397	1/600	0.40	0.50	0.50
L-7	1.00	0.222	1/600	0.35	0.40	0.40
L-8	3.35	2.007	1/200	0.90	1.00	1.00
L-9	0.45	0.182	1/600	0.35	0.40	0.40
L-10	2.10	0.520	1/600	0.50	0.50	0.50
L-11	1.65	0.442	1/600	0.50	0.50	0.50
L-12	1.65	0.597	1/600	0.50	0.60	0.60

Fig. 5-21 Geological Map of Ban Bung Dam Axis

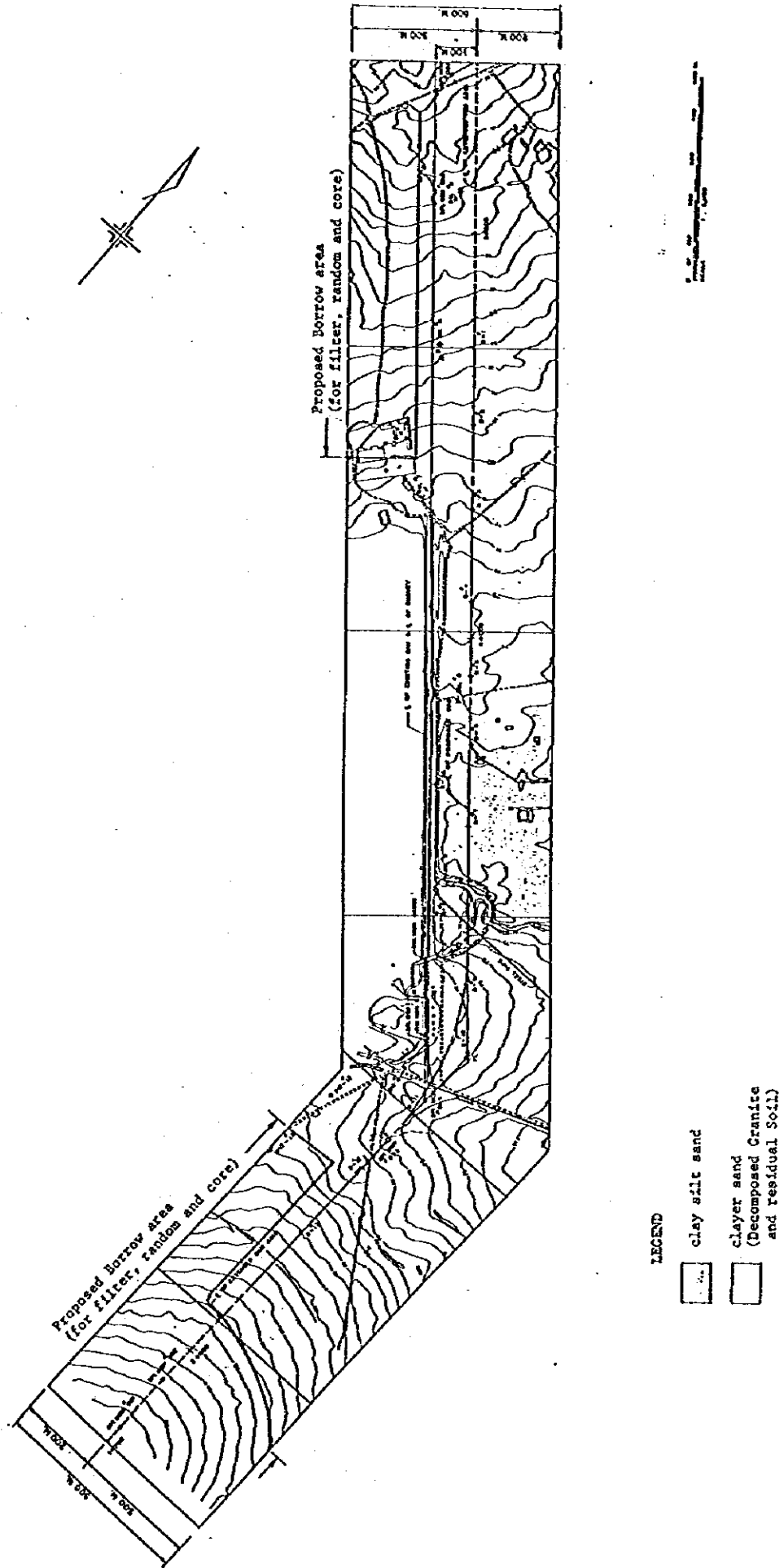


Fig. 5-22 General Plan of Bun Bung Dam

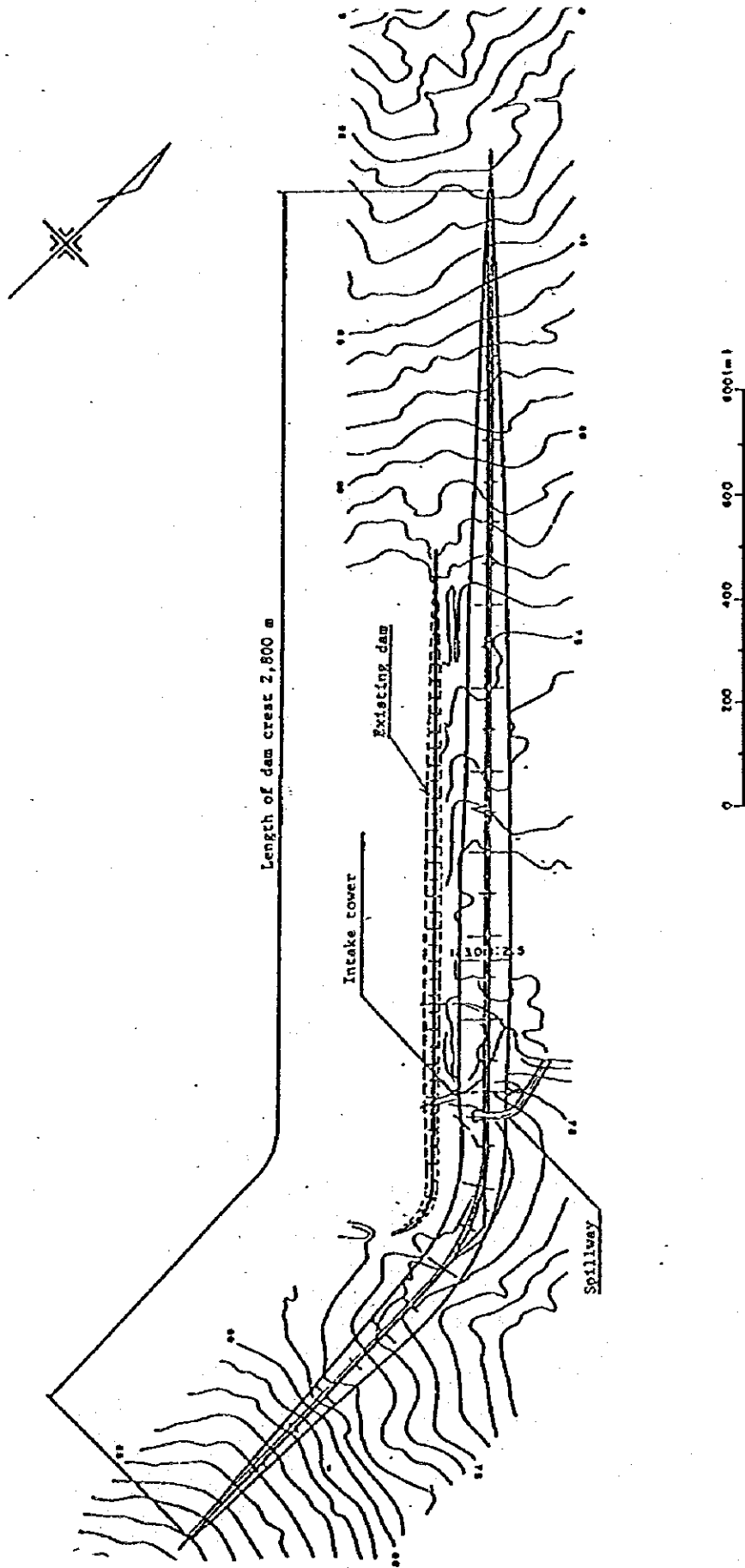
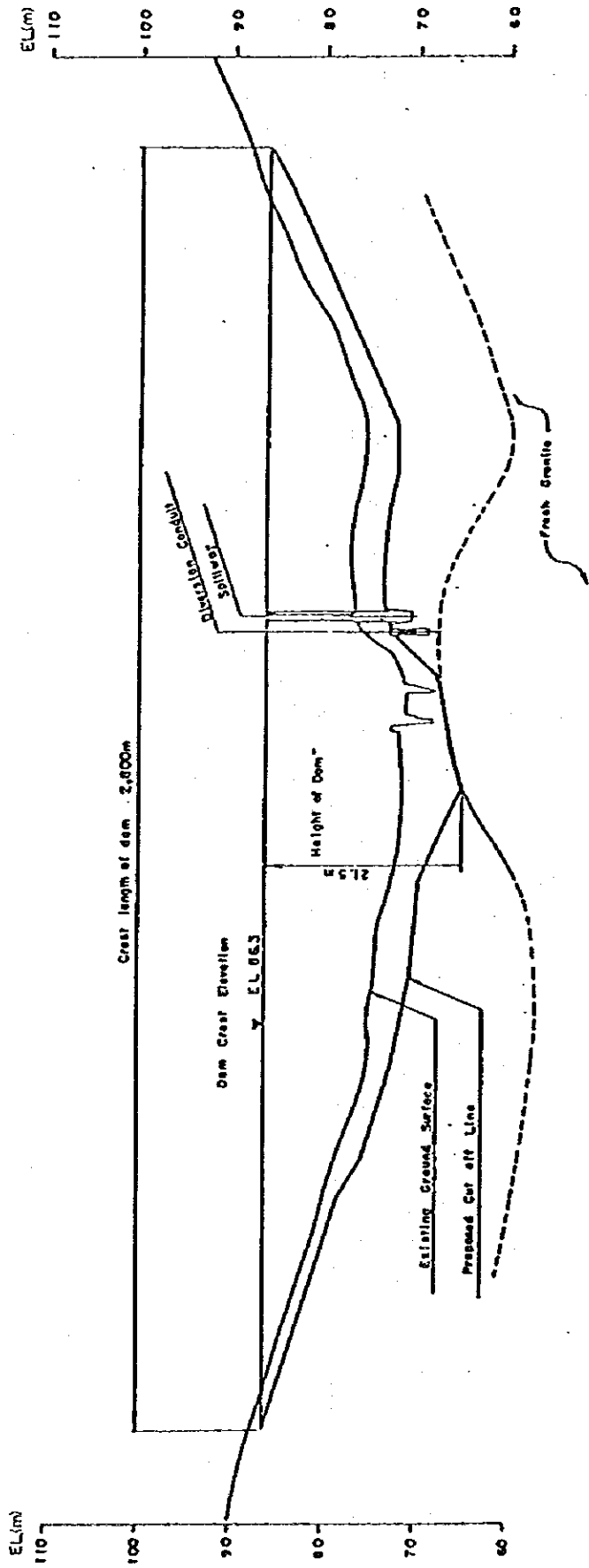


Fig. 5-23 Longitudinal Profile of Ban Bung Dam



CROSS SECTION NO.	PROPOSED CUT OFF LINE	ORIGINAL GROUND SURFACE	ACCUMULATED DISTANCE (m)
0	84.1	84.1	0
1	83.8	83.8	100
2	83.1	83.1	200
3	82.9	82.9	300
4	81.5	81.5	400
5	80.0	80.0	500
6	78.5	78.5	600
7	76.7	76.7	700
8	75.3	75.3	800
9	73.2	73.2	900
10	74.4	74.4	1,000
11	74.2	74.2	1,100
12	72.5	72.5	1,200
13	71.6	71.6	1,300
14	71.3	71.3	1,400
15	71.8	71.8	1,500
16	71.1	71.1	1,600
17	72.5	72.5	1,700
18	76.7	76.7	1,800
19	77.0	77.0	1,900
20	76.8	76.8	2,000
21	73.6	73.6	2,100
22	73.4	73.4	2,200
23	74.0	74.0	2,300
24	76.8	76.8	2,400
25	82.0	82.0	2,500
26	84.1	84.1	2,600
27	83.5	83.5	2,700
28	84.3	84.3	2,800

Fig. 5-24 Standard Cross-Section of Ban Bung Dam

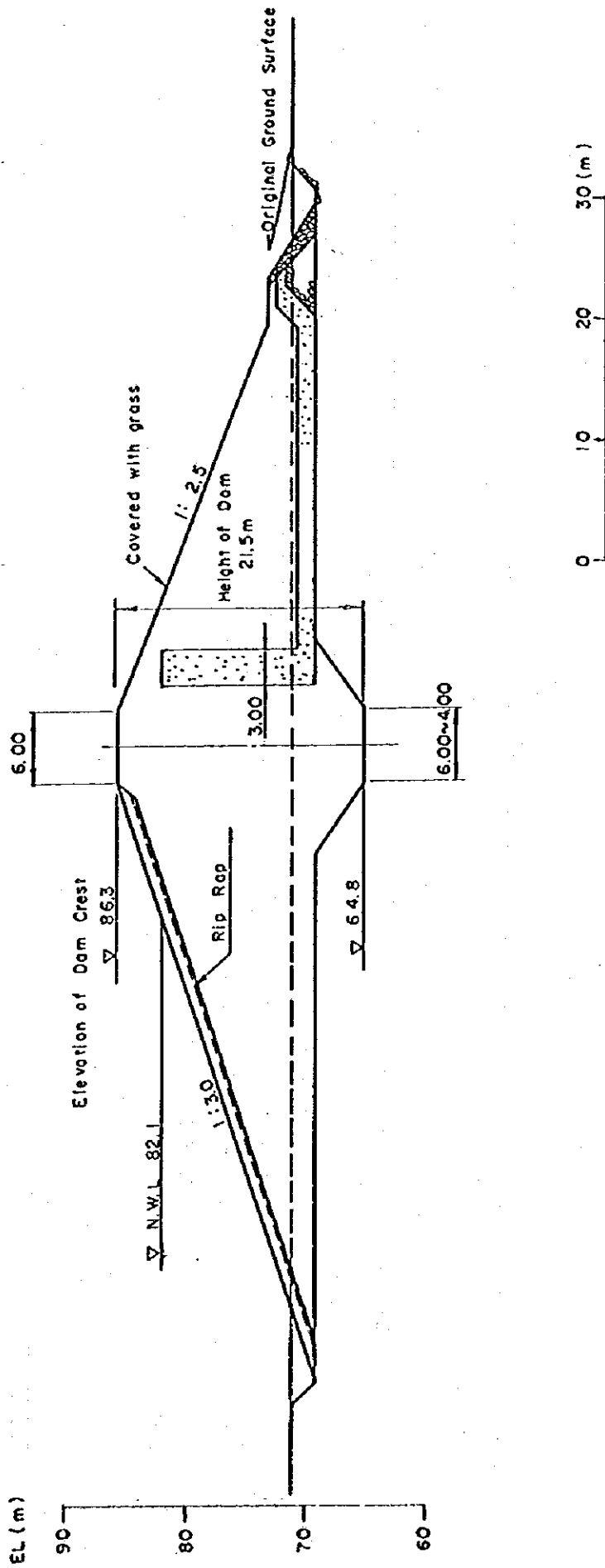


Fig. S-25 Inflow and Outflow Hydrograph of Design Flood for Spillway

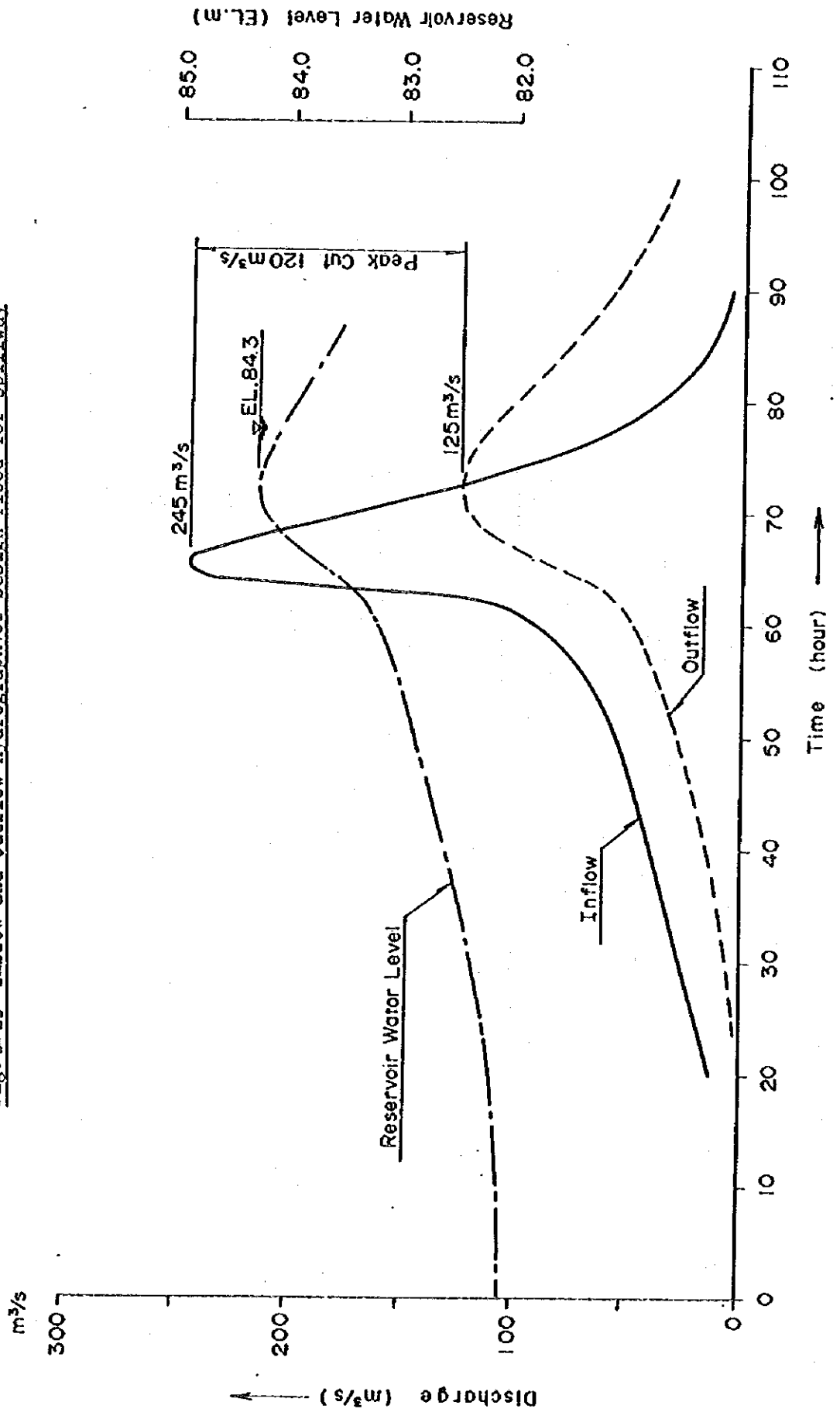


Fig. 5-26 Plan of Spillway, Intake and Outlet Facilities of Ban Bung Dam

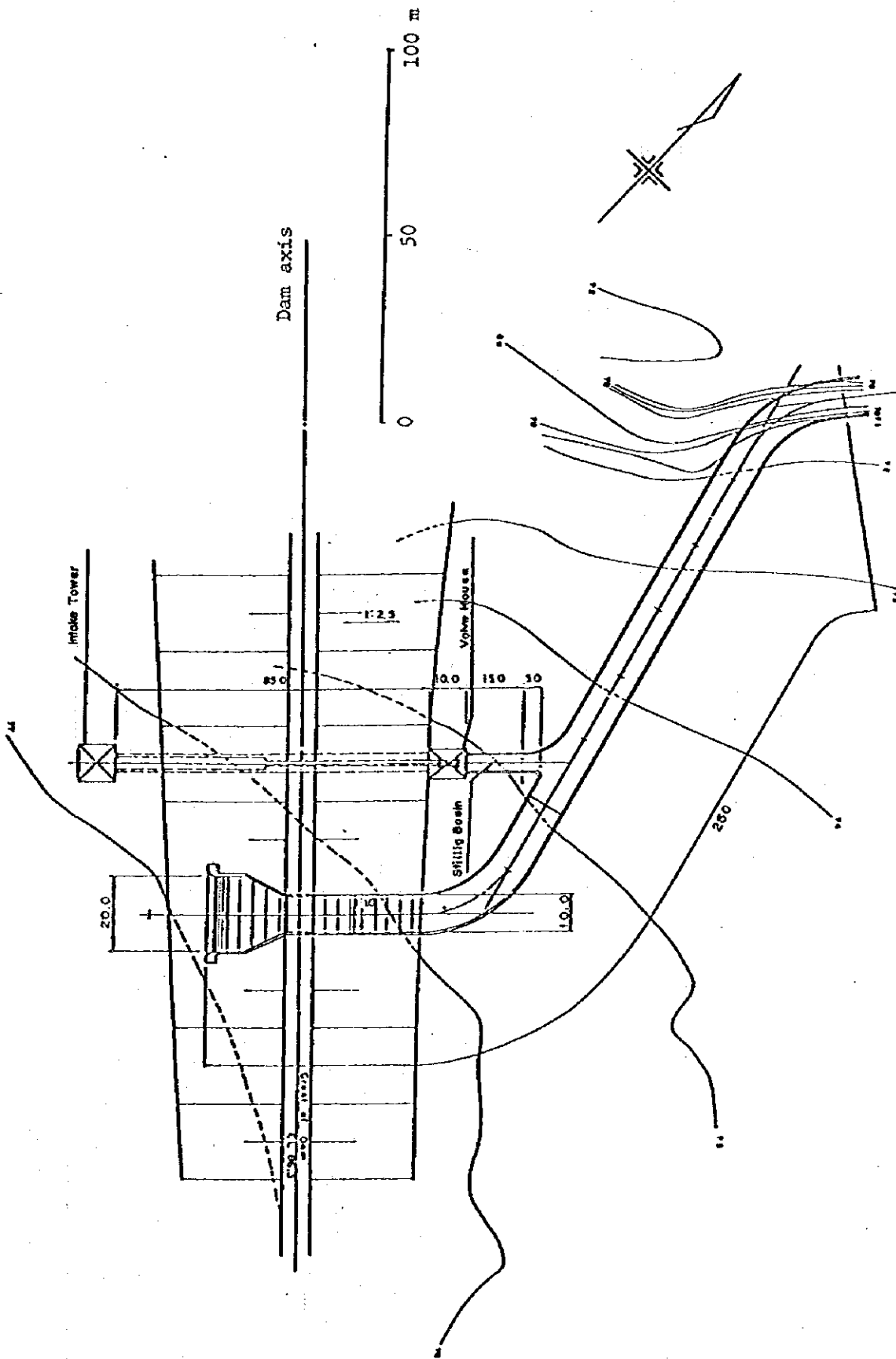


Fig. 5-27 Details of Spillway of Ban Bung Dam

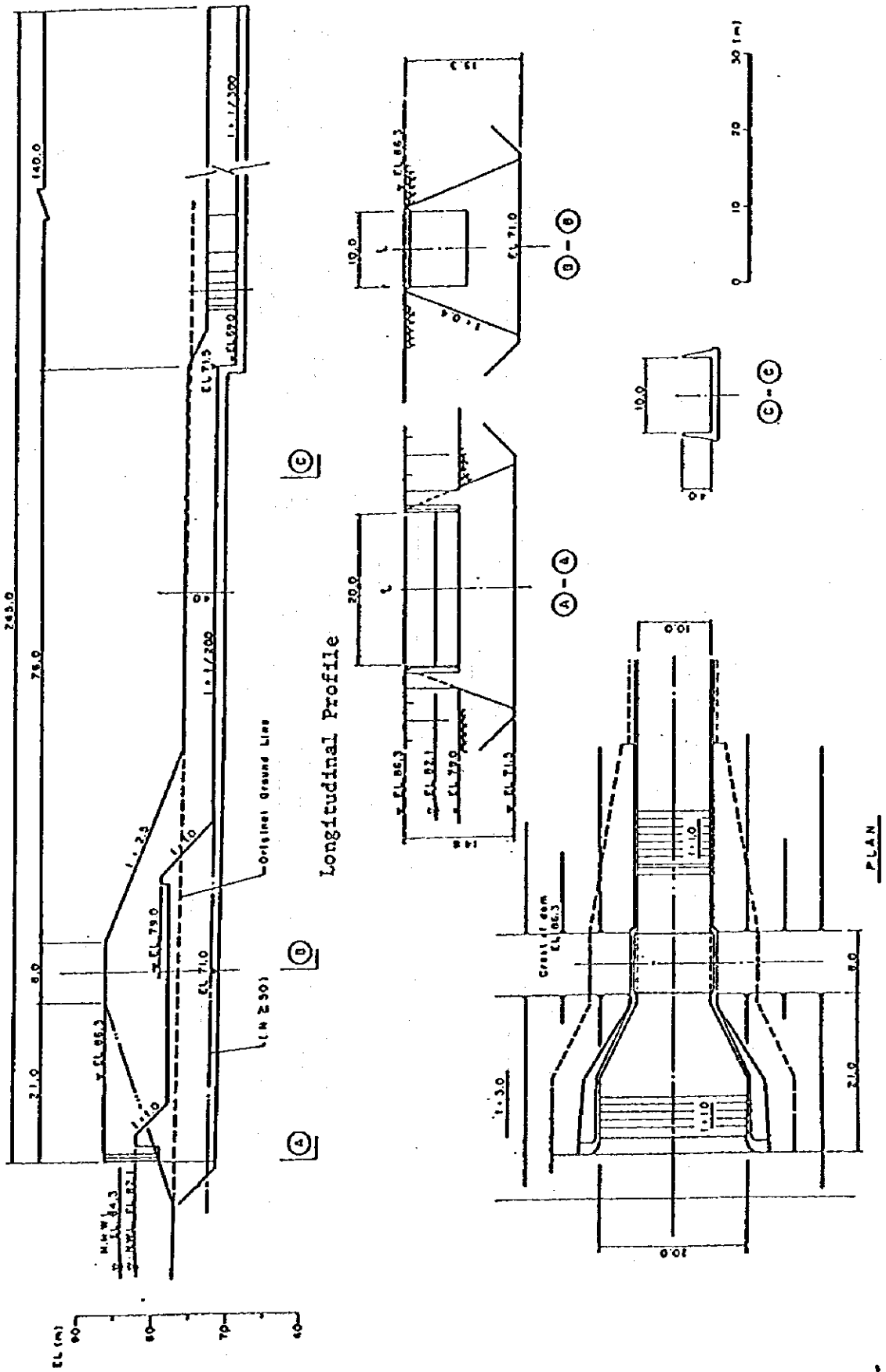


Fig. 5-28 Longitudinal Profile of Intake and Outlet Facilities of Ban Bung Dam

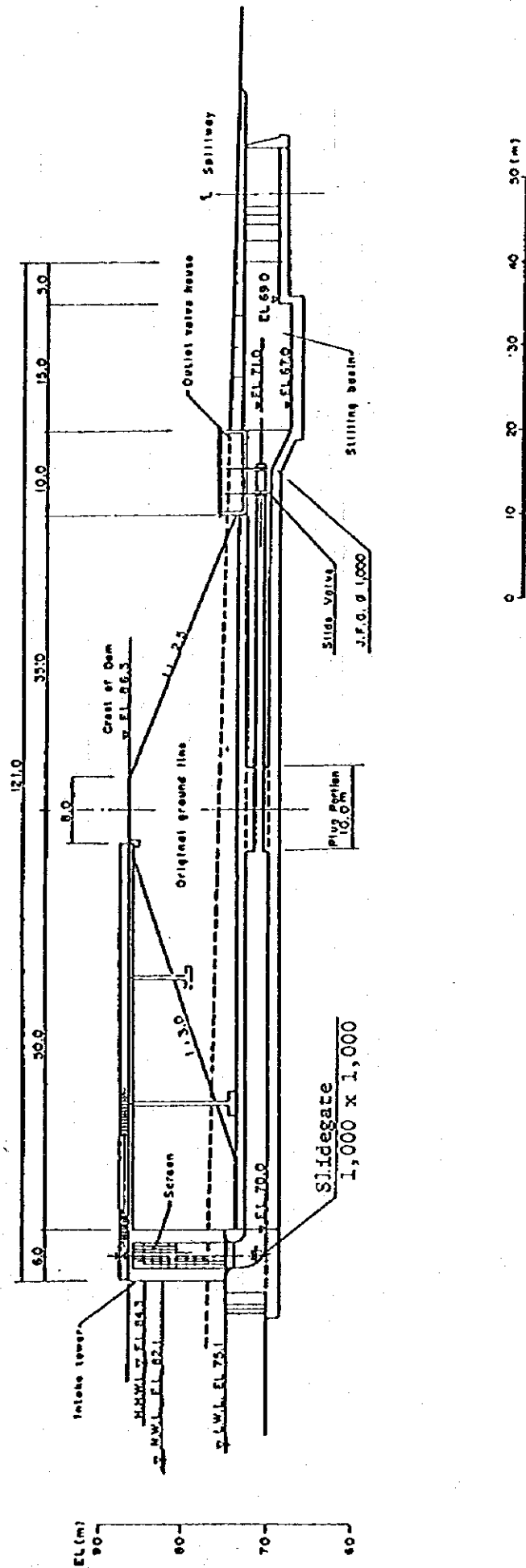


Fig. 5-29 Road Relocation

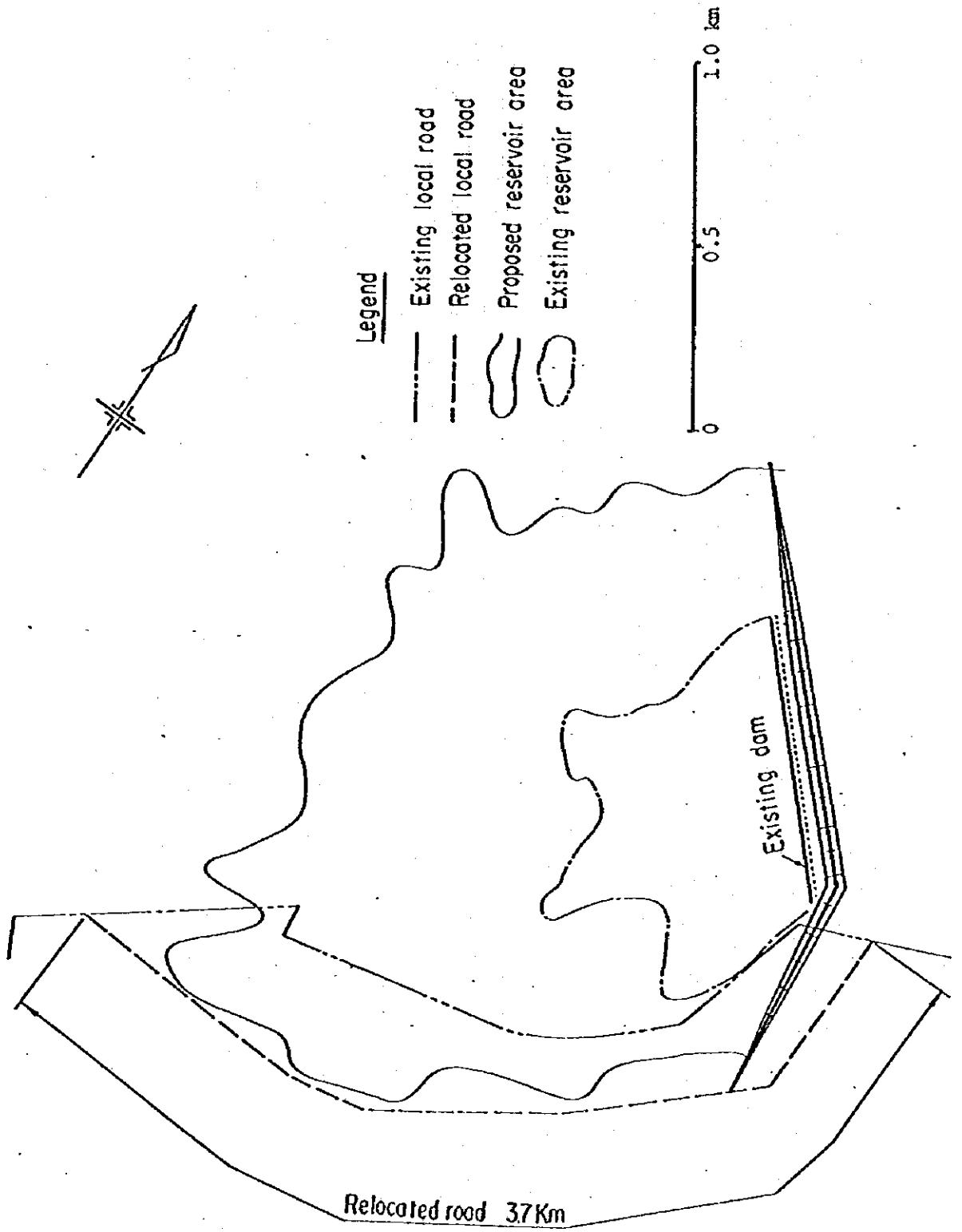
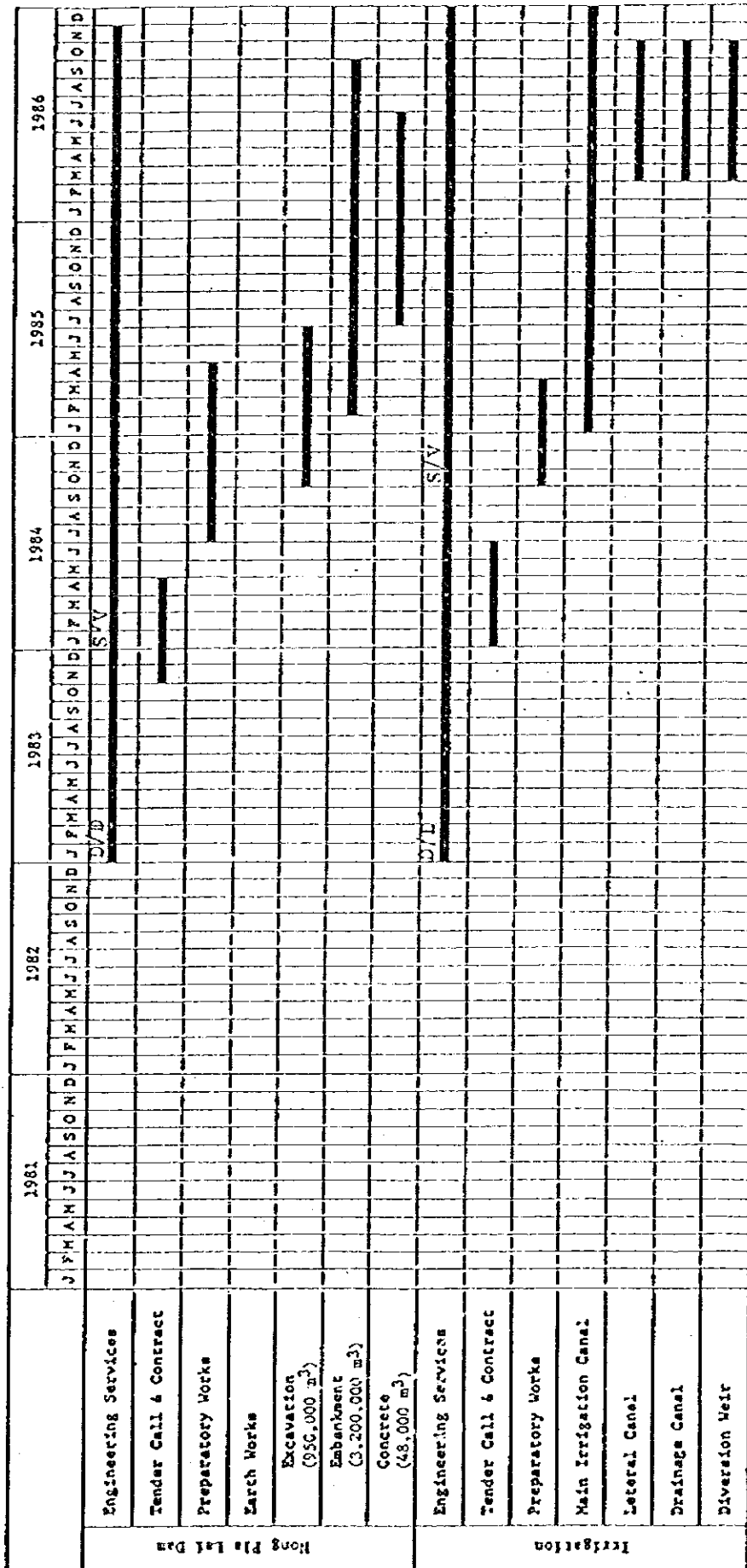


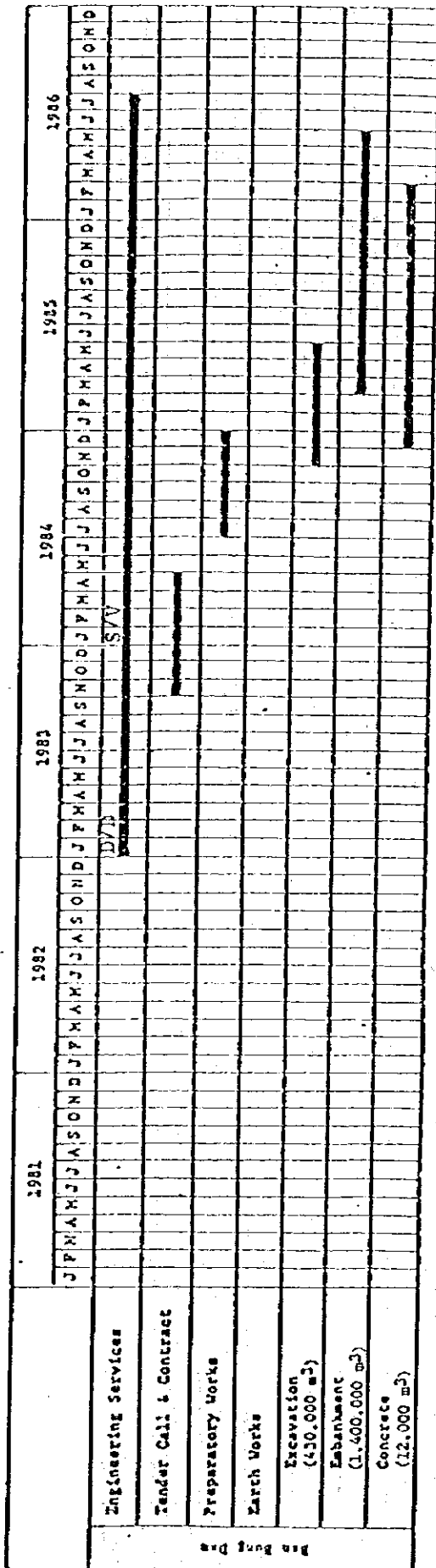
Fig. 6-1 Implementation Schedule of Nong Pia Lai Sub-Project (1)

Nong Pia Lai Dam and Irrigation



Legend : D/D: Detailed Design and Preparation of Tender
 S/V: Construction Supervision
 O/T: On the Job Training

Fig. 6-2 Implementation Schedule of Ban Bung Sub-Project



D/D: Detailed Design
 S/V: Supervision
 O/T: On the Job Training

— APPENDIX —

APPENDIX I

NONG PLA LAI SUB-PROJECT

(SUPPLY AREA : RAYONG AND SATTAHIP)

TABLE OF CONTENTS

1. GENERAL	I - 1
2. WATER DEMAND AND WATER SUPPLY	I - 1
2.1 Water Demand	I - 1
2.2 Water Supply Plan	I - 2
3. FORMULATION AND PRELIMINARY DESIGN OF THE PROJECT..	I - 2
3.1 Nong Pla Lai Dam	I - 2
3.2 Water Transmission System	I - 3
3.3 Irrigation and Drainage System	I - 6
4. CONSTRUCTION PLAN AND COST	I - 6
4.1 Construction Plan	I - 6
4.2 Construction Cost	I - 7
4.3 Operation and Maintenance	I - 7
5. PROJECT EVALUATION	I - 8
5.1 Economic Evaluation	I - 8
5.2 Financial Evaluation	I -11

LIST OF TABLES

A-1	Construction Cost of Nong Pla Lai Sub-Project	I - 13
A-2	Annual Disbursement of the Economic Project Cost (Nong Pla Lai Sub-Project)	I - 14
A-3	Annual Disbursement of the Financial Project Cost (Nong Pla Lai Sub-Project)	I - 15
A-4	Water Supply and Benefit (Nong Pla Lai Sub-Project)	I - 16
A-5	Income Statement for Industrial and Municipal Use (Nong Pla Lai Sub-Project)	I - 17
A-6	Discount Cash Flow for Industrial and Municipal Use (Nong Pla Lai Sub-Project)	I - 19
A-7	Sensitivity Analysis of Industrial and Municipal Water for Nong Pla Lai Sub-Project (Financial)	I - 20

LIST OF FIGURES

A-1	Water Supply by Dok Krai, Nong Pla Lai and Ban Bung Reservoirs	I - 21
A-2	General Plan of Ban Khai Head Works	I - 22
A-3	Implementation Schedule of Nong Pla Lai Sub-Project	I - 23

NONG PLA LAI SUB-PROJECT (SUPPLY AREAS: RAYONG AND SATTAHIP)

1. GENERAL

The Water Resources Development Plan in Changwats Chon Buri and Rayong has been formulated in this Report by utilizing the existing Dok Krai Dam and constructing four dams, namely Ban Bung, Nong Pla Lai, Khlong Yai and Thap Ma Dams to meet the industrial and municipal water demand at the year 2000 in Ban Bung, Rayong, Sattahip and Laem Chabang areas as well as to supply irrigation water to the proposed Nong Pla Lai and Thap Ma irrigation areas.

Within the framework of the above-said plan, the Nong Pla Lai Sub-Project was given the first priority and formulated with the design year of water supply set to 1995.

The formulated Nong Pla Lai Sub-Project consists of the Nong Pla Lai Dam, Water Transmission System comprising three routes to Mab Ta Pud (Rayong Area), Sattahip and Laem Chabang and Nong Pla Lai Irrigation System.

In the course of study, however, supply system to Laem Chabang area is likely to be excluded from the Sub-Project since the cost of conveyance is very high and alternative water source can be found in the vicinity of Laem Chabang area.

The present project formulation in this APPENDIX has been carried out excluding the water supply to Laem Chabang and contains specifically Nong Pla Lai Dam, water transmission routes to Mab Ta Pud (Rayong Area) and Sattahip, and Nong Pla Lai Irrigation System. The target year is set to 2000.

2. WATER DEMAND AND WATER SUPPLY

2.1 Water Demand

Industrial and Municipal

Demand for industrial-municipal water in the two supply areas of Rayong and Sattahip in the year 2000 has been estimated as in the below.

	unit: MCM/year		
	Rayong Area		
	<u>Rayong Municipality</u>	<u>Mab Ta Pud</u>	<u>Sattahip</u>
- Industry	6.4	21.5	17.2
- Industry-related municipality	3.2	12.3	1.5
-- Other municipality	12.6	-	5.3
Total	22.2	33.8	24.0

The increase of water demand in Rayong and Sattahip areas from 1996 to 2000 is equivalent to Laen Chabang's demand in 1995.

Irrigation

The irrigation water demand in the Nong Pla Lai irrigation area in the size of 3,650 ha is estimated at 69.4 KCM/year when the cropping intensity is 100% in wet season and 80% in dry season. Cropping pattern and other conditions of production are assumed to be the same as discussed in the Main Report.

2.2 Water Supply Plan

The water supply plan in the areas are broadly divided into two stages utilizing the surplus volume of the existing Dok Krai Reservoir which is exploited for Ban Khai Irrigation System and by constructing the proposed Nong Pla Lai Dam. The two stages are summarized below (refer to Fig. A-1):

First stage

The surplus water from Dok Krai Dam with storage capacity of 49 KCM will be utilized to meet the water demand in Mah Ta Pud through the water transmission system until 1986, when the construction of Nong Pla Lai Dam is completed. The water demand in 1986 is estimated at 22.8 KCM/year.

Second stage

The Nong Pla Lai Dam will be developed with storage capacity of 144.4 KCM taking physical and economical conditions into consideration.

After completion of Nong Pla Lai Dam, the Dok Krai Dam will be fully utilized to meet the industrial-municipal water demand in Rayong and Sattahip areas and the function of water supply to Ban Khai irrigation area is transferred from Dok Krai Dam to Nong Pla Lai Dam.

Nong Pla Lai Dam is utilized to meet the vested right of water in Ban Khai irrigation area and new demand of proposed Nong Pla Lai irrigation area.

3. FORMULATION AND PRELIMINARY DESIGN OF THE PROJECT

3.1 Nong Pla Lai Dam

The development scale of the Nong Pla Lai Dam is assumed to be the same as that discussed in the Main Report. Proposed features of dam and reservoir are summarized on the next page.

Reservoir

Catchment area	426 km ²
Reservoir area at H.W.L.	23 km ²

Reservoir stage

High water level (H.W.L.)	EL. 47.0 m
Normal water level (N.W.L.)	EL. 45.0 m
Low water level (L.W.L.)	EL. 33.3 m

Reservoir storage

Gross	200,700,000 m ³
Surcharge	43,500,000 m ³
Irrigation, industrial & municipal	144,400,000 m ³
Sediment	12,800,000 m ³

Dam

Dam Type	Earth fill type with cut-off trench
Crest elevation	EL. 49.0 m
Max. dam height	31.0 m
Crest length	4,000.0 m
Slope gradients	Upstream slope 1:3.0 Downstream slope 1:2.5
Embankment volume	3,200,000 m ³

Spillway

Type	Side overflow weir with emergency gate
Capacity	700 m ³ /s at H.W.L.
Gate (Emergency gate)	Roller gate 5.0m x 5.0m x 1 unit.

Intake & Outlet

Intake	Type : Vertical Tower
Outlet for irrigation water	
Regulating valve	Jet flow gate φ 1,500 mm x 1 set
Discharge capacity	14 m ³ /s at L.W.L.

3.2 Water Transmission System

Supply of municipal-industrial water to Mab Ta Pud (Rayong Area) and Sattahip will be made through pipelines extending from Dok Krai Dam. As for industrial-municipal water for Rayong municipality, the discharge from Dok Krai Dam will be flown into Rayong River and taken at an intake weir which will be constructed in the upstream of the existing Ban Khai Intake Weir and, then, sent over to the receiving well at Ban Khai.

The proposed water transmission system comprises such facilities as pumps, pipeline, receiving well, head tanks and etc. As for the route from Dok Krai to Mab Ta Pud and from Mab Ta Pud to Sattahip, the proposed scale of conveyance is aimed to meet the demand in the year 2000, and the same scale excepting that of the proposed pump has been adopted for in the APPENDIX.

The supply toward Rayong, on the other hand, is meant for a new demand. The water released from Dok Krai Reservoir is taken in the downstream and sent forward.

Supply to Mab Ta Pud

The features of the project are as follows. Refer to relevant drawings in the Main Report.

1) Pumping Station at Dok Krai Reservoir

Type of pumping station	Concrete caisson with pile foundation
Type of pump	Vertical shaft volute type pump
Design discharge	2.62 m ³ /sec (31.44 m ³ /min/unit)
Number of pumps	6 (1 for stand-by)
Total pump head	90 m
Motor output	3,000 kw

2) Pipeline

Total length	27.6 km
Steel pipe	ϕ 1,350 mm, 11.9 mm thick

3) Head tank

Location	6.0 km south of Dok Krai pumping station
Volume	3,000 m ³ x 2 unit

4) Receiving facility

Location	West of Ban Chan Luk Ya along Route-3
Receiving well	780 m ³
Receiving basin	21,000 m ³

Supply to Sattahip from Mab Ta Pud

The features of the project are as follows. Refer to relevant drawings in the Main Report.

1) Booster pumping station at Mab Ta Pud

Type of pump	Horizontal shaft volute type
Design discharge	1.09 m ³ /sec
Number of pumps	3 (1 for stand-by)
Total pump head	11 m
Motor output	150 kW

2) Pipeline

Design discharge	1.09 m ³ /sec
Total length	21.9 km
Steel pipe	φ 1,000 mm 8.7 mm thick

3) Receiving well

Location	Approx. 5 km east of Amphoe Sattahip
Volume	350 m ³

Supply to Rayong

The water flown down from the Dok Krai Reservoir will be taken in the upstream of the Ban Khai diversion weir and sent over 1 km via pipeline to the receiving facility. The water is purified and then conveyed to Rayong Municipality for consumption.

The features of the project are as follows. Refer to Fig. A-2 for the proposed weir.

1) Weir

Location	Up stream of Ban Khai diversion weir on Rayong River
Flood gate	2 gates x 20 (W) x 2.5 m (H)
Regulating gate	10 m (W) x 3.0 m (H)

2) Intake and Transmission Facilities

Design discharge	1.01 m ³ /sec
Pipe	
Lengh	1.0 km
Concrete pipe	φ1,500 mm

3) Receiving Facility

Location	Ban Khai
Volume	300 m ³

3.3 Irrigation and Drainage System

The development plan for the irrigation and drainage system of Nong Pla Lai irrigation area is same as the one in the Main Report. The features of the project are as follows. Refer to relevant drawings in the Main Report.

Irrigation

Irrigation area	3,650 ha
Cropping intensity	100% in wet season and 80% in dry season
Cropping pattern	Paddy in wet season and paddy/groundnuts in dry season
Expected crop yield	Wet paddy 4.0 ton/ha Dry paddy 4.5 ton/ha Groundnuts 1.9 ton/ha
Irrigation water	69.4 MCM/year
Diversion weir	Ban Nong Bau
Irrigation canal	
- Main length	46.2 km concrete lined
- Secondary length	20 km ditto

Drainage

Drainage area	
Inside the project area	21.3 km ²
Outside the project area	14.9 km ²
Design discharge	20.4 m ³ /sec
Drainage length	6.5 km

4. CONSTRUCTION PLAN AND COST

4.1 Construction Plan

The construction plan for Nong Pla Lai Dam, the water transmission system (Dok Kral to Sattahip via Mab Ta Pud) and the Nong Pla Lai irrigation system are the same as discussed in the Main Report. Refer to the Main Report for relevant items. As for water supply to Rayong municipality, its scope of work is separate from the Main Report.

The construction planning of the water supply system to Rayong Municipality is summarized below.

Construction Materials

The total amount of concrete required for weir, intake and etc. is estimated at about 4,100 m³. Coarse aggregate and fine aggregate are to be supplied from the local source. Reinforcement (300 tons) and steel for gate (70 tons) are to be supplied from the foreign source.

Pipes for water transmission of 1,500 mm diameter and 1 km long are to be supplied from the local source.

Land Acquisition

The area required for the project will be acquired for the construction of intake, receiving well and pipeline.

Implementation Schedule

Construction schedule for Nong Pla Lai Dam, the water transmission system and the Nong Pla Lai irrigation and drainage system are shown in Fig. A-3.

4.2 Construction Cost

Construction cost for Nong Pla Lai Dam, the water transmission system and the Nong Pla Lai irrigation and drainage system are as follows (refer to Table A-1).

	(Unit: Million US\$)		
	Foreign Currency	Local Currency	Total
Dam and Reservoir	29.85	36.70	66.55
Water Transmission System	63.73	29.07	92.80
Irrigation and Drainage System	7.01	9.04	16.05
Total	100.59	74.81	175.40

The construction cost of each sector and annual disbursement of economic cost and financial cost are shown in Tables A-2 and A-3.

4.3 Operation and Maintenance

Required Works

The operation and maintenance for the project facilities aside from pipe line system will be undertaken by Royal Irrigation Department (RID) which is also to be the executing agency for the project construction works. As for the pipe line system, the agency for the operation and maintenance has not been established.

The personnel required for the operation and maintenance of Dok Krai Dam, Nong Pla Lai Dam, water transmission system and irrigation system are shown in Table 7-1 and required works excluding the water supply system to Rayong municipality are the same as those described in the Main Report.

The required work concerning the water supply system to Rayong are as mentioned below.

- Daily patrol and inspection of dam and reservoir
- Overall management of principal facilities
- Administration for water distribution
- Hydrology data collection and filing

Operation and Maintenance Cost

The annual required cost of operation and maintenance for dam and irrigation system is estimated at 0.30 million US\$. As for the water transmission system, the annual cost of operation and maintenance is estimated at 1.20 million US\$ which mainly counts for the electric energy consumption for the pumping power.

5. PROJECT EVALUATION

The project evaluation was carried out in the same manner with the same conditions as mentioned in the Main Report.

5.1 Economic Evaluation

Economic Cost Estimation

1) Construction Cost

The total economic construction cost is estimated to be 115.13 million US\$, which can be classified by work item as follows:

<u>Work Item</u>	<u>Cost (million US\$)</u>
Nong Pla Lai Dam	35.58
Water Transmission System	67.56
Irrigation and Drainage System	8.40
Land Consolidation	3.59
Total	115.13

Annual disbursement of the cost is presented in Table A-2 by work item.

2) Cost Allocation of Dam Construction Cost

The dam construction cost has been allocated by means of "Separable Cost - Remaining Benefit Method", as shown below:

Unit: Million US\$

<u>Sector</u>	<u>Total</u>
Flood Control	4.91
Industrial and Municipal Water	21.35
Irrigation	9.32
Total	35.58

3) Cost Estimate by Sector

Based on the above allocation of the dam construction cost, the total project economic cost can be further classified by each sector as follows:

<u>Sector</u>	<u>Cost (million US\$)</u>
Flood Control	4.91
Water Transmission System	88.91
Irrigation	21.31
Total	115.13

4) Operation and Maintenance Cost

Operation and maintenance cost of Nong Pla Lai Dam together with water transmission system and irrigation system is estimated at 1.50 million US\$ per year.

Benefit Estimation

1) Direct Benefit

a. Municipal and Industrial Water

Economic value has to be assigned to municipal and industrial water developed by the project to estimate the project benefit, although it is quite difficult to quantify the value in monetary terms. In this study, the unit water value is assumed to be 5.0 $\text{฿}/\text{m}^3$ for Nong Pla Lai Sub-Project.

The direct benefit is calculated by multiplying the unit value with the water consumption volume.

Table A-4 shows the annual water supply and benefit.

The benefit for industrial and municipal water will be estimated to be 17.36 million US\$/year in full operation stage in 2000 and thereafter.

b. Irrigation Benefit

Irrigation benefit is defined as an increase of net production value under the with- and without-the-project conditions. The net production value without the project would remain at approximately 41.32 million ฿ (1.80 million US\$). On the other hand, the net production value with the project will reach 120.36 million ฿ in a year (5.23 million US\$), as detailed in Tables 8-4 and 8-6 in the Main Report.

The benefit in the year 1993 (at the time the benefit comes up to full value) turns to be 79.04 million P (3.44 million US\$). Assuming that the volume of water supply is 69.4 MCM, the benefit will be 1.14 P/m^3 (0.050 US\$/ m^3).

c. Flood control

The economic benefit by the flood control is as stated before, 6.2 million P (0.27 million US\$) on the annual average.

2) Indirect Benefit

On the account of indirect benefit, refer to the Main Report.

Economic Evaluation

The Internal Rate of Return (IRR) of the Nong Pla Lai Sub-Project is calculated at 11.2%.

Internal Rate of Return has been further calculated for each sector based on cost estimate by sector which results in the following percentages.

<u>Sector</u>	<u>IRR (%)</u>
Industrial and Municipal Water :	11.3
Irrigation :	12.1
Flood Control :	3.5
The Project :	11.2

Sensitivity Analysis

Sensitivity analysis to identify the IRR's change in response to the changes of factors such as construction cost and delay of water demand has been done.

1) Construction cost

In response to 10% and 20% increase of construction cost, IRR would decrease to 10.3% and 9.5%, respectively.

2) Delay of Water Demand by 10 years

In case that the occurrence of water demand is assumed to be delayed by 10 years from the year 2000, benefit would decrease according to the delay. Consequently, IRR would be 10.2%.

5.2 Financial Evaluation

Financial Background of the Project

In Thailand, Royal Irrigation Department is in charge of the construction of dam, water supply and irrigation system financed by national budget.

As for the collection of water tariff, it is being practiced in both industrial and municipal water, while no collection of water tariff from farmers or land-owners for the irrigation water supply service is carried out. Therefore, the financial analysis of water transmission system can afford to be discussed but financial analysis for the development of irrigation water system is impossible.

Financial Projections

For the financial analysis of industrial and municipal water supply system, financial projections are set up as follows.

1) Total Capital Requirement

According to the cost allocation, the construction cost of the dam for industrial and municipal water supply claims 60% of the construction cost of Nong Pla Lai Dam. The total capital requirement will be 132.73 million US\$, with 61.5% (81.64 million US\$) of foreign portion and 38.5% (51.09 million US\$) of local portion, as summarized below.

Unit: Million US\$

		Foreign Currency	Local Currency	Total
Dam (for water transmission sector)	(mil. US\$)	17.91	22.02	39.93
Water Transmis- sion system	(mil. US\$)	63.73	29.07	92.80
Total	(mil. US\$)	81.64	51.09	132.73

The annual disbursement of the total financial project cost is presented in Table A-3.

2) Tariff

The water tariff is set up at 3.5 B/m³ (0.152 US\$/m³) for both industrial and municipal water (refer to Supporting Report).

3) Depreciation and Operation and Maintenance Cost

37 years will be adopted as an average depreciation period of dam and water transmission system. Operation and maintenance cost is shown below at the time of full operation (after 2000).

Dam	0.18 million US\$/year
Water supply	1.20 million US\$/year
Total	1.38 million US\$/year

4) Loan Condition of Foreign Capital

The loan condition of foreign capital is assumed as below.

Interest rate	:	3%
Term of repayment	:	30 years
Grace period	:	10 years

Note: The conditions above are of the case of OECF.

Financial Analysis

1) Income Statement

Table A-5 shows the income statement based on the financial conditions set up in total capital requirement mentioned before. The revenue will accrue from 1984 when water supply is to be started. From 1987 both interest and depreciation will start to be counted so that the profit will show a sharp decrease but thereafter it will gradually continue to increase. As the repayment of foreign currency will end by 2023, from 2024 annual profit will constantly be 8.07 million US\$.

2) IRR Calculation

The calculation of Internal Rate of Return based on the Discount Cash Flow (see Table A-6) would be shown below.

$$\text{IRR} = 5.9 \%$$

Therefore, for Nong Pla Lai dam and water supply system, it is desirable to induce the capital with an interest rate of 5.9 % or less.

Sensitivity Analysis

In the sensitivity analysis, it has been studied how a change in each single factor, namely water tariff, construction cost and water demand will affect IRR. Tariff factor is especially affective to IRR.

Sensitivity analyses are summarized in Table A-7.

Table A-1 Construction Cost of Nong Pla Lai Sub-Project

Item	Grand Total			Nong Pla Lai Dam			Water Transmission System						Irrigation and Drainage System					
	L.C.	F.C.	Total	L.C.	F.C.	Total	Dok Krai-Mab Ta Pud		Mab Ta Pud-Sattahip		Ban Khai Head Works		L.C.	F.C.	Total			
							L.C.	F.C.	Total	L.C.	F.C.	Total				L.C.	F.C.	Total
1. Direct Construction Cost	31.97	57.26	89.23	10.78	14.77	25.55	8.93	22.60	31.53	4.80	10.98	15.78	3.30	6.00	9.30	4.16	2.91	7.07
Civil Works	27.25	38.37	65.62	10.55	14.07	24.62	5.96	10.10	16.06	3.51	5.86	9.37	3.07	5.45	8.52	4.16	2.89	7.05
Equipment & materials	4.72	18.89	23.61	0.23	0.70	0.93	2.97	12.50	15.47	1.29	5.12	6.41	0.23	0.55	0.78	-	0.02	0.02
2. Road Relocation	0.78	1.30	2.08	0.78	1.30	2.08	-	-	-	-	-	-	-	-	-	-	-	-
3. Compensation	9.86	-	9.86	9.37	-	9.37	0.04	-	0.04	0.04	-	0.04	-	-	-	0.41	-	0.41
4. Engineering Cost	1.14	9.99	11.13	0.13	3.02	3.15	0.31	2.11	2.42	0.27	1.80	2.07	0.20	1.50	1.70	0.23	1.56	1.79
Sub-total	43.75	68.55	112.30	21.06	19.09	40.15	9.28	24.71	33.99	5.11	12.78	17.89	3.50	7.50	11.00	4.80	4.47	9.27
5. Contingencies	31.06	28.68	59.74	15.64	9.62	15.26	3.91	6.88	10.79	4.47	6.40	10.87	2.80	3.50	6.30	4.24	2.28	6.52
Physical Price	5.66	8.04	13.70	3.17	2.87	6.04	0.93	2.47	3.40	0.51	1.28	1.79	0.34	0.75	1.09	0.71	0.67	1.38
Interest during Construction	25.40	20.64	46.04	12.47	6.75	19.22	2.98	4.41	7.39	3.96	5.12	9.08	2.46	2.75	5.21	3.53	1.61	5.14
Total (1-6)	74.81	100.59	175.40	36.70	29.85	66.55	13.19	32.60	45.79	9.58	19.72	29.30	6.30	11.41	17.71	9.04	7.01	16.05

Unit : million US\$

Table A-2 Annual Disbursement of the Economic Project Cost (Nong Pla Lai Sub-Project)

Unit : million US\$

Item	Total		1982		1983		1984		1985		1986	
	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.
I. Nong Pla Lai Dam												
1. Main Civil Works	6.88	14.07	-	-	-	-	0.97	1.60	4.08	8.39	1.83	4.08
2. Equipment & materials	0.04	0.70	-	-	-	-	-	-	-	-	0.04	0.70
3. Road Relocation	0.48	1.78	-	-	-	-	0.24	0.65	0.24	0.65	-	-
4. Land Acquisition & Compensation	4.31	4.31	-	-	1.08	-	2.15	-	1.08	-	-	-
5. Engineering Service	0.13	3.02	-	-	0.03	1.90	0.03	0.40	0.03	0.39	0.04	0.33
6. Physical Contingencies	1.78	2.87	-	-	0.17	0.29	0.51	0.40	0.81	1.41	0.29	0.77
Sub-total (1-6)	13.62	21.96	-	-	1.28	2.19	3.90	3.05	6.24	10.84	2.20	5.08
Total		35.58				3.47		6.95		17.08		8.08
II. Water Transmission System /1												
1. Main Civil Works	13.36	20.79	-	-	5.20	8.33	4.28	7.15	3.88	5.31	-	-
2. Equipment & materials	2.74	18.17	-	-	1.06	7.55	0.88	6.06	0.80	4.56	-	-
3. Land Acquisition & Compensation	-	0.08	-	-	0.04	-	0.04	-	-	-	-	-
4. Engineering Service	0.88	5.41	1.29	0.19	0.25	1.94	0.21	1.33	0.23	0.85	-	-
5. Physical Contingencies	1.70	4.43	0.33	0.02	0.66	1.78	0.54	1.45	0.48	1.07	-	-
Sub-total (1-5)	18.70	48.80	1.42	0.21	7.21	19.60	5.95	15.99	5.39	11.79	-	-
Total		67.56		1.63		26.81		21.94		17.18		-
III. Irrigation and Drainage System												
1. Main Civil Works	2.61	2.91	-	-	-	-	0.17	0.19	1.04	1.15	1.40	1.57
2. Land Acquisition & Compensation	0.23	1.56	-	-	0.09	0.65	0.04	0.37	0.05	0.27	0.05	0.27
3. Engineering Service	0.42	0.67	-	-	0.01	0.10	0.03	0.08	0.16	0.21	0.22	0.28
4. Physical Contingencies (15%)	3.26	5.14	-	-	0.10	0.75	0.24	0.64	1.25	1.63	1.67	2.12
Sub-total (1-4)		8.40				0.85		0.88		2.88		3.79
Total		8.40				0.85		0.88		2.88		3.79
Sub-total (I + II + III)	35.58	75.90	1.42	0.21	8.59	22.54	10.09	19.68	12.88	24.26	3.87	8.00
Grand Total		111.54		1.63		31.13		29.77		37.14		11.87

/1 : This cost covers the pipeline route (Dok Kral-Nab Ta Pod and Mab Ta Pod-Sattahip) and the Ban Khai Head Works

Table A-3 Annual Disbursement of the Financial Project Cost (Nong Pla Lai Sub-Project)

Unit : million US\$

Item	Total		1982		1983		1984		1985		1986	
	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.
I. Nong Pla Lai Dam												
1. Main Civil Works	10.55	14.07	-	-	-	-	1.34	1.60	6.28	8.39	2.93	4.08
2. Equipment & materials	0.23	0.70	-	-	-	-	-	-	-	-	0.23	0.70
3. Road Relocation	0.78	1.30	-	-	-	-	0.39	0.65	0.39	0.65	-	-
4. Land Acquisition & Compensation	9.37	-	-	-	2.34	-	4.69	-	2.34	-	-	-
5. Engineering Service	0.13	3.02	-	-	0.03	1.90	0.03	0.40	0.03	0.39	0.04	0.33
6. Physical Contingencies	3.17	2.87	-	-	0.36	0.29	0.97	0.60	1.36	1.41	0.68	0.77
7. Price Contingencies	12.47	6.75	-	-	0.09	0.32	3.01	0.09	5.97	3.37	2.80	2.37
8. Interest during Construction	-	1.14	-	-	-	0.03	-	0.09	-	0.35	-	0.67
Sub-Total (1-8)	36.70	29.85	-	-	3.42	2.54	10.43	3.83	16.37	16.56	6.48	8.92
Total	66.55	-	-	-	3.96	-	14.26	-	30.93	-	15.60	-
II. Water Transmission System /1												
1. Main Civil Works	12.54	21.41	-	-	4.84	8.89	4.14	7.15	3.56	5.37	-	-
2. Equipment & materials	4.49	18.17	-	-	1.73	7.55	1.48	6.06	1.28	4.56	-	-
3. Land Acquisition & Compensation	0.00	-	-	-	0.04	-	0.04	-	-	-	-	-
4. Engineering Service	0.78	5.41	0.19	1.29	0.25	1.94	0.21	1.33	0.13	0.85	-	-
5. Physical Contingencies	1.78	4.50	0.02	0.13	0.69	1.83	0.58	1.66	0.69	1.08	-	-
6. Price Contingencies	9.40	12.28	0.03	0.10	1.95	3.06	3.25	4.35	4.17	4.77	-	-
7. Interest during Construction	-	1.96	-	0.02	-	0.31	-	0.87	-	0.76	-	-
Sub-Total (1-7)	29.07	63.73	0.24	1.54	9.50	23.58	9.70	21.22	9.63	17.39	-	-
Total	92.80	-	1.78	-	33.08	-	30.92	-	27.02	-	-	-
III. Irrigation and Drainage System												
1. Main Civil Works	4.16	2.91	-	-	-	-	0.28	0.19	1.66	1.15	2.22	1.57
2. Land Acquisition & Compensation	0.41	-	-	-	-	-	0.16	-	0.25	-	-	-
3. Engineering Service	0.23	1.56	-	-	0.09	0.65	0.04	0.37	0.05	0.27	0.05	0.27
4. Physical Contingencies	0.71	1.38	-	-	0.01	0.10	0.07	0.08	0.29	0.21	0.34	0.28
5. Price Contingencies	3.53	1.61	-	-	0.03	0.11	0.22	0.14	1.29	0.51	1.99	0.85
6. Interest during Construction	-	0.26	-	-	-	0.01	-	0.03	-	0.07	-	0.15
Sub-Total (1-6)	9.04	7.01	-	-	0.13	0.87	0.77	0.81	3.54	2.21	4.60	3.12
Total	16.05	-	-	-	1.00	-	1.58	-	5.75	-	7.72	-
Sub-total (I + II + III)	74.81	100.59	0.24	1.54	13.05	26.66	20.90	25.86	29.54	36.16	21.08	12.04
Grand Total	175.40	-	1.78	-	40.04	-	46.76	-	63.70	-	23.12	-

/1 : This cost covers the pipeline route (Dak Krot-Hab Ta Tur and Hab Ta Tur-Succahip) and the Han Khai Head Works

Table A-4 Water Supply and Benefit
(Nong Pla Lai Sub-Project)

Year	Water Supply (MCM)	Benefit (1,000 US\$)
1984	6.2	1,345
1985	16.7	3,624
1986	22.8	4,948
1987	43.1	9,353
1988	43.6	9,461
1989	44.2	9,591
1990	53.6	11,631
1991	54.3	11,783
1992	54.9	11,913
1993	55.7	12,087
1994	56.4	12,239
1995	57.8	12,543
1996	60.7	13,172
1997	62.1	13,476
1998	63.6	13,801
1999	65.0	14,105
2000	80.0	17,360
2031	80.0	17,360

Table A-5(1) Income Statement for Industrial Municipal Use (Nong Pla Lai Sub-Project)

(UNIT: 1000 DOLLAR)

<<< I N C O M E S T A T E M E N T >>>

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1. REVENUE										
WATER CONSUMPTION (1)	0.0	0.0	942.4	2538.4	3406.8	6551.2	6627.2	6718.4	8147.2	8253.6
WATER CONSUMPTION (2)	0.0	0.0	6.2	16.7	22.4	43.1	43.6	44.2	53.6	54.3
WATER RATE (1)	152.0	152.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RATE (2)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST										
1) OPERATING & MAINTENANCE	0.0	0.0	130.0	640.0	790.0	980.0	6256.7	6266.7	6426.7	6426.7
2) INTEREST	0.0	0.0	130.0	640.0	790.0	980.0	980.0	990.0	1150.0	1150.0
ON LONG TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	2699.4	2699.4	2699.4	2699.4
ON SHORT TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	2699.4	2699.4	2699.4	2699.4
3) DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4) OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	2577.2	2577.2	2577.2	2577.2
3. PROFIT	0.0	0.0	812.4	1898.4	2614.8	5571.2	370.5	451.7	1720.5	1820.9
1. REVENUE										
WATER CONSUMPTION (1)	834.8	846.4	857.8	875.6	922.6	949.2	987.2	995.6	1216.0	1216.0
WATER CONSUMPTION (2)	54.9	55.7	56.4	57.8	60.7	62.1	63.6	65.5	80.0	80.0
WATER RATE (1)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST										
1) OPERATING & MAINTENANCE	1160.0	1160.0	1170.0	1210.0	1210.0	1220.0	1220.0	1230.0	1480.0	1510.0
2) INTEREST	4881.1	4881.1	4877.4	4818.2	4717.4	4565.4	4384.7	4203.2	4023.4	3842.3
ON LONG TERM DEPOSIT	4881.1	4881.1	4877.4	4818.2	4717.4	4565.4	4384.7	4203.2	4023.4	3842.3
ON SHORT TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3) DEPRECIATION	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2
4) OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. PROFIT	-4420.5	-4408.9	-4394.8	-4318.3	-4173.4	-4001.2	-3797.1	-3689.4	-3212.6	-3035.0
1. REVENUE										
WATER CONSUMPTION (1)	1216.0	1216.0	1216.0	1216.0	1216.0	1216.0	1216.0	1216.0	1216.0	1216.0
WATER CONSUMPTION (2)	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
WATER RATE (1)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST										
1) OPERATING & MAINTENANCE	4070.0	3895.2	3708.7	3527.5	3347.1	3160.3	2985.1	2804.8	2624.0	2443.2
2) INTEREST	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0
ON LONG TERM DEPOSIT	3661.5	3480.7	3300.0	3119.2	2938.6	2757.6	2576.8	2396.1	2215.3	2034.5
ON SHORT TERM DEPOSIT	3661.5	3480.7	3300.0	3119.2	2938.6	2757.6	2576.8	2396.1	2215.3	2034.5
3) DEPRECIATION	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2
4) OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. PROFIT	-2854.0	-2673.5	-2492.7	-2311.5	-2131.1	-1950.3	-1769.1	-1588.3	-1408.4	-1227.2

Table A-5(2) Income Statement for Industrial and Municipal Use (Nong Pla Lai Sub-Project)
(UNIT: 1000 DOLLAR)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
<<< I N C O M E S T A T E M E N T >>>										
1. REVENUE	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0
WATER CONSUMPTION (1)	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
WATER CONSUMPTION (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RATE (1)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST	22624.8	20817.0	19009.2	17201.3	15393.5	13585.7	11777.9	9970.1	8162.3	6391.3
1) OPERATING & MAINTENANCE	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0
2) INTEREST	18537.6	16729.7	14921.9	13114.1	11306.3	9498.5	7690.7	5882.8	4075.0	2304.1
ON LONG TERM DEPOSIT	18537.6	16729.7	14921.9	13114.1	11306.3	9498.5	7690.7	5882.8	4075.0	2304.1
ON SHORT TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3) DEPRECIATION	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2
4) OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. PROFIT	-10464.8	-8657.0	-6849.2	-5041.3	-3233.5	-1425.7	382.1	2189.9	3997.7	5766.7
<<< I N C O M E S T A T E M E N T >>>										
1. REVENUE	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0	12160.0
WATER CONSUMPTION (1)	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
WATER CONSUMPTION (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RATE (1)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
WATER RATE (2)	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
2. COST	5175.7	4375.9	4087.2	4087.2	4087.2	4087.2	4087.2	4087.2	4087.2	4087.2
1) OPERATING & MAINTENANCE	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0	1510.0
2) INTEREST	1088.5	288.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ON LONG TERM DEPOSIT	1088.5	288.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ON SHORT TERM DEPOSIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3) DEPRECIATION	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2	2577.2
4) OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. PROFIT	6984.3	7784.1	8072.7	8072.7	8072.7	8072.7	8072.7	8072.7	8072.7	8072.7

Table A-6 Discount Cash Flow for Industrial and Municipal Use
(Nong Pla Lai Sub-Project)

Unit : 1000 US\$

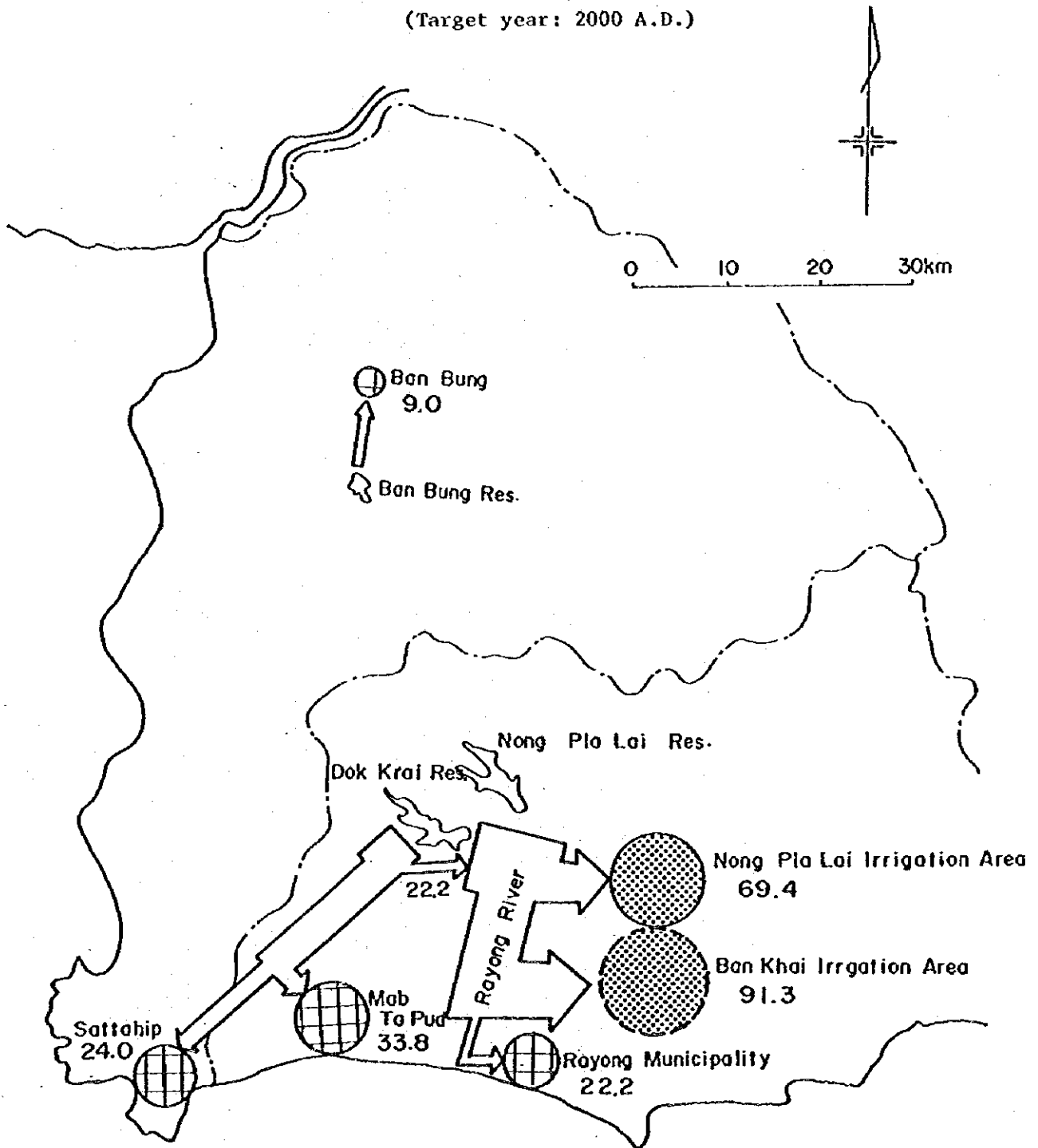
YEAR	CAPITAL COST	REVENUE	OPE. & TAX	BENEFIT
1982	1752.4	0.0	0.0	0.0
1983	36165.5	0.0	0.0	0.0
1984	37157.5	942.4	130.0	812.4
1985	42489.7	2538.4	640.0	1898.4
1986	8836.5	3404.8	790.0	2614.8
1987	0.0	6551.2	980.0	5571.2
1988	0.0	6627.2	980.0	5647.2
1989	0.0	6718.4	990.0	5728.4
1990	0.0	8147.2	1150.0	6997.2
1991	0.0	8253.6	1150.0	7103.6
1992	0.0	8344.8	1160.0	7184.8
1993	0.0	8466.4	1160.0	7306.4
1994	0.0	8752.8	1170.0	7402.8
1995	0.0	8785.6	1210.0	7575.6
1996	0.0	9226.4	1210.0	8016.4
1997	0.0	9439.2	1220.0	8219.2
1998	0.0	9667.2	1220.0	8447.2
1999	0.0	9956.0	2230.0	7726.0
2000	0.0	12160.0	1510.0	10650.0
2031	0.0	12160.0	1510.0	10650.0

Table A-7 Sensitivity Analysis of Industrial and Municipal Water for Nong Pla Lai Sub-Project (Financial)

	Water tariff (US\$/m ³)	Construction Cost	Delay of Water Demand	IRR (%)
Base Case	0.152			5.9
Case 1-1	0.066			-
1-2	0.109			3.8
1-3	0.200			8.1
Case 2-1		10% up		5.2
2-2		20% up		4.4
Case 3-1			10 years	4.5

Fig. A-1 Water Supply by Dok Krai, Nong Pla Lai and Ban Bung Reservoirs

(Target year: 2000 A.D.)



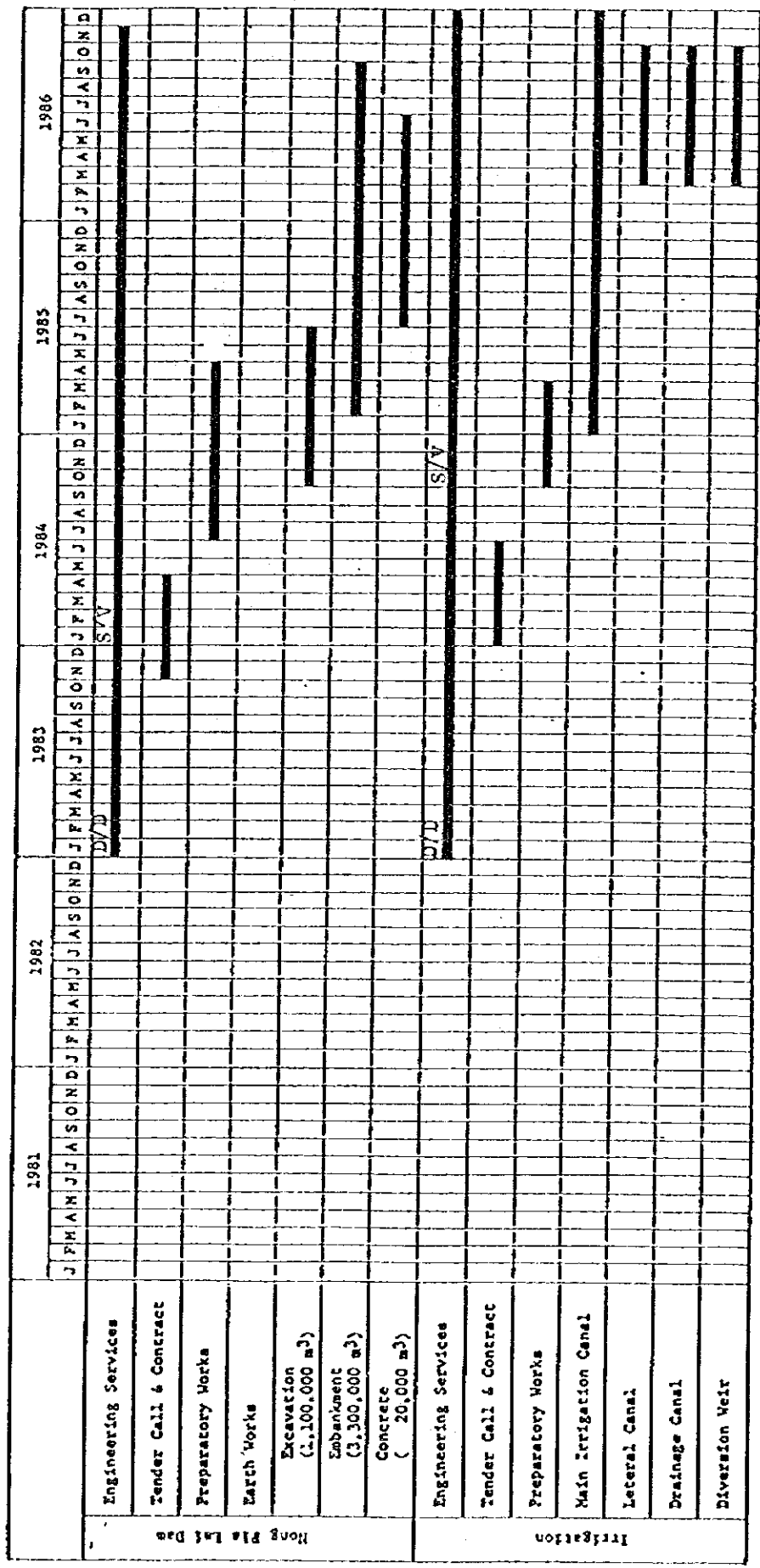
LEGEND

- ⊕ Municipal-industrial water.
- ⊙ Irrigation water. - - - - Newly developed water by the project.
- ⊙ Irrigation water - - - - Vested right water.

Figure is water demand (MCM/Year)

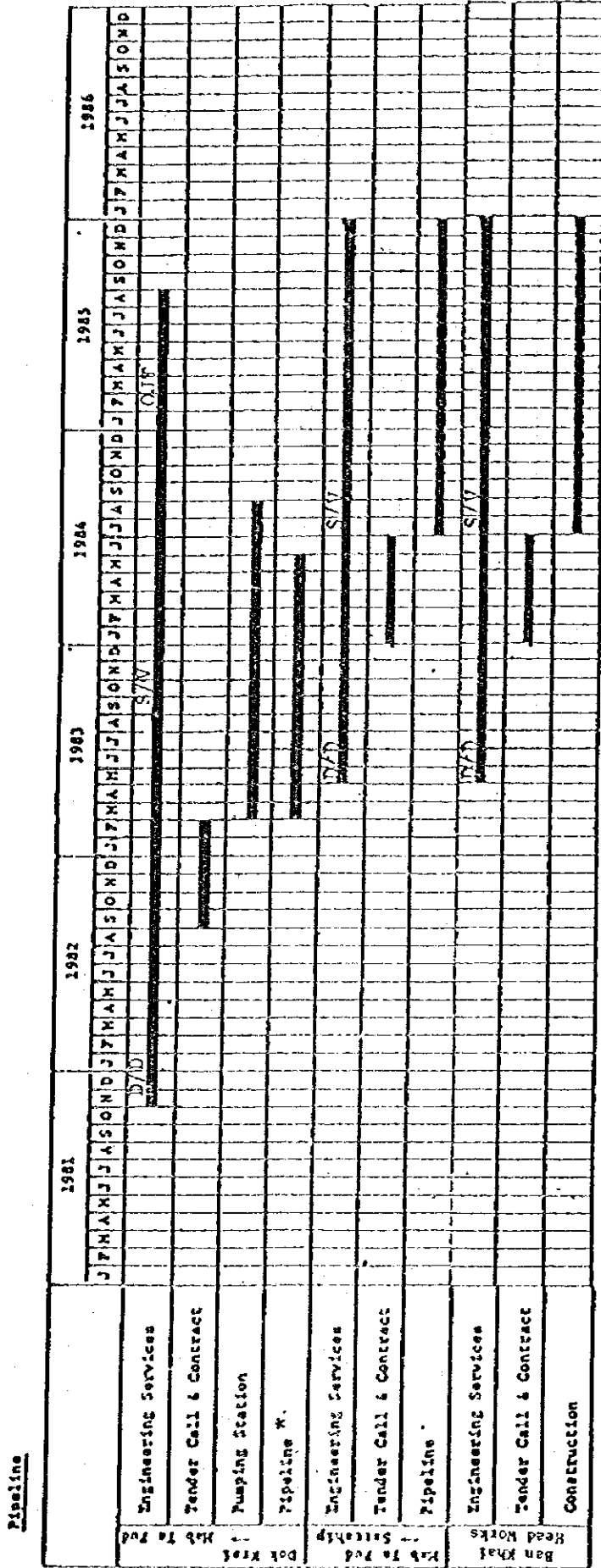
Fig. A-3 Implementation Schedule of Nong Pla Lai Sub-Project (I)

Nong Pla Lai Dam and Irrigation



NOTE: D/D: Detailed Design and Preparation of Tender
 S/V: Construction Supervision
 OJT: On the Job Training

Fig. A-4 Implementation Schedule of Nong Pia Lai Sub-Project (2)



Legend : D/D:Detailed Design
 S/V:Supervision
 OJT:On the Job Training

APPENDIX II

- 1. SCOPE OF WORK**
- 2. MINUTES OF DISCUSSIONS**

Scope of Work
for
Feasibility Study on The East Coast Water
Resources Development Project
in
The Kingdom of Thailand

December 11, 1980

K. Hisataka

Keisuke HISATAKE
Team Leader of
Japanese Preliminary Survey Team

Sunthorn Ruanglek

Sunthorn RUANGLEK
Director General
Royal Irrigation Department
Ministry of Agriculture
and Cooperatives

I. Introduction

In response to the request made by the Government of Thailand, the Government of Japan has made the decision to provide a feasibility study on the East Coast Water Resources Development Project (hereinwith referred to as "the Project") in accordance with laws and regulations in force in Japan.

The Japan International Cooperation Agency (JICA) an official agency responsible for implementation of technical cooperation programmes of the Government of Japan, will carry out this Study in close cooperation with Royal Irrigation Department, Ministry of Agriculture and Cooperatives and authorities concerned

II. Objectives of the Study

The objectives of the study are to verify the feasibility of the water resources development project at Nong Pla Lai in Changwat Rayong, and at San Bung in Changwat Chonburi.

III. Outline of the Study

The activities to be undertaken by the study team will be divided into two stages;

- (1) Field Works in Thailand
- (2) Home Office Works in Japan

I. Field Works

- (1) To collect and review the relevant existing data and information including;
 - a. Meteorology and hydrology
 - b. Topographic map
 - c. Soil
 - d. Geology and Geohydrology
 - e. Irrigation and drainage
 - f. Agriculture
 - g. Agricultural and regional economy and institution, etc.
 - h. Water utilization

To select and delineate the Project Area on the basis of a review of data and information, and a reconnaissance survey.

- (3) To carry out Field surveys in the Project Area including the following items;
 - a. Meteorological and hydrological survey
 - b. Topographical survey at proposed sites for the major structure
 - c. Soil survey with digging pits and laboratory analysis
 - d. Geology and geohydrologic survey
 - e. Various water requirement surveys
 - f. Water resource survey
 - g. Irrigation and drainage survey
 - h. On-farm development survey
 - i. Land use survey
 - j. Socio-economic survey
 - k. Agricultural survey
 - l. Regional economic and institutional survey
 - m. Construction material and cost survey
 - n. Flood control survey

2. Home Office Works

Based on the results of the field works, the home office works will be carried out by the study of the following items;

- (1) the formulation of multi-purpose water resources development plans for the Project Area
- (2) the preparation of a Preliminary design for the dam and other structures for the Project
- (3) the preparation of a Preliminary design for the irrigation and drainage structure, and other facilities for the agricultural development
- (4) the estimation of costs and benefits for the Project

- (5) the preparation of an economic evaluation
- (6) the preparation of implementation schedule for the project
- (7) the study of the effects of flood control
- (8) the study of environmental aspect
- (9) the study of organization and management for the project

IV. Reports

JICA will prepare and submit the following reports in English to the Government of Thailand:

1. Plan of Operation (30 copies)

This report will contain the programme for the study with its schedule and will be discussed as soon as possible after the Study team arrives in Thailand.

2. Interim Report (30 copies)

This report will be submitted within 3 months after the completion of the field survey.

3. Draft Report (30 copies)

This report will be submitted after the completion of the main home office work.

4. Final Report (150 copies)

The final report will be submitted within 3 months after receipt of the comments on the draft final report.

V. Undertaking of the Government of Thailand

To facilitate the smooth performance of the field works, the Government of Thailand is requested:

1. to provide the data and information necessary for the study.
2. to provide topographic maps available in the RID and other agencies.

3. to conduct several core borings, including soil tests.
4. to arrange for the quick and smooth customs clearance of the survey equipment and materials which the team members will bring into the field so as to exempt it from taxes and duties imposed by the Government on the goods brought in by the team members into Thailand.
5. to make arrangements for the exemption of income taxes, incurred by the Team during the survey.
6. to request the ministries and other governmental organizations concerned to cooperate with the team in the smooth execution of the survey.
7. to arrange the necessary computer machines and other equipment.
8. to designate the counterpart personnel in the following fields to cooperate with the team in conducting the study effectively:

- 1) General Planning
- 2) Irrigation & Drainage
- 3) Dam Engineering
- 4) Land Consolidation
- 5) Foundation & Soil Mechanical Engineering
- 6) Regional Development Planning
- 7) Surveying
- 8) Agronomy
- 9) Socio-economy
- 10) Hydrology
- 11) Soil Surveying

The number of counterpart personnel and their respective assignment periods should be decided by prior consultation by the team with the Thai Authorities concerned at the commencement of the study.

9. to provide office space with furniture for the team.
10. to make the necessary arrangements to obtain the permission of the authorities concerned for the team to conduct the survey in the objective areas.
11. Besides the above, to extend close cooperation to the team in every respect for the smooth execution of the study.

VI. Work Schedule

To carry out the study, JICA shall provide the required experts for the survey team in accordance with the work schedule attached.

TENTATIVE WORK SCHEDULE

year/month Items	81												82		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1. Preparatory Works	[Gantt bar from month 1 to 2]														
2. Field Works	[Gantt bar from month 2 to 8]														
3. Home office Works	[Gantt bar from month 6 to 12]														
4. Submission Reports	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> Δ Plan of Operation </div> <div style="text-align: center;"> Δ Progress Report </div> <div style="text-align: center;"> Δ Interim Report </div> <div style="text-align: center;"> Δ Draft Report </div> <div style="text-align: center;"> Δ Final Report </div> </div>														

APPENDIX

Attendance List

1. Mr. Sunthorn RUANGLEK
Royal Irrigation Department
Ministry of Agriculture and
Cooperatives
2. Mr. Boonthai OTAGANONTA
-ditto-
3. Mr. Boonyok VADHANADHUTI
-ditto-
4. Mr. Sutin SUSILA
Department of Technical and
Economic Cooperation (DTEC)
5. Seven Japanese Preliminary Survey Team headed by
Mr. Keisuke HISATAKE

December 11, 1980

MINUTES OF DISCUSSION

In response to the request made by the Government of Thailand, the Government of Japan dispatched a preliminary survey team from 30th November to 13th December 1980, through the Japan International Cooperation Agency (JIAC), to carry out the preliminary survey for the feasibility study on The East Coast Water Resources Development Project in Thailand.

The Team carried out the reconnaissance survey and series of discussion with The Royal Irrigation Department (RID) and authorities concerned during the stay in Thailand.

The main items which were understood by both sides are summarized as follows:

1. Draft "Scope of Work" proposed by the Team was discussed on 2nd, 9th and 11th of December and was reached to the agreement with the RID.
2. The team was requested to submit the Progress Report including an outline of the Project, rough cost estimates and benefits by the end of July 1981, which will be formed by the feasibility study team.
3. The Team requests the RID for carrying on necessary additional mapping works as follows, before the feasibility study team on duty;
 - a. Bush clearing and re-leveling works at Nong Pla Lai and Ban Bung dam axes simultaneously.
 - b. Making additional contourlines with one meter intervals on the existing sheets of map, such as
 - . Nong Pla Lai Res, sheet No.12910, up to the necessary elevation (49m).
 - . Ban Bung Res, sheet No. 10798, up to the necessary elevation (32m).

The RID admits to carry on the mapping within a short period.

- c. Show up the existing main irrigation channels clearly on the sheet No.9612 in the Ban Khai Project area.
4. The Team promises the RID to convey the request on the participation in report preparation with RID's engineers, to the Japanese Government.

11th December 1981

K. Hisatake

Keisuke HISATAKE

Team Leader

of

Japanese Preliminary Survey Team

Boonthai Otaganonta

Boonthai OTAGANONTA

Director, Design Division

Royal Irrigation Department

Ministry of Agriculture

and Cooperatives

MINUTES OF DISCUSSIONS

1. In response to the request made by the Government of Thailand, an advisory team (The Team) was dispatched by the Government of Japan from May 28 to June 4, 1981 through the Japan International Cooperation Agency (JICA), to carry out the additional study on the pipe-line system for the industrial and municipal water (the Additional Study) to the Feasibility Study on the East Coast Water Resources Development Project (the Main Study), the Scope of Work for which was signed on December 11, 1980.

The Team carried out a field survey and held a series of discussions on the Additional Study with the Royal Irrigation Department (RID), during their stay in Thailand.

The final meeting between RID and the Team was held on June 3, 1981. A list of attendance in the final meeting is attached as Annex.

2. RID and the Team reached the following agreement and understanding on the framework of the Additional Study.

3. Objective of the Additional Study

The objective of the Additional Study are to formulate the pipeline system from Nong Pla Lai dam and Dok Krai dam and to verify the feasibility of the pipeline system for the Industrial and municipal water, in addition to the Main Study.

4. The Additional Study consists of the followings

- 4-1. The Additional Study Area

- a. Water source: Nong Pla Lai dam, Dok Krai dam.
- b. Service area: Map Ta Pud, Sattahip.

- 4-2. Outline of the Additional Study

- a. to collect and review the relevant existing maps, data, information and the study reports concerning the pipeline system in the Additional Study

area for the proper plan formulation.

b. to conduct studies in the aspect of topography and foundation geology.

c. to study the alternative plans for water conveyance including outlet work, pumping station, pipe line, receiving basin etc., based on the topographical, geological and water demand studies, so as to obtain the most adequate concepts for project formulation.

d. to conduct layout and preliminary design for the pipe-line system and the related structures.

e. to conduct studies on construction plan and cost estimation.

5. The Additional Study is to be conducted in accordance with the following tentative schedule.

Field Survey: Middle of July - Middle of August, 1981

Interim Report: End of October, 1981

Draft Report: End of December, 1981

Final Report: End of March, 1982

6. The additional undertakings by the Government of Thailand are requested as follows:

1) To conduct geological exploration and profile survey along the pipe-line route.

2) To conduct topographic survey at the main structures.

7. This minutes is subject to the approval of the Minister of the Agriculture and Cooperatives, which should be informed to the Government of Japan by June 15, 1981.

June 3, 1981

Keisuke Hisatake

Keisuke HISATAKE
Team Leader
of
Japanese Advisory Team

Sunthorn Ruonglek

Sunthorn Ruonglek
Director General
of
Royal Irrigation Department

Annex

Attendance List

Mr. Sunthorn Ruanglek	Director General Royal Irrigation Department
Mr. Boonthai Otaganonta	Director, Design Division Royal Irrigation Department
Mr. Keisuke Hisatake	Team Leader Japanese Advisory Team
Mr. Norihiro Endo	Member Japanese Advisory Team
Mr. Yukihisa Sakurada	Co-ordinator Japanese Advisory Team
Mr. Takashi Kaneko	JICA, Bangkok Office

THE EAST COAST WATER RESOURCES
DEVELOPMENT PROJECT

MINUTES OF MEETING

held on February 17 & 18, 1981

I. Present:

- | | |
|-------------------------|--|
| 1. Boonthai Otaganonta | Royal Irrigation Department |
| 2. Boonyok Vadhanaphuti | " |
| 3. Prabas Masamondana | " |
| 4. K. Hisatake | Head, Advisory Committee |
| 5. T. Endo | Member, Advisory Committee |
| 6. M. Yatazawa | Leader, Japanese Survey Team |
| 7. Y. Ishii | Member, Japanese Survey Team |
| 8. H. Suganuma | " |
| 9. F. Nakajima | " |
| 10. H. Takahashi | " |
| 11. Y. Nakao | " |
| 12. K. Ishizuka | " |
| 13. K. Miyoshi | Japan International Cooperation Agency |
| 14. Kaneko | " |

II. Matters Arising:

At the commencement of the meeting, the members of the Japanese Survey Team (the Team) were welcomed by the Directors of the Royal Irrigation Department (the RID). The followings are the matters taken up for discussion:

1. The Inception Report was submitted by the Team to the RID. The content of the report was appreciated by the RID.
2. As to the request made by the Team concerning the accomodation for office use, the RID has agreed to provide one in the Bangkok Head Office and one each at Rayong and Chon Buri.
3. The counterpart staff to the experts of the Team will be assigned by the RID from time to time as the Team requires.

4. After the review of the available data by the Team, necessary survey work will be conducted by the RID with Team's surveying engineer supervising the procedures in the field and in the office.
5. After the review of the available data by the Team, necessary geologic survey in the proposed dam sites and other relevant locations will be conducted by the RID. The geology and soil engineer of the Team will be at hand to supervise the undertaking.
6. After the review of the available data by the Team, the soil tests required will be conducted by the RID in collaboration with the geology and soil engineer from the Team.
7. The RID will conduct the door-to-door interview required to collect the firsthand information on the actual flood damage, under the supervision of the member of the Team.
8. As to the Team's request for setting up a working group for the coordination among concerned agencies, the RID has agreed to make necessary arrangements.

M. Yatazawa

Masaharu Yatazawa
Team Leader
JICA East Coast Water Resources
Development Project

Boonthai Otaganonta

Boonthai Otaganonta
Director
Design Division
Royal Irrigation Department

THE EAST COAST WATER RESOURCES DEVELOPMENT PROJECT

Minutes

The Study Team and the Advisory Team from JICA for the purpose of submitting the Progress Report have been dispatched from July 22 to 31, 1981.

They held a series of discussions on the Progress Report. The final meeting with the Royal Irrigation Department (RID), the National Economic and Social Development Board (NESDB) and the National Environment Board (NEB) was held on July 29, 1981.

The list of attendance in the final meeting is attached as Annex.

The following agreements and understandings reached in the meeting will be taken into the Interim Report.

1. (Water Demand)

In the Study of water supply and demand, the Sattahip Naval Base is not taken into consideration.

2. (Water Allocation)

The allocation of developed water and reservoir capacity among industry and municipality irrigation, and flood control is agreed upon as shown in the Progress Report.

3. (Hydro-Power Generation)

The outlet penstock and foundation of turbine for small scale hydro-power generation will be taken into consideration in the preliminary design of Nong Pla Lai Dam.

4. (Operation of Dok Krai and Nong Pla Lai Dam)

Available water of 89 MCM/year at Dok Krai Reservoir will be utilized mainly for industry and municipality and 119 MCM/year at Nong Pla Lai Reservoir will be utilized mainly for irrigation. The two Reservoirs will be connected with pipe line for combined operation.

5. (Resettlement)

The resettlement for the families which is expected to be submerged will be studied in general. It is considered as an option of compensation.

6. (Operation and Maintenance)

RID takes responsibility of operation and maintenance of dam and irrigation systems. As for the pipe line system, the administrative agency is not yet decided.

7. (Environment)

Environmental impact will be studied, in general, in accordance with the NEB's guideline and one chapter of the Interim Report will be allocated to the impact study. Photos will be attached to the Report to show the present natural and social conditions.

8. (Pipe Line)

The findings on the pipe line in the Progress Report are only in the reconnaissance stage.

9. (Diameter of Pipe Line)

The proposed diameter of 1,500 mm for Dok Krai-Map Ta Pud route will be reviewed in the further study.

July 30, 1981

Y. Katayama

YUICHI KATAYAMA

Team Leader

JICA Survey Team

East Coast Water Resources

Development Project

Boonthi Otaganonta

BOONTHI OTAGANONTA

Director

Design Division

Royal Irrigation Department

T. Takeuchi

TATSUO TAKEUCHI

Member

JICA Advisory Team

ANNEX

ATTENDANCE LIST OF FINAL MEETING

Mr. Boonthai	Otaganonta	Royal Irrigation Department
Mr. Prasarn	Leelasara	"
Mr. Phyool	Chantasiro	"
Dr. Boonyok	Vadhanaphuti	"
Mr. Prasert	Milintaugul	"
Mr. Kamol	Chitarkon	"
Mr. Amphai	Muthitacharoen	"
Mr. Manas	Sanguandikul	National Economic and Social Development Board
Mr. Witit	Rachatanun	"
Mr. Suroj	Sutthiapha	"
Mr. Chalernsak	Wanichsombat	National Environment Board
Mr. Yuichi	Katayama	Team Leader, JICA Survey Team
Mr. Yunio	Ishii	Asst. Leader, "
Mr. Hirokazu	Koriki	Member, "
Mr. Yutaka	Nakao	" "
Mr. Tatsud	Takeuchi	Member, JICA Advisory Team
Mr. Tetsuro	Miyasato	" "
Mr. Yukihiisa	Sakurada	" "

THE EAST COAST WATER RESOURCES DEVELOPMENT PROJECT

FEASIBILITY STUDY

MINUTES OF DISCUSSIONS

I. Introduction

1. The Study Team/together with the Advisory Team from JICA (The Team) visited Thailand from November 4 to 11, 1981. The Team submitted the Interim Report of the Feasibility Study (the Study) on the Water Resources Development Project (the Project), and held a series of discussions on result of the Study with the officials of the Royal Irrigation Department (R I D) and the National Economic and Social Development Board (NESDB). The list of attendants is attached as Annex I.
2. The followings are certain matters for clarification and further study which were discussed and agreed upon.

II. Water Demand and Supply

3. The Team explained the water demand whose estimation is mainly based on the East Coast Development Plan prepared by the Committee for the Primary Industry Development and Deep Sea Port in the Eastern Seaboard. The Team mentioned the importance of the estimation of water demand which affects directly on the project component, especially to the pipe-line system, its design discharge and construction schedule and asked clarification of the East Coast Development Plan.

4. RID and NESDB clarified the East Coast Development Plan and through the discussion the followings are agreed upon.

- 1) The Study will be performed based on the water demand as Annex II.
- 2) The municipal water to the Rayong City and its vicinity will be supplied through the Rayong river, not through the pipe-line system.
- 3) Industrial and municipal water demand has the first priority and the Project will be designed firstly so as to meet this demand considering the existing storage capacity of the Dok Krai dam and proposed Nong Pla Lai dam.
- 4) In the Study industrial and municipal water demand for Laem Chabang area is designed so as to be supplied through the pipe-line system from Dok Krai dam.
- 5) Ban Bung dam will be designed so as to meet the municipal water demand in Ban Bung City and the vested water right of the existing Ban Bung dam.
- 6) In order to meet the future increase of water demand which the Project can not fully meet, further development of water resources will be essential.
- 7) NESDB clarified chemical fertilizer plant will be completed in 1984. The water demand will be modified according this information.

III. Project Design

Nong Pla Lai Dam

5. RID proposed the utilization of dead water storage for the urgent water supply in the period of drought. The Team accepted the proposal. The design of the dam will be modified so as to be installed with an outlet below the low water level.

Pipe-Line System

6. There is no question for the utilization of pipe-line system for the transmission of the industrial and municipal water.
7. The discussion was concentrated on the pipe-line system from Dok Krai Dam to Mab Ta Pud. The Team presented the alternatives of the system which is shown in Annex III. The Team also mentioned the selection among the alternatives has to be performed considering water demand, construction schedule and cost.
8. After the discussion on this matter, single pipe, pipe-line system with steel pipe of 1,350 mm. diameter, shown in Annex III, is clarified as the most preferable plan.

Dok Krai Dam

9. There is no comment on the pumping station which will be constructed by concrete caisson method. RID mentioned there is no possibility of draw-down of reservoir for the construction.

IV. Construction Schedule

10. The Team presented the construction schedule of the Project as shown in the Interim Report. Through the exchange of information and discussion, the schedule, at the Interim Report Stage, were modified considering the required period for selection of consultant and construction contract. The schedule is shown in Annex IV.
11. The Team mentioned the modified schedule is ^{very tight} ~~not normal~~. It is performed considering the other development projects, especially the Natural Gas Separation Plant Project. The Team recommended the closest coordination between the two projects at the further study and construction.

V. Project Cost

12. RID and NESDB raised the question on the project cost, especially on the pipe-line system and asked the Team to clarify the cost estimation.
13. The Team explained the contents of the cost. The both sides had a discussion to find out the best way for the alternative selection considering such fact affecting to the cost as water demand, construction method and schedule etc.
14. The Team tentatively estimated the project cost of the pipe-line system from Dok Krai Dam to Mab Ta Pud according to the project component and the result is attached as Annex V. The cost estimation is still at the interim stage and cost estimation will be finalized in futher study.

15. The unit cost by RID as of February 1981 is applied for cost estimation.
16. The exchange rate-US \$ 1.0 = ₪ 23.0 = ¥ 230.0 as of November 1981 is applied for cost estimation.
17. Metal material and its products, cement, oil and fuel, construction and gauging equipment are counted in foreign currency portion. Steel pipe, pump and their related equipment are estimated based on CIF cost from Japan.

VI. Operation and Maintenance

18. The Team requested the clarification of the organization for the operation and maintenance of the pipe-line system. RID mentioned no decision was made yet by the Government of Thailand and NESDB will make the decision to make IEAT or PWWA take the responsibility. The Team recommended earliest decision is required not only for the study but also for the project implementation.
19. The Team proposed the required personnel and RID took it as an suggestion. The ordinary manual operated control and gauging facilities will be adopted in the place of sophisticated electronic facilities.

VII. Project Evaluation

20. The Team explain the tariff in the Project. RID and NESDB agreed the result of the Study. The Team recommend the necessity of further study on the tariff structure.

21. The life time of the facilities by Design Criteria for Water Works by Japan Water Works Association (JWWA) will be applied for economic analysis.

Miscellaneous

22. Japan Industrial Standard (JIS), Design Criteria by JWWA and other related Japanese criteria will be applied to the design.

November 10, 1981

Y. Katayama
YUICHI KATAYAMA

Team Leader,
JICA Study Team
East Coast Water Resources
Development Project.

Boonthai Otaganonta
BOONTHAI OTAGANONTA

Chief Engineer
for Civil Engineering,
Royal Irrigation Department.

Joji Harada

JOJI HARADA

JICA Advisory Team

List of Attendants

Royal Irrigation Department

1. Mr. Boonthai Otaganonta
Chief Engineer for Civil Engineering
2. Dr. Boonyok Vadhanaphuti
Director, Project Planning Div.
3. Mr. Chari Tulayanond
Director, Medium Scale Const. Div.
4. Mr. Shoombhol Chaveesuk
Director, Design Div.
5. Mr. Osot Charnvej
Operation and Maintenance Div.
6. Mr. Dhongchart Chullasuk
Project Planning Div.
7. Mr. Prasert Milintaugul
Hydrology Div.
8. Mr. Taweechai Mackaman
Project Planning Div.
9. Mr. Suthep Tingsabhat
Program and Budget Div.
10. Dr. Katsuhiko Kimura
Colombo Plan Expert, Project Planning Div.

National Economic and Social Development Board

1. Dr. Savit Bhotiwihak
Director, Center for Integrated Plan of Operation
2. Mr. Manas Sanguandikul
Civil Engineer, Center for Integrated Plan of Operation

Japan International Cooperation Agency

Advisory Team

1. Mr. Joji Harada
Ministry of Construction
2. Mr. Tetsuro Miyasato
Ministry of Agriculture, Forestry and Fishery
3. Mr. Koichi Miyoshi
JICA coordinator

Study Team

1. Mr. Yuichi Katayama
Team Leader,
2. Mr. Yumio Ishii
Assistant Team Leader.
3. Mr. Hirokazu Koriki
Agricultural Development Planner
4. Mr. Yutaka Nakao
Economist

5. Mr. Hisataka Suganuma

Hydrologist

6. Mr. Fumio Enomoto

Pipe-line Engineer

The East Coast Water Resources Development Project

Feasibility Study

MINUTES OF DISCUSSIONS

1. The Study Team (the Team) together with the Advisory Team from JICA visited Thailand from December 14 to 20, 1981. The Team submitted the Draft Final Report and Supporting Report with the Appendix of the Feasibility Study (the Study) on the Water Resources Development Project (the Project), and held a series of discussions on the result of the Study with the officials of the Royal Irrigation Department (RID) and the National Economic and Social Development Board (NESDB). The list of attendants is attached as Annex.
2. The Team made the briefing on the result of the Study and RID accepted it as a whole. The followings are comments of RID and certain matters agreed upon.
3. The proposed schedules at the feasibility stage are agreed upon except that of the preparatory works for dams. Since the preparatory work will be conducted by a contractor, this portion of the schedule is to be revised.
4. RID mentioned that RID will make an additional study of the adoption of the construction by force account basis. In this connection, the Team will submit the data and information as soon as possible.
5. The proposed routes of pipelines, adoption of steel pipe, its diameter and the necessity of imported steel pipe are clarified by the Team and agreed upon by the both parties.
6. As for the possible contamination of reservoir, RID mentioned the sewage treatment. In this connection, the Team agreed upon to

revise the 3rd paragraph of " 11. Environment" and " 15. Recommendation" of Summary of the Report as follows.

11. Environment

(3rd paragraph)

The present condition of water quality of the reservoirs and the rivers is found to be clean enough for water supply, though there is no sewage treatment system in the catchment areas which is categorized as rural area. But the future development of municipalities and industries in the areas might possibly cause water contamination though not in near future.

15. Recommendation

9) Water Contamination

When the possible water contamination in the reservoirs and rivers may be anticipated, structural counter-measures as well as enforcement of legal regulations will become necessary.

7. The comments of RID on the Draft Final Report which is to be submitted until January 15, 1982 will be studied and compiled into the Final Report.

December 18, 1982

Y. Katayama
(YUICHI KATAYAMA)

Team Leader,
JICA Study Team for
East Coast Water Resources
Development Project

Boonthai Otaganonta
(BOONTHAI OTAGANONTA)

Chief Engineer for Civil
Engineering.
Royal Irrigation Department

Keisuke Hisatake
(KEISUKE HISATAKE)

Team Leader
JICA Advisory Team

ANNEX 1 LIST OF PARTICIPANTS

Place : RID Conference Room

Date : Dec. 15, 1981

	NAME	POSITION
1.	MR. BOONTHAI OTAGANONTA	Chief Engineer for Civil Engineering, RID
2.	MR. SHOOMBHOL CHAVEESUK	Director of Design Div, RID
3.	MR. PHYOOL CHANTASIRO	Director Survey Division, RID
4.	MR. DAMRONG JARASWATHANA	Director of Hydrology Div.
5.	MR. PRASARN LEELASORN	Director, Soil & Geo. Survey
6.	MR. SUTHEP TINGSABHAT	Director, Program & Budget Div.
7.	MR. CHAREUK NONTHATHUM	Director, Large Project Construction Div.
8.	MR. SUHA THANOMSINGHA	Director of Region Office, RID
9.	MR. PRAKAI SASTRAVAHA	Large Project Construction Div. RID
10.	MR. KAMOL CHITARKON	Large Project Construction Div. RID
11.	MR. RUONGRIT AMMAWAT	Chief Dam Design Branch, RID
12.	MR. JUMROEN PANITYING	Medium Project Construction Div. RID
13.	MR. CHALERMTHAP RATANAPRAYOON	O & M Div. RID
14.	MR. PAIROJ NANONGKAI	Law and Land Div. RID
15.	MR. SUPHON CHIRAPUNTU	Chief, Soil Eng. Investigation Branch. RID
16.	MR. DHONGCHART CHULLASUK	Economic Branch, Project & Planning Div. RID
17.	MR. SUTHI SONGVORAVIT	Chief, Policy Planning Br., Proj. Planing Div. RID
18.	MR. KATSUHIKO KIMURA	Colombc Plan Expert, Project Planning Div. RID
19.	MR. SAVIT PHOTIVIHOK	Secretary, CIPO, NESDB
20.	MR. MANAS SANGUANDIKUL	CIPO, NESDB
21.	MR. KUMROPLUK SURASWADI	CIPO, NESDB
22.	MR. HIDEAKI KONDO	First Secretary, Embassy of Japan
23.	MR. YUICHI KATAYAMA	Team Leader, JICA Team
24.	MR. YUMIO ISHII	JICA Team
25.	MR. YUTAKA NAKAO	JICA Team
26.	MR. KEISUKE HISATAKE	Advisory Team of JICA
27.	MR. TOSHIHIRO ENDO	Advisory Team of JICA
28.	MR. KOICHI MIYOSHI	Coordinator, JICA
29.	MR. TADASHI NITTA	Coordinator, JICA

ANNEX 2 LIST OF PARTICIPANTS

Place : RID Conference Room

Date : Dec. 16, 1981

	NAME	POSITION
1.	MR. BOONTHAI OTAGANONTA	Chief Engineer for Civil Engineering, RID
2.	MR. PRAHAS MASAMONDANA	Chief, Design Section 6th Design Div. RID
3.	MR. PRAKAI SASTRAVAHA	Large Scale Construction Div. RID
4.	MR. SUWIT THANOPANUWAT	Civil Engineer, Project Planning Div. RID
5.	MR. SIRIPONG HUUGSPREUG	Civil Engineer, Section 6th, Design Div. RID
6.	MR. YUICHI KATAYAMA	JICA Team
7.	MR. YUMIO ISHII	JICA Team
8.	MR. YUTAKA NAKAO	JICA Team
9.	MR. FUMIO ENOMOTO	JICA Team
10.	MR. KEISUKE HISATAKE	Advisory Team, JICA
11.	MR. TOSHIHIRO ENDO	Advisory Team, JICA
12.	MR. YUICHI MISHIMA	Advisory Team, JICA
13.	MR. KOICHI MIYOSHI	Coordinator, JICA
14.	MR. TADASHI NITTA	Coordinator, JICA

ANNEX 3 LIST OF PARTICIPANTS

Place : RID Conference Room

Date : Dec. 17, 1981

	NAME	POSITION
1.	MR. BOONTHAI OTAGANONTA	Chief Engineer for Civil Engineering, RID
2.	MR. PRAHAS MASAMONDANA	Chief Design Section 6th, Design Div. RID
3.	MR. PRAKAI SASTRAVAHA	Large Scale Construction Division RID
4.	MR. SUWIT THANOPANUWAT	Civil Engineer, Project Planning Div. RID
5.	MR. SIRIPONG HUNGSPREUG	Civil Engineer, Design Div. RID
6.	MR. YUICHI KATAYAMA	Team Leader, JICA
7.	MR. YUMIO ISHII	Assist. Team Leader, JICA
8.	MR. YUTAKA NAKAO	Economist, JICA Team
9.	MR. KEISUKE HISATAKE	Advisory Team, JICA
10.	MR. TOSHIHIRO ENDO	Advisory Team, JICA
11.	MR. KOICHI MIYOSHI	Coordinator, JICA
12.	MR. TADASHI NITTA	Coordinator, JICA

