Table 5.2.6 IRRIGATION BENEFITS OF ALTERNATIVE CASES

Case	Gross Reservoir Capacity (MCM)	Irrigation Area (ha)	Cropping Intensity (%)	Net Production Value			Benefit per ha (₱/ha)
				Without Project (M₱)	With Project (M₱)	Incremental Benefit (M₱)	
101	200	36,800	100	228.2	475.8	247.6	6,730
102	250	36,800	105	228.2	484.1	255.9	6,950
103	250	37,600	100	229.8	486.3	256.5	6,820
201	120	36,800	100	228.2	475.8	247.6	6,730
202	250	36,800	130	228.2	526.8	298.6	8,110
205	170	42,400	100	242.0	548.2	306.2	7,220
206	250	42,400	116	242.0	579.8	337.8	7,970
207	200	45,600	100	248.5	589.8	341.3	7,480
208	250	45,600	108	248.5	606.5	358.0	7,850
209	220	46,700	100	250.8	604.1	353.3	7,570
301	250	46,700	105	250.8	614.8	364.0	7,790

Table 5.2.7 ECONOMIC O & M COST AND REPLACEMENT COST

Case	O & M Cost (10^6 ₱)	Replacement Cost	
		O & M Equipment/1 (10^6 ₱)	Gate/2 (10^6 ₱)
101	48.1	44.2	27.3
102	48.4	44.2	27.3
103	48.7	44.2	27.5
201	13.4	44.2	40.9
202	14.4	44.2	40.9
205	16.7	44.2	42.9
206	17.2	44.2	42.9
207	17.7	44.2	44.1
208	17.9	44.2	44.1
209	18.1	44.2	44.6
301	18.1	44.2	44.6

Note: /1: Useful life
/2: Useful life

Table 5.2.8 ECONOMIC COMPARISON ON ALTERNATIVE

Alternative Case	G.R.C (MCM)	Irrigation Area (ha)	Cropping Intensity (%)	Constrruction Cost (Economic)			O/M Cost (M₱)	Annual Benefit (M₱)	IRR (%)
				Dam (M₱)	Irrigation (M₱)	Total (M₱)			
101	200	36,800	100	1,132.8	109.4	1,242.2	48.1	247.6	11.6
102	250	36,800	105	1,176.6	109.4	1,286.0	48.4	255.9	11.6
103	250	37,600	100	1,176.6	123.8	1,300.4	48.7	256.5	11.5
201	120	36,800	100	954.3	575.8	1,530.1	13.4	247.6	11.5
202	250	36,800	130	1,176.6	575.8	1,752.4	14.4	293.6	12.1
205	170	42,400	100	1,082.7	724.7	1,807.4	16.7	306.2	12.0
206	250	42,400	116	1,176.6	724.7	1,901.3	17.2	339.8	12.5
207	200	45,600	100	1,142.3	761.4	1,903.7	17.7	341.3	12.6
208	250	45,600	108	1,176.6	761.4	1,938.0	17.9	358.0	12.9
209	220	46,700	100	1,164.4	782.4	1,946.8	18.1	353.3	12.8
301	250	46,700	105	1,176.6	782.4	1,959.0	18.1	364.0	13.0

Table 5.3.1 CROP PRODUCTION COST UNDER "WITHOUT PROJECT" CONDITION (1/2)

(Unit: Baht/ha)

Item	Unit Price (Economic)	Wet Season Paddy						Dry Season Paddy	
		Rain-fed		Semi-i-rigated		Irrigated			
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Farm Input									
1. Seed - Local Variety (Paddy)	4.2/kg	60 kg	252.0	60 kg	252.0	60 kg	252.0	17 kg	71.4
- High Yield Variety (Paddy)	5.5/kg	20 kg	110.0	20 kg	110.0	20 kg	110.0	48 kg	264.0
- Local Variety (Mung beans)	6.6/kg	-	-	-	-	-	-	-	-
- High Yield Variety (Mung beans)	11.9	-	-	-	-	-	-	-	-
2. Fertilizer - Urea	6.1/kg	-	-	20 kg	122.0	30 kg	183.0	60 kg	366.0
- Compound fertilizer	4.3/kg	48 kg	206.4	42 kg	180.6	60 kg	258.0	100 kg	430.0
3. Agro-chemical - Inspecticides	172/	-	-	-	-	0.21	36.1	1	172.0
- Fungicides	143/	-	-	-	-	-	-	0.4	57.2
4. Land Preparation - Hand Tractor	84/day	6.3 day	529.2	6.3 day	529.2	6.3 day	529.2	6.3 day	529.2
- Large Tractor	110/hour	-	-	-	-	-	-	-	-
5. Thresing Machine	84/day	1.8 day	151.2	2.0 day	168.0	2.2 day	184.8	2.2 day	201.6
Sub-total (A)			1,249.0		1,362.0		1,553.0		2,091.0
Labour Requirement									
1. Nursery Preparation	37/day	1.5 day	55.5	1.5 day	55.5	1.5 day	55.5	1.5 day	55.5
2. Land Preparation	37/day	6.3 day	233.1	6.3 day	233.1	6.3 day	233.1	6.3 day	233.1
3. Transplanting or Sowing	37/day	20.0 day	740.0	21.0 day	777.0	22.0 day	814.0	22.0 day	814.0
4. Weeding	37/day	2.0 day	74.0	2.0 day	74.0	3.0 day	111.0	3.0 day	111.0
5. Fertilizer Application	37/day	1.0 day	37.0	1.5 day	55.5	2.0 day	74.0	2.5 day	92.5
6. Chemical Application	37/day	-	-	-	-	1.0 day	37.0	2.0 day	74.0
7. Harvesting	37/day	21.0 day	777.0	22.8 day	843.6	24.0 day	888.0	24.0 day	888.0
8. Thresing, Drying & Winnowing	37/day	4.0 day	148.0	4.5 day	166.5	6.0 day	222.0	6.0 day	222.0
9. Water Management	37/day	-	-	1.0 day	37.0	2.0 day	74.0	3.0 day	111.0
Sub-total (B)		55.8 day	2,065.0	60.6 day	2,242.0	67.8 day	2,509.0	70.3 day	2,601.0
Miscellaneous Cost	5% of (A+B)		166.0		180.0		203.0		235.0
Total			3,480.0		3,784.0		4,265.0		4,927.0

Note: This table is made based on the Farm Economic Survey. Some modification, however, were done by the data and information from the Extension Office, Office of Agricultural Economic, etc.

Table 5.3.1 CROP PRODUCTION COST UNDER "WITHOUT PROJECT" CONDITION (2/2)

Item		Unit Price (Economic)	Mung Beans (Dry Season) Quantity	Mung Beans (Dry Season) Value	Maize (Wet Season) Quantity	Maize (Wet Season) Value
Farm Input						
1. Seed	- Local Variety (Mung beans)	6.9/kg	40 kg	276.0	-	-
	- High Yield Variety (Mung beans)	12.5/kg	-	-	-	-
	- Local Variety (Maize)	2.5/kg	-	-	40 kg	100.0
2. Fertilizer	- Urea	6.1/kg	-	-	-	-
	- Compound Fertilizer	4.3/kg	-	-	30 kg	129.0
3. Agro-chemical	- Insecticides	172/ℓ	-	-	-	-
	- Fungicides	143/ℓ	-	-	-	-
4. Land Preparation	- Hand Tractor	84/day	-	-	-	-
	- Large Tractor	110/hour	6.0 hour	660.0	6.0 hour	660.0
5. Thresing Machine		84/day	-	-	-	-
Sub-total (A)				936.0		889.0
Labour Requirement						
1. Nursery Preparation		37/day	-	-	-	-
2. Land Preparation		37/day	2.5 day	92.5	2.5 day	92.5
3. Transplanting or Sowing		37/day	3.0 day	111.0	5.0 day	185.0
4. Weeding		37/day	7.0 day	259.0	16.5 day	610.5
5. Fertilizer Application		37/day	-	-	1.5 day	55.5
6. Chemical Application		37/day	-	-	-	-
7. Harvesting		37/day	18.0 day	666.0	13.0 day	481.0
8. Thresing, Drying & Winnowing		37/day	2.0 day	74.0	6.0 day	222.0
9. Water Management		37/day	-	-	-	-
Sub-total (B)			32.5 day	1,203.0	44.5 day	1,647.0
Miscellaneous Cost		5% of (A+B)		107.0		126.8
Total				2,246.0		2,663.0

Table 5.3.2 CROP PRODUCTION COST UNDER "WITH PROJECT" CONDITION

(Unit: Baht/ha)

Item	Unit Price (Economic)	Paddy		Mungbeans	
		Quantity	Value	Quantity	Value
Farm Input					
1. Seed - Local Variety (Paddy)	4.2/kg	7 kg	29.4	-	-
- High Yield Variety (Paddy)	5.5/kg	28 kg	154.0	-	-
- Local Variety (Mungbean)	6.9/kg	-	-	-	-
- High Yield Variety (Mungbean)	12.5/kg	-	-	40 kg	500.0
2. Fertilizer - Urea	6.1/kg	100 kg	610.0	-	-
- Compound fertilizer	4.3/kg	120 kg	516.0	100 kg	430.0
3. Agro-chemical - Insecticides	172/lit	2.4 lit	412.8	1.8 lit	309.6
- Fungicides	143/lit	1.2 lit	171.6	0.6 lit	85.8
4. Land Preparation - Hand Tractor	84/day	6.3 day	529.2	-	-
- Large Tractor	110/hour	-	-	6.0 hour	660.0
5. Threshing - Machine	84/day	3.0 day	252.0	-	-
(A) Sub-total			2,675.0		1,985.0
Labour Requirement					
1. Nursery Preparation	37/day	1.5 day	55.5	-	-
2. Land Preparation	37/day	6.3 day	233.1	2.5 day	92.5
3. Transplanting or Sowing	37/day	22.0 day	814.0	3.0 day	111.0
4. Weeding	37/day	4.0 day	148.0	8.0 day	296.0
5. Fertilizer Application	37/day	3.0 day	111.0	3.0 day	111.0
6. Chemical Application	37/day	4.0 day	148.0	2.0 day	74.0
7. Harvesting	37/day	24.0 day	888.0	18.0 day	666.0
8. Threshing, drying & winnowing	37/day	6.0 day	222.0	3.0 day	111.0
9. Water management	37/day	3.0 day	111.0	1.0 day	37.0
(B) Sub-total		73.8 day	2,731.0	40.5 day	1,499.0
Miscellaneous Cost	5% of (A) + (B)		270.0		174.0
Total			5,676.0		3,658.0

Note: This table is made based on the Standard Cultivation Method (see Table VIII-6 and -7).

Table 5.3.3 ECONOMIC PRICE STRUCTURE OF PADDY

Items	Unit	Constant 1985 Price
Projected 1995 world market price/1	US$/ton	319
Converted to Thai Baht	฿/ton	8,610
Grade differential/2	฿/ton	-260
Export price	฿/ton	8,350
Port charges/3	฿/ton	-175
Exporter's margin/4	฿/ton	-370
Wholesaler's margin/5	฿/ton	-420
Ex-mill price of rice	฿/ton	7,385
Ex-mill price of paddy/6	฿/ton	4,950
Miller's margin/7	฿/ton	-330
Price of paddy at mill	฿/ton	4,620
Merchant's margin/8	฿/ton	-390
Farmgate price of paddy	฿/ton	4,230

Note: /1: Based on the IBRD Commodity Price Projection, June 1985. The IBRD estimated price given in 1983 constant US$ has been adjusted by a factor of 0.977 (MUV) to allow for price escalation between 1983 and 1985.

/2: Weighted average F.O.B. price assuming 67% is Grade A (100% white rice and 5% broken), 20% is Grade B (10% and 20% broken) and 13% is Grade C (25% and 45% broken) equivalent to 97% of the price for 5% broken.

/3: ฿180 of port charge, conversion factor 0.92 (S.C.F)

/4: The margin covers ฿310/ton of handling charge (conversion factor 0.87) and 1.5% of export price as profit (conversion factor 0.84).

/5: The margin covers ฿240/ton of transportation cost (conversion factor 0.87) and 3.0% of export price as profit (conversion factor 0.84).

/6: Milling ratio of 67% including the value of bran which is 2% of ex-mill price of rice.

/7: On average 8% of ex-mill price of paddy, conversion factor 0.84.

/8: Includes transport and profit, corresponding to about 10% of paddy price at Mill, conversion factor 0.84.

Table 5.3.4 ECONOMIC PRICE STRUCTURE OF MUNG BEANS

Item	Unit	Constant 1985 Price
Export price F.O.B. price at Bangkok/1 in 1995	฿/ton	8,740
Exporter's margin/2	฿/ton	450
Wholesale price of mung beans	฿/ton	8,290
Transport to Bangkok and handling/3	฿/ton	590
Retail price	฿/ton	7,700
Merchant's margin/4	฿/ton	780
Farmgate price of maize	฿/ton	6,920

Note: /1: The international market price of mung beans for the year of 1995 is estimated by using the forecasted soy beans price, because mung beans is correlative with soy beans in its price change. According to IBRD commodity projection, the soy beans price in 1983 will become lower by 13% in 1995, from US$282/ton to US$244/ton. The price of mung beans, C.I.F. Bangkok in 1983, was ฿10,285/ton. The estimated mung beans price in 1995 is therefore ฿8,948/ton at 1983 constant US$. The estimated price is adjusted, by using a factor of 0.977 (MUV) to allow for price escalation between 1983 and 1985.

/2: The margin covers ฿260/ton of handling charge (conversion factor 0.87) and 3% of F.O.B. Bangkok price as profit (conversion factor 0.84).

/3: This item covers ฿240/ton for transportation cost (conversion factor 0.87) and 5.5% of wholesale price as handling and profits (conversion factor 0.84).

/4: The margin covers transport, handling and profit, corresponding to 12% of retail price (conversion factor 0.84).

Table 5.3.5 IRRIGATION BENEFIT ESTIMATES

Crop	Cultivated Area (ha)	Unit Yield (ton/ha)	Total Production (ton)	Unit Price (฿/ton)	Gross Production Value (฿/million)	Unit Production Cost (฿/ha)	Total Production Cost (฿/million)	Net Production Value (A) (฿/million)
(1) Without Project								
Wet Season Paddy								
- Irrigated	22,000	2.8	61,600	4,230	260.6	4,270	93.9	166.7
- Semi-irrigated	14,800	1.6	23,100	4,230	100.2	3,780	55.9	44.3
- Rainfed	7,800	1.3	9,800	4,230	42.9	3,480	27.1	15.8
Dry Season Paddy	1,100	3.5	3,900	4,230	16.3	4,930	5.4	10.9
Mung Beans (Paddy field)	3,300	0.6	2,000	6,920	13.7	2,250	7.4	6.3
Mung Beans (Upland Field)	800	0.5	400	6,920	2.8	2,250	1.8	1.0
Maize	2,100	2.2	4,600	2,470	11.4	2,660	5.6	5.8
Total					447.9		197.1	250.8
(2) With Project								
Wet Season Paddy								
- H.Y.V	37,400	4.5	168,300	4,230	711.9	5,680	212.4	499.5
- Improved local	9,300	4.0	37,200	4,230	157.4	5,680	52.8	104.6
Mung Beans	2,300	1.2	2,800	6,920	19.1	3,660	8.4	10.7
Total					888.4		273.6	614.8
(3) Incremental Benefit (1) - (2)								364.0

Table 5.4.1 IRRIGATION WATER REQUIREMENT OF PRESENT CONDITION
(IRRIGATED FIELD)

(Unit : mm)

Year	Wet Season Crop (Paddy)							Dry Season Crop (Paddy)					Dry Season Crop(Mung Bean)			
	JUN	JUL	AUG	SEP	OCT	NOV	Total	DEC	JAN	FEB	MAR	Total	DEC	JAN	FEB	Total
1954	0	187	206	144	292	256	1,085	43	822	501	345	1,711	116	318	210	644
1955	0	160	218	173	417	136	1,104	43	822	414	436	1,715	116	318	162	596
1956	6	170	214	174	265	250	1,079	43	796	501	357	1,697	116	304	210	630
1957	0	196	220	134	266	224	1,040	43	744	501	387	1,675	116	278	210	604
1958	0	217	253	134	281	256	1,141	43	822	501	364	1,730	116	318	210	644
1959	0	143	230	134	310	245	1,062	43	822	501	498	1,864	116	318	210	644
1960	0	172	249	193	243	211	1,068	43	822	453	498	1,816	116	318	182	616
1961	0	206	206	183	241	256	1,092	39	822	501	470	1,832	95	318	210	623
1962	0	167	226	134	308	240	1,075	43	822	465	465	1,795	116	318	190	624
1963	0	222	205	162	238	153	980	43	822	501	487	1,853	116	318	210	644
1964	0	155	193	134	254	228	964	43	822	356	498	1,719	116	318	127	561
1965	0	226	161	139	295	239	1,060	43	552	487	474	1,556	116	173	202	491
1966	0	175	220	264	238	151	1,048	34	822	501	498	1,855	75	318	210	603
1967	0	235	282	179	297	207	1,200	43	822	479	446	1,790	116	318	198	632
1968	0	141	294	265	293	250	1,243	43	681	501	450	1,675	116	249	210	575
1969	0	168	257	134	319	145	1,023	43	822	496	333	1,694	116	318	207	641
1970	0	211	281	204	243	234	1,173	38	691	420	488	1,637	93	253	165	511
1971	0	245	180	170	295	239	1,129	43	822	477	422	1,764	116	318	196	630
1972	0	254	226	143	243	221	1,087	37	822	496	449	1,804	88	318	207	613
1973	0	280	196	134	364	242	1,216	43	822	501	385	1,751	116	318	210	644
1974	0	155	219	147	243	214	978	43	561	463	466	1,533	116	181	188	485
1975	0	181	246	177	253	111	968	31	822	501	377	1,731	65	318	210	593
1976	0	218	228	196	279	244	1,165	43	822	501	449	1,815	116	318	210	644
1977	29	272	233	186	299	221	1,240	37	646	448	498	1,629	87	232	180	499
1978	0	127	210	158	267	248	1,010	43	822	441	498	1,804	116	318	176	610
1979	0	186	215	147	422	256	1,226	43	822	501	486	1,852	116	318	210	644
1980	0	156	214	136	257	226	989	42	822	501	338	1,703	112	318	210	640
1981	0	175	212	189	305	102	983	43	822	501	451	1,817	116	318	210	644
1982	0	220	231	201	278	189	1,119	41	762	501	495	1,799	107	287	210	604
Mean	1	194	225	168	286	214	1,088	41	783	480	442	1,746	109	298	198	605

Table 5.4.2 IRRIGATION WATER REQUIREMENT OF PRESENT CONDITION (SEMI-IRRIGATED FIELD)

	Wet Season Crop (Paddy)						
Year	JUL	AUG	SEP	OCT	NOV	DEC	Total
1954	96	150	123	294	370	140	1,173
1955	67	167	158	420	209	140	1,161
1956	78	162	158	268	362	140	1,168
1957	107	170	111	269	326	140	1,123
1958	130	217	111	284	370	140	1,252
1959	49	184	111	313	355	140	1,152
1960	80	211	182	245	310	140	1,168
1961	118	151	170	244	370	125	1,178
1962	75	179	111	310	348	140	1,163
1963	135	149	145	241	231	140	1,041
1964	61	132	111	257	332	140	1,033
1965	140	87	118	297	346	140	1,128
1966	84	170	266	241	228	110	1,099
1967	150	257	164	299	304	140	1,314
1968	46	274	266	296	362	140	1,384
1969	76	222	111	322	221	140	1,092
1970	123	256	194	245	340	124	1,284
1971	161	114	155	298	347	140	1,215
1972	170	178	122	245	323	120	1,158
1973	188	137	111	366	350	140	1,292
1974	61	169	127	245	314	140	1,056
1975	91	206	162	225	175	102	991
1976	131	181	185	282	353	140	1,272
1977	183	189	173	301	323	119	1,288
1978	30	156	140	269	359	140	1,094
1979	96	163	126	424	370	140	1,319
1980	63	162	114	259	330	137	1,065
1981	84	158	177	307	163	140	1,029
1982	133	185	191	280	279	134	1,202
Mean	104	177	151	289	313	135	1,169

Table 5.4.3 IRRIGATION WATER REQUIREMENT OF WITH-PROJECT CONDITION (WITHOUT UPGRADING WORKS)

(Unit : mm)

	Wet Season Crop							Dry Season Crop				
Year	JUL	AGU	SEP	OCT	NOV	DEC	Total	JAN	FEB	MAR	APR	Total
1954	92	217	180	298	173	16	976	40	263	281	45	629
1955	54	232	210	422	96	16	1,030	40	199	352	85	676
1956	67	228	210	273	170	16	964	36	263	291	64	654
1957	106	235	169	274	153	16	953	30	263	318	93	704
1958	138	276	169	288	173	16	1,060	40	263	298	86	687
1959	49	248	169	317	167	16	966	40	263	398	93	794
1960	70	271	231	250	145	16	983	40	226	398	64	728
1961	121	218	220	249	173	15	996	40	263	377	58	738
1962	63	243	169	314	163	16	968	40	235	373	78	726
1963	144	216	198	246	107	16	927	40	263	390	68	761
1964	53	201	169	261	155	16	855	40	152	398	93	683
1965	151	162	175	301	162	16	967	4	252	380	88	724
1966	76	235	304	246	106	13	980	40	263	398	74	775
1967	163	316	216	304	142	16	1,157	40	246	359	35	680
1968	49	334	305	300	170	16	1,174	23	263	362	80	728
1969	64	281	169	326	102	16	958	40	259	270	74	643
1970	128	315	242	250	159	14	1,108	24	203	390	82	699
1971	178	185	207	302	163	16	1,051	40	244	342	35	661
1972	190	242	179	250	151	14	1,026	40	259	361	89	749
1973	214	205	169	369	164	16	1,137	40	263	317	57	677
1974	53	234	183	250	147	16	883	6	233	374	61	674
1975	84	267	213	260	80	12	916	40	263	309	58	670
1976	139	244	233	286	166	16	1,084	40	263	361	54	718
1977	207	251	223	306	151	14	1,152	18	222	398	63	701
1978	44	222	194	274	168	16	918	40	217	398	72	727
1979	91	229	182	427	173	16	1,118	40	263	389	90	782
1980	53	228	171	264	154	16	886	40	263	275	60	638
1981	75	224	226	311	75	16	927	40	263	363	59	725
1982	141	248	239	285	130	16	1,059	32	263	396	76	767
Mean	105	242	204	293	146	16	1,006	35	247	356	70	708

Table 5.4.4 IRRIGATION WATER REQUIREMENT
OF WITH-PROJECT CONDITION
(WITH UPGRADING WORKS)

(Unit : mm)

	Wet Season Crop							Dry Season Crop				
Year	JUL	AUG	SEP	OCT	NOV	DEC	Total	JAN	FEB	MAR	APR	Total
1954	75	177	147	244	142	13	798	35	233	250	40	558
1955	45	190	172	345	79	13	844	35	176	313	75	599
1956	55	186	172	223	139	13	788	32	233	259	56	580
1957	87	192	138	224	125	13	779	26	233	283	83	625
1958	113	226	138	236	142	13	868	35	233	265	76	609
1959	40	203	138	259	136	13	789	35	233	354	83	705
1960	58	222	189	205	118	13	805	35	201	354	57	647
1961	99	178	180	203	142	12	814	35	233	335	51	654
1962	52	199	138	257	134	13	793	35	209	332	70	646
1963	118	177	162	201	88	13	759	35	233	347	60	675
1964	43	165	138	214	127	13	700	35	135	354	82	606
1965	123	132	143	247	133	13	791	3	224	338	78	643
1966	62	192	249	201	87	10	801	35	233	354	66	688
1967	133	259	176	248	116	13	945	35	219	319	31	604
1968	40	273	249	245	139	13	959	20	233	322	71	646
1969	53	230	138	266	84	13	784	35	230	240	66	571
1970	105	258	198	205	130	12	908	21	180	347	72	620
1971	146	152	169	247	133	13	860	35	217	304	31	587
1972	156	198	146	205	124	11	840	35	230	321	79	665
1973	175	168	138	302	134	13	930	35	233	282	51	601
1974	43	191	150	205	120	13	722	5	207	332	54	598
1975	69	218	175	213	66	10	751	35	233	275	51	594
1976	114	200	191	234	136	13	888	35	233	321	48	637
1977	169	206	183	250	124	11	943	16	198	354	56	624
1978	36	182	159	224	138	13	752	35	193	354	64	646
1979	75	187	149	349	142	13	915	35	233	346	80	694
1980	43	186	140	216	126	13	724	35	233	244	53	565
1981	62	184	185	255	61	13	760	35	233	322	53	643
1982	115	203	195	233	107	13	866	28	233	352	67	680
Mean	86	198	167	240	120	13	824	31	219	316	62	628

Table 5.5.1 FLOOD CONTROL BY RESERVOIR
UPPER MAE WONG DAM C.A. 612 Km²

Year	Reservoir Inflow ($10^3 m^3$)	Outlet for Irrigation ($10^3 m^3$)	Spillout ($10^3 m^3$)	Maximum & Second Maximum Flood			
				Without Reservoir (m^3/s)	With Reservoir (m^3/s)	Without Reservoir (m^3/s)	With Reservoir (m^3/s)
1954	186,570	158,271	75,389	35.5	35.1	35.1	34.4
1955	180,776	193,279	2,072	29.3	2.4	28.3	-
1956	196,781	144,626	0	27.9	-	27.0	-
1957	275,353	96,354	151,228	48.4	48.0	45.2	44.8
1958	221,851	170,294	50,161	39.0	34.1	35.1	17.6
1959	230,936	120,083	96,106	39.9	39.4	34.5	31.3
1960	169,826	174,190	0	28.8	-	25.0	-
1961	232,091	120,114	68,411	27.8	26.5	26.6	23.8
1962	218,252	138,071	76,718	39.6	39.2	38.1	28.9
1963	230,919	115,113	56,839	41.8	28.1	38.7	19.1
1964	309,768	60,024	231,020	45.5	45.1	45.1	44.7
1965	195,743	152,539	44,942	29.8	24.3	26.5	14.5
1966	182,081	163,908	0	22.6	-	20.6	-
1967	123,339	301,460	0	18.9	-	17.5	-
1968	135,804	144,536	0	18.4	-	17.0	-
1969	155,223	114,035	0	29.0	-	16.9	-
1970	259,108	150,096	0	34.6	-	32.6	-
1971	195,740	188,611	0	46.9	-	24.1	-
1972	252,293	172,535	0	43.3	-	42.2	-
1973	239,414	213,530	0	42.6	-	41.8	-
1974	376,448	92,700	242,150	93.8	93.3	80.7	32.8
1975	236,002	137,644	80,978	43.3	17.4	30.1	16.0
1976	215,393	200,379	13,099	59.6	12.5	29.4	0.9
1977	57,336	263,273	0	11.3	-	7.7	-
1978	221,867	127,827	0	65.9	-	36.3	-
1979	182,122	222,301	0	64.5	-	26.3	-
1980	282,828	134,009	0	108.8	-	40.5	-
1981	204,075	165,131	0	38.8	-	29.4	-
1982	108,338	279,883	0	19.4	-	16.3	-
Mean	209,526	162,580	41,004	41.2	15.4	31.5	10.6

Table 6.1.1 SUMMARY OF RESERVOIR AND DAM

1.	Reservoir		
	Catchment area	612	km²
	Total storage volume	250	MCM
	Effective storage volume	230	MCM
	Dead storage volume	20	MCM
	Water level		
	Total storage level	El 204.5	m
	Flood surcharge level	El 207.5	m
	Dead storage level	El 180.0	m
	Reservoir area		
	Total storage area	17.6	km²
	Flood surcharge area	19.8	km²
	Dead storage area	3.0	km²
2.	Dam		
	Type	Center-cored rockfill type	
	Height	57	m
	Crest elevation	El 211	m
	Crest length	794	m
	Crest width	10	m
	Slopes	upstream 1 : 1.75	
		downstream 1 : 1.6	
	Embankment volume	2,500,000	m³
3.	Spillway		
	Service spillway	Ungated side channel type	
	Design discharge	1,200	m³/s
	Crest length	110	m
	Emergency spillway	Ungated chute type	
	Design discharge	570	m³/s
	Crest length	210	m
4.	River diversion		
	Approach canal	220	m
	Diversion tunnel	230	m
	Diameter	2R Horse shoe 7.6	m
	Diversion canal	790	m
	Diversion dam	90,000	m³
5.	Intake and outlet works		
	Intake design discharge	43	m³/sec
	Intake structure	Drop inlet	
	Outlet pipe diameter	3.4	m

Table 6.2.1 MAIN FEATURES OF IRRIGATION FACILITIES

1.	Source of Irrigation Water	:	Mae Wong River	
2.	Net Irrigable Area	:	46,700 ha	
			Up-grading	36,800 ha
			New development	9,900 ha
3.	Intake Weir			
	(1) Ban Tha Ta Yu weir			
	Type	:	Ogee type	
	Length	:	30.0 m	
	Height	:	2.7 m	
	Scouring sluice	:	Gates, W 2.0 m x H 1.5 m x 2 sets	
	Intake	:	Gates, W 2.0 m x H 2.5 m x 4 sets	
	(2) Khlong Saingu weir			
	Type	:	Ogee type	
	Length	:	28.0 m	
	Height	:	1.3 m	
	Scouring sluice	:	Stop log, W 1.5 m x H 0.8 m	
	Intake	:	Existing regulator	

			Upgrading	New construction	Total
4.	Main Canal				
	(1) Type & length of canal				
	Trapezoidal unlined canal	:	64.7 km	12.0 km	64.7 km
	Trapezoidal concrete lined canal	:		12.0 km	12.0 km
	(2) Side slope of canal		1 : 1.5	1 : 1.5	
	(3) Related structures				
	Culvert	:		2 nos.	2 nos.
	Check structure	:		53 nos.	53 nos.
	Turnout	:		63 nos.	63 nos.
	Water measuring device	:		5 nos.	5 nos.
	Spillway	:		6 nos.	6 nos.
	Drop	:		5 nos.	5 nos.
	Syphon	:		3 nos.	3 nos.
	Bridge	:		3 nos.	3 nos.
5.	Lateral and Sub-lateral Canal				
	(1) Type & length of canal				
	Trapezoidal unlined canal	:	171.4 km	112.2 km	283.6 km
	Trapezoidal concrete lined canal	:		1.6 km	1.6 km
	(2) Side slope of canal	:	1 : 1.5	1 : 1.5	
	(3) Related structures				
	Cluvert	:		38 nos.	38 nos.
	Check structure	:		244 nos.	244 nos.
	Turnout	:		274 nos.	274 nos.
	Water measuring device	:		27 nos.	27 nos.
	Apillway	:		12 nos.	12 nos.
	Drop	:		8 nos.	8 nos.
	Syphon	:		8 nos.	8 nos.
	Bridge	:		21 nos.	21 nos.
6.	Drainage Canal				
	(1) Length of canal	:	96.1 km	108.1 km	204.2 km
	(2) Related structures				
	Cross drain	:		20 nos.	20 nos.
	Culvert	:		26 nos.	26 nos.
7.	Inspection Road				
	(1) Main inspection road				
	Road width	:		5 m	
	Pavement material	:		Laterite	
	Width of pavement	:		4 m	
	Length	:		76.7 km	
	(2) Lateral and sub-lateral inspection road				
	Road width	:		4 m	
	Pavement material	:		-	
	Width of pavement	:		-	
	Lnegth	:		285.2 km	
8.	Land Reclamation	:		6,000 rai (1,100 ha)	

Table 6.3.1 EARTH MOVING PLAN OF UPPER MAE WONG DAM

EXCAVATION \ EMBANKMENT AND BACKFILL			DAM					DIVERSION DAM				SERVICE SPILLWAY	EMERGENCY SPILLWAY	SPOIL AREA	REMARKS
			CORE	FILTER & DRAIN	SEMI-RERVIOUS	TRANSITION	ROCK	CORE	FILTER	ROCK	RIPRAP	BACKFILL	BACKFILL		
			(360,300)	(213,200)	(493,500)	(630,600)	(857,500)	(19,800)	(16,300)	(51,100)	(3,000)	(16,600)	-	452,100	
D A M	T/S C/S	104,300 14,000												118,300	
	W/R	14,000				14,000 (14,000)									
	R	42,200				42,200 (54,900)									
DIVERSION DAM	T/S C/S	14,600												14,600	
SERVICE SPILLWAY	T/S C/S	39,700 54,900				31,000 (27,900)						18,400 (16,600)		45,200	
	W/R	87,400				52,400 (52,400)	17,500 (17,500)							17,500	
	R	508,800				101,700 (132,200)	356,200 (463,000)							50,900	
EMERGENCY SPILLWAY & QUARRY SITE	T/S C/S	152,900												152,900	
	W/R	229,300				229,300 (229,300)									
	R	382,200				92,200 (119,900)	290,000 (377,000)								
DIVERSION CANAL	T/S C/S	18,500 15,500						13,900 (12,500)						20,100	
	W/R	22,700								22,700 (22,700)					
	R	56,700								21,800 (28,400)	2,300 (3,000)			32,600	
DIVERSION TUNNEL	R	15,100		15,100 (19,600)											
BORROW AREA (Down Stream)	T/S	102,100													
	C/S	408,400	400,300 (360,300)					8,100 (7,300)							
BORROW AREA (Up Stream)	T/S	54,800													
	C/S	548,300			548,300 (493,500)										
RIVER SITE	S	199,400		183,900 (194,600)					15,500 (16,300)						
	G														

Table 6.4.1 SUMMARY OF FINANCIAL CONSTRUCTION COST FOR MAE WONG IRRIGATION SCHEME (Case 301)

	Total ($x10^6$฿)	Foreign Currency ($x10^6$฿)	Local Currency ($x10^6$฿)
1. Construction Cost (including Overhead, Profit and Tax)			
1.1 Dam Construction	1,051.0	807.3	243.7
1.2 Irrigation Facilities	638.8	367.8	271.0
1.3 Office & Quarters	24.2	-	24.2
Sub-total	1,714.0	1,175.1	538.9
2. Land Aquisiton, Resettlement & Compensation	28.0	-	28.0
3. O & M Equipment	44.6	40.5	4.1
4. Administration	42.9	-	42.9
5. Physical Contingency	183.0	121.6	61.4
6. Engineering Services	235.3	194.9	40.4
Sub-total	533.8	357.0	176.8
Total	2,247.8	1,532.1	715.7
7. Price Contingency	647.3	414.1	233.2
Grand Total (Financial Cost)	2,895.1	1,946.2	948.9

(Exchange Rate : US$ 1 = ฿ 27 = ¥ 240)

Table 6.4.2 ANNUAL DISBURSEMENT SCHEDULE OF MAE WONG IRRIGATION SCHEME

	Total		1st year		2nd year		3rd year		4th year		5th year		6th year		7th year	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Construction Cost																
1.1 Dam Construction	807.3	243.7	-	-	-	-	80.7	24.4	121.1	36.6	161.5	48.7	242.2	73.1	201.8	60.9
1.2 Irrigation Facilities	367.8	271.0	-	-	-	-	-	-	18.4	13.6	117.7	86.7	117.7	86.7	114.0	84.0
1.3 Office & Quarters	-	24.2	-	-	-	-	-	24.2	-	-	-	-	-	-	-	-
Sub-Total	1,175.1	538.9	-	-	-	-	80.7	48.6	139.5	50.2	279.2	135.4	359.9	159.8	315.8	144.9
2. Land Aquisition, Resettlement and Compensation	-	28.0	-	-	-	14.0	-	14.0	-	-	-	-	-	-	-	-
3. O & M Equipment	40.5	4.1	-	-	-	-	-	-	-	-	-	-	20.3	2.1	20.2	2.0
4. Administration	-	42.9	-	-	-	-	-	3.7	-	4.7	-	10.3	-	12.9	-	11.3
5. Physical Contingency	121.6	61.4	-	-	-	1.4	8.1	6.6	14.0	5.5	27.9	14.6	38.0	17.5	33.6	15.8
6. Engineering Services	194.9	40.4	48.8	15.4	32.6	10.2	22.7	3.0	22.7	3.0	22.7	3.0	22.7	2.9	22.7	2.9
Sub-Total	357.0	176.8	48.8	15.4	32.6	25.6	30.8	27.3	36.7	13.2	50.6	27.9	81.0	35.4	76.5	32.0
Total	1,532.1	715.7	48.8	15.4	32.6	25.6	111.5	75.9	176.2	63.4	329.8	163.3	440.9	195.2	392.3	176.9
7. Price Contingency	414.1	233.2	1.2	0.5	2.5	2.3	14.5	11.9	32.8	14.3	81.0	49.0	135.7	73.7	146.4	81.5
Grand Total (Financial Cost)	1,946.2	948.9	50.0	15.9	35.1	27.9	126.0	87.8	209.0	77.7	410.8	212.3	576.6	268.9	538.7	258.4

Table 6.4.3 ANNUAL OPERATION AND MAINTENANCE COST

Item	Amount (10³฿)
1. Salaries & Wages	
1.1 Staff salaries	1,037
1.2 Labour wages (200 M/M @฿1,500)	300
2. Office Expenses	31
3. Operation and Maintenance Cost	
3.1 Depreciation of O & M Equipment	9,315
3.2 Dam	5,369
3.3 Irrigation	15,970
Total	32,022

Table 6.4.4 O &M STAFF SALARY

Item	Required Number	Monthly Rate (฿)	Annual Amount (10³฿)
Project Engineer	1	10,000	10
Sr. Irrigation Engineer	3	8,000	24
Jr. Irrigation Engineer	7	5,000	35
Zonemen	30	4,000	120
Sub-total	41		189
Gate Tender	10	5,000	50
Canal Tender	150	3,000	450
Sub-total	160		500
Hydrographer	5	6,000	30
Surveyor	5	4,000	20
Draftsman	2	4,000	8
Agronomist	5	7,000	35
Sub-total	17		93
Mechanical Engineer	2	7,000	14
Mechanic/Electrician	2	7,000	14
Communication Technician	2	5,000	10
Radio Operator	5	5,000	25
Sub-total	11		63
Administrator	10	7,000	70
Accountant	2	6,000	12
Store Keeper	4	5,000	20
Typist	3	5,000	15
Driver	15	5,000	75
Sub-total	34		192
Total	263		1,037

Table 6.4.5 REPLACEMENT COST

Item	Useful Life (Year)	Replacement Cost (10^6฿)
1. O & M Equipment	10	44.6
2. Project Facilities		45.5
(1) Dam	25	27.6
(2) Weir	25	0.3
(3) Irrigation Facilities	25	17.6

Table 8.2.1 STRUCTURE OF FINANCIAL AND ECONOMIC COST (IN PERCENT)

Cost Component	Financial Cost				Economic Cost				Weighted Conversion Factor
	Local Cost			Foreign Cost	Local Cost			Foreign Cost	
	Transfer Payment	Unskilled Labour	Others		Transfer Payment	Unskilled Labour	Others		
Capital Cost									
1. Dam & Reservoir	9	5	17	69	-	2	16	69	0.87
2. Irrigation Works	9	10	28	53	-	5	26	53	0.84
3. Office & Quarters	9	15	76	-	-	7	70	-	0.77
4. Land Acquisition	-	-	100	-	-	-	92	-	0.92
5. Resettlement & Compensation	-	-	100	-	-	-	92	-	0.92
6. O & M Equipment	-	-	10	90	-	-	9	90	0.99
7. Administration	-	-	100	-	-	-	92	-	0.92
8. Engineering Services	10	-	15	75	-	-	14	75	0.89
9. On-farm Development	10	80	10	-	-	34	9	-	0.43
O & M Cost									
1. Salaries & Wages	10	20	70	-	-	9	64	-	0.73
2. Office Expenses	10	-	90	-	-	-	83	-	0.83
3. O & M Expenses									
a. Dam	9	5	86	-	-	2	79	-	0.81
b. Irrigation	9	10	81	-	-	5	75	-	0.80

Note: The conversion factor for the transfer payments like taxes and duties is 0, compared to 0.46 for unskilled construction labour, 0.92 for other local costs and 1.00 for foreign costs. Last column indicates the specific economic conversion factor for each cost component.

Table 8.2.2 ECONOMIC COST FOR ON-FARM DEVELOPMENT

1. Financial cost for on-farm development in the model area of 8,160 ha.

	Work Item	Quantity	Unit Cost (₱)	Amount (10^3₱)
a.	Canals	133,460 m	19.0	2,536
b.	Drains	95,330 m	16.0	1,525
c.	Related structure	L.S.	-	609
	Total			4,670

2. Total on-farm development cost for a whole irrigation area of 46,700 ha (financial)

46,700 ha/8,160 ha x 4,670 = 26.7 million ₱

3. Calculation of Economic Cost

a.	Financial Cost	26.7 million ₱
b.	Conversion Factor/1	0.43
c.	Economic Cost (a x b)	11.4 million ₱

Note: /1: see Table X-1

Table 8.2.3 COST AND BENEFIT STREAM
(Original Case)

(Unit: Million ₱)

Year in Order	Cost				Benefits
	Capital Cost	O & M Cost	Repayment Cost	Total	
1	57.1	0	0	57.1	0
2	47.1	0	0	47.1	0
3	158.2	0	0	158.2	0
4	207.6	0	0	207.6	0
5	430.7	0	0	430.7	0
6	558.0	7.2	0	565.2	36.4
7	500.3	10.9	0	511.2	72.8
8	0	18.1	0	18.1	218.4
9	0	18.1	0	18.1	254.8
10	0	18.1	0	18.1	291.2
11	0	18.1	0	18.1	327.6
12	0	18.1	0	18.1	364.0
⋮	⋮	⋮	⋮	⋮	⋮
17	0	18.1	44.2	62.3	364.0
18	0	18.1	0	18.1	364.0
⋮	⋮	⋮	⋮	⋮	⋮
27	0	18.1	44.2	62.3	364.0
28	0	18.1	0	18.1	364.0
⋮	⋮	⋮	⋮	⋮	⋮
32	0	18.1	45.0	63.1	364.0
33	0	18.1	0	18.1	364.0
⋮	⋮	⋮	⋮	⋮	⋮
37	0	18.1	44.2	62.3	364.0
38	0	18.1	0	18.1	364.0
⋮	⋮	⋮	⋮	⋮	⋮
47	0	18.1	44.2	62.3	364.0
48	0	18.1	0	18.1	364.0
.	.	.	.	.	.
50	0	18.1	0	18.1	364.0

IRR: 13.0%

Table 8.3.1 FINANCIAL CASH FLOW STATEMENT

(Unit: Million Baht)

Year	Year in Order	Cash Outflow						Cash Inflow				Balance (B)-(A)	Accumulated Loan
		Project Cost	O & M Cost	Replacement Cost	Loan Interest	Loan Repayment	Total Outflow (A)	Foreign Loan	Government Budget	Government Subsidy	Total Inflow (B)		
1987	1	65.9			1.8	-	67.7	50.0	15.9	1.8	67.7	0	50.0
1988	2	63.0	-	-	3.0	-	66.0	35.1	27.9	3.0	66.0	0	85.1
1989	3	213.8	-	-	7.4	-	221.2	126.0	87.8	7.4	221.2	0	211.1
1990	4	286.7	-	-	14.7	-	301.4	209.0	77.7	14.7	301.4	0	420.1
1991	5	623.1	-	-	29.1	-	652.2	410.8	212.3	29.1	652.2	0	830.9
1992	6	845.5	12.8	-	49.3	-	907.6	576.6	268.9	62.1	907.6	0	1,407.5
1993	7	797.1	19.2	-	68.1	-	884.4	538.7	258.4	87.3	884.4	0	1,946.2
1994	8	-	32.0	-	68.1	-	100.1	-	-	100.1	100.1	0	1,946.2
1995	9	-	32.0	-	68.1	-	100.1	-	-	100.1	100.1	0	1,946.2
1996	10	-	32.0	-	68.1	-	100.1	-	-	100.1	100.1	0	1,946.2
1997	11	-	32.0	-	64.7	97.3	194.0	-	-	194.0	194.0	0	1,848.9
1998	12	-	32.0	-	61.3	97.3	190.6	-	-	190.6	190.6	0	1,751.6
1999	13	-	32.0	-	57.9	97.3	187.2	-	-	187.2	187.2	0	1,654.3
2000	14	-	32.0	-	54.5	97.3	183.8	-	-	183.8	183.8	0	1,557.0
2001	15	-	32.0	-	51.1	97.3	180.4	-	-	180.4	180.4	0	1,459.7
2002	16	-	32.0	-	47.7	97.3	177.0	-	-	177.0	177.0	0	1,362.4
2003	17	-	32.0	44.6	44.3	97.3	218.2	-	44.6	173.6	218.2	0	1,265.1
2004	18	-	32.0	-	40.9	97.3	170.2	-	-	170.2	170.2	0	1,167.8
2005	19	-	32.0	-	37.5	97.3	166.8	-	-	166.8	166.8	0	1,070.5
2006	20	-	32.0	-	34.1	97.3	163.4	-	-	163.4	163.4	0	973.2
2007	21	-	32.0	-	30.7	97.3	160.0	-	-	160.0	160.0	0	875.9
2008	22	-	32.0	-	27.3	97.3	156.6	-	-	156.6	156.6	0	778.6
2009	23	-	32.0	-	23.8	97.3	153.1	-	-	153.1	153.1	0	681.3
2010	24	-	32.0	-	20.4	97.3	149.7	-	-	149.7	149.7	0	584.0
2011	25	-	32.0	-	17.0	97.3	146.3	-	-	146.3	146.3	0	486.7
2012	26	-	32.0	-	13.6	97.3	142.9	-	-	142.9	142.9	0	389.4
2013	27	-	32.0	44.6	10.2	97.3	184.1	-	44.6	139.5	184.1	0	292.1
2014	28	-	32.0	-	6.8	97.3	136.1	-	-	136.1	136.1	0	194.8
2015	29	-	32.0	-	3.4	97.3	132.7	-	-	132.7	132.7	0	97.5
2016	30	-	32.0	-	0	97.5	129.5	-	-	129.5	129.5	0	0

Foreign Loan: Annual interest of 3.5% for repayment period of 30 years including 10-year grace period.

Table 9.1.1 ENVIRONMENTAL PARAMETERS FOR ANALYSIS OF DAM AND RESERVOIR PROJECTS

Environmental Resource / Project Component		Physical Resources							Ecological Resources					Human Use Values													Quality of Life Values						
		Surface Water Hydrology	Surface Water Quality	Ground Water Hydrology	Ground Water Quality	Soils	Geology/Seismology	Erosion/Sedimentation	Climate	Fisheries	Aquatic Biology	Terrestrial Wildlife	Forests	Agriculture/Irrigation (if applicable)	Aquaculture	Water Supply	Navigation	Recreation	Power (if applicable)	Flood Control	Dedicated Area Uses	Industry	Agro-Industry	Mineral Development	Highways/Railways	Land Use	Socio-Economic	Resettlement	Cultural/Historical	Aesthetic	Archaeological	Public Health	Nutrition
Dam and Reservoir	A	3	2	2	1	-	-	3	1	((3))	((3))	((3))	2	(3)	(3)	(3)	(2)	(3)	(3)	(3)	3	-	-	(2)	((2))	3	(3)	3	1	((3))	1	((2))	(3)
	B	3	-	3	-	2	3	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	3	-	-	-	1	-
Irrigation System	A	1	3	2	-	3	-	2	-	(3)	(3)	1	-	(3)	(3)	(3)	-	(1)	-	-	-	(2)	(2)	-	1	3	(3)	-	-	-	-	(2)	(3)
	B	2	3	3	1	3	3	3	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-

NOTES: (a) (A) means significant impact of project on environmental resources, whereas (B) means impact of the environment on the project.

(b) Numerical value of 3 means probable major impact, 2 means intermediate, and 1 means significant but relatively minor.

(c) Numbers in parentheses indicate effects are mostly enhancement of environmental.
Numbers in double parentheses represent combination of adverse and beneficial effects.
Numbers without parentheses represent either adverse or beneficial effects.

Table 9.1.2 CLASSIFICATION OF ENVIRONMENTAL STUDY ITEMS

	Environmental Resources	Included Already in F/S	Proposed Additional Study Item in F/S	RID Contri-bution
Physical Resources	Surface Water Hydrology	o		
	Surface Water Quality	o		
	Ground Water Hydrology	o		
	Ground Water Quality	o		
	Soils	o		
	Geology/Seismology	o		
	Erosion/Sedimentation	o		
	Climate	o		
Ecological Resources	Fisheries		o	
	Aquatic Biology		o	
	Terrestrial Wildlife		o	
	Forests		o	
Human Use Values	Agriculture/Irrigation (if applicable)	o		
	Aquaculture		o	
	Water Supply	o		
	Recreation			o
	Power (if applicable)	o		
	Flood Control	o		
	Dedicated Area Uses	o		
	Industry			o
	Agro-Industry	o		
	Mineral Development			o
	Highways/Railways			o
	Land Use	o		
Quality of Life Values	Socio-Economic	o		
	Resettlement	o	o	
	Cultural/Historical			o
	Aesthetic			o
	Archaeological			o
	Public Health			o
	Nutrition			o

Table 9.2.1 NUMBER OF HOUSEHOLDS AND SAMPLES IN UPPER MAE WONG RESERVOIR AREA

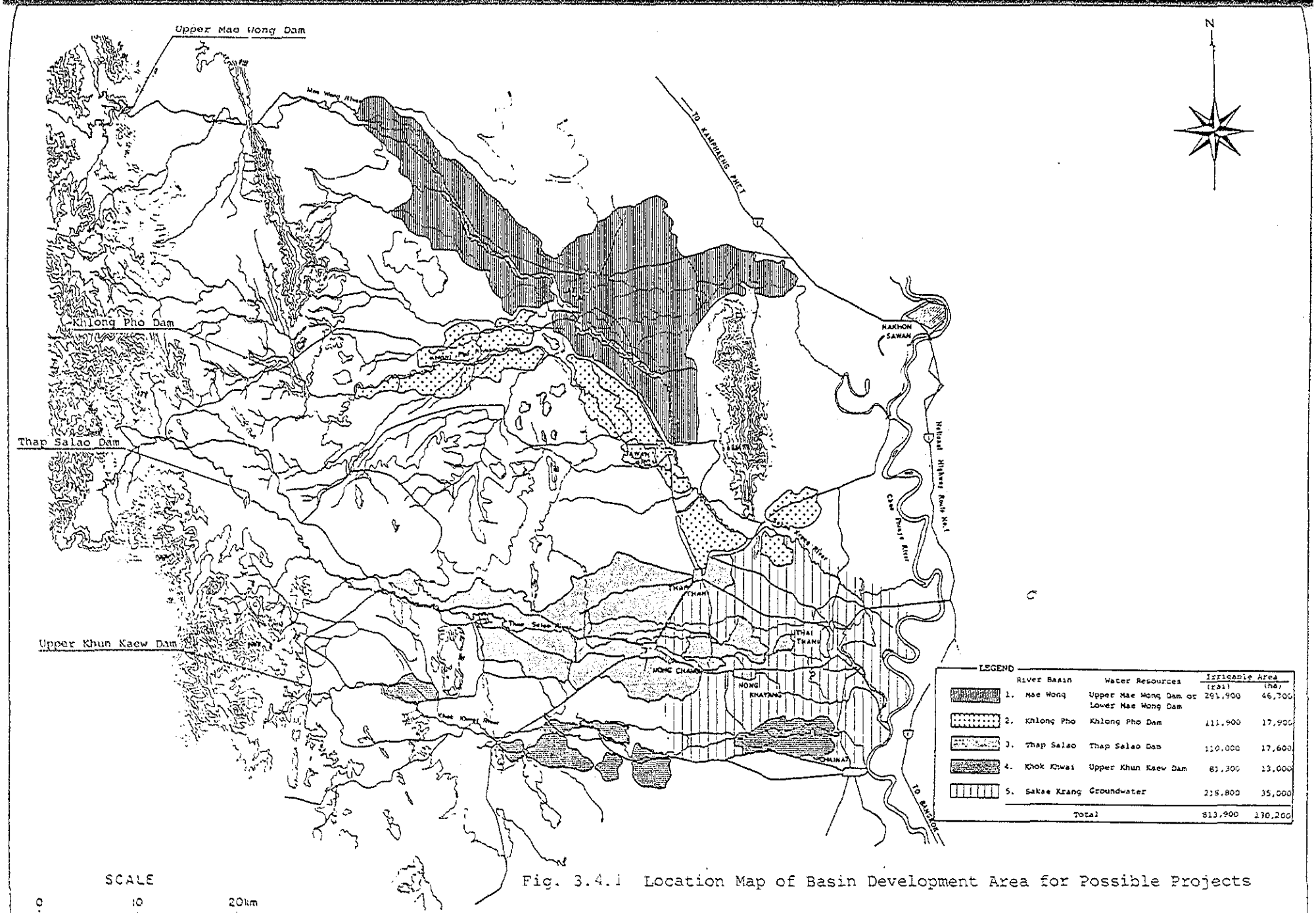
Changwat (Province)	Amphoe (District)	Tambon (Sub-Dist.)	Name of Village, (*1) (Muban)	House-holds	Number of Sample
Kamphan-phet	Khlong Klung	Po Thong	HUAI WUA	25	10
			BUNG KHO	3	
			MO DINDANG	2	6
			PHRAN NGOEN	12	
			SAM RUAN	2	
			PAND KHAO SAN	5	4
			PHRAN CHIEN	3	
			CHONG KHAEB	3	
			TOTAL	55	10
Nakhon-Sawan	Lat Yao	Mae Le	PANG PU KONG		
			PANG FAEK	16	8
			CHEK THIENG		
			SAN POON (*2)		
			PONG NOK (*2)	30	2
			PANG KHAO SAN(*2)		
			TOTAL	46	10
			GRAND TOTAL	101	30

Note; *1 Name of these village is not official identified, only for reference.

*2 Most of them are inaccessible, as reported.

From : RID. PPD, Economic Sec.; originally figures of households number are investigated by the inquirer at the field survey.

FIGURE



	River Basin	Water Resources	Irrigable Area (rai)	Irrigable Area (ha)
	1. Mae Wong	Upper Mae Wong Dam or Lower Mae Wong Dam	291,900	46,700
	2. Khlong Pho	Khlong Pho Dam	111,900	17,900
	3. Thap Salao	Thap Salao Dam	110,000	17,600
	4. Khok Khwai	Upper Khun Kaew Dam	81,300	13,000
	5. Sakae Krang	Groundwater	218,800	35,000
	Total		813,900	130,200

Fig. 3.4.1 Location Map of Basin Development Area for Possible Projects

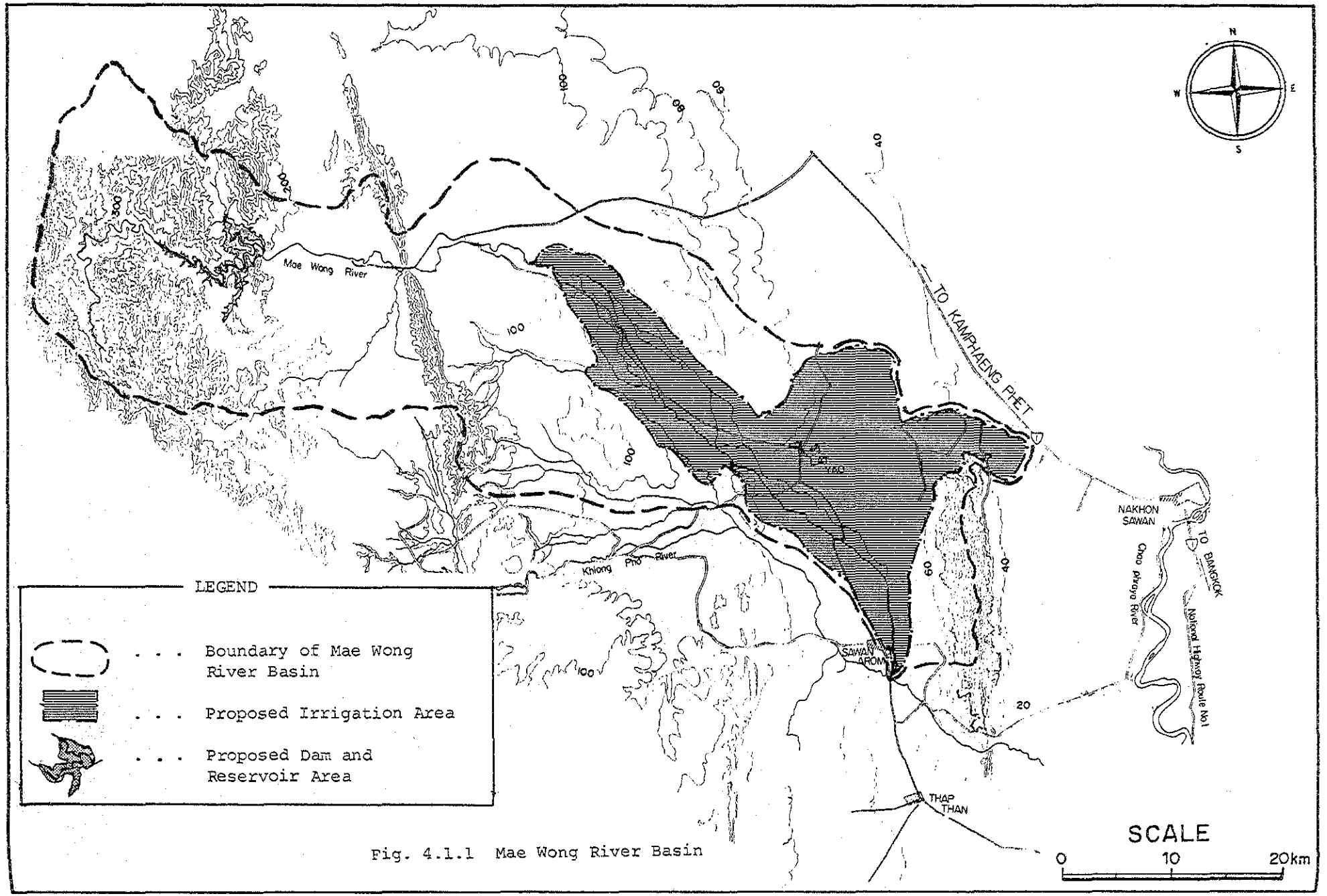


Fig. 4.1.1 Mae Wong River Basin

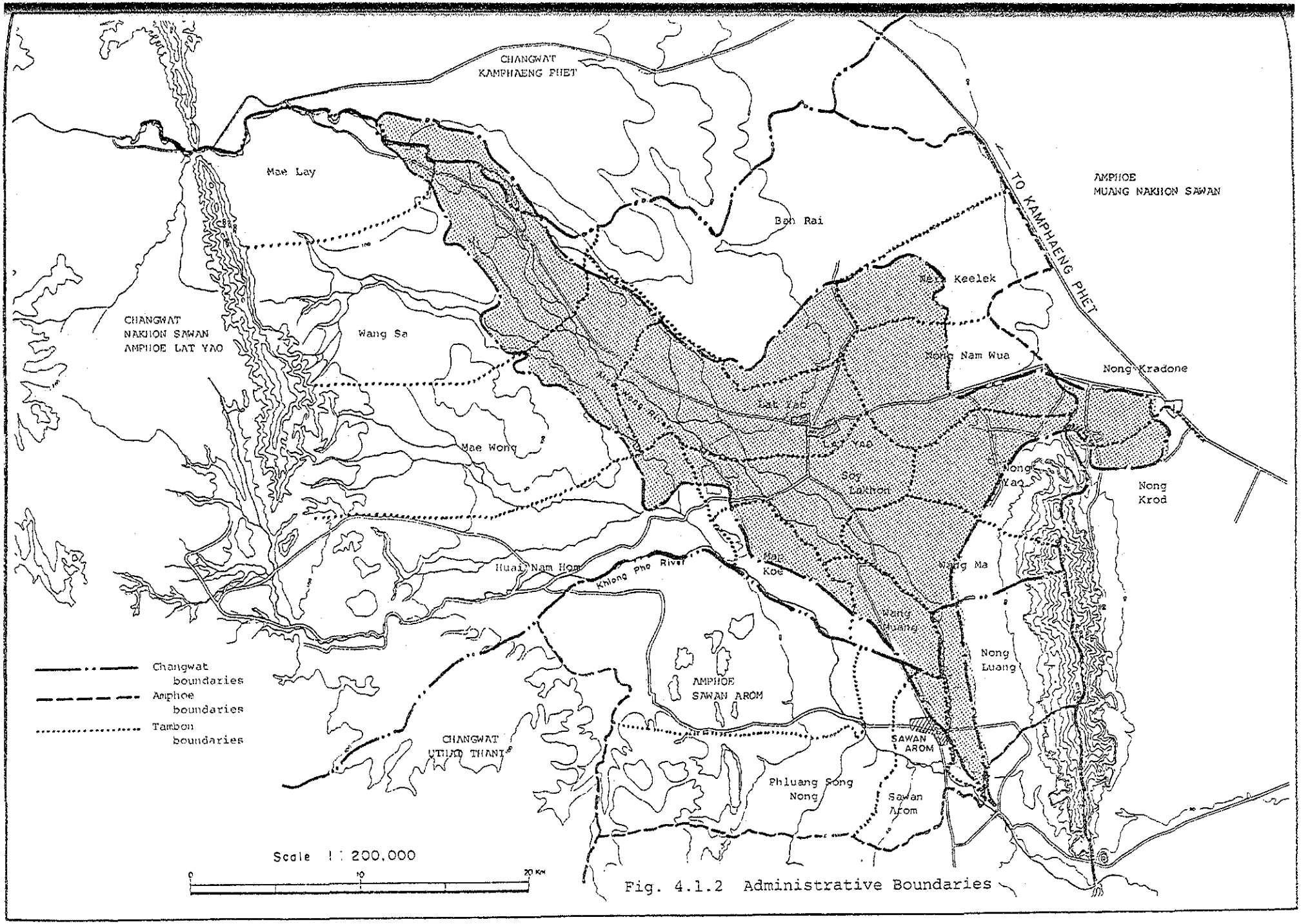


Fig. 4.1.2 Administrative Boundaries

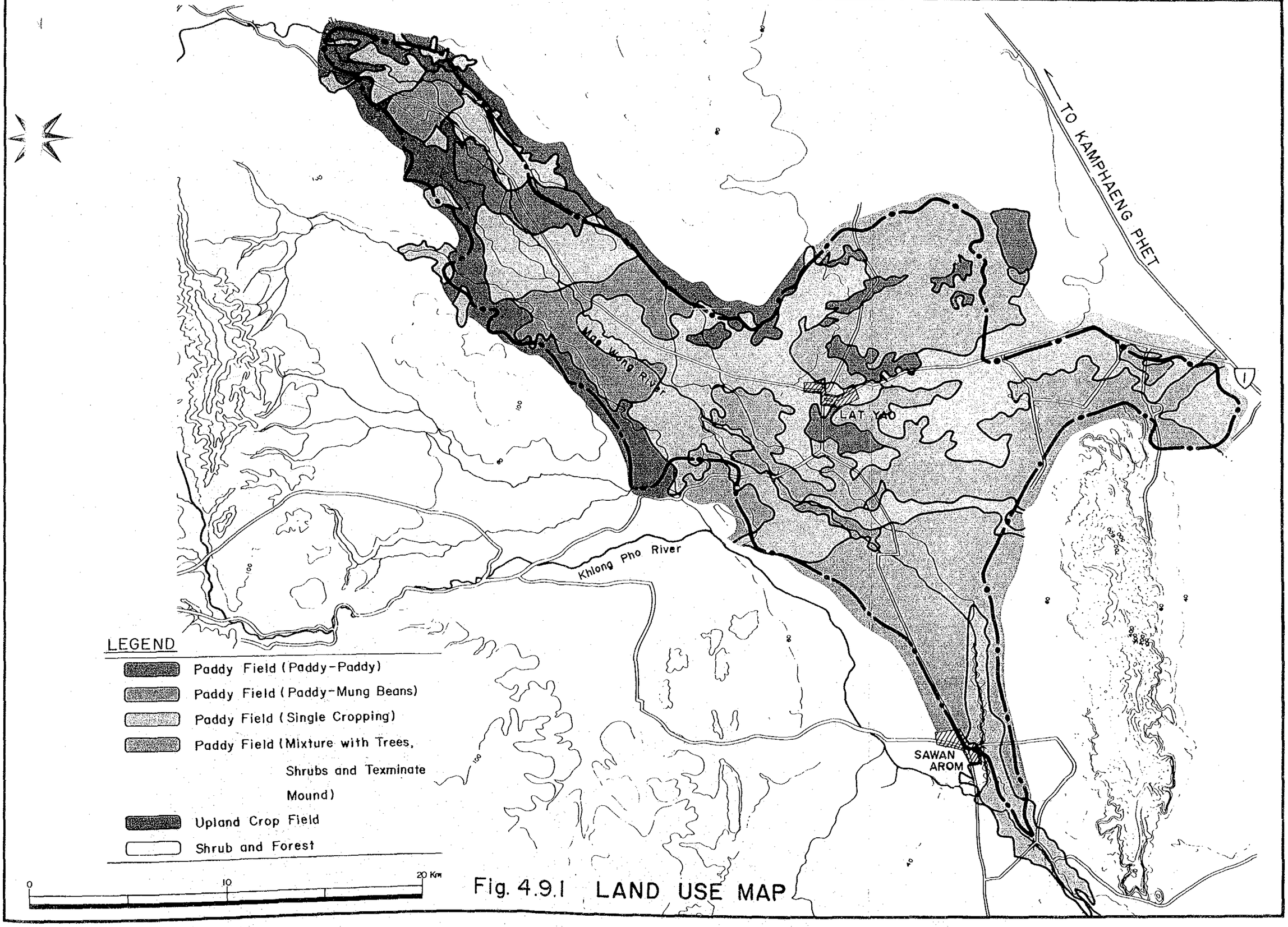


Fig. 4.9.1 LAND USE MAP

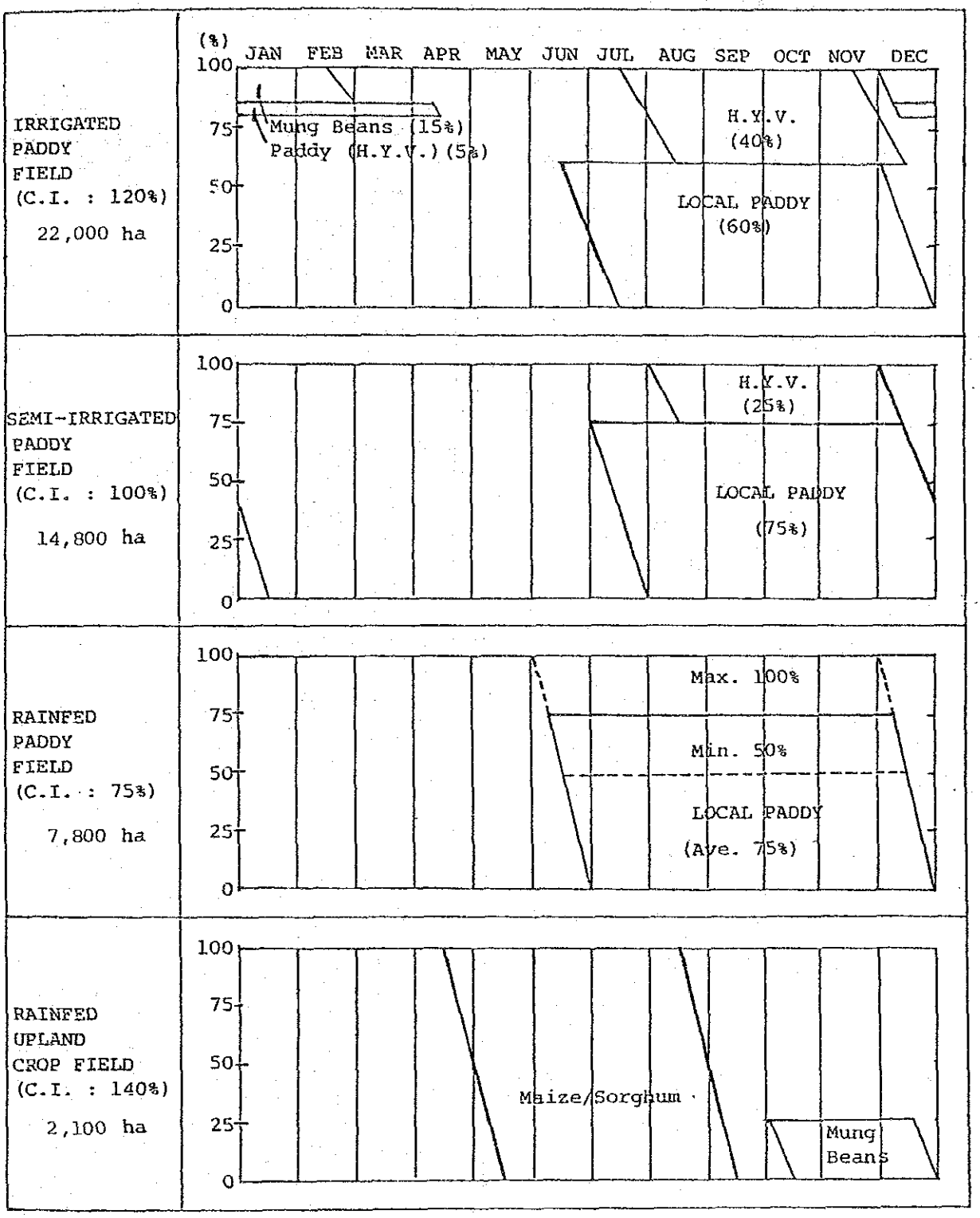


Fig. 4.9.2 Present Cropping Pattern

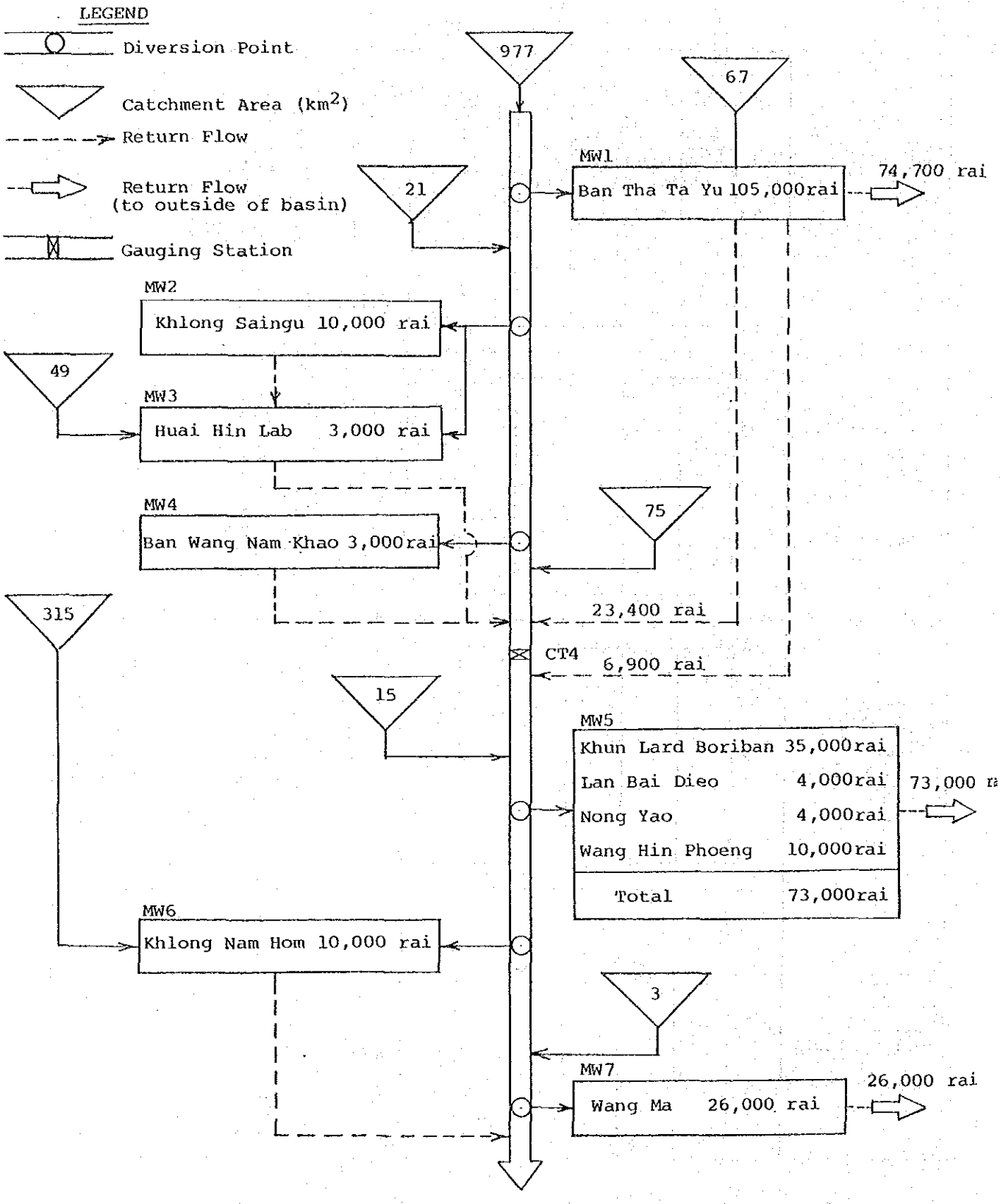


Fig. 5.2.1 Systematic Diagram of Mae Wong River Basin for Water Balance Study Under Present Condition

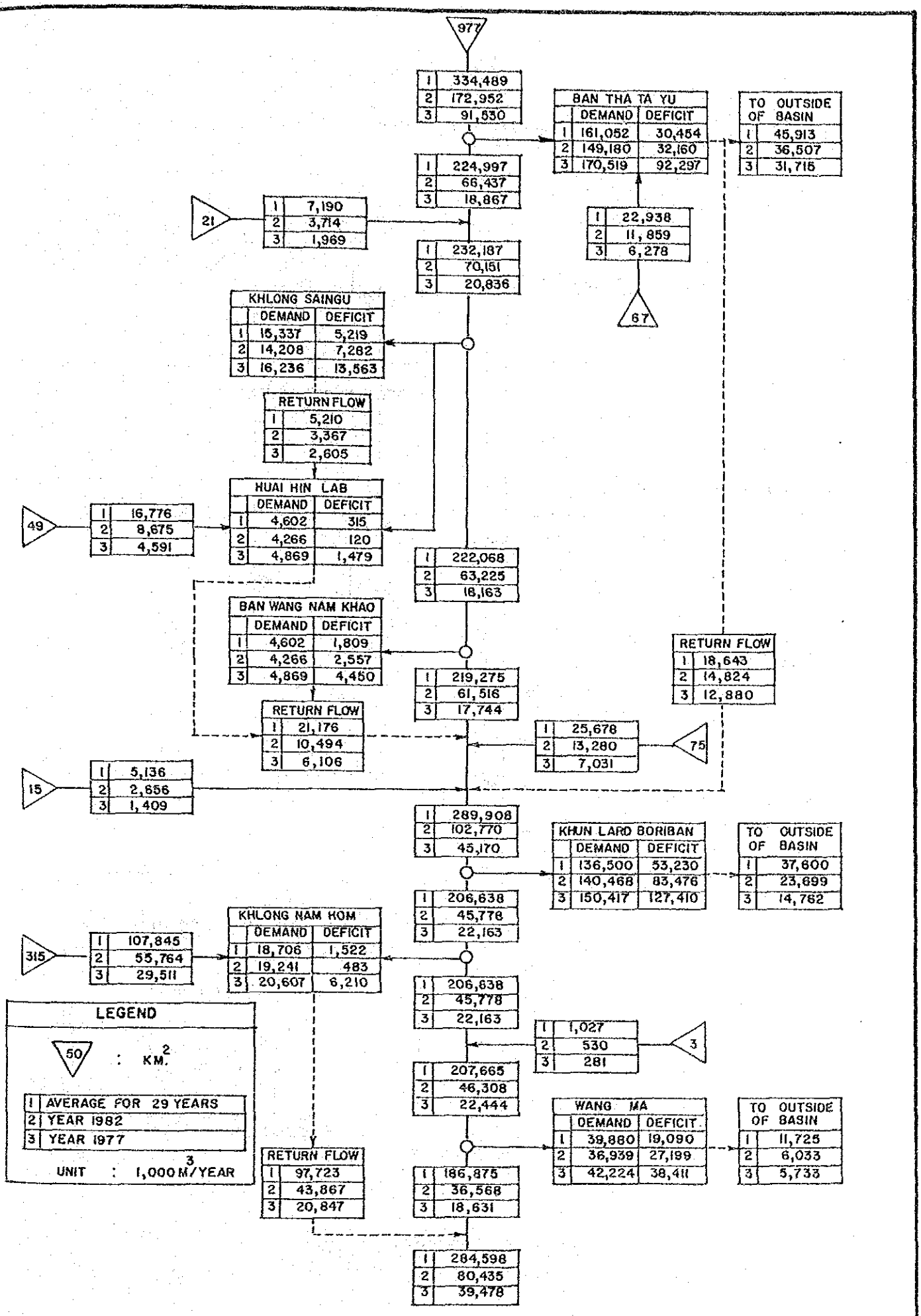


Fig. 5.2.2 Present Water Use in Mae Wong River Basin

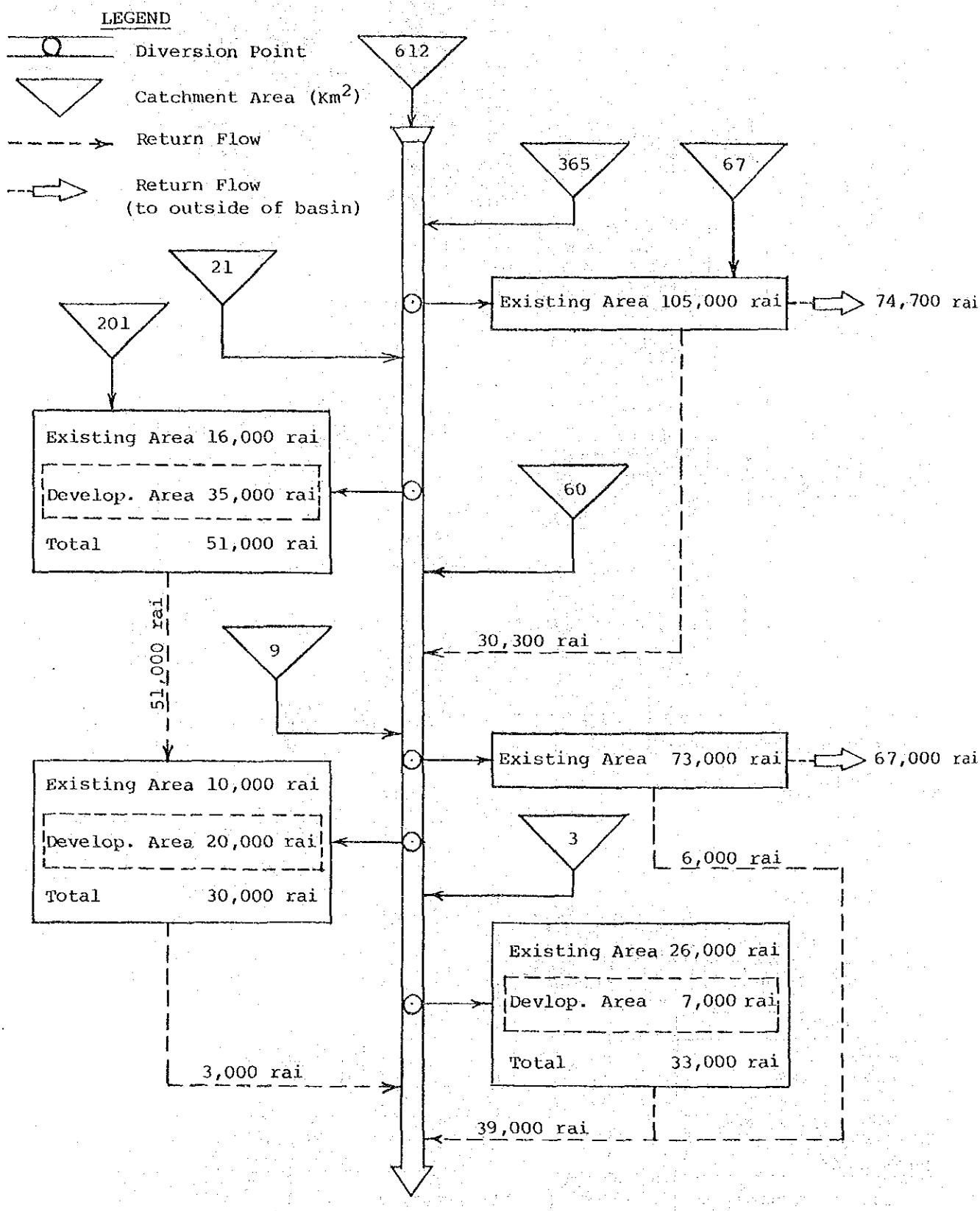


Fig. 5.2.3 Systematic Diagram of Mae Wong River Basin for Water Balance Study Under With-Project Condition

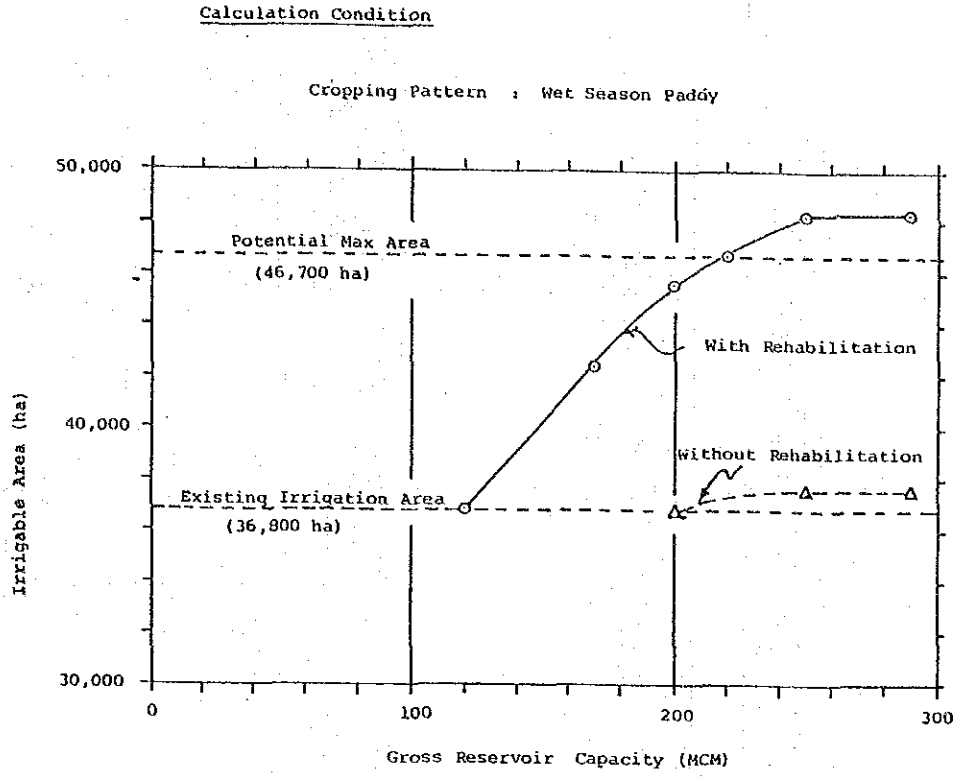
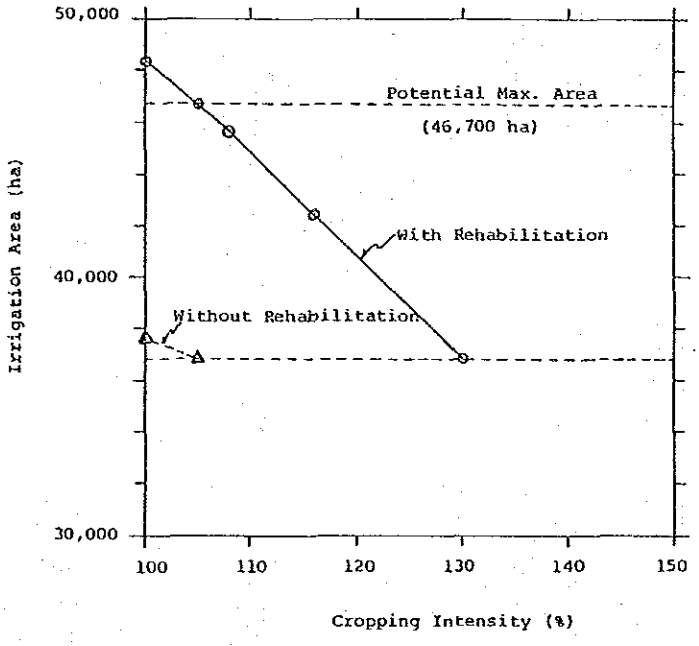


Fig. 5.2.4 Relationship between Gross Reservoir Capacity and Irrigable Area



Calculation Condition

Gross Reservoir Capacity : 250 MCM

Cropping Pattern : Paddy + Mung Bean

Fig. 5.2.5 Relationship between Irrigable Area and Cropping Intensity

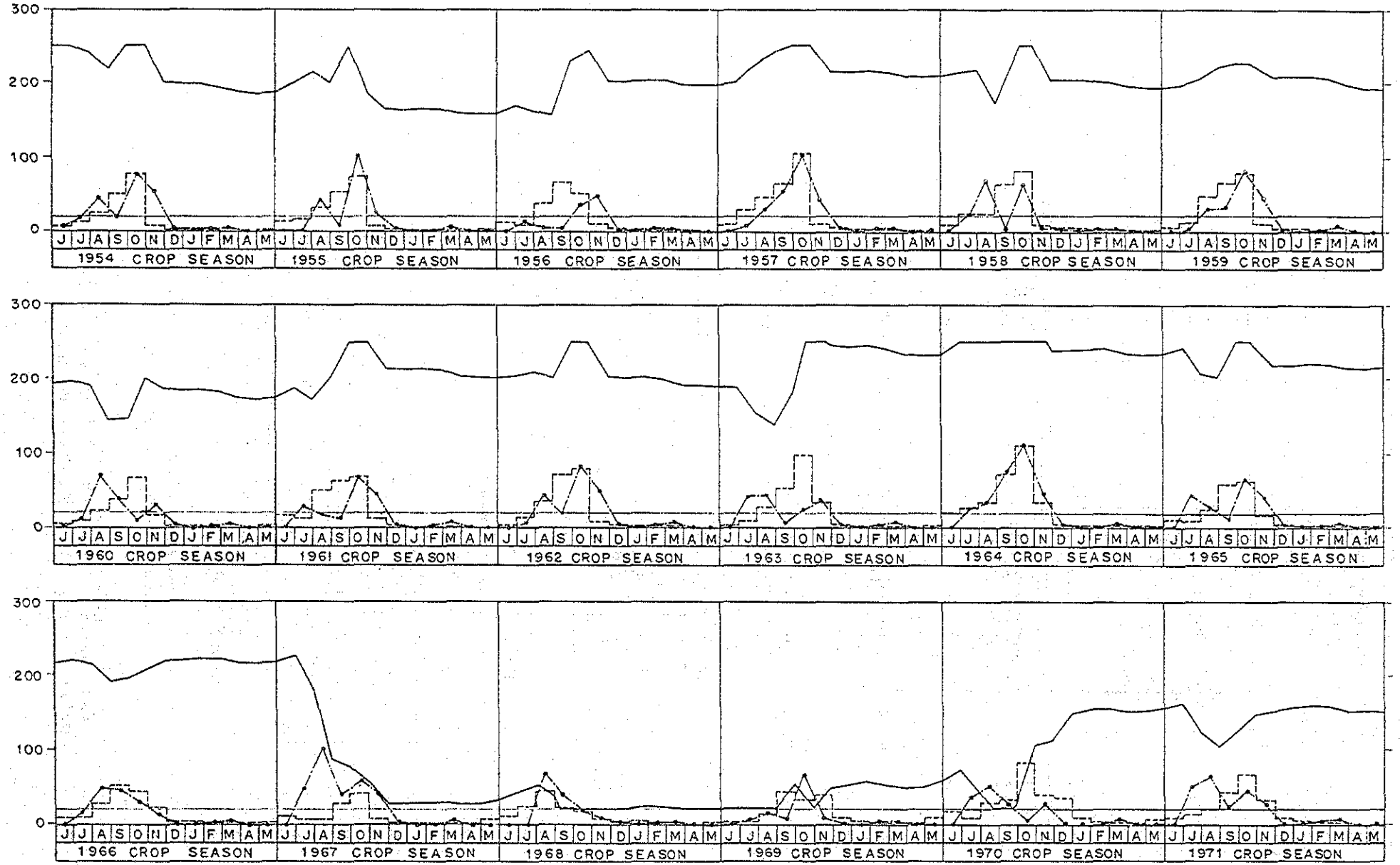


Fig. 5.2.6 Storage Change of Upper Upper Mae Wong Reservoir (1/2)

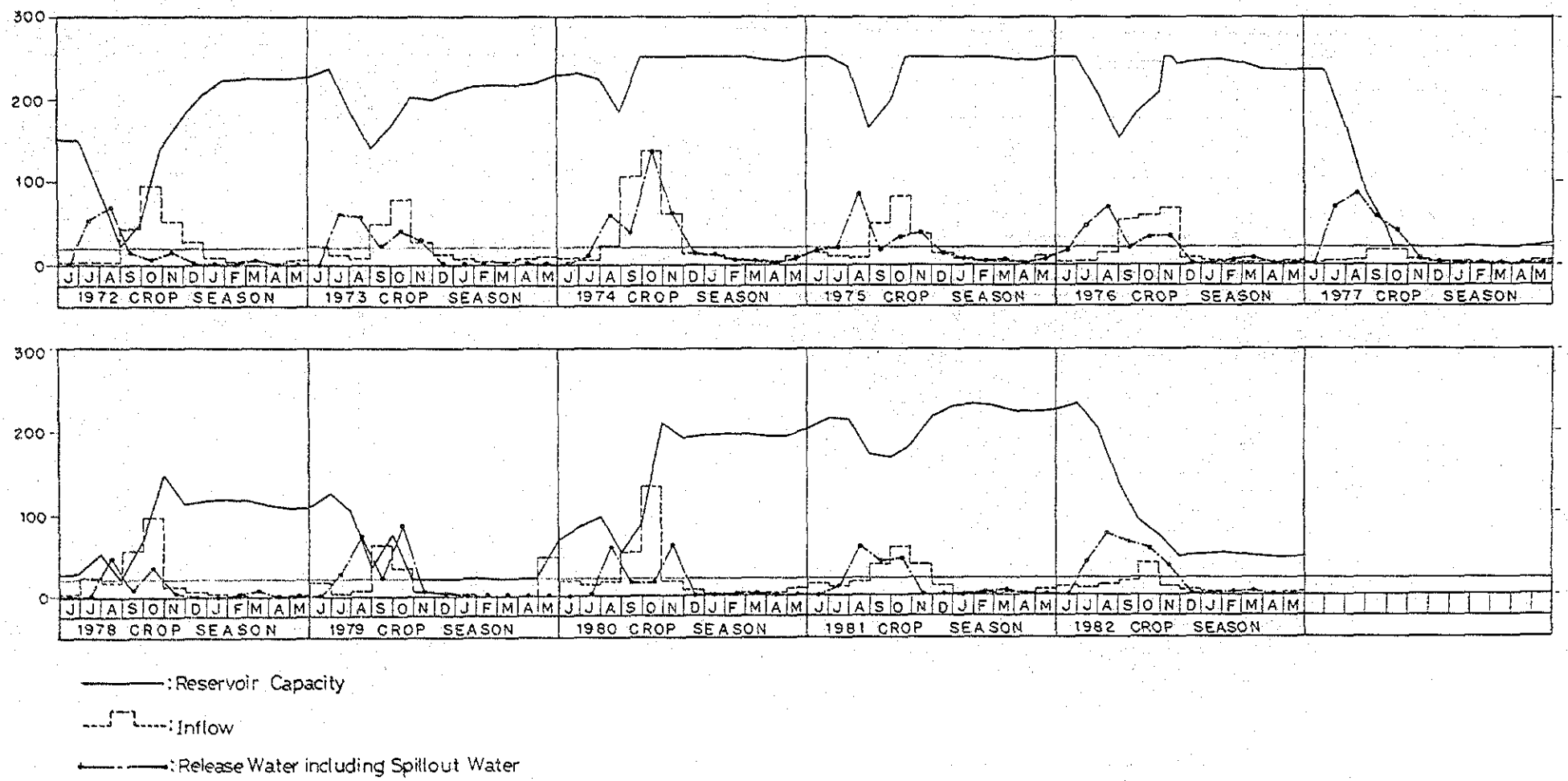
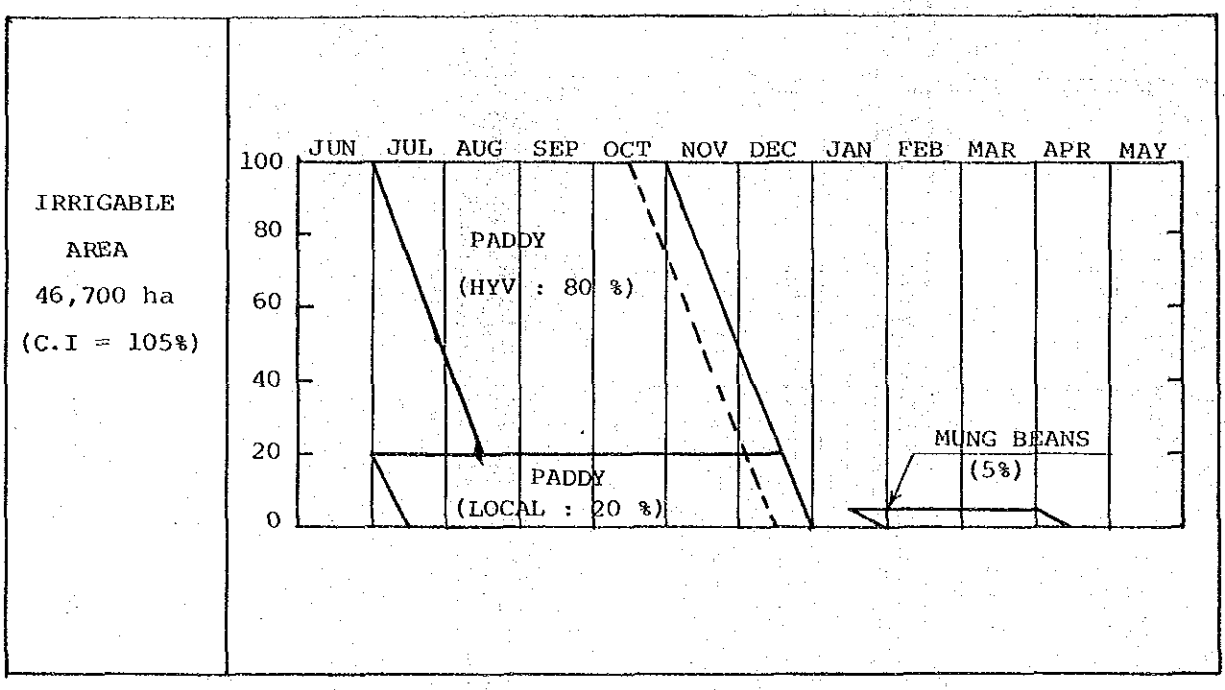


Fig. 5.2.6 Storage Change of Upper Mae Wong Reservoir (2/2)



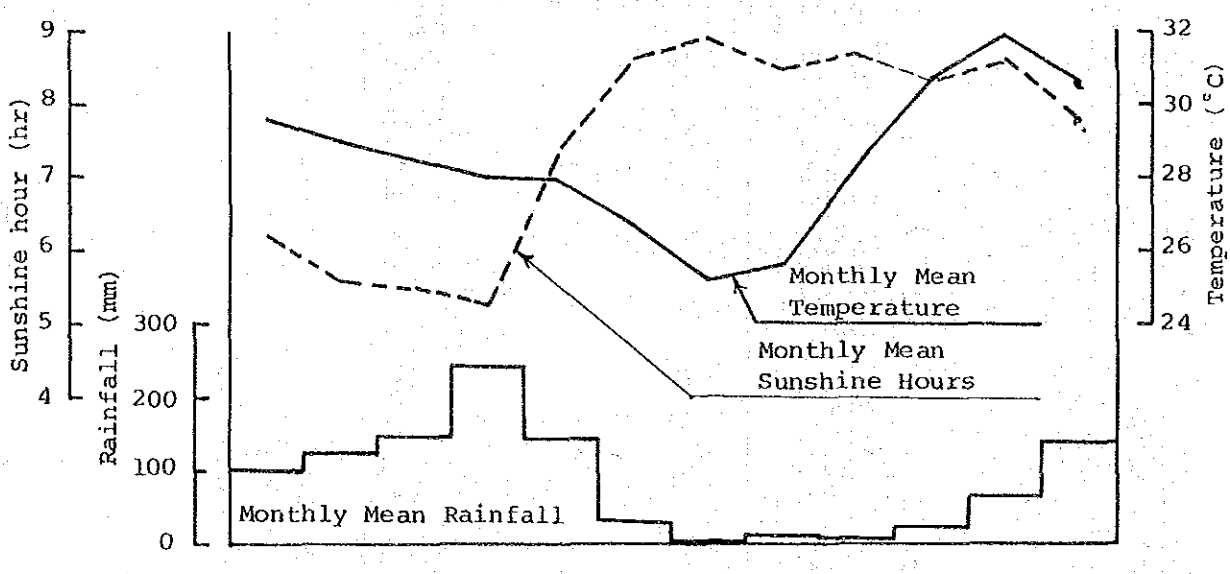


Fig. 5.3.1 Proposed Cropping Pattern

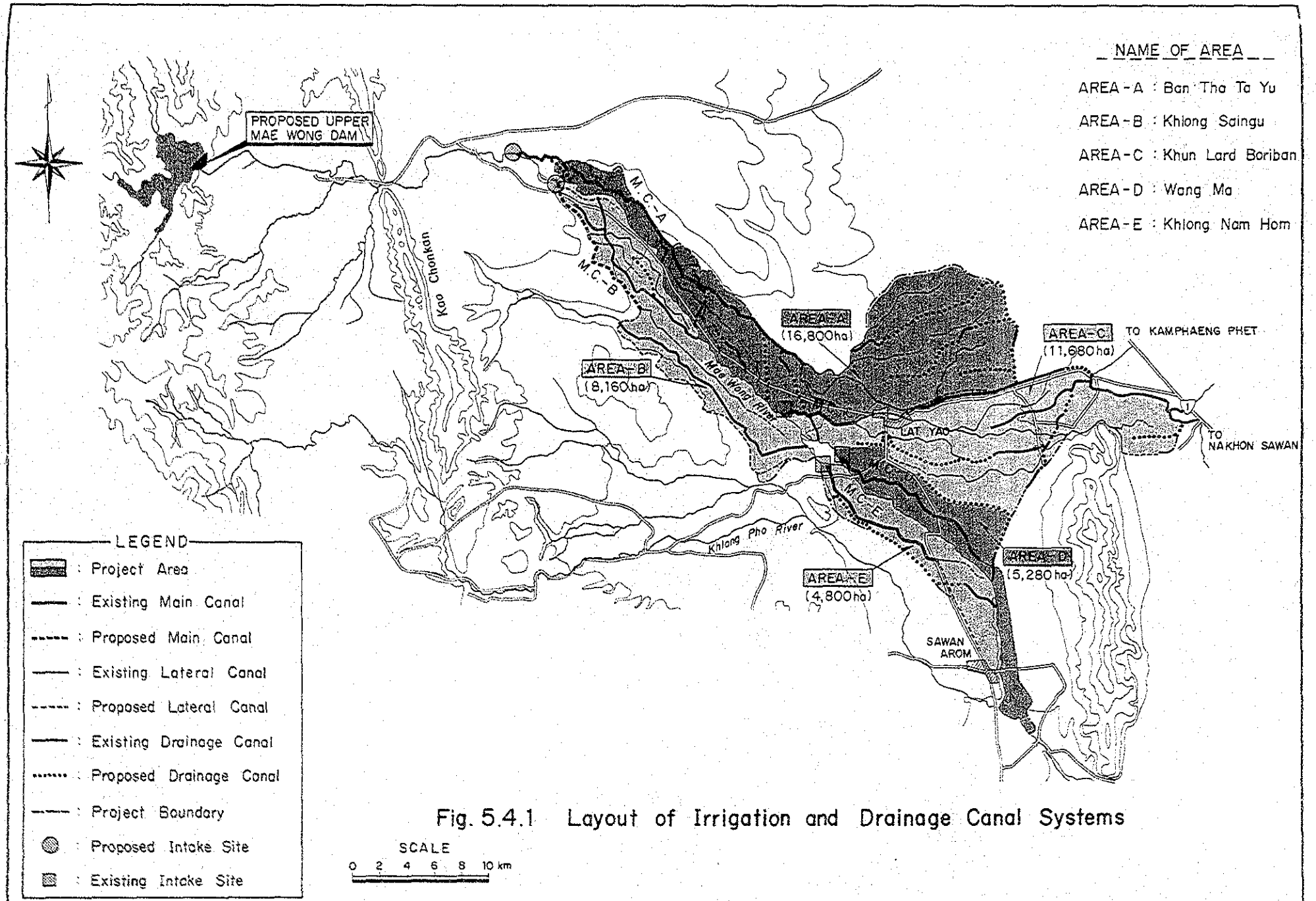


Fig. 5.4.1 Layout of Irrigation and Drainage Canal Systems

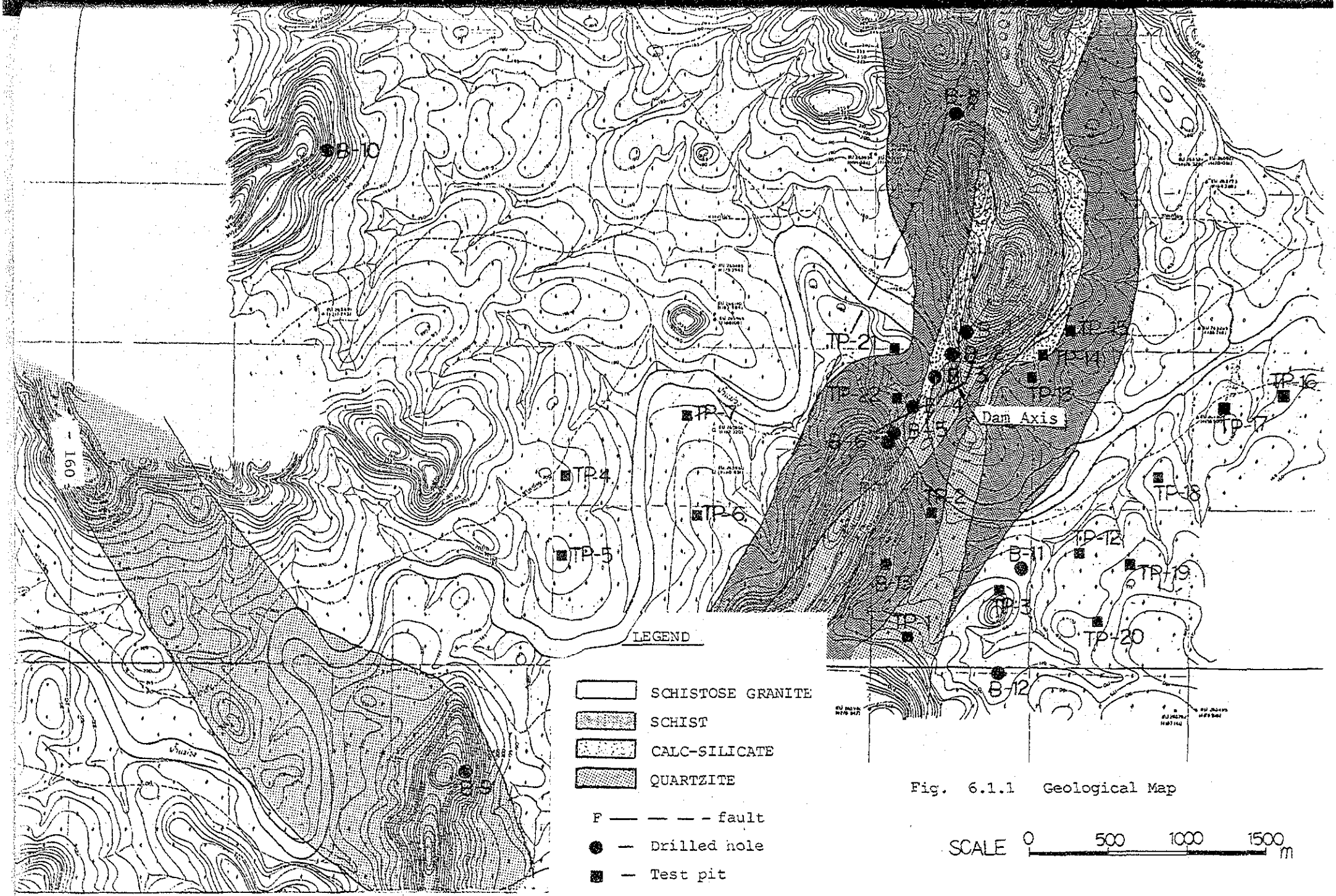


Fig. 6.1.1 Geological Map

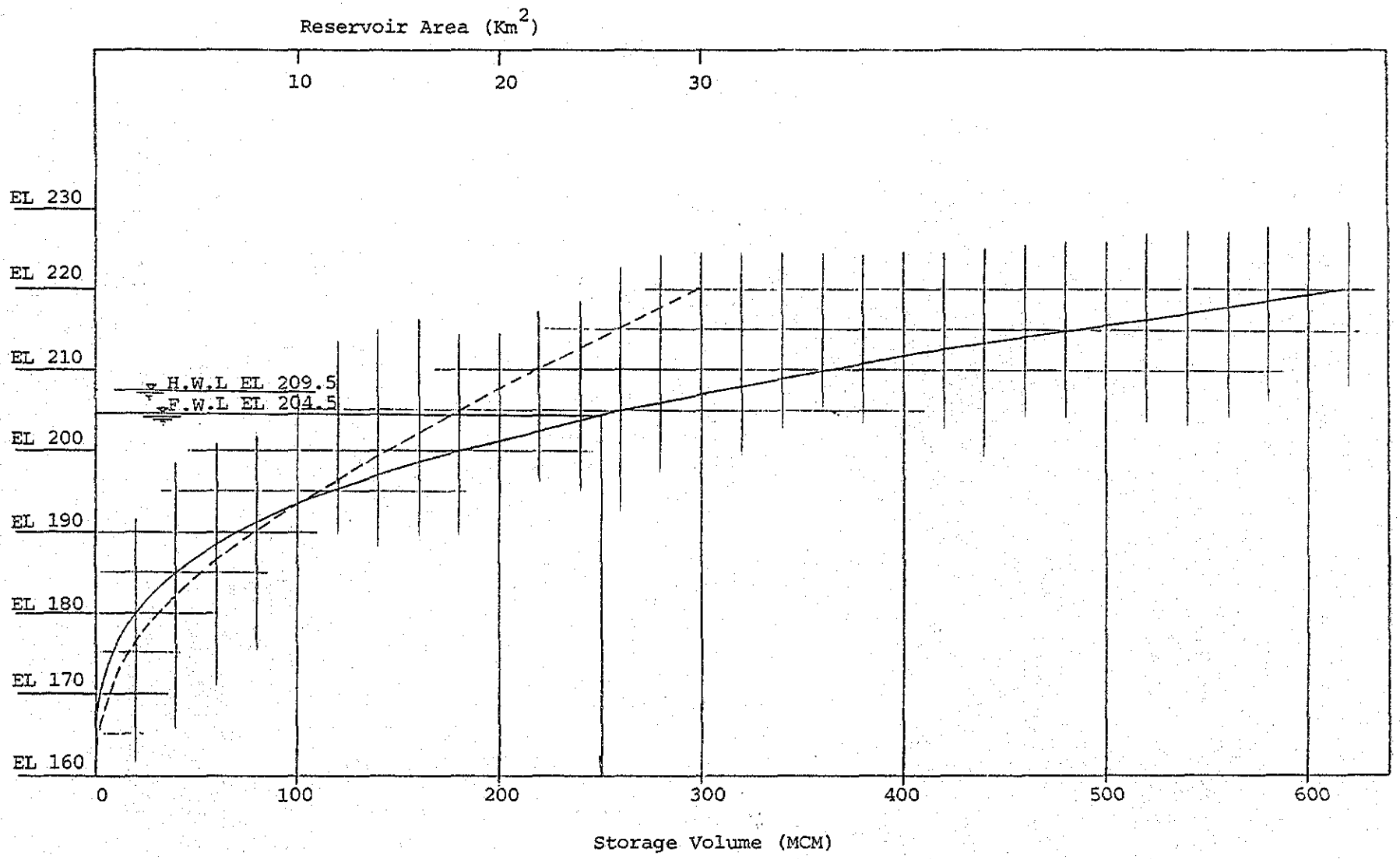


Fig. 6.1.2 Area-Capacity Curve

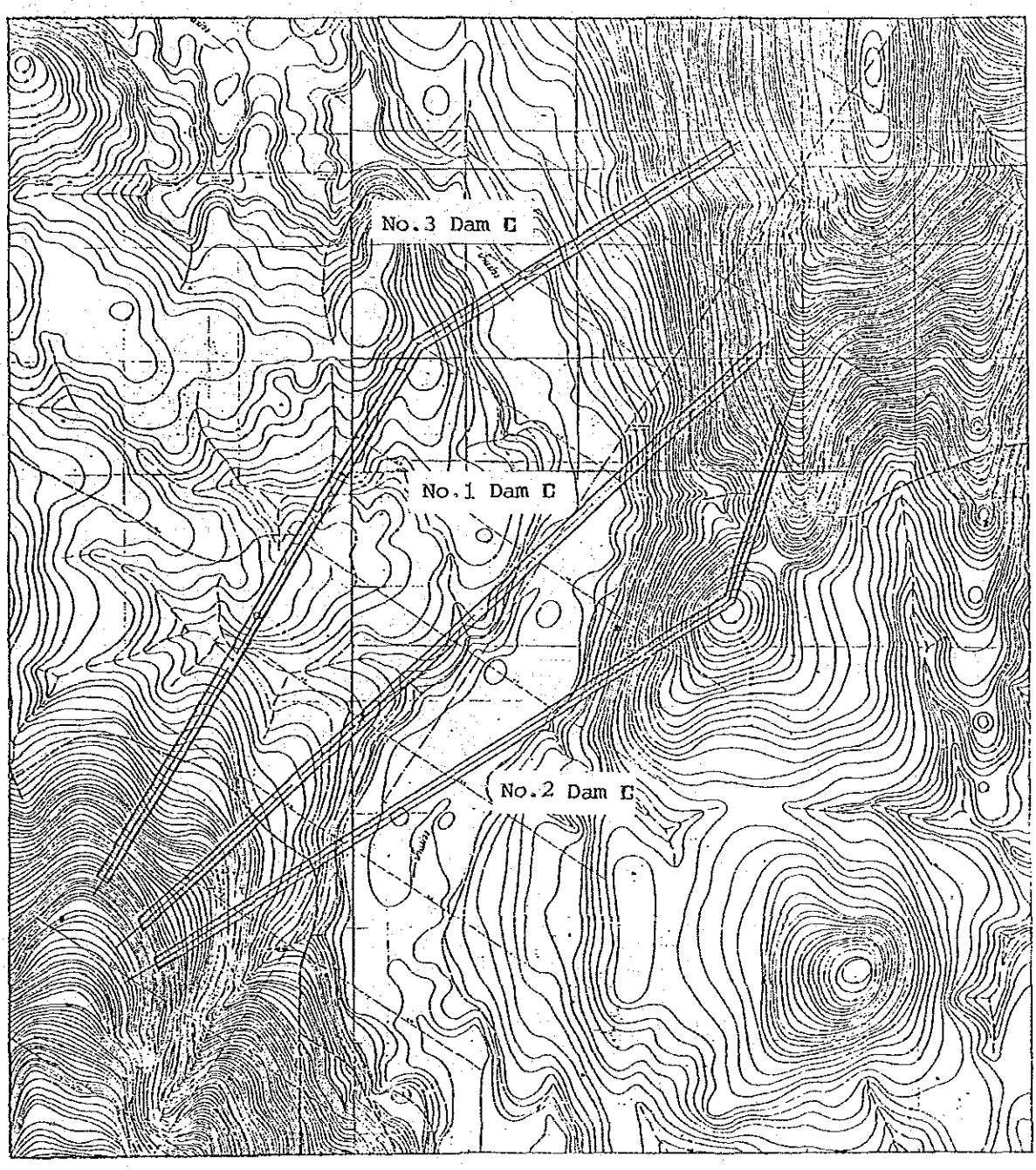


Fig. 6.1.3 Alternative Dam Axes

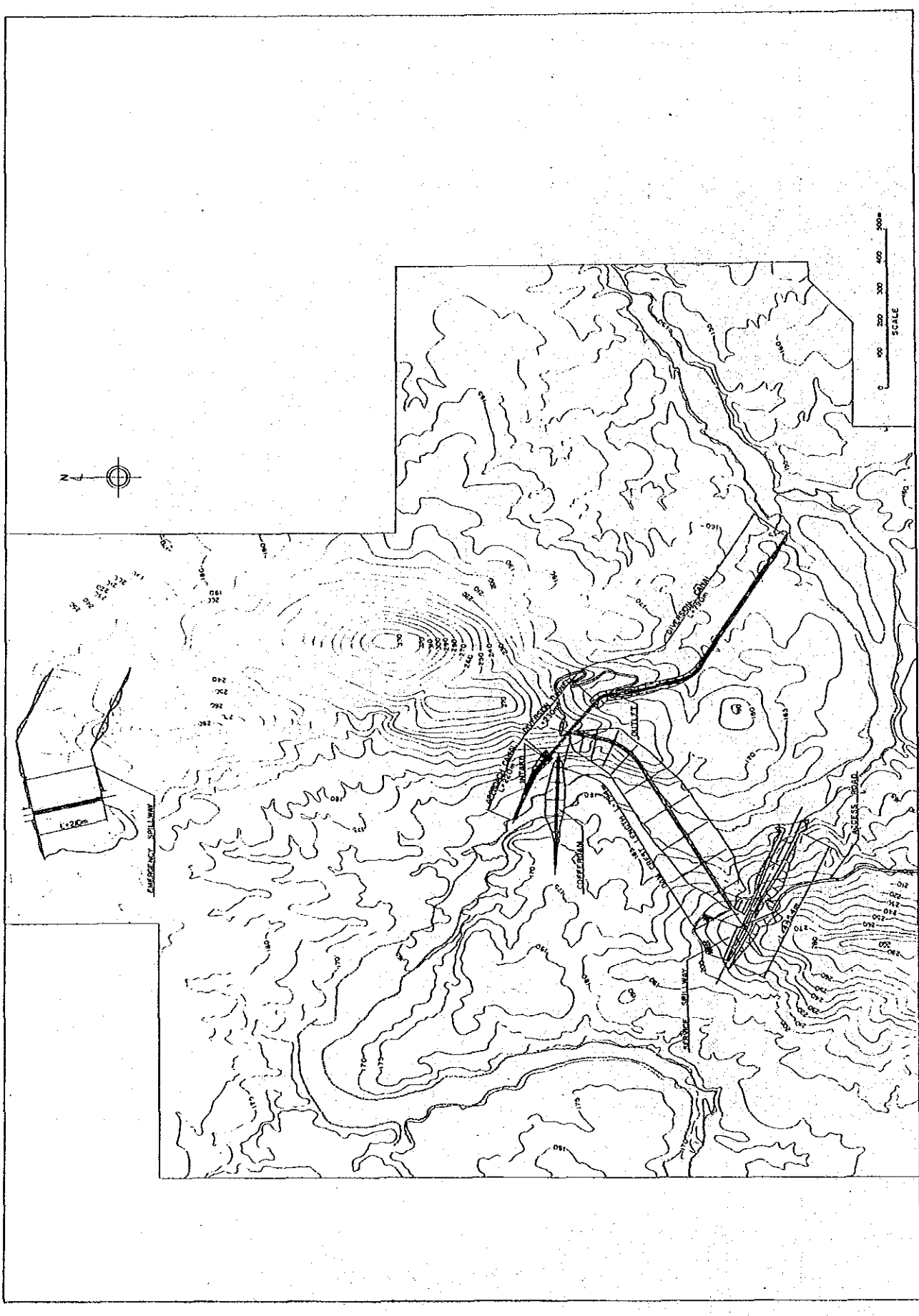


Fig. 6.1.4 Site Map

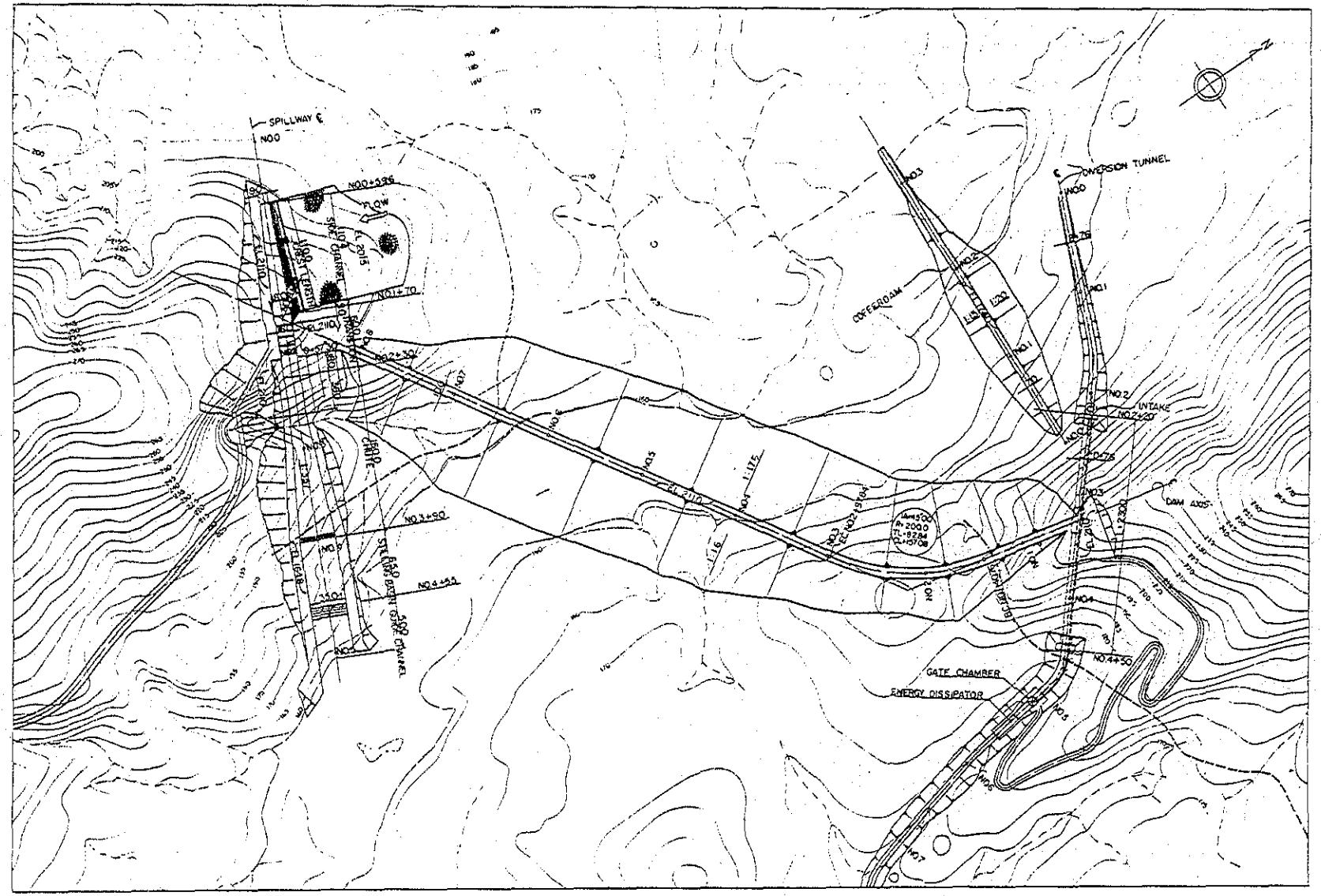


Fig. 6.1.5 General Plan

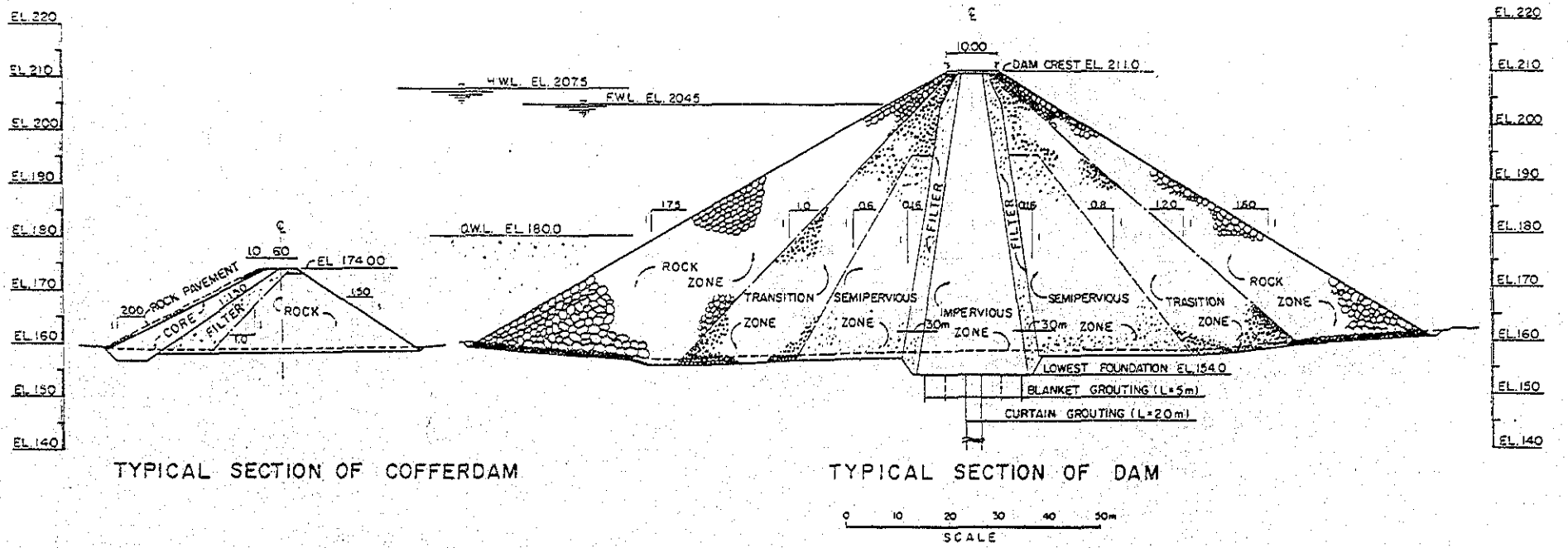


Fig. 6.1.6 Cross Section of Dam

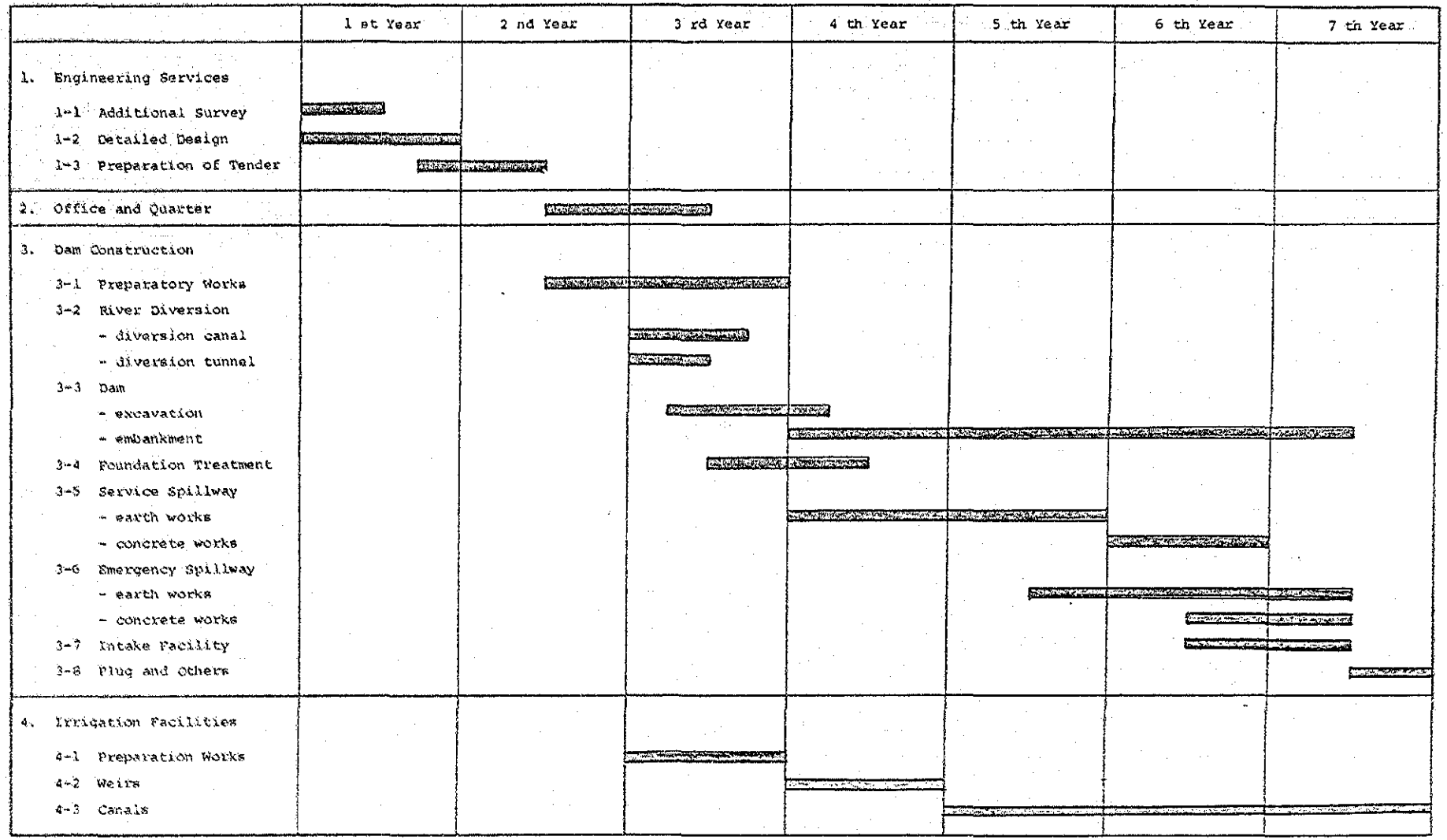


Fig. 6.3.1 Implementation Schedule of Mae Wong Irrigation Scheme

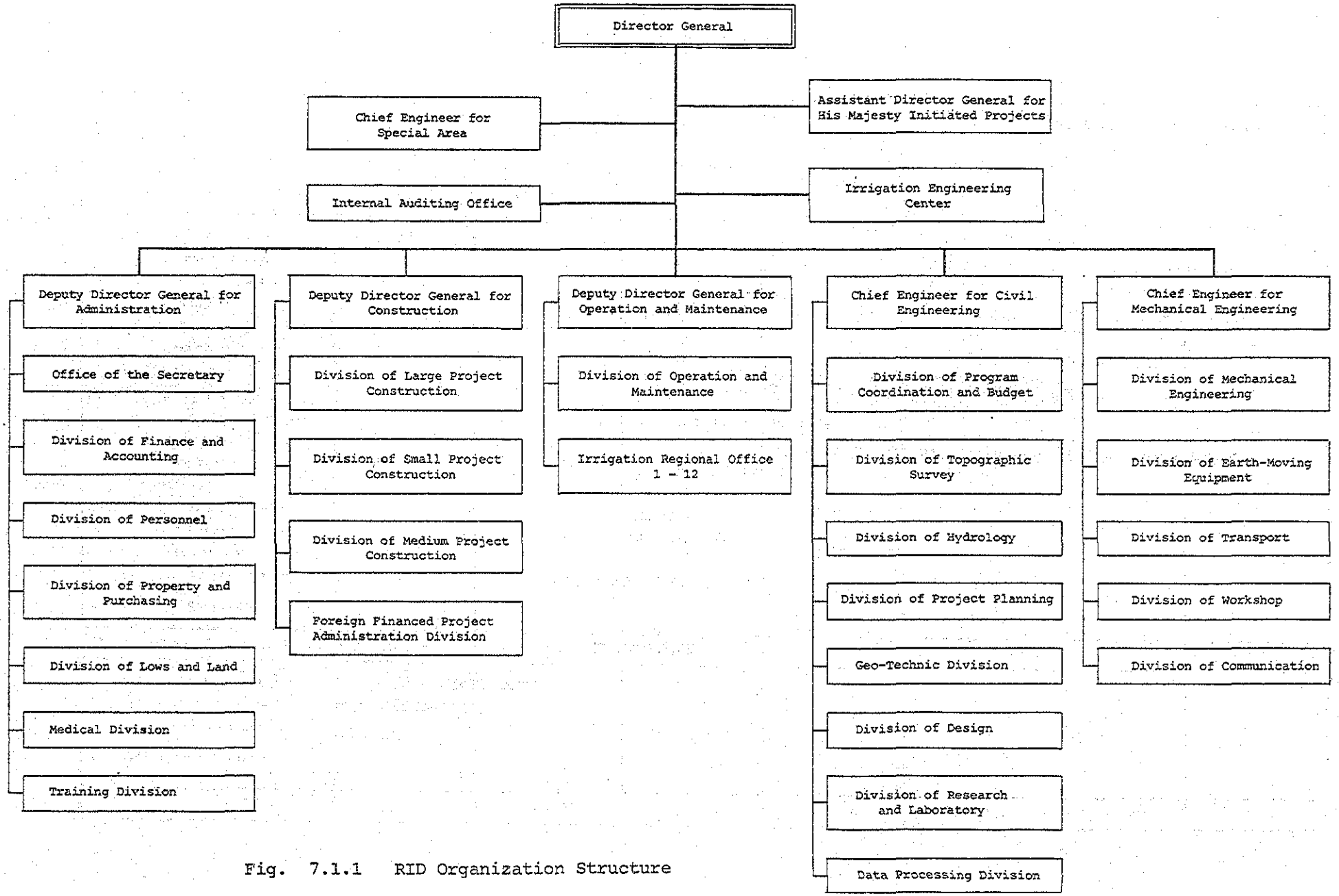


Fig. 7.1.1 RID Organization Structure

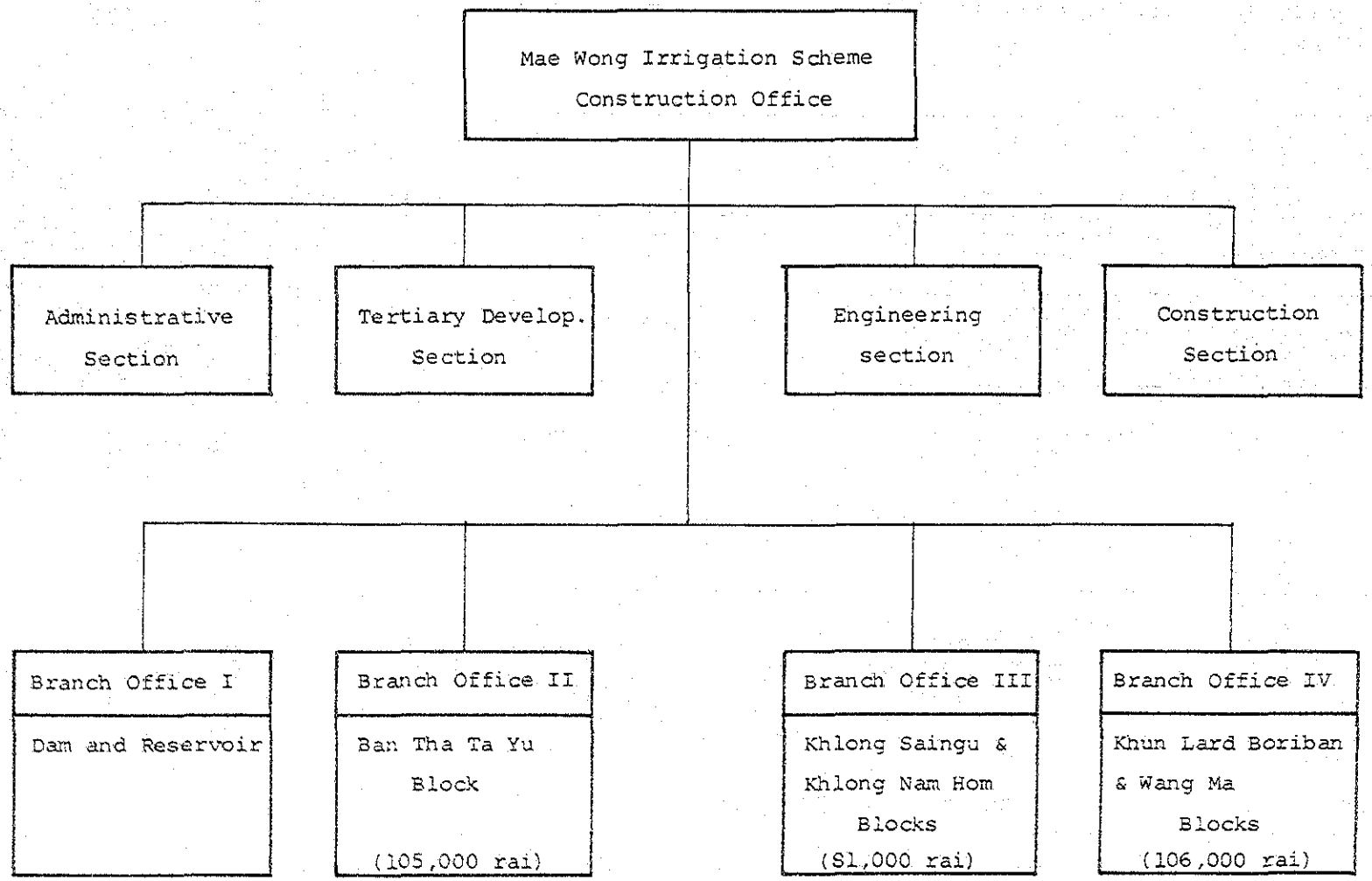


Fig. 7.1.2 Organization of Mae Wong Irrigation Scheme Construction Office

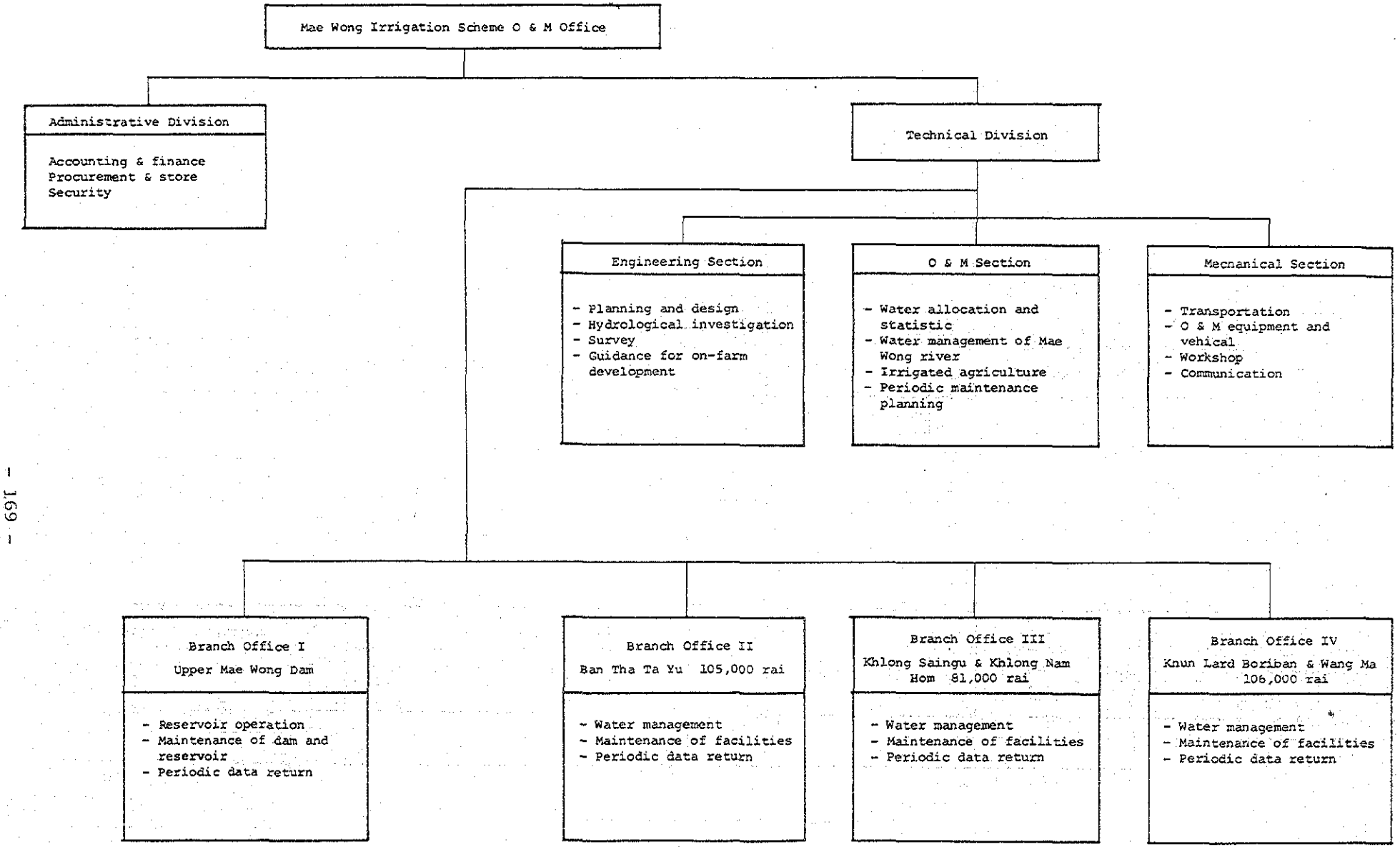


Fig. 7.2.1 Organization of Operation and Maintenance Office for Mae Wong Irrigation Scheme

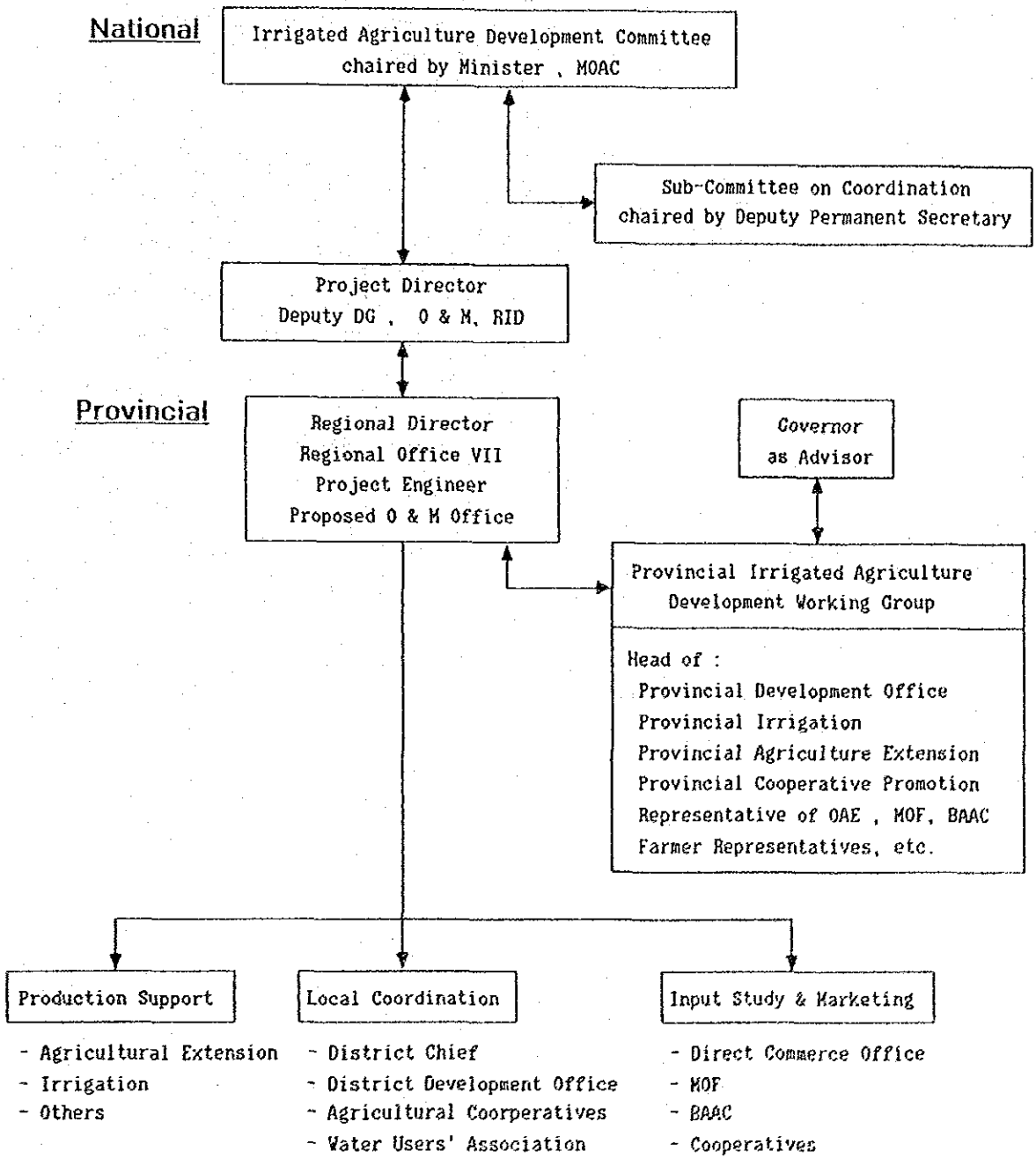


Fig. 7.2.2 Relationship of Organizations for the Project

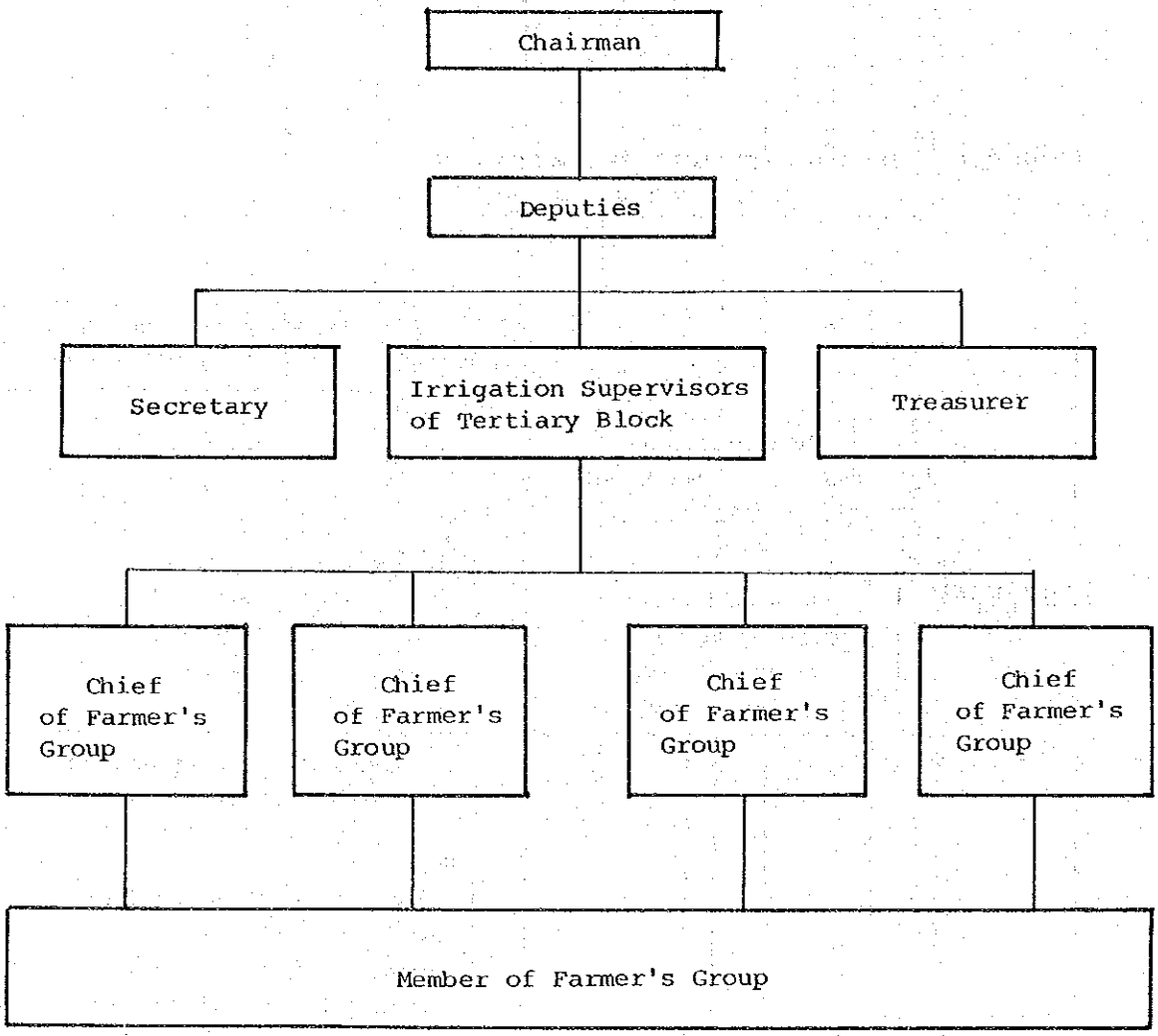


Fig. 7.2.3 Organization of Water User's Association

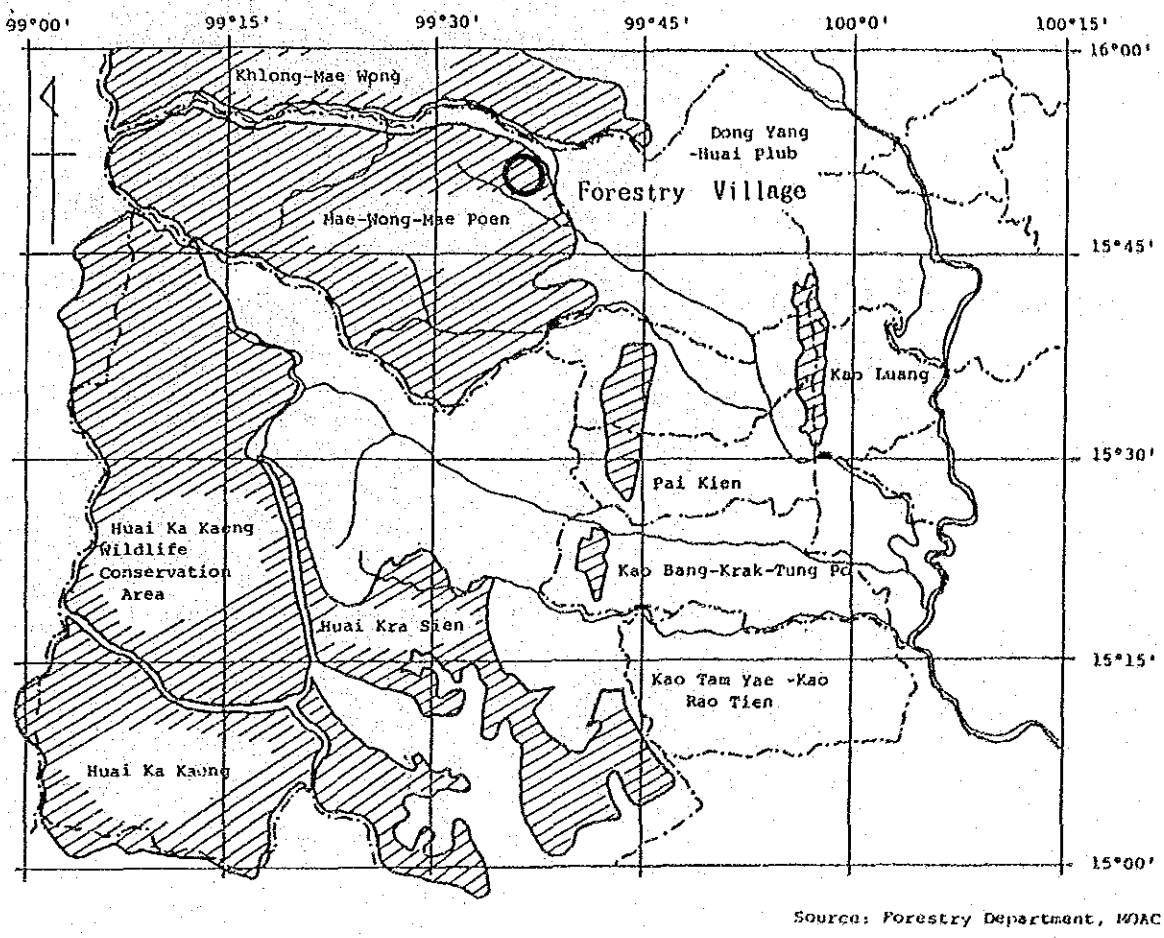


Fig. 9.2.1 Forest Reserve Area and Location of Forestry Village

ATTACHMENT

SCOPE OF WORK

FOR

FEASIBILITY STUDY

ON

THE SAKAE KRANG RIVER BASIN IRRIGATION PROJECT

IN

THE KINGDOM OF THAILAND

AGREED UPON BETWEEN

ROYAL IRRIGATION DEPARTMENT

AND

THE JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK, July 6 , 1984

Chari Tulayanond.

MR. CHARI TULAYANOND
CHIEF CIVIL ENGINEER
ROYAL IRRIGATION DEPARTMENT
MINISTRY OF AGRICULTURE
AND COOPERATIVES

H. Nakamichi

DR. HIROSHI NAKAMICHI
LEADER OF THE PRELIMINARY
SURVEY TEAM,
THE JAPAN INTERNATIONAL
COOPERATION AGENCY

I. INTRODUCTION

In response to the request of the Government of the Kingdom of Thailand (hereinafter referred to as "the Government"), the Government of Japan decided to implement the feasibility study on the Sakae Krang River Basin Irrigation Project (hereinafter referred to as "the Study"), within the general framework of technical cooperation between Japan and Thailand, which is set forth in the Agreement on Technical Cooperation between the Government of Japan and the Government of the Kingdom of Thailand signed on 5 November 1981.

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of technical cooperation programs of the Government of Japan, will undertake the Study, in accordance with the relevant laws and regulations in force in Japan and in close cooperation with the authorities of Thailand.

Royal Irrigation Department (hereinafter referred to as "RID") shall act as counterpart agency to the Japanese study team and also as coordinating body to other relevant organizations for the smooth implementation of the Study.

The present document sets forth the Scope of Work for the Study.

II. OBJECTIVES OF THE STUDY

The objectives of the Study are:

1. to review the overall Sakae Krang river basin water resources development plan.
2. to identify the possible projects and recommend the stage of development.
3. to conduct the pre-feasibility study on the potential project(s).
4. to conduct the feasibility study on the first priority project, and
5. to undertake on-the-job training of the government's officials in the course of the Study.

III. OUTLINE OF THE STUDY

1. Study Area

   The study area covers the Sakae Krang river basin with a gross area of 7,000 km^2, which is composed of four sub-basins; the Mae Wong, the Klong Pho, the Thap Salao and the Khok Khwai.

2. Scope of the Study

   The activities to be undertaken by the Team will be divided into two stages as follows:

(1) Pre-Feasibility Study; to conduct the overall river basin development study on the Sakae Krang river basin (Part-A) and the pre-feasibility study on the project(s) to be selected in the Part-A study (Part-B).

(2) Feasibility Study; to conduct the feasibility study on the project to be selected in the pre-feasibility study (Part-C).

2.1 Work Plan for the Pre-Feasibility Study

The study will cover the following items:

Part-A

(1) To review all existing and proposed irrigation projects in the basin.

(2) To evaluate the agricultural land and water resources (surface water and groundwater) and identify the possible reservoirs and other water uses.

(3) To study the basic concept for the plan of agricultural development and formulate possible irrigation projects.

(4) To identify the possible project and recommend the implementation schedule of basin development, and select the project(s) to be studied at pre-feasibility level.

(5) To study the environmental impact and recommend water and/or soil conservation

(6) To determine the hydropower development potential in the basin. Detail study should be carried out by others.

Part-B

(1) To collect and review the relevant existing data and information including;

a. Topography
b. Meteorology
c. Hydrology
d. Geology and Hydrogeology
e. Soil
f. Irrigation and Drainage
g. Agriculture
h. Agro and regional economy and institution
i. Flood control
j. Others

(2) To survey in the project area including;

a. Topographical survey

b. Meteorological survey

c. Hydrological survey

d. Agricultural survey

e. Socio-economic survey

f. Regional economic and agro-institutional survey

g. Flood control survey

h. Construction material and cost survey

i. Other survey including resettlement

(3) To formulate the development plan and estimate all project requirements at the pre-feasibility level.

(4) To identify the project priority taking into account of the technical and economic feasibility as well as the social elements involved in each projects and select the project to be studied at the feasibility study level.

(5) To recommend and suggest the further study or measures to be undertaken based on the results obtained from the pre-feasibility study.

2.2 Work Plan for the Feasibility Study

Part-C

Based on the results of the pre-feasibility study, the study will cover the following items:

(1) Additional field survey and data collection including;

a. Soil and land classification survey

b. Geological survey

c. Groundwater survey

d. Others

(2) Determination of the basic items for the project planning in the field works including;

a. Project area

b. Land use and cropping pattern

c. Water requirements

d. Dam planning and design in view of irrigation, flood control, hydro-power development potential and other potential water uses

e. Irrigation and drainage canal networks and facilities

f. Estimation of yields

g. Agro-institutional plan

h. Social-institutional services

i. Others

(3) Formulation of the integrated development plan for the project

(4) Preliminary design of the major structure of the project

(5) Preparation of the implementation schedule

(6) Estimation of the project costs and benefits

(7) Evaluation of the project

(8) Operation and maintenance

(9) Recommendation

IV. WORK SCHEDULE

The Study will be executed in accordance with the attached tentative working schedule.

V. REPORTS

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

1. Plan of Operation

Twenty (20) copies at the commencement of the pre-feasibility study and the feasibility study.

2. Progress Report

Twenty (20) copies at the end of the field works of the pre-feasibility study.

3. Pre-Feasibility Study Report

Fifty (50) copies at the end of the pre-feasibility study.

4. Interim Report

Fifty (50) copies at the end of the field works of the feasibility study.

5. Draft Final Feasibility Study Report

Fifty (50) copies within one (1) month after the end of the feasibility study.

The Government is requested to provide its comments on the Draft Final Report to JICA through JICA office in Bangkok within one (1) month after the submission of the Draft Final Report.

6. Final Feasibility Study Report

Hundred (100) copies within two (2) months after receiving the comments of the Government on the Draft Final Report.

VI. UNDERTAKING OF THE GOVERNMENT OF THE KINGDOM OF THAILAND

1. In accordance with the Agreement on Technical Cooperation between the Government of Japan and the Government of the Kingdom of Thailand, the Government of the Kingdom of Thailand shall accord benefits to the Japanese study team and, through the authorities concerned, take necessary measures to facilitate the smooth implementation of the Study.

2. RID shall make necessary arrangements with the cooperation of other relevant organizations for the followings:

   (1) to secure the safety of the Study team,

   (2) to permit the members of the Japanese study team to enter, leave and sojourn in Thailand for the duration of their assignment therein, and exempt them from allen registration requirements and consular fees,

   (3) to exempt the members of the Japanese study team from income tax and other fiscal charge imposed on or in connection with any emolument or allowance paid to the members of the Japanese study team for their services in connection with the implementation of the Study.

   (4) to facilitate medical services as needed, its expenses will be chargeable on the member of the Japanese study team,

   (5) to secure permission within its authority to take available data and documents related to the Study out of Thailand to Japan by the Study team.

3. RID shall, at its own expense, provide the Japanese study team with the followings, in cooperation with other relevant organizations:

   (1) available data and information related to the Study,

(2) topographical survey, for the first priority project (by the beginning of the feasibility study),

a. topographical maps

- dam sites ; scale of 1/1,000
- reservoir areas ; scale of 1/4,000
- irrigation areas; scale of 1/10,000
- resettlement areas; scale of 1/4,000

b. cross and vertical sectional survey

c. topographical maps of borrow areas for embankment material

(3) geological and soil mechanical survey, for the first priority project (by the beginning of the feasibility study),

a. geological and soil mechanical survey

b. sampling and laboratory investigation of the embankment material

(4) land acquisition and compensation,

a. survey of affected households, lands and public facilities in the proposed reservoir area

(5) additional surveys related to the feasibility study if necessary,

(6) counterpart personnel as follows,

a. General Planning Engineer

b. Irrigation and Drainage Engineer

c. Geologist and Hydrogeologist

d. Hydrologist

e. Soil Mechanical Engineer

f. Soil Scientist

g. Agronomist

h. Agro-economist

i. Agro-institutional Specialist

j. Dam Engineer

k. Construction Planning & Cost Engineer

l. Environmental Specialist

m. Survey Engineer

The number of counterpart personnel and their respective assignment should be decided by RID in consultation with the study team,

(7) suitable office space with necessary equipment in Bangkok and project site,

(8) appropriate number of vehicles with driver in the project area,

(9) credentials or identification cards.

4. The Government of Kingdom of Thailand shall bear claims, if any arises against the members of the Japanese study team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Japanese study team.

VII. UNDERTAKING OF THE GOVERNMENT OF JAPAN

For the implementation of the Study, the Government of Japan shall, in accordance with the relevant laws and regulations in force in Japan, take the following measures through JICA:

1. to dispatch, at its own expense, study teams to Thailand,

2. to perform technology transfer to the Thai counterpart personnel in the course of the Study.

VIII. JICA and RID will consult with each other in respect of any matter that is not agreed upon in this document and may arise from or in connection with the study.

RID OFFICIALS CONCERNED, LOCAL GOVERNMENT OFFICIALS CONCERNED
MEMBERS OF SUPERVISORY COMMITTEE AND STUDY TEAM OF THE PROJECT

A. RID Officials Concerned

(1)	Mr. Suthep Tingsabhat	Chief Engineer of Civil Engineering
(2)	Dr. Boonyok Wadhanaphuti	Director, Project Planning Division
(3)	Mr. Shoombhol Chaveesuk	Director of Design Division
(4)	Mr. Arom Khumkomkul	Director of Program & Budget Division
(5)	Mr. Nukool Thongthawee	Director of O & M Division
(6)	Mr. Suthi Songvoravit	Chief of Policy Branch, Project Planning Division
(7)	Mr. Jongrak Isarangkura	Chief of Project Planning Sub-Division 2
(8)	Mr. Chanchai Klinhom	Chief of Project Planning Sub-Division 3
(9)	Mr. Thriphan Makjaroon	Chief of Environmental, Project Planning Division
(10)	Mr. Ruongrit Ammawat	Design Division
(11)	Mrs. Nophakhun Somsin	Hydrology Division
(12)	Mr. Taweechai Mackaman	Hydrology Division
(13)	Mr. Klaus Lindner	Advisor, Project Planning Division
(14)	Mr. Kaiwan Devahasdin	Program Co-ordination & Budget Division
(15)	Mr. Virat Khao-Uppatum	O & M Division
(16)	Mr. Osot Charnvej	Agronomist, O & M Division
(17)	Mr. Vira Poomvises	Geo-technic Division
(18)	Mr. Maitri Poolsup	Civil Engineer, Design Division
(19)	Mr. Jumsak Tejasen	Director, Research & Laboratory Division
(20)	Mr. Prasert Milintangul	Chief of Research & Applied Division
(21)	Mr. Saguan Jamprawit	Chief of Soil and Geology Division
(22)	Mr. Silpachai Niyomsilpa	Director of Topographical Division
(23)	Mr. Sompoch Pimonpun	Chief of Ground Survey Sub-Division
(24)	Mrs. Supha Sing Intara	Chief of Economic Branch, Project Planning Division
(25)	Mr. Supote Rujikakul	Engineer, Project Planning Division
(26)	Mr. Roungrit Ammawat	Chief of Engineer, Dam Design Sub-Division
(27)	Mr. Prasart Chuntrniyom	Director of Irrigation Region 7

(28)	Mr. Chalerpmorn Phirunsarn	Civil Engineer, Region 7
(29)	Mr. Seni Wichitsiri	Civil Engineer, Region 7
(30)	Mr. Preecha Chotesangasa	Topographical Survey
(31)	Dr. Suphon Chirapuntu	Geo-technical Division
(32)	Mr. Awphai Muthitacharoen	Chief, Geological Survey Branch Geotechnical Division
(33)	Mr. Donai Traitan	Chief of Land Classification Branch Geo-technical Division
(34)	Mr. Dacha Luangpitakchumpol	Geo-technical Division
(35)	Mr. Runroj Chumthong	Geo-technical Division
(36)	Mr. Somkiat Subhadhadapong	Geo-technical Division
(37)	Mr. Supannee Rojanapornsak	Geo-technical Division
(38)	Mr. Direk Tongaram	O & M Division
(39)	Mr. Prompong Leesirisern	Medium Scale Project Division
(40)	Dr. Vachi Ramnarong	Groundwater Division
(41)	Mr. Dhongchait	Economic Section, Project Planning Division
(42)	Dr. Siripong Hungspreug	Planning Division
(43)	Mr. Traibhun Nekjrson	Project Planning Division
(44)	Mr. Chaiyuth Suksri	Project Planning Division
(45)	Mr. Somsak Boonprajurb	Engineer, Project Planning Division
(46)	Mr. Suwit Thanopanuwat	Project Planning Division
(47)	Mr. Lertviroj Kowatthana	Engineer, Project Planning Division
(48)	Mr. Anan Phoonthawee	Engineer, Project Planning Division
(49)	Mr. Prateep Kanchanalarb	Engineer, Project Planning Division
(50)	Mr. Akkapong Boonmash	Civil Engineer, O & M Division
(51)	Mr. Toshiki Saito	Colombo Plan Expert, Project Planning Division
(52)	Mr. Katsuro Shioda	Colombo Plan Expert, O & M Division
(53)	Mr. Fumio Ikeda	Colombo Plan Expert, Design Division
(54)	Mr. Kazushige Matsuo	Colombo Plan Expert, Irrigation Center
(55)	Mr. Yoji Ebihara	Colombo Plan Expert, Irrigation Center

B. Local Government Officials Concerned

NAKHON SAWAN PROVINCE

(1)	Mr. Prakit Pinchareon	Governor
(2)	Mr. Yuthana Buanwong	Deputy Governor
(3)	Mr. Boonyun Supasansatorn	Officer of Lat Yao District
(4)	Mr. Watana Lertdhamtavi	Assistant Officer of Lat Yao District

UTHA THANI PROVINCE

(5)	Mr. Yong Pakdee	Governor
(6)	Mr. Sangad Chan-Chanchoy	Vice Governor
(7)	Mr. Precha Sirikawin	Deputy Governor

C. Supervisory Committee

(1)	Dr. H. Nakamichi	Leader	Agricultural Structure Improvement Bureau, Ministry of Agriculture, Forestry and Fisheries
(2)	Mr. M. Kameda	Irrigation/ Drainage	Agricultural Structure Improvement Bureau, Ministry of Agriculture, Forestry and Fisheries
(3)	Mr. Y. Kinoshita	Agriculture/ Soil	Thokai Regional Agricultural Administration Office, Ministry of Agriculture, Forestry and Fisheries
(4)	Mr. T. Fujinuma	Economy	Loan Department I, The Overseas Economic Cooperation Fund (Japan)
(5)	Mr. H. Arai	Coordinator	Technical Affaire Division, Japan International Cooperation Agency

D. Study Team

(1)	Mr. T. Sakamoto	Team Leader
(2)	Mr. T. Yamazaki	Agronomist/Agro-Economist (Co-Team Leader)
(3)	Mr. I. Akizuki	Irrigation and Drainage Engineer
(4)	Mr. T. Ohori	Dam Engineer
(5)	Mr. H. Tsuji	Hydrologist
(6)	Mr. H. Isogai	Soil Mechanical Engineer
(7)	Mr. M. Okamoto	Geo-ogist
(8)	Mr. N. Ariga	Pedologist
(9)	Mr. S. Azegami	Design Engineer
(10)	Mr. M. Masaki	Irrigation and Drainage Engineer
(11)	Mr. Y. Yukawa	Construction Planner
(12)	Mr. H. Sato	Hydropower Engineer
(13)	Mr. J. Watanabe	Environmental Specialist
(14)	Mr. M. Sekine	Environmental Specialist
(15)	Mr. H. Aoki	Environmental Specialist

MINUTES OF MEETING

FOR

DRAFT FINAL REPORT

ON

FEASIBILITY STUDY

FOR

THE SAKAE KRANG RIVER BASIN IRRIGATION PROJECT

1. Date : January 9, 1986
2. Time : 14:00 - 15:30 p.m.
3. Place : RID Conference Room No.300
4. Attendants : See Attached List

In accordance with the "Scope of Work for Feasibility Study on the Sakae Krang River Basin Irrigation Project" agreed on July 6, 1984 between the Royal Irrigation Department (RID) and the Japan International Cooperation Agency (JICA), the JICA Study Team (Team) has submitted 50 copies of "Draft Final Report" on December 1985 and the meeting was held for discussion on the said Report.

At the request from the chairman, Dr. Boonyok Vadhanaphuti, Director of Project Planning Division, RID, Mr. T. Sakamoto, the Team Leader made a brief explanation on the draft final report and various discussions were made between RID representative and Team.

The followings were mutually agreed through discussions:

(1) The secondary benefits of the project will be presented in the form of table in the summary.

(2) The annual escalation rate for price contingency in the financial cost estimation will be examined by using additional data provided by RID.

(3) The unit price of agricultural input and output will be examined by using the latest data on IBRD Commodity Price Projection.

(4) Official Comments from RID on the draft final report will be submitted to JICA Bangkok Office by the end of January 1986.

January 14, 1986

Chari Tulayanond

Mr. Chari Tulayanond
Deputy Director General
for Construction,
Royal Irrigation Department
Ministry of Agriculture
and Cooperatives

H. Nakamichi

Dr. Hiroshi Nakamichi
Chairman of Supervisory
Committee, Japan International
Cooperation Agency

T. Sakamoto

Mr. Tadashi Sakamoto
Leader of JICA Study Team

Name of Attendants	Division
R I D	
1. Dr. Boonyok Vadhanaphuti	Director of Project Planning Division
2. Mr. Jumsak Tejasen	Director of Research & Laboratory Division
3. Mr. Maitri Poolsup	Acting for Director of Design Division
4. Mr. Vira Poomvises	Director of Geo-technic Division
5. Mr. Danai Triyadhen	Chief of Land Classification Branch
6. Mr. Taweechai Mackaman	Director of Hydrology Division
7. Mr. Somkiat Subhadhadaphong	Geology Survey Branch
8. Mr. Virat Khao-Uppatum	Water Operation Branch, O & M Division
9. Mr. Sompoch Pimonpun	Acting for Director of Topographic Survey Division
10. Mr. Preecha Chotesangasa	Topographical Survey Division
11. Mr. Traibhun Mekjaroon	Environmental Impact Assessment Section
12. Mr. Surasak Srikhirin	Regional Irrigation Office 7
13. Mr. Chaiermporn Phirunsarn	Regional Irrigation Office 7
14. Mr. Vudhichai Chullakesa	Sub-Division 3, Project Planning Division
15. Mr. Chaiporn Korprapun	Sub-Division 2, Project Planning Division
16. Ms. Supha Sing-Intara	Chief of Economic Branch, Project Planning Division
17. Mr. Osot Charnvej	Agronomist, O&M Divisior
18. Mr. Jumvoen Panitying	Chief of Program Branch, Program & Budget Division
19. Mr. Obeua Varatorn	Design Division
20. Mr. Jomsak Boonprajvab	Project Planning Division
21. Mr. Suwit Thanopanuwat	Sub-Division 1, Project Planning Division
22. Mr. Anan Phoonthawee	Sub-Division,1, Project Planning Division
JICA Study Team	
1. Mr. Tadashi Sakamoto	Team Leader
2. Mr. Takayoshi Yamazaki	Agronomist/Agro-Economist (Co-Team Leader)
3. Mr. Tadashi Ohori	Dam Engineer

MINUTES OF MEETING

FOR

INTERIM REPORT

ON

FEASIBILITY STUDY

FOR

THE SAKAE KRANG RIVER BASIN IRRIGATION PROJECT

1. Date : September 25, 1985
2. Time : 9:30 - 11:50 a.m.
3. Place : RID Conference Room
4. Attendants : See attached list
5. Summary of Discussion :

In accordance with the "Scope of Work for the Feasibility Study on the Sakae Krang River Basin Irrigation Project" agreed on July 6, 1984 between the Japan International Cooperation Agency (JICA) and the Royal Irrigation Department (RID), the JICA Study Team (Team) submitted to RID fifty (50) copies of "Interim Report" on September 19, 1985 and the meeting was held today for discussion on the said Interim Report.

At the request from the chairman, Mr. Suthep Tingsabhat, Chief Engineer for Civil Engineering, RID, Mr. T. Sakamoto, the Team Leader made a brief explanation on the Interim Report using overhead projector, and various discussions were made between RID attendants and Team.

The followings were mutually understood through discussions :

(1) The proposed Mae Wong Irrigation Scheme should aim at covering the potential maximum irrigation area of 291,900 rai (46,700 ha) under the maximum exploitation of water resources. Dry season cropping should be considered as a secondary importance in order to expand the irrigation area in the wet season.

(2) More detailed studies, particularly for environmental aspects and stagewise implementation plan, would be carried out by the Team in Japan, and the study results would be incorporated into the

Draft Final Report which would be submitted to RID by the mid-December, 1985.

(3) The stagewise implementation would be studied on the proposed definite plan.

September 26, 1985

Suthep Tingsabhat

Mr. Suthep Tingsabhat
Chief Engineer for
Civil Engineering
Royal Irrigation Department

T. Sakamoto

Mr. Tadashi SAKAMOTO
Leader of JICA
Study Team for the
Irrigation Project

LIST OF ATTENDANTS

RID

1.	Mr. Suthep Tingsabhat	Chief Engineer for Civil Engineering
2.	Mr. Taweechai Mackaman	Director of Hydrology Division
3.	Mr. Arom Khumkomkul	Director of Program & Budget Division
4.	Mr. Prasaat Chuntroniyom	Director of Region 7
5.	Mr. Vira Poomvises	Director of Geo-technical Division
6.	Mr. Jumsak Jejasen	Director of Research and Lab, Division
7.	Ms. Supha Sing-intara	Chief of Economic Branch, P.P.D.
8.	Mr. Thribnun Mekuaroom	Chief of Environmental Branch, P.P.D.
9.	Mr. Prasert Milintangul	Chief of Research & Applied Hydrology Branch
10.	Mr. Osot Charnvej	Agronomist, O/M Division
11.	Mr. Maitri Poolsup	Design Division
12.	Mr. Chalernporn Phirunsarn	Region 7
13.	Mr. Roungrit Ammawat	Chief of Engineer, Dam Design Sub-Division
14.	Mr. Preecha Chotesangasa	Survey Division
15.	Mr. Suttiphong Koonthong	Program & Budget Division
16.	Mr. Sompoch Pinonpun	Survey Division
17.	Mr. Chongrak Isarangkura	Chief of Sub-project Planning Division
18.	Mr. Vudhichai Chullakesa	Project Planning Division
19.	Mr. Somsak Boonprajuab	Project Planning Division
20.	Mr. Suwit Thanapanuwat	Project Planning Division
21.	Mr. Prateep Kancheralarb	Project Planning Division
22.	Mr. Anan Phoonthawee	Project Planning Division
23.	Mr. Toshiki Saito	Colombo Plan Expert (JICA), Project Planning Division
24.	Mr. Fumio Ideda	Colombo Plan Expert (JICA), Design Division

JICA STUDY TEAM

1.	Mr. Tadashi Sakamoto	Team Leader
2.	Mr. Takayashi Yamazaki	Co-Leader
3.	Mr. Isao Akizuki	Irrigation Engineer
4.	Mr. Tadashi Ohori	Dam Engineer
5.	Mr. Naoki Ariga	Pedologist
6.	Mr. Shigeharu Azegami	Structural Design Engineer
7.	Mr. Manabu Masaki	Irrigation/Drainage Design Engineer
8.	Mr. Yoshimitsu Yukawa	Construction Planning Engineer

MINUTES OF MEETING

FOR

PLAN OF OPERATION

ON

FEASIBILITY STUDY

FOR

THE SAKAE KRANG RIVER BASIN IRRIGATION PROJECT

1. Date : July 9, 1985
2. Time : 9:00 - 11.30 a.m.
3. Place : RID Conference Room
4. Attendants : See Attached List
5. Summary of Discussion

In accordance with the "Scope of Work for the Feasibility Study on the Sakae Krang River Basin Irrigation Project" agreed on July 6, 1984 between the Japan International Cooperation Agency (JICA) and the Royal Irrigation Department (RID), the JICA Study Team (Team) has submitted 20 copies of "Plan of Operation for the Feasibility Study" and the meeting was held for discussion on the said plan of operation.

At the request from the chairman, Mr. Suthep Tingsabhat, Chief Engineer of Civil Engineering, RID, Mr. T. Sakamoto, the Team Leader explained the outline of the plan of operation. The chairman asked the attendants to make comments and suggestions, and various discussions were made between RID representatives and Team.

The followings were mutually agreed through discussions:

(1) The feasibility study will be made for the Upper Mae Wong Project.

(2) The irrigation area envisaged under the Project is to be limited to the downstream area, exclusive of the existing crop lands extending the upstream of the Lower Mae Wong dam site. In the water balance study, however, the water use for the people living in the Lower Mae Wong reservoir area will be considered in the form of allowance.

(3) The environmental study will be carried out, following the "Plan of Operation" agreed on March 18, 1985. For discussions on detailed methodology and RID's requirement for environmental study, another technical meeting will be arranged after JICA environmental experts will arrive at Bangkok.

(4) Effective storage of reservoir will be determined from the irrigation development plan. The dam height will be determined based on the alternative study on the hydropower development plan excluding the study of regulating reservoir.

(5) Secondary and/or intangible benefits accrued from flood mitigation, inland fishery, etc. will be considered in the overall evaluation of the project.

(6) Institutional aspects for agricultural support services will be studied in the agricultural development plan.

July 18, 1985

Suthep Tingsabhat

Mr. Suthep Tingsabhat
Chief Engineer of
Civil Engineering
Royal Irrigation Department

T. Sakamoto

Mr. Tadashi SAKAMOTO
Leader of JICA
Study Team

Name of Attendants	Division
RID	
1. Mr. Suthep Tingsabhat	Chief Engineer of Civil Engineer RID
2. Dr. Boonyok Vadhanaphuti	Director of Project Planning Division
3. Mr. Sompoch Pimonpun	Director of Topographical Survey Division
4. Mr. Pra. Sart Chuntrniyom	Director of Irrigation Region 7
5. Mr. Jumsak Tejasen	Director of Lab & Research Division
6. Mr. Maitri Poolsup	Design Division
7. Ms. Supojana Rujirakul	Project Planning Division
8. Mr. Suttiphong Koonthong	Program Coordination & Budget Division
9. Mr. Mongkol Kulyaruen	Project Planning Division
10. Mr. Toshiki Saito	JICA Colombo Plan Expert, P.P.D.
11. Mr. Katsuro Shioda	JICA Colombo Plan Expert, O & M Division
12. Mr. Yoji Ebihara	Coordinator, Irrigation Engineering Center
13. Mr. Snguan Jamprawit	Geotechnical Division
14. Mr. Somkiat Subhadhadapong	Geotechnical Division
15. Mr. Suchin Charoonsak	O & M Agronomist
16. Ms. Supannee Rojanapornsuk	Geotechnical Division
17. Ms. Supha Sing-Intara	Economic Branch, P.P.D.
18. Mr. Preecha Chotesangasa	Survey Division
19. Mr. Suthi Songvoravit	Project Planning Division
20. Dr. Suphon Chirapuntu	Geotechnical Division
21. Mr. Runroj Chumthong	Geotechnical Division
22. Mr. Dacha Luangpitakchumpol	Geotechnical Division
23. Mr. Chongrak Lsarangkura	Project Planning Division
24. Mr. Taweechai Mackaman	Hydrology Division
25. Mr. Traibhun Nekjrson	P.P.D.
26. Mr. Prateep Kanchanalarb	Engineer 4
27. Mr. Somsak Boonprajuab	P.P.D. Engineer
28. Mr. Anan Poonthawee	P.P.D. Engineer
JICA Study Team	
29. Mr. Tadashi Sakamoto	Team Leader
30. Mr. Takayoshi Yamazaki	Agronomist/Agro-Economist (Co-Team Leader)
31. Mr. Isao Akizuki	Irrigation & Drainage Engineer
32. Mr. Tadashi Ohori	Dam Engineer
33. Mr. Hideo Tsuji	Hydrologist
34. Mr. Naoki Ariga	Pedologist
35. Mr. Manabu Masaki	Irrigation & Drainage Engineer

MINUTES OF THE MEETING

FOR

PRE-FEASIBILITY REPORT

ON

THE SEKAE KRANG RIVER BASIN IRRIGATION PROJECT

Date	:	March 18, 1985
Time	:	13.30 - 15.00
Place	:	RID Conference Room No. 300
Attendance	:	Attached List

In accordance with "SCOPE OF WORK FOR FEASIBILITY STUDY ON THE SAKAE KRANG RIVER BASIN IRRIGATION PROJECT IN THE KINGDOM OF THAILAND" agreed on July 6, 1984 between the Japan International Cooperation Agency (JICA) and the Royal Irrigation Department (RID), JICA has submitted Fifty (50) copies of Pre-Feasibility Report prepared by the Study Team (the Team) and the meeting was held for discussion on the said report.

Both sides have mutually agreed as follows :

1. Explanation on the Pre-Feasibility Report was made by the Team and it was generally accepted by RID.

2. The first priority project was recommended by the Team to be the Upper Mae Wong Project and it was agreed by RID attendance.

3. The RID explained that the additional surveys required for the Feasibility Study were on progress and the expected completion date will be informed to the Team by the end of March.

4. Feasibility Study on the selected first priority project will be commenced as soon as after the completion of the required additional surveys.

5. Plan of operation for environmental study submitted by the Team as per attached, was accepted by RID.

Suthep Tingsabhat.

Mr. Suthep Tingsabhat
Chief Engineer for Civil
Engineering
Royal Irrigation Department

T. Sakamoto

Mr. Tadashi SAKAMOTO

Leader of JICA Study Team

March 14, 1985

PLAN OF OPERATION FOR ENVIRONMENTAL STUDY ON SAKAE KRANG RIVER BASIN IRRIGATION PROJECT

(DRAFT)

JICA STUDY TEAM FOR
SAKAE KRANG RIVER BASIN
IRRIGATION PROJECT

1. General

The environmental study will be made as a part of the feasibility study on the first priority project, basically following the general guideline given by NEB.

2. Study Area

The study area covers the Mae Wong river basin of about 1,500 km^2 which may receive more or less environmental impacts by development of dam and irrigation under the first priority project.

3. Approach to the Study

The environmental study required by NEB comprises manifold items of environmental impacts evaluations. They are classified into three groups as listed in the attached table.

1) For the items already included in the original scope of the feasibility study, additional data collection will be made by JICA study team in close cooperation with RID and the study results in those fields obtained through the feasibility study will be fully utilized for the environmental study.

2) For the remaining items which are not included in the original scope, additional survey and data collection will be required. RID will be requested to make such survey and data collection to the extent that RID considers necessary.

3) JICA study team will assist RID to make the additional surveys and data collection in the following fields:

   a. Resettlement

   b. Aquaculture

   c. Ecological resources including fisheries, aquatic biology, terrestrial wild life and forests

4) JICA study team will make the required study on the basis of the data and information to be collected in the above manner, and will prepare a report on the environmental impacts evaluations as a part of the feasibility study.

5) The environmental study will be made, in close coordination with RID, making the best possible use of the experience acquired in the similar projects of RID.

4. Undertaking of RID

To facilitate smooth performance of the environmental study, RID will be requested:

1) to specify its requirement for environmental study through its own re-examination of the NEB guideline,

2) to make additional field survey and data collection and complete them by the end of May, 1985, and

3) to assign full-time counterpart experts who will secure the closest coordination between the study team and RID, and also fulfill the study requirements indicated in the attached table as the RID contribution.

Environmental Resources		Included Already in F/S	Proposed Additional Study Item in F/S	RID Contribution
Physical Resources	Surface Water Hydrology	o		
	Surface Water Quality	o		
	Ground Water Hydrology	o		
	Ground Water Quality	o		
	Soils	o		
	Geology/Seismology	o		
	Erosion/Sedimentation	o		
	Climate	o		
Ecological Resources	Fisheries		o	
	Aquatic Biology		o	
	Terrestrial Wildlife		o	
	Forests		o	
Human Use Values	Agriculture/Irrigation (if applicable)	o		
	Aquaculture		o	
	Water Supply	o		
	Recreation			o
	Power (if applicable)	o		
	Flood Control	o		
	Dedicated Area Uses	o		
	Industry			o
	Agri-Industry	o		
	Mineral Development			o
	Highways/Railways			o
	Land Use	o		
Quality of Life Values	Socio-Economic	o		
	Resettlement	o	o	
	Cultural/Historical			o
	Aesthetic			o
	Archaeological			o
	Public Health			o
	Nutrition			o

Name of Attendants	Division
1. Mr. Suthep Thingsabhat	Chief Engineer for Civil Engineering
2. Dr. Boonyok Vadhanaphuti	Director of Project Planning Div.
3. Mr. Kaiwan Devahastin	Director of Program Coordination and Budget Div.
4. Mr. Chongrak Isarangkura	P.P.D.
5. Mr. Amphai Muthitacharoen	Geotechnical Div.
6. Mr. Maitri Poolsup	Design Div.
7. Mr. Jumsak Tejasen	Director of Research and Lab. Div.
8. Mr. Virat Khao-uppatum	O & M Div.
9. Mr. Lersak Rewtarkulpaiboon	O & M Div.
10. Mr. Chalermporn Phirunsarn	Regional 7
11. Mr. Sa-ngad Onnum	P.P.D.
12. Mr. Osot Charnvej	Agronomist, O & M Div.
13. Mr. Supojana Rujirakul	P.P.D.
14. Mr. Toshiki SAITO	Attached P.P.D. (JICA)
15. Mr. Sompoch Pimonpun	Topographical Div.
16. Mr. Taweechai Machaman	Hydrology Div.
17. Mr. Tadashi OHORI	Dam Engineer
18. Mr. Tadashi SAKAMOTO	Team Leader
19. Mr. Norio KUNIYASU	Technical Affairs Div., JICA
20. Mr. Masahiko KAMEDA	Chief Irrigation Engineer MAFF
21. Dr. Nakamichi HIROSHI	Chief Irrigation Engineer MAFF
22. Dr. Kazuji UNO	Geotechnic Div.
23. Mr. Suvit Thanopanuwat	P.P.D.
24. Mr. Somsak Boonprajuab	P.P.D.
25. Mr. Anan Poontawee	P.P.D.

MINUTES OF MEETING

FOR

DRAFT PROGRESS REPORT

ON

FEASIBILITY STUDY

FOR

THE SAKAE KRANG RIVER BASIN IRRIGATION PROJECT

1. Date : December 13, 1984
2. Time : 2:00 - 3:30 P.M.
3. Place : RID Conference Room
4. Attendants : See Attached List
5. Summary of Discussion

The Chairman, Mr. Suthep Tingsabhat, Chief Engineer of Civil Engineering RID introduced Dr. Hiroshi Nakamichi, Chairman of JICA advisory committee and Mr. Tadashi Sakamoto, Leader of JICA Study Team, to the attendants. Dr. H. Nakamichi explained the present work progress and made a remark that the study is now in progress as scheduled.

Mr. T. Sakamoto explained the outline of the progress report, following the summary of the draft report and supplementary note No. 1 and No. 2 which dealed with results of reservoir operation study and selection of high priority projects. He pointed out that the high priority projects should be selected through the discussion as the study team would leave for Japan to carry out the pre-feasibility study on high priority projects. The Chairman asked the attendants to make comments and suggestions on the report and notes, and several discussions were made between RID representatives and JICA study team. The followings were mutually confirmed through discussions:

(1) High priority projects would be Upper Mae Wong, Lower Mae Wong and Khlong Pho projects.

(2) Detailed technical discussions will be made for confirmation on the above selection of high priority projects. Selection of the first priority project will also be discussed. RID would make an arrangement of such technical meetings.

(3) JICA study team agreed, on the request from RID, that the following alternative studies would be made in Part B programme:

a. water balance studies for different cropping intensities, and

b. project alternative studies for irrigation development under two different development strategies; i.e.,

i. irrigation development with moderate investment on existing facilities for more effective use of water, and

ii. irrigation development with minor investment on existing facilities for minimizing the project costs.

(4) For irrigation development, the first priority should be given to the existing irrigation areas.

(5) Groundwater exploitation should be considered for future stage of development.

Suthep Tingsabhat.

Suthep Tingsabhat
Chief Engineer of Civil Engineering
Royal Irrigation Department

T. Sakamoto

Tadashi SAKAMOTO
Leader of JICA
Study Team

LIST OF ATTENDANTS

1.	Mr. Suthep Tingsabhat	Chief Engineer of Civil Engineering
2.	Dr. Boonyok Wadhanaphuti	Director, Project Planning Division
3.	Mr. Shoombhol Chaveesuk	Director of Design Division
4.	Mr. Ruongrit Ammawat	Design Division
5.	Mrs. Nophakhun Somsin	Hydrology Division
6.	Mr. Taweechai Mackaman	Hydrology Division
7.	Mr. Klaus Lindner	Advisor, Project Planning Division
8.	Mr. Toshiki Saito	Colombo Plan Expert, Project Planning Division
9.	Mr. Katsuro Shioda	Colombo Plan Expert, O & M Division
10.	Mr. Fumio Ikeda	Colombo Plan Expert, Design Division
11.	Mr. Kaiwan Devahasdin	Program Co-ordination & Budget Division
12.	Mr. Virat Khao-Uppatum	O & M Division
13.	Mr. Osot Charnvej	Agronomist, O & M Division
14.	Mr. Vira Poomvises	Geo-technic Division
15.	Mr. Maitri Poolsup	Civil Engineer, Design Division
16.	Mr. Jumsak Tejasen	Director, Research & Laboratory Division
17.	Mr. Supote Rujirakul	Engineer, Project Planning Division
18.	Mr. Chalermporn Phirunsarn	Civil Engineer; Region 7
19.	Mr. Sompoch Pimonpun	Topographical Survey
20.	Mr. Preecha Chotesangasa	Topographical Survey
21.	Mr. Chaiyuth Suksri	Project Planning Division
22.	Mr. Suwit Thanopannwat	Project Planning Division
23.	Dr. Nakamichi Horoshi	Chief Irrigation Engineer, MAFF
24.	Mr. Norio Kuniyasu	Technical Affairs Division, JICA
25.	Mr. Tadashi Sakamoto	Team leader of Sakae Krang F/S team (JICA)
26.	Mr. Takayoshi Yamazaki	Member of Sakae Krang F/S team (JICA)
27.	Mr. Isao Akizuki	Member of Sakae Krang F/S team (JICA)
28.	Mr. Tadashi Ohori	Member of Sakae Krang F/S team (JICA)
29.	Mr. Naoki Arigá	Member of Sakae Krang F/S team (JICA)
30.	Mr. Hideo Sato	Member of Sakae Krang F/S team (JICA)