Table L-2-2(2) Estimation of Cash Flow of Typical Farmer (Right Bank: Upper Area)

Unit: 1,000 Baht

Year	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
Initial Fund	0	-5,855	-5,033	1,380	13,775	33,928	56,284	80,918	105,545	130,530	155,873
Farm Credit (Medium)	1,062	2,120	2,120	2,120	2,120	2,120	2,120	2,120	2,120	2,120	2,120
Farm Credit (Short)	12,843	12,843	12,843	12,843	12,843	15,715	15,715	15,715	15,715	15,715	15,715
Sub-total (A)	13,905	14,963	14,963	14,963	14,963	17,835	17,835	17,835	17,835	17,835	17,835
Required Fund (Stage I)											
Production Cost	12,843	12,843	12,843	12,843	12,843	15,715	15,715	15,715	15,715	15,715	15,715
Living Expenses	9,427	9,427	9,427	9,427	9,427	9,427	9,427	9,427	9,427	9,427	9,427
Sub-total (B)	22,270	22,270	22,270	22,270	22,270	25,142	25,142	25,142	25,142	25,142	25,142
Farm Income											
Sub-total (C)	25,631	32,276	38,920	45,565	52,210	56,310	56,668	57,026	57,384	57,742	57,742
Interest (Short)	803	803	803	803	803	973	973	973	973	973	973
Repayment (Short)	12,843	12,843	12,843	12,843	12,843	15,715	15,715	15,715	15,715	15,715	15,715
Sub-total (D)	13,646	13,646	13,646	13,646	13,646	16,688	16,688	16,688	16,688	16,688	16,688
Balanced Carried Forward	3,620	5,468	12,934	25,992	45,032	66,243	88,957	113,949	138,934	164,277	189,620
Farm Credit (Short)											
Sub-total (E)	3,784	4,424	4,424	4,424	4,424	4,059	4,059	4,059	4,059	4,059	4,059
Required Fund (Stage II)											
Production Cost	5,437	6,495	6,495	6,495	6,495	6,795	6,795	6,795	6,795	6,795	6,795
Living Expenses	9,428	9,428	9,428	9,428	9,428	9,428	9,428	9,428	9,428	9,428	9,428
Sub-total (F)	14,865	15,923	15,923	15,923	15,923	16,223	16,223	16,223	16,223	16,223	16,223
Farm Income											
Sub-total (G)	7,564	7,861	8,135	8,662	9,775	11,238	13,158	13,158	13,158	13,158	15,078
Term-end Fund											
O/M Charge	1,805	1,805	1,805	1,805	1,805	1,805	1,805	1,805	1,805	1,805	1,805
Interest (Short)	236	236	236	236	236	254	254	254	254	254	254
Repayment (Short)	3,784	4,424	4,424	4,424	4,424	4,059	4,059	4,424	4,424	4,424	4,424
Interest (Medium)	133	398	663	795	795	795	795	795	795	795	795
Repayment (Medium)	0	0	1,062	2,120	2,120	2,120	2,120	2,120	2,120	2,120	2,120
Sub-Total (H)	5,958	6,863	8,190	9,380	9,380	9,033	9,033	9,398	9,398	9,398	9,398
Balanced Carried Forward	-5,855	-5,033	1,380	13,775	33,928	56,284	80,918	105,545	130,530	155,873	183,136

Note: Stage I ... Wet Season
Stage II .. Dry Season

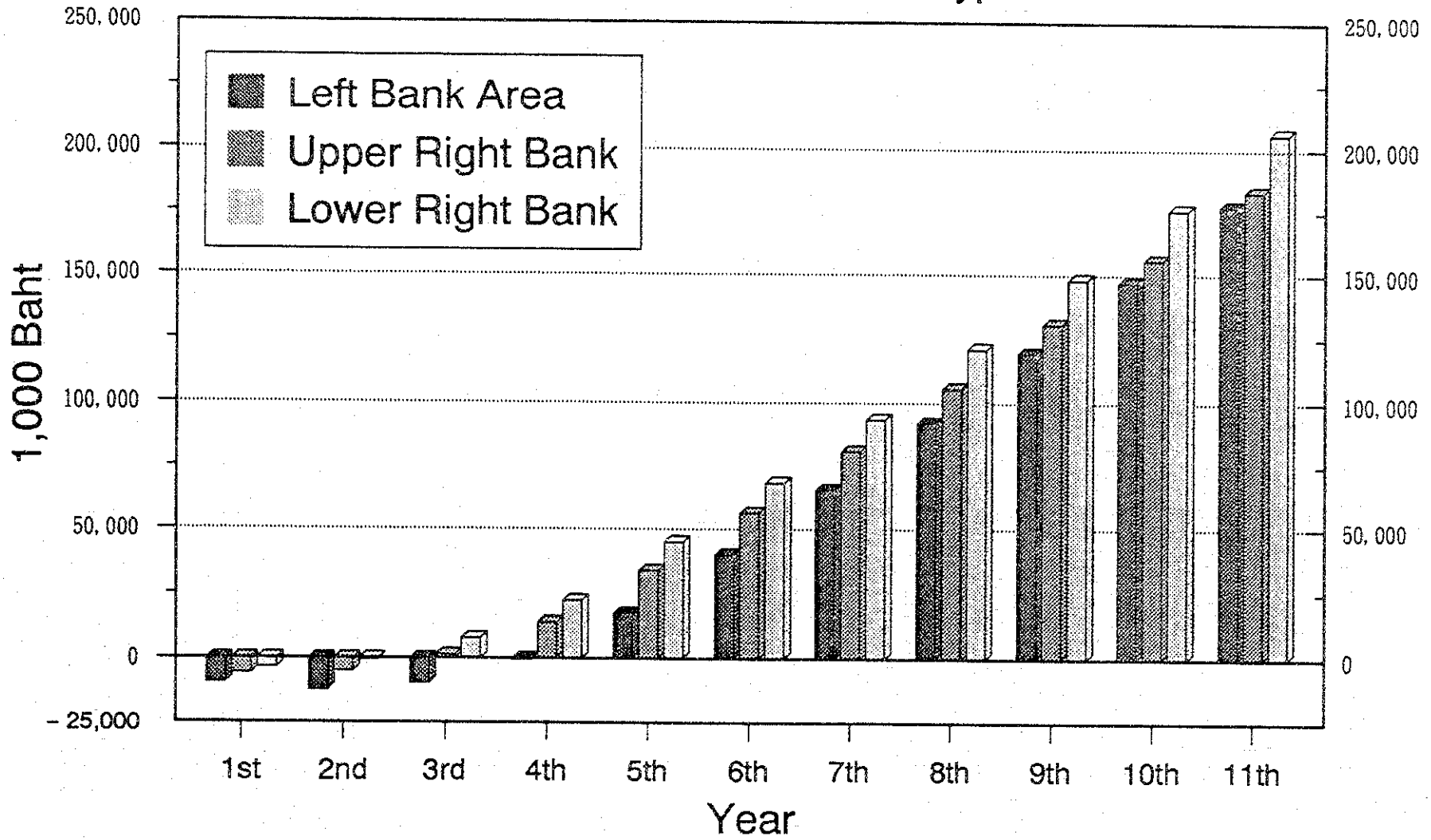
Table L-2-2(3) Estimation of Cash Flow of Typical Farmer (Right Bank: Lower Area)

Unit: 1,000 Baht

Year	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
Initial Fund	0	-3,582	-619	7,806	22,193	44,961	68,409	93,454	120,754	148,173	175,711
Farm Credit (Medium)	1,383	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760
Farm Credit (Short)	12,553	12,553	12,553	12,553	12,553	13,511	13,511	13,511	13,511	13,511	13,511
Sub-total (A)	13,936	15,313	15,313	15,313	15,313	16,271	16,271	16,271	16,271	16,271	16,271
Required Fund (Stage I)											
Production Cost	12,553	12,553	12,553	12,553	12,553	13,511	13,511	13,511	13,511	13,511	13,511
Living Expenses	8,629	8,629	8,629	8,629	8,629	8,629	8,629	8,629	8,629	8,629	8,629
Sub-total (B)	21,182	21,182	21,182	21,182	21,182	22,140	22,140	22,140	22,140	22,140	22,140
Farm Income											
Sub-total (C)	25,052	31,547	38,042	44,537	51,032	52,399	52,518	52,638	52,757	52,876	52,876
Interest (Short)	785	785	785	785	785	845	845	845	845	845	845
Repayment (Short)	12,553	12,553	12,553	12,553	12,553	13,511	13,511	13,511	13,511	13,511	13,511
Sub-total (D)	13,338	13,338	13,338	13,338	13,338	14,356	14,356	14,356	14,356	14,356	14,356
Balanced Carried Forward	4,468	8,758	18,216	33,136	54,018	77,135	100,702	125,867	153,286	180,824	208,362
Farm Credit (Short)											
Sub-total (E)	4,396	4,396	4,396	4,396	4,396	4,787	4,787	4,787	4,787	4,787	4,787
Required Fund (Stage II)											
Production Cost	6,445	7,823	7,823	7,823	7,823	8,249	8,249	8,249	8,249	8,249	8,249
Living Expenses	8,630	8,630	8,630	8,630	8,630	8,630	8,630	8,630	8,630	8,630	8,630
Sub-total (F)	15,075	16,453	16,453	16,453	16,453	16,879	16,879	16,879	16,879	16,879	16,879
Farm Income											
Sub-total (G)	9,190	9,586	9,960	10,657	12,543	13,324	14,074	16,574	16,574	16,574	19,074
Term-end Fund											
O/M Charge	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717
Interest (Short)	275	275	275	275	275	299	299	299	299	299	299
Repayment (Short)	4,396	4,396	4,396	4,396	4,396	4,787	4,059	4,424	4,424	4,424	4,424
Interest (Medium)	173	518	863	1,035	1,035	1,035	1,035	1,035	1,035	1,035	1,035
Repayment (Medium)	0	0	1,062	2,120	2,120	2,120	2,120	2,120	2,120	2,120	2,120
Sub-Total (H)	6,561	6,906	8,313	9,543	9,543	9,958	9,230	9,595	9,595	9,595	9,595
Balanced Carried Forward	-3,582	-619	7,806	22,193	44,961	68,409	93,454	120,754	148,173	175,711	205,749

Note: Stage I ... Wet Season
Stage II .. Dry Season

Figure L-2-1 Trend of Cash Flow of Typical Farmers



Data Source: Table L-2-2

ANNEX M. ENVIRONMENTAL STUDY

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PART - I (MASTER PLAN STUDY)

CHAPTER I. INTRODUCTION

Dam construction is usually proposed to the water resources development project in the last three decades, especially in Thailand. Man-made reservoir causes the water body to replace forest areas, cultivated land, human settlement, cultural resources, and infrastructure. Normally, the area of reservoir is estimated about 10 percent of the catchment area as found from the previous time in Thailand. Therefore, there are quite a lot of forest lands lost by the water resources development projects, but they can be retrieved by utilization of storage water for irrigation, hydro-electric generation, fish culture, and recreation. However, some groups of people disagreed because the said items cannot be compensated, particularly the losses of forest trees, wild animals, good land for agriculture, cultural heritage, and invaluable nature. This is the reason why the water resources development project with dam construction cannot be smoothly implemented in Thailand, for example, the multipurpose dam project launched by EGAT. Very small number of dam construction belonging to RID has been executed because of most of them are occupied by medium to small reservoir areas in all parts of the country, except Kaeng Sue Ten in Phrae (the north), and Haew Naroke at Khao Yai National Park in Nakhon Nayok (the east). In this connection, forest losses are the issue that has been picked up as main cause and tangible losses of good land for agriculture and intangible losses of cultural heritage follow, inducing the suffer of local people.

Lam Dom Yai Basin Irrigation Project is proposed by RID, and expected to provide water to increase the land productivity, particularly paddy areas. Only one dam-site will be selected to implement in the future. It looks like no problem on engineering technical know how and socio-economic returns, but question on environmental impacts has arisen. This is why this part of paper has to be organized in order to focus on the issues of environmental effect evaluation of eight proposed dam-sites, i.e., J-1, J-2, J-7, D-22, D-23, D-24, D-25, and D-28 on the basis of screening process. Priority of the least environmental impacts will be arranged and justification be also presented. However, the evaluation will be carried out based on the previous data and field reconnaissance.

CHAPTER II. EXISTING WATERSHED RESOURCES

Lam Dom Yai watershed is one of the big sub-watershed areas of Mun-Chi river basin and located at the southern part of Ubon Ratchathani and eastern part of Si Sa Ket in the lower northeast region of Thailand. The total area is approximated about 4,905 sq.km which includes Ubon Ratchathani 4,474 sq.km and Si Sa Ket 431 sq.km. Based on the watershed classification mapped on the sheets with the Approval of Cabinet on 12 July 1998, the topographical characteristics of Lam Dom Yai watershed has been dominated by watershed class-5 (WSC-5)*1 and WSC-4, approximately 45 and 40 percent, respectively, WSC-1 only 6 percent and WSC-2 and -3 are almost the same size in total of 9 percent. By this conceptual area size, Lam Dom Yai tributary can be classified as perennial stream and water flow released exactly all year round without shortage even in very dry period of the year. Looking at 1988-report of Royal Forest Department, it is found the forest cover in the whole area of Ubon Ratchathani Province is about 20.58 percent (2,432,124 rai), and the destruction rate during the period of 1985 - 1988 about 9,500 rai per annum. In fact, the forest area covers on the WSC-1, -2, and -3. In other hands, good lands for agriculture were overtaken and caused the depletion of forest areas. Field reconnaissance found that the existing forest ecosystems shown unhealthy structure and unwealthy wood timber.

Ubon Ratchathani Province occupies approximately 26 percent of pasture and rangeland, 40 percent of crop cultivation, and 1.4 percent of fisheries resources areas, and the others are forest cover and idle lands. Due to those numbers of cultivated land, this Province should be the richest area in agricultural products, but real situation is not that in the statement. Poor soils with low water holding capacity as well as lack of water are the root of problems. Increasing water yield and its distribution are hopefully thought as the main issues, especially for food crop and protein sources production. In principles of watershed management, increasing soil productivity and water distribution capability are under the vital objectives.

Note : *1 WSC-1 : Conservation forest and headwater source area
WSC-2 : Productive forest and functioning as headwater source area
WSC-3 : Forest and fruit tree plantation
WSC-4 : Upland Cropping area
WSC-5 : Lowland cropping area

With regards to population and household on-site of the basin, it is found the population are 395,000 persons with the density of 91.7 persons/sq.km and the number of households are 69,150 with a family of 5.7 persons. It can be explained based on numbers that the population density is identified in medium density. If the natural resources were fruitful, wealthy family should be found. In reality, more than one-third of people are poor because of low yields of agricultural products. Unavoidedly, natural resources have been utilized without any care and planning. Finally, degradation of watershed resources has been faced since last two decades.

CHAPTER III. WATERSHED MANAGEMENT IN PRACTICES

3. 1 Principles and Background

Watershed management is defined as "the management of land for optimum quantity, desirable quantity, and regulation of water flow along with soil erosion control, flood reduction and well-planned utilization of natural resources" (Chunkao, 1983).

The definition implied that land hereby is watershed or unit area which drains water through the given point or outlet. However, this unit area is comprised of three groups of watershed resources, namely biotic, abiotic, and social resources. They are under consecutive components, i.e., species diversity quantity of each species, proportion among species, (vertical and horizontal portions of total species diversity), and distribution of each species. If the watershed ecosystem was identified as imbalance of nature, there would be the changes on components of species diversity, quantity, proportion, and distribution one way or anothers (Chunkao, 1987). However, Chunkao (1983) proposed the principles of watershed management under three consecutive-important issues: i) land use planning, ii) resources utilization and conservation measures, and iii) pollution control and self-recovery.

3. 2 Land Use and Its Effects

Based on practices in watershed management under the said principles mentioned above, land use planning is the first task among all activities, and it must be accomplished before hand. If so, the degradation of watershed resources would not be appeared as seen at the present time. Even it may be so late, but Department of Land Development accomplished land use map of the whole Province of Ubon Ratchathani in 1988, and it transfers to each unit of the proposed sites as shown in Table M-1. The result of field study shows the cultivation crop land dominated when it is compared with the scale of forested land, and it seems deviating from output of Table M-1. Theoretically speaking, the forest has rapidly depleted and turned to be croplands, but it usually occurs only on the good land. It may not be applied in the northeast of the country, that every spot of forest area can be replaced by agricultural area

because of homogeneous and low-medium-soil fertility in case of peneplain and low-level land. Also, man can go on foot and by vehicles even in the remote areas, especially in the summer time.

TABLE M-1 PERCENTAGE OF LAND USE PATTERN OF LAM DOM YAI WATERSHED

No	Watershed	Watershed Area (sq.km)	Size of Land Use (%) DDF	MDF	WL+WA	Range	Upland Crops	Total
1	J-1	1,062.4	27.1	17.8	1.0	0.3	53.0	100.0
2	J-2	73.4	48.5	-	-	0.8	50.7	100.0
3	J-7	141.3	50.2	3.4	-	2.5	43.9	100.0
4	D-22	53.3	23.2	48.9	-	1.7	26.2	100.0
5	D-23	646.6	80.8	1.0	0.1	0.8	17.3	100.0
6	D-24	891.8	30.2	14.8	0.6	0.2	54.2	100.0
7	D-25	223.4	0.7	24.0	-	0.2	75.1	100.0
8	D-28	1,560.9	61.2	10.3	0.1	0.5	27.9	100.0

Notes : DDF = Dry-Dipterocarp Forest
MDF = Mixed-Deciduous Forest
WL = Wetland
WA = Water Body Area
Range = Range Land/Pasture
Upland Crop = Upland crop farming includes areas of corn, cassava, kenaf, and rainfed areas.

Lam Dom Yai watershed has been identified as poor and less education area, and such conventional utilization practices occur in every village, as crop cultivation, fuelwood harvesting, and log timber cutting. Unavoidedly, land is tending to cause less fertility and productivity as pointed out by Bennett (1955), Chunkao (1981), Colman (1953), DLD (1980), DOC (1986), Komkris (1970), Kunstatter and Chapman (1970), and Satterlund (1972). The main factor would be the changes of ecological characteristics from the land use changes as indicated by Copeland (1965) and causing the losses of accumulative nutrients, especially from the forest trees (Herrera et al. 1981). In other words, the changes of land use from forest cover to be crop land or another types usually cause the losses of nutrients due to removal of forest trees. Nutrient losses usually occur from the consequent removal of trees by surface flow and sedimentation as described by Benett (1955), Colman (1953), Burton (1969), Anderson et al. (1976), and DLD (1980). An estimation of Land Development Department found the amount of nutrient losses by washing out of surface flow

and sediment transport of main river of Thailand more than million tons per annum. Therefore, changing forest cover to agricultural area exactly causes the losses of not only trees or plant cover, but also plant nutrients. Consequently, conventional agriculture would be confronted with the decrease of products in the long run. There are a lot of recommendations to maintain the sustainability of conventional agriculture on keeping headwater sources in the watershed area with big enough size (ARS-USDA and ORD-EPA 1975, Burton 1969, Chunkao 1981 and 1983, Colman 1953, Hewlett and Nutler 1969, Komkris 1970, Satterlund 1972, UNESCO 1978, and UNESCO-MAB 1979).

Unfortunately, there is no data available in the basin, but the same phenomena would occur. This is the information supporting why the Study Areas of Lam Dom Yai found poor soil and low productivity, and finally causing less income of the local people. Furthermore, total cover of forest area and its distribution cannot find any information to support. Therefore, intensive study should be conducted before implementing the project.

3.3 Reflection of Misusing Resources

Resources utilization of any watershed zones has to rely on the principles of conservation, otherwise the sustainable yields cannot be fulfilled. To relate this statement, the resources utilization of the proposed areas was under easy-going-careless means of the users. The witness can normally see reflection of misusing resources in every proposed area, such as traces of soil erosion, sand-paved surface soils, denuded-splash-tree distribution, unfertile soils, flooding tracks, and siltation areas. However, the indicators which are reflected as the environmental problems will be discussed as follows:

1) Forestry and Wildlife

The forest area of the northeast Thailand has been changed from 50,671 sq.km in 1973 to 31,221 sq.km in 1978, 14.03 percent of country forest area, with the depletion rate of 10 percent of the northeast area (Wacharakitti et al., 1978). Ubon Ratchathani was covered with the forest, approximately 20.58 percent of the total area, in which the depletion rate 9,500 rai/annum (RFD, 1989)

According to DLD's land use map in 1988, the existing forest cover was determined in each proposed area and the results are shown in Table M-2. Every proposed area has been covered with dense forest, especially watershed areas of D-22, D-23, and D-28, and moderate condition in areas of J-1, J-2, J-7, and D-24, but low percentage in watershed D-25. Observation was made during site visit and learnt that areas around dam-sites and reservoirs have been covered with forest trees only from proposed areas, they are J-2, D-23, D-24, and D-28. If anyone of these dam-sites were chosen, intensive study on forestry and wildlife had to be carefully conducted. However, only two forest types were found in the proposed areas, i.e., dry-dipteracarp and mixed-deciduous forests, and also some wetland in some areas (see Table M-1).

Field survey evaluation found that the covers are somewhat lower than the report in Table M-2 and tree density was a little low and sparse distribution at all parts of watershed areas. Reviewing of literature as conducted the research in the northeast was presented in Table M-3. Actually, only two types of forest were found in the basin, i.e., dry-dipteracarp forest and mixed deciduous forest, and the others are farm forest, wetland and cultivated areas (see T able M-2). It is also quite surprising when the forest map of 1988 as accomplished by RED (1989) and found the forest cover in each proposed area that indicated so much differences from DLD' land use map 1988. Intensive study would solve which one is possible. This report will take DLD's maps effective data, especially for effect evaluation.

TABLE M-2 FOREST COVER OF THE PROPOSED AREA OF LAM DOM YAI BASIN

No.	Site	Watershed Area*1	DLD Forest Area*1		RFD 1988 Forest *2
		(sq.km)	(sq.km)	(%)	
1.	J-1	1,062.4	787.6	45.9	12.7
2.	J-2	73.4	35.6	48.5	18.1
3.	J-7	141.3	75.7	53.6	50.1
4.	D-22	53.3	38.4	72.1	68.1
5.	D-23	646.6	528.9	81.8	69.1
6.	D-24	891.8	401.3	45.0	12.8
7.	D-25	223.4	55.2	24.7	-
8.	D-28	1,560.9	116.0	71.5	62.8

Remarks: *1 Data from land use map of Lam Dom Yai Basin Project by DLD
*2 RFD land use map from LANDSAT-MSS

TABLE M-3 TREE DENSITY AND TIMBER VOLUME OF THREE MAIN LAND USE IN THE BASIN

No.	Land Use	Location	Tree Density (tree/ha)				Timber Volume (cu.m/ha)	References
			Tree	Sapling	Seedling	Total		
1.	Dry-Dipterocarp Forest	1. Park Mun Project						EGAT (1982)
		1.1 Reservoir	57	1,517	12,759	14,333	29.77	
		1.2 Resettlement A	93	1,125	110,000	111,222	56.61	
		1.3 Resettlement B	43	2,457	56,071	58,571	13.60	
		2. Lower Nam Kam Project						RID (1983)
		2.1 Natural	4	520	68,980	69,504	1.65	
		2.2 Disturbed	3	125	28,770	28,898	0.65	
		3. Production Distribution Project						MOA (1989)
		3.1 Amphoe Tabo, Nong Khai	62	2,800	13,500	16,362	14.00	
		3.2 Amphoe Phone Phisai, Nong Khai	27	6,400	31,000	37,427	1.90	
		3.3 Amphoe Na Duang, Loei	44	2,600	22,900	25,544	7.4	
		3.4 Amphoe Muang, Loei	85	3,900	32,700	36,685	14.5	
2.	Mixed-Deciduous Forest	4. Nam Pong Project	-	320	-	-	56.80	Wacharakitti et al. (1979)
		5. Phuphan National Park	-	394	-	-	193.1	Songai (1981)
3.	Farm Forest	6. Nam Pong Project	-	51	-	-	12.66	Wacharakitti et al. (1979)
		7. Phuphan National Park	-	35	-	-	1.76	Songai (1981)
		8. Pak Mun Project	39	293	2,439	2,771	24.34	EGAT (1982)
		9. Amphoe Tabo, Nong Khai	60	-	-	-	14.2	MOA (1989)

Taking a look closely to Table M-3, the tree density of the basin are normally lower than natural conditions, except at the resettlement area of Pak Mun project that found trees of 93 trees/ha, saplings of 1,125 trees/ha and seedlings of 110,000 trees/ha, and also timber volume of 56.61 cu.m/ha. Some of them may be included in high numbers of either one (tree, sapling, or seedling) but less in the others. Moreover, tree density was almost natural but timber volume was very low. Summarily speaking, the tree density as an indicator of healthy and wealthy structure was shown in disturbed condition everywhere and this is the sign that found in the existing condition of all the basin. Luckily, the headwaters of the Mun river basin found high density and high quantity of timber volume such as 90.48 - 127.94 cu.m/ha at Khao Yai National Park (Ratasermpong, 1978), 313.28 cu.m/ha at SERS Amphoe Pakthongchai Nakhon Ratchasima (Sangtongpraow and Sukwong, 1981). These numbers are expected to find out in the headwater sources of Lam Dom Yai river basin. Since these areas are protected as National Parks and Wildlife Sanctuary and still green as found from field observation. Unfortunately, there is no data available in wild animal study, the information in this report is obtained by interviewing and discussing with experts. Some birds were found during site visit as well as the others learnt by interviewing.

2) Water Flow and Its Regime

Due to RID's data as measured from 1966 to 1989, the results are indicated in Table M-4 and double-mass analysis in Figure M-1. During 23 year period of measurement, the flow pattern can be divided into two period: firstly, between 1966 - 1978 and secondly, between 1978 - 1989. The average of water flow was estimated in the first period at about 423,000 cu.m/sq.km/yr, the second period at about 495,000 cu.m/sq.km/yr. The reason why water flow has increased can not pinpoint and need to search. However, there might depend upon the causes of: i) siltation on the streambed at the measuring point would cause the increasing of flow rate: ii) patchy-clear cutting and illegally exploitation by local people reached at the optimum cover of approximately 70 percent would decrease the water loss by evapotranspiration as found by Packer (1951), DOC (1986), and Chunkao et al. (1981); and iii) clearing forest cover caused more impacts of raindrop to soil surface and induced finer materials to block soil pores, this is the phenomena decreases infiltration and percolation, then increasing surface water. Therefore, further study of this result is really needed in details.

TABLE M-4 ANNUAL FLOW AND ITS ACCUMULATION AS MEASURED AT HIGHWAY BRIDGE (M. 80), (CATCHMENT AREA = 3,363 SQ.KM)

Year	Stream Flow		
	Annual	Accumulative	
	(10^8 cu.m/sq.km/yr)	(10^9 cu.m/sq.km/yr)	
1966	620	620	
1967	340	960	
1968	350	1,310	
1969	370	1,680	
1970	340	2,020	
1971	420	2,440	
1972	900	3,340	
1973	130	3,470	
1974	290	3,760	
1975	600	4,360	
1976	430	4,790	
1977	290	5,080	
1978	520	5,370	Ave. 413,000
1979	490	5,860	
1980	470	6,330	
1981	410	6,740	
1982	560	7,300	
1983	460	7,760	
1984	720	8,480	
1985	540	9,020	
1986	430	9,450	
1987	540	9,990	
1988	500	10,490	
1989	330	10,820	Ave. 495,000

Ave. 470,000 cu.m/sq.km/yr

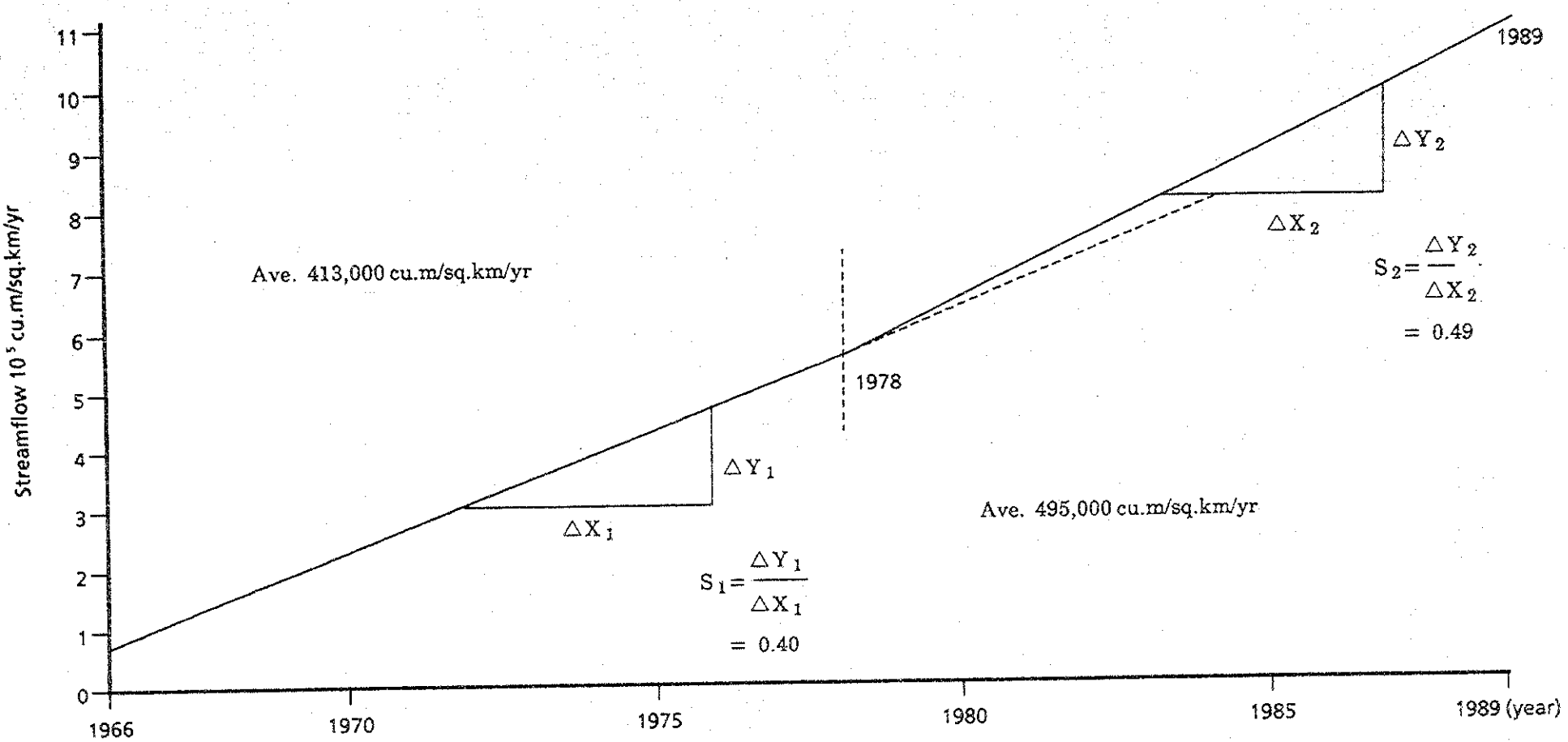

FIGURE M-1 DOUBLE-MASS ANALYSIS OF STREAM FLOW MEASURED AT HIGHWAY BRIDGE (M.80)

It is surprising noted that the amount of surface water of Lam Dom Yai river found approximately 470,000 cu.m/sq.km/yr while the hill-evergreen and mountainous watershed yielded about 1,000,000 cu.m/sq.km/yr (DOC, 1986), dry-evergreen mixed dry-dipteracarp forest watershed of Pakthongchai-Nakhon Ratchasima produced about 202,300 cu.m/sq.km/yr or 16.4 percent of rainfall (Chunkao et al., 1981), and Khao Yai National Park at Lam Thaklong was measured about 700,000 cu.m/sq.km/yr. It would be said that the Lam Dom Yai basin was given some water flow at the moderate amount.

The proposed area were modified by RID's data to determine the annual flow and results, and study results are shown in Table M-5. The annual run-off is ranged from 427,000 to 478,000 cu.m/sq.km/yr, and this amount of flow relied on the amount of rainfall. The more rainwater was obtained, the more annual flow can be expected because every proposed area has been characterized as almost homogeneous topography of flat terrain and hilly headwater. This is why well regularity of rainfall distribution was found. If observation was made, the results of Table M-5 indicated the amount of annual flow very close to Lam Dom Yai river flow (470,000 cu.m/sq.km/yr). On the other hands, the loss of water from the watersheds of all proposed areas seems very similar amount, approximately 69 percent of rainfall, while the annual flow was about 31 percent. Actually water losses of the watershed were determined in the hill-evergreen forest about 50 percent (DOC, 1986), in the whole Ubon Ratchathani Province by average about 76 percent (MOA, 1989), and 73 percent on an average in United States (Colman, 1953). Conclusively speaking, there is no resolution of forest cover affecting on amount of annual flow. In other words, the existing forest cover of all proposed areas can function in the the same role in water yield of the watershed areas. For example, watershed D-25 produces annual run-off of 460,000 cu.m/sq.km/yr, but forest cover only 24.7 percent, while watershed D-23 found annual runoff 443,000 cu.m/sq.km/yr and forest cover 81.8 percent.

TABLE M-5 ANNUAL FLOW OF PROPOSED DAMSITES IN THE BASIN AS MODIFIED FROM RID'1991 DATA

No.	Proposed Area	Watershed Area	Annual Rainfall	Annual Runoff		Loss of Water
		(sq.km)	(mm)	(MCM)	(cu.m/sq.km/yr)	(cu.m/sq.km/yr)
1.	J-1	1,062.4	1,543	508	478,000	1,065
2.	J-2	73.4	1,430	33	444,000	986
3.	J-7	141.3	1,430	63	443,000	987
4.	D-22	53.3	1,510	25	467,000	1,043
5.	D-23	646.6	1,430	286	443,000	987
6.	D-24	891.8	1,379	381	427,000	952
7.	D-25	223.4	1,484	103	460,000	1,024
8.	D-28	1,560.9	1,446	676	448,000	998

3) Waste and Pollution Existences

In the past, waste and pollution control which is one of three principles of watershed management can never initiate in the basin, because they are quite far from town and out of social control. This is why the natural resources are rapidly degrading in the last two decades. The situation of watershed resources would bring to state that waste and pollution can exist, at least water pollution, debris from fermenting fiber plant, soil pollution, and erosion. (Chunkao 1987, ARS-USDA and ORD-EPA 1975, APHA 1975, and Hunt 1975). Clear evidence was pointed out by Hornbeck and Reinhart (1964) under an investigation on the influence of different forestry practices on stream flow. The maximum turbidities of streams about 56,000 ppm on the commercial clearcut and only 25 ppm on the intensive selection cut watershed, were found and most of the damage on water quality occurred during and immediately after logging. On the other hands, changing of the forest cover more or less might change the ecological characteristics, (Copeland, 1965) consequently causing the disturbance of nutrient cycling (Herrera et al, 1981), and increasing sediment transport (Holeman 1968, UN 1953, Hunt 1975, Colman 1953, and Satterlund 1975). Pesticides are another pollutants that would occur in the basin, because there are existence of pesticide application and traces of residuals found in some spots of the basin. Unluckily, there is no study on the pesticide application data, only Mun river water qualities are available. Agronomical activities have surely utilized fertilizer and may transport it into stream or river. Erosion and leaching processes as encouraged by topographic

condition changes texture of soil profile as described by Fair el al. (1971). Waste of fertilizer from cultivation crop does not have any information in the basin.

Field experiences would summarily conclude that there are the existences of wastes and pollutants occurring in the Study Areas. Since it is hard to assess the positive or negative impacts by the project, further study is really needed.

3. 4 Sediment Yields in Soil Erosion Conditions

The average suspended sediment yield was investigated during 1978 - 1987 (10-year period) about 63 ton/sq.km/yr with maximum of 83 ton/sq.km/yr and minimum of 37 ton/sq.km/yr, as shown in Table M-6. Based on the application of bedload determination as suggested by EGAT (1982), the bedload is about 20 percent of suspended sediment yields. Therefore, the bedload will be 12.6, 16.6, and 7.4 ton/sq.km/yr, and the total sediment will be 75.6, 99.6, and 44.4 ton/sq.km/yr of average, maximum, and minimum yields, respectively. Previous research results were determined at Khao Yai National Park 76 *ton/sq.km/yr* , (KU Forestry, 1982), Kog Ma Watershed Research Station in Chiangmai 40 ton/sq.km/yr. Holeman (1968) studied from major rivers in the world and recommended that natural soil loss from watershed area should be less than 65 ton/sq.km/yr, and supported by UN (1953). By setting standard, the basin at Lam Dom Yai could be characterized as a little more than it should be, but it is not under the serious condition. Field survey found that soil loss occurred in the basin, especially cultivated areas, streambanks, and some hilly areas. However, only suspended sediment yield can be stated that the Lam Dom Yai watershed would be classified as in normal condition.

September is the month of maximum sediment yield of 23.17 ton/sq.km/yr. This is not big quantity and could not cause any serious problem but losses of nutrients found whenever rainstorm occurs. In other words, soil erosion is not the cause of problem in the basin, because topographic condition cannot be the main factor and the density of forest cover can protect soil erosion.

TABLE M-6 MONTHLY AND ANNUAL SUSPENDED SEDIMENT TRANSPORT OF LAM DOM YAI (3,363 CU.M) AT DET UDOM STATION

Monthly Sediment Transport			Annual Sediment Transport		
Month	Monthly Sediment		Year	Annual Sediment	
	(ton)	(ton/sq.km/yr)		(ton)	(ton/sq.km/yr)
Apr.	117	0.03	1978	208,445	83
May	617	0.18	1979	243,612	72
Jun.	7,983	2.37	1980	215,944	64
Jul.	17,466	5.19	1981	168,874	50
Aug.	43,675	13.00	1982	208,032	62
Sep.	77,921	23.17	1983	125,600	37
Oct.	52,828	15.71	1984	269,355	80
Nov.	10,164	3.02	1985	196,238	58
Dec.	1,451	0.43	1986	216,663	64
Jan.	463	0.14	1987	205,186	61
Feb.	206	0.06	Ave.	212,995	63
Mar.	105	0.03	Max.	280,445	83
Total	212,995	63.33	Min.	125,600	37

3. 5 Development and Rural Management Activities

According to the review on the Ubon Ratchathani's general information, the total population is about 1.9 million dwelling in 21 Amphoes, 3 King-Amphoes, 245 Districts (Tambon), 2,682 villages (Muban). Total income of the province was estimated at 15, 261.26 million Baht in 1988, and 8,545 Bath/person on an average. About eighty percent of population are agriculturists of both crop cultivators and animal-raising farmers, and using rice paddy field of 4.4 million rai, cassava of 120,000 rai, kenaf of 170,000 rai, soybean of 10,152 rai, corn of 25,900 rai, cotton of 4,000 rai, mulberry trees of 9,488 rai, and doing livestock farming for 376,178 buffaloes, 155, 330 cows; 141,447 pigs, 485, 782 ducks, and 2,089,910 chickens.

To support the agricultural activities to provide sustainable income of the local people, there are a lot of projects to encourage some developmental and rural management activities, such as, water resources development, transportation development, tourism, and health programs. Unfortunately, there is no specific information in the basin, and this is very difficult to transfer the basic information to impact assessment from irrigation projects by RID in

the Lam Dom Yai watershed. My site visit learnt that there were a lot of developmental and rural management activities undertaken at the proposed areas. Intensive investigation is really needed, if the Lam Dom Yai project would be launched for irrigation program in future.

Forest development programs have been conducted for years, such as protection programs, national parks and recreation, wildlife sanctuary, land consolidated programs, privatized-community forest manipulation, and reforestation. The study of these forestry programs is also needed as a part of intensive investigation. Eucalyptus is the main species to be grown in the basin, but needed intensive study.

Fisheries products have been collected since 1969 by the Department of Fisheries. The gross products only in 1989 were surveyed and estimated at about 3,113 tons for the whole Province of Ubon Ratchathani. The amount of products have mostly received from the Mun river. If the man-made reservoir under the irrigation Lam Dom Yai project was needed to initiate, intensive study of fisheries and its productivity must be included in the whole programs of study on environmental impact assessment (EIA).

3. 6 Archaeological and Cultural Environments

Although there is nothing to worry about archaeological issues in the basin as reported by Ministry of Education, but the intensive study should pay more attention at the dam-sites and reservoir areas. However, the report recommended that any development program should avoid the location of Phu-Arng and some remote areas. These areas have potentials to preserve the archaeological materials as well as old cultural environment that can be found out.

There is no report concerning the culture of the basin, but only telling by old generation, interviewed during my site visit, and there are some their own culture differing from the other groups. Intensive study is also needed before taking any action of the irrigation project in Lam Dom Yai basin.

3. 7 IEE Evaluation to Site Screening

Existing background presented in the previous sections plays vital role in initial environmental effect (IEE) evaluation to site screening. As stated before, one proposed areas will be selected to implement Feasibility Study in Lam Dom Yai Irrigation Project. For environmental survey and evaluation, the proposed areas with the proposed areas water the least effect or impact should be chosen. It was told at the beginning when the proposed site was visited and observed on the basis of field reconnaissance. The evaluation is relied on field reconnaissance and reviewing of literature as well as the expertise of an evaluator. By the said procedure, evaluation might mislead because of lacking some basic information to support for predicting the environmental impacts.

As evaluation procedure, the scaling checklist method has been applied. The basic principle is given the maximum and minimum scale of effect. This evaluation is fixed maximum number as five (5) for maximum effect and gradually decreasing degree of effect down to one (1) as the least effect. The least of total number is the least effect of the project on environment. On the other hands, the more the total number is the more effects. Therefore, the decision maker should take the least number to implement the project.

The study has been taken 18 environmental parameters (within six groups) as indicated in Table M-7. Based on the basic principle as stated above, the dam-site D-28 is the least effect on environment, the dam-site D-24 and J-2 as the second D-23, and J-1 as the third, and D-22 and J-7 as the fourth. However, the evaluating scores of eight proposed areas are very close and do not show any difference, because the areas are very similar in topography, ecology, climatology, hydrology, penology, geology, and forestry as found on the site visit and from the review of literature. One area may get a difficulty in compensation (more population and crop land) but having less tree cover, in such watersheds D-25 and D-28. If and only if, the decision maker needed two watershed areas, as proposed areas, D-28 and D-23 should be recommended, with the reason of large area of headwaters covering dense forest. Self regulation of water flow and soil erosion control would be reached at the satisfaction level as well as fulfillment of the objectives of irrigation programs. If not, the decision maker must take the consideration with engineering

TABLE M-7 APPLICATION OF SCALING CHECKLIST TO EVALUATE THE PROBABLE EFFECTS OF LAM DOM YAI IRRIGATION PROJECT ON ENVIRONMENTS

No	Environment	Scaling of Probable Effect								
		J-1	J-2	J-7	D-22	D-23	D-24	D-25	D-28	Total
1	Forest									
	1. Area/Land Use	2	2	4	5	5	2	3	5	28
	2. Density	4	4	4	4	4	4	4	4	3
	3. Cover of Reservoir	3	5	3	3	5	5	3	5	32
2	Wildlife	3	3	3	3	3	3	3	3	24
3	Water Flow									
	1. Quantity	3	2	2	3	2	2	3	2	19
	2. Quality	3	3	3	3	3	3	3	3	24
	3. Headwater Potentials	3	2	2	1	1	3	4	1	17
4	Soil Erosion									
	1. Sediment Yield	2	2	2	2	2	2	2	2	16
	2. Ground Surface	2	2	2	2	2	2	2	2	16
	3. Siltation	3	3	3	3	3	3	3	3	24
	4. Streambank	2	2	2	2	2	2	2	2	16
5	Irrigation Potentials									
	1. Reservoir Capacity	4	4	4	4	3	3	2	2	26
	2. Irrigated Area	2	2	2	2	2	2	1	1	14
6	Socio-Ecomonics									
	1. Social Effects	1	1	1	1	1	1	1	1	8
	2. Economy	1	1	1	1	1	1	1	1	8
	3. Archaeology	2	2	2	2	2	2	2	2	16
	4. Compensation	5	3	5	5	3	3	5	3	32
	5. Social Need	1	1	1	1	1	1	1	1	8
	Total	45	45	46	47	45	44	45	43	360
	Average	-	-	-	-	-	-	-	-	20

Note : Series of effect, beginning from the least 1, 2, 3, 4, and 5 as the most effects.

technique and economic criteria, and integration of all considerations will be the answer, which watershed should be chosen.

Among the proposed areas of eight watersheds, the dominant influences could be divided into four groups: they are the most sensitive environment such as forestry (areas, density, and cover of reservoirs), reservoir capacity, and compensation; the second are medium effects such as wildlife, water quantity and quality, and siltation; the third are headwater potentials, sediment yields, ground surface erosion, streambank erosion, size of irrigated area and archaeological importances; and final groups are the least negative effects or gaining benefits from the project such as social effects, economy, and social need. In so far, the average was estimated at about 20 marks from 90 marks or 22 percent and, this project can implement but carefulness of forestry wildlife, soil erosion, and compensation must be taken.

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CHAPTER IV. ENVIRONMENTAL SETTING

4. 1 Aquatic Ecosystem

The impoundment of the Lam Dom Yai reservoir would alter existing conditions of fisheries and aquatic biology to some extents. The impoundment by itself would cause aquatic population in the lower-reaches of the river to change as a consequence of changes in the river flow regime. The fish production from the reservoir is expected to increase considerably, but some species may be affected by the blockage of river flow by the dam. Socio-economically, the fishing occupation would become more important for subsistence fishermen than at present, and a great number of households may be converted from rice farmers to full-time fishermen, depending on the extent to which fish production will increase.

The results of the study on hydro-biological and fishery survey in Sirinthorn Reservoir, Ubon Ratchathani Province (in 1988) in which the reservoir is created by the closure of the dam on Lam Dom Noi river at Amphoe Phibun Mangsaham near by the project on Lam Dom Yai, are summarized in the tables below.

TABLE M-8 CHARACTERISTICS OF WATER IN SIRINTHORN RESERVOIR (JAN.-SEPT. 1987)

Characteristics	Ban Kok Thieng (at the Dam)	Ban Non Chan (Middle of Reservoir)	Ban Na Dom (Inlet from Lam Dom Noi)
Air Temp (°C)	25.0 - 33.0	24.0 - 31.0	27 - 32
Water Temp (°C)	25.5 - 33.5	24.0 - 30.5	27 - 31
Transparency (cm)	Clear - 150	Clear - 120	clear - 10
pH	7.0 - 7.3	7.0 - 7.2	5.5 - 6.5
DO. (mg/lit.)	8.8 - 9.6	7.6 - 9.2	5.2 - 6.5
CO_2 (mg/lit.)	2.0 - 4.0	2.0 - 4.0	4.0 - 6.0
Alk. (mg/lit.)	12 - 22	20 - 32	14 - 28
Hardness (mg/lit.)	10 - 14	14 - 22	14 - 28

TABLE M-9 COMPOSITION AND DENSITY OF PLANKTON IN SIRINTHORN RESERVOIR (JAN. - SEPT. 1987)

(Unit : 1.000 cell/cu.m)

Plankton (Phylum)	Ban Kok Thieng (at the Dam)	Ban Non Chan (Middle of Reservoir)	Ban Na Dom (Inlet from Lam Dom Noi)
Phytoplanton			
Chrysophyta	295 - 325	70 - 1,105	75 - 130
Chlorophyta	525 - 1,370	60 - 435	40 - 520
Charophyta	65 - 435	20 - 250	30 - 45
Phrophyta	0 - 110	0 - 50	0 - 5
Total	1,185 - 1,775	150 - 1,799	170 - 698
Zooplankton			
Protozoa	5 - 100	15 - 75	30 - 80
Englenoid	0 - 15	0	0
Arthropoda	5 - 30	5 - 15	0 - 10
Rotifere	0 - 20	0	0
Total	40 - 130	20 - 110	45 - 100
Total Plankton	1,230 - 1,820	170 - 1,909	215 - 745

TABLE M-10 COMPOSITION AND DENSITY OF BENTHIC IN SIRINTHORN RESERVOIR (JAN. - SEPT. 1987)

(Unit : ind./sq.ft)

Benthic	Ban Kok Thieng (at the Dam)	Ban Non Chan (Middle of Reservoir)	Ban Na Dom (Inlet from Lam Dom Noi)
Oligocheate	0	0	0
Insects	8 - 32	12 - 44	0 - 5.2
Ostracod	0 - 20	0 - 96	0
Decapod	0 - 24	0 - 4	0 - 16
Gastropod	0	0 - 4	0 - 14
Pelecypod	0	0	0 - 4
Total	8 - 60	24 - 108	0 - 56

TABLE M-11 FISH STANDING CROP (ESTIMATED BY SPOT POISONING) AND PERCENT BY WEIGHT OF EACH KIND OF FISH IN SIRINTHON RESERVOIR (JAN. - SEPT. 1987)

Sampling Station	Location	Month	Fish Standing Crop (kg/rai)	% by weight of fish standing crop			
				Carp	Cat fish	Mullet	Misc.
Ban Poo Thong	at the Dam	Jan	8.89	6.4	0.80	-	92.8
Ban Kok Thieng		May	4.95	6.1	-	13.1	80.8
Ban Kok Thieng		Sep	1.56	-	-	80.6	19.4
Ban Non Chan	Middle of	Jan	8.70	5.2	-	24.6	70.2
Ban Non Chan	Reservoir	May	7.12	17.8	-	35.0	47.2
Ban Non Chan		Sep	4.27	5.7	-	-	94.3
Ban Na Dom	Inlet from	May	11.78	13.3	8.63	47.4	30.67
	Lam Dom Noi	Sep	6.98	63.7	0.7	2.5	33.1
Average fish standing crop			6.78	14.8	1.3	25.4	58.5

TABLE M-12 VARIATION OF FISH STANDING CROP AT BEGINNING OF FILL PERIOD OF SIRINTHON RESERVOIR

The Year	Fish Standing Crop (kg/rai)	No. of Species	% by weight of fish standing crop			
			Carp	Cat fish	Mullet	Misc.
1970	11.30	-	26.42	0.80	56.66	16.12
1971	8.60	40	18.86	9.08	31.11	40.95
1972	8.30	42	17.57	1.65	34.67	45.78
1973	11.80	43	11.71	7.16	38.35	42.78
1987	6.78	52	14.80	1.30	25.40	58.50

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4. 2 Terrestrial Ecosystems

1) Forest Ecology

Forest is one of the most concerned ecological resources for any irrigation development project. Flooding of the reservoir area will undoubtedly destroy the forest areas in the impounding zone. Regarding the Lam Dom Yai Basin irrigation project, the reservoir area of about 43.3 sq.km would destroy the forest areas of 24 sq.km. In these affected areas, it is necessary to investigate existing forest ecology and economics in order to assess the total impacts resulting from the project development.

2) Methodology

The study on forest ecology was carried out in the area inside the proposed reservoir area. This area was divided by Lam Dom Yai into left bank forest and right bank forest. Circular sample plots were established in each forest type distributed along both the banks at random. Each circular sample plot having a radius or 17.85 m., covering an area of 0.1 ha or 1,000 sq.m. Within each of these plots, the diameter of every trees having a diameter bigger than 10cm at breast height (dbh) was measured (classified as commercially valuable trees), and record was made on the number of merchantable logs (each with a length of 10m) together with the local name of the trees. These data were used for calculation of stem volumes for economic evaluation, as well as for calculation of stand density. At the center of each plot, the circular radius of 12.64 and 5.65m was set up in order to record number of sapling (trees having dbh below 10cm) and seedling (trees having height less than 1.30 m). The data on sapling and seedling were used in estimating the abundance of forest natural generation.

3) Results of the Study - - - Distribution and Ecological Characteristics of Forest Communities inside the Reservoir Area

Forests in Lam Dom Yai Project Area can be divided into two major types : i) mixed deciduous forest and ii) dry dipterocap forest. Distribution and ecological characteristics of each forest type can be discussed in details as follows:

a) Mixed Deciduous Forest

Mixed deciduous forest covers the major area of about 16sq.km or 66.7percent of the total forest within reservoir area. The unique characteristics of this phenotype is the hardwood with dark color. Other common species were found during the inventories such as Taback (Largerstroemia cuspidata), Dang or Iron wood (Xylia xylocarpa), Pradun (Ptercarpus macrocarpus), Makok or Hogplun (Spondias pinnata), Saan (Dillenia obovata), Taklow or Celon Oak (Schleichera oleosa).

Mixed deciduous forest in reservoir area is mainly formed by small-sized trees with diameter at breast height (dbh) ranging between 10-30 cm. A few trees having dbh exceeding 60 cm with the high more that 15 m were found and the important species are Taback and Dang.

b) Dry Dipterocarp Forest

Dry dipterocarp forest found in reservoir area covers an area of about 8 sq.km or only 33.3 percent of the total reservoir area. this forest type is mainly composed of small to medium - sized trees with diameter at breast height (dbh) ranging from 10 to 30 cm. The common tree species are Teng or Burma Sal (Shorea obtusa) and Dang.

The field surveys were conducted during the Phase II field survey, and the results were calculated and shown in Table M-13 to Table M-19.

TABLE M-13 PLANT DENSITY OF EACH PLOT IN RESERVOIR AREA

(Unit : tree/ha)

No.of Plot	Tree Density					
	dbh 10-30cm	>30-60	>60	Total	Sapling	Seeding
R1	4	2	-	6	-	-
R2	10	4	1	15	-	3
R3	15	2	1	18	-	14
R4	9	1	-	10	-	11
R5	32	-	-	32	-	-
R6	6	1	-	7	-	-
R7	3	11	-	14	-	-
R8	25	3	-	28	-	-
R9	2	3	-	5	-	-
R10	-	3	1	4	-	-
R11	1	2	1	4	-	-
R12	3	2	-	5	-	-
R13	1	2	1	4	-	-
R14	4	3	-	7	-	-
R15	1	5	-	6	-	-
R16	28	6	-	34	-	-
R17	6	4	-	10	-	-
R18	14	5	-	19	-	-
Total	164	59	5	228	-	28
Tree/ha	9	3	-	13	-	2

TABLE M-14 PLANT DENSITY OF EACH PLOT IN RESERVOIR AREA

(Unit : tree/ha)

No.of Plot	Tree Density					
	dbh 10-30cm	>30-60	>60	Total	Sapling	Seeding
L1	6	5	1	12	-	5
L2	7	6	3	16	-	4
L3	7	7	1	15	-	5
L4	1	8	-	9	-	-
L5	7	2	2	11	-	-
L6	3	3	-	6	-	-
L7	14	1	-	15	-	17
L8	23	3	1	27	-	8
L9	5	-	-	5	-	-
Total	73	35	8	116	-	39
Tree/ha	8	4	1	13	-	4

TABLE M-15 TREE VOLUMES OF VARIOUS QUALITY IN RESERVOIR AREA

(Unit : cu.m)

No.of Plot	Timber Quality Class					Total
	1.1	1.2	1.3	2	3	
R1	-	-	0.4888	0.2310	0.0818	0.8016
R2	1.7567	1.1437	0.6681	-	0.2269	3.7954
R3	1.7567	-	0.8122	0.2068	0.2690	3.0447
R4	-	-	0.3347	0.4051	0.1589	0.8987
R5	-	-	-	0.6021	0.7673	1.3694
R6	-	-	0.5960	0.5545	0.0926	1.2431
R7	2.7147	1.9911	0.9021	-	0.6243	6.2322
R8	2.2583	-	0.2841	2.2847	0.4277	5.2548
R9	-	-	1.0313	0.4525	-	1.4838
R10	3.4186	-	0.5961	-	-	4.0147
R11	2.9329	-	-	0.2081	-	3.1410
R12	-	-	1.0470	0.4720	-	1.5190
R13	1.7567	-	0.7219	0.0517	-	2.5303
R14	-	-	1.1709	0.4391	0.0316	1.6416
R15	1.1314	-	1.8598	0.2081	-	3.1993
R16	-	-	2.1388	1.2397	0.5237	3.9022
R17	-	-	2.1064	0.7730	0.0644	2.9438
R18	-	-	2.2068	0.1551	0.3144	2.6763
Total	17.726	3.1348	16.965	8.2835	3.5826	49.6919
Aver/Plot	0.9848	0.1742	0.9425	0.4602	0.1990	2.7607
Vol/ha	9.848	1.742	9.425	4.602	1.990	27.607

TABLE M-16 TREE VOLUMES OF VARIOUS TIMBER QUALITY IN RESERVOIR AREA

Left Bank

(unit: cu.m)

No.of Plot	Timber Quality Class					Total
	1.1	1.2	1.3	2	3	
L1	3.1967	-	1.2771	0.4679	0.0467	4.9824
L2	9.5475	-	1.2359	0.1752	0.0704	11.0290
L3	3.1967	-	1.2711	0.4679	0.0467	4.9824
L4	2.2397	-	1.7098	0.2081	-	4.1576
L5	2.9835	-	0.8122	0.4051	0.1042	4.3050
L6	-	0.5960	0.7584	-	0.2286	1.5830
L7	0.9596	-	-	0.7735	0.2310	1.9741
L8	2.5715	-	0.7078	0.4321	0.5424	4.2438
L9	-	-	-	0.1453	0.1339	0.2792
Total	24.6952	0.5960	7.7663	3.0751	1.4139	37.5465
Aver/Plot	2.7439	0.0662	0.8629	0.3417	0.1571	4.1718
Vol/ha	27.439	0.662	8.629	3.417	1.571	41.718

TABLE M-17 TREE VOLUMES OF VARIOUS TIMBER QUALITY

Right Bank

(Unit : cu.m/ha)

Size of Timber (Perimeter)	Timber Quality Class					Total
	1.1	1.2	1.3	2	3	
> 80cm	6.2281	1.1437	-	-	-	7.3718
< 80cm	11.4979	1.9911	16.9650	8.2835	3.5826	42.3201

Left Bank

Size of Timber (Perimeter)	Timber Quality Class					Total
	1.1	1.2	1.3	2	3	
> 80cm	15.9404	0.5960	-	-	-	16.5369
< 80cm	8.7543	-	0.7663	3.0751	1.4139	21.0096

TABLE M-18 TIMBER PRICE BASED ON VOLUME PER HECTARE FOR EACH CLASS OF TIMBER QUALITY

Right Bank

Size of Timber	Class 1		Class 2		Class 3		Total	
(Perimeter)	Volume	Price	Volume	Price	Volume	Price	Volume	Price
	(cu.m)	(Baht)	(cu.m)	(Baht)	(cu.m)	(Baht)	(cu.m)	(Baht)
> 80cm	7.3718	10,460	-	-	-	-	7.3718	104,600
< 80cm	13.4890	6,879	8.2835	4,224	20.5476	10,479	42.3201	215,820

Left Bank

Size of Timber	Class 1		Class 2		Class 3		Total	
(Perimeter)	Volume	Price	Volume	Price	Volume	Price	Volume	Price
	(cu.m)	(Baht)	(cu.m)	(Baht)	(cu.m)	(Baht)	(cu.m)	(Baht)
> 80cm	16.5369	23,466	-	-	-	-	16.5369	234,660
< 80cm	8.7543	4,465	3.0751	1,568	9.1802	4,682	21.0096	107,150

Note : 1. Timber Price for size > 80cm is about 1,419 Baht/cu.m
2. Timber Price for size < 80cm is about 510baht/ cu.m
3. Timber class :
   (a) Timber class 1 = Timber Quality 1.1 + 1.2 for good quality timber with dbh > 30 cm.
   (b) timber Class 2 = T. Q. 2 for good qualtiy timber with dbh 10-30 cm.
   (c) Timber Class 3 = T.Q. 1.3 + 3 for good quality timber, suitable for fuel wood

TABLE M-19 LOCAL AND BOTANICAL NAME IN THE BASIN

Series	Local Name (Tree)	Botanical Name
1.	ยางกราด	Dipterocarpus Intricatus Dyer
2.	พลวง	Dipterocarpus tuberculatub Roxb
3.	รัก	Semecarpus reticulata Lec
4.	ตั้วขน	Cratoxylum formosum (Jack)
5.	จิก	Barringtonia coccinea Kostel
6.	มะเม่าขน	Antidesma montanum BL.
7.	แดง	Xylia xylocarpa Taub
8.	ยอป่า	Moernda coreia Ham
9.	กว้าว	Adina cordifolia Hook f.
10.	หว้า	Eugenia cumini
11.	แสลงใจ	Strychnos nux-vomica
12.	ตีนนก	Vitex pinmata Linn
13.	พยอม	Shorea floribunda G. Dom
14.	เล็บเหยี่ยว	Ziryyphus oenoplia (L) Mill
15.	กระบอก	Thevetia peruviana Schum
16.	เหมือดคน	Scleropyrum wallichianum Asnott
17.	ชงโค	Bauhinia subsessilis Craib
18.	เต็ง	Shorea obtusa Wall
19.	ตะแบก	Lagersroemia calyculata Wall
20.	ฉนวน	Dalbergia nigrescense Kurry
21.	หลาย	Grewia Microcos Linn
22.	มะกอกป่า	Spondias pinnata
23.	มะกอกเกลื้อน	Canarium subulatum Guill
24.	ประดู่	Pterocarpus macrocarpus Kurry
25.	มะหาด	Celtis tetranda Roxb
26.	กระเชากลัก	Hydnocarpus ilicifolium King
27.	เหียง	Dipterocarpus intricatus
28.	ร่อย	Streblus asper Lour
29.	กระโดน	Careya sphaerica Roxb
30.	กระทุ่มนา	Mitr agyna javanica Koord
31.	กระบก	Irvingia malayana Olivex A. Benn
32.	ส้าน	Dillenia supp.
33.	สะเดาช้าง	Toxicodendron succedanea Mold
34.	ตะคร้อ	Schleichera oleosa (Lour)Oken
35.	มะพอก	Parinari anamense Hance

4. 3 Social Setting

1) Introduction

The Lam Dom Yai Basin Irrigation project area covers three Ampoes of Changwat Ubon Ratchathani, namely : Amphoe Det Udom, Amphoe Phibun Mungsahan, and Amphoe Na Chaluai. According to the plan, there are two alternatives schemes : In alternative plan A-1, the water will be fed by pumping to the irrigated areas which lying on both sides of the river just downstream of the reservoir. There are 8,300 ha of irrigation area on the left side and 23,900ha area on the right side. In alternative plan B-1, the water will be delivered to the area on the right side only, having the same total area as in alternative plan A-1, table M-20 shows the list of the 26 Tambons situated in the proposed irrigation area for both alternatives.

TABLE M-20 LIST OF TAMBONS IN THE PLANNED IRRIGATED AREAS

Alternative Plan A-1		Alternative Plan B-1
Left Bank	Right Bank	Right Bank
Non Sawan	Klang	Klang
Top Hu	Bua Ngam	Tha Pho Si
Yang	Kham Khrang	Muang Det
Kut Rua	Kut Prathai	Phon Ngam
Kaeng	Na Yia	Bua Ngam
Na Khasem	Na Pho	Kam Khrang
Som Sa-at		Kut Prahtai
Maung Det		Na Yia
		Na Pho
		Rai Tai
		Pho Sai
9 Tambols	6 Tambols	11 Tambols

Note The above Tambons are in Amphoes of Changwat Ubon Ratchathain, namely : Amphoe Det Udom, Amphoe Phibun Mangsahan, Amphoe Na Chaluai.

At the planned compensation water level of EL. 140.0m in the reservoir, eight villages in five Tambons would be affected in case of a flood time, without any protection dikes. There are 122 affected households, with the total population of 659 persons (5.4 person per household) with protection dikes

2 m high. These villagers have to be evacuated to a selected resettlement sites. The basic socio-economic data as well as public health information of the communities both in the irrigation areas and in the inundated area are necessary for the evaluation of the impacts on quality of life value and in the drafting of an effective resettlement plan.

TABLE M-21 LIST ON VILLAGES TO BE AFFECTED BY COMPENSATION WATER LEVEL

Village	Tambon	Amphoe
Left Side :		
Ban Bua Thiam	Klang	Det Udom
Ban Khok Thiam	Non Sombun	Na Chalui
Ban Fang Phe	Pon Sawan	Na Chalui
Ban Non Sawang	Pon Swan	Na Chalui
Ban Sung Kham	Pon Sawan	Na Chalui
Right Side :		
Ban Kham Tao	Top Hu	Det Udom
Ban Non Wan	Non Sawan	Na Chalui
Ban Kaeng Kok Hai	Non Sawan	Na Chalui

2) Methodology of Data Collection

The basic socio-economic data for the communities in the project areas were obtained mainly from data collection, field observation, and field surveys. The field surveys were conducted during the period of Phase II field survey using questionnaire forms which had bean prepared in advance with the purposes of finding out the present socio-economic background of the villagers in the proposed inundated area and in the areas to be irrigated by the project. In addition, the questionnaires also aim at finding out, indirectly, the villagers' attitude towards the general idea of developing water resources by the construction of weirs and dams. The total number of 103 sets of questionnaires were used, with 32 sets for the inundated villages, and 71 sets for the irrigated area.

The questionnaire consists of the questions on the following items:

- General village conditions

- Occupation of villagers
- Sources of water supply
- General sanitation and health
- Infrastructure, such as, roads, electricity, and water supply
- Problems and needs for local development
- Attitude forwards water resources development in general, on awareness and attitude on the governmental land reforming scheme, on Pak Mun Dam project, which is selected as a typical case of a large-scale water resources scheme.

For the inundated area, all the villages were surveyed, in which, several samples for each villages, were interviewed. The persons interviewed include village leaders, priests, teachers, and some villagers selected at random. But for the irrigated areas, only one interview with the village leader of each village could possibly be made in this survey to obtain general picture of the villages.

Other source of information also consulted are:

- The National Surveys at Tambon level, carried out by the National Statistics Office, Ministry of Interior, 1991.
- JICA Socio - economic survey data in the Study Area in 1991.

- Data from the Institute of Data Processing for Education and Development, Thammasart University, 1988.

3) Results of the Study

(a) General Village Characteristics

The people living in the Project Areas just recently have migrated from the nearby areas and provinces within 10 - 30 years period, to settle and convert forests into cultivated lands. Although most of them do not hold complete official documents of land owernship, but they do pay land duty regularly to the local district offices. Most villagers hold the temporary land permits.

All the villages in the Project Area have similar characteristics. Nearly all the houses are of semi-permanent type, indicating the well-being of the villagers, with the average income level in the middle scale.

The main occupation is farmer (rice-growing), followed by crop plantation using rain water, for which a family owns a large strip of cultivated land. The villagers also grow vegetable and rear livestock for their own consumption.

Electrical power lines have been laid to all the villages by the Provincial Electricity Authority, with a network of relatively good rural roads joining the villages, although most of road become impossible to pass in the wet season. The tradition of using water buffaloes for ploughing the paddy fields is still practised. Drinking water comes from rainwater stored in jars and shallow wells without boiling, but the water for general use is obtained from deep groundwater pumping wells which has unpleasant taste. The villagers expressed a general need for additional water for cultivation to supplement rainwater. The water in the Lam Dom Yai has not been used because of the great distance between the cultivation fields and the source of water.

The general conditions of public health of the villagers appear to be in goods conditions. Some water-borne diseases and malaria have occasionally reported. Nearly all the households in the Project Area use pit latrines.

There is one Wat (temple) in each village and there is one priest, on the average, in each of these Wats. The cooperation and the felling-togther of the villagers relatively good. Usually each village consists of several clusters of houses, and there is a leader for each cluster. Each village will have its own rules which promote cares amongs the villagers and help each other taking care of their properties. The problems of theft are little.

(b) Attitudes Towards Construction of Water Resources Projects

With regards to the opinion on the water resources development schemes in general, the majority of the villagers (over 80 percent) in the area to be inundated prefer weirs to dams. About 50 percent of the people fear that the construction of a large dam would deprive them of their lands and that the compensation cost would not be adequate. However, if the dam construction is

unavoidable, they want fair compensation cost, a nearby resettlement site, and they will probably not change their occupation.

The similar attitudes were expressed by the people in the proposed irrigated areas of the project. Most of villagers in all the areas surveyed support the idea of agricultural land reform schemes, but they do not like the waiving of the right to sell their lands.

ANNEX N. COLLECTED DATA AND GOVERNMENT OFFICIALS INTERVIEWED BY STUDY TEAM

ANNEX N. COLLECTED DATA AND GOVERNMENT OFFICIALS INTERVIEWED BY STUDY TEAM

CHAPTER I. COLLECTED DATA AND INFORMATION

The subsequent data related to the Lam Dome Yai river basin have been collected by the Study Team in the course of the field works.

1.1 Meteorology and Hydrology

Maps and Drawings

1. Topographic map of Lam Dome Yai river basin, prepared by Survey Division in 1974 and 1984, S = 1/50,000
2. Topographic map of Lower Northeast Region, prepared by Survey Division in 1989, S = 1/250,000

Reports

1. Climatological Statistics (Amphoe Muang, Ubon Ratchathani), prepared by Northeastern Region Meteorological Center, Ubon Ratchathani Province in 1989 and 1990
2. Climatological Report (1988-1990), prepared by Si Sa ket Agrometeorological Station
3. Hydrological Year Book (1965-1988), prepared by RID Hydrological Division

Data and Information

1. Rainfall record as indicated below are collected from RID Hydrology Division.

- Amphoe Warin Chamrap Station	: 1952 - 1989
- Amphoe Muang Station	: 1952 - 1989
- Amphoe Phibun Mangsahan Station	: 1955 - 1989
- Amphoe Det Udom Station	: 1952 - 1989
- Amphoe Nam Yun Station	: 1980 - 1989
- Amphoe kan Thararom	: 1952 - 1989
- Amphoe Kantharalak	: 1952 - 1989

2. River run-off record as indicated below are collected from RID Hydrology Division

- Ban Kaeng Yang (M75	: 1965 - 1989
- Det Udom (M80)	: 1965 - 1989

- Huai khayung (M66) : 1965 - 1989
- Ban Alang (M98) : 1979 - 1989

1.2 Water Resources Planning

Maps and Drawings

1. Location map of Lam Dome Yai River Basin Development Project,prepared by Regional Irrigation Office(RIO) V, RID, S = 1/100,000
2. Location Map of Existing and Proposed Irrigation Project, prepared by RIO V, RID, S = 1/50,000
3. Location Map of Phanom Dong Rek Program, prepared by RIO V, S=1/100,000

Reports

1. Policies for Development of Water Resources, prepared by National Water Resources Committee, Office of the National Water Resources Committee, 1990

2. Water for the Northeast: A strategy for the Development of Small-Scale Water Resources, prepared by the Asian Institute of Technology in 1978.
3. Summary Report of Pak Mun Project, prepared by Electricity Generating Authority of Thailand (EGAT) in 1989
4. Summary Report of Upper and Lower Huai Phalan Sua Project, prepared by RIO V, RID
5. Report of Phanom Dong Rek Project, prepared by RIO V, RID

Data and Information

1. Outlines of existing Medium-Scale Irrigation Project (MSIP), prepared by RIO V, RID
2. Outlines of existing Small-Scale Irrigation Project (SSIP), prepared by RIO V, RID
3. Outlines of proposed MDIP and SSIP in Phanom Dong Rek Program, prepared by RIO V, RID
4. Outlines of proposed Large and Medium-Scale Irrigation Project in Lam Dome Yai River Basin Development Project
5. Number of domestic water source by Tambon in Lam Dome Yai river basin

1.3 Soil and Land Use

Maps and Drawings

1. Detailed Reconnaissance Soil Map of Ubon Ratchathani Province, prepared by Department of Land Development(DLD) in 1974, S= 1/100,000
2. Detailed Reconnaissance Soil Map of Si Sa Ket Province, prepared by DLD in 1974, S= 1/100,000
3. Land Use Map in Ubon Ratchathani Provinces, prepared by DLD in 1988 S = 1/100,000

Reports

1. Soil Survey Report of Changwat Ubon Ratchathani, prepared by Soil Survey Division, Department of Land Development (DLD) in 1971
2. Soil Survey Report of Changwat Si Saket, prepared by Soil Survey Division, DLD in 1977
3. Land Use Report of Ubon Ratchathani, prepared by Land Use Planning Division, DLD in 1985

1.4 Geology and Embankment Material

Maps and Drawings

1. Geological Map of Thailand, S=1/1,000,00, prepared by Department of Mineral Resources (DMR)
2. Geological Map of Thailand (Northern Sheet), S=1/50,000, prepared by DMR
3. Hydrogeological Map of Thailand, S=1/500,000, prepared by DMR
4. Geological Map of Thailand (Ubon Ratchathani and Si Sa ket), S=1/250,000, prepared by DMR

Reports

1. Geology of Khorat Plateau, prepared by DMR
2. Existing Well Investigation (1960 - 1982), prepared by DMR
3. Geological Investigation Report of Huai Wang Yai, prepared by RID
4. Geological Investigation Report of Huai Luang, prepared by RID
5. Geological Investigation Report of Lam Dom Yai, prepared by RID
6. Geological Investigation Report of Huai Khanun, prepared by RID

7. Potential Evaluation of Groundwater Resource Development, prepared by Agricultural Land Reform Office

1.5 Irrigation, Drainage and Water Management

Maps and Drawings

1. Packaged Lam Dome Yai River Basin Irrigation Project, S = 1/50,000
2. Lam Dom Noi Large-Scale Irrigation Project, S = 1/50,000
3. Boundary of National Park and Reserved Forest, S = 1/250,000
4. Ubon Ratchathani Land Reform Area, prepared by ALRO
5. Cadastral Map of Ubon Ratchathani Agricultural Land Reform Area, Prepared by ALRO

Reports

1. Preliminary Report of Lam Dome Yai Basin Project, prepared by RIO V
2. 1988 Annual Report, prepared by Ubon Ratchathani Provincial Office, April 1989
3. Wet Season Paddy Report in Ubon Farmers, prepared by Ubon Ratchathani Provincial Office, December 1988
4. Brief of Ubon General Information, prepared by Ubon Ratchathani Provincial Office
5. Operation Plan for Rural and Water Resources Development in 1991, prepared by Ubon Ratchathani Provincial Office
6. Summary of Phanom Dong Rek Project, prepared by PPD in February 1990
7. Brief of Pak Mun Hydropower Project Prepared by EGAT in September 1988
8. Ubon Land Reform Area Development Project, prepared by Agricultural Land Reform Office (ALRO)

Data and Information

1. Existing irrigation areas by related agencies(RID, DLD, ARD and farmers group and their features in Lam Dome Yai river basin
2. Planned irrigation project (Large, Medium, Small-scale) in the Lam Dom Yai river basin
3. Water requirement and its distribution
4. Procedures of project formulation and implementation of Large /

Medium, Small-Scale and Phanom Dong Rek Irrigation Project

5. List of pump irrigation project in Ubon Ratchathani Province, prepared by National Energy Authority (NEA) in 1991
6. Operation and maintenance method of project facilities by government and farmers
7. Crop damages by flood
8. General information of Lam Dome Noi Irrigation Project
9. General information of Pak Mun Hydroelectric Power Project

1.6 Agriculture and Agro-Economy

Maps and Drawings

1. Administrative division map in Lam Dome Yai river basin, S = 1/250,000

Reports

1. The International Network on Soil Fertility and Sustainable Rice Farming, prepared by Ubon Rice Research Center in 1991
2. Agricultural Statistics of Thailand Crop Year 1989/1990, prepared by Ministry of Agriculture and Cooperatives in 1991
3. Intercensus Report 1988, prepared by National Statistic Office in 1990
4. General Information of Changwat Ubon Ratchathani, prepared by Provincial Government in 1991
5. General Information of Changwat Si Saket, prepared by Provincial Government in 1991
6. Agriculture and Cooperatives Development Report of Ubon Ratchathani Province, prepared by Office of Agricultural Economics, MAOC in 1986
7. Agriculture and Cooperatives Development Report of Si Saket Province, prepared by Office of Agricultural Economics,MAOC in 1986
8. Annual Report Fisheries in Ubon Ratchathani, prepared by Provincial Office in 1990
9. Socio-Economic Report 1987/1988, prepared by Economic Zone 3 in 1989
10. General Information of Public Health, prepared by Provincial Office in 1991

11. Industry of Changwat Ubon Ratchathani, prepared by Provincial Office in 1989
12. Annual Report of Marketing Ubon Ratchathani, prepared by Provincial Office in 1990
13. Annual Report of Marketing Si Saket, prepared by Provincial Office in 1989
14. Guideline for Agricultural Development of Tambon Level in Ubon Ratchathani Province, prepared by Department of Agricultural Extension (DOAE) in 1989
15. Guideline for Agricultural Development of Tambon level in Si Saket Province, DOAE in 1990
16. Guideline of Development for Phibun Mungsahan, Na Chaluai, Det Udom, and King A Sam Rong, prepared by DOAE Provincial Office in 1988
17. Framework of Rural Development by Tambon in Ubon Ratchathani, prepared by Department of Town and Country Planning, Ministry of Interior in 1990
18. Seed, prepared by DOAE in 1985
19. Report of Paddy in Ubon Ratchathani, prepared by DOAE Provincial Office in 1988
20. Pesticide for Main Crop, prepared by DOAE Provincial Office
21. Farmer's Group, prepared by DOAE
22. Extension Activities by TV System, by DOAE
23. Guideline of Development, prepared by DOAE
24. Report of Basic Data for Farm Development Project of Rubber Dam, prepared by DOAE Region 2 in 1987

Data and Information

1. Production and yield of rice, maize, kenaf, cassava, soybean, groundnut and sesame in the study area in 1990
2. Seed of main crops; variety, seeding and unit price in 1990
3. Price of fertilizer and chemicals
4. Agricultural Statistics by Tambon Det Udom in 1987
5. Fruit production of Ubon Ratchathani in 1990
6. Agricultural land holding in Changwat Ubon Ratchathani in 1986
7. Livestock statistic by Amphoe Ubon Ratchathani

8. Planted area and yield of main crops by Amphoe, Ubon Ratchathani in 1987/1988
9. Fruit production Si Saket in 1990
10. Agricultural statistics by Amphoe Si Saket in 1989/1990
11. Present conditions of Amphoe Det Udom,Warin Chamrap, Na Chaluai, Khantharalak
12. Name of fish cultured by farmer
13. Fish landing statistic by EGAT in 1990
14. Production of fisheries by Amphoe, Ubon Ratchathani 1990
15. Economic data of Ubon Ratchathani in 1990/1991
16. Trend analysis of Price for crops in 1990
17. Land Price of Amphoe Na Chaluai, Det Udom and Nam Yun in 1991, prepared by Central Valuation Authority

1.7 Facilities Planning and Cost Estimate

Data and Information

1. Typical Drawings for Designing Canals and On-farm Facilities, oreoared by RID
2. Cost Estimation Procedures used in RID
3. Unit Costs for labor and Materials

1.8 Environment

Data and Information

1. Environmental and Ecological investigation of Pak Mun Project, prepared by NEA in Thailand
2. Environmental Impact Assessment of Kaeng Sua Ten Project, prepared by RID
3. Hydrological and Fishery Survey in Shirinthorn Reservoir, prepared by Department of Fishery
4. Map of Forest, prepared by Department of Royal Forest
5. General Information of Ubon Ratchathani, prepared by Office of the Governor

CHAPTER II. THAI GOVERNMENT OFFICIALS INTERVIEWED BY STUDY TEAM

RID in Bangkok

1. Mr. Leck Jindasanguan	Former Director General, RID
2. Mr. Yuth Kingkale	Director General, RID
3. Dr. Boonyok Vathanaphuti	Former Special Expert for Project Planning
4. Mr. Maitri Poolsup	Former Director, Project Planning Division (PPD)
5. Mr. Kitla Thepalaglekha	Director, PPD
6. Mr. Prasert Milintangul	Director, Geotechnical Division
7. Mr. Suthi Songvoravit	Former Chief, Section 1, PPD
8. Mr. Somphorn Thapthong	Chief, Engineering Section, Topographic Survey Division
9. Dr. Thanu Harnpattanapanich	Civil Engineer, Research and Laboratory Division
10. Mr. Suwit Thanopanuwat	Acting Chief, Section 1, PPD
11. Mr. Mondhian Kangsasithiam	Civil Engineer, Research and Laboratory Division
12. Mr. Phonchai Klinkhachorn	Hydrologist, Hydrology Division
13. Mr. Osot Charnvej	Agronomist, O & M Division
14. Mr. Dharapong Sridhavat	Geological Investigation Branch Geotechnical Division
15. Mr. Paiboon Siridamrong	Research and Laboratory Division
16. Mr. Surakarn Asavavallobh	Chief Engineer, Design Division
17. Mr. Suksun Phocharassaengkul	Engineer, Data Processing Division
18. Mr. Manus Kurunnoetmanee	Engineer, Planning and Budget Division
19. Mr. Nattha Jaksudee	Assistant Chief, Programming and Budget Division
20. Mr. Theera Wongsamut	Chief Engineer, Medium-Scale Construction Division
21. Mr. Asani Molagool	Project Manager, Phanom Dong Rek, Large-Scale Project Construction Division
22. Mr. Chamnuan Chaempaiboon	Lawyer, Law and Land Division
23. Mr. Narong Sophak	Topographic Survey Division
24. Miss Supha Sing-Intara	Chief, Economic Section, PPD
25. Mr. Danai Triyadhen	Chief, Land Classification Branch Geological Division
26. Mrs. Aramsri Phathanasobhon	Chief, Soil Science, Research and Laboratory Division

27. Miss Premrudee Seadwich	Soil Scientist, Land Classification Branch, Geological Division
28. Mr. Apichai Wathnayomnaporn	Agronomist, O & M Division
29. Mr. Somnuk Siewsakul	Civil Engineer
30. Mr. Grunchorn Sornpratoom	Irrigation Engineer
31. Mr. Traibhun Mekjaroon	Chief, Environmental Section, PPD
32. Mr. Boonsong Bhothoya	Economist, Economic Section, PPD
33. Mr. Daeha Luangpitakehumpol	Geologist
34. Miss Apiradee Udnoonpong	Economist, Economic Section, PPD
35. Mr. Anan Phoonthawee	Irrigation Engineer, Section 1, PPD
36. Mrs. Chawee Wongprasittiporn	Irrigation Engineer, Section 1, PPD
37. Miss Phatcharawee Pinyophummin	Water Resource Engineer, PPD
38. Mr. Charoon Rookheb	Irrigation Engineer, Section 1, PPD
39. Mr. Wichit Sriwisead	Geologist, Geological Investigation Branch, Geotechnical Division
40. Mr. Warawoot Utsahaphanich	Civil Engineer, Geotechnical Division
41. Mr. Nipong Vatjarapoom	Geologist, Geotechnical Division
42. Mr. Narucha Sangtong	Geologist, Groundwater Branch, Geotechnical Division
43. Miss Chaneewan Maenchte	Lawyer, Law and Land Division
44. Mr. Sanchaj Ketworrachai	Medium-Scale Construction Division
45. Mr. Vudhichai Chullakesa	Chief, Section 3, PPD
46. Mr. Thanar Suwattana	Engineer, PPD
47. Mr. Nattavuth Watananusan	Water Resource Engineer, PPD
48. Mr. Suvech Kitchakarn	Water Resource Engineer, PPD
49. Mr. Weera Wangwarawong	Water Resource Engineer, PPD
50. Mr. Mahit Wongsa	Environmental Expert, PPD
51. Mr. Direk khiomaneevong	Civil Engineer
52. Mr. Grunchorn Sornpratoom	Civil Engineer
53. Mr. Somyos Jamrongnart	Civil Engineer

NEA in Bangkok

1. Mr. Somchet Swangnetr	Chief, Pump Service Section
2. Mr. Thanee Montraivade	Water Resource Planning Branch
3. Mr. Wichit Wechaparn	Project Planning Division

ALRO in Bangkok

1. Dr. Thiravira Subhanij	Project Manager, Ubon Ratchathani Land Reform Project

2. Mr. Chaiwat Chaiyacupt	Geographic Information Center

RID in Ubon Ratchathani

1. Mr. Chat Sarikabhuti	Director, Regional Irrigation Office V
2. Mr. Suwan Suepchakdee	Head, Engineering Section, Regional Irrigation Office V
3. Mr. Metha Hovarongkura	Chief, O & M Management Section, Regional Irrigation Office V
4. Mr. Penta Giathigong	Project Manager, Lam Dom Noi Irrigation Project
5. Mr. Suppakiat Oransathian	Civil Engineer, Ubon Ratchathani Irrigation Project
6. Mr. Sanong Yanthong	Chief, Ubon Ratchathani Irrigation Project
7. Mr. Nirun Nartubtim	Irrigation Engineer, O & M Branch
8. Mr. Samran Phiwphong	Chief, Topographic Survey Division
9. Mr. Pratuang Iwleing	Law and Land Division
10. Mr. Rangson Udomdachavate	Preliminary project Consideration Section, Regional Irrigation Office
11. Mr. Sanong Yanthona	Ubon Provincial Irrigation Office
12. Mr. Wanchai Noppakhow	Engineer, Engineer Branch
13. Mr. Varaphong Phoapan	Engineer, Engineer Branch
14. Mr. kittichai Krataithong	O & M Section
15. Mr. Chalerm Lordkaew	Surveyor, Engineer Branch
16. Mr. Suphan Rithichoo	Irrigation Engineer, Ubon Provincial Irrigation Office
17. Mr. Chalerm Lordkaew	Irrigation Engineer, Project Construction Section
18. Mr. Taweerat Chunjaruphono	Irrigation Engineer, Provincial Irrigation Office
19. Mr. Chalongpan Siriophat	Irrigation Engineer, Provincial Irrigation Office

RID in Si Sa Ket

1. Mr. Vinai Vongfufuangkajarn	Chief, Si Sa Ket Irrigation Project, Regional Irrigation Office VI
2. Mr. Rassamee Chaiprasert	Irrigation Engineer, Si Sa Ket Irrigation Project
3. Mr. Thongmo Pollasen	Irrigation Engineer, Si Sa Ket Irrigation Project

Changwat Office in Ubon Ratchathani

1. Mr. Vongsak Swasdiphaniek	Chief, Governor Office
2. Mr. kanchit Salabsaeng	Policy and Plan Analysis Section
3. Mr. Vallop Sedhakomut	Provincial Office of Industry
4. Mr. kanchit Salabsaeng	Data and Planning Analysis Officer
5. Mr. Nikorn Sooksai	Local Administration Officer
6. Mr. Yongyutdh khomase	Provincial Officer of Commerce
7. Mr. Pracha Meetham	Mechanical Engineer, Provincial Industrial Office
8. Mr. Prasert Khiendet	Civil Engineer, Amphoe Warin Chamrap
9. Mr. Pradit Yun-Yuen	Senior Deputy, Amphoe King A. Samrong

Changwat Office in Si Saket

1. Mr. Shan Chvensiva	Provincial Administrative Secretary
2. Mr. Nikorn Sookai	Local Administrartion Office,
3. Mr. Surat Auypornsong	Local Development Section, Amphoe kantharalak

Accelerated Rural Development Department (ARD) in Ubon Ratchathani

1. Mr. Suchit Sriboonlueng	Chief, Civil Section, Ubon Ratchathani

Department of Land Development (DLD) in Ubon Ratchathani

1. Mr. Sirichai kitiyarak	Director, DLD in Ubon Ratchathani
2. Mr. Amorn Intrawech	Soil Scientist, DLD in Ubon Ratchathani
3. Mr. Kumnuan Suprasert	Administration Officer, DLD in Ubon Ratchathani
4. Mr. Piroj Tananchaibbot	Chief, Ubon Ratchathani Land Development Station, Region IV
5. Mr. Chanchai Klomklew	Staff, Ubon Ratchathani Land Development Station, Region IV
6. Mrs. Nongpan Thienthong	Accounting, Ubon Ratchathani Land Development Station, Region IV

Agricultural Land Reform Office (ALRO) in Ubon Ratchathani

1. Mr. Paitoon Tongsa-ad	Chief, ALRO in Ubon Ratchathani
2. Mr. Vudhi Chai	Chief, Executive Branch, ALRO
3. Mr. Somyos Sorn-Arch	Assistant Chief, ALRO

National Statistic Office, Office of Prime Minister

1. Mr. Eaimchan Premyothin	Chief, Statistical Technical Division
2. Mr. Phunvadee Pornpatimakorn	Staff, Statistical Technical Division
3. Mr. Vichai Suwiwattanakul	Chief, Office of Ubon Ratchathani
4. Mr. Bumrong Boonsavang	Chief, Office of Si Sa Ket

National Economic and Social Development Board

1. Mr. Wirat Wattanasiritham	Assistant Secretary General
2. Mr. Pairoj Suchinda	Director, Rural Development Division
3. Mr. Kitisak Sinthuvnnich	Rural Development Division

Agriculture and Cooperatives Office in Ubon Ratchathani

1. Mr. Boontam Prommani	Director, Agri.Economic Research Div.
2. Mr. Vichai Sumurit	Director, Department of Agricultural Extension (DOAE) Provincial Office in Ubon Ratchathani
3. Mr. Preeda Suendee	Chief, DOAE Amphoe Na Chauai Office
4. Miss Pranee Siribunpipattana	Agricultural Extentionist, DOAE Provincial Office in Ubon Ratchathani
5. Mr. Suiya Piewpan	Agricultural Extentionist, DOAE Provincial Office in Ubon Ratchathani
6. Mr. Manop Taweesuk	Assist. Agricultural Extentionist, DOAE Provincial Office in Si Sa Ket
7. Mr. U-thon Sunthornvipart	Assist. Agricultural Extentionist, DOAE
8. Mr. Chailit Ruagsit	Provincial Office in Ubon Ratchathani
9. Mr. Charus Pholboon	Chief, DOAE Amphoe Khantharalak Office
10. Mr. Sawaeng Narsan	Deputy Director, Provincial Office of Livestock
11. Mr. Naret Chaiyongyot	Director, Provincial Office of Forestry
12. Mr. Anont Trakunsantirat	Chief, Forest Land Management Section, Provincial Office of Forestry in Ubon Ratchathani
13. Mr. Nipon A-Nukul	Head, Forest Land Management Section, Provincial Office of Forestry in Ubon Ratchathani
14. Mr. Sathit Rittivud	Forest Surveyor, Provincial Office of Forestry in Ubon Ratchathani
15. Mr. Pinit Sihapitukgiat	Director, Ubon Ratchathani Fresh Water Fishery Development Center, Department of Fisheries

16. Mr. Mamloo Chansam	Chief, Agricultural Economic Zone 3 Office of Agricultural Economics

Public Health Office in Ubon Ratchathani

1. Dr. Suchart Laoboripat	Deputy Director, Public Health Center of Ubon Ratchathani

Electricity Generating Authority of Thailand (EGAT)

1. Dr. Nattawuth Udayasen	Civil Engineer,Pak Mun Hydroelectric Project
2. Mr. Bhong Khantee	Assistant Project Superintendent Pak Mun Hydroelectric Project
3. Mr. Tepawan Wattanaprateep	Irrigation and Water Resources Engineer, Pak Mun Hydroelectric Project Project

National Energy Authority (NEA) in Ubon Ratchathani

1. Mr. Sukun Phisaiphun	Chief, Ubon Ratchathani Pump Station

Northeastern Provincial Meteorological Center

1. Mr. Chalermchai Eg-karntrong	Director, Meteorological Center

Si Saket Agro-Meteorological Station

1. Mr. Prasert Anopunt	Director, Si Sa Ket Horticultural Research Center, Institute of Horticulture

Agricultural Development Research Center in Northeast Thailand (ADRC)

1. Mr. Wisuthi Amaritsut	Director, ADRC

Tourism Authority of Thailand

1. Mr. Nopwong Piroon Ma	Director, Ubon Ratchathani Office

ANNEX O. REPLY TO COMMENTS ON DRAFT FINAL REPORT

ANNEX O. REPLY TO COMMENTS ON DRAFT FINAL REPORT

LIST OF FIGURES

1. Comments and Reply for the Lam Dom Yai Basin Irrigation Project

1.1 RID Comments for the Draft Final Report

The following comments and suggestions on the Draft Final Report on the Lam Dom Yai Basin Irrigation Project were prepared by RID.

I. Engineering Aspects

- Confirmation of re-alignment and shortening of left main canal
- Giving the comments regarding to the necessity of soil experiment on dispersive soil as material of dam in the course of detailed design stage
- Additional explanation of the grouting area necessity for D28
- Other related comments

II. Economic Aspects

- Consideration of benefit from resettlement besides cost
- Suitable timing for full development of incremental benefit
- Effects of insecticides / farm practices to benefit from fish production in paddy
- Reconsideration of on-farm costs
- Possibility of fishery in irrigation canal in additional case
- Estimation of benefit from drinking water for livestock which the project is proposed to use machines instead of.

1.2 Basic Idea for Reply to the comments and Suggestions

After receiving the above-mentioned comments, Study Team analyzed these comments and reflected them for the compilation of Final Report of the project. The subsequent section describes basic replies on these comments.

1) Engineering Aspects

a) Confirmation of realignment and shortening of left main canal

Alternative alignment of left main canal is drawn up and comparative study was undertaken from technical, economical and operation and maintenance viewpoints.

b) Necessity of geological investigation for dispersive soil

Geological investigations and analyses on the dispersive soil were not conducted in this Feasibility Study stage, however, these investigations will be essential for the dam design in the vicinity of the Protect Area. Accordingly, these investigations and analyses were recommended to be undertaken in the detailed design stage.

c) Additional explanation for grouting area necessary for D-28 dam

Additional explanations on the captioned subject were made in the Final Report.

d) Other related comments

In addition to the above-mentioned comments, Study Team received several verbal comments and suggestions from RID, and these comments were analyzed and reflected in the Final Report.

2) Economic Aspects

a) Consideration of benefit from resettlement besides cost

The anticipated benefits to be obtained by resettlement projects were not counted in the economic evaluation of the project, because the required costs for resettlement projects were also not included in the evaluation. However, those anticipated benefits will be presented in terms of itemized descriptions.

b) Suitable timing for full development of fish incremental benefit

In the project plan, the goal of full development for crop benefits was set up at five years after completion of the project implementation, applying the other similar projects in Northeast Region such as Sebai-Sebok Irrigation Project, while fish benefits were of three years. Benefits from saving cost of transport were assumed to be the same to that of crop production. And also the benefits from domestic water use were decided to be first year after completion

of the project implementation.

However, the timing in case of fish production was revised to be three years after project implementation considering the local situations in the area.

c) Effects of insecticide / farm practices to benefit from fish production in paddy

Considering the Northeast Rainfed Agriculture Improvement Project as mentioned in Inland Fishery, Annex H " Agriculture and Agro-economy", fish productions in paddy field have been practiced. In the project plan, fish productions with paddy areas of 5,380 ha were proposed. In these fish productions in paddy fields, the proposed quantity of fertilizers and pesticides will not be applied. Therefore, effects of insecticide on farm practice will not be considered.

d) Reconsideration of on-farm cost

The required on-farm costs were not counted in the project evaluation, because on-farm works principally are to be implemented under the responsibility of farmer themselves in RID projects. However, as an alternative case of project evaluation, additional project evaluation in case with on-farm costs was made in the Final Report.

e) Possibility of fishery in irrigation canal in additional case

In secondary and tertiary irrigation canal systems, village ponds were proposed to meet the rural community development. These village ponds, 68 ponds in total, in canal systems are also planned to be utilized for fish cultivation in village level.

f) Estimation of benefit from drinking water for livestock

In the case of similar irrigation project in the Northeast Region such as Nam Oon, most the farmers have been raising livestock as buffalo, which have nor been used for farming despite the farm

machineries were introduced. It seems that they are raising the livestock as their properties. Hence, estimated head of 2.8 per farm household is calculated considering some head reduced from the present situation. Under the situations, benefits from drinking water by these livestock could be expected in the project.

2. Descriptions of Reply to the Comments and Suggestions

Additional analyses and descriptions on the comments and suggestion mentioned above are incorporated in the related section or paragraph in the Final Report. However, regarding the subsequent subjects, additional explanation paper were prepare and attached hereinafter, considering their own natures in the project.

- Forest land-use in the basin
- Lam Dom Yai Lower Basin Irrigation Project planned by NEA
- Alternative Study on Left Main Canal Alignment
- Alternative Implementation Program

2.1 Forest Land-Use in the Basin

1) Present Forest Development and Problems in the Basin

According to the data obtained from Ubon Ratchathani Forest Office, the followings are found out;

- On the right bank of Huai Ka-Yung Forest, Don Na Kae Forest, Son Dong Tui Forest, Huai Mae Nam Forest, and on the left bank of Huai Mae Wed Forest and Non Huai Rang Reng Forest(see Figure O-1), no forest development plan can be proceeded, because no forests are left, although land categories are registered to be forest. Since local peoples have reclaimed the land as paddy field in the wet season, it gives difficulties to the Department of Forest in rehabilitating the forest. Many problems and resistance may be occurred by the local people.

- On the right bank of Lam Dom Yai Forest, the Department of Forest have assigned the Department of Agricultural Land Reform Office to develop the forest in agricultural land, and to reserve some forest area as a community center forest.

- Department of Forest Planned S.T.K.(who has only cultivation and dwelling rights incapable of making transactions) project in the Khao Phra Wi-Han Forest, where it had been reclaimed by the local people and encouraged the people to plant the threes in S.T.K. plots or in the fields.

- On the left bank of Lam Dom Yai Forest, Yod Dom Wild Life Sanctuary Area, and Phu Jong Na-Yai National Park, the Department of Forest stipulated to be the conservative forest and mill plant forest in the reclaimed areas to rehabilitate the forest into the original conditions.

- Most of the forest problems are caused by the local peoples who have no their own land. Therefore they try to reclaim the forest to earn their living. For the agricultural areas, Ubon Ratchathani Forest Office established the authority consisting related offices concerned to protect and prevent the forest from such reclamation. However, The functions of the authority are not enough to attain the objectives. These situations lead the local people to smuggle and cut down the trees in the areas.

2) Forest Land-Use Plan in the Project

Under the prevailing circumstances of forest land in the basin,

the concept of proposed land-use in the Project Area is planned as kdfollows;

- The existing cultivated land is defined as the benefited area of the project, and no expansion of cultivated land by means of land reclamation from forest is planned.

- Present registered forest area is 18,410 ha in the Project Area as shown below, however, out of this registered area, 4,220 ha of forest land has been reclaimed to cultivated land by the local people, and actual forest land is 14,190 ha at present.

- In the project, the forest land is estimated at 16,100 ha inclusive of 1,910 ha of converted forest land from the cultivated land.

Proposed Land-Use

(unit : ha)

Land Category	Present Land-Use	Irrigated	Rainfed	Forest	Village & Others	Total
Cultivated Area						
Paddy Field	31,430	25,740	2,200	1,900	1,580	31,430
Upland Field	3,570	2,620	770	-	180	3,570
Fallow Land	1,500	1,420	-	-	80	1,500
Sub-Total	36,500	29,780	2,970	1,900	1,840	36,500
Non-Cult. Area						
Forest	18,410	4,220	-	14,190	-	18,410
Village/Others	590	-	-	-	590	590
Sub-Total	19,000	4,220	-	14,190	590	19,000
Total	55,500	34,000	2,970	16,100	2,430	55,500

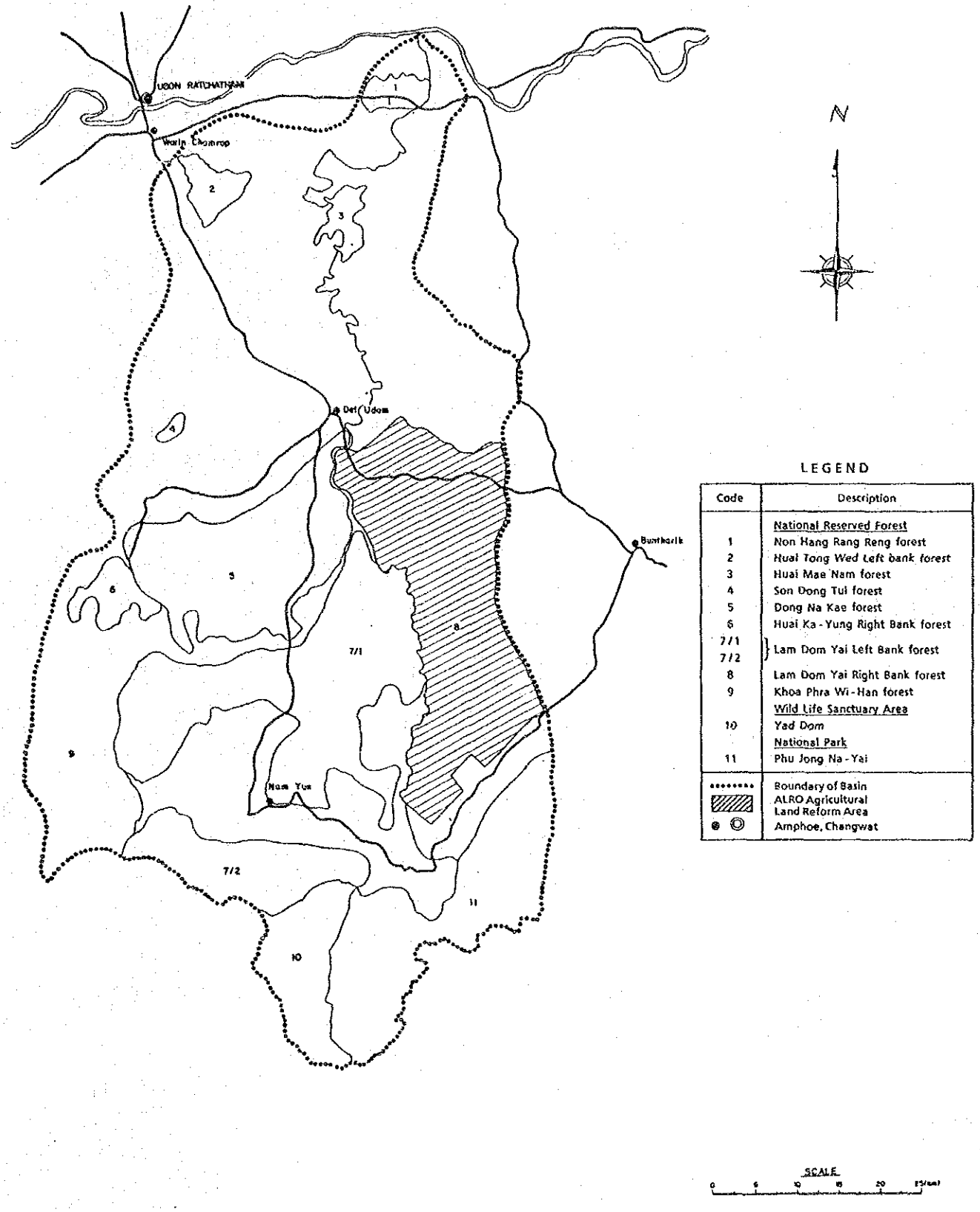


FIGURE O-1 FOREST LAND-USE PLAN

2.2 Lam Dom Yai Lower Basin Irrigation Project planned by NEA

The Study Team was informed the new project by RID at the stage of submitting the Draft Final Report of the Lam Dom Yai Basin Irrigation Project. The new project is presently under planning by NEA at the most down-stream of the Dom Yai river(see Figure O-2).

The new project is not reflected in this project plan, due to limited time of the report compilation of the project. However, for the reference, major features of the new project are briefly described hereinafter.

Location	: Ban Saphan Dom, Ubon Ratchathani
Dam Type	: Diversion Dam
Height of Dam	: 8.0 m
Width of Dam	: 12.0 x 4 gates
Elevation of Gate Sill	: 107.0 m
Designed Water Level	: 115.0 m
Storage Water	: 19.55 MCM
Canal Length	: 70 km
Total Width of Structure	: 63.58 m
Irrigation Area	
- Wet Season	: 22,400 ha (140,000 rai)
- Dry Season	: 2,288 ha (14,300 rai)
Total Project Cost	: 2,208.65 million Baht
Agricultural Benefit	: 462.73 million Baht
Economic Evaluation	
- EIRR	: 20.85 %
- B/C	: 1.73
- B-C	: 1,262.39 million Baht

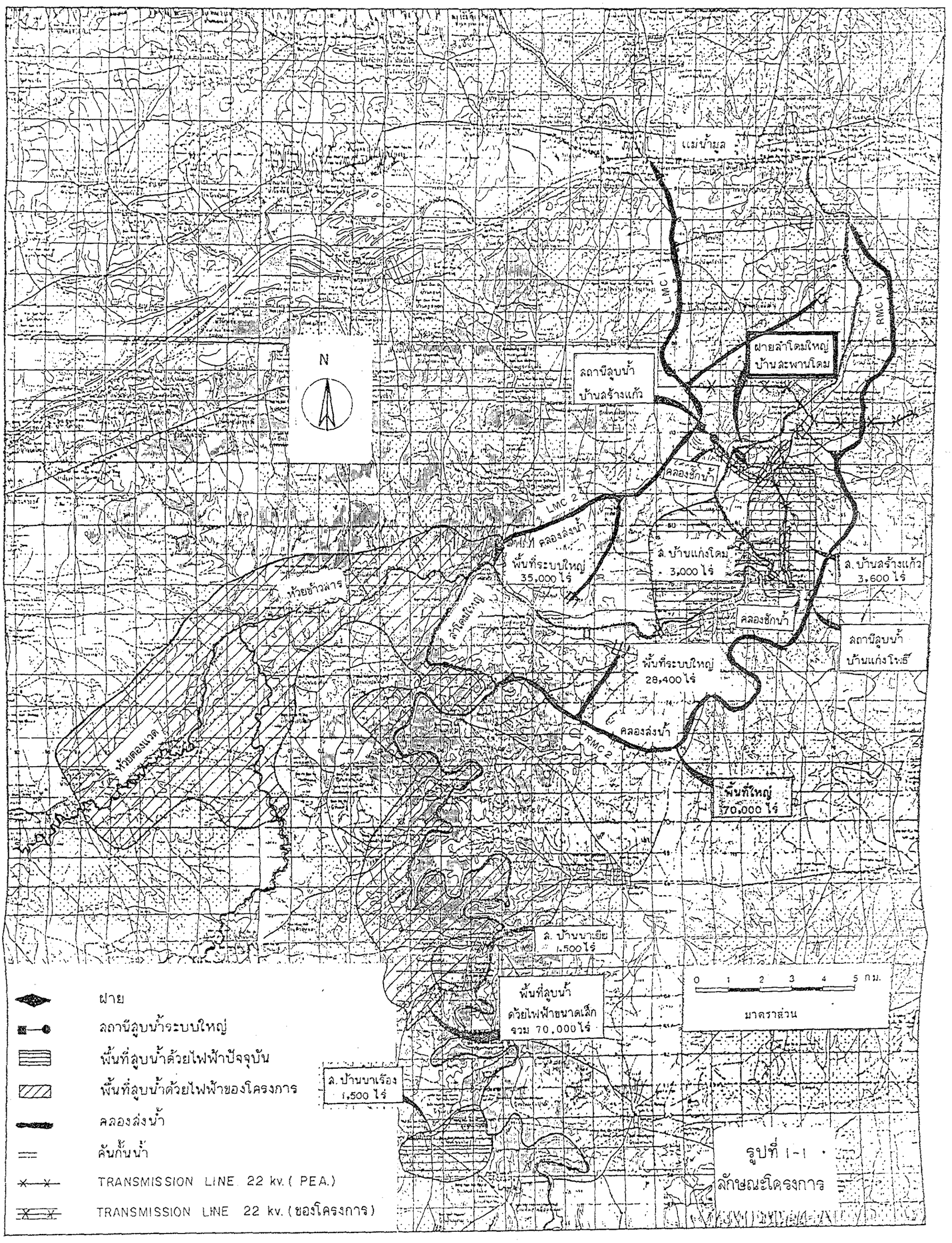


FIGURE O-2 LOCATION OF LAM DOM YAI LOWER IRRIGATION PROJECT BY NEA

2.3 Alternative Study on Left Main Canal Alignment

As an alternative study on the left main canal alignment, the main canal was planned by branching off its canal alignment at the distance of about 1.7 km downstream from the Lateral canal of L-2 (see Figure O-3). The alternative study was made from technical, economical and O/M viewpoints on the basis of the following conditions;

- By the alternation of canal alignment, benefited areas of 3,400 ha located on the upper portions, which will be irrigated by the original plan was reduced. However, this area is extended to the downstream area near the Det Udom township. Therefore, designed discharges of left pump capacity will be the same to the original plan formulated in the project.

- Length of realignment canal is 5.5 km in total, and the reduced canal length in the case of original plan is 22.5 km. The type of realignment canal will be of embankment type except the river crossing portions at Nam Som river, which will be of siphon structure. Typical cross section of canal for the embankment portions is shown in Figure O-4.

According to the study results on the basis of above-mentioned conditions, the original plan is more advantageous and recommendable because of the following reasons;

- The canal construction costs inclusive of related structures are as follows;

  . Original plan : 41 million Baht
  (reduction of construction plan -- reduction of canal length : 22.5 km)
  . Alternative Plan : 64 million Baht
  (additional canal length : 30.5 km)

  Therefore, canal costs in the case of the original plan is more cheaper than the those of alternative plan.

- In the case of alternative plan, the following disadvantages are pointed out;

. Drainage problems at upstream area of the embanked portions of canal, due to the intercept of stream-flow in the area.

. Disadvantages of inner communication for local people in the area, owing to the intercept of communication and transportation between up and downstream of the embankment, of which height will be in the ranges from 2.7 m to 7.7 m.

. Hardness of O/M works for the siphon structure

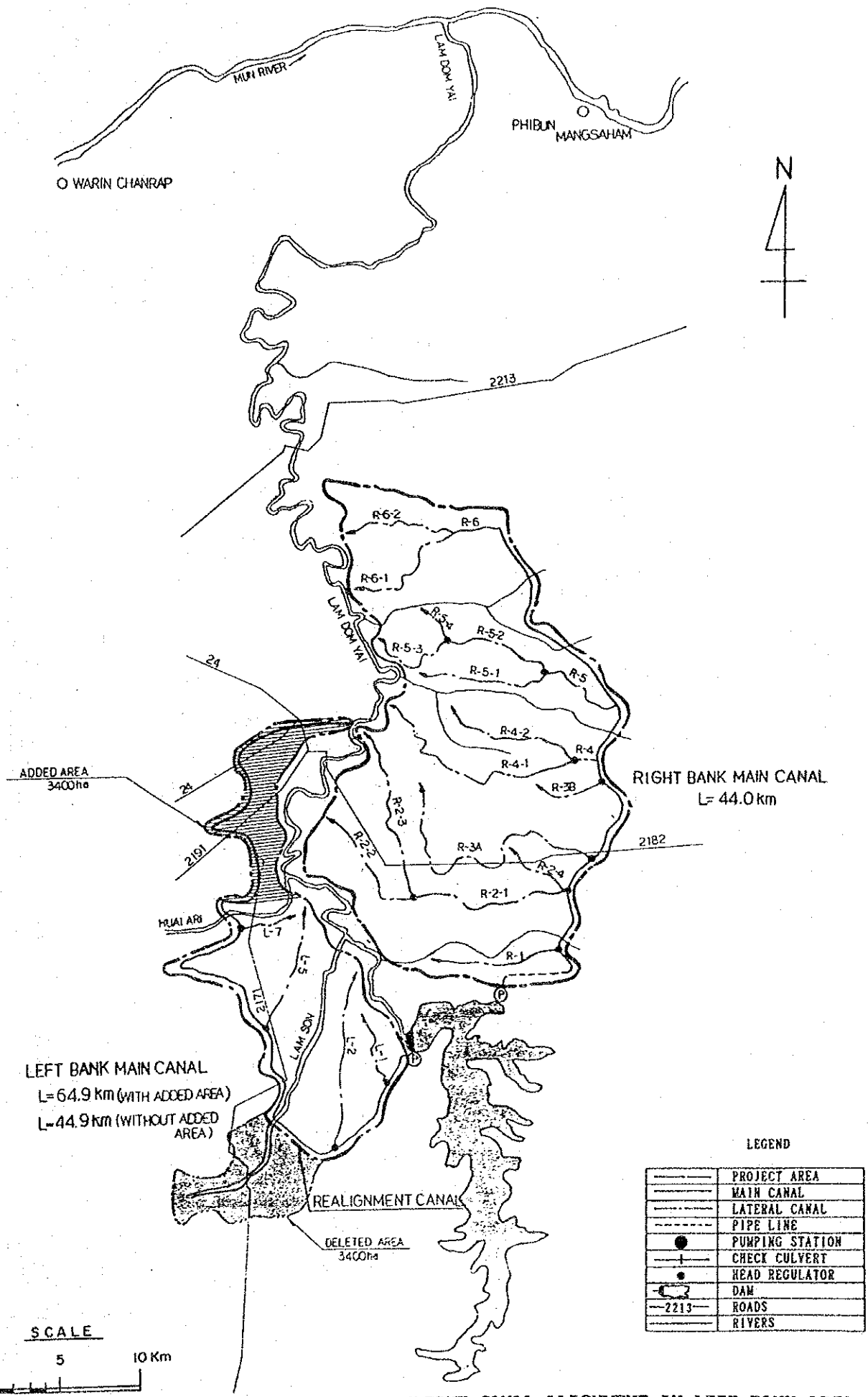


FIGURE O-3 ALTERNATIVE CANAL ALIGNMENT IN LEFT BANK AREA

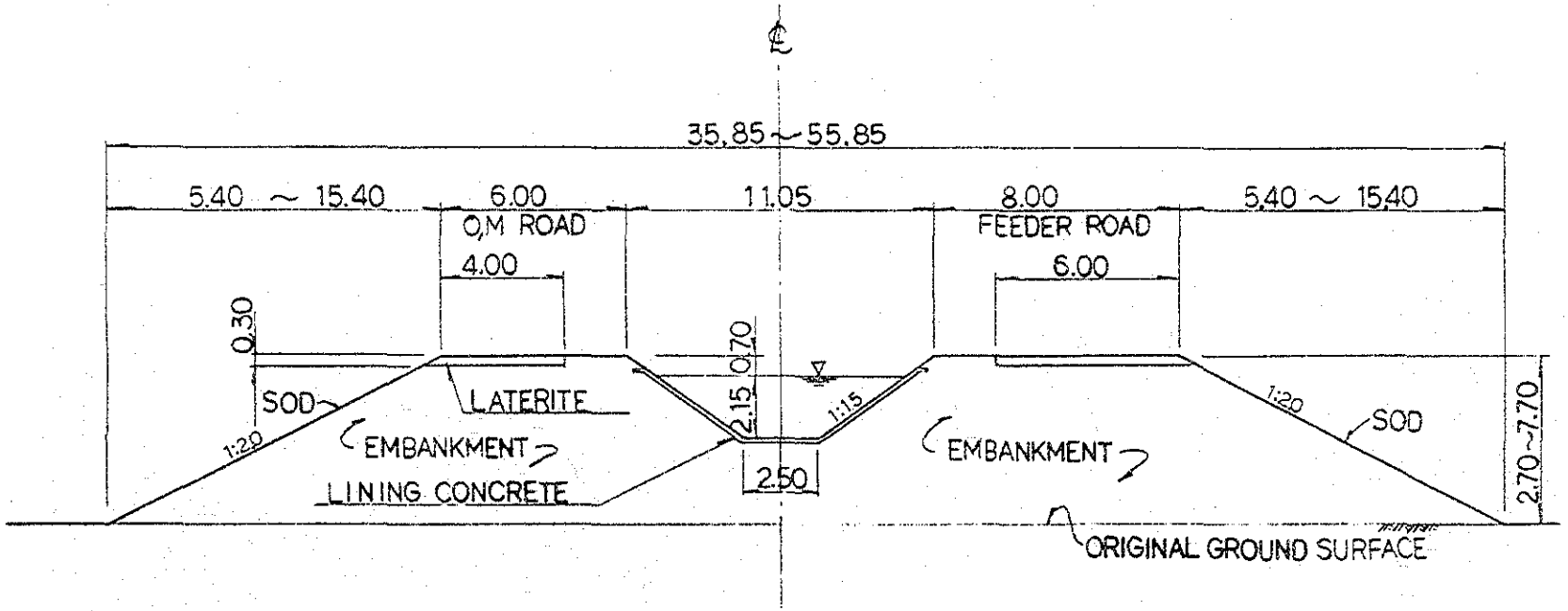


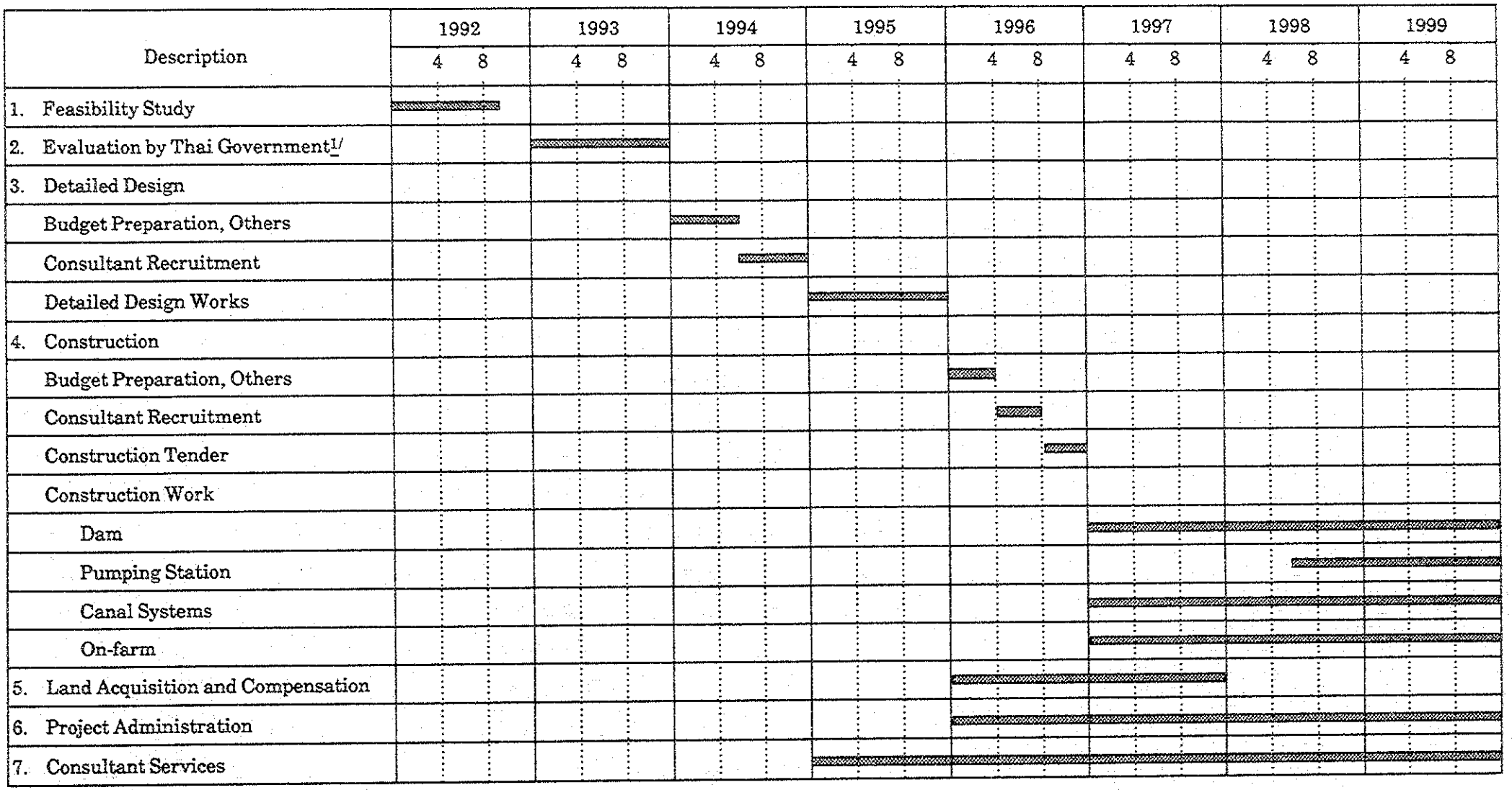
FIGURE O-4 TYPICAL CANAL SECTION OF EMBANKED PORTION

2.4 Alternative Implementation Program

Alternative implementation program of the project is formulated based on the loan basis as indicated in the Main Report, an alternative implementation program in the case by suing local budget was formulated as shown in Figure O-5.

However, implementation period of seven years from 1993 to 1999 is basically same with only alternation of works such as budget preparation during the detailed design stage and construction loan procedure in the construction stage.

FIGURE O-5 IMPLEMENTATION PROGRAM FOR THE PROJECT (BY USING LOCAL BUDGET)



1/ : including environmental aspects and economic viability