

## (2) Change in Water Quality

The change in water quality downstream will reflect the evolution of water quality in the reservoir as previously presented. Without mitigating infrastructures, it is most probable that the water released downstream will be of low quality, hardly suitable for fish and other aquatic life. Forced water re-aeration facilities and implementation of a fishery intensification program are strongly recommended.

### 7.4.6 ENVIRONMENTAL COMPARISON BETWEEN ALTERNATIVES

The following Table 7.4.9 presents, for each project alternative the quantified indicators discussed in this report, in order to facilitate the comparison in the environmental field.

The environmental efficiency of an hydropower project may be measured by the number of ha of land affected and the number of displaced persons for each MW of installed capacity. The position of both Nam Ngiep alternatives is compared with several other projects in the world and presented in the following Figure 7.4.15.

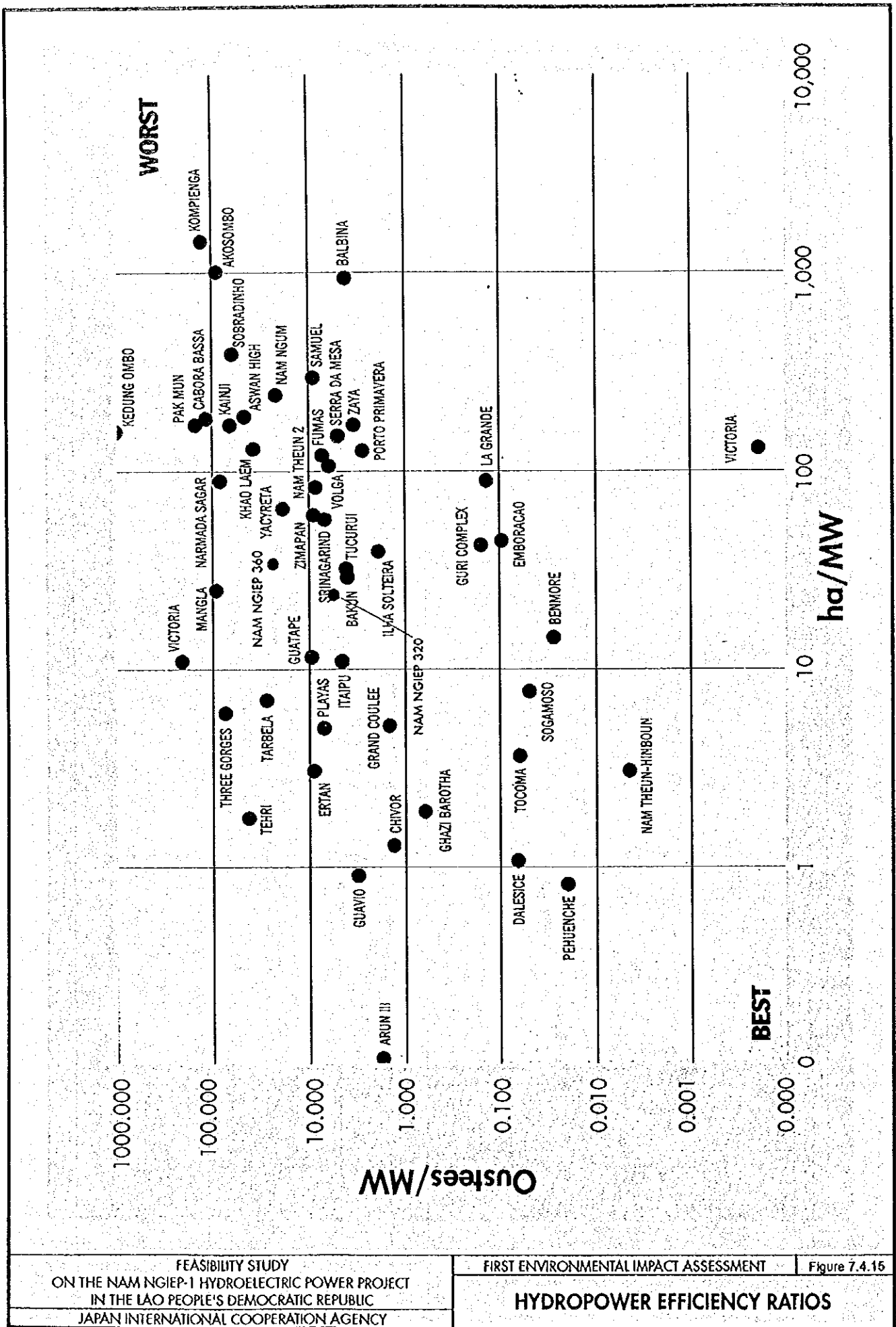
### 7.4.7 CONCLUSIONS

The following conclusions may be drawn from the First EIA studies and investigations:

- (i) Both the proposed FSL alternatives EL.360m and EL.320m have the same dam site. Consequently, the environmental impacts in the downstream area are very similar and do not provide a significant basis for differentiating the two (2) alternatives from the environmental point of view.
- (ii) The large-scale dam alternative (FSL.360m) will inundate exactly not only twice more land (14,820ha) than the medium-scale alternative (FSL.320m, 7,390ha), but also three (3) times more cultivated land (950ha compared to 310ha). Almost 10,000ha of forest, representing a potential timber volume of 290,000m<sup>3</sup> are also flooded by FSL.360m, against only half of these values for FSL.320m.
- (iii) The clearing of reservoir is efficient to reduce the duration of low water quality. However, the clearing of the forest in the vast Nam Ngiep reservoir of 74km<sup>2</sup> may require an immeasurable long time and huge cost. Therefore, it seems not economical and realistic. The improvement of the low-water quality at the downstream river stretch will have to be planned with some re-aeration facilities.
- (iv) With the flooding of the forest, Laos will lost a potential for sequestering the carbon, resulting eventually in a higher contribution to global warming. It represents a loss for a potential selling of carbon credits to any industrialized nations. Based on a forest growth of 2 to 3 m<sup>3</sup>/ha/year, the loss may be estimated at US\$180,000-270,000/year for FSL.360m and at US\$88,000-130,000/year for FSL.320m.

Table 7.4.9 Comparison of Alternatives

No.	Components & Indicators	Unit	Alternative	
			FSL EL 360m	FSL EL 320m
<b>I. RESERVOIR</b>				
1.	FSL Area	km <sup>2</sup>	148.2	73.8
2.	FSL Volume	Mill.m <sup>3</sup>	6,780	2,280
3.	MOL Level	m	335	284
4.	MOL Area	km <sup>2</sup>	104	32.7
5.	MOL Volume (Dead storage)	Mill.m <sup>3</sup>	3,689	627
6.	Mean Level	m	342	306
7.	Mean Area	km <sup>2</sup>	133	54
8.	Mean Volume	Mill.m <sup>3</sup>	5471	1548
9.	Mean Depth	m	41.4	28.7
10.	Reservoir shoreline at FSL	km	565	350
11.	Draw down (DD) magnitude	m	25	36
12.	DD area (maximum)	ha	4,420	4,110
13.	DD area exposed >120 days	ha	1,200	2,300
14.	Length of river flooded	km	90	70
15.	Average river width in reservoir area	m	80	80
16.	River area flooded	ha	720	560
17.	River area above reservoir	ha	228	388
18.	Length of tributary system dammed	km	372	372
19.	Area of tributary system dammed	ha	2,100	2,100
20.	Average river bank width in reservoir	m	50	50
21.	Area of river bank flooded	ha	450	350
22.	Controlled catchment area	km <sup>2</sup>	3,700	3,700
<b>II. RESERVOIR FORECASTS</b>				
1.	Hydraulic Residence Time (months)	month	13.2	3.6
2.	Areal Hydraulic Loading (m <sup>3</sup> /year)	m <sup>3</sup> /yr	34.5	68.1
3.	Catchment to Reservoir area ratio	-	25.0	49.3
4.	Duration of water quality problems	year	6	2
5.	Filling Period (no riparian release)	month	15	3
6.	Filling Period with RR of 20 m <sup>3</sup> /s	month	16	3
7.	Filling Period with RR of 50 m <sup>3</sup> /s	month	18	4
8.	Mean annual evaporation	Mill.m <sup>3</sup>	204	83
9.	Reservoir shoreline development	-	13.1	11.4
10.	Maximum temperature	°c	29	29.7
11.	Minimum temperature	°c	21	21.4
12.	Phosphorus loading rate (gP/m <sup>2</sup> /y)	-	0.449	0.902
13.	Electrical conductivity in future lake	µS/cm	46	62
14.	Morpho-edaphic index (MEI)	-	0.65	0.93
15.	Reservoir potential fish catch	tons/y	160	96
16.	Reservoir potential fish yields	kg/ha/y	11.3	13.6
<b>III. TERRESTRIAL RESOURCES</b>				
1.	Forest area flooded	ha	9,780	4,930
2.	Timber standing volume (30 m <sup>3</sup> /ha)	m <sup>3</sup>	293,000	148,000
3.	Timber annual production (1.5 m <sup>3</sup> /ha/y)	m <sup>3</sup> /y	16,500	8,000
4.	Open woodland	ha	2,890	1,770
5.	Distance to nearest (NBCA)	km	14	14
6.	Area with important wildlife species	ha	100	100
7.	Flooded biomass rapid decay	'000 t	568	284
8.	Flooded biomass slow decay	tons	2,140	1,071
<b>IV. DOWNSTREAM AREA AND CONSTRUCTION SITES</b>				
1.	Length of river downstream	km	54	54
2.	Area of river downstream	ha	880	880
3.	Area of river banks	ha	400	400
4.	flow change driest month (dam)	initial	355%	333%
5.	flow change wettest month (dam)	initial	34%	49%
6.	Villages along river	nos.	14	14
7.	Households	nos.	1,132	1,132
8.	Population	nos.	6,473	6,473
9.	Grazing land	ha	19,716	19,716
10.	Buffalo	nos.	864	864
11.	Cattle	nos.	986	986
12.	Average flow velocity	m/s	0.2	0.2
13.	Population km 0-10 (from dam site)	nos.	785	785
14.	Population km 10-20 & 20-30	nos.	0	0
15.	Population km 30-40	nos.	3,307	3,307
16.	Population km 40-54	nos.	3,166	3,166
17.	Area for re-regulation pond	ha	240	240
18.	Area for dam construction site & camps	ha	150	150
19.	Area for quarries and borrow areas	ha	150	100?
20.	Length of new access road	km	10	10
21.	Area for new access road	ha	20	20
22.	Length of transmission line	km	110	110
23.	Area for transmission line (ROW)	ha	550	550
24.	Area for TL (land acquisition)	ha	2.0	2.0



FEASIBILITY STUDY  
 ON THE NAM NGIEP-1 HYDROELECTRIC POWER PROJECT  
 IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC  
 JAPAN INTERNATIONAL COOPERATION AGENCY

FIRST ENVIRONMENTAL IMPACT ASSESSMENT Figure 7.4.15

**HYDROPOWER EFFICIENCY RATIOS**

- (v) During operation, the water level of the reservoir will fluctuate, exposing draw-down areas which may be developed for agriculture or grazing. For rice production, the land must be exposed around 5 months. FSL.320m offers almost twice more areas for rice cultivation than FSL.360m: almost 2,000ha against 1,000ha. Only a part of this area is suitable for rice culture when considering soil quality and local topography.
- (vi) The residence time of water into the reservoir is about 13 months for FSL.360m and only 3.6 months for FSL.320m. This short residence time combined with a limited inflow of Phosphorus from the watershed leads to the conclusion that there should be no problem of water quality in the medium and long term. After the impoundment, as the intense decay of organic matter in the water which consume all the dissolved oxygen, it is anticipated that the water will recover a reasonable level of oxygen after only 5 to 6 years for FSL.360m and after only 2 years for FSL.320m.
- (vii) However, because of its depth, the reservoir will probably be stratified, with a 15-20m depth layer of well aerated water over a deeper water body of colder and anoxic water. Turn over may occur during the cold season as observed in the Nam Ngum reservoir, but its magnitude has still to be assessed. As the water intake is located most of the year below 20m from the surface, it is anticipated a release of low quality water in the downstream river, with impacts on aquatic life and population. To mitigate this impact, appropriate facilities as multi level intake or downstream re-aeration structure may be studied in a further investigation.
- (viii) A re-regulation facility will be constructed below the tailrace channel to regulate the flow over 24 hours, to avoid daily changes in river flow which could have resulted in hazards for the population and excessive erosion of the riverbed.
- (ix) The average monthly flow will be significantly changed at the downstream area: the dry season flow will be increased 3 times and the wet season flow reduced by 50% from present situation.
- (x) Impacts on land at downstream will be limited to land acquisition for only 10km of access road and 110km of transmission line. Compensation for the loss of land will be provided to the concerned population. Impact is the same for both alternatives.
- (xi) To mitigate the impacts during construction, filling of the reservoir and operation stages, a program of activity has been prepared in the Environmental Management Plan (EMP). The constitution of an Environmental Management Unit (EMU) is also proposed.

## 7.5 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

### 7.5.1 OBJECTIVES OF THE PLAN

There are two (2) objectives in the Environmental Management and Monitoring Plan (EMP). One is to provide the framework for undertaking all the Environmental Protection Measures (EPMs) recommended and related to direct impacts of the Project. And the other is to establish a monitoring of these measures throughout the life of the project, but with a special focus during the construction and filling phases. The EMP also provides a basis for evaluating the performances of the Project in carrying out the EPMs.

These EPMs include the mitigation measures, monitoring activities and studies for physical and biological impacts of the Project. However, some compensation measures of land acquisition in the downstream area for access roads and power transmission lines have been included at this stage of the study.

The EMP also provides a possible institutional organization framework for its implementation, defining briefly the roles and responsibilities of each party.

### 7.5.2 INSTITUTIONAL ORGANIZATION AND RESPONSIBILITIES

It is recommended that an Environmental Management Unit (EMU) be established under the responsibility of the Executing Agency, to implement all the measures proposed in the EMP. The EMU will provide manpower for monitoring activities, and coordination for study activities subcontracted to GOL Agencies or private consultants.

For Upper level decision making, the creation of a Consultative Committee is also recommended. This Committee will provide advice and recommendations in order to reflect some of the measures proposed by the national view and policy. Some measures requiring policy orientation may concern, for example, watershed management, creation of conservation areas, and participation of the Project to Environmental Trust fund.

The Committee will also provide advice during the course of the construction phase in case of disagreement between parties, particularly for measures involving compensation or direct effects on the population.

It is recommended that this Committee be chaired by STENO, as the agency responsible for the enforcement of the Environmental Law. Other members should be representatives of each concerned Ministry, together with Provincial and District representatives.

The Executing Agency must ensure that the Project conforms with the environmental criteria set out in the final EIA and in the Final EMP. To successfully achieve this objective, the Executing

Agency will appoint an Environmental Manager (EM) on a full time basis, for a minimum period of 7 years (5 years of construction and first 2 years of operation). The EM will report directly to the Project Manager. The EM will act on behalf of the Project Manager in dealing with Government Agencies or other parties concerned. He will represent the Executing Agency in the Consultative Committee and will be responsible for maintaining good relations and communication with the local communities and authorities.

The EM will have to carry out basic activities: Coordination, supervision, monitoring and reporting. The EM should be assisted by a staff including at least:

- (i) a full time technical assistant from the Engineer side, to ensure appropriate coordination with construction activities,
- (ii) a water quality specialist, in charge of supervising monitoring and sub-contracted studies in this field, and
- (iii) a forest specialist to coordinate all the activities related to land use, forest and biomass inventory and technical studies in these fields.

Temporary staff from government agencies and consulting firms will also be appointed according to needs.

A close coordination will be required with STENO and with CPAWM for aspects dealing with conservation and wildlife. Also, the same close coordination will be established with the main Contractor, who will be required to appoint an Environmental Officer.

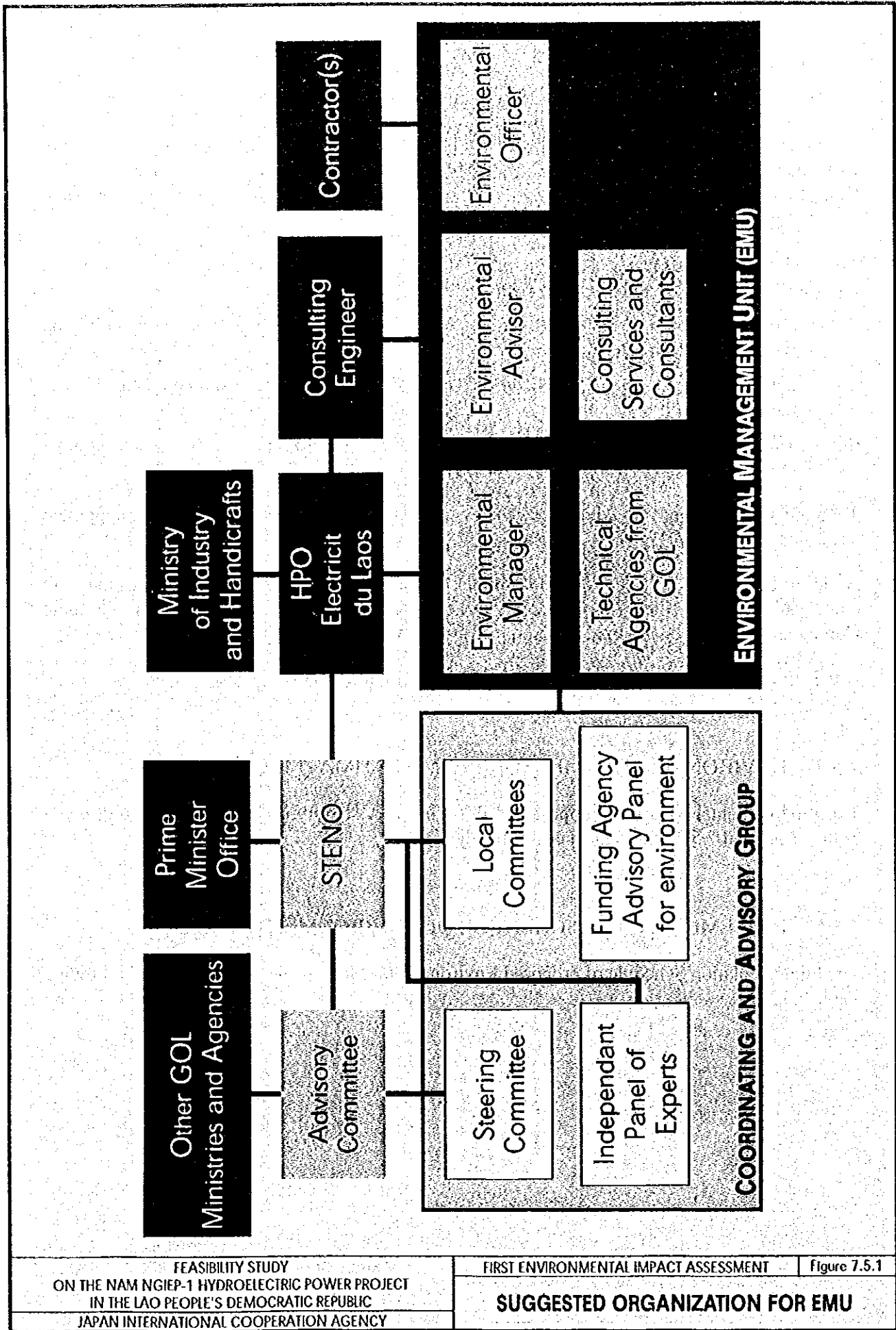
A tentative possible organization diagram is shown in Figure 7.5.1.

### 7.5.3 ENVIRONMENTAL MEASURES AND ESTIMATED COST

The Environmental Measures proposed in this First EIA study are presented in the following Tables 7.5.1 and 7.5.2 with related cost estimates.

### 7.5.4 IMPLEMENTATION SCHEDULE OF ENVIRONMENTAL MEASURES

The Implementation Schedule of proposed Environmental Measures is presented in the following Table 7.5.3.



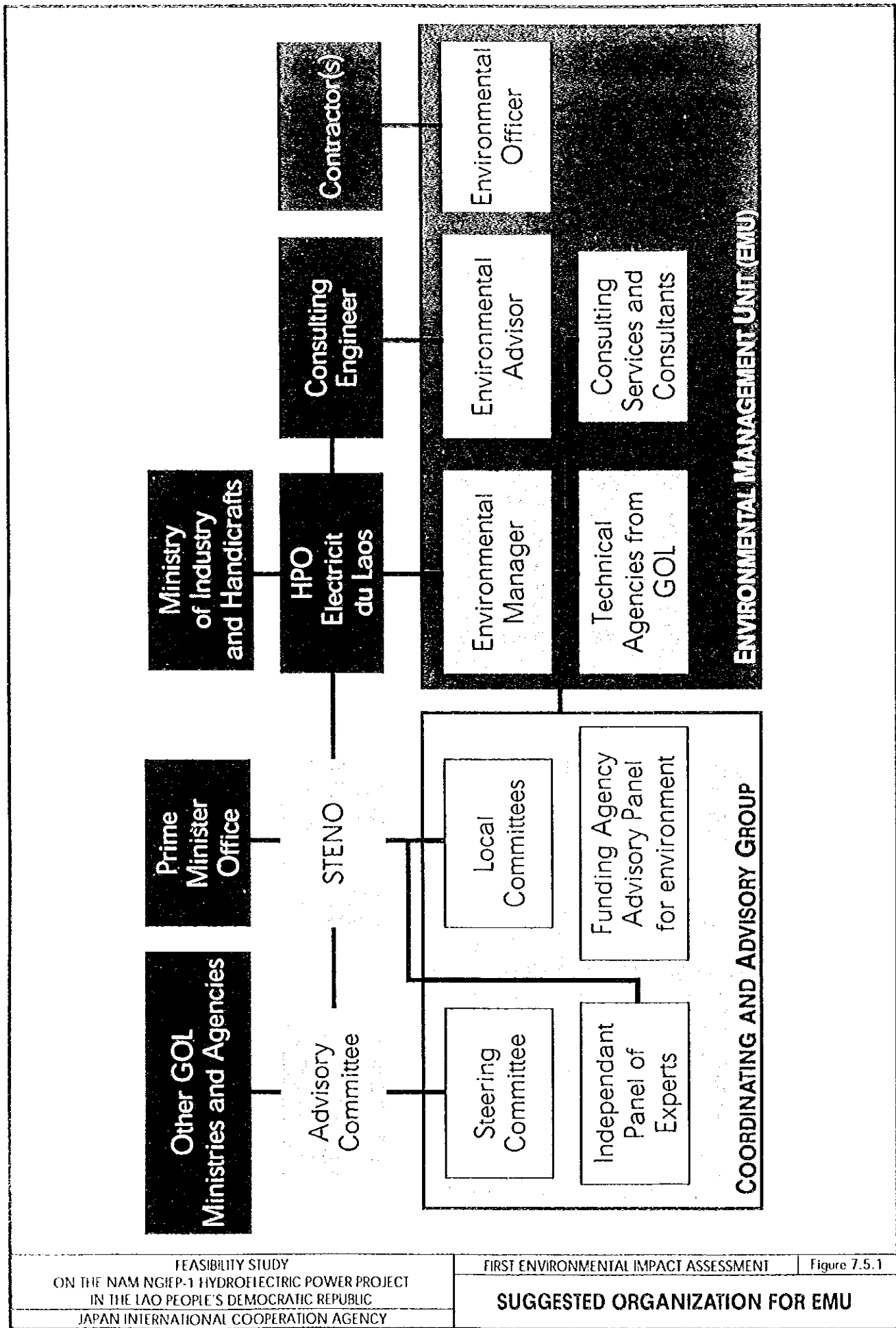




Table 7.5.1 Environmental Mitigation Studies and Measures with Related Budget Estimated

No	Environmental Measures	Responsible Organism	Executing Organism	Duration of Activity (years)	Unit Cost Estimate (US\$)	Total Cost of Period (US\$) FSL360	Total Cost of Period (US\$) FSL320
<b>A</b>	<b>Completion of EIA Study to International Standards</b>	<b>JICA/GOL</b>	<b>IHO/Consultant</b>	<b>2</b>			
A1	Monitoring of fisheries	JICA/HPO	Dept. Fishery	2	15,000	30,000	30,000
A2	Aquatic Ecology surveys	JICA/HPO	Consulting	2	60,000	60,000	60,000
A3	Study on intensification of fisheries in reservoir area and in downstream villages	JICA/HPO	Consulting	1	60,000	60,000	60,000
A4	Water quality monitoring	JICA/HPO	Consulting	2	25,000	50,000	50,000
A5	Water quality forecast study (reservoir modeling)	JICA/HPO	Consulting	1	60,000	60,000	60,000
A6	Study of sedimentation and backwater effects	JICA/HPO	Consulting	1	100,000	50,000	100,000
A7	Study and design of water re-aeration structures	JICA/HPO	Consulting	1	50,000	50,000	50,000
A8	Study for optimization of riparian release	JICA/HPO	Consulting	1	20,000	20,000	20,000
A9	Study for Downstream villages water supply	JICA/HPO	Consulting	1	50,000	50,000	50,000
A10	Land use study based on new aerial photos for reservoir, access road and TL	JICA/HPO	Consulting	1	60,000	60,000	50,000
A11	Land use study of village gardens along river banks in downstream area	JICA/HPO	Consulting	1	20,000	20,000	20,000
A12	Study on wildlife and biodiversity with preparation of a rescue plan	JICA/HPO	Consulting	1	80,000	80,000	80,000
A13	Survey of reservoir timber and vegetation biomass	JICA/HPO	NOFIP, Consulting	2	150,000	150,000	110,000
A14	Preparation of a logging and clearing plan	JICA/HPO	Consulting	1	50,000	50,000	46,000
A15	Strategic study for biodiversity compensation and support (participation to trust fund?)	JICA/HPO	CPAWM, Consulting	1	20,000	20,000	20,000
A16	Preliminary watershed management plan	JICA/HPO	Consulting	1	10,000	10,000	10,000
A17	EIA for resettlement sites (Provisional budget)	JICA/HPO	JICA/HPO	1	100,000	100,000	70,000
A18	Preparation of detailed Environmental Management and Monitoring Plan	JICA/HPO	Consulting	-	60,000	60,000	60,000
A19	Coordination, reporting, presentation	JICA/HPO	Consulting	-	60,000	60,000	60,000
<b>SUB TOTAL A</b>						<b>1,040,000</b>	<b>1,006,000</b>
<b>B</b>	<b>Organization of the Environmental Management Unit (EMU) and Committee</b>	<b>GOL/DEV</b>	<b>STENO</b>				
B1	Constitution of EMU	GOL/DEV	STENO/HPO/EDL	0.5	80,000	80,000	80,000
B2	Capacity building of EMU (1 year Technical Assistance) and Creation of Committee	STENO/DEV	EMU/Consulting	1	300,000	300,000	300,000
B3	Preparation of detailed working program for EMU	GOL/DEV	STENO/Consulting	0.5	Included in previous	-	-
B4	Appointment of Independent Panel of Experts (2)	GOL/DEV	STENO	-	-	-	-
B5	Preparation of detailed envir. spec. for Contractors	JICA/HPO	Consulting	-	30,000	30,000	30,000
<b>SUB TOTAL B</b>						<b>410,000</b>	<b>410,000</b>
<b>C</b>	<b>Measures during Construction Phase</b>	<b>GOL/DEV</b>	<b>EMU</b>	<b>5</b>			
C1	Provide operating budget for EMU	GOL/DEV	STENO	5	180,000	900,000	900,000
C2	Appointment of Independent Panel of Experts (2)	GOL/DEV	EMU	-	60,000/yr	300,000	300,000
C3	Monitoring of contractor's construction sites and camps	GOL/DEV	EMU	5	EMU operation	-	-
C4	Provision for compensation for accidental spill or downstream pollution	STENO	EMU	When justified	(reimb. by contractor)	100,000	100,000
C5	Provision for independent investigation audit and arbitration of impact event if required	EMU	Consulting	When justified	(reimb. by contractor)	20,000	20,000
C6	Monitoring of fisheries in reservoir & D/S villages	EMU	Fishery Dept.	5	15,000	75,000	75,000
C7	Construction of water supply facilities for downstream villages last 1-2 years of Construction	EMU	Contractor	1-2	250,000	250,000	250,000
C8	Water quality monitoring (incl. tech. assistance)	EMU	Vientiane Laboratory	5	25,000	125,000	125,000
C9	Study for detailed rehabilitation of quarries, borrow and spoil banks	EMU	Consulting	1	30,000	30,000	30,000
C10	Preparation of specifications for logging and clearing tender documents, evaluation of tenders	STENO Forest Dept.	EMU Consulting	0.5	20,000	20,000	20,000
C11	Technical Assistance to EMU for supervision and monitoring of logging and clearing	EMU	Consulting D. Forestry	2	200,000	200,000	150,000
C12	Clearing of reservoir	EMU	Contractor	2	5800,000	5,800,000	3,000,000
C13	Preparation of a detailed watershed development and management plan	STENO CPAWM	Consulting	1	100,000	100,000	100,000
C14	Study for creation of wildlife reserve	STENO	EMU, Consulting	1	50,000	50,000	50,000
C15	Budget for land acqui. & compens. along A/road & T/L	STENO/DEV	EMU	1	110,000	110,000	110,000
<b>SUB TOTAL C</b>						<b>8,080,000</b>	<b>5,230,000</b>

Table 7.5.2 Environmental Mitigation Studies and Measures with Related Budget Estimated

No	Environmental Measures	Responsible organism	Executing organism	Duration of activity (years)	Unit cost estimate (US\$)	Total cost of period (US\$) FSL360	Total cost of period (US\$) FSL320
<b>D</b>	<b>Measures during filling phase</b>	<b>STENO</b>	<b>EMU</b>	<b>1</b>			
D1	Provide operation budget for EMU			1	180,000	180,000	180,000
D2	Water quality monitoring	EMU	Vientiane Laboratory	1	12,000	12,000	12,000
D3	Specific monitoring of released water quality	STENO	EMU, Consulting	1	12,000	12,000	12,000
D4	Monitoring of downstream fisheries	EMU	Fishery Dept.	1	15,000	15,000	15,000
D5	Implementation of the animal rescue plan and management of the filling event (2 years)	EMU	Consulting, Contractor	1 <sup>st</sup> year	180,000	180,000	130,000
D6	Removal of floating trunks and branches and release on ground landings	EMU	Contractor	1	200,000	200,000	150,000
D7	Implementation of the fisheries intensification program in downstream villages	MOAF	Fish Dept. Contractor	-	Not project	-	-
<b>SUB TOTAL D</b>						<b>599,000</b>	<b>499,000</b>
<b>E</b>	<b>Measures during operation phase (year 1-5)</b>	<b>STENO</b>	<b>EMU</b>	<b>1-5 Years</b>			
E1	Provide operation budget for EMU	GOL/DEV		1	180,000	180,000	180,000
E2	Water quality monitoring	EMU	Vientiane Laboratory	5	18,000	90,000	90,000
E3	Specific monitoring of released water quality	STENO	EMU Consulting	2	12,000	24,000	24,000
E4	Management of the filling event (2 years)	EMU	Consulting Contractor	2 <sup>nd</sup> year	70,000	70,000	40,000
E5	Evaluation of Compensation for loss of river bank gardens and existing irrigation facilities	STENO	EMU	1	EMU budget	-	-
E6	Provision for Compensation for loss of river bank gardens and existing irrigation facilities	STENO	EMU	1	50,000 (provision)	50,000	50,000
E7	Monitoring of downstream fisheries	EMU	Fish. Dept.	5	15,000	75,000	75,000
E8	Development of irrigation in the downstream area	MOAF	Irrig. Dept. Contractor	-	Not project	-	-
E9	Compensate for lost biodiversity by annual contribution to environmental trust fund ?	GOL	EDL or DEV	5	?	?	?
E10	Implementation of watershed management plan (for aspects related to Project)	GOL	EDL or DEV	5	?	?	?
<b>SUB TOTAL E</b>						<b>489,000</b>	<b>459,000</b>
<b>F</b>	<b>Measures during operation phase (year 6-50)</b>	<b>STENO</b>	<b>EMU</b>	<b>Years 6-50</b>			
F1	Water quality monitoring	EMU	Vientiane Laboratory	5	12,000	60,000	60,000
F2	Compensate for lost biodiversity by annual contribution to environmental trust fund ?	GOL	EDL or DEV	45?	?	?	?
F3	Implementation of watershed management plan	GOL	MOAF	20	?	?	?
F4	Implementation of commercial fisheries program in the reservoir	GOL/DEV	MOAF	5	Not project	-	-
F5	Implementation of fish culture in the reservoir	GOL/DEV	MOAF, Private Sect.	5	Not project	-	-
<b>SUB TOTAL F</b>						<b>60,000</b>	<b>60,000</b>
<b>GRAND TOTAL (A to F)</b>						<b>10,678,000</b>	<b>7,664,000</b>

Note: DEV= Developer, EMU= Environmental management Unit, GOL= Government of Laos



Table 7.5.3 Preliminary Implementation Schedule for Environmental Management & Monitoring Plan

No.	TASKS Period (Years)	Feasibility + Final EIA		DD-Funding			Construction					Filling		Operation	
		1	2	2 to 3 years		1	2	3	4	5	Years 1-5	Years 6-50			
A	Completion of EIA to Internat. Stand.	█	█												
A1	Monitoring of fisheries	█	█												
A2	Aquatic Ecology surveys	█	█												
A3	Study on intensification of fisheries	█	█												
A4	Water quality monitoring	█	█												
A5	Water quality study (reservoir modeling)	█	█												
A6	Study of sedimentation / backwater effects	█	█												
A7	Study/ design of water re-aeration struct.	█	█												
A8	Study for optimization of riparian release	█	█												
A9	Study Downstream villages water supply	█	█												
A10	Land use study reservoir, access road, TL	█	█												
A11	Land use study of village gardens	█	█												
A12	Study on wildlife / rescue plan	█	█												
A13	Survey reservoir timber and veg. biomass	█	█												
A14	Preparation of a logging and clearing plan	█	█												
A15	Strategic study for biodiversity support	█	█												
A16	Preliminary watershed management plan	█	█												
A17	EIA resettlement sites (Provisional budget)	█	█												
A18	Preparation of detailed EMP	█	█												
A19	Environmental specific. for Contractors	█	█												
A20	Coordination, reporting, presentation	█	█												
B	Organization of EMU (Year -1)														
B1	Constitution of EMU														
B2	Capacity building of EMU														
B3	Preparation of working program														
B4	Selection Panel of Experts														
B5	Environmental Specification for Contractors														
C	During construction Phase														
C1	Provide operating budget for EMU														
C2	Appointment of Panel of Experts (2)														
C3	Monitoring contractor's sites and camps														
C4	Provision for compensation of spill														
C5	Provision for audit and arbitration of impact														
C6	Monitoring of fisheries														
C7	Construction of water supply facilities														
C8	Water quality monitoring														
C9	Study rehabilitation quarries, borrow areas														
C10	Logging / clearing tender documents														
C11	TA for supervision of logging and clearing														
C12	Cleaning of reservoir														
C13	Watershed management plan														
C14	Study for creation of wildlife reserve														
C15	Land acquisition road & TL (Budget)														
D	During Filling Phase														
D1	Provide operation budget for EMU														
D2	Water quality monitoring														
D3	Monitoring of released water quality														
D4	Monitoring of downstream fisheries														
D5	Filling event management, year 1														
D6	Removal of floating wood														
D7	Implement fisheries intensification D/S														
E	During Operation Phase (years 1-5)														
E1	Operation budget for EMU														
E2	Water quality monitoring														
E3	Monitoring of released water quality														
E4	Management of the filling event, year 2														
E5	Evaluation of compensation for bank garden														
E6	Provision of compensation for bank garden														
E7	Downstream fisheries monitoring														
E8	Development of irrigation downstream														
E9	Annual contribution to envir. trust fund ?														
E10	Implement watershed management plan														
F	During Operation Phase (years 6-?)														
F1	Water quality monitoring														
F2	annual contribution to envir. trust fund ?														
F3	Implement watershed management plan														
F4	Implement reservoir fisheries program														
F5	Implement fish culture in the reservoir														



## 7.6 SUMMARY OF PRELIMINARY RESETTLEMENT PLAN (PRP)

### 7.6.1 PROPOSED RESERVOIR AREA

The entire NNHP Reservoir Area will be within the *Khetpiset* (Special Zone) Xaysomboon as shown in Figure 7.6.1. Formerly part of Vientiane and Xieng Khouang Provinces, Xaysomboon was set up on July 23, 1994 to give the area special preference for community development. *Lao Soung* represent the majority of the population in the area (45 %) followed by *Lao Theung* (35 %) and *Lao Loum* (20 %).




The *Upper Reservoir Area* of the proposed NNHP is within Thathom District, in Thaviang Sub-District. With a population of approximately 7,500 people living in 33 villages, Thathom District has the second lowest population in Xaysomboon. The present National Route 4 (NR4) to be upgraded to National Road 1 passes through the proposed Upper Reservoir Area. The Government plans to extend the national network with a center spine NR1. This road is strategically important for the social economic development of the country and will run from the northern-most point of Lao's border with China to Cambodia in the south, adding another 1,000 km to the network.

The Upper Reservoir Area will also benefit from the transmission line route for the ADB-financed Power Transmission and Distribution Project, since the line is along NR4. The district will have an even more strategic location when NR5 is completed, linking Thailand through Vientiane to Vietnam. The junction of NR5 and NR1 will be in the Thaviang Sub-District of Thathom, the Upper Reservoir Area of the NNHP.

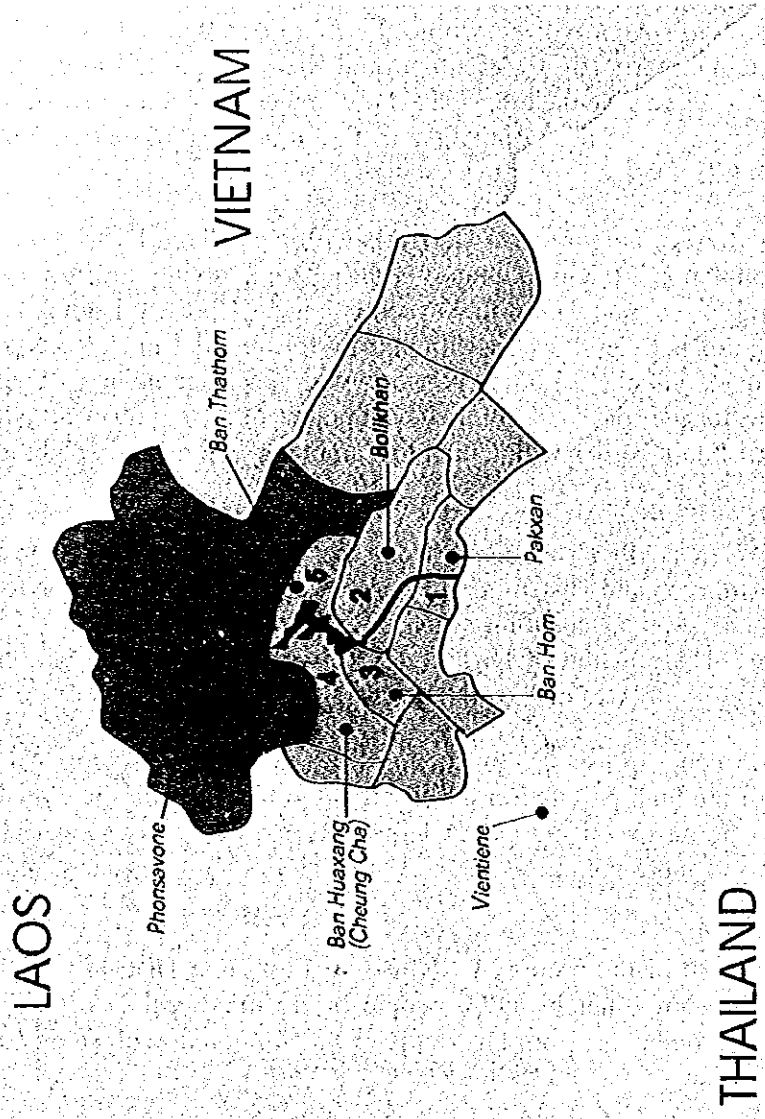
It is possible that with better transportation facilities in the Upper Reservoir Area as shown in Figure 7.6.2, and with the high population density relative to cultivable land area in China and Vietnam, there could be an excellent potential in *niche* market items grown at high tropical elevations, in addition to more common products such as horticulture, dairy and beef cattle or reservoir fisheries.

The *Lower Reservoir Area* of the proposed NNPP is within Hom District, Xaysomboon. The District's population is approximately 6,600 people living in 31 villages, making it the least populated district in Xaysomboon. Hom District is 90 % *Lao Soung* with some *Lao Theung* and *Lao Loum* making up balance.<sup>2</sup>

<sup>2</sup> In addition to the formal questionnaire survey, the JICA Study Team reviewed the existing sociocultural studies that have been conducted by ethnographers on behalf of other hydro projects in the Lao PDR and the ethnographic literature in general as a basis for planning. In line with accepted international practice for identifying vulnerable 'indigenous peoples' and describing aspects of life not readily captured in questionnaire surveys, a similar study is planned for the second phase of the feasibility study. However, whether or not or how this will take place will be according to the security situation in the Reservoir Area.

-  Bolikhamxay Province
-  Xiengkhouan Province
-  Xaysomboon Province

- 1 Pakxan District
- 2 Bolikhan District
- 3 Hom District
- 4 Xaysomboon District
- 5 Thathom District
- 6 Khoune District



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Figure 7.6.1

Boundary Orientation Map

Bolikhamxay Province



Xiengkhouan Province



Xaysomboon Province

1

Pakxan District

2

Bolikhan District

3

Hom District

4

Xaysomboon District

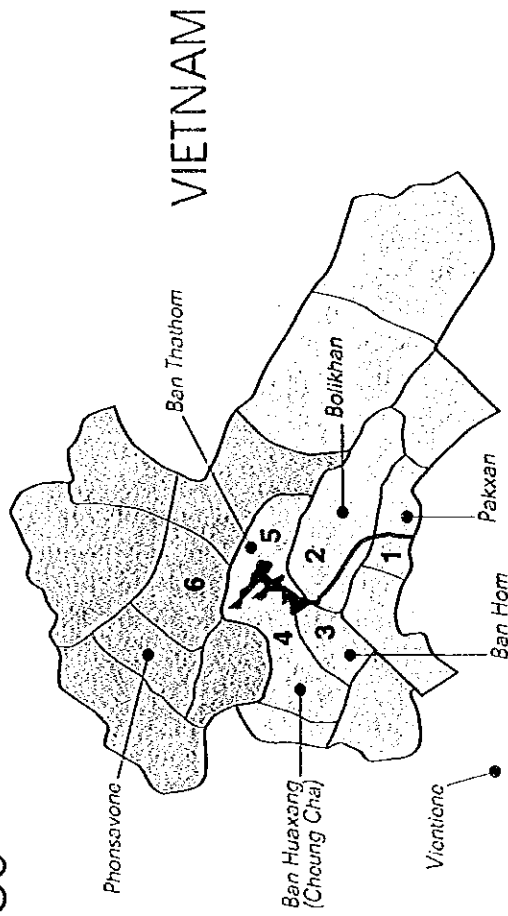
5

Thathom District

6

Khoune District

LAOS



THAILAND

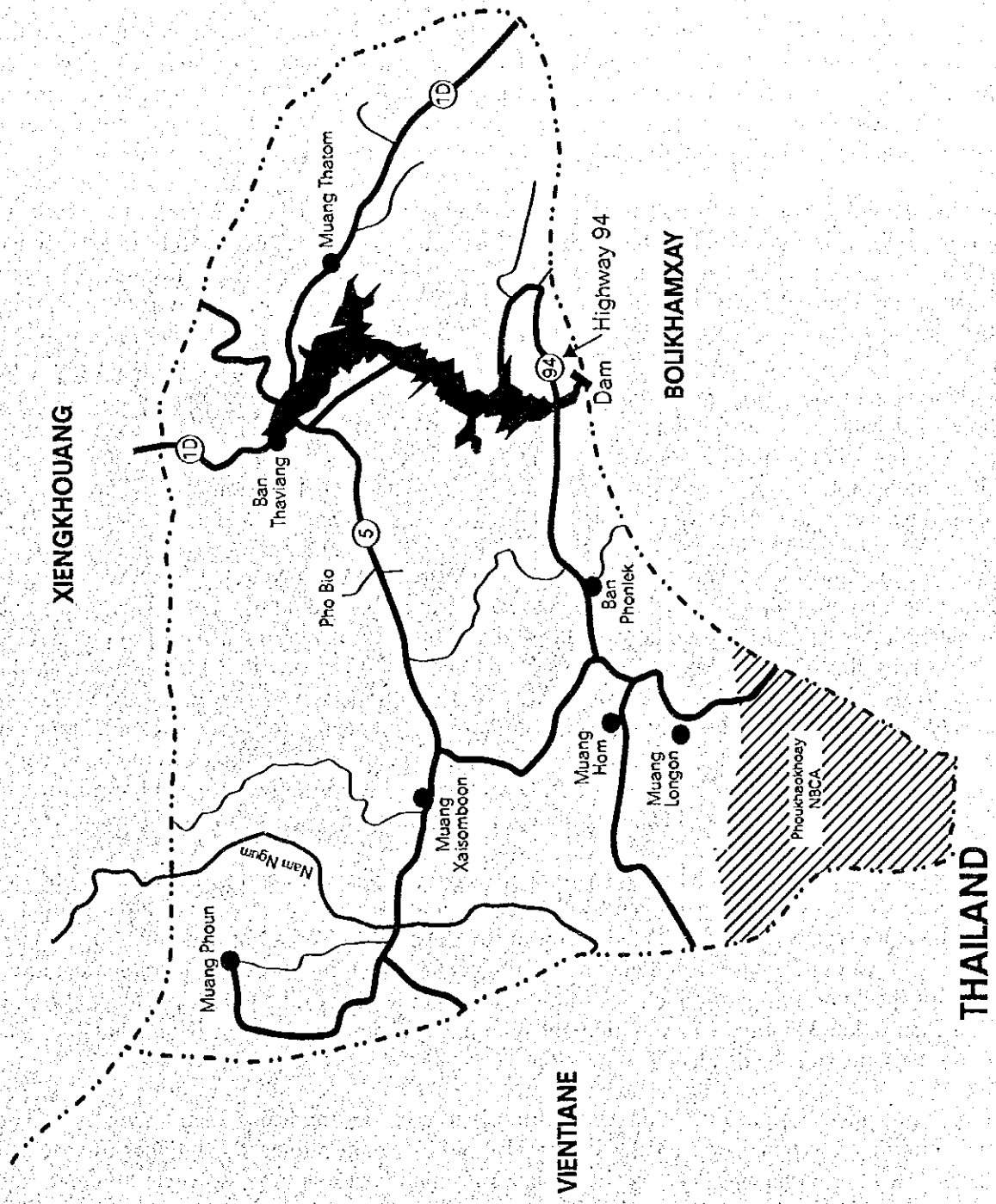
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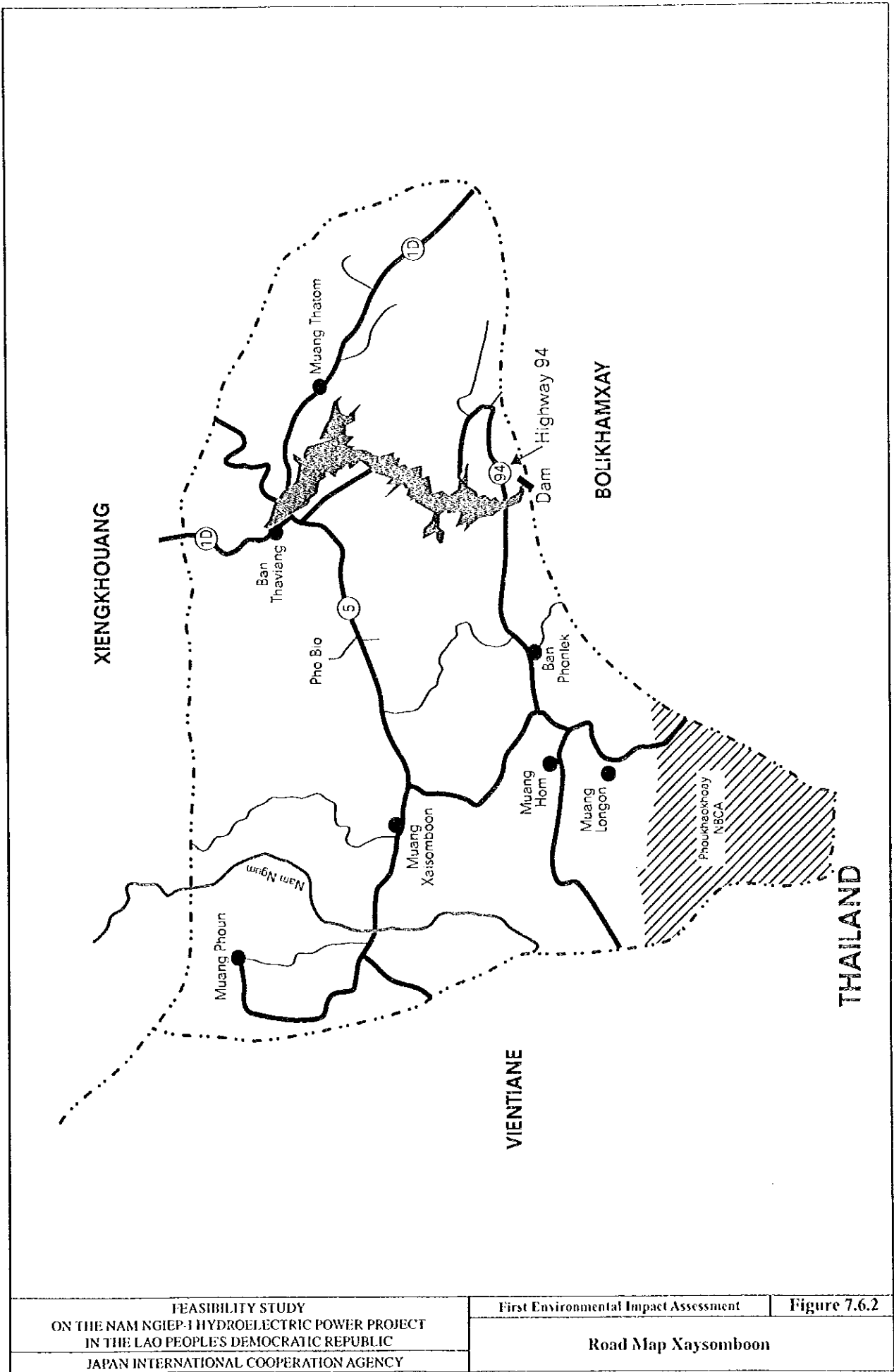
Figure 7.6.1

Boundary Orientation Map





FEASIBILITY STUDY ON THE NAM NGIEP-1 HYDROELECTRIC POWER PROJECT IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC JAPAN INTERNATIONAL COOPERATION AGENCY	First Environmental Impact Assessment	Figure 7.6.2
	Road Map Xaysomboon	



## 7.6.2 RESETTLEMENT IMPACTS OF RESERVOIR INUNDATION

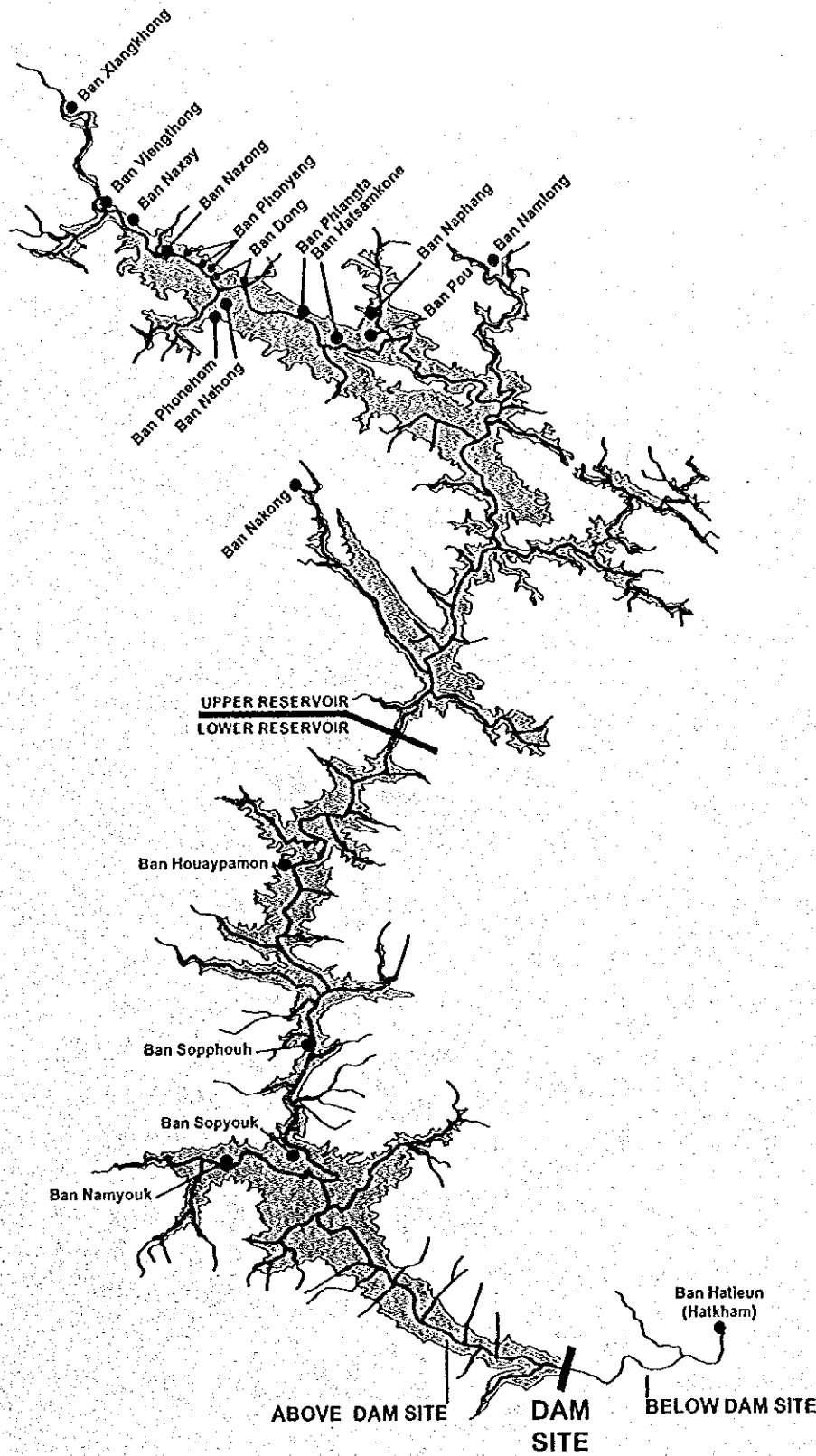
A reconnaissance field visit August 25-28, 1998 for the IEE found the population within the planned Reservoir Area to be more built up than anticipated. Instead of around an expected 2,000 people, it found the overall reservoir area population to be more than double this figure, at somewhat less than 5,500 persons. The reconnaissance team also found considerable government-supported irrigation development in the proposed Reservoir Area.

The extent of this was confirmed by a socioeconomic survey carried out December 1998 to January 1999. This survey found about 650 ha of irrigated rice paddy, with 150 ha more planned by GOL, instead of, as was originally assumed, only dry evergreen tropical forest, temporary or permanent agricultural areas, degraded forest, old re-growth and fallow resulting from shifting cultivation in the proposed Reservoir Area. In addition, the *Upper Reservoir Area* is a national Focal Area for Rural Development (FARD), making it a resettlement receiving area for highland populations; and the *Lower Reservoir Area* has been under a UNDP development project for a couple of decades. At FSL.360m, the proposed reservoir will flood 17 villages consisting of some 853 households, with a population of 5,204. More than 800 ha of irrigated paddy land built through GOL or UNDP aid schemes would be inundated. Distribution of all villages in the proposed reservoir area is shown in Figure 7.6.3.

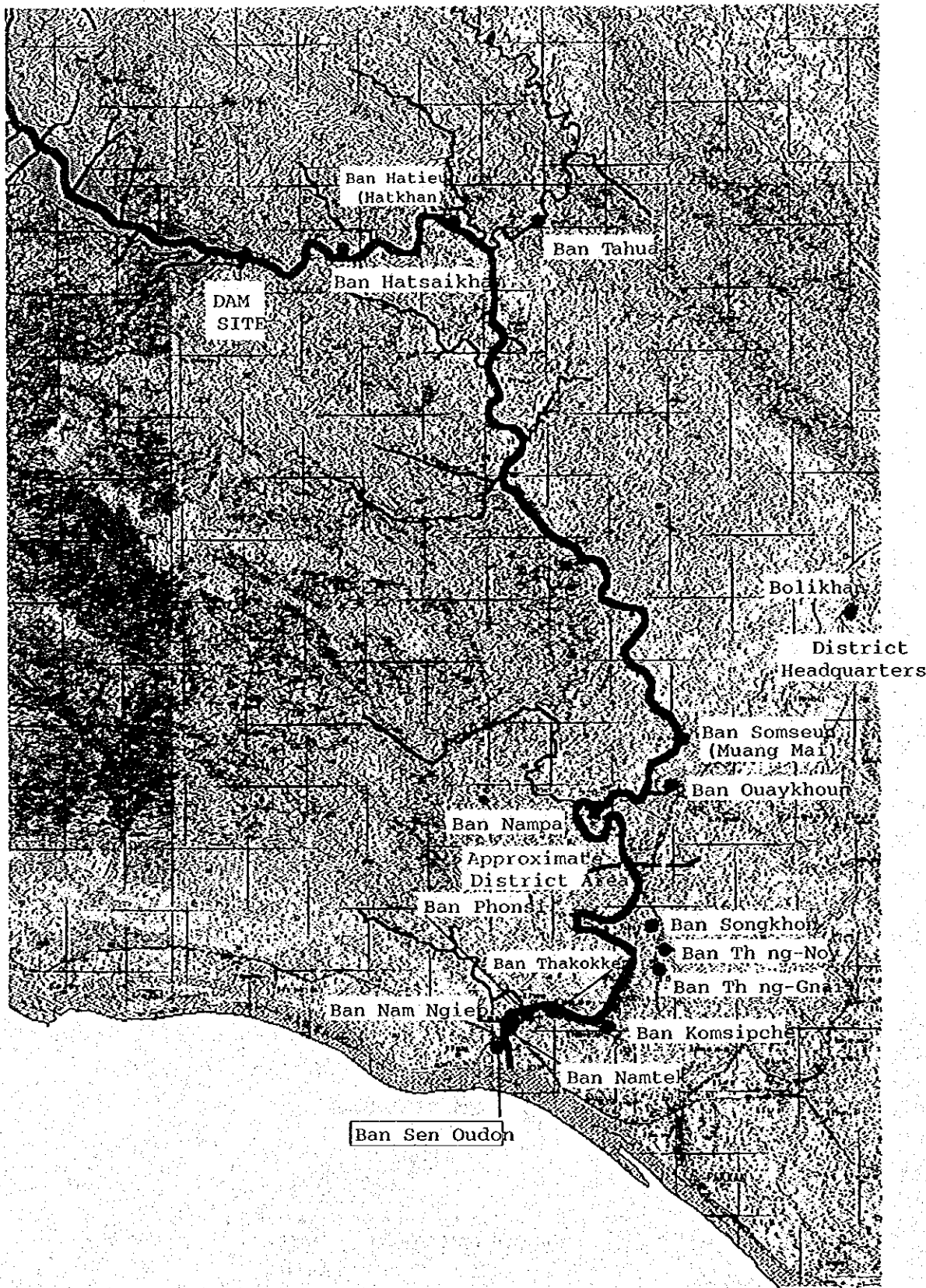
The socioeconomic survey was extended to the downstream area in March 1999. According to the socioeconomic survey of the Project Area, overall, including both Upstream and Downstream Areas, nearly 2,000 households and 12,000 persons may be affected to one degree or another by the NNHP. About 660 households and 5,000 persons in 14 villages are in the Upper Reservoir and another 200 households and 1,200 persons in 4 villages the *Lower Reservoir* could potentially be affected by involuntary resettlement. For Downstream Villages as shown in Figure 7.6.4, about 1,300 households and 6,800 people in 15 villages would be affected through changes in the Nam Ngiep River flow and water. The villages affected both upstream and downstream of the proposed Dam are shown in Table 7.6.1.

The table also illustrates which villages will be affected at FSL.360m and FSL.320m. While not all villages would be submerged even by FSL.360m alternative, their rice lands are all situated along the Nam Ngiep River and its territories at low levels. So we can assume that virtually all the villages would require resettlement, if FSL.360m dam is chosen for implementation. Generally speaking, mitigation includes minimizing resettlement to the extent possible, carrying out an international standard of resettlement planning and implementation if unavoidable, and fair compensation for the displaced population.

The recommended design mitigation at this time is to consider the lower dam alternative. The initial thinking was that lowering the FSL to EL.320m would reduce the number of affected villages down to 5 villages. There is not enough information at this time, however, to determine the amount of *backwater effect* would be, *i.e.*, how much higher the water at the back of the reservoir will be than at the front end. We would assume about 2m, including a safety margin. Therefore, consideration of the backwater effect indicates that EL.318m might be necessary to protect the majority of irrigated paddy land belonging to the Upper Reservoir villages, nearly 300 ha of the total reservoir paddy land. This FSL.318m dam would more surely reduce the affected population down to 260 households and about 1,600 people.



<p>FEASIBILITY STUDY ON THE NAM NGIEP-1 HYDROELECTRIC POWER PROJECT IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC JAPAN INTERNATIONAL COOPERATION AGENCY</p>	<p>First Environmental Impact Assessment</p>	<p>Figure 7.6.3</p>
<p>Reservoir Area Overview</p>		



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Figure 7.6.4

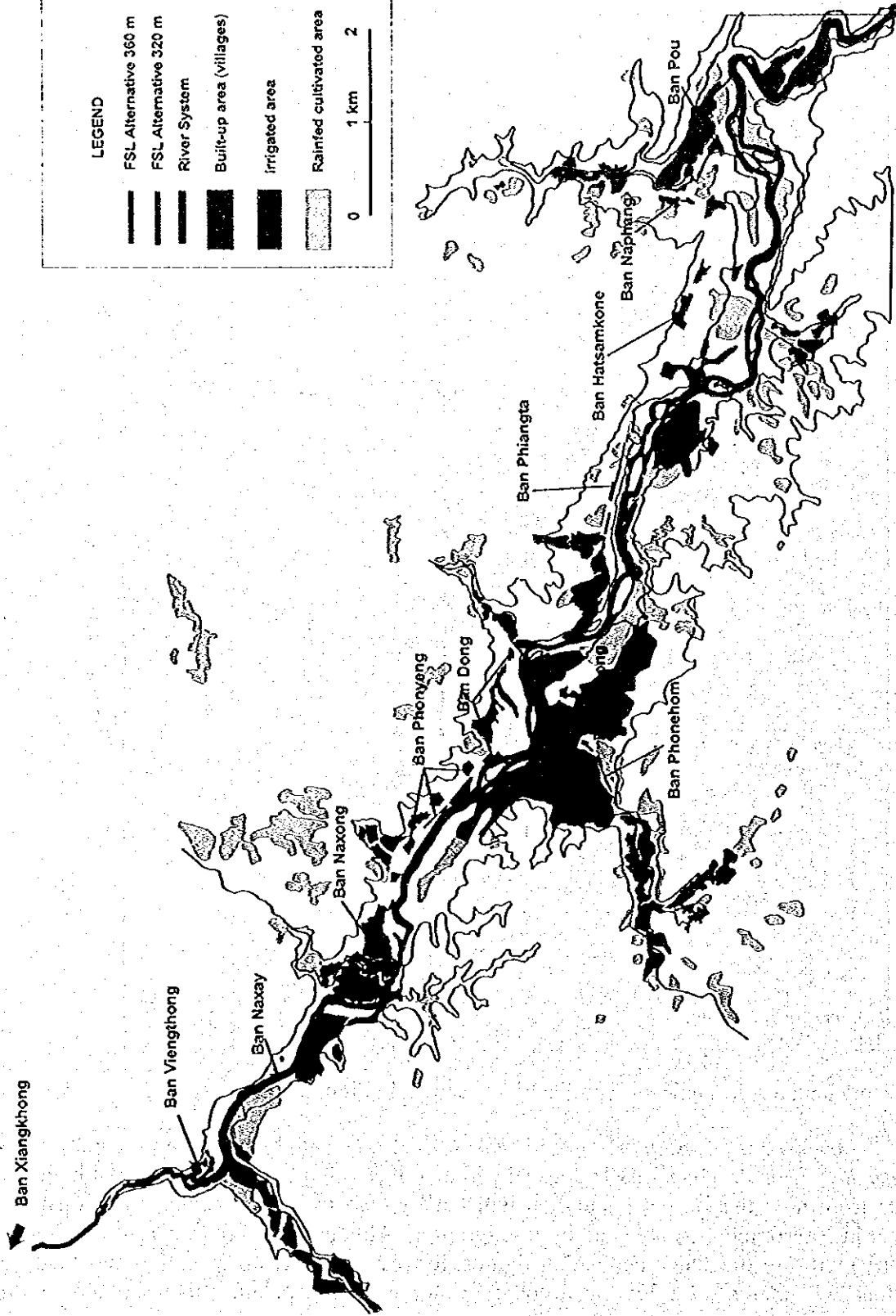
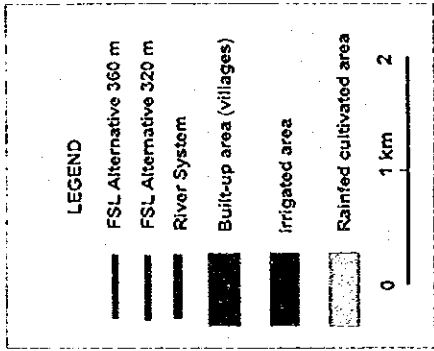
**VILLAGES OF THE DOWNSTREAM AREA**

Table 7.6.1 Numbers of Households and Population in Reservoir Area and Downstream of Dam

Reservoir Area				
Upper Reservoir:		Households	Population	EL.(m)
1.	B. Phonhom	67	375	368
2.	B. Namlong	17	107	364
3.	B. Xiangkhong	39	247	362
4.	B. Nakang	25	132	355
5.	B. Nahong	75	446	342
6.	B. Viengthong	46	273	339
7.	B. Naxay	22	125	332
8.	B. Naxong	81	522	330
9.	B. Phonyeng	63	349	328
10.	B. Dong	82	509	327
11.	B. Hatsamkhone	27	174	326
12.	B. Phiangta	49	322	323
13.	B. Pou	66	416	319
<b>Upper Reservoir Sub-Total:</b>		<b>659</b>	<b>3,997</b>	<b>-</b>
Lower Reservoir:		Households	Population	EL.(m)
1.	B. Houaypamon	18	127	275
2.	B. Namyouk	86	540	271
3.	B. Soppouh	23	132	261
4.	B. Sopyouk	67	408	245
<b>Lower Reservoir Sub-Total:</b>		<b>194</b>	<b>1,207</b>	<b>-</b>
<b>Total of Reservoir:</b>		<b>853</b>	<b>5,204</b>	<b>-</b>
Downstream of Dam				
Bolikhhan District		Households	Population	EL.(m)
1.	Hat Kham	88	533	-
2.	Tahua	55	252	-
3.	Somseum	185	1,136	-
4.	Nam Pa	71	427	-
5.	Houay Koun	281	1,632	-
<b>Bolikhhan District Sub Total :</b>		<b>680</b>	<b>3,980</b>	<b>-</b>
Pakxan District		Households	Population	EL.(m)
1.	Nong - Deng	19	112	-
2.	Thong - Noi	50	329	-
3.	Thong - Gnai	62	340	-
4.	Song Khon	42	239	-
5.	Phonsi	48	276	-
6.	Thakokkhen	58	349	-
7.	Nam Tek	39	203	-
8.	Nam Ngiep	67	331	-
9.	Sen - Oudom	67	314	-
10.	Komsipchet (Military Village)	147	363	-
<b>Pakxan District Sub Total :</b>		<b>599</b>	<b>2,856</b>	<b>-</b>
<b>Total of Dam D/S</b>		<b>1,279</b>	<b>6,836</b>	<b>-</b>

The existing land use in Thaviang Sub-District is shown in Figure 7.6.5.

Besides the backwater effect, *population increase* will also need to be taken into account. Since the *Upper Reservoir Area* is a FARD, located within a river valley and along a national highway, 10 years from now the current population will have grown by natural increase (nationally at 2.6% and in Xaysomboon at 3%) and by in-migration. Although this Preliminary Resettlement Plan (PRP) will use the above population figures, for planning sake all quantities and financial evaluations will increase by 30% to account for the natural population increase and for in-migration over a 10 year period ending in 2010.

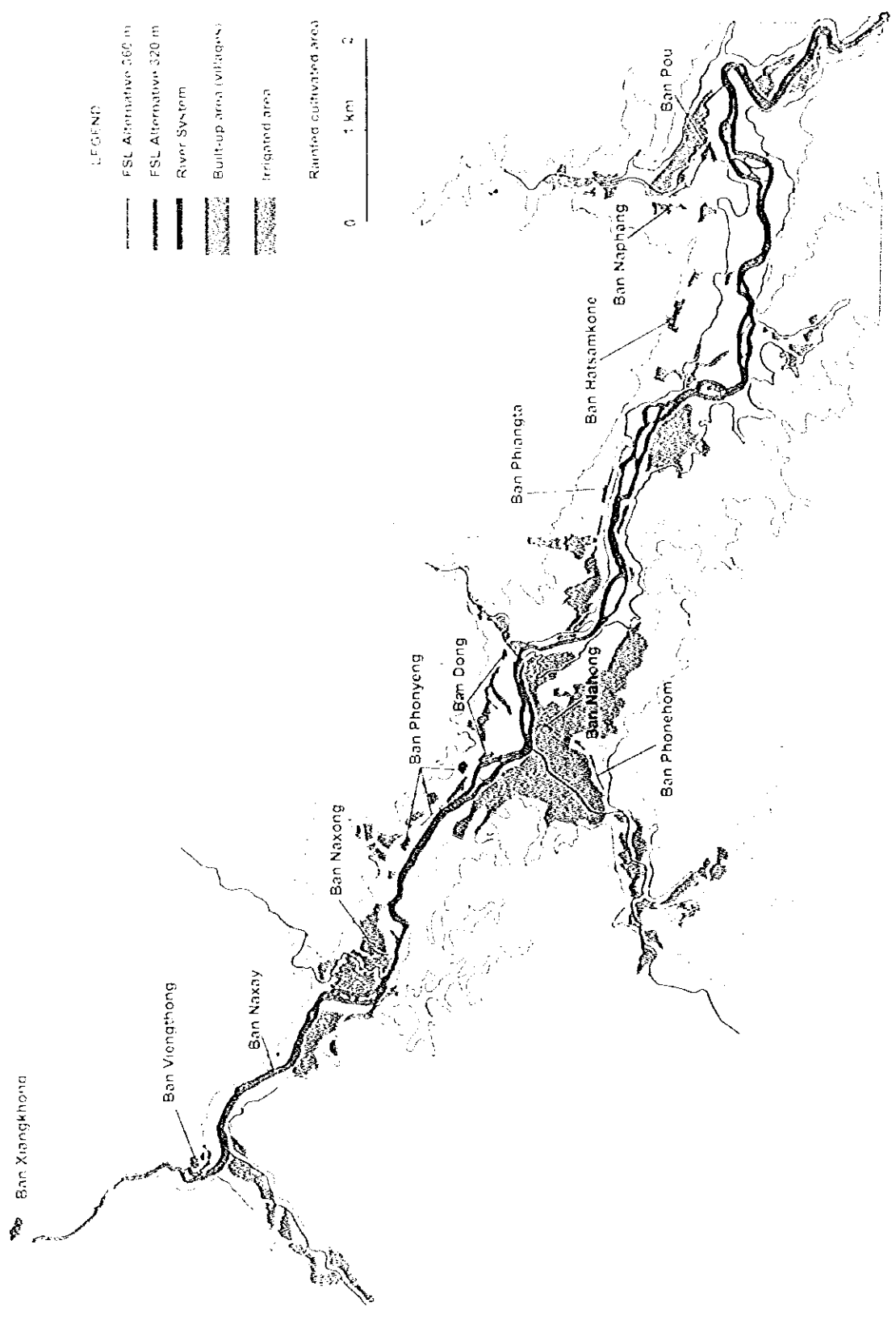


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Figure 7.6.5

Land Use in The Thaviang Area





According to the socioeconomic survey, some 53% of households in the Reservoir Area have been there for less than 5 years. For the Upper Reservoir this figure is nearly 60% and for the Lower Reservoir almost 40%. Similarly, some 42% of households reported that they had been 'officially resettled' in the Reservoir Area, 43% in the Upper Reservoir and 41% in the Lower Reservoir. The Reservoir Area households surveyed have come from 23 different districts in the 7 northern Provinces of (i)Xieng Khouang, (ii)Xaysomboon, (iii)Houaphanh, (iv)Bolikhamsay, (v)Vientiane, (vi)Luang Namtha, and (vii)Luang Prahbhangh.

Most village households in the Upper Reservoir surveyed came from Kham District, Xieng Khouang Province. Thathom District itself, which is the district where the Upper Reservoir is located, accounts for the second largest number of households after Kham District. In contrast to the Upper Reservoir, most of the Lower Reservoir households surveyed, virtually all *Lao Soung*, came from Hom District of Xaysomboon, the district in which they now live.

### 7.6.3 DEVELOPMENT OF DRAFT RAP & FINAL RAP

This document, the Preliminary Resettlement Plan (PRP) is prepared without the final design of the NNHP having been decided. Once the dam height is arrived at, a full Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) will be required by internationally accepted guidelines, as well as preparation of a full Resettlement Action Plan (RAP) and a Social Action Plan (SAP) for mitigating other social impacts. During preparation of a draft RAP, the following studies will take place:

- (i) Socio-Cultural Assessment of Resettlement and Host Communities (Part of SIA)
- (ii) Preparation of a Public Consultation Framework
- (iii) Capacity Assessment of Resettlement Sites
- (iv) Backwater and Sedimentation Modeling
- (v) Archeological Review and Field Survey
- (vi) Technical Resources explored and detailed TOR for development of Livelihood Packages prepared

Upon completion of the draft RAP, the F/S should also come to an end, and Project Preparation, including Detailed Project Engineering Design and a final RAP, should coincide with the process of securing finance and international guarantees for the Project.

During the Project's Detailed Engineering Design Phase, following the F/S, a number of studies and program design activities should be carried out to finalize the RAP as shown in Table 7.6.2. These will include, but not necessarily be limited to:

- (i) Detailed Design of Livelihood Packages
- (ii) Detailed Census of Population and Inundation Loss of Assets and Natural Resources, including detailed Land Tenure Survey
- (iii) New Village Design, including access roads, electricity, water, infrastructure, housing and community layout of resettlers' choice, and other features determined through community consultation

Table 7.6.2 Preliminary Construction and Resettlement Task Schedule

YEAR	Feasibility & Final EIA/SIA		Detailed Design + Funding (2-3 Years)			Construction (5 Years)			Filling	
	1	2	3	4	5	6	7	8	9	10
Wet Season										
Beginning of Phase Two Feasibility Study										
Environmental Impact Assessment (EIA)										
Social Impact Assessment (SIA)										
Preparation of Draft RAP										
Preparation of Public Consultation Program										
Preparation TORs for Livelihood Programs										
1 <sup>st</sup> Capacity Assessment Resettlement Sites										
Backwater & Sedimentation Modelling										
Archaeological Review & Field Survey										
End Phase Two Feasibility Study										
Beginning of Project Preparation										
Setting Up Financing Arrangements										
Detailed Technical Design										
Preparation of Final RAP										
Community Consultation Program										
Agricultural Development Program Design Phase										
Aquaculture Development Program Design Phase										
Forest Management Program Design Phase										
Livestock Improvement Program Design Phase										
Dairy Development Program Design Phase										
Horticulture Development Program Design Phase										
Community Development Program Design Phase										
Technical Training Program Design Phase										
Detailed Census of Inundation Losses										
Formal Acceptance of Final RAP										
Formal Agreement to Build Dam										
Construction Start										
Coffer Dam Completion										
Filling to Lower Elevation										
Dam Completion										
Filling to Higher Elevation										
Commercial Operation Date (COD)										
New Village Location and Layout Planning										
Design/Construct New Village Infrastructure										
Commence New Village Construction										
Pre-Relocation Village Activities										
Pilot Village Establishment										
M&C Care, Vulnerable & Elderly Health Program										
Livestock Health & Relocation Program										
Relocation of Villages - Lower Elevation										
Relocation of Villages - Higher Elevation										
Land Clearing and Fencing										
Village Road Construction										
Village Site Preparation										
Farm/Home Plot Development										
House Construction										
Village Water Supply System										
Rice Land Development										
Irrigation System										
Village Electricity System										
Community Buildings										
Health Program Implementation										
Forest Management Implementation										
Community Development Program Implementation										
Livestock Improvement Program Implementation										
Technical Training Program Implementation										
Livestock Improvement Program Implementation										
Dairy Development Program Implementation										
Horticulture Development Program Implementation										
Aquaculture Development Program Implementation										
Agricultural Development Program Implementation										
Post-Relocation Village Activities										
Resettlement Monitoring Program										
Health Program Implementation										
Aquaculture Development Implementation										
Agricultural Development Implementation										
Resettlement Management Unit										
Monitoring and Evaluation										

II. After Dam Completion

YEAR	Filling		Operation	
	10	Years 1-5	Years 1-5	Years 6-50
Wet Season				
Dam Completion				
Filling to Higher Elevation				
Commercial Operation Date (COD)				
New Village Location and Layout Planning				
Design/Construct New Village Infrastructure				
Commence New Village Construction				
Pre-Relocation Village Activities				
Pilot Village Establishment				
Relocation of Villages - Lower Elevation				
Relocation of Villages - Higher Elevation				
Land Clearing and Fencing				
Village Road Construction				
Village Site Preparation				
Farm/Home Plot Development				
House Construction				
Village Water Supply System				
Rice Land Development				
Irrigation System				
Village Electricity System				
Community Buildings				
Forest Management Program Implementation				
Livestock Improvement Program Implementation				
Community Development Program Implementation				
Fisheries Development Program Implementation				
Agricultural Development Program Implementation				
Dairy Development Program Implementation				
Horticulture Development Program Implementation				
Post-Relocation Village Activities				
Resettlement Monitoring Program				
Health Program Implementation				
Aquaculture Development Implementation				
Agricultural Development Implementation				
Resettlement Management Unit				
Monitoring and Evaluation				



- (iv) Unexploded Ordinance (UXO) Reconnaissance and, as Necessary, Clearance of Resettlement Sites
- (v) Livestock Transport And Health Program Design
- (vi) Pre Resettlement Health Program Design, with focus on maternal and child health, elderly, handicapped and otherwise vulnerable persons
- (vii) AIDS/HIV Awareness And Prevention Program, with focus on construction sites and surrounding areas
- (viii) Estimate of land and population affected by Transmission Line(s) and Access Roads and formulation of compensation plan for affected persons.
- (ix) Environmental Impact Assessment (EIA) of RAP

Other studies and program design activities, with TORs and costs will be determined during preparation of a Social Action Plan (SAP) and Watershed Management *cum* Regional Development Plan.

Some very rough figures for the preparatory RAP studies might be approximately US\$1,100,000 for FSL.360m alternative and about US\$600,000 for FSL.320m alternative as shown in Table 7.6.3, not including costs for studies included under the EIA.

Table 7.6.3 Cost Estimate of Preparatory PRP Studies

STUDIES FOR DRAFT RAP	Responsible Organization	Executing Organization	Duration of Activity (Years)	Unit Cost (US\$) per Year (360 m)	Total Cost of Period (US\$) FSL.360 m	Total Cost of Period (US\$) FSL.320 m
Preparation of Draft RAP	JICA/HPO	Consulting	2	\$60,000	\$120,000	\$60,000
Study on Floating Net Aquaculture/Fisheries Intensification	JICA/HPO	Consulting	1	Incl.EIA	Incl.EIA [A3]	Incl.EIA [A3]
EIA for Resettlement Sites	JICA/HPO	JICA/HPO	1	Incl.EIA	Incl.EIA [A17]	Incl.EIA [A17]
Archeological Review & Field Survey	JICA/HPO	Archeological Department	1/4 <sup>th</sup>	\$20,000	\$5,000	\$5,000
Detailed (Participatory) Design of Floating Net Aquaculture Livelihood Program	JICA/HPO	Consulting	2	\$60,000	\$120,000	\$60,000
Agricultural Development Program Design Phase	JICA/HPO	Consulting	2	\$60,000	\$120,000	\$60,000
Forest Management Program Design Phase	JICA/HPO	Consulting	2	\$60,000	\$120,000	\$60,000
Livestock Improv. Program Design Phase	JICA/HPO	Consulting	2	\$60,000	\$120,000	\$60,000
Dairy Develop. Program Design Phase	JICA/HPO	Consulting	2	\$60,000	\$120,000	\$60,000
Horticulture Develop. Program Design Phase	JICA/HPO	Consulting	2	\$60,000	\$120,000	\$60,000
Technical Training Program Design Phase	JICA/HPO	Consulting	2	\$60,000	\$120,000	\$60,000
Detailed Census of Inundation Losses	JICA/HPO	Consulting	1	\$60,000	\$60,000	\$30,000
Preparation of Public Consultation Program	JICA/HPO	Consulting	1	\$60,000	\$60,000	\$30,000
Capacity Assessment Resettlement Sites	JICA/HPO	Consulting	1	\$60,000	Incl.EIA[A10]	Incl.EIA [A10]
Backwater & Sedimentation Modeling	JICA/HPO	Consulting	1	\$100,000	Incl.EIA[A6]	Incl. EIA [A6]
<b>Total [Rounded Upwards]</b>					<b>\$1,100,000</b>	<b>\$600,000</b>