APPENDIX K. WATER RESOURCES DEVELOPMENT

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CHAPTER 1. INTRODUCTION

The Water Resources Development Projects constructed and to implemented by the RID will be discussed in this Appendix. Any information regarding water resources development at present and in future, such as the water resources potential, water balance study, DEDP's projects, water resources development projects related to the Mekong river, domestic and industrial water supply and so on are not involved in this Appendix, according to the terms of reference.

CHAPTER 2. PHYSICAL FEATURES

2.1 Location and Area

2.1.1 Location

The Study Area is situated in the Northeast region of the Thailand, and extended over the provinces of Nong Khai, Udon Thani and Nong Bua Lamphu lies on the other side of Laos over the Mekong river. The area is surrounded roughly with the latitude of 17°N to 18°N and the longitude of 102°E to 103°30'E. Main Town is Udon Thani, located about 650 km from Bangkok to the North-northeast at a distance.

2.1.2 Area

The Study Area, within the Mekong river basin, is organized into four (4) basins; namely, Huai Mong basin, Nam Suai basin, Huai Luang basin and other basins grouped with several river basins discharge the water directly to the Mekong river (refer to Figure K-2-1), and tabulated for each basin, as follows:

Name of Basins	Drainage Area
Huai Mong Basin	2,711 sq.km
Nam Suai Basin	1,314 sq.km
Huai Luang Basin	4,100 sq.km
Other Basin	482 sq.km
Total	8,607 sq.km

The Huai Mong river basin with a drainage area of some 2,711 sq.km is located in the west of the study area, extending to Nong Khai, Udon Thani and Nong Bua Lamphu provinces. Based on the topography, river regime, etc., the river basin may be divided into the upper reaches with a drainage area of some 1,307 sq.km, the middle reaches with some 747 sq.km and lower reaches with some 657 sq.km.

The Nam Suai river basin is located in the middle of the Study Area to the north, extending to Nong Khai and Udon Thani Provinces, and has the drainage area of some 1,314 sq.km. The basin can be divided into tow reaches, the upper reaches with a drainage area of some 403 sq.km and the lower reaches with a drainage area of some 911 sq.km, bounded by the highway No.2 to the west and east, respectively.

The Huai Luang river basin widely extends over the southern and the eastern parts of the Study Area, and has a drainage area of some 4,100 sq.km in the total. The basin can be divided into three (3) sub-basins, the upper reaches with a drainage area of some 1,730 sq.km, middle reaches with an area of some 1,355 sq.km and lower reaches with an area of some 1,015 sq.km, from a standpoint of the topography, the river regime, etc.

The Study Area involves other river systems with a total drainage area of some 482 sq.km directly joined to the Mekong river, in addition to the said three (3) big river basin. These basins are made several groups according to geographical location, such as Six (6) River Basins (50 sq.km) in the northwest, Pa Sak Drainage Area(18 sq.km), Kong Khai East Drainage Area(384 sq.km), Huai Mak Kong(26 sq.km) & and Nong Saen Drainage Area(4 sq.km).

2.2 Climate

The Study Area is situated in the tropical and inland climate zone affected by northeast and southwest monsoon, and typhoon for September through October. The annual rainfalls are varied from about 1,520 mm in Nong Khai to 950 mm in Nong Bua Lamphu (refer to Figure K-2.2). The rainfalls are much on the north and less on the south of the Study Area, because of high mountain ranges in Laos. The rainfall in the North of Nong

Bua Lamphu and the west of Udon Thani may be greatly affected by Typhoon as indicated in a variance of the rainy season rainfall. The rainfall probability of non-exceedance are listed in Table K-2.1, for the reference.

2.3 Topography

2.3.1 Huai Mong Basin

The Huai Mong upper reaches may be classified into the Huai Mong upper sub-basin and Nam Bon sub-basin, taking topographic condition into account.

Topography in the Huai Mong upper sub-basin is steep and declines to the east with a slope of 1/10 to 1/20 in the mountainous area of the western part, moderate in the eastern area, declining to the east along Huai Mong and the southeast in the other parts with a slope of about 1/150. The land elevations are about 600 m above M.S.L. in the top of mountains, and about 190 m above M.S.L. in the lower land. The farm lands distributes in strips along the rivers/streams. On the other hand, in the Huai Nam Bon sub-basin, the lands are undulated and gently sloped down to the north with a gradient of about 1/300 to 1/500 and about 250 m to 190 m above M.S.L. in the elevation of farm lands.

The middle reaches is bounded by the Phuphankham mountain range on the west, the Huai Luang river basin on the south and east, and the lower reaches of Huai Mong on the north. Topography in the flood plain, situated in the west of the middle reaches, is gentle and sloped down with a gradient of about 1/2,000 along the Huai Mong. Due to narrow span length of bridges along the road, route 7040, those low lands are currently flooded in the rainy season and developed to about 23 km in the distance and about 3 to 5 km in the width. On the other hand, topography in the hilly lands area moderate and undulated, and declines to the said flood plain with a slope of 1/40 to 1/400.

The lower reaches of the Huai Mong consists of three areas in the topography, the hilly land area in the left river side, the flood plan area in the middle area and terrace land area to the right river side.

Topography in the hilly land in the left river side is steep in the mountainous parts with a gradient of about 1/10 to 1/50 and moderate in the hilly parts with a slope of about 1/100 to 1/300. The land elevation are varied from 588 m above M.S.L. in the highest mountain and 170 m above M.S.L. in the low land. Paddy fields are distributed in strips along the rivers/streams in its lower land.

2.3.2 Nam Suai Basin

The topography in the upper reaches is moderate and undulated, slopes to the east-northeast in a gradient of 1/200 to 1/400. The width of drainage area for each river is 4 to 5 km and sloped in 1/50 to 1/100 to the respective river. The land elevation varies from 170 m to 220 m above M.S.L.

The topography in the lower reaches are gentle in the upstream area, flat in the middle and down-stream area along the river. The land slopes to the nearest river varies from about 1/50 to 1/300. Land elevation range from about 190 m to 160 m above M.S.L. but about 20 % of the total land area is below 165 m above M.S.L.

2.3.3 Huai Luang Basin

The topography in the upper reaches are steep in the mountainous area of water shed with a slope of about 1/20 to 1/50, moderate and undulated in the hilly land with a slope of about 1/50 to 1/200 and the ground elevation of about 190 m to 230 m above M.S.L. in the western parts of the upper reaches, relatively flat with a gradient of about 1/1,000 to 1/2,000 and ground elevation of about 170 m to 190 m above M.S.L. in the eastern parts of the reaches, near the town of Udon Thani.

The topography in the Middle reaches along the Huai Luang is gentle and undulated with a slope of about 1/600 to 1/1,000 and land elevation of about 170 m to 190 m above M.S.L. While, the Huai Dan drainage area is moderate and undulated in the topography with about 1/100 to 1/300 in the slope of land, and ground elevation of 170 m to 200 m above M.S.L. The paddy field distributed along the rivers/streams in strips.

The topography in the lower reaches is flat along the Huai Luang and moderate with a gradient of about 1/200 to 1/300 toward the river. The land elevation varies from 160 m to 190 m above M.S.L. in the cultivated land, while the land elevation is below 160 m M.S.L.in the swampy area.

2.3.4 Other Basins

Nong Khai East Drainage Area, among them, has a large drainage area with a land area of some 384 sq.km, consisting of the Huai Khuk and Huai Bang Phuan river basins. Both basins have a land slope of about 1/100 to 1/300 and land elevation of 180 m to 200 m above M.S.L. in the upper and middle stream area, and a land slope of 1/300 to 1/800 in the down-stream
area. The land along the rivers/streams are cultivated in the elevation 170 m to 190 m above M.S.L. and forms swampy/natural reservoir below 170 m M.S.L. in the downstream area.

2.4 Geology

The Study Area is formed by the folding made the Sang Mountain range on the west of the Study Area as a antisyncline axis and inclined to the east in the geological structure. Most of the Study Area lies in the concave of this gentle fold. The fault lies in the downstream area of the Nam Sual basin in Nong Khai province.

The geology in the Study Area is classified into the korat group in the major part, and the quarternary sediments in the low land, and the paleozonic rocks in the mountain side.

The Korat group are composed of Maha Sarakham, khok kruat, Phu Phan, Sao Khua, Phra Wihan, Phu Kradung and Nam Phong formations in ascending order. Among them, Maha Sarakham formation, consisting of the mudstone, siltstone, and fine-grained sandstone with salt rock at the lower part, accounts for over 60 % of the Study Area. Nevertheless, salt problems are reported only in a few spots on the ground surface but not be particular restrictive factor in the overall Agricultural development plan.

The Phuphankham mountain range, which is a boundary between the Huai Mong and Huai Luang river basin and the upstream and middle stream areas of the Huai Mong, consists of sandstone, Phra Wihan formation. In the upstream reaches of Huai Mong, the geology comprises the late Mesozoic to palaeozonic rocks. Among others, the Phu Nok formation, consisting of limestone and shale, are distributed in the middle and east part of Suwanakhuha district, Nong Bua Lamphu Province.

The alluvial deposit, consisting of gravels, sand, silt and clay, are spread along the Huai Mong in the downstream area. The land along the Mekong river in Nong Khai district comprises terrace deposit. Those area are negligible to the Study Area.

2.5 Ground Water

The Study Area consists of Metasediment aquifer, Lower Khorat aquifer, Middle Khorat aquifer, Upper Khorat aquifer, Alluvial aquifer in Hydrogeology.

Metasediment aquifer, distributed in the Huai Mong upper reaches, consists of conglomerate, shale, sandstone, Limestone, phylite, quartzite and schist in the Devonian to Permian. The groundwater is mainly in joints and fractures. A yield of well is generally less than 5 cu.m/hr, with good quality.

The upper Khorat aquifer, lies along the Phuphankham mountain range in the Huai Mong Upper reaches, consists of shale, siltsotne and sandstone of Khok Kuat formation. The groundwater of good quality can be generally obtained from the depth of 30 m to 60 m at the pumping rate of 5 to 25 c.m/hr. Yield of water is only meager at deeper zones.

The middle Khorat aquifer, extends to the eastern side area along the Phuphankham mountain range, comprises massive sandstone and conglomerate of the Phu Phan formation on top, massive thick bedded quartzes sandstone of the Phra Wihan formation on bottom and shale and siltstone of the So khua formation in between. A yield of well is not less than 3 cu.m/hr.

Many wells are of artesian flowing with a rate of 5 cu.m/hr.

The lower Khorat aquifer, distributed in most of the Study Area, consists of shale, mudstone, siltstone sandstone of the Maha Sarakham and Khok Kruat formations. The salt rock is interbedded at the depth of 60 m to more than 290 m. The groundwater of this aquifer varies both in quality and quantity all over the place. A yield of well is from 3 to 10 cu.m/hr. Many wells produces brackish water.

The alluvial aquifer, is lying along the Huai Mong up to the middle reaches as a narrow strip, consists of alluvial gravel, sand, silt and clay. A yield of well give 10 to 30 cu.m/hr in the unconsolidated layer.

For the purpose of domestic water use, a great number of wells were constructed by the various government agencies, as of September,1993, as shown below:

Number of Wells Installed by Government Agencies

Province	DMR	ARD	PWD	DOH	NSC	PAO	Others	Total
Nong Khai	269	596	164	268	40	9	19	1,365
Udon Thani	1,292	462	8	314	40	33	176	2,325
Total	1,561	1,058	172	582	80	42	195	3,690

Source: Study of Potential Development in Mae Khong River Basin (AIT)

The groundwater potential in the Huai Mong river basin is less from the Metasediment aquifer and expected from the Lower Khorat aquifer with a yield of 3-10 cu.m/hr in the upper reaches, and low in the middle reaches. In the lower reaches of Huai Mong as well as the Nam Suai, HUai Luang and other river basins, the groundwater are available from the upper Khorat aquifer with a yield of well 3-20 cu.m/hr or 3-5 cu.m/hr in the average of existing data. The groundwater potential is high in the area along the Mekong river.

The groundwater development, however, has problem in water quality. The water is generally brackish and high in the chloride ion content. The salt rock interbedded in the Lower Khorat aquifer dissolves and makes the water salty. The depth of salt rock is about 80 m below the ground in

Amphoe Muang, Udon Thani province and Amphoe Si Chiang Mai, Nong Khai province, according to the groundwater map published by the Department of Mineral Resources. The groundwater with a chloride content of over 1,000 ppm widely spread over the vicinity of those area (refer to Figure K-2.3). The overuse of ground water may result in spreading the salt water area.

2.6 River Morphology

2.6.1 Huai Mong River Basin

The Huai Mong originates in the mountains in Na Duang District, Loei Province and runs to the east, joining with the tributaries of Huai So, Huai Yap, etc. The river again joins with other 3 major tributaries, Huai Kholo, Huai Khana and Huai Nam Bon up to the vale of the Phuphankham mountain range which is the boundary between the upstream and middle stream areas of the Huai mong river basin.

The stream of the Huai Mong turns toward the north-northeast in its direction immediately after passing the vale of the said mountain range, and traverses the flood plain situated in the west of the middle reaches bifurcating and interconnecting each other. In the flood plain the Huai Mong joins with several tributaries , such as the Huai Nam Ngao, Huai kradon, Huai sit, etc., from the right river side and a few tributaries from the left river side, interconnecting each other, and finally consolidate as one stream and runs to the lower reaches of the Huai Mong.

The Huai Mong, in the lower reaches, traverse the flood plain meandering to the north-northeast and the northeast before reaching at the river-mouth in the direction, connecting with the Huai Thon and several streams on the right river side directly and several rivers/streams on the left river side through the flood plain, and finally contacts with the Mekong river at Tha Bo, Nong Khai Province.

2.6.2 Nam Suai River Basin

The Nam Suai, originates in the undulated hilly land to the south of the highway No. 2021 in Amphoe Ban Phu, Udon Thani province, and run to

the northeastward, and changes the direction to the north-northeast at a distance of about 20 km from the origin, joins with the Huai Thong at the point before reaching at the Highway No.2, and enter to the lower reaches.

The river, and then, runs to the east-northeast in the direction after joining with Huai Thong, and then turns to the northward at Ban Suai Long, Amphoe Muang, Udon Thani province and proceed to the lower lying flood plain in Amphoe Muang, Nong Khai province, joining with the Huai Bak Ya, the Huai Dan, the Huai Phen, the Huai Bo and other rivers/streams. After passing the lower flood plain, the river runs to the river mouth meandering, changing the direction to the east-northeast and contacts with the Mekong river at ban Pak Suai Noi, Amphoe Muang, Nong Khai province.

2.6.3 Huai Luang River Basin

The Huai Luang originates in the Wat mountain in Amphoe Nong Wua So, Udon Thani province, runs to the northward and reaches at the Huai Luang reservoir completed in 1984. After joining with the Huai Sari, the Huai Siang and the Huai Ri, the river, collecting the silt water from the reservoir, turns to the east gradually and runs to the east in the northern part of the reaches, collecting the water from the Huai Raeng, the Loeng Nong Bo, the Huai It and other tributaries.

The Huai Luang run meandering continuously to the east in the direction, joining Suang Luang and other tributaries. The Huai Dan, tributary of the Huai Luang, located in the southeast of the Study Area, and runs to northward and then joins with the Huai Luang at the end of the middle reaches.

After joining with Huai Dan, the Huai Luang runs to the northward widely meandering with almost flat in the river bed slope, joining with Huai Rai Noi, Huai Thon, Huai Chiang and a number of other rivers and streams. In the lower land area within about 20 km from the river mouth, a number of natural reservoir and swampy lands are distributed.

2.6.4 Other River Basin

The several rivers in the northwest drainage area run directly to the Mekong river with a short distance. While, other rivers, such as Huai Mak, Huai Khuk, etc., equip with drainage sluice at the respective river mouth. Among others, Huai Khuk and Huai Bang Phuan rivers in the Nong Khai east drainage area are run through the swamp land which form a flood plain in the rainy season, collecting the excess water in the hilly land.

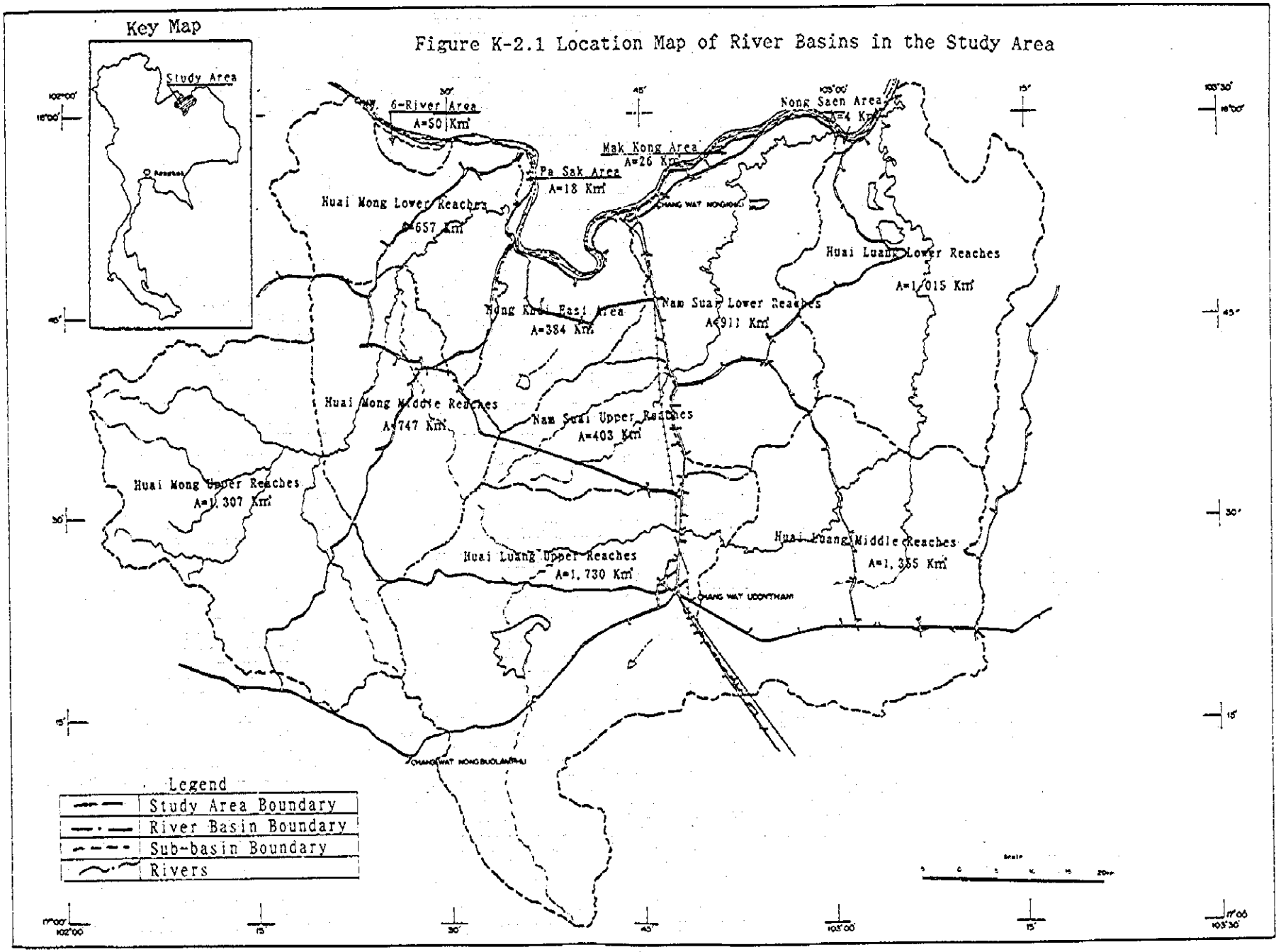

Key Map
Study Area
Figure K-2.1 Location Map of River Basins in the Study Area
6-River Area
A=50 Km²
Nong Saen Area
A=4 Km²
Mak Kong Area
A=26 Km²
Pa Sak Area
A=18 Km²
Huai Mong Lower Reaches
A=657 Km²
Huai Luang Lower Reaches
A=1,015 Km²
Nong Khai East Area
A=384 Km²
Nam Suan Lower Reaches
A=911 Km²
Huai Mong Middle Reaches
A=747 Km²
Nam Suai Upper Reaches
A=403 Km²
Huai Mong Upper Reaches
A=1,307 Km²
Huai Luang Middle Reaches
A=1,355 Km²
Huai Luang Upper Reaches
A=1,730 Km²
Legend
Study Area Boundary
River Basin Boundary
Sub-basin Boundary
Rivers

Table K-2.1 Probability of Non-exceedance for each Station

Station	Muang, Nong Khai			Tha Bo, Nong Khai		
Return P.	Wet S.	Dry S.	Annual	Wet S.	Dry S.	Annual
Mean	1,382.4	144.0	1,520.5	1,357.5	141.1	1,452.5
1/5 yr.	1,323.4	134.9	1,509.5	1,273.7	122.2	1,410.4
1/10yr.	1,305.7	134.4	1,506.8	1,256.7	118.8	1,383.6
1/15yr.	1,296.9	134.1	1,505.5	1,248.4	117.1	1,370.4
1/20yr.	1,291.1	133.9	1,504.6	1,243.0	116.0	1,361.8
1/25yr.	1,286.9	133.8	1,504.0	1,239.0	115.2	1,355.6

Station	Huai Pleo Nguak(Tank-4)			Kh-29, Udon Thani		
Return P.	Wet S.	Dry S.	Annual	Wet S.	Dry S.	Annual
Mean	1,842.7	146.7	1,968.8	1,116.2	111.1	1,227.1
1/5 yr.	1,731.4	128.3	1,882.1	944.2	79.0	1,060.4
1/10yr.	1,710.1	124.4	1,860.2	879.8	67.2	999.1
1/15yr.	1,699.7	122.5	1,849.5	850.4	61.9	971.2
1/20yr.	1,693.0	121.3	1,842.6	832.0	58.5	953.9
1/25yr.	1,688.1	120.3	1,837.5	819.0	56.2	941.6

Station	Muang, Udon Thani			Ban Phu, Udon Thani		
Return P.	Wet S.	Dry S.	Annual	Wet S.	Dry S.	Annual
Mean	1,268.3	144.3	1,405.6	1,200.6	118.2	1,328.3
1/5 yr.	1,071.0	95.3	1,211.4	973.6	55.0	1,117.7
1/10yr.	977.8	83.7	1,118.5	862.3	37.5	1,006.3
1/15yr.	931.8	78.9	1,072.3	807.7	30.2	951.0
1/20yr.	901.7	76.1	1,042.1	772.3	25.8	914.9
1/25yr.	879.7	74.2	1,019.8	746.4	22.8	888.3

Station	Nong Bo Tank(TNK-80), U.T.			Phen, Udon Thani		
Return P.	Wet S.	Dry S.	Annual	Wet S.	Dry S.	Annual
Mean	1,172.0	85.2	1,263.1	1,365.3	137.7	1,504.4
1/5 yr.	882.7	25.0	956.3	1,156.3	84.4	1,275.7
1/10yr.	790.2	12.6	855.1	1,066.0	67.6	1,179.8
1/15yr.	749.6	7.8	810.3	1,023.3	60.2	1,134.2
1/20yr.	724.8	5.1	782.7	996.0	55.8	1,105.2
1/25yr.	707.5	3.2	763.4	976.3	81.5	1,084.2

Station	Muang, Nong Bua Lamphu			Suwanakhuha, N.B.L.		
Return P.	Wet S.	Dry S.	Annual	Wet S.	Dry S.	Annual
Mean	879.6	85.5	950.4	1,151.1	153.9	1,298.1
1/5 yr.	706.4	28.7	783.2	982.6	101.6	1,118.8
1/10yr.	630.1	16.3	702.1	897.1	89.3	1,033.0
1/15yr.	593.0	11.4	664.7	854.9	84.1	1,072.3
1/20yr.	568.9	8.6	641.3	827.2	81.2	844.9
1/25yr.	551.4	6.7	624.7	807.1	79.1	820.4

Figure K-2.2 Isohytal Map of Annual Rainfall

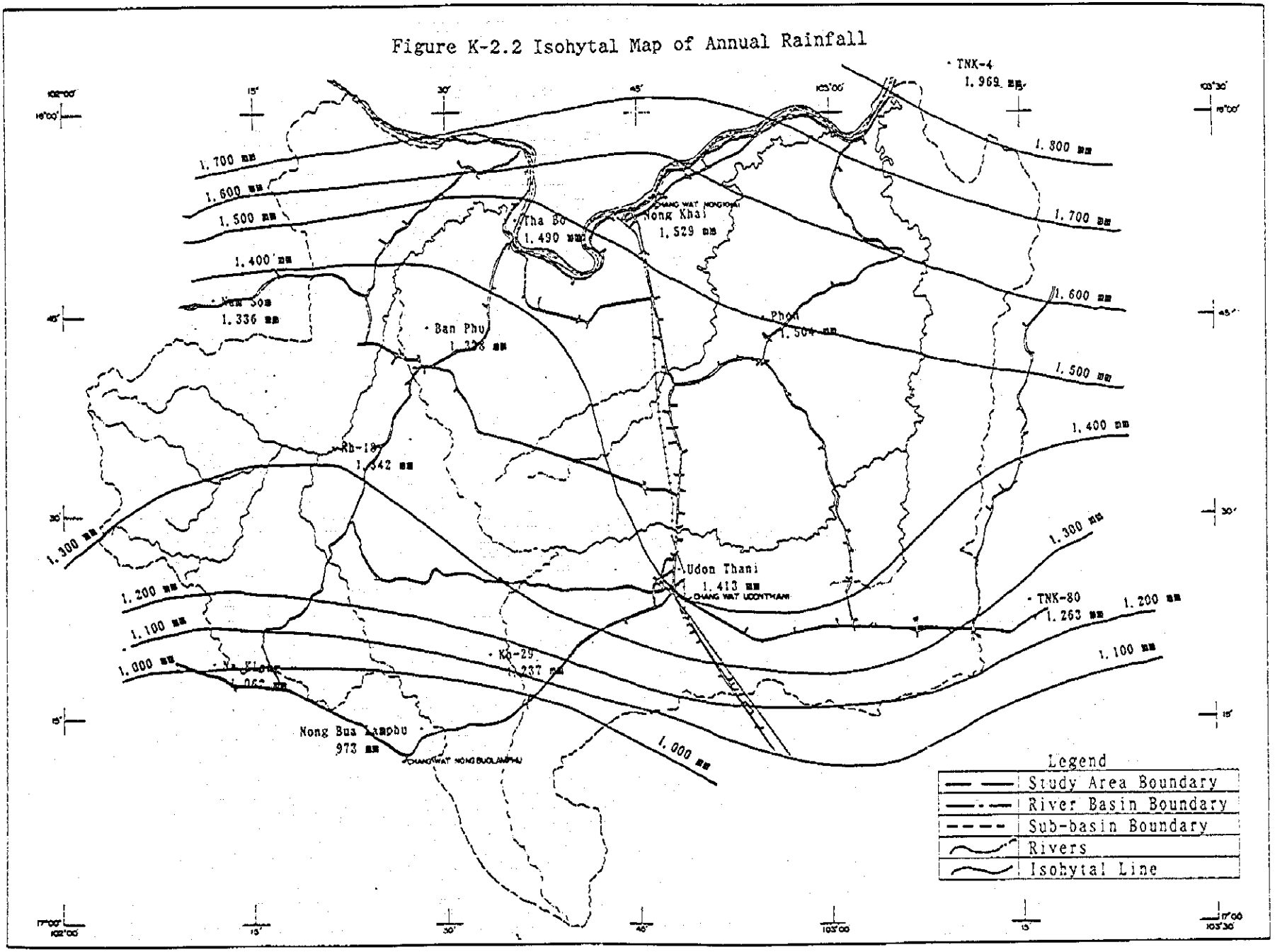


Figure K-2.3 Groundwater Salinity Map

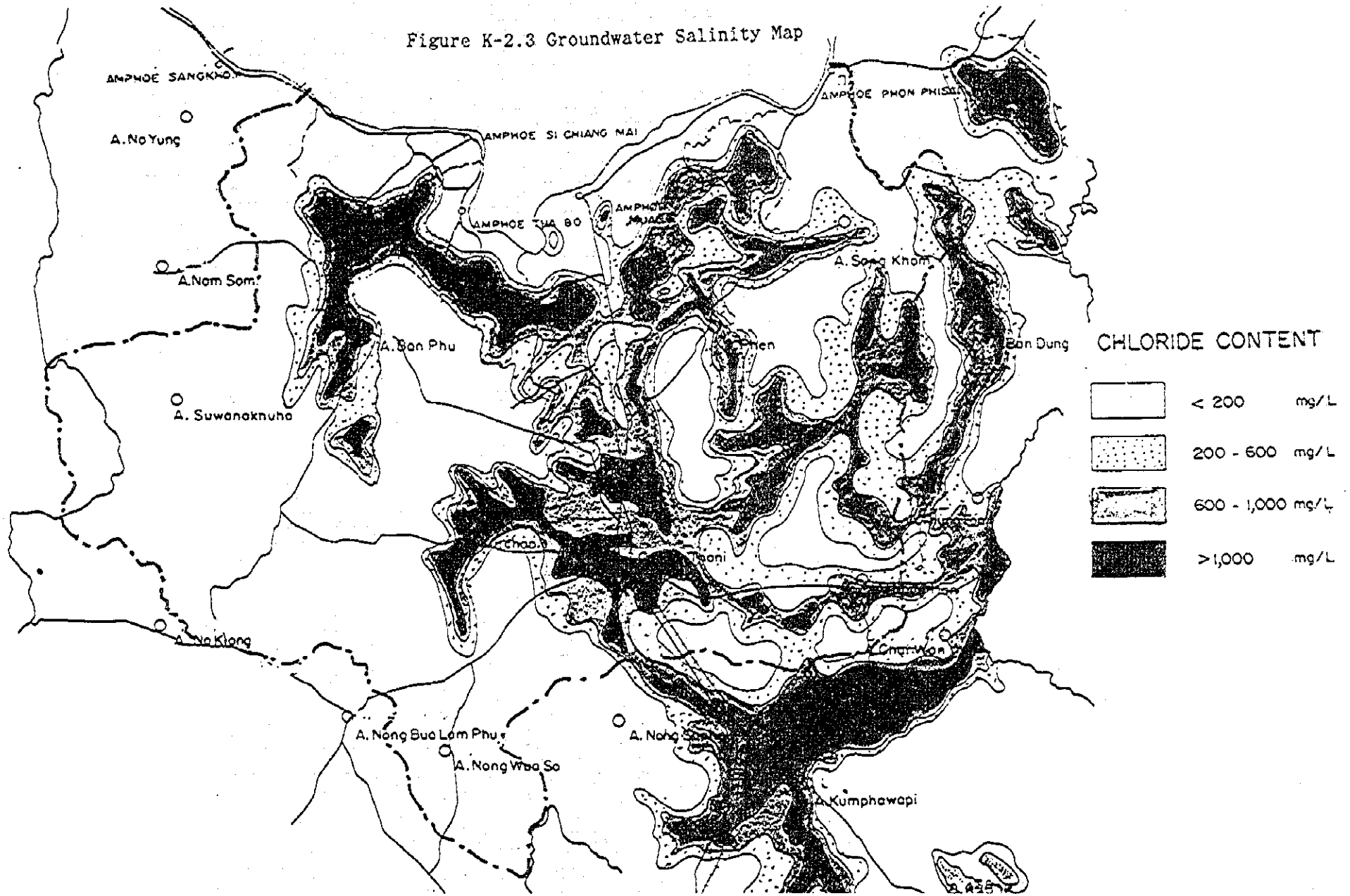


Figure K-2.4 Schematic Diagram of Huai Mong River System

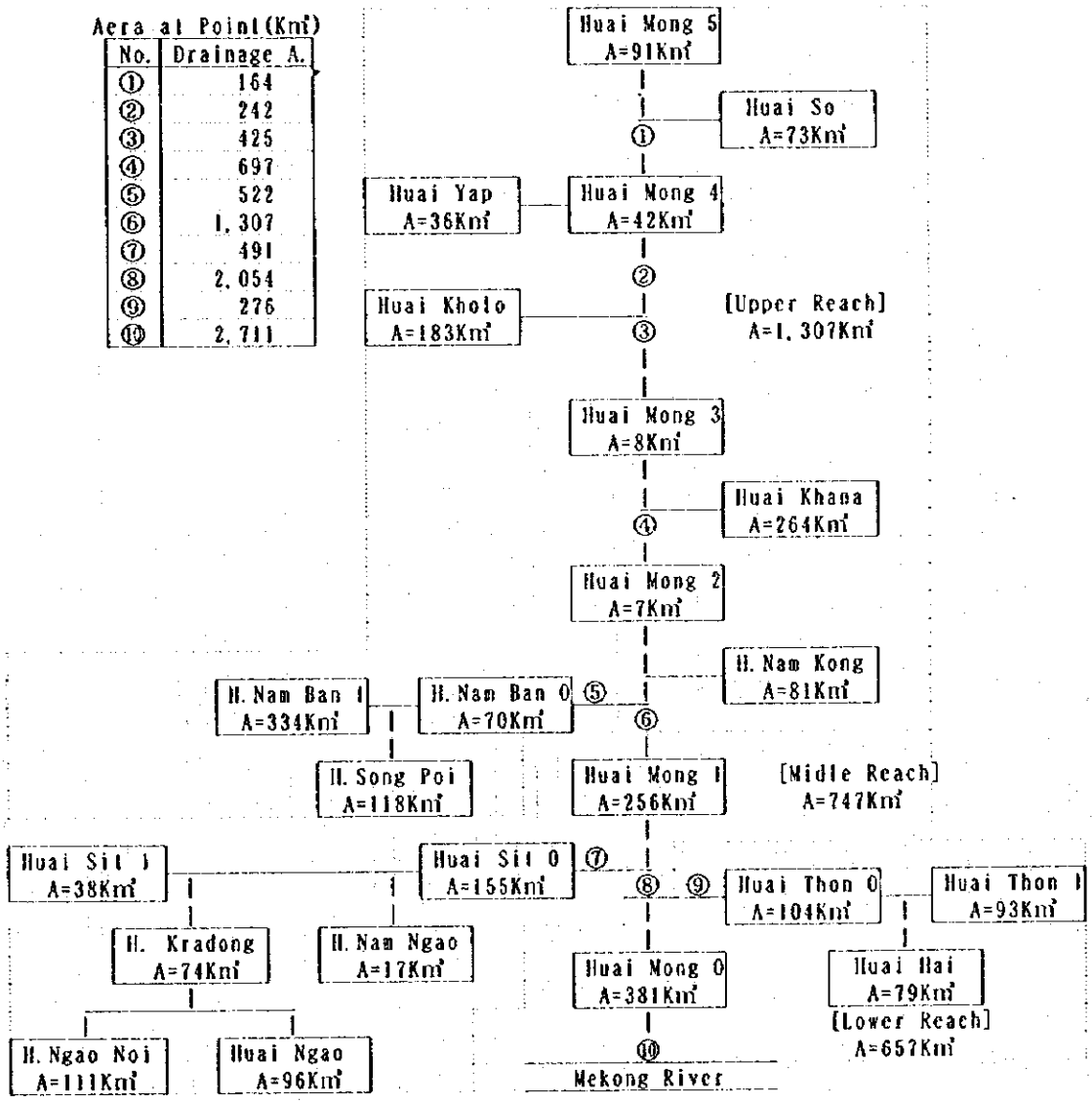
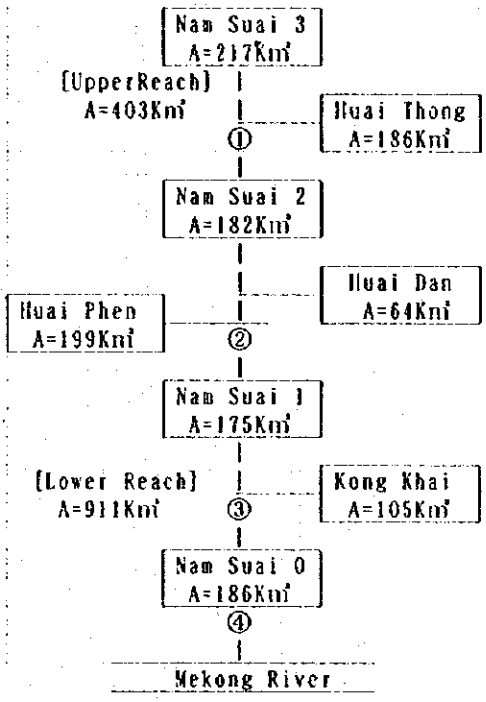


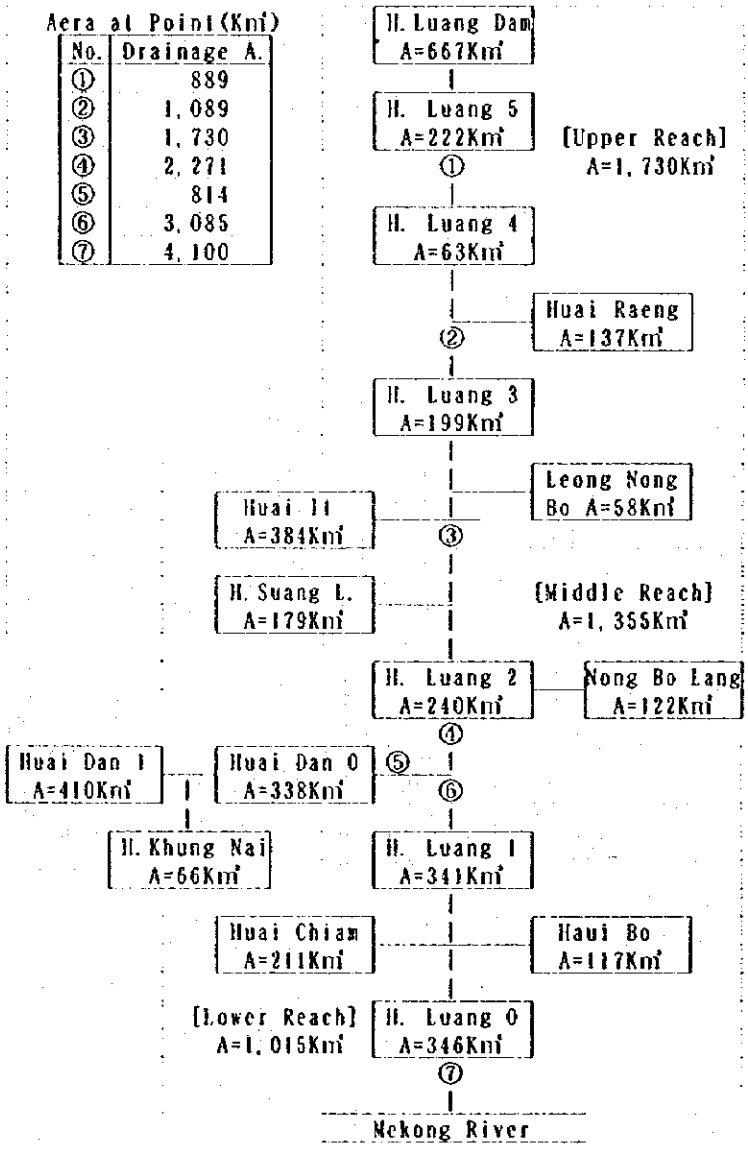
Figure K-2.5
Schematic Diagram of Nam Suai River System



Aera at Point(Km²)

No.	Drainage A.
①	403
②	848
③	1,128
④	1,314

Figure K-2.6
Schematic Diagram of Huai Luang River System



Aera at Point(Km²)

No.	Drainage A.
①	889
②	1,089
③	1,730
④	2,271
⑤	814
⑥	3,085
⑦	4,100

Figure K-2.7
Diagram of River Basins Directly Discharged to Mekong River

CHAPTER 3. PRESENT WATER RESOURCES DEVELOPMENT PROJECTS

3.1 General

3.1.1 RID Projects

The Royal Irrigation Department has dealt with gravity irrigation, domestic water supply, dredging, flood alleviation projects. For implementation of those project, the RID defines the large, medium and small scale projects as follows:

Large Scale Projects;

Construction Costs > 200 million Baht
Storage Volume > 100 MCM
Water Surface Area > 15 sq.km
Irrigation Are > 80,000 rai
Construction Period > 5 years

Medium Scale Projects;

200 million Baht < Construction Costs > 4 million Baht
10 MCM < Storage Volume > 100 MCM
5 years < Construction Period > 1 year

Small Scale Projects;

Construction Costs < 4 million Baht
Construction Period < 1 year

The RID has direct responsibility for the implementation of the large scale irrigation projects with cooperation of department of Land Development and the Office of Accelerated Rural Development for the provision of water supply as a part of rural development. In case of multipurpose projects, the EGAT is responsible for all project components.

Most of the medium scale projects, except EGAT and DEDP projects, are constructed, operated and maintained by the RID. The selection of suitable sites must rest with the RID. In practice, most medium scale projects are initiated by social conditions, and followed by economic return.

The small scale projects are initiated by the request of the beneficiaries and approved by the central government through endorsement of the Water Resources Development Council in the province. The project budget provides for the water storage/diversion facilities but not for distribution works and land compensation. The RID implement for construction of earth dam, concrete weir, and tank rehabilitation for the purposes of irrigation and domestic water supply. In addition, The RID also implement the pumping projects, providing supplementary and compensation water supplies with the diesel driven pump.

3.1.2 DEDP Projects

The Department of Energy Development and Promotion (DEDP) is in charge of the overall energy development policy and also implements the water resources development projects mostly in the Northeast region and small pumping projects for irrigation all over the country as a part of the rural development program. The details are discussed in Appendix L.

3.1.3 Other Agencies' Projects

As for the water resources development, thirty five (35) government agencies, state enterprises, committees etc., under eight (8) ministries. Out of those agencies, sixteen (16) agencies included the RID and DEDP, while the other agencies, etc. are engaged in planning and budgeting etc. The large and medium scale projects are undertaken by the RID, DEDP, EGAT, etc.

The government departments, except the RID and DEDP, involved in the implementation of the small scale projects for the agricultural water and domestic water development are summarized below:

Department of Land Development (DLD) for farm ponds;
Department of Fisheries (DOF) for fish ponds;
Department of Local Administration (DOLA) for People's Volunteer weir program;
Office of Accelerated Rural Development (ARD) for small reservoirs and ponds; and
Community Development Department (CDD) for small water projects.

For the domestic water supply in the Study Area, a number of government agencies involve particularly in the construction of wells, except the Provincial Water Works Authority (PWWA), as follows:

Department of Local Administration, MOI;
Public Works Department, MOI;
Office of Accelerated Rural Development, MOI;
Community Development Department, MOI;
Provincial Water Works Authority, MOI;
Department of Health, MOPH;
Department of Mineral Resources, MOI; and
Ministry of Defense.

In addition to the well construction, the provincial office is also involved in the construction of reservoir and ponds for the domestic water project and accelerated in its activities, in Nong Khai and Udon Thani provinces.

3.2 Large Scale Projects

Huai Luang project has initially constructed diversion dam with about 28.5 km of irrigation canals to serve a land area of some 3,200 ha. The reservoir project started in 1970 to expand the irrigation service area and completed in 1984, which is located about 25 km on road to the west of the town of Udon Thani. The project is equipped with the reservoir, diversion dam and irrigation canal and structures, and has served for a land area of some 13,900 ha. Major elements of the project facilities as follows:

Reservoir	Type;	Earth-fill dam
	Catchment Area;	666.4 sq.km
	Reservoir Area;	31.5. sq.km
	Total Storage Capacity;	127. MCM
	Effective Storage Capacity;	113.25 MCM
	Top Elevation of Dam;	202.5 m
	Design Water Surface El.;	201.5 m
	Dam Length;	4,900 m
	Dam Height;	12.5 m

Diversion Dam	Type;	Barrage
	Width	6.0 m x 2
Irrigation Canal	Left Main Canal	48.9 km
	Right Main Canal	32.2 km
	Secondary Canals	81.7 km
	Laterals	50.15km

The reservoir water level are recovered every year by the collecting runoff in the wet season, except 1993, according to the water operation of the reservoir. The water surface level, however, have not been reached to the design water level every year. The water have been allocated to irrigation water, domestic water and industrial water, giving first priority to the domestic water. Thereby, the irrigation water was supplied by about 30 % of planned quantity in 1993, though the domestic water was given up to nearly 100 % of planned ones.

The spillways, main and emergency spillway, have enough capacity (710cu.m/s and 500 cu.m/s at maximum,respectively) to discharge the excess water from the reservoir during the flooding. However, seeing that the water depth between the Maximum water level (El.201.5 m) and Design Water Level(El.201.0 m) is only 0.5 m and freeboard is 1.0 m, the spillway is currently operated in advance of the flooding, anticipating the huge flood discharge. The reason is to avoid the risk of flowing over the dam and flooding in the downstream area due to sudden opening of the gates. Thereby, the water level has not reached yet up to the Design Water Level so far.

The inflow to the reservoir have been calculated based on the daily reservoir operation records for the period of 1990 through 1995. The calculation have made to balance the inflow and outfow through the intakes for right and left main canals and spill way, assuming that the domestic water to Muang Udon Thani have been supplied through the Right Main canals and the domestic water to Nong Wua So and Kut Chap have been ignore. The reservoir operation losses, such as evaporation, seepage etc., have also been incorporated as a function to the daily water surface area. The estimated inflow, shown in Table K-3.1, is about 160.5 MCM per annum, which corresponds about 24 % of annual area rainfall or about 22 % of

annual rainfall at KH-29 station.

The service area, on the other hand, are currently irrigated for the wet season paddy area of about 13,600 ha and the dry season crops area of about 1,560 ha on the average, according to the available data (refer Table K-3.2). The cropping intensity is estimated to be about 111 % on an average.

The irrigation canals and structures have been operated and maintained in good condition. However, the diversion dam seems to be timeworn, which was constructed in 1952 and has leakage water through the gates and structure. the intake gates is deteriorated. In addition, on-farm ditches are irregular shape and have no check structures. The Improvement and upgrading of on-farm facilities may be required. The existing canals and structures are listed in Table K-3.3.

3.3 Medium Scale Projects

2) Medium Scale Project

Within the Study Area, eleven (11) medium scale projects exist and tow (2) projects are under construction (refer to Table K-3.4), which are tabulated in numbers of the projects for each basin, as follows:

Existing Medium Scale Projects

Name of River Basin	Nos.	Service Area (ha)
Nam Suai River Basin	2	130
Huai Luang River basin	8	1,670
Huai Bang Phuan Basin	1	1,920
Total	11	3,720

On-going Medium Scale Projects

Name of River Basin	Nos.	Service Area (ha)
Huai Mong River Basin	1	640
Huai Luang River basin	1	50
Total	2	690

The detailed dimension of the reservoir and dam for each existing and on-going projects are tabulated in Table K-3.5.

Those existing medium scale projects were constructed and be operated and maintained by the RID. The land area actually irrigated in both the dry and wet season are about 2,690 ha and 530 ha in the wet and dry season, respectively, according to the information collected in the course of the Study.

Among nine (9) existing projects, Kut Ling Ngo reservoir in the Huai luang river basin and Bang Phuan reservoir in Nong Khai Drainage Area, are operated comparatively well, which are supplied the water to the land area of some 2,570 ha for the wet season crops and 530 ha for the dry season crops or about 88 % of the service area, while the remaining seven (7) reservoirs are irrigated to be some 120 ha and 20 ha for the wet and dry season crops or about 30 % of service area in the wet season.

In fact, the distribution canals are improperly maintained. No check structures are provided. The on-farm ditches network are absent. Such inadequate infrastructures may result in the ineffective water delivery. Some projects are not operated due to social constraint, such as land ownership and right-of-way problems. In order to increase the irrigation rate, the upgrading of distribution canals and structures as well as on-form facilities will be required.

3.4 Small Scale Projects

One hundred forty seven (147) of the small scale irrigation projects (SSIP) have been constructed in the Study Area up to the present, as shown in Table K-3.6. As the SSIP are provided to serve the basic needs of rural peoples, the project facilities are utilized for various fields, such as domestic water, irrigation, livestock and fisheries. According to the post-evaluation report for the SSIP with the financial assistance of OECF, about 73 % of the reservoir are used for domestic water, and about 85 % of the irrigation purpose project are actually used for the irrigation but only about 50 % and 25 % of the project land area are irrigated in the wet and dry season, respectively. More than 90 % of the project

facilities are used for livestock during the dry season. About 95 % of the facilities are used for fisheries. Thus, the reservoirs constructed by the SSIP are utilized for the multi-purposes after the completion of the project.

Table K-3.1 Estimated Inflow Based on The Reservoir Operation Record (Unit:MCM)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1990	4.542	2.526	3.979	2.679	12.762	32.696	26.951	48.381	99.442	64.602	5.909	2.636	307.105
1991	2.934	2.842	6.196	4.920	7.749	5.237	4.822	21.652	55.061	23.030	2.987	1.204	138.634
1992	1.844	0.000	2.263	2.664	4.822	10.979	17.958	47.055	60.415	7.351	2.992	1.003	159.346
1993	1.626	1.924	2.284	2.375	7.106	5.107	5.136	0.418	18.460	1.115	1.112	0.979	47.642
1994	1.626	1.715	3.189	1.634	3.369	4.508	6.176	8.278	84.859	18.182	4.418	3.522	141.476
1995	0.000	2.951	3.385	3.032	7.587	9.635	28.797	61.148	38.761	11.003	1.803	0.761	168.863
Avg.	2.095	1.993	3.549	2.884	7.233	11.360	14.973	31.155	59.500	20.881	3.204	1.684	160.511

Table K-3.2 Irrigated Area in Huai Luang Project

Year	Wet Season Rice			Dry Season Crops				Fish-Ponds (ha)
	RMC (ha)	LMC (ha)	Total (ha)	Rice (ha)	Upland C. (ha)	Vegetable (ha)	Subtotal	
1983	n.a.	n.a.	n.a.	72	266	59	397	0
1984	n.a.	n.a.	n.a.	63	253	138	454	0
1985	n.a.	n.a.	n.a.	26	663	233	922	0
1986	n.a.	n.a.	n.a.	12	94	38	144	0
1987	n.a.	n.a.	n.a.	60	935	178	1,173	0
1988	6,816	7,102	13,918	82	1,277	262	1,621	0
1989	6,816	7,102	13,918	301	1,523	639	2,463	0
1990	6,816	7,102	13,918	266	1,713	466	2,445	0
1991	6,761	7,102	13,863	256	1,506	266	2,028	0
1992	6,691	7,102	13,793	666	1,827	338	2,831	0
1993	6,218	7,375	13,593	-	-	-	-	-
1994	6,096	7,375	13,471	143	1,387	320	1,850	205
1995	5,294	7,404	12,698	222	1,788	390	2,400	216
Average	6,439	7,208	13,647	181	1,103	277	1,561	
(%)	47%	53%	100%	1%	8%	2%	11%	

Note : n.a. means data are not available
Data Source : Huai Luang O&M Project Office

Table K-3.3 List of Canals and Structures for Huai Luang Project

Name	Canal-L. (m)	Drop (pls.)	Chute (pls.)	Flume (pls.)	Check (pls.)	R. Cult (pls.)	P. Cult (pls.)	Bridge (pls.)	W-way (pls.)	T/O (pls.)
Right MC	32,250	1	1	2	10	10	23	22	11	82
1L-R	1,610	1			1	2				7
2L-R	6,210	5				2	5	3	1	18
1R-2L-R	3,195	1				1	1	1		6
3L-R	8,850	0			4	3	7	6		27
1R-3L-R	7,560	1			1	1	7	4		20
1L-3L-R	1,355	1				1	2		1	5
2L-3L-R	1,730						1	1	1	7
4L-R	6,470	3			1	2	5	3	1	21
2L-4L-R	1,010	1				1	1			4
5L-R	2,550	2				1	3	3		11
6L-R	7,200	3				6	4	7		10
1L-6L-R	3,160	3				2	1	3	1	9
1L-1L-6L-R	1,050					1	1	1		5
2L-6L-R	1,200	1				1	1			4
7L-R	2,110	3				1	3		1	7
T-Lateral	55,260	25	0	0	7	25	42	32	6	161
Left MC	48,900	0	0	0	0	0	0	0	0	0
1R-L	6,400	4				3	7	3		15
1L-1R-L	4,900	4				1	2	1		13
2L-1R-L	3,600	2				1	2		1	6
2R-L	3,860	3			1	1	2	2	1	11
3R-L	13,300	9			1	4	10	5	1	34
1L-3R-L	3,125					1	3	2	1	3
2L-3R-L	2,260	1				1	1			5
3L-3R-L	1,620	1				1	1	1		5
4R-L	3,650	4	1			3	1	1		9
1R-4R-L	1,670				1	1	2	1	1	2
2R-4R-L	2,155	1				1	2	1	1	5
5R-L	2,050	2				1	2			4
6R-L	1,700	1	1			1	2		1	6
7R-L	3,830	5				1	2	1	1	9
8R-L	5,700	3	1			4	3	6	1	11
1L-8R-L	1,260					1	2		1	2
1R-8R-L	4,828	3				2	2	1	2	12
1L-1R-8R-L	1,730					1	2		1	4
2L-8R-L	1,250					1	1		1	1
9R-L	5,080	3	1			2	3	4	1	8
10R-L	2,800	4				1	1	1	1	7
T-Lateral	76,768	50	4	0	3	33	53	30	16	172
Total										
For MC	81,150	1	1	2	10	10	23	22	11	82
For Lat.	132,028	75	4	0	10	58	95	62	22	333
Total	213,178	76	5	2	20	68	118	84	33	415

Data Source : Huai Luang O&M Project Office

Table K-3.4 Existing/On-going Medium Scale Projects by RID in the Study Area

Name of River Basin	Name of Sub-basin	Project Name	Location			Storage Capacity (MCM)	Project-ed Area (ha)	Irrigated Area		Year Complete	Present Conditions and/or Operation and Maintenance
			Tanbon	Amphoe	Province			Wet S. (ha)	Dry S. (ha)		
Huai Mong	Low. Basin	Huai Thon Res.	Dan Srisuk	S. Chiangmai	Nong Khai	7.80	640	n.a.	n.a.	1996	Under consruction
	Total					7.80	640	n.a.	n.a.		
Nam Suai	Low. Basin	Nong Song Hong R.	N. S. Hong	Muang	Nong Khai	0.58	60	10	0	1956	Under rehabilitation
		H. Nam Thiang Res.	Phen	Phen	Udon Thani	0.21	70	50	0	1951	Well maintained
	Total						130	60	0		
Huai Luang	Uppr. Basin	Nong Samrong Res.	Mu Mon	Muang	Udon Thani	5.17	470	0	0	1952	Reservoir silted
		Nong Pla Chak Re.	Muang	Muang	Do.	1.14	0	Domestic Use		1953	Under Udon Thani Municipality
		Nong Om Res.	Chiang Pin	Muang	Do.	0.37	20	20	0	1956	Erosion in the reservoir side
		Nong Takai Res.	Nong Bua	Muang	Do.	0.63	70	40	0	1952	Mainly Domestic use
		Kut Ling Ngo Res.	Na Di	Muang	Do.	5.62	1,000	1,000	180	1962	Well maintained
		Sok Nom Khao Res.	Nong Hi	Muang	Do.	0.53	70	0	0	1951	No operation
		Lam Pla Khao Res.	Nong Hai	Muang	Do.	0.40	40	0	0	1957	No operation
		Nong Khon Kwang R	N. K. Kwang	Muang	Do.	1.00	0	Domestic Use		1953	Under military
		Huai Sari Res. #2	Mak Ya	Nong Wua So	Do.	0.70	50	0	0	1996	Under consruction
	Total					15.56	1,720	1,060	180		
Others to Mekong R.	Nong Khai Basin	H. Bang Phuan Res.	Nong Nang	Tha Bo	Nong Khai	10.75	1,920	1,570	350	1963	Rquested Improvement
	Total					10.75	1,920	1,570	350		
Ground Total						34.90	4,410	2,690	530		

Data Source : Provincial Office Report, RID

Note : n.a. means data are not available

: Irrigated area in 1994, as reported, except Huai Thon and Huai Sari Res. 2 reservoirs

Table K-3.5 General Description of Existing/On-going Medium Scale Projects by RID in the Study Area

Project Name	Type of Reservoir	Cat'nt Area (Km²)	Mean Qin/yr. (MCM)	Reservoir Capacity			W.S. Area	
				Eff. (MCM)	Dead (MCM)	Total (MCM)	Max. (ha)	Design (ha)
Huai Thon Res.	Earth Dam	42.80	13.48	7.80	n.a.	7.80	314.4	249.3
Sub-total		42.80	13.48	7.80	n.a.	7.80	314.4	249.3
Nong Song Hong R.	Earth Dam	3.80	3.39	0.38	0.20	0.58	52.0	49.7
H. Nam Thiang Res.	Do.	2.10	0.67	0.19	0.02	0.21	11.5	10.5
Sub-total		5.90	4.06	0.57	0.22	0.79	63.5	60.2
Nong Samrong Res.	Pond	18.00	6.14	4.8	0.37	5.17	358.0	307.5
Nong Pla Chak Re.	Do.	-	n.a.	1.14	n.a.	1.14	39.4	39.4
Nong Om Res.	Earth Dam	1.40	0.42	0.31	0.06	0.37	15.6	13.6
Nong Takai Res.	Pond	6.00	3.90	0.51	0.12	0.63	60.6	49.2
Kut Ling Ngo Res.	Earth Dam	46.00	16.99	5.44	0.18	5.62	288.0	261.0
Sok Nom Khao Res.	Do.	3.00	0.88	0.47	0.06	0.53	32.6	28.4
Lam Pla Khao Res.	Do.	1.50	0.30	0.39	0.01	0.40	50.0	40.0
Nong Khon Kwang R	Pond	1.50	0.66	0.82	0.18	1.00	35.2	35.2
Huai Sari Res. #2	Earth Dam	2.60	0.89	0.68	0.02	0.70	n.a.	0.26
Sub-total		80.00	30.18	14.56	1.00	15.56	879.4	774.6
H. Bang Phuan Res.	Earth Dam	41.00	10.99	10.70	0.05	10.75	380.0	380.0
Sub-total		41.00	10.99	10.70	0.05	10.75	380.0	380.0
T o t a l		169.7	58.71	33.63	1.27	34.9	1,637.3	1,464.1

Data Sources : Provincial Irrigation Offices, RID
Note : n.a. means data are not available

Project Name	Dimension of Dam					Div. W. Req'nt (cu.m/s)	Canal Length	
	Height (m)	Length (m)	Top B. (m)	Side Slope			Mains (m)	Lats. (m)
				R. Side	Out S.			
Huai Thon Res.	18.00	666	8.00	n.a.	n.a.	n.a.	2,145	-
Sub-total	18.00	666	8.00	n.a.	n.a.	n.a.	2,145	-
Nong Song Hong R.	6.00	850	4.00	1:3	1:2	0.24	1,800	1,150
H. Nam Thiang Res.	6.80	490	4.00	1:3	1:1.5	0.13	1,000	490
Sub-total	12.80	1,340	8.00			0.37	2800	1,640
Nong Samrong Res.	5.00	2,200	4.00	1:3	1:2	0.78	1,532	3,845
Nong Pla Chak Re.	3.70	4,000	n.a.	1:2	1:2	-	-	-
Nong Om Res.	5.00	340	5.00	1:3/3.5	1:2.5	0.17	1,000	-
Nong Takai Res.	3.00	1,320	4.00	1:2	1:2	0.33	3,970	1,800
Kut Ling Ngo Res.	9.00	1,230	5.00	1:3	1:3	1.81	7,503	20,788
Sok Nom Khao Res.	6.00	485	4.00	1:1.5	1:1.5	0.26	2,700	-
Lam Pla Khao Res.	7.00	385	4.00	1:3	1:2.5	0.05	385	-
Nong Khon Kwang R	4.00	900	4.00	1:2	1:2	-	-	-
Huai Sari Res. #2	8.00	300	5.00	1:3	1:2.5	n.a.	n.a.	n.a.
Sub-total						3.40	17,090	26,433
H. Bang Phuan Res.	10.50	1,700	5.00	1:3	1:2.5	1.40	10,316	6,972
Sub-total	10.50	1,700	5.00	1:3	1:2.5	1.40	10,316	6,972
T o t a l						5.17	32,351	35,045

Sub-total						3.40	17,090	26,433
H. Bang Phuan Res.	10.50	1,700	5.00	1:3	1:2.5	1.40	10,316	6,972
Sub-total	10.50	1,700	5.00	1:3	1:2.5	1.40	10,316	6,972
T o t a l						5.17	32,351	35,045

Table K-3.6 Medium Scale Projects Identified for the Study

Name of River Basin	Name of Sub-basin	Project Name	Location			Expected Storage (MCM)	Projected Area (ha)	Submerged Area (ha)	Tentative C. (M.B)
			Tanbom	Amphoe	Province				
Huai Mong	Uppr. Basin	Huai Kholo Res.	Dong Sa-Wan	Na Klang	N.B. Lamphu	37.10	380	130	555.0
		Huai Mong Res.	Bun Than	Suwan Khuha	Do.	38.70	480	220	429.0
		Huai Yap Res.	Do.	Do.	Do.	22.60	160	30	213.5
		Huai Khanan Res.	Ban Yuek	Nam Som	Udon Thani	37.60	400	80	250.5
		Huai Han Res.	Na Si	Suwan Khuha	N.B. Lamphu	4.50	130	10	68.4
		Sub-total				140.50	1,550	570	1,516.4
	Mid. Basin	Huai Ngao	Khao Son	Ban Phu	Udon Thani	13.40	2,180	190	120.0
	Low. Basin	Huai Ma	Kam Duang	Ban Phu	Udon Thani	6.00	1,240	110	42.5
	Total					159.90	4,970	870	1,678.9
Nam Suai	Uppr. Basin	Huai Thong	Kam Bong	Ban Phu	Udon Thani	11.30	1,920	160	110.0
	Low. Basin	-	-	-	-	-	-	-	-
	Total					11.30	1,920	160	110.0
Huai Luang	Uppr. Basin	Huai Hin Lat Res.	Nikhom Songkhroa	Muang U.T.	Udon Thani	7.80	1,280	130	80.0
		Huai Sari Res. 1	Mak Ya	Nong Wua So	Do.	2.48	290	40	30.0
		Huai Takrai Res.	Nong Bua Ban	Do.	Do.	1.00	140	20	17.0
		Huai Pla Dap Res.	Mak Ya	Do.	Do.	2.00	320	30	30.0
		Huai Limi Res.	Nong Phon	Kut Chap	Do.	3.28	640	80	35.0
		Huai Mek Res.	Song Koa	Do.	Do.	3.90	690	100	40.0
		Huai Chiang Res.	Kut Chap	Do.	Do.	2.89	480	50	32.8
		Sub-total				23.35	3,840	320	184.8
	Mid. Basin	-	-	-	-	-	-	-	-
	Huai Dan Basin	Huai Dan Res.	Nong Mek	Nong Harn	Udon Thani	29.90	5,120	320	200.0
	Low. Basin	Huai Yai Res.	Narm Phan	Phen	Udon Thani	3.28	1,280	130	80.0
		Huai Chiam Res.	Na Lab	Ban Dung	Do.	18.10	3,200	290	160.0
	Total					56.53	10,240	770	464.8
Others to Mekong R.	Nong Khai Basin	Huai Khuk	Khao Sam	Do.	Udon Thani	5.50	990	100	40.0
	Total					5.50	990	100	40.0
Ground Total						233.23	18,120	1,900	2,293.7

Data Source : Master Plan Study for Water Resources in the Country and Other Information, RID

Table K-3.7 List of Existing Small Scale Projects by RID (Continued)

Name of River Basin	Name of Sub-basin	Project Name	Location			Type of Structure	Storage Capacity (MCM)	Irrigat'n Area (ha)	Year Completed
			Tanbom	Amphoe	Province				
Huai Mong	Uppr. Basin	Huai Kholo W.	Kut Din Chi	Na Klang	N. R. Lamphu	Weir	0.12	32	1983
		Huai Lum Yai R.	Dong Sawan	Do.	Do.	Reservoir	0.45	80	1992
		Huai Rai-1 Res.	Do.	Do.	Do.	Do.	0.20	64	1992
		Huai Rai-2 Res.	Do.	Do.	Do.	Do.	0.70	112	1992
		Ban Na Nong Tum	Kut Din Chi	Do.	Do.	Weir	0.40	64	1993
		H. Phai (Tam Tao)	Na Kae	K.A. Na Wang	Do.	Reservoir	0.50	69	1993
		Ban Suwan Khuha R	Suwan Khuha	Suwan Khuha	Do.	Do.	0.10	16	1983
		Nong Bua Noi R.	Na Dan	Do.	Do.	Do.	0.50	48	1983
		Ban Klong Charoen	Ban Than	Do.	Do.	Do.	1.00	112	1983
		Huai Mong Weir	Do.	Do.	Do.	Weir	0.25	80	1985
		Huai Mong Weir	Suwan Khuha	Do.	Do.	Do.	0.50	160	1986
		Ban Dong Ma Fai W	Dong Ma Fai	Do.	Do.	Do.	0.12	32	1988
		Huai Kong Weir	Na Di	Do.	Do.	Do.	0.12	32	1991
		Huai So Res.	Ban Than	Do.	Do.	Reservoir	0.63	192	1991
		Huai Hin Kow Res.	Na Di	Do.	Do.	Do.	0.51	112	1991
		Huai Ka Nam W.	Dong Ma Fai	Do.	Do.	Weir	0.25	80	1991
		Huai Mong Weir	Suwan Khuha	Do.	Do.	Do.	0.50	160	1991
		Huai Mong Weir	Ban Khok	Do.	Do.	Do.	0.25	96	1991
		Huai Chot Res.	Na Di	Do.	Do.	Reservoir	0.50	80	1995
		Huai Nong Som W.	Nong Waeng	Nam Son	Udon Thani	Weir	-	48	1995
	Sub-total	15-Res. Project					6.58	1,365	
		5-Weir Project					1.02	304	
		20-Project					7.60	1,669	
	Mid. Basin	Huai Hin Kham R.	Ban Phu	Ban Phu	Udon Thani	Reservoir	0.06	88	1978
		Khuk Srisamran R.	Do.	Do.	Do.	Do.	0.02	Dom. W	1978
		Bhudabat Buabok R	Muang Phan	Do.	Do.	Do.	0.10	Dom. W	1979
		Ban Nong Waeng R.	Khao San	Do.	Do.	Do.	0.10	16	1983
		Huai Si Da Res.	Nong Hua Ku	Do.	Do.	Do.	0.27	112	1985
		Huai Mong Weir	Cham Pa Mong	Do.	Do.	Weir	-	160	1988
		Wang Duan Ha R.	Ban Phu	Do.	Do.	Reservoir	0.09	Dom. W	1989
		Ban Klang Noi W.	Cham Pa Mong	Do.	Do.	Weir	-	96	1991
		Ban Nong Thong W.	Non Thong	Do.	Do.	Do.	-	48	1991
		Ban Tan Lian Res.	Khom Yung	Cut Chap	Do.	Reservoir	0.80	32	1980
	Sub-total	4-Res. Project					1.23	248	
		3-Domestic Res. P.					0.21	0	
		3-Weir Project					-	304	
		10-Project					1.44	552	
	Lowr. Basin	Huai Siew Res.	Nong Pla Pak	Si Chiang Mai	Nong Khai	Reservoir	0.01	80	1978
		Huai Nam Oil Res.	Phong Thong	Do.	Do.	Do.	0.03	48	1984
		Wat Aranya Bunpod	Ban Mo	Do.	Do.	Do.	0.03	Dom. W	1986
		Nong Aum Bad Res.	Phong Thong	Do.	Do.	Do.	0.07	32	1989
		Huai Khom Pla W.	Khon Kham	Tha Bo	Do.	Weir	-	32	1978
		Huai Tid Kham R.	Khok Nang	Do.	Do.	Reservoir	0.30	16	1978
		Ban Thon Weir	Ban Thon	Do.	Do.	Weir	-	48	1982
		Huai Pong Sung W.	Khon Kham	Do.	Do.	Do.	-	48	1984
		Huai Yai Weir	Ban Wan	Do.	Do.	Do.	-	48	1990
		Huai Bong Res.	Hai Sok	Ban Phu	Udon Thani	Reservoir	0.40	160	1977
		Huai Chaeng W.	Do.	Do.	Do.	Weir	-	80	1991
	Sub-total	5-Res. Project					0.84	336	
		1-Domestic Res. P.					0.03	0	
		5-Weir Project					0	256	
		11-Project					0.87	592	
	Total	24-Res. Project					8.65	1,949	
		4-Domestic Res. P.					0.24	0	
		13-Weir Project					1.02	864	
		41-Project					9.91	2,813	
Nam Suai	Uppr. Basin	Nong Don Ngue R.	Na Kha	Muang	Udon Thani	Reservoir	0.12	3	1988
		Huai Nam Suai W.	Na Phu	Phen	Do.	Weir	-	240	1991
		Wat Pa Ban Ko R.	Khua Nam	Ban Phu	Do.	Reservoir	0.07	32	1986
		Nong Kut Chap R.	Do.	Do.	Do.	Do.	0.03	2	1988
		Huai Suai Weir	Do.	Do.	Do.	Weir	-	64	1991
		Huai Thong Weir	Nong Hua Ku	Do.	Do.	Do.	-	64	1991
		Huai Khak Hung W.	Ban Fang	K.A. Sra Krai	Nong Khai	Do.	-	32	1978
		Huai Thong Weir	Do.	Do.	Do.	Do.	-	192	1979
		Huai Thong Weir	Khok Chang	Do.	Do.	Do.	-	192	1979
		Nong Bua Res.	Ban Fang	Do.	Do.	Reservoir	0.55	64	1984
		Nam Suai Weir	Khok Chang	Do.	Do.	Weir	-	80	1988
	Sub-total	4-Res. Project					0.77	101	
		7-Weir Project					-	864	
		11-Project					0.77	965	

Table K-3.7 List of Existing Small Scale Projects by RID (Continued)

Name of River Basin	Name of Sub-basin	Project Name	Location			Type of Structure	Storsge Capacity (MCM)	Irrigat'n Area (ha)	Year Completed
			Tanbom	Amphoe	Province				
Nam Suai	Low. Basin	Hon Pa Pao Res.	Khai Bok Wan	Muang	Nong Khai	Reservoir	0.02	32	1978
		Nong Pa Kao W. T.	Song Hong	Do.	Do.	W. Tank	0.30	48	1981
		Ban Sudi Long W.	Do.	Do.	Do.	Weir	-	160	1982
		Ban Perd Yai R.	Wat Tai	Muang	Do.	Reservoir	0.65	64	1988
		Nong Don Res.	Pho Chai	Do.	Do.	Do.	0.08	32	1988
		Nong Bo E. W. T.	Lao Tang Kham	Phon Phisai	Do.	W. Tank	1.50	320	1980
		Ban Na Tam Nua R.	Wat Luang	Do.	Do.	Reservoir	1.50	128	1982
		Huai Hin Muk R.	Do.	Do.	Do.	Do.	2.28	400	1988
		Huai Hin Res.	Lao Tang Kham	Do.	Do.	Do.	0.50	32	1985
		Yod Wang No Res.	Phen	Phen	Do.	Do.	0.30	32	1977
		Nong Khak Res.	Chom Sri	Do.	Do.	Do.	0.80	80	1980
		Huai Wang Tu Res.	Chiang Wang	Do.	Do.	Do.	1.00	16	1984
		Nam Suai Weir	Ban That	Do.	Do.	Weir	-	80	1989
		Huai Yang Weir	Phen	Do.	Do.	Do.	-	48	1990
		Huai Haew Res.	Do.	Do.	Do.	Reservoir	0.40	80	1994
		Sok Din Daeng R.	Sra Khrai	K. A. Sra Khrai	Do.	Do.	0.10	16	1980
		Huai Dong Dr. C.	Do.	Do.	Do.	Dr. Culvt.	0.30	32	1981
	Sub-total	11-Res. Project					7.63	912	
		3-Weir Project					-	288	
		2-W. Tank Project					1.80	368	
		1-Dr. Culvert P.					0.30	32	
		17-Project					9.73	1,600	
	Total	15-Res. Project					8.40	1,013	
		10-Weir Project					0.00	1,152	
		2-W. Tank Project					1.80	368	
		1-Dr. Culvert P.					0.30	32	
		28-Project					10.50	2,565	
Huai Luang	Uppr. Basin	Mee Non Weir	Non Sung	Muang	Udon Thani	Weir	-	160	1977
		Nong Dum Res.	Chiang Pin	Do.	Do.	Reservoir	0.28	0	1978
		Nong Sawan Res.	Do.	Do.	Do.	Do.	0.20	0	1979
		Ramasun Res.	Non Sung	Do.	Do.	Do.	0.55	0	1984
		Ban Kham kling R.	Ban Cham	Do.	Do.	Do.	0.50	8	1985
		Huai Hin Lat R.	Ni Khom Song Khro	Do.	Do.	Do.	0.15	48	1987
		Nikhom Taharri Phan Suek Res.	Ban Tat	Do.	Do.	Do.	0.26	32	1988
		Nong E Lern Res.	Chiang Yun	Do.	Do.	Do.	0.15	5	1988
		Huai Rin Res.	Ban Tat	Do.	Do.	Do.	0.64	160	1988
		Huai Sam Phad W.	Non Sung	Do.	Do.	Weir	-	160	1989
		Nong Luang Res.	Ban Tat	Do.	Do.	Reservoir	0.03	0	1990
		Nong Bo Kong R.	Na Kha	Do.	Do.	Do.	0.08	0	1990
		Nong Toun Res.	Ban Chan	Do.	Do.	Do.	3.00	0	1994
		Ban Srang Ko Res.	Sang Kao	Kut Chap	Do.	Do.	0.03	0	1978
		Huai Na Oi Res.	Khong Yung	Do.	Do.	Do.	0.60	80	1979
		Ban Tum Tao Res.	Sang Kao	Do.	Do.	Do.	0.80	32	1980
		Huai Kham Yai W.	Khon Yung	Do.	Do.	Weir	-	160	1983
		Huai Yang Res.	Kut Chap	Do.	Do.	Reservoir	0.20	160	1987
		Nong Non Whai R.	Non Whai	Nong Wua So	Do.	Do.	0.15	0	1978
		Huai Rai Res.	Oup Mung	Do.	Do.	Do.	0.50	48	1979
		Huai Hai Weir	Kut Mak Fai	Do.	Do.	Weir	-	80	1980
		Huai Hin Tak Res.	Do.	Do.	Do.	Reservoir	0.40	160	1981
		Huai Klay Res.	Do.	Do.	Do.	Do.	0.30	48	1983
		Khuk Nong Saeng R.	Non Whai	Do.	Do.	Do.	0.78	128	1985
		Huai Pham Po Res.	Oup Mung	Do.	Do.	Do.	0.12	32	1988
		Nong No Res.	Non Whai	Do.	Do.	Do.	0.07	8	1989
		Huai Khamin Res.	Oup Mung	Do.	Do.	Do.	0.58	128	1988
		Huai Luang -2 W.	Nong Oo	Do.	Do.	Weir	-	240	1990
		Huai Luang Weir	Nong Sawan	Do.	Do.	Weir	-	80	1995
		Huai Pone Pek W.	Nong Oo	Do.	Do.	Weir	-	64	1995
	Sub-total	15-Res. Project					6.05	1,077	
		8-Domestic W. P.					4.32	0	
		7-weir Project					0.00	944	
		30-Project					10.37	2,021	

Table K-3.7 List of Existing Small Scale Projects by RID (Continued)

Name of River Basin	Name of Sub-basin	Project Name	Location			Type of Structure	Storsge Capacity (MCM)	Irrigat'n Area (ha)	Year Com Pleted
			Tanbom	Amphoe	Province				
Huai Luang	Mid. Basin	Ban Kon Saen R.	Sam Phrao	Muang	Udon Thani	Reservoir	0.30	0	1981
		Nong Yai Res.	Do.	Do.	Do.	Do.	0.09	64	1989
		Huai Luang -1 W.	Do.	Do.	Do.	Weir	-	160	1990
		Kham Phak Nham R.	Tao Hai	Phen	Do.	Reservoir	0.20	64	1978
		Na Bua Weir	Na Bua	Do.	Do.	Weir	-	112	1978
		Huai Kham Res.	Khok Klang	Do.	Do.	Reservoir	0.03	32	1979
		Yang Sung Res.	Na Bua	Do.	Do.	Do.	0.50	32	1980
		Nong Na Hai Res.	Sum Sao	Do.	Do.	Do.	1.00	80	1980
		Nong Na Hai Res.	Do.	Do.	Do.	Do.	0.10	16	1980
		Nong Bua Res.	Na Bua	Do.	Do.	Do.	0.11	8	1988
		Nong Thom Res.	Ban Lao	Do.	Do.	Do.	0.11	0	1992
		Ban Hua Din Res.	Do.	Do.	Do.	Do.	0.50	64	1993
		Ban Pak Tob Weir	Phak Top	Nong Han	Do.	Weir	-	16	1980
		Huai Srai Noi R.	Nong Han	Do.	Do.	Reservoir	0.80	32	1981
		Ban Don Bak Res.	Nong Phai	Do.	Do.	Do.	0.50	32	1984
		Nong Sadi Res.	Sroi Phrao	Do.	Do.	Do.	0.04	32	1984
		Ban Sa Bang Weir	Sa Bang	Do.	Do.	Weir	-	48	1987
		Nong Suai Daway R.	Nong Han	Do.	Do.	Reservoir	0.05	32	1989
		Ban Tai Res.	Don Kloy	Phulbul Rak	Do.	Do.	0.35	80	1982
		Nong Lerng Noi R.	Na Sai	Do.	Do.	Do.	0.74	112	1987
		Nong Thung Yai R.	Thung Yai	Thung Fon	Do.	Do.	2.00	160	1979
		Huai Ban Weir	Na Sai	Phulbul Rak	Do.	Weir	-	80	1995
	Sub-total	15-Res. Project					7.01	840	
		2-Domestic Res.P.					0.41	0	
		5-Weir Project					0.00	416	
		22-Project					7.42	1,256	
	Low. Basin	Huai Ban Res.	Na Nang	Phon Phisai	Nong Khai	Reservoir	1.70	80	1979
		Ban Na Paengyai R.	Chung Pon	Do.	Do.	Do.	0.10	16	1980
		Nong Tan Muang P.	Wai Luang	Do.	Do.	W. Tank	0.60	32	1985
		Wang Duen Ha Res.	Ban Chai	Ban Dung	Udon Thani	Reservoir	0.30	48	1983
		Kham E Keng	Na Mai	Do.	Do.	Do.	0.05	48	1985
		Nong E Wo Weir	Ban Chai	Do.	Do.	Weir	-	48	1985
		H. Kham Man Pla R.	Do.	Do.	Do.	Reservoir	0.12	48	1988
		H. Dong Hua Po R.	Do.	Do.	Do.	Do.	0.32	32	1989
		Nong Bam Non Udon	Na Kham	Do.	Do.	Do.	0.06	32	1992
		H. Wana Chang R.	Song Khom	Sang Khom	Do.	Do.	2.00	240	1979
		Ban Talina Cham R.	Ban Yued	Do.	Do.	Do.	0.60	64	1980
		Nong Ya Wo Res.	Chang Kham	Do.	Do.	Do.	0.18	48	1982
		Ban Khok Ban Phoe	Ban Khok	Do.	Do.	Do.	0.01	48	1983
		Nong Ya Wo Res.	Ban Yued	Do.	Do.	Do.	0.55	128	1984
		Huai Wang Sim W.	Ban Khok	Do.	Do.	Weir	-	48	1990
		Nong Kee Mok Res.	Do.	Do.	Do.	Reservoir	0.01	0	1991
	Sub-total	12-Res. Project					6.02	832	
		1-Domestic Res.P.					0.01	0	
		1-W. Tank Project					0.60	32	
		2-Weir Project					-	96	
		16-Project					6.66	960	
	Total	42-Res. Project					19.08	2,749	
		11-Domestic Res.P.					4.77	0	
		14-Weir Project					-	1,456	
		1-W. Tank Project					0.60	32	
		68-Project					24.45	4,237	

Table K-3.7 List of Existing Small Scale Projects by RID (Continued)

Name of River Basin	Name of Sub-basin	Project Name	Location			Type of Structure	Storage Capacity (MCM)	Irrigat'n Area (ha)	Year Completed
			Tanbon	Amphoe	Province				
Others to Mekong R.	Nong Khai Basin	Huai Khuk Weir	Ban Dua	Tha Bo	Nong Khai	Weir	-	32	1983
		Ban Phun Ngam R.	Ban Thon	Do.	Do.	Reservoir	2.97	160	1990
		Huai Na Weir	Do.	Do.	Do.	Weir	-	0	1991
		Nong Oerd Res.	Mi Chai	Muang	Do.	Reservoir	0.13	8	1988
		H. Bung Phuan W.	Phra Tai Bang Phuan	Do.	Do.	Weir	-	160	1990
		Ban Huai Srai R.	Ban Fang	K. a. Sra Khrai	Do.	Reservoir	0.05	16	1979
	Sub-total	3-Res. Project					3.15	184	
		1-Domestic W. P.					-	0	
		2-Weir Project					-	192	
		6-Project					3.15	376	
	Others	Phraput Tabat R.	Phraput Tabat	Si Chiang Mai	Nong Khai	Reservoir	0.02	0	1979
		Huai Kluang Weir	Do.	Do.	Do.	Weir	-	24	1984
		Huai Hin Siew R.	Do.	Do.	Do.	Reservoir	0.91	112	1986
		H. Hin Lood Dr. C.	Wat Luang	Phon Phisai	Do.	Dr. Culvt.	-	32	1980
	Sub-total	1-Res. Project					0.91	112	
		1-Domestic Res. P.					0.02	0	
		1-Weir Project					-	24	
		1-Drain. Culvt. P.					-	32	
		4-Project					0.93	168	
	Total	4-Res. Project					4.06	296	
		2-Domestic W. P.					0.02	0	
		3-Weir Project					-	216	
		1-Drain. Culvt. P.					-	32	
		10-Project					4.08	544	
Ground Total		85-Res. Project					40.19	6,007	
		17-Domestic W. P.					5.03	0	
		40-Weir Project					1.02	3,688	
		3-W. Tank Project					2.4	400	
		2-Drain. Culvt. P.					0.30	64	
		147-Project					48.94	10,159	

Figure K-3.1 Location Map of Existing/On-going and Proposed MSIP

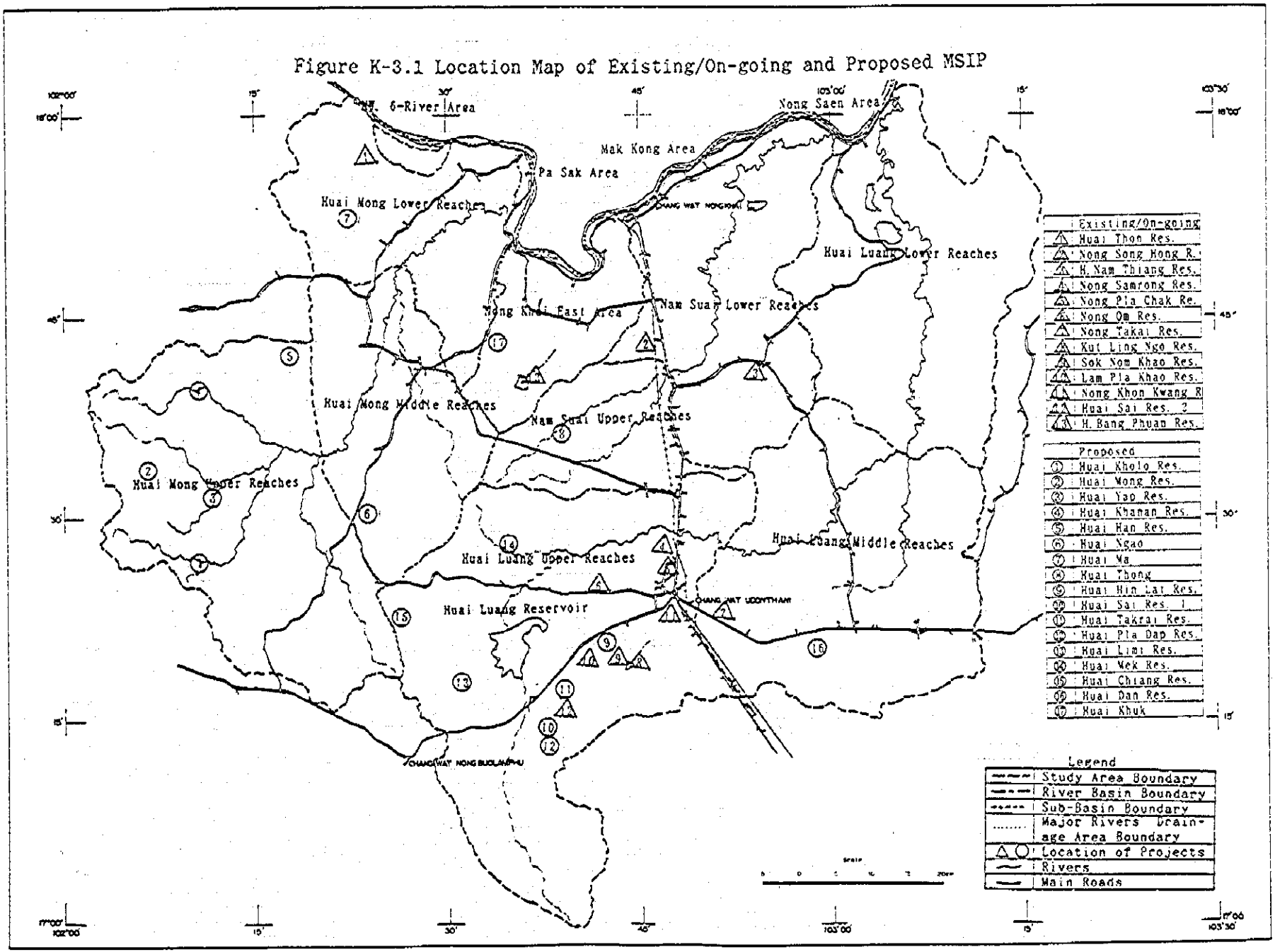
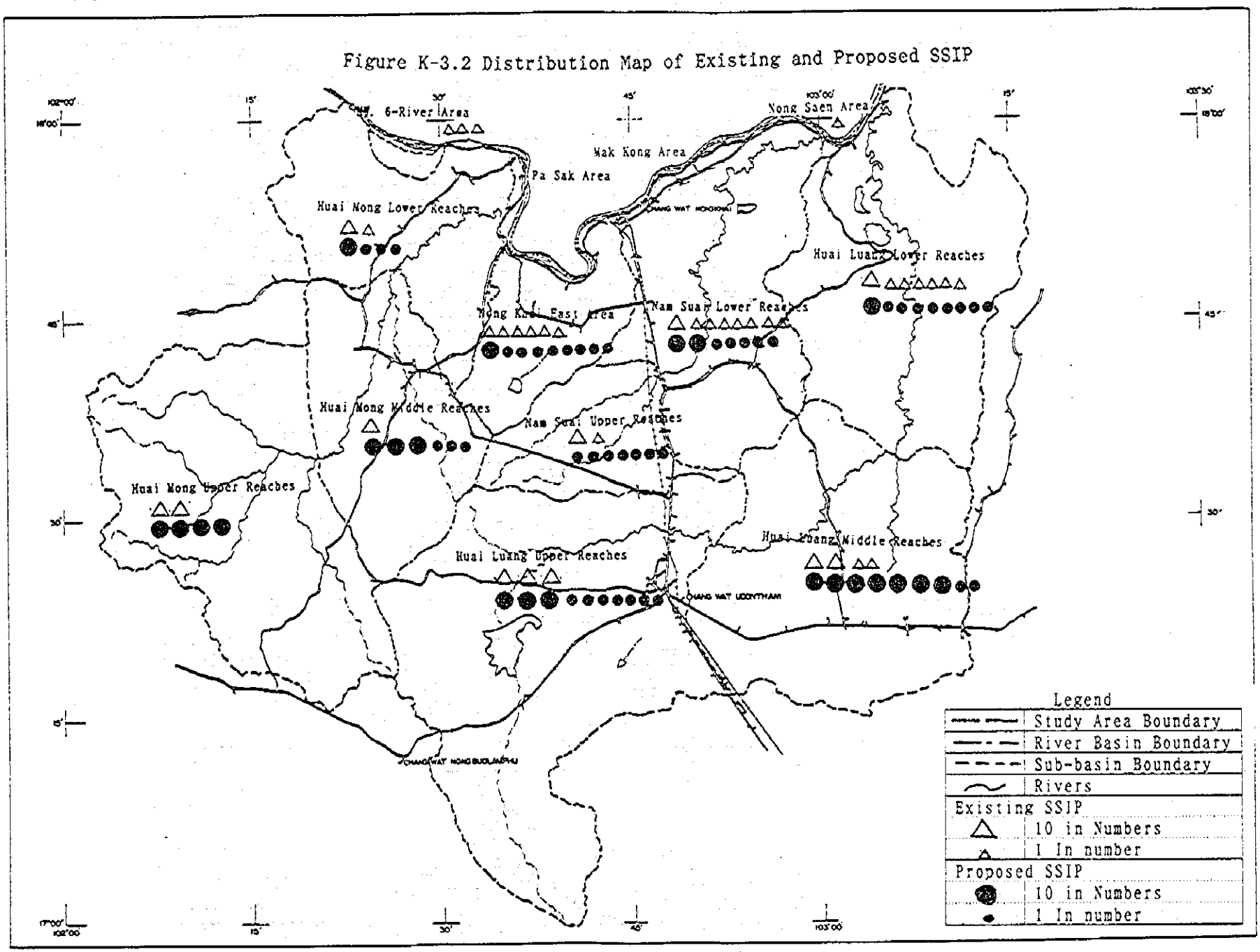


Figure K-3.2 Distribution Map of Existing and Proposed SSIP



CHAPTER 4. PROPOSED WATER RESOURCES DEVELOPMENT

4.1 Basic Conception and Strategy

4.1.1 Basic Conception

1) Effective Utilization of Available Water Resources

The water resources in the study area are available only in the rainy season because of the rainfall distribution and presence of very little forest area. To retain the water during the rainy season, the construction of the reservoir will be effective means. However, available reservoir sites are limited, due to the topography and social constraint. The natural reservoirs will be utilized as a storage reservoir by providing the dike around the reservoir, taking into account the topography, distance to the rivers and drainage.

2) Improvement of Existing Water Resources Facilities

The rehabilitation and/or improvement of existing water resources facilities, such as reservoir, weir, natural reservoir, swamp, pond etc., will enhance their functions in terms of the water resources utilization with low construction costs and less social constraint.

3) Flood Mitigation

The flood and inundation problems, on the other hand, have been taken place not only in the lower reaches of the rivers but also in the middle reaches, due to narrow width and meandering of the rivers. The dredging and training of the rivers/streams will bring about not only the mitigation of flood but also increase of runoff discharge, storage of the water in the river course and natural reservoirs along the river, and reclamation of the agricultural land.

4.1.2 Development Strategy

In order to distribute the benefits to many farmers over the Study Area, the small scale projects including the dredging will be effective. The small scale pumping projects will be also proposed for the purposes of domestic and irrigation, particularly for garden and cash/diversified crops by using existing project reservoirs, natural reservoir, farm ponds and/or the river water impounded in the natural reservoirs, since the pumping projects only for irrigation purpose are very costly in the O&M costs.

In addition to the SSIP, the rehabilitation and improvement of existing large, medium and small scale projects will pursue effectively to use the available water with low costs. Since the potentiality of the large and medium scale water resources development projects in the study area may be limited in the Study Area, due to the physical conditions, such as rainfalls, topography, soils, etc., and social constraints, the natural reservoirs will be developed by impounding the river water.

Under the above views, the water resources development projects for the study area will be planned and discussed in the following section.

4.2 Planned Water Resources Development Projects

4.2.1 Large Scale Irrigation Project

The Existing Hual Luang Reservoir Project will be improved in terms of water management, since the sites for new large scale projects have not been identified in the Study Area. The Hual Luang Project has been completed in 1984 but should be re-examined its water elevation for distribution systems in t farm plots and on-farm facilities.

The overflow type of spillway have been studied to improve the pre-discharging, as mentioned previously. However, the required length of spillway will be too long (refer to Table K-4.1). Since the orifice type of existing spillway are available, it is better to increase the depth of freeboard at one more meter rather than constructing an additional over-

flow type spillway. So that, the heightening up of the dam for ensuring the better spillway operation is proposed.

As additional water source, Huai Luang Diversion Dam exists in the downstream of the reservoir to divert the water from other basin with a drainage area of some 222 sq.km. The major facilities are consists of the barrage with 2 gates of 5 m width, the intake with 2 gates of 3 m width, the diversion canal to connect with the Right Main Canal and dikes for the length of about 3 km. Those facilities are timeworn. To conduct effective water operation and management, the intake gates shall be replaced. It was noticed that the gate leaves are broken. In addition, it is proposed to heighten the water surface level in front of the intake by 0.5 m so that more water will be diverted to the Right Main Canal.

The main and lateral canals are lined with concrete, except Right Main Canal which are paved by concrete for the he side slope but dry riprap for the bottom. According to the O&M project office information, the water of 1 cu.m/s is lost at the ending point of RMC, in case of the water of 2 cu.m/s flown down at the beginning point of RMC. The Right Main Canal shall be lined with concrete to save the water effectively.

The canal system shall be reviewed based on at least 1/5,000 topographic map with contour lines of 25 cm interval. The some portion of canal shall be repaired. Since it seems that the check structures and turnouts are not fully functional, therefore, they will be inspected for remedy or construct additional ones. In addition to those canal system, the width of O&M road along the laterals shall be widened by at least 1.0 m for the farmers with tractor. The numbers of bridges/road crossings/foot bridges will be increased at a rate of every 1.2 km for Main Canals and 1.0 km for Laterals for convenience to O&M activity and the farmers.

The improvement project will provide, heightening up to dam height, improvement of the diversion dam, remedial measures for canal and structures, increase of check structures, road crossings and bridges, and widening of O&M roads along the lateral canals with the costs of about 203.1 million baht excluding the price escalation.

4.2.2 Medium Scale Irrigation Projects

Nineteen (19) reservoir projects are identified to be constructed in the futures. Among them, seventeen (17) projects have been examined from an engineering and economical points of view. Since the beneficial areas of two (2) proposed projects, Huai Yai and Huai Chiam reservoir projects have already been scheduled to irrigate by pumps and to place in the reservoir area by the other agency. The Projects will retain the effective storage capacity of about 111.6 MCM and create the irrigated land area of some 11,010 ha with the costs of about 3,638.4 million baht excluding price escalation (refer to Table K-4.2).

In addition to the new projects, the improvement and rehabilitation of seven (7) existing projects have been proposed. By implementation of the Projects, the irrigated land area are expected to be increased from 2,600 ha at present to 4,160 ha in future by 1,560 ha (refer to Table K-4.3). The Project costs estimated to be about 222.7 million baht excluding the price escalation.

4.2.3 Small Scale Irrigation Projects

The small scale projects will be implemented by the RID, in terms of the water resources development, for the purposes of the irrigation, domestic water, water for livestock and fishery. Among others, the provision of domestic water use will be given priority than irrigation.

The project will provide three (3) types of the facilities, such as reservoir, weir and pumping station. The reservoir will be constructed in the form of reservoir dam, farm pond, public pond and fish pond (drainage water tank), which will provide the water for domestic use, irrigation, livestock and fisheries. The river water impounding along the river may be categorized in to this reservoir works. If such reservoirs are located far from the villages, it will be suggested to construct weirs to get the enough water head in the upstream and diversion canal to convey the water to the pond to be built near the village.

The pumping facilities including delivery pipes and tank/pond will be provided to supply the water to the village people for garden farming and cultivation of cash crops, such as vegetable, flowers,etc., giving first priority to the domestic use.

The land with irrigation facilities and/or irrigated account for about 12 % of the irrigable land (about 335,000 ha) and increased up to about 26 % by the implementation of MSIP and other agencies' projects. In order to increase more irrigated land over the Study Area, only small scale projects will be able to supplemented. The target to be irrigated in the future up to 2006 have been set up to be about 32 % of the irrigable area (refer to Table K4.4). To come up with this target, the small scale irrigation projects proposed for the future up to 2006 have been estimated to be 263 projects with an irrigation area of some 20,120 ha including 33 pumping irrigation project with an irrigation area of some 2,610 ha(refer to Table K-4.5).

In addition to the new projects, the existing projects under the SSIP program will call for the rehabilitation and/or improvement, to recover the function of facilities, increase the capacity of the storage, improve the water management, protect from flood, utilize better for farmers and make for other beneficial matters. The proposed rehabilitation and improvement of SSIP will be about 121 projects for the future up to 2006, assuming that about 40 % of the existing projects and 20 % of the future projects completed in the early stage will be rehabilitated and/or improved(refer to Table K-4.6).

4.2.4 Dredging Projects

The dredging projects, to recover the storage capacity of existing swamps, rivers, streams, farm pond and public ponds, have been implemented extensively by the RID, and will be extended actively in the future. The dredging works have been implemented satisfactory to the beneficiaries and still has its demand from the many villages. The impounded water by the dredging are used for domestic and irrigation waters. In the future, seeing that this dredging works expected to be successfully implemented, 138 projects are scheduled up to 2006 (refer to Table K-4.7).

4.2.5 River Dredging and Training Projects

The Huai Luang river ha s narrow width and extremely meandering and bring the flood along the river. To mitigate the damages due to flood, the Huai Luang will be dredged and trained for about 88 km from the downstream of Huai Luang Diversion Dam up to the confluence of Huai Dan, because the area is below El. 160 m MSL along the downstream of Huai Luang have been scheduled to be used as reservoir by the other agency's plan. The design discharge was computed by applying 1/50 year's flood. The planned section and design discharges of the Huai Luang listed, below

Section	Distance	Design Discharge
Old Barrage to Huai Raeng Confluence	11.0 km	300 cu.m/s
Huai Raeng Confluence to Loeng Nong Bo	28.0 km	510 cu.m/s
Loeng Nong Bo to Huai It confluence	1.5 km	540 cu.m/s
Huai It confluence to Huai Suang Luang	1.0 km	710 cu.m/s
Huai Suang Luang to Ban Wan Noi	21.5 km	820 cu.m/s
Ban Wan Noi to Huai Dan confluence	25.0 km	950 cu.m/s
Total Length	88.0 km	

4.2.6 Weir Construction Projects

The weirs will be constructed after the Huai Luang river improvement, to retain the necessary water level to divert the water for the water impounding of the natural reservoirs and the supplemental water to the reservoirs constructed near the river. In addition, the available water to be retained in the river course will also be used for the domestic and irrigation water along the river. Three (3) weirs are proposed in the Huai Luang, because of irrigable land below the Ban Wa Noi, Amphoe Muang Udon Thani planned to be irrigated by the other agency. The storage volume in the river course will be about 1.4 MCM.

4.2.7 River Water Impounding Project

The river water will be impounded in the natural reservoirs and the reservoirs constructed near the river, since the storage reservoir sites are limited, due to topographical and social constraints. The

number of identified projects are eight (8) natural reservoirs and one project reservoir (1) in the total storage volume of about 35.31 MCM. The impounded water will be used for the domestic water and the irrigation water for the diversified crops in the dry season. The reservoirs identified to be impounded are as follows:

Name of Reservoirs	Expected Storage
Ban Ya Yi Res.	1.31 MCM
Nong Khae Res.	2.73 MCM
Leong Nong Bo Res.	2.99 MCM
Nong Bo Khong Res.	1.56 MCM
Bung Sang Res.	5.45 MCM
Nong Samrong Res.	3,58 MCM
Nong Ban Thin Res.	1.89 MCM
Ban Wan Res.	9.77 MCM
Total Storage	29.28 MCM

4.2.8 Huai Mong River Dike Project

The Huai Mong river in the middle reach, interconnecting with several streams, forms flood plain during the rainy season. The river improvement will be required but may be realized after 20 years. Before the improvement of the river, the flood plain can be reclaimed by providing the dike along the river, taking the future plan of the river improvement in to account. As the plan up to 2006, four (4) Dike with temporary weir Projects are proposed to create the arable land of some 6,900 ha, as follows:

Project Name	Reclaimed land Area
Polder Dike No.	1200 ha
Polder Dike No.	2500 ha
Polder Dike No.3	5,900 ha
Polder Dike No.4	300 ha
Total Land Area	6,900 ha

4.2.9 Summary of Water Resources Development Project

The Projects proposed for the future up to 2006 are summarized in its numbers and costs of the projects for each river basin, as shown in Table K-4.9. And the detailed those for each river reach are tabulated in Table K-10 to 11.

4.3 Water Resources Development for each River Basins

4.3.1 Huai Mong Basin

1) Upper Reaches

The Huai Mong upper reaches is classified into two sub-basins, which are the Huai Mong upstream basin available the moderate amount of the surface water, and Huai Nam Bon basin endured the comparatively limited water resources, in terms of the water resources development. The high dam may be expected in the mountainous area of the Huai Mong upstream basin, from a standpoint of topography and geology. However, the rainfall at Suwan Khuha station in the Huai Mong upstream basin varies with relatively high variance in the rainy season, as compared to the rainfall at Udon Thani station. Also, in the stream flow at kh-18 station located at the ending of the upper reaches basin, the stream discharges varies with a standard deviation of 50 % of the average discharge in the rainy season. This means that careful attention shall be taken in the estimates of runoff discharge for the design of reservoir capacity.

The medium scale projects have been identified for the study, which are five reservoir projects on Huai Kholo, Huai Mong, Huai Yap, Huai Khana and Huai Han in the Huai Mong upstream basin. These projects will serve not only for the irrigation but also for the domestic water purpose. The reservoirs may be earthfill type. The total irrigable area are expected to be some 2,490 ha for the rainy season crops and some 1,000 ha for the dry season crops.

The small scale projects are also expected for the construction of small reservoirs, weirs, ponds and so on for the purposes of irrigation,

domestic water, livestock and fisheries. The construction of small reservoirs and weirs may be expected in the Huai Mong upstream basin but limited in the Huai Nam Bon basin.

2) Middle Reaches

The Huai Mong middle reaches is categorized to the flood plain and hilly land bounded by road, Ban Phu to Suwan Khuha, to the west and to the east for the water resources development plan, respectively. In the west part of the flood plain along side the Phuphankham mountain range, only the small scale projects are expected, because of the topography. The remained flood plain may as well be provided with the flood protection dikes to alleviate the current flood. In the hilly land, the Medium scale projects may be limited, and the water resources development may be desirable to be undertaken by the small scale projects.

The medium scale project for the study is proposing one on Huai Ngao at Ban Na Ngam, Amphoe Ban Phu, Udon Thani province. The catchment area of the proposed reservoir is some 85.3 sq.km. The irrigable land area will be some 800 ha.

The small scale projects for small reservoirs, weirs and ponds construction will be provided. Most projects are expected to be construction of small reservoirs and ponds from a standpoint of topography. The plan is expected to constructed to 30 SSIPs, improvement of 12 SSIPs and 23 Dredging Project for the future up to 2006.

Aside from the irrigation Projects, four Huai Mong river dike projects are planned to be constructed for the future up to 226

3) Lower Reaches

The lower reaches of the Huai Mong river basin is classified to three parts, the hilly land in the west, flood plain in the middle to downstream and terrace land in the south of the basin, from a stand point of the water resources development. The hilly land has a high potential in the water resources development because the forested mountainous land are

extended in the west and much rainfall are expected. while, terrace lands have less water resources development potential, due to poorly forested and undulated. The flood plain has less potential for development without the flood control projects but may be irrigated for the dry season crops by pump.

The one (1) medium scale project has been identified for the study to construct the reservoir dam on the Huai Ma, tributary of Huai Thon in the Huai Mong river system to supplement the water for the rainy season crops and supply the water for dry season crops. The service area are estimated to be some 1,000 ha and 400 ha in the rainy and dry seasons, respectively. The project costs are estimated at about 129.5 million baht. The project may be constructed starting from 1996.

The small scale projects are expected to construct the small reservoirs and ponds in the hilly lands and terrace lands. Construction of 13 SSIPs, the improvement of 8 SSIPs and 31 dredging projects are scheduled for the future up to 2006.

4.3.2 Nam Suai Basin

1) Upper Reaches

The upper reaches of Nam Suai river basin is poorly forested and undulated in the land. Most rivers are drayed up in the dry season. The possible reservoir sites are limited in terms of topography. Nevertheless, one medium scale project is identified for the study on the upstream of Huai Thong.

The Huai Thong reservoir project is a medium scale project, located at Amphoe Ban Phu, Udon Thani province, and planned to irrigate a land area of some 1,920 ha and 700 ha in the rainy and dry seasons, respectively. The dam may be earthfill type.

The small scale projects are also expected to construct the small reservoirs and ponds but may be not so much in the number of the project due to topographical condition. The construction of about 2 SSIPs, im-

provement of 13 SSIPs and 9 dredging projects are scheduled for the future up to 2006.

2) Lower Reaches

The lower reaches of Nam suai river basin may be divided into the middle reaches and downstream area. In the middle reaches, the lands are poorly forested and moderately undulated. The suitable sites for the construction of reservoir dam are hardly identified in the 1/50,000 topographic maps. while, the downstream area can not be developed without flood protection projects or use in the dry season only as the land irrigated by pumps.

The medium scale projects have not been identified but the improvement of Huai Nong Song Hong are expected to be improved in the future up to 2006, since most of farm lands were covered by the study area for Nam Suai Basin project to irrigate the land area of some 12,600 ha by pumps from the retained water during the rainy season in the lower lands. So that, the water resources development projects other than the said project will be scheduled to be

4.3.3 Huai Luang Basin

1) Upper Reaches

The upper reaches of Huai Luang river basin have been developed by constructing the one (1) large scale and nine (9) medium scale projects. These projects operate, giving the first priority to the domestic water use. The rainfall in the catchment area of existing Huai Luang reservoir is less than 900 mm in the rainy season and about 700 mm in 80 % or 1/5 years probability. On the other hand, the rainfall at Udon Thani station is about 1,270 mm in an average and 1,070 mm in 80 % probability. In addition, the basin are not do endowed with vegetation and topography in terms of the water resources.

The medium scale projects, nevertheless, has been originally

scheduled to be eight (8) projects but selected seven (7) projects for the study which are Huai Hin Lat, Huai Sai No.1, Huai Takrai, Huai Pla Dap, Huai Limi, Huai Mek and Huai Chiang reservoir projects, since the Huai Sari Project has been already started the construction in 1995. Among them, five (5) projects are located in the upstream of the Huai Luang reservoir. The proposed projects are small, some 120 ha to 500 ha, or about 310 ha in an average, in the irrigable area, except Huai Hin Lat reservoir project with an irrigable land area of some 1,100 ha in Amphoe Muang, Udon Thani province. Total irrigable area are some 3,210 ha for the rainy season crops and some 470 ha for the dry season crops. All reservoirs may be earthfill type of dam.

The small scale projects will be implemented by 25 projects for the construction of the reservoirs and weirs, 12 projects for the construction of pumping facilities, 18 projects for the improvement of the existing ones and 37 projects for dredging.

The existing irrigation systems, particularly in the large scale and medium scale projects. will be rehabilitated and improved to improve an irrigation efficiency and facilitate the water management. The rehabilitation and improvement projects will be composed of the improvement of Huai Luang old barrage, minor repair of main and secondary canals and structures, improvement of turnout gates and upgrading of on-farm facilities for the Huai Luang reservoir project. For five (5) medium scale projects, the rehabilitation of canals and structures, provision of check structures and gated turnout, upgrading of on-farm facilities are required.

In addition to the irrigation component, the Huai Luang will be improved by the dredging and river training in the length of 41.5 km from the existing Huai Luang diversion dam to the confluence of Suang Luang. At the same time, three (3) weirs will be constructed to deliver the water to the natural reservoir and retain the water in the river course. Five (5) natural reservoirs will be used for the irrigation and domestic water supply source by providing the dike around the reservoirs and dredging.

2) Middle Reaches

The lands in the middle reaches, included Huai Dan basin, are poorly forested. The plain land are extended to the east of Udon Thani town in a land area of some 14,000 ha or about 10 % of the middle reaches area, and the remaining land are undulated. There are no particular source of water to irrigate these land. The land is irrigated through the weirs of barrage type on the rivers/streams and the cofferdam constructed by the farmers in October to supplement the water to the rainy season crops. In the dry season, little area of lands are irrigated by pumps. The land area along the Huai Luang below Ban Wan, Amphoe Muang, Udon Thani province are planned to irrigate under the Lower Huai Luang Project.

The medium scale project will be proposed to be only one project for the study in the upstream of the Huai Dan river basin. The Huai Dan reservoir project, located at Tambon Nong Mek, Amphoe Nong Harn, Udon Thani province, is planned to irrigate a land Area of some 600 ha in the rainy season and 240 ha in the dry season. However, it was found out that the small scale project was already constructed near the proposed dam site by the provincial office. So that, some modification of plan may be required.

The small scale projects will be implemented are 30 projects through the construction of small reservoirs and weirs, 8 projects as construction of pumping facilities, 12 projects as the improvement of the existing ones and 23 projects as dredging of existing natural reservoirs/ponds for the irrigation and domestic water supply purposes but very limited in the construction of weirs.

In addition to Huai Luang, below the confluence of Huai Suang Luang up to the confluence of Huai Dan will be improved by the means of dredging and river training. At the same time, two (2) water impounding projects and one (1) weir construction are expected to be implemented in the future up to 2006.

3) Lower Reaches

The land in the lower reaches of Huai Luang consists of plain

lands along the Huai Luang, traverses the center of the basin and hilly lands distributed both side of the plain land. The plain lands are currently flooded in the rainy season and endows a number of natural reservoirs and swamps, and scheduling to be irrigated for the dry season crops under the Lower Huai Luang Projects. In the hilly land, the paddy fields are distributed along the tributaries with narrow stretch, and have a suitable reservoir dam site in low potentiality, because of topography widening to the downstream.

The medium scale projects have been proposed on the Huai Yai and Huai Chiam. However, the Huai Chiam reservoir project area have been scheduled to be used as reservoir area and the Huai Yai reservoir project area is completely overlapped with the area of the said Lower Huai Luang Project. Thereby, no medium scale projects are planned.

The small scale projects will be scheduled for the construction are 18 in number as the small reservoirs and weirs, 11 projects for the improvement of existing ones and 13 projects for the dredging for the irrigation and domestic water supply purposes.

4.3.4 Other Basins

The medium scale Huai Khok reservoir project have been proposed in the Nong Khai east drainage area to irrigate a land area of some 990 ha and 400 ha in the rainy and dry seasons, respectively. In addition, the existing Bang Phuang reservoir project will be required to be rehabilitated and improved in its irrigation system. The rehabilitation of canals and structures, improvement/provision of checks and turnouts, and upgrading of on-farm facilities will be the main component for the improvement of this project facilities.

The small scale projects will be programed for the construction of the reservoirs and weirs are 30 in number, 11 projects for the improvement of the existing ones and 31 projects for the dredging.

Table K-4.1 Required Length of Overflow Type Spillway

Item	1/100yr.	1/50yr	1/20yr
Rainfall (mm/day)	213	194	170
Flood-Q (cu.m/s)	2,638	2,403	2,106
Required Length (m)			
at Max W.L.=202.5 m	410	340	280
at Max W.L.=203.5 m	150	120	80

Table K-4.2 Major Figures of Proposed Medium Scale Projects

Project Name	Type of Reservoir	Cat'nt Area (Km²)	1/5 yr. Inflow (MCM)	Reservoir Capacity			Water Level		W.S. Area	
				Effect. (MCM)	Dead (MCM)	Total (MCM)	HHWL (m)	HWL (m)	HHWL (ha)	HHWL (ha)
Huai Kholo Res.	Earth Dam	80.0	18.0	9.8	1.6	11.4	272.0	271.0	214	206
Huai Mong Res.	Earth Dam	57.1	12.8	12.2	1.1	13.3	269.0	268.0	178	165
Huai Yap Res.	Earth Dam	27.9	6.3	2.0	0.6	2.6	229.0	228.0	140	128
Huai Khanan Res.	Earth Dam	18.4	4.1	4.3	0.4	4.7	232.0	231.0	148	142
Huai Han Res.	Earth Dam	5.6	1.3	1.3	0.1	1.4	209.0	208.0	9	6
Sub-total		189.0	42.5	29.6	3.8	33.4			689	647
Huai Ngao	Earth Dam	85.3	18.8	9.8	1.7	11.5	194.5	193.5	760	570
Huai Ma	Earth Dam	27.1	7.3	6.2	0.5	6.7	194.0	193.0	400	360
Huai Thong	Earth Dam	74.0	23.1	17.5	1.5	19.0	179.0	178.0	526	480
Huai Hin Lat Res.	Earth Dam	48.9	7.5	10.6	1.0	11.6	191.0	190.0	430	400
Huai Sai Res. 1	Earth Dam	9.0	1.4	1.9	0.2	2.1	241.0	240.0	60	55
Huai Takrai Res.	Earth Dam	5.4	0.8	1.2	0.1	1.3	241.0	240.0	30	23
Huai Pla Dap Res.	Earth Dam	10.6	1.6	2.3	0.2	2.5	223.0	222.0	33	28
Huai Limi Res.	Earth Dam	22.5	3.5	4.8	0.5	5.3	228.5	227.5	115	100
Huai Mek Res.	Earth Dam	26.5	4.1	5.7	0.5	6.2	192.0	191.0	38	28
Huai Chiang Res.	Earth Dam	23.7	3.6	5.1	0.5	5.6	247.0	246.0	83	76
Sub-total		146.6	22.5	31.6	3.0	34.6	1557.5	1556.5	789	710
Huai Dan Res.	Earth Dam	120.6	39.4	7.3	2.4	9.7	174.0	173.0	480	390
Huai Khuk	Earth Dam	37.0	13.0	9.6	0.7	10.3	183.0	182.0	550	440
T o t a l		679.6	166.6	111.6	13.6	125.2			4,194	3,597

(Continued)

Project Name	Dimension of Dam						Div. W. Req'nt (cu.m/s)	Canal Length		Irr. Area (ha)	Project Costs	
	Top El. (m)	Height (m)	Length (m)	Top B. (m)	Side Slope R. Side	Out S.		Mains (m)	Lats. (m)		Total (M.B.)	per ha ('000 B)
Huai Kholo Res.	274.0	32.0	1900.0	8.0	1:3.0	1:2.5	0.94	19.0	16.0	800	734.5	918
Huai Mong Res.	271.0	26.0	150.0	7.0	1:3.0	1:2.5	1.18	19.0	12.0	1,000	118.9	119
Huai Yap Res.	231.0	15.0	1900.0	5.0	1:3.0	1:2.5	0.19	5.6	2.4	160	160.3	1,002
Huai Khanan Res.	234.0	14.0	700.0	5.0	1:3.0	1:2.5	0.47	6.6	6.0	400	102.1	255
Huai Han Res.	211.0	15.0	400.0	5.0	1:3.0	1:2.5	0.15	2.6	1.3	130	44.6	343
Sub-total								52.8	37.7	2,490	1,160.4	466
Huai Ngao	196.5	14.5	700.0	5.0	1:3.0	1:2.5	0.94	20.0	9.6	800	290.7	363
Huai Ma	196.0	14.0	900.0	5.0	1:3.0	1:2.5	1.18	15.2	20.0	1,000	129.5	130
Huai Thong	181.0	17.0	1800.0	6.0	1:3.0	1:2.5	2.27	35.5	28.3	1,920	468.4	244
Huai Hin Lat Res.	193.0	11.0	1000.0	4.0	1:3.0	1:2.5	1.30	14.2	24.2	1,100	220.9	201
Huai Sai Res. 1	243.0	19.0	500.0	6.0	1:3.0	1:2.5	0.24	6.1	2.4	200	121.2	606
Huai Takrai Res.	243.0	15.0	900.0	5.0	1:3.0	1:2.5	0.14	3.5	1.2	120	109.2	910
Huai Pla Dap Res.	225.0	17.0	800.0	6.0	1:3.0	1:2.5	0.27	7.4	3.5	230	111.9	487
Huai Limi Res.	230.5	16.5	1500.0	6.0	1:3.0	1:2.5	0.59	10.1	7.5	500	230.5	461
Huai Mek Res.	194.0	12.0	1500.0	5.0	1:3.0	1:2.5	0.68	0.6		580	131.1	226
Huai Chiang Res.	249.0	17.0	900.0	6.0	1:3.0	1:2.5	0.57	10.6	7.2	480	175.1	365
Sub-total	1559.5							52.5	46.0	3,210	1,099.9	343
Huai Dan Res.	176.0	14.0	1500.0	5.0	1:3.0	1:2.5	0.71	18.4	7.2	600	277.3	462
Huai Khuk	185.0	13.0	800.0	5.0	1:3.0	1:2.5	1.17	17.4	14.9	990	212.2	214
T o t a l								211.8	164.2	11,010	3,638.4	330

Table K-4.3 Major Work Items of Improvement for MSIP

Project Name	Dam					Irrigation System			Drain.	Irrigat'n Area		Project
	Dam Boddy	Riprap	Intake	Spil-W	Drege (M.cu.m)	Canals (m)	Lining (m)	Struct. (nos.)	Canals (m)	Present (ha)	Planned (ha)	Costs (M.B.)
Nong Song Hong R.	Remedy	Provide	Improv.	Improv.	0.25	2,950	-	6		10	640	51.1
Nong Samrong Res.	Remedy	-	Improv.	Improv.	0.25	4,377	-	9	500	0	470	17.5
Nong Om Res.	Remedy	Provide		Constr.		1,000	1,000	4	-	20	20	17.8
Kut Ling Ngo Res.	-	-	-	-	2.60	28,191		6	-	1,000	1,000	94.6
Sok Nom Khao Res.	-	-	Improv.	-	-	2,700	2,700	4	-	0	70	2.3
Lam Pla Khao Res.	-	-	Constr.	-	-	380	380	4	-	0	40	30.0
Sub-total						36,648	4,080	27	500	1,020	1,600	162.2
H.Bang Phuan Res.						18,300	-	20	-	1,570	1,920	9.4
T o t a l						57,898	4,080	53	500	2,600	4,160	222.7

Table K-4.4 Projected Small Scale Projects for the Future up to 2006

R. Basin	Sub-B.	Area		Irr. Area		Irrigatio Rate			Proposed SSIP		
		Gross (sq. km)	Irr. A (sq. km)	Pres't (sq. km)	w/MSIP (sq. km)	Present (%)	w/MSIP (%)	Proposed (%)	Area (sq. km)	R/W (Nos.)	Pump (Nos.)
H. Momg	U/R	1,307	384.3	16.7	24.9	4	11	18	26.9	35	5
	M/R	747	249.5	5.5	8.0	2	5	15	25.0	30	3
	L/R	657	220.8	74.7	10.0	34	38	42	8.8	13	-
	Sub-T	2,711	854.6	96.9	42.9	11	16	23	60.7	78	8
N. Suai	U/R	403	134.2	9.7	37.0	7	35	39	5.4	5	2
	L/R	911	462.8	50.7	159.8	11	45	49	18.5	25	-
	Sub-T	1,314	597.0	60.4	196.8	10	43	47	23.9	30	2
H. Luang	U/R	1,730	467.1	168.2	32.1	36	43	49	28.0	25	12
	M/R	1,355	676.1	12.6	82.8	2	14	23	60.8	64	8
	L/R	1,015	506.5	28.2	115.2	6	28	31	15.2	18	-
	Sub-T	4,100	1,649.7	209.0	230.1	13	27	33	104.0	107	20
Others	(N. Khal)	482	251.1	30.9	9.9	12	16	21	12.6	15	3
T o t a l		8,607	3,352.4	397.2	479.7	12	26	32	201.2	230	33

Note: Irrigation area consists of 31.9 sq.km for paddy field and 1.64 for upland crops

Table K-4.5 Small Scale Projects Proposed for the Future up to 2006 (Continued)

Name of River Basin	Name of Sub-basin	Project Name	Location			Type of Structure	Storage Capacity (MCM)	Irrigation Area (ha)	Project Costs (M.B.)
			Tambon	Amphoe	Province				
Huai Mong	Uppr. Basin	Lam Nam Mong W.	Ban Khok	Suwan Khuha	N.E. Lamphu	Weir	-	48	7.0
		Huai Chat Res.	Na Di	Do.	Do.	Reservoir	0.3	48	7.0
		Huai Han Res.	Dong Sawan	Na Klang	Do.	Do.	0.5	80	8.0
		Huai Kholo W.	Ban Khuk	Suwan Khuha	Do.	Weir	-	64	6.0
		Huai Rai W.	Kut Din Chi	Na Klang	Do.	Do.	-	80	7.0
		Ban Sai Udom W.	Do.	Do.	Do.	Do.	-	64	7.0
		N.W. Khiribunpot	Suwan Khuha	Suwan Khuha	Do.	Reservoir	0.5	80	4.0
		Nong Nam Khan Noi	Na Dan	Do.	Do.	Do.	0.3	48	5.0
		Huai Phonaeng W.	Dan Chang	Na Klang	Do.	Weir	-	64	7.0
		Huai Phonaeng W.	Wang Plapom	K.A. Na Wang	Do.	Do.	-	128	10.0
		H. Nam Khong Res.	Na Di	Suwan Khuha	Do.	Do.	0.4	56	5.0
		Huai Phonaeng W.	Wang Plapom	K.A. Na Wang	Do.	Do.	0.2	32	5.0
		Huai Hin Res.	Na Si	Suwan Khuha	Do.	Reservoir	0.2	32	2.0
		Huai Nam Pu	Dong Ma Fai	Do.	Do.	Do.	2.9	160	10.0
		H. Khoke Sa-at R.	Wang Plapom	K.A. Na Wang	Do.	Do.	0.2	32	2.0
		Huai Bong Res.	Dong Ma Fai	Suwan Khuha	Do.	Do.	0.2	32	2.0
		B. Choen Phuthong	Na Di	Do.	Do.	Do.	0.3	40	2.0
		Huai Som Poi Res.	Na Dan	Do.	Do.	Do.	0.3	48	3.0
		Huai Yang Res.	Do.	Do.	Do.	Do.	0.3	40	3.0
		H. Nam Bon Res.	Do.	Do.	Do.	Do.	0.4	64	4.0
		Huai E-Cheen Res.	Na Ma Fuang	Mang	Do.	Do.	0.5	80	5.0
		Huai Kha Nam W.	Dong Ma Fai	Suwan Khuha	Do.	Weir	-	96	6.0
		Huai Khanan W.	Ban Yuak	Nam Son	Udon Thani	Do.	-	112	5.0
		12-Unidentified	Indefinite	Indefinite	Do.	R/W	3.9	784	142.0
		5-Pump Projects	Indefinite	Indefinite	N.E. Lamphu	Pump	-	380	8.0
	Sub-total	40-Project					11.3	2,692	272.0
	Mid. Basin	Huai Nam Fah (1)	Klang Yai	Ban Phu	Udon Thani	Weir	-	128	15.9
		Huai Mong RC. W.	Champa Mong	Do.	Do.	Do.	-	128	14.3
		Huai Nam Fah (2)	Muang Phan	Do.	Do.	Do.	-	80	5.0
		H. Mong W. (H. Sit)	Ban Phu	Do.	Do.	Do.	-	96	7.0
		Huai I Pie W.	Ban Phu	Ban Phu	Udon Thani	Do.	-	96	7.0
		Ban Klong Yai R.	Klang Yai	Do.	Do.	Reservoir	0.4	80	6.0
		Huai Khut Bak W.	Muang Phan	Do.	Do.	Weir	-	64	7.0
		Huai Klang Thung	Non Thong	Do.	Do.	Do.	-	80	7.0
		Huai Khit W.	Non Thong	Do.	Do.	Do.	-	80	7.0
		Huai Phan W.	Muang Phan	Do.	Do.	Do.	-	80	7.0
		Huai Nong Kong W.	Ban Phu	Do.	Do.	Do.	-	80	7.0
		19-Unidentified	Indefinite	Indefinite	Do.	R/W	1.6	1,256	115.0
		3-Pump Projects	Indefinite	Indefinite	Do.	Pump	-	250	5.0
	Sub-total	33-Project					2.0	2,498	210.2
	Low. Basin	Huai Rang W.	Na Yung	Na Yung	Udon Thani	Weir	-	80	7.0
		Huai Huer	Ban Mo	S. Chiang Mai	Nong Khai	Resevoir	0.6	96	6.0
		Ban Tha Katin R.	Ban Mo	Do.	Do.	Do.	-	64	7.0
		Huai Hin Kao Res.	Dan Si Suk	Do.	Do.	Do.	-	48	7.0
		Huai Mui W.	Nam Mong	Tha Bo	Do.	Weir	0.5	80	6.0
		Ban Mo Res.	Ban Mo	S. Chiang Mai	Do.	Resevoir	-	64	6.0
		Huai Hin Lat Res.	Nong Plapak	S. Chiang Mai	Do.	Do.	-	48	5.0
		Huai Khuk Res.	Dan Si Suk	Do.	Do.	Do.	-	48	5.0
		Huai Pak Kuad W.	Khok Khon	Tha Bo	Do.	Weir	-	80	6.0
		3-Unidentified	Indefinite	Indefinite	Do.	R/W	1.0	192	19.0
		1-Unidentified	Indefinite	Indefinite	Udon Thani	Do.	-	80	7.0
	Sub-total	13-Project					2.1	880	81.0
	Total	86-Project					15.4	6,070	563.2

Table K-4.5 Small Scale Projects Proposed for the Future up to 2006 (Continued)

Name of River Basin	Name of Sub-basin	Project Name	Location			Type of Structure	Storage Capacity (MCM)	Irrigat'd Area (ha)	Project Costs (M.B.)
			Tanbom	Amphoe	Province				
Nam Suai	Uppr. Basin	5-Unidentified	Indefinite	Indefinite	Udon Thani	R/W	1.9	400	33.0
		2-Pump Projects	Do.	Do.	Do.	Pump	-	130	3.0
	Sub-total	7-Project					1.9	530.0	36.0
	Low. Basin	Ban Khampongpaeng	Kai Bok Wan	Muang	Nong Khai	Weir	-	32	5.0
		Huai Mek W.	Wat Tai	Muang	Do.	Do.	-	80	6.0
		Huai Tang Kham W.	Lao Tang Khan	Phon Phisai	Do.	Do.	-	64	8.0
		Nong Kho Res.	Na Kha	Muang	Udon Thani	Resevoir	0.6	88	8.0
		Huai Nong Thon W.	Ban That	Phen	Do.	Weir	-	56	5.0
		Huai Toey Res.	Phen	Do.	Do.	Resevoir	0.4	56	5.0
		6-Unidentified	Indefinite	Indefinite	Nong Khai	R/W	0.9	456	20.0
		13-Unidentified	Indefinite	Indefinite	Udon Thani	Do.	1.9	1,016	85.0
	Sub-total	25-Project					3.7	1,818	142.0
	Total	32-Project					5.6	2,378	178.0
Huai Luang	Uppr. Basin	Sai 82 Irr. System	Mak Ya	Nong Wua So	Udon Thani	Irr. Syst.	-	80	5.3
		Huai Luang W.	Muang Phua	Kut Chap	Do.	Weir	-	80	8.0
		Huai Hin W.	Nong Hai	Muang	Do.	Weir	-	64	6.0
		Huai Sung	Sam Phrao	Do.	Do.	Weir	-	80	8.0
		Huai Luang W.	Nong Oo	Nong Wua So	Do.	Weir	-	88	8.0
		Huai Li Phi Res.	Do.	Do.	Do.	Resevoir	0.4	64	6.0
		Ban Nong Bo W.	Muang	Muang	Do.	Weir	-	88	8.0
		Ban Tha Rae W.	Mu Non	Do.	Do.	Do.	-	88	8.0
		Huai Luang W.	Mak Ya	Nong Wua So	Do.	Do.	-	88	8.0
		Huai Lek Res.	Nong Bua	Muang	Do.	Do.	-	56	5.0
		15-Unidentified	Indefinite	Indefinite	Udon Thani	R/W	1.4	1,096	98.0
		12-Pump Project	Do.	Do.	Do.	Pump	-	980	20.0
	Sub-total	37-Project					1.8	2,852	188.3
	Mid. Basin	Ban Khuk W.	Phon Ngam	Nong Han	Udon Thani	Weir	-	192	5.0
		H. Wang Nam Khieng	Don Hai Sok	do.	Do.	Resevoir	0.3	112	5.0
		Huai Wangplakleng	Nong Phai	Nong Han	Do.	Weir	-	80	7.0
		Huai Ban Song Kau	Mu Non	Muang	Do.	Do.	-	80	7.0
		Huai Luang W.	Don kloy	Phibul Rak	Do.	Do.	-	64	6.0
		Don Som Khao Res.	Don Hai Sok	Nong Han	Do.	Resevoir	0.4	56	5.0
		58-Unidentified	Indefinite	Indefinite	Do.	R/W	12.1	4,824	379.0
		8-Pump Project	Do.	Do.	Do.	Pump	-	670	14.0
	Sub-total	72-Project					12.5	6,078	418.0
	Low. Basin	Huai Ban Weir	Ban Chai	Ban Dung	Udon Thani	Weir	-	88	8.0
		Huai Luang W.	Sang Khom	Sang Khom	Do.	Do.	-	80	7.0
		14-Unidentified	Indefinite	Indefinite	Do.	R/W	1.5	1,184	92.0
		2-Unidentified	Indefinite	Indefinite	Nong Khai	Do.	0.4	168	13.0
	Sub-total	18-Project					1.9	1,520	120.0
	Total	127-Project					16	10,450	726.3
Mekong R.	Nong Khai Basin	Huai Pha Rai W.	Nong Nang	Tha Bo	Nong Khai	Weir	-	80	6.0
		12-Unidentified	Indefinite	Indefinite	Do.	R/W	0.5	792	78.0
		2-Unidentified	Indefinite	Indefinite	Udon Thani	Do.	0.2	128	13.0
		3-Pump Project	Do.	Do.	Do.	Pump	-	250	5.0
	Total	18-Project					0.7	1,250	96.0
Ground Total		263-Project					37.8	20,148.0	1,563.5

Table K-4.6 Small Scale Projects to be improved for the Future up to 2006

Name of River Basin	Name of Sub-basin	Project Name	Location			Type of Improvment			Project Costs (M.B.)
			Tanbon	Amphoe	Province	Reserv.	Weir (MCM)	Canal (ha)	
Huai Mong	Uppr. Basin	Pa Naeng Weir	Wang Pla Pom	Na Wang	N.B. Lamphu	-	Drg. Rpr.	Reh. Lng.	3.5
		Huai Kholo Weir	Kut Din Ji	Na Klang	Do.	-	Drg. Rpr.	Reh. Lng.	2.0
		Huai Lai Tour R.	Na Kae	Na Wang	Do.	Drg. Reh.	-	Reh. Lng.	3.0
		Huai So Res.	Bun Than	Suwanakhuha	Do.	Brdg.	-	Reh. Lng.	3.0
		Huai Lam Vai R.	Dong Sawan	Na Wang	Do.	Drg.	-	Reh. Lng.	2.0
		11-Unidentified	Indefinite	Indefinite	Do.	Drg. Hng.	Drg. Rpr.	Reh. Lng.	30.0
	Sub-total	16-Project							43.5
	Mid. Basin	Budda Bad Bua Rok	Klang Yai	Ban Phu	Udon Thani	Drg.	-	-	2.0
		11-Unidentified	Indefinite	Indefinite	Do.	Drg. Hng.	Drg. Rpr.	Reh. Lng.	30.0
	Sub-total	12-Project							32.0
	Low. Basin	Huai Hin Kes.	Phrapud Tabal	S. Chiang Mai	Nong Khai	Hng.	-	-	3.0
		Huai Sico Res.	Nong Pla Pak	Do.	Do.	Do.	-	-	3.0
		4-Unidentified	Indefinite	Indefinite	Do.	Drg. Hng.	Drg. Rpr.	Reh. Lng.	11.0
		2-Unidentified	Indefinite	Indefinite	Udon Thani	Drg. Hng.	Drg. Rpr.	Reh. Lng.	5.5
	Sub-total	8-Project							22.5
	Total	36-Project							98.0
Nam Suai	Uppr. Basin	13-Unidentified	Indefinite	Indefinite	Udon Thani	Drg. Hng.	Drg. Rpr.	Reh. Lng.	36.0
	Sub-total	13-Project							
	Low. Basin	Nong Na Hai Res.	Nong Na Hai	Phen	Udon Thani	Drg. Hng.	-	-	3.0
		Huai Hin Nok Res.	Lao Tong Kham	Phon Phisai	Nong Khai	-	-	Lng.	3.0
		H. Na Tan Nuer R.	Thung Luang	Do.	Do.	Drg.	-	-	2.0
		Nong Bo Emok R.	Lao Tong Kham	Do.	Do.	Drg.	-	-	3.5
		2-Unidentified	Indefinite	Indefinite	Udon Thani	Drg. Hng.	Drg. Rpr.	Reh. Lng.	11.0
		4-Unidentified	Indefinite	Indefinite	Nong Khai	Drg. Hng.	Drg. Rpr.	Reh. Lng.	5.5
	Sub-total	10-Project							28.0
	Total	23-Project							64.0
Huai Luang	Uppr. Basin	Huai Hin Tek Res.	Kut Mak Fai	Nong Wus So	Udon Thani	Drg.	-	-	2.5
		Huai Rim Res.	Nong Hai	Muang	Do.	Hng.	-	-	3.0
		Huai Sam Phad W.	Do.	Do.	Do.	Drg. Hng.	-	-	3.5
		Huai Khamin Res.	Um Mong	Nong Wua So	Do.	Hng.	-	-	3.0
		14-Unidentified	Indefinite	Indefinite	Do.	Drg. Hng.	Drg. Rpr.	Reh. Lng.	38.5
	Sub-total	18-Project							50.5
	Mid. Basin	Huai Srai Noi R.	Nong Han	Nong Han	Udon Thani	Drg.	-	-	2.0
		Huai Sawadi Res.	Do.	Do.	Do.	Drg.	-	-	2.0
		20-Unidentified	Indefinite	Indefinite	Do.	Drg. Hng.	Drg. Rpr.	Reh. Lng.	55.0
	Sub-total	22-Project							59.0
	Low. Basin	Nong Thung Yai R.	Thung Yai	Thung Fon	Udon Thani	Drg.	-	-	2.0
		Kham E Kaeng Res.	Na Mia	Ban Dung	Do.	Drg.	-	-	2.0
		Ban Lao Muang R.	Chiang Da	Sang Khom	Do.	Hng.	-	-	3.0
		Nong Ya Wo Res.	Ban Yod	Do.	Do.	Hng.	-	-	3.0
		Huai Wang Sim W.	Ban Khok	Do.	Do.	Drg.	-	-	2.0
		Huai Ling Lod	Wai Luang	Phon Phisai	Nong Khai	-	-	Dike	2.0
		3-Unidentified	Indefinite	Indefinite	Udon Thani	Drg. Hng.	Drg. Rpr.	Reh. Lng.	8.5
		2-Unidentified	Indefinite	Indefinite	Nong Khai	Drg. Hng.	Drg. Rpr.	Reh. Lng.	5.5
	Sub-total	11-Project							28.0
	Total	51-Project							137.5
Others to Mekong R.	Nong Khai Basin	Huai Khuk Weir	Ban Dua	Tha Bo	Nong Khai	Drg. Hng.	-	Reh.	3.0
		Huai Hua Ma W.	Ban Thon	Do.	Do.	Do.	-	Do.	3.0
		Huai Yai Weir	Ban Wan	Do.	Do.	Do.	-	Do.	3.0
		Ban Perd Yai R.	Wai Tai	Muang	Do.	Do.	-	Do.	3.0
		Ban Poon Ngam R.	Ban Thon	Tha Bo	Do.	Drg.	-	-	2.0
		4-Unidentified	Indefinite	Indefinite	Udon Thani	Drg. Hng.	Drg. Rpr.	Reh. Lng.	5.5
		2-Unidentified	Indefinite	Indefinite	Nong Khai	Drg. Hng.	Drg. Rpr.	Reh. Lng.	5.5
	Total	11-Project							25.0
Ground Total		121-Project							324.5

Note: Drg. :Dredging. Hng. :Heightening. Reh. :Dam Boddy Rehabilitaion. Brdg. :Bridge Construction for Reservoirs
Drg. :Dredging of Sediments. Rpr. :Remidy of Weir and Structures for Weirs
Reh. :Rehabilitation. Lng. :Concrete Lining. Dike:Flood Protection Dike for Canal System

Table K-4.7 Dredging Projects for the Future up to 2 up to 2006

Name of River Basin	Name of Sub-basin	Project Name	Location			Type of Structure	Storage Capacity ('000cu.m)	Irrigat'n Area (ha)	Project Costs (M.B.)
			Tanbom	Amphoe	Province				
Huai Mong	Huai Mong Uppr. Basin	Huai Khanan Drg.	Dong Ma Fai	Suwanakhuha	N.B.Lamphu	Swamp	144.0	-	3.0
		Huai Kholo Drg.	Kut Din Chi	Na Klang	Do.	Do.	96.0	-	2.0
		Huai Kong Drg.	Na Di	Suwanakhuha	Do.	Do.	144.0	-	3.0
		Huai Khanan Drg.	Dong Ma Fai	Do.	Do.	Do.	144.0	-	3.0
		Huai Mong Drg.	Bun Than	Do.	Do.	Do.	96.0	-	2.0
		Huai Mong Drg.	Suwanakhuha	Do.	Do.	Do.	240.0	-	5.0
		Lam H.Nam Phun D.	D.M.H.	Do.	Do.	Do.	96.0	-	2.0
		Lam Huai Mong D.	Ban Khuk	Do.	Do.	Do.	144.0	-	3.0
		Lam H.Kum Kong	Na Di	Do.	Do.	Do.	96.0	-	2.0
		Huai Hin Lat Drg.	Na Dan	Do.	Do.	Do.	96.0	-	2.0
		Huai Hin Lat Drg.	Do.	Do.	Do.	Do.	96.0	-	2.0
		Nong Ban Phon D.	Ban Yuak	Nam Som	Udon Thani	Do.	72.0	-	1.5
		Lam Huai Phong D.	Do.	Do.	Do.	Pond	96.0	-	2.0
		3-Unidentified	Indefinite	Indefinite	Do.	S/P	96.0	-	11.0
		9-Unidentified	Do.	Do.	N.B.Lamphu	Do.	1,056.0	-	22.0
	Sub-total	25-Project					2,712.0	-	65.5
	Mid.Basin	Nong Ya Sai Drg.	Champa Mong	Ban Phu	Udon Tani	Pond	96.0	-	2.0
		Kut Mak Drg.	Non Thong	Do.	Do.	Do.	72.0	-	1.5
		Epuay Drg.	Ban Phu	Do.	Do.	Do.	40.0	-	1.0
		Sit Drg.	Non Thong	Do.	Do.	Do.	96.0	-	2.0
		Nong Sai Drg.	Champa Mong	Do.	Do.	Do.	96.0	-	2.0
		Huai Mong Drg.	Do.	Do.	Do.	Do.	96.0	-	2.0
		Nong Kut Mao Drg.	Khao San	Do.	Do.	Do.	48.0	-	1.0
		Huai Sun	Ban Phu	Do.	Do.	Do.	96.0	-	2.0
		15-Unidentified	Indefinite	Indefinite	Do.	S/P	672.0	-	14.0
	Sub-total	23-Project					1,312.0	-	27.5
	Low.Basin	Nong Ngau Drg.	Kham Dong	Ban Phu	Udon Thani	Pond	250.0	-	2.0
		Nong Gruat Drg.	Na Kha	Tha Bo	Nong Khai	Swamp	96.0	-	2.0
		Nong Thom Drg.	Ban Mo	S.Chiang Mai	Do.	Do.	96.0	-	2.0
		Nong Som Hung D.	Na Kha	Tha Bo	Do.	Do.	96.0	-	2.0
		Nong Hua Chang	Ban Thon	Do.	Do.	Do.	72.0	-	1.5
		Nong Klang Ban D.	Phong Thong	S.Chiang Mai	Do.	Do.	72.0	-	1.5
		Huai Pong Chang	Pha Tung	Song Khom	Do.	Do.	48.0	-	1.0
		Huai Pla Bak Drg.	Nong Pla Pak	S.Chiang Mai	Do.	Do.	240.0	-	5.0
		Bun Khum Paeng D.	Phan Phrao	Do.	Do.	Do.	240.0	-	5.0
		Nong Thai Drg.	Nam Mong	Tha Bo	Do.	Do.	336.0	-	7.0
		Nong Wo Worm Drg.	Na Kha	Do.	Do.	Do.	384.0	-	8.0
		Nong Mai Tai Drg.	Phong Thong	S.Chiang Mai	Do.	Do.	144.0	-	3.0
		Nong Phong Thon	Do.	Do.	Do.	Do.	192.0	-	4.0
		Nong Mai Tai	Do.	Do.	Do.	Pond	96.0	-	2.0
		Nong Sico Drg.	Na Kha	Tha Bo	Do.	Pond	144.0	-	3.0
		Huai Sum Khwang	Phong Thong	S.Chiang Mai	Do.	Pond	96.0	-	2.0
		Nong Bo Whoum D.	Na Kha	Tha Bo	Do.	Pond	96.0	-	2.0
		Nong Bung Drg.	Nam Mong	Do.	Do.	Pond	96.0	-	2.0
		Huai Nui Drg.	Do.	Do.	Do.	Pond	96.0	-	2.0
		11-Unidentified	Indefinite	Indefinite	Do.	S/P	1,632.0	-	34.0
		1-Unidentified	Do.	Do.	Udon Thani	Do.	96.0	-	3.0
	Sub-total	31-Project					4,618.0	-	96.0
	Total	79-Project					8,642.0	-	187.0
Nam Suai	Uppr.Basin	Nong Ya Ma Drg.	Nong Hua Ku	Ban Phu	Udon Thani	Pond	48.0	-	1.0
		7-Unidentified	Indefinite	Indefinite	Do.	S/P	384.0	-	8.0
		1-Unidentified	Do.	Do.	Nong Khai	Do.	96.0	-	2.0
	Sub-total	9-Project					528.0	-	11.0
	Low.Basin	Nong Muk Drg.	Chom Sri	Phen	Udon Thani	Swamp	240.0	-	5.0
		Wangkan Drg.	Phen	Phen	Do.	Pond	75.0	-	1.5
		Huai Nangken Drg.	Do.	Do.	Do.	Do.	96.0	-	2.0
		Nong Pet Drg.	Nongsonghong	Muang	Nong Khai	Swamp	72.0	-	1.5
		Bon Suai Thong D.	Do.	Do.	Do.	Do.	192.0	-	4.0
		Huai Lak Sri Drg.	Do.	Do.	Do.	Do.	96.0	-	2.0
		Nong Suai Long D.	Song Hong	Do.	Do.	Do.	480.0	-	10.0
		Nong Reat Drg.	Phralat Bangphuan	Do.	Do.	Pond	96.0	-	2.0

Table K-4.7 Dredging Projects for the Future up to 2 up to 2005

Name of River Basin	Name of Sub-basin	Project Name	Location			Type of Structure	Storsge Capacity ('000cu.m)	Irrigat'n Area (ha)	Project Costs (M.B.)
			Tanbom	Amphoe	Province				
Nam Suai	Low. Basin	Nong Bna Bae Drg.	Do.	Do.	Do.	Pond	96.0	-	2.0
		Nong Som Kung D.	Do.	Do.	Do.	Pond	96.0	-	2.0
		Nong Phua Bae D.	Do.	Do.	Do.	Pond	72.0	-	1.5
		Nong Sa Tai Pho	Lao Thangkham	Phon Phisai	Do.	Pond	96.0	-	2.0
		Huai Pla Khao D.	Song Phong	Muang	Do.	Pond	96.0	-	2.0
		10-Unidentified	Indefinite	Indefinite	Udon Thani	S/P	1,344.0	-	28.0
		12-Unidentified	Do.	Do.	Nong Khai	Do.	2,160.0	-	45.0
	Sub-total	35-Project					5,307.0	-	110.5
	Total	44-Project					5,835.0	-	121.5
Huai Luang	Uppr. Basin	Nong Waeng Amcum	Non Nhai	Nong Wua So	Udon Thani	-	96.0	-	2.0
		36-Unidentified	Indefinite	Indefinite	Do.	S/P	3,456.0	-	72.0
	Sub-total	37-Project					3,552.0	-	74.0
	Mid. Basin	Noi Yai Drg.	Sam Phrao	Muang	Udon Tani	Swamp	192.0	-	4.0
		Nong Phia Kaeo D.	Na Bua	Phen	Do.	Do.	192.0	-	4.0
		Nong Bo Drg.	Nong Han	Nong Han	Do.	Do.	192.0	-	4.0
		Nong Bo Noi Drg.	Na Sai	Phibul Rak	Do.	Do.	144.0	-	3.0
		Nong Kut Tha Drg.	Nong Mek	Nong Han	Do.	Do.	384.0	-	8.0
		Huai Dong Tao D.	Phang N-gu	Do.	Do.	Do.	96.0	-	2.0
		H. Kham Phung D.	Sa Bang	Do.	Do.	Do.	96.0	-	2.0
		Nong Kut Ban Drg.	Ban Daeng	Phibul Rak	Do.	Do.	384.0	-	8.0
		Huai Wong Phai D.	Phang Ngu	Nong Han	Do.	Do.	96.0	-	2.0
		Lam Huai Kum Phu	Sa Bang	Do.	Do.	Do.	96.0	-	2.0
		Huai Yang Drg.	Pon Ngam	Phibul Rak	Do.	Do.	98.0	-	2.0
		Phibul Rak Shl.	Ban Daeng	Do.	Do.	Do.	15.0	-	1.0
		22-Unidentified	Indefinite	Indefinite	Do.	S/P	3,696.0	-	77.0
	Sub-total	34-Project					5,681.0	-	119.0
	Low. Basin	Nong Bo Res. Drg.	Sang Khom	Sang Khom	Udon Thani	Swamp	240.0	-	5.0
		Nong Ack Drg.	Ban Phu	Phon Phi Sai	Nong Khai	Swamp	240.0	-	5.0
		Nong Tao Drg.	Na Nang	Do.	Do.	Do.	720.0	-	15.0
		Huai Suan Klacy	Wat Luang	Do.	Do.	Do.	384.0	-	8.0
		Nong Dan Drg.	Wat Luang	Phon Phisa	Do.	Do.	144.0	-	3.0
		Nong Waeng Drg.	Do.	Do.	Do.	Do.	96.0	-	2.0
		Nong Na Bong Drg.	Do.	Do.	Do.	Do.	96.0	-	2.0
		3-Unidentified	Indefinite	Indefinite	Udon Thani	S/P	576.0	-	12.0
		3-Unidentified	Do.	Do.	Nong Khai	Do.	528.0	-	11.0
	Sub-total	13-Project					3,024.0	-	63.0
	Total	84-Project					12,257.0	-	256.0
Others to Mekong R.	Nong Khai Basin	Huai Nug Drg.	Cham Sri	Ban Phu	Udon Tani	-	240.0	-	5.0
		Nong Kon Muang D.	Phratat Bangphuan	Muang	Nong Khai	Swamp	120.0	-	2.5
		Nong Bo Drg.	Do.	Do.	Do.	Do.	144.0	-	3.0
		Nong Ya Nha Drg.	Phratat Bangphuan	Muang	Do.	Do.	72.0	-	1.5
		Nong Hua Chang D.	Ban Thon	Tha Bo	Do.	Do.	72.0	-	1.5
		Nong Khai Mo D.	Do.	Do.	Do.	Do.	96.0	-	2.0
		Nong Phue Drg.	Phratat Bangphuan	Muang	Do.	Do.	96.0	-	2.0
		Nong Loeng Bo D.	Do.	Do.	Do.	Do.	144.0	-	3.0
		Bun Kham Paeng D.	Phan Phrao	S.Chiang Mai	Do.	Do.	240.0	-	5.0
		Nong Wong Raideou	Phon Sa	Tha Bo	Do.	Do.	192.0	-	4.0
		Nong Ka Sa Drg.	Do.	Do.	Do.	Do.	192.0	-	4.0
		Nong Uang Chan D.	Nong Nang	Do.	Do.	Do.	288.0	-	6.0
		Nong Tub Drg.	Kong Nang	Do.	Do.	Do.	120.0	-	2.5
		Nong Bo Bab Drg.	Phratat Bangphuan	Muang	Do.	Pond	96.0	-	2.0
		Upper Huai Rai D.	Nong Nang	Tha Bo	Do.	Do.	480.0	-	10.0
		Nong Ma Khur Drg.	Phratat Bangphuan	Muang	Do.	Do.	48.0	-	1.0
		1-Unidentified	Indefinite	Indefinite	Udon Thani	S/P	240.0	-	5.0
		14-Unidentified	Do.	Do.	Nong Khai	Do.	2,256.0	-	47.0
	Total	31-Project					5,136.0	-	107.0
Ground Total		238-Project					31,870.0	-	671.5

Table k-4.8 Planned River Improvement and Water Impuncing Projects for the Future up to 2006

Name of River Basin	Name of Sub-basin	Project Name	Location: Tanbom	Location: Amphoe	Location: Province	Major Works	Storsge Capacity (MCM)	Irrigat'n Area (ha)	Project Costs (M.B.)
Huai Mong Basin	Uppr. Basin	H. Mong R. Impr.	Ban Thun etc.	Suwanakhuha	N.B.Lamphu	Drdg. Dike	-	-	3.0
	Mid. Basin	H.Mong P.Dike #1	Muang Phan	Ban Phu	Udon Thani	Dike & W.	-	200	109.2
		H.Mong P.Dike #2	Do.	Do.	Do.	Do.	-	500	114.7
		H.Mong P.Dike #3	Do.	Do.	Do.	Do.	-	5,900	220.7
		H.Mong P.Dike #4	Do.	Do.	Do.	Do.	-	300	74.2
	Sub-total	4-P.Dike Project					-	6,900	518.8
Total	4-Project						-	6,900	521.8
Huai Luang Basin	Uppr. Basin	H.Luang R. Impr. #1	Pa Kho	Kut Chap	Udon Thani	Drdg. Dike	-	-	58.8
		H.Luang R. Impr. #2	Chiang Yun	Do	Do.	Do.	-	-	254.0
		H.Luang R. Impr. #3	Kut Sra	Muang	Do.	Do.	-	-	15.0
		H.Luang R. Impr. #4	Sam Prao	Do		Do.	-	-	14.2
		4-R. Impr. Project					-	-	342.0
		H.Luang Weir #1	Mu Mon	Do	Do.	Weir	0.38	30	87.1
		H.Luang Weir #2	Na Kha	Do	Do.	Do.	0.39	30	97.2
		2-Weir Project					0.77	60	184.3
		Ban Ya Yi Res.	Chiang Yun	Kut Chap	Do.	Dike/Pipe	1.31	120	23.9
		Nong khae Res.	Nong Bha	Muang	Do.	Do.	2.73	260	27.7
		Leong Nong Res.	Sam Prao	Do	Do.	Do.	2.99	280	32.1
		Nong Bo Khong R.	Kut Sra	Do	Do.	Do.	1.56	150	19.8
		Bung Sang Res.	Mu Mon	Do	Do.	Do.	5.45	510	81.9
		Nong Samrong Res.	Mu Mon	Do	Do.	Do.	3.58	-	61.6
		6-Res. Project					17.62	1,567	247.0
	Sub-total	12-Project					18.39	1,627	773.3
	Mid. Basin	H.Luang R. Impr. #5	Don Kloi	K.A.Phibulrak	Udon Thani	Drdg. Dike	-	-	366.8
		H.Luang R. Impr. #6	Ban Daeng	Do	Do.	Do.	-	-	500.6
		2-R. Impr. Project					-	-	867.4
		H.Luang Weir #3	Ban Wan	Do	Do.	Weir	0.63	60	128.5
		Nong Ban Thin R.	Sam Prao	Muang	Do.	Dike/Pipe	1.89	170	37.9
		Ban Wan Res.	Ban Wan	K.A.Phibulrak	Udon Thani	Do.	9.77	900	124.9
	Sub-total	2-Res. Project					11.66	1070	162.8
	Total	5-Project					12.29	1,130	1,158.7
Total	17-Project						30.68	2,757	1,932.0
Nam Suai Basin	Uppr. Basin 1-Project	Bung Chuan Res.	Ban Khao	Muang	Udon Thani	Dike/Pipe	4.63	400	67.4
Grand Total	22-Project						35.31	10,057	2,521.2

Table K-4.9 Summary of Water Resources Development Projects for the Future up to 2006

Item	Huai Mong		Nam Suai		Huai Luang		Nong Khai Basin		Study Area	
	Q'ty (Proj.)	Costs (M.B)	Q'ty (Proj.)	Costs (M.B)	Q'ty (Proj.)	Costs (M.B)	Q'ty (Proj.)	Costs (M.B)	Q'ty (Proj.)	Costs (M.B)
1. Large Scale I.P.										
a. Improvement	-	-	-	-	1	203.1	-	-	1	203.1
2. Medium Scale I.P.										
a. Construction	7	1,580.6	1	468.4	8	1,377.2	1	212.2	17	3,638.4
b. Improvement	-	-	1	51.1	5	162.2	1	9.4	7	222.7
3. Small Scale I.P.										
a. Construction	86	563.2	32	178.0	127	726.3	18	96.0	263	1,563.5
b. Improvement	36	98.0	23	64.0	51	137.5	11	25.0	121	324.5
4. Dredging										
a. Construction	79	187.0	44	121.5	84	256.0	31	107.0	238	671.5
5. River Imprvement										
a. Dredging/Training	-	-	-	-	6	1,209.4	-	-	6	1,209.4
b. Weir Construction	-	-	-	-	3	312.8	-	-	3	312.8
c. Water Impounding	-	-	1	67.4	8	409.8	-	-	9	477.2
d. Poldr Project	4	518.8	-	-	-	-	-	-	4	518.8
Total	212	2,947.6	102	950.4	293	4,794.3	62	449.6	669	9,141.9

Tble K-4.10 Huai Nong River Basin Development Plan

Item	Upper Reach		Middle Reach		Lower Reach		Whole Basin	
	Q'ty (proj.)	Costs (M.B)	Q'ty (proj.)	Costs (M.B)	Q'ty (proj.)	Costs (M.B)	Q'ty (proj.)	Costs (M.B)
1. Large Scale I.P.								
a. Improvement	-	-	-	-	-	-	-	-
2. Medium Scale I.P.								
a. Construction	5	1,160.4	1	290.7	1	129.5	7	1,580.6
b. Improvement	-	-	-	-	-	-	-	-
3. Small Scale I.P.								
a. Construction	40	272.0	33	210.2	13	81.0	86	563.2
b. Improvement	16	43.5	12	32.0	8	22.5	36	98.0
4. Dredging								
a. Construction	25	65.5	23	27.5	31	94.0	79	187.0
5. River Imprvement								
a. Dredging/Training	1	3.0	-	-	-	-	-	-
b. Weir Construction	-	-	-	-	-	-	-	-
c. Water Impounding	-	-	-	-	-	-	-	-
d. Poldr Project	-	-	4	518.8	-	-	4	518.8
Total	87	1,544.4	73	1,079.2	53	327.0	212	2,947.6

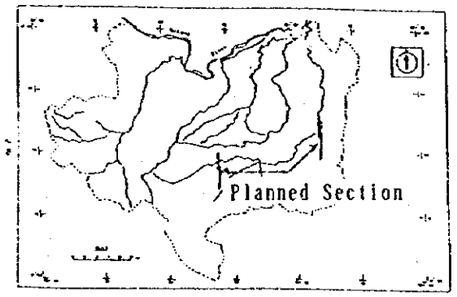
Table k-4.11 Nam Suai and Nong Khai River Basin Development Plan

Item	Upper Reach		Lower Reach		Whole Basin		Nong Khai Basin	
	Q'ty (proj.)	Costs (M.B)	Q'ty (proj.)	Costs (M.B)	Q'ty (proj.)	Costs (M.B)	Q'ty (proj.)	Costs (M.B)
1. Large Scale I.P.								
a. Improvement	-	-	-	-	-	-	-	-
2. Medium Scale I.P.								
a. Construction	1	468.4	-	-	1	468.4	1	212.2
b. Improvement	-	-	1	51.1	1	51.1	1	9.4
3. Small Scale I.P.								
a. Construction	7	36.0	25	142.0	32	178.0	18	96.0
b. Improvement	13	36.0	10	28.0	23	64.0	11	25.0
4. Dredging								
a. Construction	9	11.0	35	110.5	44	121.5	31	107.0
5. River Imprvement								
a. Dredging/Training	-	-	-	-	-	-	-	-
b. Weir Construction	-	-	-	-	-	-	-	-
c. Water Impounding	1	67.4	-	-	1	67.4	-	-
d. Poldr Project	-	-	-	-	-	-	-	-
Total	31	618.8	71	331.6	102	950.4	62	449.6

Table k-4.12 Huai Luang River Basin Development Plan

Item	Upper Reach		Middle Reach		Lower Reach		Whole Basin	
	Q'ty (proj.)	Costs (M.B)	Q'ty (proj.)	Costs (M.B)	Q'ty (proj.)	Costs (M.B)	Q'ty (proj.)	Costs (M.B)
1. Large Scale I.P.								
a. Improvement	1	203.1	-	-	-	-	1	203.1
2. Medium Scale I.P.								
a. Construction	7	1,099.9	1	277.3	-	-	8	1,377.2
b. Improvement	5	162.2	-	-	-	-	5	162.2
3. Small Scale I.P.								
a. Construction	37	188.3	72	418.0	18	120.0	127	726.3
b. Improvement	18	50.5	22	59.0	11	28.0	51	137.5
4. Dredging								
a. Construction	37	74.0	34	119.0	13	63.0	84	256.0
5. River Imprvement								
a. Dredging/Training	4	342.0	2	867.4	-	-	6	1,209.4
b. Weir Construction	2	184.3	1	128.5	-	-	3	312.8
c. Water Impounding	6	247.0	2	162.8	-	-	8	409.8
d. Poldr Project	-	-	-	-	-	-	-	-
Total	117	2,551.3	134	2,032.0	42	211.0	293	4,794.3

Figure K-4.1 Location Map of Proposed River Improvement and Water Impounding Projects



Key Map

Huai Luang River Improvement		20yr/ 50yr Flood
Old Barage to Huai Raeng	11.0 km	Q= 260/300 cu.m/s
Huai Raeng to Loeng Nong Bo	28.0 km	Q= 440/510 cu.m/s
L.Nong Bo to Huai It	1.5 km	Q= 450/540 cu.m/s
Huai It to Huai Suang Luang	1.0 km	Q= 500/710 cu/m/s
H.Suang L. to Ban Wan Noi	21.5 km	Q= 620/820 cu.m/s
Ban Wan Noi to Huai Dan	25.0 km	Q= 750/950 cu.m/s
Total	88.0 km	

Figure K-4.2 Location Map of Proposed Polder Dike Projects