

Asian Development Bank

SUMMARY ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

NAM THEUN 2 HYDROELECTRIC PROJECT

IN

LAO PEOPLE'S DEMOCRATIC REPUBLIC

November 2004

CURRENCY EQUIVALENTS

(as of 30 October 2004)

US\$ 1 = Kip 10,835

ABBREVIATIONS

ADB	–	Asian Development Bank
AFD	–	Agence Française de Développement
BOOT	–	build-own-operate transfer
CIA	–	Cumulative Impact Assessment
COD	–	commercial operating date
DRWG	–	District Resettlement (or Compensation) Working Group
EAMP	–	Environmental Assessment and Management Plan
EDFI	–	Electricité de France International
EDL	–	Electricité du Laos
EGAT	–	Electricity Generating Authority of Thailand
EGCO	–	Electricity Generating Public Company Limited
EIA	–	Environmental Impact Assessment
EI	–	Elevation above sea level in meters
EMDP	–	Ethnic Minorities Development Plan
EMO	–	Environmental Management Office (GOL)
EMU	–	Environmental Management Unit (NTPC)
GDP	–	gross domestic product
GOL	–	Government of Lao PDR
HCC	–	Head Construction Contract
HCCEM	–	Head Construction Contractor's Environmental Management and Monitoring Plan
MP		
HIV/AIDS	–	Human Immunodeficiency Virus/Acute Immunodeficiency Syndrome
HNN		Hin Nam Nor
IPP	–	Independent Power Project/Producer
ITD	–	Italian-Thai Development Public Company Limited
IUCN	–	International Union for the Conservation of Nature
Lao PDR	–	Lao People's Democratic Republic
LDC	–	least developed country
LWU	–	Lao Women's Union
MIH	–	Ministry of Industry and Handicrafts
NGO	–	Nongovernment Organization
NNT	–	Nakai Nam Theun-National Protected Area
NPA	–	National Protected Area
NTEC	–	Nam Theun 2 Electricity Consortium
NTFP	–	Non-Timber Forest Product
NTPC	–	Nam Theun 2 Power Company Limited
OD	–	Operational Directive
PAP	–	Project Affected Person
PCD	–	Public Consultation and Disclosure
PCRS	–	Physical Cultural Resources Survey
PDR	–	People's Democratic Republic

PHP		Phou Hin Poun
PIC	–	Public Information Centre
PM	–	Prime Minister
PMO	–	Prime Minister's Office
POE	–	Panel of Experts
RAP	–	Resettlement Action Plan
RC	–	Resettlement Committee
RMO	–	Resettlement Management Office
RMU	–	Resettlement Management Unit
ROR	–	Run of River
ROW	–	Right of Way
SDP	–	Social Development Plan
SEMFOP	–	Social and Environment Management Framework and 1 st Operational Plan
SESIA	–	Summary Environmental and Social Impact Assessment
SMEC	–	Snowy Mountain Engineering Corporation
STD	–	Sexually Transmitted Disease
STEA	–	Science, Technology and Environment Agency
UNDP	–	United Nations Development Programme
VRC	–	Village Resettlement Committee
WB	–	World Bank
WCS	–	Wildlife Conservation Society
WMPA	–	Watershed Management and Protection Authority
XBF	–	Xe Bang Fai

WEIGHTS AND MEASURES

µg	-	microgram
cm	-	centimeter
El	-	elevation above sea level in meters
GWh/y	-	gigawat-hour per year
ha	-	hectare
kg	-	kilogram
km	-	kilometer
Km ²	-	square kilometer
KV	-	kilovolt
L	-	Liter
M	-	meter
m ³	-	cubic meter
m ³ /s	-	cubic meter per second
mg	-	milligram
MW	-	megawatt
°C	-	degree celsius

NOTE

Throughout this report, the Lao words “*Nam*”, “*Xe*” and “*Houay*” are used to mean “river” and “*Ban*” to mean “village”. To avoid repetition, the English word is not repeated after the Lao name, i.e. “Nam Theun” is used rather than “Theun River”

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I. INTRODUCTION

A. Background

1. The potential for hydropower development on the Nam Theun and Nam Kading systems in central Lao People's Democratic Republic (Lao PDR) was first identified by the Mekong Secretariat in the 1970s. These studies identified a series of potential sites for hydropower development on the Nam Theun which were given numbers for reference purposes including the Nam Theun 2 site. In 1991, following initial studies, the Government of Lao PDR (GOL), with support from the World Bank (WB) and the United Nations Development Program (UNDP), commissioned the Snowy Mountain Engineering Corporation (SMEC) to undertake a Feasibility Study for the Nam Theun 2 Hydroelectric Project (the Project). A number of detailed studies were subsequently completed, including the investigation of alternative options and economic evaluations. Since 1994, the Nam Theun 2 Electricity Consortium (NTEC) has been responsible, with support from the Asian Development Bank (ADB), Agence Française de Développement (AFD), WB, and GOL, for development of the Project design. On January 1st 2004, the responsibilities of NTEC to develop the Project were transferred to Nam Theun 2 Power Company Limited (NTPC), which is wholly owned by Electricité de France International (EDFI, 35%), Electricité du Laos (EDL, 25%), Electricity Generating Public Company Limited (EGCO, 25%) and Italian-Thai Development Public Company Limited (ITD, 15%).

2. The Project will dam the Nam Theun, a tributary of the Mekong, generating 1,070MW of electricity for supply to the Electricity Generating Authority of Thailand (EGAT) (93%) and EDL (7%). The Project is forecasted to generate approximately US\$1.9 billion in revenues (in nominal terms) for GOL over the 25-year Project concession period. In so doing, the Project is expected to be one of the largest sources of foreign currency income for GOL over its lifetime, a very important contributor to Lao PDR's Gross Domestic Product, and a significant contributor to GOL fiscal revenues after repayment of the commercial debt. The Project is recognized by GOL as an essential part of the country's development framework to alleviate poverty.

B. Purpose and Scope of this Report

3. This Summary Environmental and Social Impact Assessment (SESIA) presents the baseline conditions, then summarises the key environmental and social impacts of the Project and the approach and methods proposed for their resolution. It draws on the work presented in a series of separate reports submitted to the GOL, ADB, AFD and the WB as shown in *Table A.1* below. These studies have been undertaken to meet the safeguard policies and requirements of the GOL, ADB, AFD and WB and are available on the NTPC's website (www.namtheun2.com). They reflect several additional studies and analyses that have been undertaken to improve the impact assessment and management approaches documented in earlier drafts. They also reflect comments received during stakeholder consultation carried out in the Project area and internationally between May and September 2004.

Table A.1. Documents Used in the Preparation of this SESIA

Document	Version	Purpose
Environmental Assessment and Management Plan (EAMP)	Final Draft, November 2004	Presentation of the baseline condition and assessment of the environmental impacts associated with the Project and development of plans to minimise, mitigate or compensate for these impacts.
Social Development Plan (SDP)	Final Draft, November 2004	Plan to manage social impacts including those related to resettlement, health and downstream impacts in the Xe Bang Fai and to manage special issues related to ethnic minorities.
Social and Environment Management Framework and 1st Operational Plan (SEMFOP)	Final Draft, November 2004.	Plan to manage the Nakai-Nam Theun National Protected Area and its Corridors. Its funding is provided by the Project as a compensation for the environmental impacts related to the Project.
Cumulative Impact Analysis and Nam Theun 2 Contribution	Final Report, November 2004	Environmental and social analysis of combined impacts of a number of development projects in the Mekong basin including effects of other (future) developments on Nam Theun 2 impacts and developments in other sectors that are induced by Nam Theun 2
Lao PDR Hydropower Sector Environmental Assessment	Draft Final Report, August 2004	Assessment of combined impacts of 21 hydropower projects planned for implementation in Lao PDR before 2020 with recommendations on the management of environmental and social impacts within the sector.
Environmental and Social Cost/Benefit Analysis	Draft Final Report, June 2004	Provides estimates of the environmental and social costs and benefits of the Project for those impacts that can be valued. Final results are being used for the overall Project economic analysis

C. Scope of Environmental and Social Studies for the Project

4. The environmental and social studies carried out to date address different needs. Environmental issues are discussed in the EAMP; issues related to the compensation for project-related environmental impacts provided through the management of the Nakai-Nam Theun National Protected Area¹ (NNT NPA) are dealt with in the SEMFOP; while social aspects including resettlement and Ethnic Minorities issues are addressed in the SDP. The SDP itself has a number of subcomponents as follows:

- (i) Final Draft Resettlement Action Plan (RAP) and Ethnic Minorities Development Plan (EMDP) for the Nakai Plateau / reservoir resettlement area;
- (ii) Final Draft Compensation Framework and EMDP for areas affected along the Xe Bang Fai; and
- (iii) Project Lands Resettlement Plan and Compensation Framework.

5. These studies have involved extensive surveys of the existing environmental and social conditions in the Project area followed by subsequent identification and assessment of potential environmental and social impacts. Mitigation and compensation measures have then been

¹ National Biodiversity Conservation Area (NBCA) and National Protected Area (NPA) have the same meaning and are transposable in Lao PDR.

developed where impacts cannot be avoided. Monitoring actions have also been identified to be undertaken during project implementation.

6. The EAMP, SEMFOP and SDP consider the construction and operation of the Project and to a lesser extent, its decommissioning.¹ Their geographical scope covers an area of approximately 6,700km² including some 4,025km of river. Only a portion of this area (approximately 1,306km²) is however likely to be impacted by the Project. In addition to this impacted area, approximately 3,950km² covering the Nakai-Nam Theun National Protected Area (NNT NPA) and its adjoining Corridors will be supported by the Project through implementation of the SEMFOP. While the project has minimal adverse impacts on this area, it is considered part of the Project because its conservation under the SEMFOP will be used as compensation for a portion of the environmental impacts related to the Project. Recognizing that such projects can have impacts beyond this immediate study area particularly when combined with impacts of other development projects, a Cumulative Impact Assessment (CIA) and a Sectoral Environmental Assessment have been completed. The CIA considers the Project in the context of development projects in the hydropower and other sectors across the whole Mekong Basin and over a 20 year time frame. The Sectoral Environmental Assessment examines the potential combined social and environmental impacts of 21 hydropower projects planned for implementation before 2020 in Lao PDR. Their findings are summarised here in Section VII.

7. While the environmental and social studies undertaken to date identify potential impacts, some of these impacts, particularly during construction, have only undergone preliminary assessment within the current studies. This is because the location and specifications of a number of construction elements (e.g. exact location of construction worker camps, location of quarries and spoil disposal sites etc) will only be developed during detailed design of the Project. Studies on these issues have so far been limited to identifying major areas of consideration. Under contractual obligation, the Head Construction Contractor (Electricité de France) is preparing and must fully implement a Head Construction Contractor's Environmental Monitoring and Management Plan including specific management plans such as a Waste Management Plan, Project Staff Health Management Plan, etc (a full list of these plans is given in Appendix 1).

II. DESCRIPTION OF THE PROJECT

A. Description of Project Scope

8. The Project plans to dam the Nam Theun near Ban Sop Hia, Khammouane Province, impounding some 195km of the river and creating the Nakai Reservoir on the Nakai Plateau. The reservoir will have a surface area of approximately 450km² at full supply level and a total storage capacity of 3,910 million m³. Water from the reservoir will drop about 350m through a tunnel to a Power Station located at the base of the Nakai escarpment taking advantage of the difference in elevations between the Nakai Plateau and the Gnommalat plain. From the Power Station, water will then flow into a Regulating Pond and then via a 27km Downstream Channel into the Xe Bang Fai. The Project will therefore transfer an average annual flow of 220m³/s from the Nam Theun into the Xe Bang Fai. Water from the Power Station will also be released into the Nam Kathang below the Regulating Dam at a rate equivalent to current natural inflows.

9. The Power Station will have a generating capacity of 1,080MW (net 1,070MW); 995MW of which will be delivered to EGAT for use in Thailand via a 138km-long 500kV double circuit

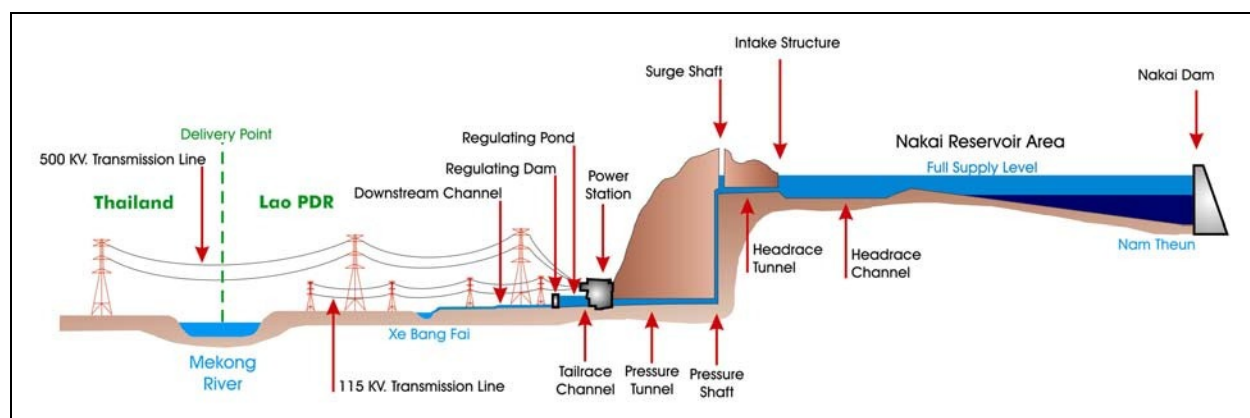
¹ It is noted that decommissioning such a major infrastructure development would entail nearly as much planning as the original construction works.

transmission line. EDL will receive 75MW for use in Lao PDR via a 70km-long, 115kV transmission line to Thakhek, although approximately 20MW of this can be directed via existing and Project-built 22kV transmission lines to the local area including the resettlement sites. The total estimated cost of the Project is US\$1.3 billion (including a US\$0.1 billion contingency).

10. The main Project components, illustrated in Figure B.1 are as follows:

- (i) A 48m high dam on the Nam Theun, and 13 saddle dams to create the Nakai Reservoir;
- (ii) 4.25km Headrace Channel and Intake Structure on the Nakai Plateau approximately 35km southeast of the Nakai Dam to divert water from the Nakai Reservoir to the Power Station;
- (iii) A Power Station with 6 electricity generating units and accompanying administration, operating and control rooms;
- (iv) A Regulating Pond (to control downstream flows) and a 27km long, excavated channel to direct the diverted flows from the Power Station into the main channel of the Xe Bang Fai near the town of Mahaxai;
- (v) 500kV, 115kV and 22kV transmission lines to interconnect the Power Station switchyards with the EGAT and EDL power transmission systems; and
- (vi) Ancillary works such as access roads, bridges and residences to enable construction, operation and maintenance of the Project and to meet other obligations of NTPC.

Figure B.1. Nam Theun 2 Project Components



Source: Final Draft EAMP, November 2004

11. The Project area with key Project features is shown in Figure B.2. Construction activities will also require road construction and upgrading, sourcing of limestone for aggregate production, disposal of spoil and establishment of construction camps. Possible locations for these are illustrated in Figures 1 to 3 of Appendix 5.

B. Project Location

12. The main area to be affected by the Project is the Nakai Plateau. The Project will also impact areas between the Plateau and the Mekong River, along the Xe Bang Fai and Nam Theun and along the alignment of Transmission Lines. Figure B.3 divides the Project area into 15 zones whose characteristics are then summarised in Table B.1.

Figure B.2. Principle Project Features

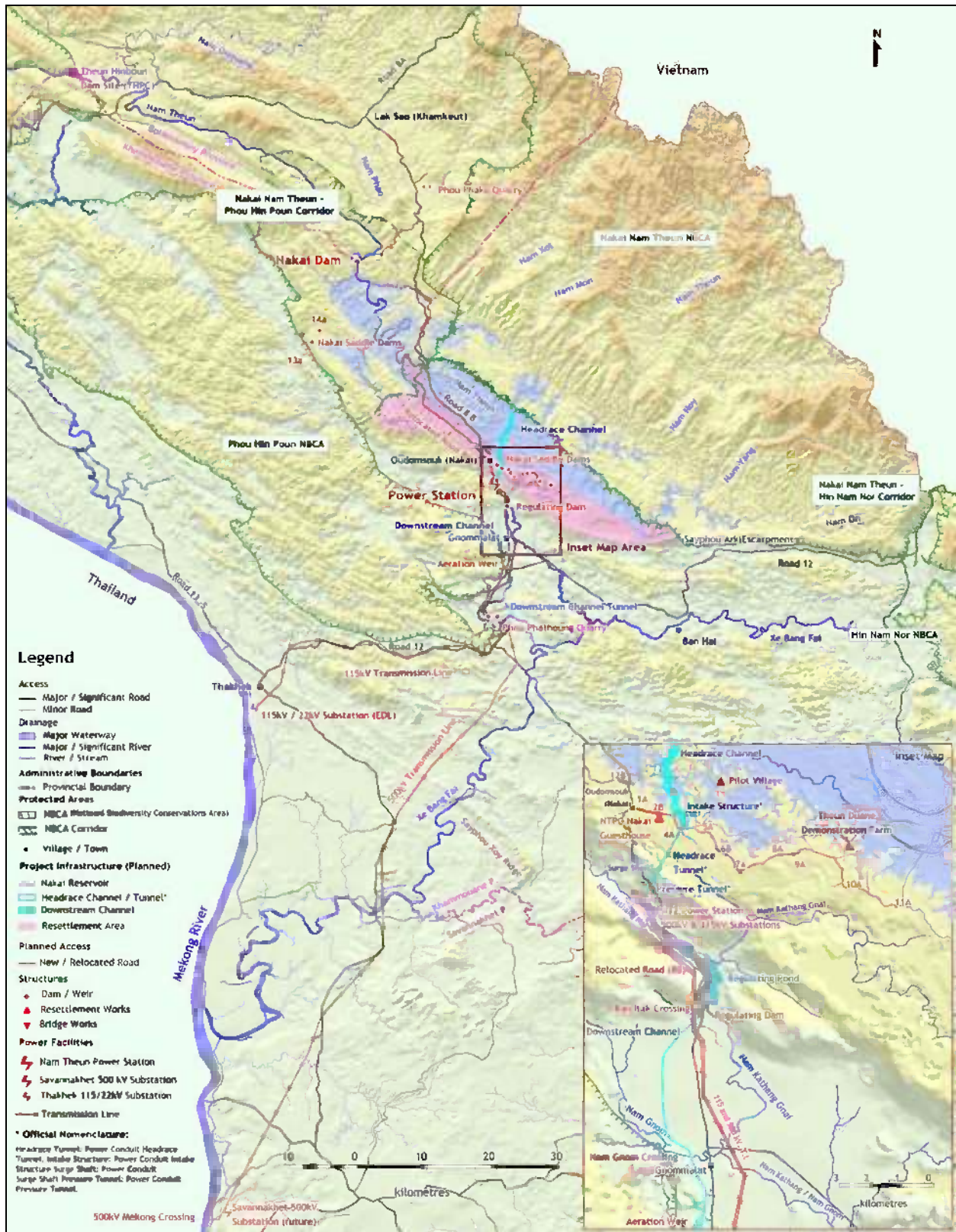


Figure B.3. Study Areas

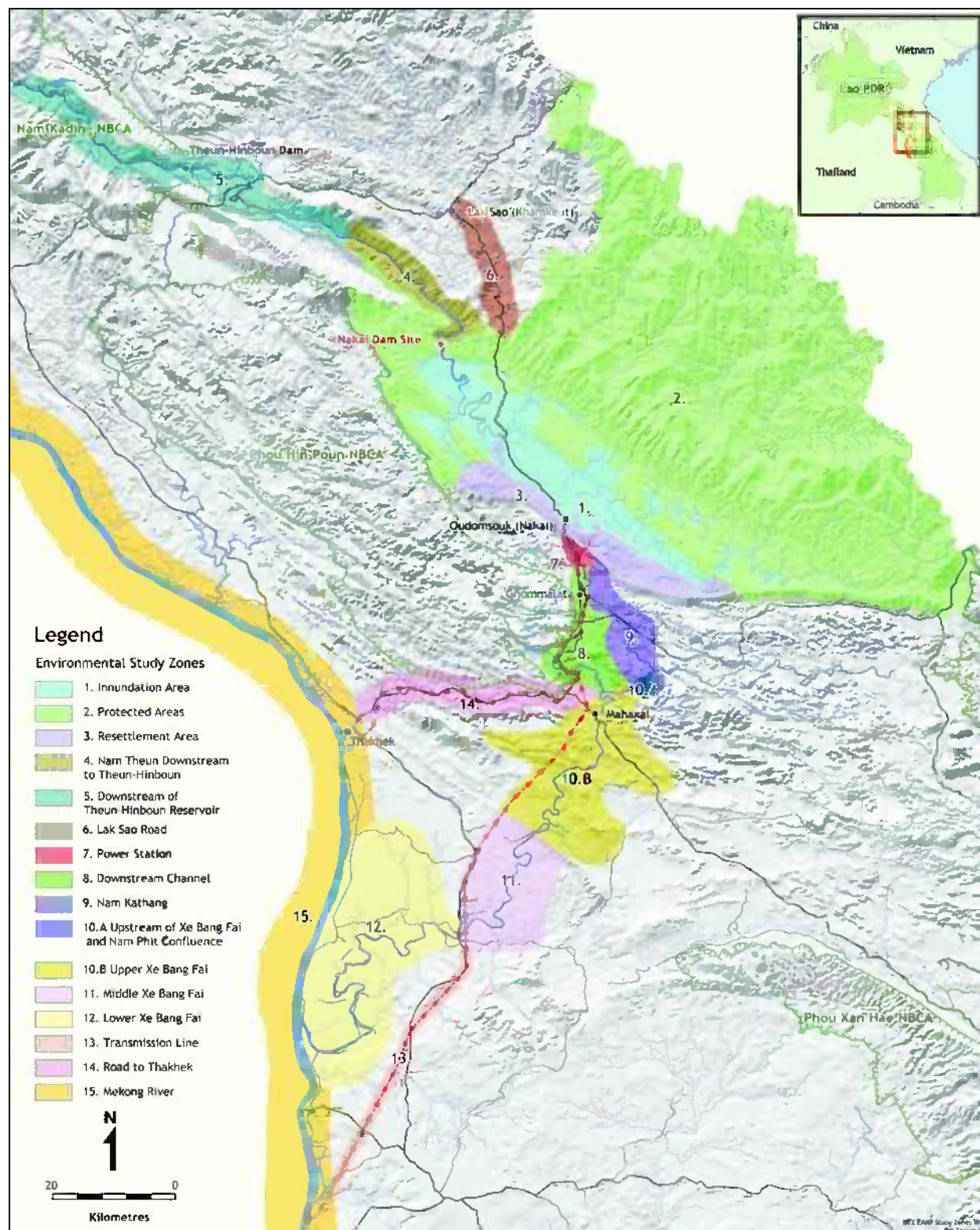


Table B.1. Summary of Characteristics of Study Zones (referenced in Figure B.3.)

Zone	Area	Overview of key characteristics	Key issues
1	Inundation Area	<ul style="list-style-type: none"> Area below 538m on the Nakai Plateau to be inundated by the Reservoir (Approximately 450km² at full supply level (538m) and 108km² at minimum operating level (525.5m) 	<ul style="list-style-type: none"> Impacts primarily attributable to impoundment of river creating the reservoir, including inundation of land, water quality, plants and animals and human settlements. Construction activities will also affect this area.
2	Protected Areas	<ul style="list-style-type: none"> Includes NNT NPA (area 3,500km²) and 2 corridor areas (approx. 770km²) that connect the NNT NPA with the Phou Hin Poun NPA to the west and the NNT NPA with the Hin Nam No NPA to the south 	<ul style="list-style-type: none"> Poor land use practices in NNT NPA (forms 88% of the Nam Theun catchment for the Nakai Reservoir) would result in increased sedimentation shortening the life of the reservoir. Management of the NNT NPA is to focus on conservation of internationally recognized biodiversity and recognition of customary rights of ethnic minorities together with support for livelihood activities.
3	Resettlement Area	<ul style="list-style-type: none"> 208km² area along southern rim of Nakai Reservoir selected for resettlement following consultation with affected households Vegetated with mixed broadleaf and coniferous forest, dry evergreen forest, unstocked forest and agricultural areas Existing population in resettlement area primarily in villages of Nakai Tai and Nakai Neua. District headquarters, Ban Oudomsouk is also located in this area. Currently approx. 520 households in this area some of which will lose land / crops to inundation 	<ul style="list-style-type: none"> Efficient implementation of resettlement and development programme Carrying capacity of land and optimum sustained use of land Movement of wild elephants through the zone and potential for human-elephant conflict Construction activities (including a construction camp) will affect host population
4	Nam Theun downstream to Theun Hinboun Reservoir	<ul style="list-style-type: none"> Riparian land along Nam Theun from Nakai Dam to start of Theun Hinboun reservoir approx. 32km downstream Much of zone is included in the NNT-Phou Hin Poun Corridor Nam Phao discharges into Nam Theun approx 11.7km downstream of the Nakai Dam No established villages or permanent settlements in the zone, however some use of the river by villages for fishing 	<ul style="list-style-type: none"> Effects on riparian habitats, riparian releases from Nakai Dam and the plants and animals that inhabit the area Amount of riparian release will influence fish populations in the Nam Theun and the fisheries of nearby villages
5	Downstream of Theun Hinboun Reservoir	<ul style="list-style-type: none"> Includes Theun Hinboun Reservoir and a riparian area along the Nam Kading that potentially stretches to the Mekong 	<ul style="list-style-type: none"> Discharge to the Nam Kading will be limited to a minimum riparian release from the Theun Hinboun reservoir to the Nam Mouan at a distance of approximately 36km below the Theun Hinboun Dam
6	Lak Sao Road	<ul style="list-style-type: none"> Includes Road 8b south of Ban Lak Sao to approximately the intersection of Road 8b and the border of zone 2. Includes quarry to be opened at Pha Phen (Phou Phako) to provide aggregate for construction 	<ul style="list-style-type: none"> Issues are associated with construction including noise, air pollution, and water-related issues such as run-off and drainage Construction of a workforce camp will create issues related to waste disposal, health impacts, resource

Zone	Area	Overview of key characteristics	Key issues
			use and cultural issues
7	Power Station	<ul style="list-style-type: none"> Small area immediately surrounding the Power Station There are no residents in this area although there are some gardens 	<ul style="list-style-type: none"> Issues are associated with construction and operation of Power Station Also water quality, quantity, diversion of flow into surrounding rivers and rerouting of the natural stream drainage
8	Downstream Channel	<ul style="list-style-type: none"> Includes 27km length of the Downstream Channel from the Regulating Dam to the Xe Bang Fai confluence Includes adjacent areas that will be modified as part of construction of the Downstream Channel 	<ul style="list-style-type: none"> Downstream Channel (DC) will impact rice paddies and will require modification of the Nam Phit channel Also location of spoil disposal sites, placement of embankments, bridges along the DC and the elimination of some wetland areas at the lower end of the DC Approx. 200 households who either use or occupy land on the DC alignment will be affected
9	Nam Kathang	<ul style="list-style-type: none"> Covers Nam Kathang and riparian land from the Regulating Pond to its confluence with the Xe Bang Fai Includes approx 1,632 households within 23 villages 	<ul style="list-style-type: none"> Zone will not be affected by any increase in discharge Environmental issues include the quality of water released from the Regulating Dam.
10	Upper Xe Bang Fai	<ul style="list-style-type: none"> Zone extends from the confluence of the Downstream Channel (Nam Phit) and the Xe Bang Fai to the Sayphou Xoy Ridge about 25km downstream of Mahaxai 12 villages are located along the river reach 	<ul style="list-style-type: none"> Primary issues related to increase in discharge in Xe Bang Fai, changes in discharge regime, erosion of river banks, changes in water quality, effect on land use along river bank, effects on fisheries and restrictions on crossing the river
11	Middle Xe Bang Fai	<ul style="list-style-type: none"> Area between Sayphou Xoy Ridge and Road 13 crossing; includes 5 mainstream villages and 7 backwater villages (on the Xe Noy, a tributary of the Xe Bang Fai) 	<ul style="list-style-type: none"> Will experience increase in dry season discharge that may facilitate navigation and improve irrigation potential Some villages have initiated dry season irrigation; this may improve with additional water in the Xe Bang Fai Other issues in this zone are similar to Zone 10 (Upper Xe Bang Fai) but severity of impact expected to be less due to distance from Downstream Channel and larger size of channel
12	Lower Xe Bang Fai	<ul style="list-style-type: none"> Covers approx. 500km² from its confluence with the Mekong up to the Road 13 crossing; includes approx. 70km of river Area is fairly densely populated with some 53 villages and approx. 400km² of rice paddy fields; it is a major area of rice production for Khammouane Province Zone experiences natural flooding almost every year and is hydraulically controlled by the Mekong. 	<ul style="list-style-type: none"> Area will experience higher dry season flows facilitating increased dry-season irrigation
13	Transmission Lines	<ul style="list-style-type: none"> Zone extends from bridge over Xe Bang Fai on Road 13 to Savannakhet along the route of the transmission line 	<ul style="list-style-type: none"> Primary issues are social including land acquisition and compensation for loss of assets

Zone	Area	Overview of key characteristics	Key issues
		that will deliver electricity to Thailand	<ul style="list-style-type: none"> Also some loss of forest
14	Road to Thakhek	<ul style="list-style-type: none"> Consists of area along the road between Mahaxai and Thakhek along which 115kV Transmission line passes 	<ul style="list-style-type: none"> Habitat loss and human occupancy issues
15	Mekong River	<ul style="list-style-type: none"> EAMP and SDP consider the Mekong between its confluences with the Nam Kading and Xe Bang Fai, plus consideration of the 500kV Transmission Line crossing immediately north of Savannakhet. The CIA looks at the wider impacts along the Mekong downstream of Savannakhet 	<ul style="list-style-type: none"> Flood stage levels of the Mekong are key issue for EAMP and SDP. Also migration of fish through the area, navigation and flooding.

Source: Final Draft EAMP, November 2004.

C. Project Construction and Operation

13. Construction of the project is estimated to take 54 months (including commissioning). A single HCC, EDF, will be responsible for overseeing all construction contracts. Current plans are for the project to begin delivery of electricity to EGAT and EDL in December 2009.

14. Construction of the Project is expected to employ approximately 4000 workers. Four potential zones have been identified for the development of construction work camps; at the Nakai Dam site (~800 workers), at Ban Oudomsouk on the Nakai Plateau (~800 workers), at the Power Station (~2200 workers) and downstream of the Power Station, between Ban Gnommalat and Mahaxai (~400 workers). Operation and maintenance of the Project is estimated to employ 150 staff. An operator's village will be constructed near the Regulating Dam to accommodate these employees.

D. Project Owners and Developers

15. The Project is to be developed on a build-own-operate-transfer (BOOT) basis by NTPC. NTPC will be responsible for designing, constructing and operating the Project for the Concession Period of 25 years from Commercial Operating Date (COD), after which it will be transferred to GOL for continued operation and maintenance.

E. Policy Context and Project Rationale

16. Lao PDR is currently recognized as a least developed country (LDC) and relies heavily on external aid. Almost half of its 5.4 million people live in poverty.¹ The country has few options to secure sustainable environmentally and socially sound development and the government has recognized hydropower as being a key element in achieving the macro-economic foundation from which poverty will be tackled (within its economic development strategies and its National Growth and Poverty Eradication Programme). Other key revenue generating options for Lao PDR are tourism (which continues to grow), mining (which has been initiated in several locations and whose potential is still under investigation) and timber harvesting (which historically has not been sustainable). GOL and EGAT entered into a

¹ As determined by the National Statistics Centre (State Planning Committee) in the Lao Expenditure and Consumption Survey of 1997-98. This survey and the updated national poverty line will be published soon and incorporated into final versions of this SESIA and other Project safeguard documentation.

Memorandum of Understanding in 1996 for the development and supply of up to 3000MW of electricity from Lao PDR to Thailand. This has subsequently been increased to 3,300MW.

17. The Project is expected to generate around US\$1.9 billion in revenues (in nominal terms) for the GOL over the 25 year Project concession period. This is based on agreements signed for the purchase of the electricity between NTPC and EGAT. In this respect, it will be a very important contributor to Lao PDR's GDP as discussed in Section I. A.1. GOL intends to use its share of revenues to develop programmes that will contribute to the alleviation of poverty through the promotion of economic and social development. Additionally, NTPC has committed to providing US\$31.5 million (US\$6.5 million before commercial operations and US\$1 million for each year of the concession period) to finance the management and protection of the NNT NPA under the framework provided in the SEMFOP. This and other direct and indirect benefits of the Project are described in more detail in Section V.

III. DESCRIPTION OF THE PHYSICAL, BIOLOGICAL AND SOCIAL ENVIRONMENTS

A. Physical Environment

18. The Project area, illustrated in Figure B.2, covers two river systems in central Lao PDR; the Nam Theun and the Xe Bang Fai; and extends from the lowlands along the Mekong River to the rugged Annamite Mountain Range along the Lao-Vietnamese border. Midway between the Mekong and the Lao-Vietnamese border lies the Nakai Plateau, located approximately 350m above the adjacent plain to its south and southwest. The Power Station is located at the base of the escarpment beneath the Nakai Plateau, whilst the proposed dam is located at the northwestern edge of the Nakai Plateau.

19. The Nam Theun itself originates at an elevation of 2,286m in the Annamite Mountains and is joined by 3 tributaries on the Nakai Plateau (Nam On, Nam Noy and Nam Xot). Together these form the Project watershed which is protected under the NNT NPA. The watershed is characterized by mountainous, mainly forested terrain and is remote and sparsely populated. The Plateau itself, lies at an elevation of 520-550m. Sandstone peaks of elevation 1,100-1,300m form its northeastern margin whilst to the southwest, it is surrounded by a sandstone lip at elevation 600-700m. The Nam Theun meanders across the relatively flat Nakai Plateau. Downstream of the proposed dam, it cuts through heavily forested hills where additional tributaries join (e.g. Nam Phao) before reaching the headpond of the Theun-Hinboun Hydroelectric Project and then the Mekong approximately 96km further downstream.

20. The Project will transfer water from the Nam Theun into the Xe Bang Fai; the water entering the Xe Bang Fai just north of Mahaxai. In this area, the Xe Bang Fai meanders through sandy banks in a karstic limestone plain. Approximately 25km downstream of Mahaxai, the Xe Bang Fai passes through the Sayphou Xoy ridge which acts as a hydraulic control and can cause water to back up upstream during flooding. From the ridge, the river flows through low-lying plains to its confluence with the Mekong. Flooding in this area is common during the wet season (May – October) caused by backwater from the Mekong moving up the Xe Bang Fai. Flooding of up to 1.5m can occur over low-lying areas.

21. The Project area experiences a tropical monsoon climate with distinct wet and dry seasons. River discharges are directly related to precipitation with approximately 85% of annual runoff typically occurring between June and October whilst low flows occur in April. Mean annual and monthly discharges in the main rivers to be affected by the Project are summarised in Table C.1.

Table C.1. Summary of Mean Annual and Monthly Flows (in m³/s)

Monitoring site	Data series	Mean annual Discharge	Mean monthly Discharge	
			Driest Month	Wettest Month
Nam Theun @ Ban Thalang (Nakai Plateau)	1986-2002	205.6	24 (Apr)	653 (Aug)
Nam Theun @ dam site	1950 – 2002	238	31.9 (Apr)	734.7 (Aug)
Nam Kathang @ Regulating dam site	1994-2002	10.2	0.3 (Apr)	38.5 (Sept)
Xe Bang Fai @ Mahaxai	1989-2002	265.4	12.7 (Apr)	921.2 (Aug)
Mekong @ Nakhon Phanom (upstream of Xe Bang Fai)	1924-1999	5,865	1,493 (Apr)	19,879 (Aug)
Mekong @ Mukdahan (downstream of Xe Bang Fai)	1922-1992	6,960	1,552 (Apr)	21,453 (Aug)

Source: Final Draft EAMP, November 2004

22. Average annual discharge in the Mekong at Nakhon Phanom has decreased by over 10% in the past 75 years. Seasonal flood magnitudes have also decreased whilst annual minimum monthly flows have increased. This could be the result of withdrawal or storage of water in the upper Mekong for irrigation or other uses, climatic changes and/or changes in vegetative cover and land use.

23. Measured water quality in the Nam Theun is good reflecting the fact that the river is located in a relatively undisturbed catchment with a small population and no industry. Water quality in the Xe Bang Fai basin is similarly good although orthophosphate and total phosphorus are comparatively higher. Groundwater is used for domestic supply in the Gnommalat area. Groundwater is also available in the proposed resettlement area and its quality is good. A water quality monitoring programme starting in 2004 will extend the existing baseline data before the start of construction and operation.

B. Biological Environment

1. Aquatic Habitats and Fish Diversity

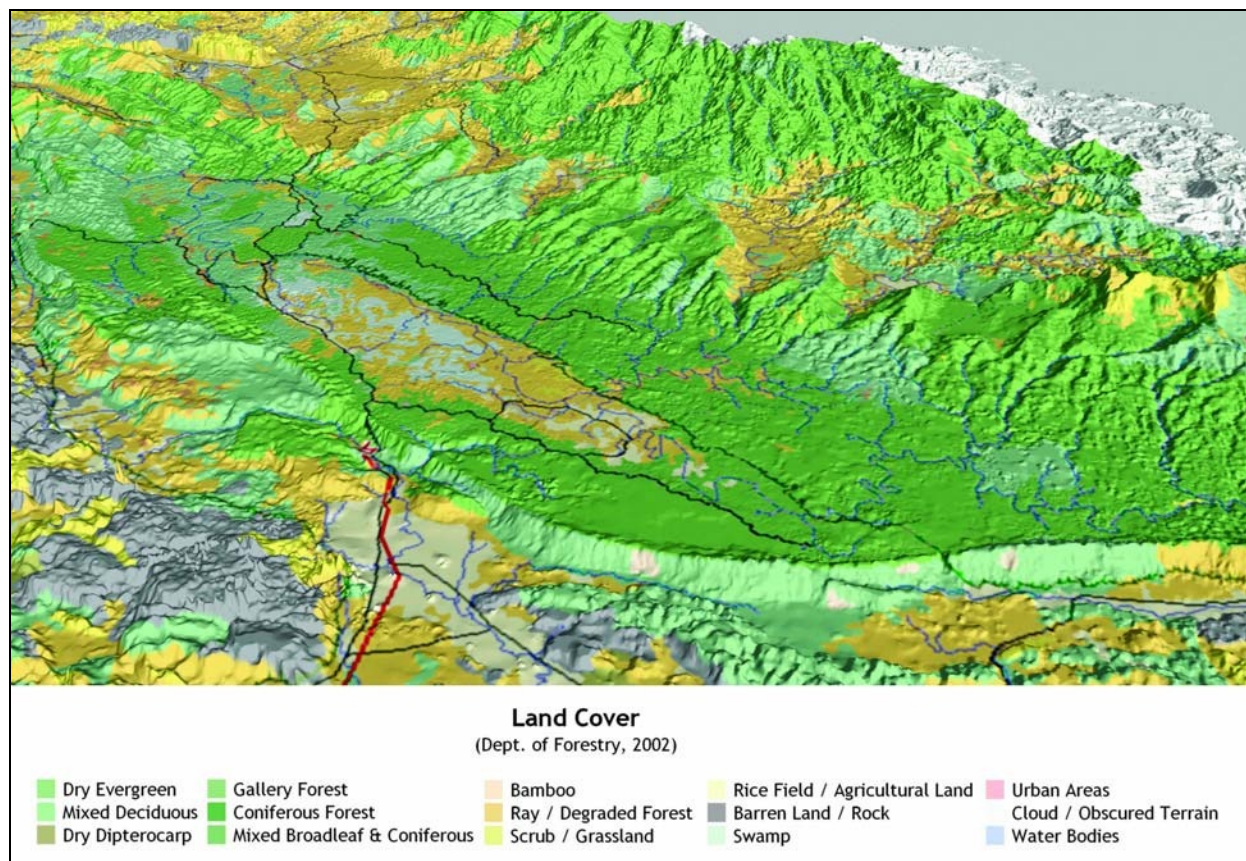
24. The diversity of fish species in the Nam Theun is low compared with the Mekong mainstream and the adjacent Xe Bang Fai basin. 131 species of fish have been observed in the Xe Bang Fai and 68 in the Nam Theun basins. All fish species currently observed in the Project area exist either in other basins or outside the area of direct Project impacts. Habitats that are important to fish populations in the Nam Theun and Xe Bang Fai include riverbank terraces and floodplains; the flood plains at the confluence of the Xe Bang Fai with the Mekong River are particularly important for Xe Bang Fai fisheries. Flooded areas serve as nursery grounds and refuges for juvenile fish. Habitats in the Xe Bang Fai are more diverse and the river has direct communication with the rich Mekong fauna. Furthermore, the presence of only juvenile fish at some locations in the Nam Theun suggests locally intense fishing activity.

25. Seasonal fish migrations between the Mekong River and Xe Bang Fai are important components of the economic livelihoods of communities on and adjacent to the Xe Bang Fai. Fish are harvested in the rivers either as a source of protein or for sale in local markets. A comprehensive baseline study of aquatic resources in the Xe Bang Fai has been ongoing since 2001 and will continue through to operation of the Project and thereafter to determine Project impacts on availability and fish catch for use by local communities.

2. Terrestrial Biodiversity

26. Climate and the diversity of geological conditions in the area have led to an extraordinarily high diversity of species, isolation and endemism. The Annamite Mountains that form the border between Lao PDR and Vietnam are recognized as an area of global significance in terms of biodiversity. The distribution of vegetation and land use in the Project area is illustrated in Figure C.1.

Figure C.1. Forest types and land use within the Project area



Source: Final Draft EAMP, November 2004

27. In the Northern Annamite Rain Forest Ecoregion within which the NNT NPA is situated, 19 mammal and bird taxa¹ are considered near or strict endemic. These currently include langurs, crested gibbons, saola, large-antlered muntjac, Annamite muntjac, Indochinese wartypig, Annamite striped rabbit, crested argus, Edward's pheasant and the orange-necked partridge. Three forest species (Fokien Cypress – *Fokienia hodginsii*, Yunnan youshan/May kinh – *Keetelaria evelyniana*, and Tenasserim pine—*Pinus latteri*) and the habitats they provide will also need special measures directed towards their conservation. Whilst they occur in other parts of the region, their precise extent is uncertain and natural populations may be limited.

28. Currently, of the 106 mammal, 403 bird, 38 reptile and 25 amphibian species recorded on the Nakai Plateau, NNT NPA and the Nam Theun Corridor, 38 mammal, 17 bird and 10 reptile species are classified as globally threatened according to IUCN's Red List of Threatened Animals. Some 115 species are considered nationally at risk in Lao PDR. A summary of the most threatened species identified in the NNT NPA is given in Appendix 2.

¹ Groups of organisms that are considered distinct enough to be treated as a separate ecological unit.

29. In terms of the NNT NPA, since most of the Nam Theun catchment is remote, sparsely populated and difficult to access, a large portion remains in near pristine condition and contains a wide variety of wildlife of global and national conservation significance. Threats to this area include hunting, collection of non-timber forest products (NTFPs) focusing on tree species with fragrant bark/wood and medicinal properties and logging, most notably in the area of the NNT NPA on the Nakai plateau. Commercial logging in the NNT NPA has however ceased.

30. In terms of the area on the Nakai Plateau to be inundated by the reservoir on the Nakai plateau, it contains secondary, dry deciduous, evergreen and conifer forest habitats, a large portion of which has been degraded. Logging has reduced forest cover in the inundation area from 61% to 48% from 1973 to 2003. The Nakai Plateau was once inhabited by an outstanding density and diversity of wildlife species. These species have come under increasing pressure over the last 30 years from settlement expansion, logging and hunting.

31. Of the endangered species in the Project impact area, two have been identified as requiring special management attention because of the threat posed to their populations by reservoir inundation and because if well managed, they can help conserve other wildlife species using the same habitats. These are the Asian elephant and white winged duck; their status in the Project area is summarised in *Table C.2*.

Table C.2. Asian elephant and White-winged duck in the Project area

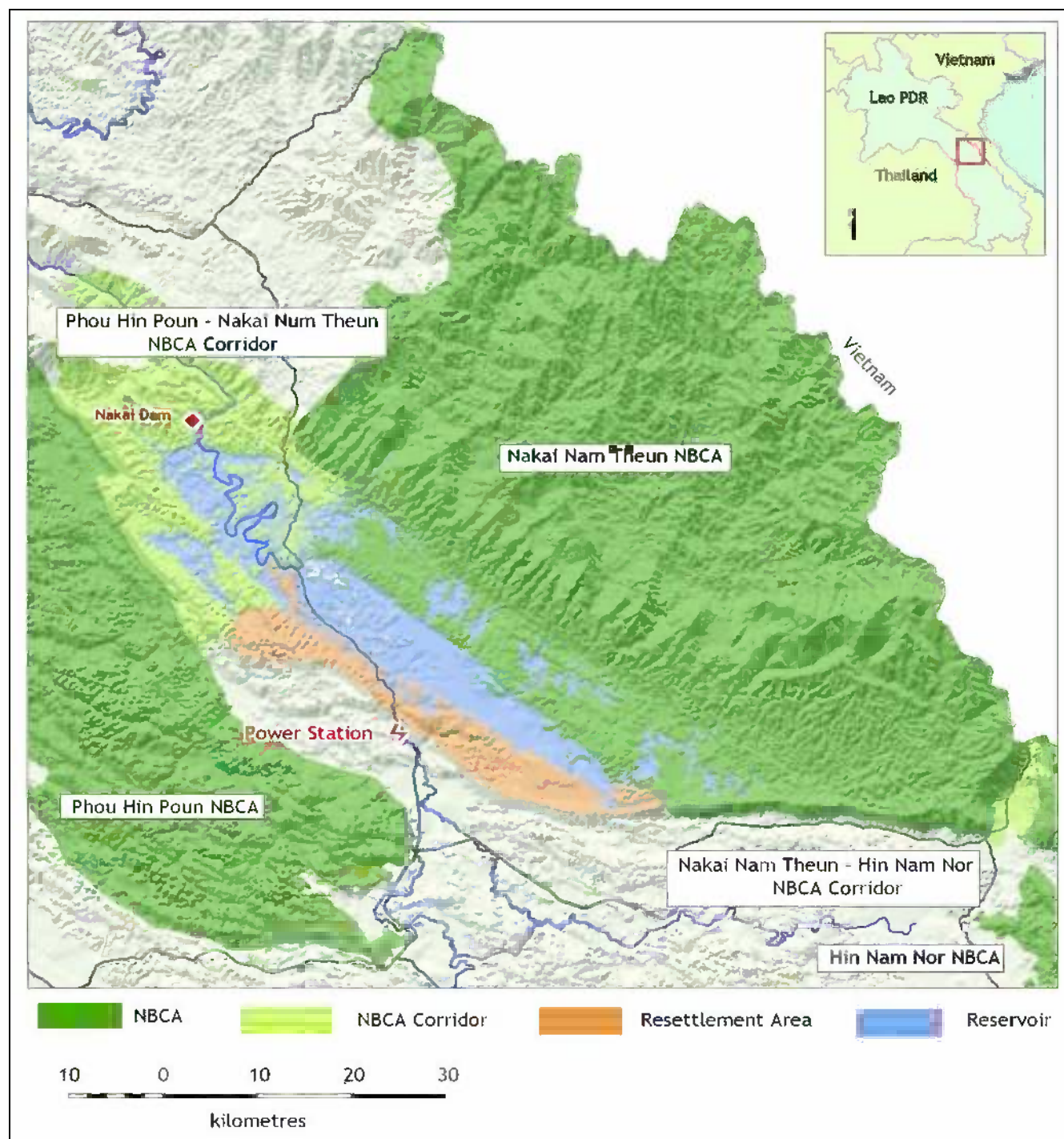
Species	Key Characteristics in the Project Area
Asian elephant	<p>Two distinct sub-populations have been recorded: one in the northwest, the other in the southeast of the Nakai Plateau. Estimates put the northwestern population at 90-120 individuals and the southeastern population between 100-400 individuals. These populations are currently threatened by poaching, by snares (meant for other large mammals), and habitat reduction associated with agricultural encroachment. Human-elephant conflicts exist due to agricultural expansion and the elephants' acquired taste for agricultural crops.</p> <p>Elephants frequently visit mineral licks located on the Nakai Plateau indicating the importance of these resources. During peak rains, groups from both sub-populations have also been observed to congregate along the Nam Theun, apparently to socialize and mate. An elephant programme has been initiated by NTPC to identify, amongst other things, the actual size of elephant populations and habitats likely to be affected on the Nakai Plateau</p>
White-winged duck	<p>WCS (1995, 1996) identified a population of five to ten pairs of white-winged duck at the western end of the Nakai Plateau. Its habitat is stagnant or slow-moving natural and artificial wetlands, within or adjacent to evergreen, moist, deciduous or swamp forests. They are relatively intolerant of human disturbance; potentially abandoning an area after only a single contact. Their population has experienced dramatic decline in south and south-east Asia, such that in 1997, global population was estimated at 450 individuals, and the total population for Lao PDR, Thailand, Vietnam and Cambodia was estimated at 130 individuals (BirdLife International, 2003). It continues to decline, largely attributable to widespread lowland deforestation, compounded locally by drainage and conversion of wetlands. The resultant small, fragmented populations are vulnerable to extinction.</p>

3. Protected Areas

32. Three National Protected Areas (NPAs) surround the immediate Project area; the Nakai Nam Theun NPA (NNT NPA) which constitutes 88% of the drainage for the Project reservoir, the Phou Hin Poun NPA, a region of karst limestone and the Hin Nam Nor NPA located to the south of the NNT NPA (see *Figure C.2*). Prime Ministerial (PM) Decree 193 of 1993 established a series of corridors to connect the three NPAs to enable wildlife migration between them. The

Project itself is expected to have minimal negative impact on these NPAs; the NNT NPA will be conserved through financing provided by the Project.

Figure C.2. National Protection Areas and Protected Wildlife Corridors



Source: Final Draft EAMP, November 2004

33. Each NPA, including the NNT NPA is noted for the presence of several threatened and endangered species. IUCN/WCS surveys also identified three new mammal species inhabiting

the NPAs including the Saola (a new species of muntjac) and a new rabbit or hare species. Fish studies have also identified numerous new species. The habitats of these species may extend onto the Plateau. Shifting cultivation has however affected and continues to degrade the forests and habitats of the NNT NPA and GOL does not currently have adequate personnel or resources to control this degradation.

C. Existing Human Settlements, Livelihoods and Infrastructure

34. For the purpose of describing social characteristics, the Project area has been divided into five main zones as follows:

- (i) Nakai-Nam Theun NPA;
- (ii) Nakai Plateau;
- (iii) Xe Bang Fai;
- (iv) Nam Theun downstream of the Nakai dam; and
- (v) Project Lands.

35. In general terms, population densities in the NNT NPA, on the Nakai Plateau and along the Nam Theun downstream of the Nakai dam are low, and characterized by pronounced ethnicity, dependence on subsistence livelihoods with household income levels well below the national poverty line, and limited or no access to infrastructure and services such as education, health, electricity and water supply. This is in contrast to the Xe Bang Fai basin within which (when moving towards the Mekong River) population numbers gradually increase, together with income and education levels, ethnic identity becomes less pronounced, livelihoods more secure and connections to electricity and water supply more common. A comparison of key social characteristics currently available for areas 1-3 is presented in *Table C.3*. Social characteristics in the Nam Theun downstream of the Nakai dam and in Project Lands are discussed in Sections III.C.1 and III.C.2 respectively.

36. The population that will need to be resettled by the creation of the Nakai Reservoir represent a mix of cultures as a result of numerous inward and outward migrations over the last 200 years. Despite this, several characteristics qualify the original population and those ethnic groups that have migrated to the area over the last 200 years, as “indigenous” according to ADB and WB safeguard policies. These include a definite sense of belonging to the Nakai Plateau, the fact that people on the Plateau are economically disadvantaged, traditional institutions prevail and a primarily subsistence-oriented livelihood production system exists.

37. In 1998, average household income on the Nakai Plateau (of US\$450/year) was well below the national poverty line of US\$800. Whilst agriculture (mainly rice) dominates the economy of this area, productivity is constrained by low yields under rain-fed conditions, poor soils, adverse weather conditions and lack of modern technology. Only 17% of families can produce sufficient rice for the year and 50% have a rice deficiency for more than 6 months of the year. To make up for this deficit, these communities traditionally depend on maize, starchy roots and general gathering in the forest to supplement their food as well as the sale and barter of NTFPs and livestock (mainly buffalo). Men in general are considered as the heads of households and have most dealings with organizations and government outside the village. Women tend to be more active in the economic sphere and also in domestic and child rearing chores. The Lao Women’s Union (LWU) is active in this respect assisting women throughout Lao PDR with economic development opportunities.

Table C.3. Key Social Characteristics of Project

Characteristic	NNT NPA	Nakai Plateau	Xe Bang Fai (XBF)
Population	Approximately 5,800 people (<i>ref. SEMFOP 2003</i>)	6,783 people in 1,298 households (2003 Census), of which 970 households will be fully eligible for the housing and livelihood programme (i.e. fully impacted) while 94 households will be eligible for housing and a further 130 eligible for the livelihoods programmes only (i.e. partly affected households).	Approximately 40,600 people in 7,096 households along XBF riverbanks (2001) below the Nam Phit confluence. Another approximate 3,300 persons living in c. 1,700 households live in hinterland villages seasonally travel to catch fish or collect aquatic products in the XBF
Ethnicity	Diverse mix comprising 3 main ethno-linguistic groups: Brou (53%), Vietic (25%) and Tai Kadai (16%).	5 main ethno-linguistic groups: Brou (40%), Tai Bo (40%), Upland Tai (11%) Vietic (6%) and Sek (1%). However distinctions between groups blurred.	Mainly Lao Tai but also several communities of Brou.
Livelihoods	Shifting cultivation, livestock raising, hunting, fishing, collection of NTFPs & some sedentary cultivation. Most households only able to grow rice for sustainable consumption for 2-6 months/yr. Supplement this through cash or barter sale of NTFPs, livestock & fish.	Swidden rice, fish, livestock raising, hunting and gathering forest products – all primarily for household use and for sale / barter for rice. Only 17% of families are able to produce sufficient rice for the full year.	Secure livelihoods, based on agriculture (mainly paddy rice), animal husbandry and fishing. 84% of villages have irrigation pumps. Off-farm income more important (relative to other areas) including shops and services.
Income	Estimate of annual average <i>cash</i> income per household was US\$87 in 1996 with <i>total</i> annual average income estimated to be double this per household (i.e. includes imputed income)	National Statistics Office survey of 1998 gave annual average cash income of US\$225 per household and total average annual household income of US\$450 (cash and imputed income).	2001 survey gave annual average household income of US\$ 664. 40% of population live below the poverty line.
Infrastructure	Remote with access limited to footpaths and river transportation. Limited access to electricity (some micro-hydro) or water supply. Water tends to be sourced from groundwater, rivers and collected from rainwater	Ban Oudomsouk has electricity but most households without electricity. Some use batteries. 60% of population use river/stream water as only domestic water source. Boiling is uncommon. Roads are unsealed and of poor quality.	Most villages along XBF are, or will soon be connected to electricity grid. 40% of population relies on river for domestic water supply. 20% of population has some form of sanitary facility. Access roads (Road 12, 13 and 8b) are gravel surface subject to degradation in the wet season. Access tracks to villages in middle XBF are of poor quality.
Education	Few single-room primary schools teaching 1 or 2 grades although this number has recently been increased following WB assistance. Teachers paid irregularly by GOL.	Schools only functioning in larger villages. Attendance is low. 63% report no schooling at all; 31% had primary school education (1998). Small percentage of villagers literate in the Lao Language; none of ethnic languages of the Plateau are written. Literacy levels are higher amongst men than women.	Education status is reportedly better than Nakai Plateau but schools often do not function due to lack of resources. ~31.6% of adults literate, 12.4% attended secondary school and 6% progressed beyond. Education levels highest in lower XBF

Characteristic	NNT NPA	Nakai Plateau	Xe Bang Fai (XBF)
Public Health	No sustained health care. Reliant on ritual specialists. Malaria, respiratory diseases and gastro-intestinal diseases found throughout. Drinking water rarely boiled.	Average distance to nearest hospital (located at Ban Oudomsouk) is 11km – for most only accessible by walking. 3.9% of communities surveyed reported visiting a doctor in 1998. Most villages have a designated Village Health Volunteer but they seldom have the necessary medicines or skills. Fever, malaria, diarrhoea and respiratory infections prominent.	Access to medical facilities, use of mosquito nets and nutritional status in most respects better than on Nakai Plateau.

Source: Based on data presented in the Final Draft SDP (November 2004).

39. The Xe Bang Fai areas are typical of many lowland areas in Lao PDR where the population is dependent on paddy cultivation, fishing and some degree of non-agricultural income with only a few ethnic minorities distinct from the Lao-Tai ethnic group. The GOL has previously supported major irrigation developments along the lower Xe Bang Fai and has requested that this Project contribute towards expanding this to other areas by providing additional water in the Xe Bang Fai. Dry-season riverbank gardens supply most of the vegetables for local consumption and riverine forests and wetlands are an additional source of edible plants, aquatic animals, NTFPs and herbal medicines. Most communities fish in the river at different times of the year. Fish is the main source of protein and most fish are consumed locally. On average, households also catch several kilograms of non-fish aquatic products monthly; the rainy season from April to October provides the highest production. Each household also raises on average 2-3 head of cattle, 1 pig and 10 chickens. Cattle are a form of saving and are sold for cash to meet household expenditure.

1. Social Characteristics of the Downstream Nam Theun (below Nakai Dam)

40. There are no permanent or established villages located along the Nam Theun from below the Nakai Dam until some 50km downstream (Ban Katok) and no land is cultivated from the Nakai Dam to the headpond of the Theun-Hinboun Hydroelectric Project. Fishermen and hunters from nearby villages do however use this stretch of the Nam Theun. A detailed study has been conducted to reconfirm the populations in this downstream zone and the extent to which they depend upon the river for their livelihoods. Fish and aquatic animals are an element of livelihood strategies and in surveys, ranked second or third in terms of household food security after rice and vegetable cultivation or other forms of natural resource exploitation (hunting and gathering NTFPs). Communities were found to collect flora and fauna species from the forest habitats in the riparian zone although collection tended to be away from river banks.

2. Social Characteristics of the Project Lands

41. Area 5 Project Lands include areas for the construction of the Nakai Dam, Nakai saddle dams, headrace channel, power conduit intake structure, the Power Station, Regulating Pond and Dam, Residence Nam Theun, the proposed quarry areas, construction work camps as well as corridors for transmission lines, Downstream Channel and for roads to be upgraded and constructed. The Concession Agreement defines an area of about 5,500ha, excluding transmission lines, within which the NTPC and its HCC may choose to design and construct the above infrastructure. The actual area required however is considerably less; about 2,565 ha during the construction phase and 760 ha during the operation phase.

42. Communities in a number of different areas with a diverse range of social characteristics will be affected by Project Lands. A first phase in baseline data collection involved the review and interpretation of remote sensing data of the area covered in the Concession Agreement. This indicated that for 37 of the 57 Project Lands, approximately 37% of the area affected is characterised by disturbed forest, 35% by swidden plots (either fallow or in use), 11% by little disturbed forest and 7% by rice paddies. The route of the 500kV transmission line traverses paddy fields in the Gnommalat plain, mixed paddy and forest around Mahaxai, sparsely populated farming in degraded forested areas just after crossing Road 13 and then medium densely populated area before reaching the Mekong. Some 36 villages with approximately 2,700 households are located close to the route of this transmission line. Ethnicity, income levels and other social indicators also vary throughout the Project Lands. Broadly, Project Lands associated with the Pha Phen (Phou Phako) quarry and dam site are populated with Tai Meuy, Hmong and Viet groups while along the transmission lines there are some villages and land

belonging to Brou (Makong) (especially around Gnommalat and Mahaxai) and Lao Loum (further south).

43. A second phase of baseline studies, involving more detailed ground and household surveys and covering all Project Lands began in June 2004. They will be complete in April 2005.

D. Physical Cultural Resources

44. Two surveys undertaken in the Project area in 1991 and in 1994/5 indicate that few items of historical or archaeological importance are likely to exist in the area affected by the Project. An additional field based Physical Cultural Resources Survey (PCRS) was carried out in the first half of 2004 for the whole Project area (including Project Lands). This includes lands not previously covered due to changes in the Project design. It involved a detailed inventory of all sites and artefacts and identified a number of sites of prehistoric, historic, spiritual, religious and palaeontologic significance, cemeteries and other cultural sites within the Project area including:

- (i). Sites of spiritual significance, cemeteries, an abandoned Buddhist temple near Ban Nakai Tai (believed to be approximately 200 years old), and the foundations of a royal hunting lodge built in the 1940's on the Nakai Plateau;
- (ii). A number of historic Buddhist temples, a prehistoric cave and territorial spirit sites in the Downstream Channel area (although outside Project Lands);
- (iii). An important religious site (Wat Sen Sayalarm), historic limestone kilns and a cemetery on the banks on the Xe Bang Fai;
- (iv). Historic sema stones (believed to predate the 18th century) adjacent to the transmission line corridor plus other territorial, religious and cultural sites in other Project Lands; and
- (v). Evidence of prehistoric human occupation (possibly Neolithic and Palaeolithic) in a number of limestone rock shelters and caves in the Pha Phen (Phou Phako) region.

IV. ANALYSIS OF ALTERNATIVES

A. Consideration of Options

45. GOL commissioned a comprehensive Study of Alternatives in 1997 (1998, updated in 2000 with the Hydropower Development Strategy Study and again in 2004 with the Power Sector Development Strategy) in order to determine whether the Nam Theun 2 Hydroelectric Project was indeed the most attractive option for power export to Thailand. Amongst other things, these studies have aimed to determine how the Project compared to other power export schemes and whether the proposed configuration of the Project was optimal. Three major workshops, attended by an average 150 participants including representatives from ministries, NGOs, donor and embassy representatives and various experts were held as part of the 1997-2000 studies.

46. Nineteen candidate Independent Power Projects (IPPs) were examined in the Study of Alternatives and compared against technical, economic, financial, environmental and social criteria. The study found that incorporating additional design features, such as multiple level intakes and regulating ponds, could achieve a significant reduction in the environmental impacts of several of the proposed IPPs. The scale of social impacts was also found to relate directly to the scale of resettlement; all projects were evaluated to determine whether resettlement could be reduced or eliminated. In most cases however, projects would need to be reduced to run-of-

river status to achieve a significant reduction in resettlement, as populations tend to reside close to riverbanks.

47. Nineteen hydropower schemes are also being examined in the Power Sector Development Strategy which is currently being finalized. This study compares the relative merits of the different hydropower developments on technical, economic, social and environmental grounds. Both the Hydropower Development Strategy Study (2000) and preliminary results from this Power Sector Development Strategy rank Nam Theun 2 first against other potential hydropower developments in Lao PDR. *Table D.1* presents preliminary ranking and characteristics of the ten highest ranked projects.

Table D.1 Preliminary Ranking and Characteristics of Alternative Hydropower Projects

Rank	Project	Project Type	Installed Capacity (MW)	Annual Energy Output (GWh p.a.)	Adjusted Weighted Generation Cost ^a (¢/kWh)
1	Nam Theun 2	Storage / transfer	1074	5922	1.6
2	Theun Hinboun Expansion	Storage / transfer	105	686+	2.4
3	Thakho	R-of-R / Mekong	30	214	2.6
4	Nam Mo	Storage	125	603	2.7
5	Xe Kaman 3	Storage	250	1369	2.8
6	Xe Kaman 1 (u/s reg.)	Storage	470	2086	3.1
7	Nam Ngum 2 (u/s reg.)	Storage	460	1901	3.2
7a	Nam Ngum 2B	Storage	140	196	8.7
8	Xe Kong 5	Storage	400	1795	3.2
9	Nam Sane 3	Storage	60	283	3.3
10	Nam Ngiep 1 (+ reg dam)	Storage	330	1537	3.8

Source: Meritec/Lahmeyer International (2004 – preliminary results) Power Sector Development Strategy.

^a The Economic weighted average cost of generation has been calculated using economic, social and environmental evaluation software. It takes into account economic and financial costs and revenues of developing each scheme weighted against monetary valuations of environmental and social impacts. It attempts to provide a more objective analysis of environmental and social costs and benefits compared to earlier studies which used multi-criteria evaluation methods using impact categories and weightings based on the views of stakeholders.

48. Preliminary overall findings of the analysis of alternatives conclude that:

- (i) The growth in demand for electricity in Thailand, even with moderate economic growth and a well established programme of energy conservation, is strong enough to accommodate at least the Nam Theun 2 Project plus other hydropower projects in Lao PDR, depending on their cost; and
- (ii) The tariff negotiated with EGAT for the Nam Theun 2 Project is very close to the least cost alternative supply source—combined cycle gas turbine (CCGT)—when taking into account the impact on projected natural gas prices of forecast world oil prices, the capital cost of recent CCGT plants in SE Asia and the base project cost. Additionally, Laotian hydropower provides the Thai system with a useful diversification of supply close to an area (northeast Thailand) which is currently under-served.

B. The 'No Project' Scenario

49. The Study of Alternatives also assessed the trade-offs between the best alternative scenario to the Project and implementation of Nam Theun 2. The tradeoffs were US\$ 320 million less income to GOL; 2,430 fewer people to be resettled; 286km² less area flooded by reservoirs and 138km less river inundated.

50. Furthermore, an Economic Impact Study¹ and an Environmental and Social Management Plan² for the Project concluded that the consequences of adopting a “no-project” alternative would be:

- (i) Continued low GDP rates and high poverty levels in Lao PDR;
- (ii) Forgone direct economic benefits including improvement of infrastructure, health services, etc.; and
- (iii) Accelerated exploitation of forests and biodiversity in the NNT NPA.

C. Alternative Configurations

51. The Study of Alternatives also considered alternative configurations for the Project. Three parameters were identified to be critical to the overall environmental and social impacts, namely the size of the Nakai Reservoir; the flow pattern in the Xe Bang Fai; and the flow pattern in the Nam Theun, downstream of the Nakai Dam. The options considered and conclusions reached are summarised in *Table D.2*.

Table D.2 Comparison of Alternative Configurations for Nam Theun 2 Project

Alternative Configuration	Options Assessed	Conclusions
Reduce size of Nakai Reservoir	Seven alternatives were considered in relation to the size of the reservoir. Following public consultation, it was agreed that three options be examined further. These were a dam at Nakai, a dam further upstream at Ban Thalang, and developing the Project as a run-of-the-river (ROR) scheme.	Generation capacity decreases and relative cost, per unit energy generated increases as reservoir size is reduced. E.g. if reservoir is reduced to run of river, 3,220 GWh/y less power will be generated and the relative generation cost would be 236% compared to the Nakai Dam option of the Nam Theun 2 Project.
Reduce effects of discharges into the Xe Bang Fai	The following means were investigated: <ul style="list-style-type: none"> (i) Divert Power Station releases into the Nam Thon, a tributary of the Nam Hinboun (ii) Deepen the river channel of the Xe Bang Fai at strategic locations (iii) Provide regulation upstream of where the Xe Bang Fai receives water from the Project, so as to reduce the natural flood hydrograph (iv) Build a reservoir in the Nam Se Noy tributary, which could then possibly be diverted to the Nam Phong river system for irrigation use 	Of these options (a) to (e) were found to have either no marked impact, were prohibitively expensive compared to their beneficial impacts, or were technically not feasible. Furthermore, a subsequent mitigation measure agreed with EGAT is to enable electricity generation to stop and therefore stop discharge into the Xe Bag Fai when this river is close to flooding. Options (f) and (g) have been incorporated into the scheme.

¹ Louis Berger International, 1997.

² IUCN, 1998.

Alternative Configuration	Options Assessed	Conclusions
	(v) Divert the upper Xe Bang Fai (vi) Increase the size of the Regulating Pond to enable a more consistent discharge into the Xe Bang Fai during periods when the Power Station is not operating; and (vii) Shut down the Power Station when the Xe Bang Fai floods to reduce the potential for increased flooding.	
Reduce the impacts in the downstream Nam Theun	3 options are available to reduce the impact of a limited riparian release into the Nam Theun: (i) Increase in mandatory riparian release (ii) Aeration of riparian release (iii) Partial diversion of a natural stream into the Nam Theun to increase its flow.	These options were not considered in the Study of Alternatives; The Project already provides for the riparian release to be aerated through a cone valve in order to increase the levels of dissolved oxygen in the released water.

Source: Final Draft EAMP, November 2004

V. ANTICIPATED ENVIRONMENTAL AND SOCIAL IMPACTS AND THEIR MITIGATION

A. Physical Environment

52. Key impacts of Project operation on the physical environment are associated with changes to hydrology, water quality, erosion rates and to a lesser extent climate and groundwater. Impacts during Project construction are discussed in more detail in Section V.F. *Table E.1.* presents a summary of key impacts to the physical environment.

Table E.1. Summary of Key Impacts to the Physical Environment and their Mitigation

Impact Receptor	Direct and Indirect Impacts of the Project	Proposed Mitigation
Hydrology	<ul style="list-style-type: none"> Impoundment of 195km of Nam Theun Diversion of 220m³/s from Nam Theun to Xe Bang Fai (annual average) Significant reduction in flow of Nam Theun downstream of Nakai Dam Almost doubling of annual average flow in Xe Bang Fai Average 3% reduction in Mekong flow between Nam Kading and Xe Bang Fai Potential reduced risk of flooding along Nam Theun and Mekong (Mekong ~18cm lower at times of flood at confluence of Xe Bang Fai) 	<ul style="list-style-type: none"> Project will provide minimum 2m³/s (weekly average) of flow into Nam Theun downstream of the Nakai Dam to help sustain the riparian environment Inclusion of Regulating Pond into the Project design to enable a more constant and controlled release of water into the Xe Bang Fai Project has committed to restrict outflow from Regulating Dam in periods when Xe Bang Fai is in, or threatened by, flooding
Water Quality	<ul style="list-style-type: none"> Periodic episodes of low dissolved oxygen concentration in parts of the reservoir and downstream rivers Increased nutrient concentrations in initial years Wastewater discharges from construction sites and work camps 	<ul style="list-style-type: none"> Removal of some biomass in inundation area prior to reservoir filling Discharges into Nam Theun will come from the epilimnion (oxygen rich water layer) of the reservoir Discharge to the Nam Theun will be through an aerating structure (a cone

Impact Receptor	Direct and Indirect Impacts of the Project	Proposed Mitigation
	and sedimentation from construction sites (see <i>Section V.F.</i>)	valve) <ul style="list-style-type: none"> • Construction of an aeration weir in the Downstream Channel • Aeration structures incorporated into the Nam Kathang release • Solid waste and wastewater management • Erosion and sedimentation management on the construction sites. • Effective catchment management
Erosion and Sedimentation	<ul style="list-style-type: none"> • Sedimentation in the reservoir and reduced sedimentation in the downstream Nam Theun • Reduced riverbank erosion in Nam Theun downstream of the Nakai Dam • Increase in riverbank erosion in Xe Bang Fai below confluence with the Downstream Channel • Potential erosion in Downstream Channel 	<ul style="list-style-type: none"> • Restrict construction to dry season to the extent possible • Implement soil protection measures in construction areas • Riverbank protection / stabilization in the Xe Bang Fai • Monitoring of erosion in the Xe Bang Fai. • Protection of exposed sections of Downstream Channel and its confluence with Xe Bang Fai • Inclusion of an erodible section in the Downstream Channel to reduce the erosion potential in the Xe Bang Fai • Inclusion of Regulating Pond in design facilitating more constant and controlled release of water into the Xe Bang Fai • Asset and livelihood compensation for any land / assets / livelihood lost

1. Hydrological Impacts

53. Averaged over a year, the Project will divert 220m³/s from the Nakai Reservoir, through the Power Station to the Xe Bang Fai. As a consequence, discharge in the Nam Theun downstream of the Nakai Dam will be reduced to a minimum of 2m³/s (averaged over one week) plus the spills of the rainy season and a complementary release of 5 million m³ over a period of 12 months. This compares to calculated mean annual flows of 238m³/s at the Nakai Dam site at present. Impacts below the Nakai dam will primarily be felt in the first 12km section to the confluence with the Nam Phao. Thereafter the impact will be moderated by the flows from the Nam Phao. Flows in the Mekong between its confluences with the Nam Kading¹ and the Xe Bang Fai will be reduced by an annual average of 302m³/s with an average 220 and 82m³/s being diverted by the Nam Theun 2 and Theun Hinboun Hydroelectric Projects respectively (the latter is already operational and located approximately 50km downstream of the Nakai Dam, also on the Nam Theun). The diversion for the Nam Theun Project represents only 3% of total flows (as an annual average) in this area of the Mekong and therefore is not expected to significantly affect navigation or fish populations in this area.

54. Discharge into the Nam Kathang will be equivalent to its natural flow with no resultant hydrological impact. From the Power Station, discharge into the Downstream Channel will be controlled by the Regulating Dam. Flows into the Xe Bang Fai will however increase by an average 220m³/s (averaged over the year) and a maximum of 315m³/s compared to current calculated mean annual flows of 265m³/s at Mahaxai. Changes in water levels are expected to be greatest at Mahaxai, the first major settlement downstream of the Xe Bang Fai / Downstream

¹ The Nam Theun becomes the Nam Kading downstream of the Theun Hinboun dam.

Channel confluence, and will be more prominent in the dry season: an increase in water levels of 5.8m in April (dry season) compared to an increase of 1.5m in August (wet season). The effects of this increased flow will on average diminish progressively downstream as the contributing catchment increases. Discharge into the Downstream Channel from the Regulating Dam on Sundays will be lower (c. 80m³/s) to reflect less power demand in both Thailand and Lao PDR.

55. The Nakai Reservoir is expected to significantly reduce flooding immediately downstream of the Nakai Dam, retaining floods completely or attenuating them, depending on the extent of rainfall and resultant levels in the Nakai Reservoir. Modelling indicates that flood levels at the Xe Bang Fai – Mekong confluence will reduce by approximately 0.18m. However, modelling suggests that overall flood levels in the Xe Bang Fai and its flood plain could increase by approximately 0.5, 0.4 and 0.2m in the upper, middle and lower reaches of the Xe Bang Fai respectively when combined with floods that exceed the bankfull flow and a maximum release from the Regulating Pond (i.e. worst case situation). The resulting area flooded (when natural Xe Bang Fai flows reach 1,970m³/s) is estimated to increase by 3.75% (from 324km² without the Project to 335km² with a maximum Project discharge of 315m³/s). For such an extreme case, flood depths in lower Xe Bang Fai are estimated to increase by between 0 and 0.55m. The largest changes in depth are expected to occur close to Road 13 diminishing towards the Mekong confluence.

56. **Mitigation:** Negative hydrological impacts will be mitigated through operational management of the Project, and specifically operation of the Regulating Dam. To prevent additional flooding caused by the Project, outflow from the Regulating Dam will be restricted when flows in the Xe Bang Fai approach 1,970m³/s and outflow will cease before the natural flow reaches 2,270m³/s (point at which flooding currently occurs in Xe Bang Fai). The Regulating Dam will limit the rate of increased discharge into the Xe Bang Fai to a maximum of 20m³/s/hour.

57. The hydrological changes caused by the Project provide significant opportunities to enhance the economies and livelihoods of downstream Xe Bang Fai populations. Higher dry season flows will provide an increased and guaranteed water resource for irrigation and reduced irrigation water pumping costs; these benefits are discussed further in Section V.D.5.

2. Water Quality

58. Changes in water quality during filling and storage of water in the Nakai Reservoir could affect water quality in the Nam Theun (downstream of the Nakai Dam), Xe Bang Fai, Nam Kathang and possibly the Mekong. Fish, other aquatic life and people who depend on the rivers for their domestic water consumption and aquatic products could in turn be impacted. Factors affecting water quality in the reservoir include solar radiation of the reservoir surface, mixing of the water column (and nutrients therein), the volume of biomass inundated, growth of aquatic weeds, sedimentation and the use of agricultural chemicals.

59. It is expected that the Nakai Reservoir will be thermally stratified each year from late dry season through the first few months of the wet season. Maximum water temperatures at the reservoir surface could be 30°C compared to bottom temperatures of 20-25°C. Under these conditions, periodic episodes of low dissolved oxygen (<2mg/l) are predicted to occur in deeper waters. These anoxic conditions are expected to last for 1-3 months. Because of the shallow nature of the reservoir, anoxic conditions will affect less than 3% of reservoir volume. Modelling predicted that dissolved oxygen concentrations in the dry season through the Power Station and

the Nakai Dam were above 5mg/l (generally acceptable to sustain aquatic life) and low in nutrients. Nutrient levels will be higher during the initial years of reservoir inundation (due to decomposition of organic matter in the reservoir). Models did however predict that levels of dissolved oxygen in the Nam Kathang and the Xe Bang Fai would be affected and would require specific measures to protect fish populations.

60. Peak concentrations of 25µg/l ammonia are predicted to occur in the Nakai Reservoir during the wet season after thermal destratification; this is in line with baseline values for the receiving waters and is not expected to impact fish. Predicted pH levels in the Nakai Reservoir also fall within the desirable pH range for good fish production (between 6.5-9). Suspended sediment concentrations into the reservoir are expected to be quite low given the relatively undisturbed nature of the catchment. However, agricultural activities in the resettlement area may lead to an increase in the use of pesticides. These are extremely toxic to fish and can bioaccumulate to levels harmful for human consumption.

61. **Mitigation:** The identified impacts on water quality in the Nakai Reservoir and downstream water quality (in the Nam Theun and Xe Bang Fai) will be mitigated by the following measures:

- (i) *Good catchment management* to protect the Nakai Reservoir from sedimentation;
- (ii) *Reduction of biomass in the inundation area:* the removal of some biomass prior to flooding will be encouraged including firewood collection and salvaging timber;
- (iii) *Drawing riparian releases from the epilimnion¹ and aeration by a cone valve:* this will help improve water quality and conditions for fish populations in the downstream Nam Theun;
- (iv) *Drawing the Power Station water from the majority of the water column:* thereby ensuring that water discharged into the Downstream Channel consists of a mix of potentially anoxic hypolimnion and oxygenated epilimnion;
- (v) *Aerating the water released into the Nam Kathang;* The Nam Kathang release of the Regulating Dam will incorporate two aeration structures, including a hydraulic jump and a weir.
- (vi) *Aerating the water in the Downstream Channel before its release into the Xe Bang Fai:* an aeration weir in the Downstream Channel will improve dissolved oxygen concentrations in the flow. Bacterial and algal build up, which could diminish the efficiency of the aeration weir will be cleared during periodic low discharges on Sundays;
- (vii) *Managing aquatic weeds by reservoir draw-down:* the annual seasonal draw-down and refill of the Nakai Reservoir will control aquatic weeds;
- (viii) *Managing the use of fertilizer, pesticides and other synthetic chemicals* through the implementation of a Pest Management Plan; and
- (ix) *Ensuring strict compliance to the existing construction schedule:* NTPC will ensure the Head Contractor strictly complies with the construction schedule so that waters in the reservoir do not build up for a longer period than planned (e.g. before water is drawn-down and thereby mixed through operation of the Power Station). Such a delay could result in fish kills because of anoxic conditions in the Nakai Reservoir.

¹ The warmer, upper layers of the water column within which most biological activity occurs.

62. NTPC is also committed to maintaining the existing beneficial uses of water in the Project area. It is therefore prepared to support the development of other sources of domestic water supply in those villages that depend partly or fully on the Xe Bang Fai and Nam Kathang for their water. Water quality in all concerned water bodies will also be subject to monitoring during construction and operation. A baseline water quality monitoring programme is to begin in 2004.

3. Erosion and Sedimentation

63. Increased erosion is only expected to be a significant impact in the Xe Bang Fai as a result of the considerably higher flows, lower sediment load of Project waters entering the Xe Bang Fai and the pore pressure in river banks resulting from weekly changes in discharge. SMEC (2002 & 2004) estimated that the Xe Bang Fai channel could widen on average between 10.7m and 15.9m along the length of the river with maximum widening of no more than 20m before the river adjusts to its new regime and morphology. This new morphology is not expected to reach equilibrium until at least 2 years after the new flow regime in the Xe Bang Fai. The extent of widening will decrease as distance from the confluence with the Downstream Channel increases so that by the time the river reaches the bridge on Road 13 the loss is predicted to be negligible. Erosion will result in damage or loss of land used for local cultivation. The adjustment to river width is likely to be slow and obvious, giving communities time to adjust without unpredicted losses to property or injury. In contrast, erosion in the Nam Theun downstream of the Nakai dam is not expected to be a problem due to the low flow and the existence of rocks and vegetation. Infrequent spills could result in some minor, locally restricted erosion. The Downstream Channel will be protected from erosion at critical locations. No significant increase in erosion rate is expected in the Nam Kathang due to maintenance of natural flow levels.

64. Sedimentation of the Nakai Reservoir is anticipated to be minimal due to very low rates of topsoil loss in the largely undisturbed forested catchment that consists of the NNT NPA. It is not expected to affect the reservoir's storage capacity or hydropower generating potential. Management of the NNT NPA will be needed to maintain the current low level of erosion.

65. **Mitigation:** Several Project components have been designed to minimise erosion impacts in the Xe Bang Fai. These include the controlled and consistent release of water from the Regulating Dam, limiting the rate of increasing and decreasing discharge into the Xe Bang Fai, and strengthening of the Downstream Channel and the Xe Bang Fai confluence to prevent erosion. Erosion levels along the Xe Bang Fai are currently being monitored; the Xe Bang Fai, together with the Downstream Channel, will also be monitored during operation and remedial mitigation measures such as bank protection, stabilization, and asset and livelihood compensation (or a mix of these) will be considered on a case-by-case basis. Villagers will be able to alert District Compensation Committees of any abnormal erosion rates or affected infrastructure / livelihoods. The SEMFOP details plans to manage land use activities in the NNT NPA to avoid excessive erosion and therefore prevent sedimentation of the Nakai Reservoir.

4. Other impacts on the Physical Environment

66. The creation of the Nakai Reservoir is expected to generate minor micro-climatic changes on the Plateau (in air temperature, relative humidity, winds, etc.) however these changes are only expected to exist for short periods of time due to the overpowering dominance of the monsoon. Minor seismic impacts are possible as a result of river impoundment and dam construction, however the height of the dam (48m) is well below the size at which such impacts are known to be probable (100m). Reduced amounts of water in the Nam Theun downstream of

the Nakai Dam are not expected to significantly affect groundwater levels due to steep valley sides preventing the river from being a major source of aquifer recharge. Increased water flows in the Downstream Channel and the Xe Bang Fai will result in higher groundwater levels, reducing the energy requirements for abstraction for use by communities. No further mitigation for these issues is considered necessary.

B. Biological Environment

67. The Project's principal impacts on the biological environment are on aquatic and terrestrial habitats, species diversity, protected areas and endangered species. Key impacts and their mitigation are summarised in *Table E.2*.

Table E.2. Summary of Key Impacts to the Biological Environment and their Mitigation

Impact Receptor	Direct and Indirect Impacts of the Project	Proposed Mitigation
Aquatic habitats and fish diversity	<ul style="list-style-type: none"> Transformation of 195km of the Nam Theun into the Nakai reservoir will permanently alter habitats and disfavoured species adapted to fast flowing conditions The Nakai Dam will represent a barrier to migration between the lower Nam Theun and its headwaters Large seasonal fluctuations in water level in the reservoir and changes in water quality (anoxic conditions) are likely to lead to unfavourable conditions for some fish and other aquatic species Changes in water flow, quality and temperature in the Xe Bang Fai might alter the species composition and the productivity of the river Work in or along rivers might increase the sediment load causing damage to fish (gills), destroy spawning areas and reduce productivity of the river 	<ul style="list-style-type: none"> Diversion of the river away from the Nakai Dam site during construction Stabilization of road sides and other areas to reduce erosion Clearing of some vegetation in the inundation area to remove biomass and reduce the likelihood of adverse water quality developing (see also <i>Table E.1</i> and Section V.A.2) Construction of retention tanks around areas where liquid and solid fuels and chemicals are to be stored Implementation of a pest management plan Ban on fishing with explosives by Project workers
Terrestrial Biodiversity	<ul style="list-style-type: none"> 1170km² of land and associated vegetation affected by Project (construction phase). Areas of broadleaved and coniferous forests, swamps and gallery forests are most affected 450km² permanently lost by the impoundment of the reservoir Improved accessibility to NNT NPA (due to the reservoir) and increased human population on Plateau stimulating increased hunting pressure and trade in wildlife 	<ul style="list-style-type: none"> Designation of NNT NPA and provision (by NTPC) of US\$31.5 million towards its management and protection (through the SEMFOP) Compensatory forestry programme covering 28,000ha of degraded forest Alternative livelihood systems combined with conservation for inhabitants of NPA The HCC must also assure a ban on hunting amongst construction workers
Endangered Species	<ul style="list-style-type: none"> Disturbance to catchment and corridor areas could threaten habitats of a wide range of animals including endangered species such as the Elephant, Tiger, Macaques, Dhole, Gaur, Banteng and White-winged duck. 	<ul style="list-style-type: none"> Conservation programmes for the Asian elephant and the White-winged duck Survey of 16 key wildlife species and development of management programmes if found to be present Management and financial support to the NNT NPA Research and associated planning to minimise impacts of inundation on wildlife

1. Aquatic Habitats and Fish Diversity

68. Aquatic habitats are likely to be affected by activities during Project construction and operation. Impacts during construction could be generated by sedimentation caused by work in the riverbed, clearing of vegetation in the inundation area and erosion at construction sites; water pollution caused by oils, fuels and chemical use; and use of explosives. Increased sediment loads can directly affect fish downstream through damage to or accumulation in their gills leading to death or sub-lethal effects. Increased sediment loads will also indirectly affect fish through modification of habitats (e.g. rocky river bed to mud-covered), destroy spawning sites, and reduce primary production and therefore fish food. Spills of fuels and chemicals may directly affect aquatic fauna or humans and animals feeding on aquatic products. Use of explosives in water can either instantly kill fish or severely damage their internal organs, an impact which can occur at a considerable distance from the explosion site.

69. Once construction is complete, long-term impacts on aquatic habitats and fish biodiversity in the Project area will occur. In the Nam Theun headwaters (in the NNT NPA), impacts are unlikely if the area is properly and successfully managed. However species that migrate between the headwaters and the middle and lower Nam Theun will be affected. Impoundment of 195km of the Nam Theun and creation of the Nakai Reservoir with few distinct habitats, plus the changes in water quality in the reservoir (see Section V.A.2) will displace many species not able to adapt to the new conditions. Sedimentation as the reservoir fills will further remove distinct habitats favoured by some species. The Nakai Dam will block possible migration routes between the Plateau and downstream areas. Of the 68 fish species recorded in the Nam Theun basin estimates suggest that 35% will not adapt to the changed conditions and a further 17% are unlikely to adapt. Only 21% are expected to adapt without difficulties. Downstream of the Nakai Dam, reductions in water flow will reduce the carrying capacity of the river, both in terms of fish diversity and abundance. Some species may adapt to these changes whilst others may disappear. Baseline studies indicate however that all species currently recorded in the Nam Theun basin exist either in other basins or outside the area of direct Project impacts.

70. In the Xe Bang Fai, several habitats will disappear due to increased water levels, some will be displaced while others will be altered. Water temperatures will also drop in the Xe Bang Fai, perhaps by up to 3.5°C; in synergy with other changes (such as sedimentation, increased discharge, discharge fluctuations and water quality), this could increase the stress on the aquatic community. The impact of changed hydrological conditions and fish populations in the Mekong mainstream is negligible. Tributaries are of utmost importance for Mekong mainstream fish as spawning and nursery grounds. It is possible that increased flows in the Xe Bang Fai may instigate spawning migrations into the river. The dynamics and possible impacts remain uncertain.

71. **Mitigation:** During construction, strict management and regulation of construction activities, including measures to minimise sedimentation, prevent and control fuel / chemical spills, banning the use of explosives underwater or for fishing (by Project workers) and scheduling of sediment-generating construction activities to occur during the dry season, will be implemented to mitigate construction related impacts. A number of the operational impacts (e.g. impacts caused by impoundment and creation of the reservoir environment and preventing migration) cannot be mitigated. Management of the NNT NPA should however ensure the survival of most fish species that are present elsewhere in the river system compensating for this impact. Populations of critical species will be monitored in order to detect possible declining populations and to help provide recommendations for appropriate support measures (e.g. restrictions or ban of captures, establishment and use of captive stock for stocking and

supporting the wild population, increasing areas of protected pools etc.). No new fish species will be introduced for 10-15 years to allow existing species to stabilize in the new conditions. To mitigate the impact of reduced, but even flows along the Nam Theun downstream of the dam, adjustments to the river morphology will be considered for purposes of sustaining water flows and depths in critical areas. There are no plans to provide fish ladders as these have proven ineffective elsewhere in the tropics. Mitigation of water quality impacts was discussed in *Section V.A.2*. NTPC are currently undertaking monitoring of baseline fisheries in the Xe Bang Fai; this monitoring will continue after COD.

2. Terrestrial Biodiversity

72. Direct impacts on terrestrial biodiversity will occur as a result of clearing land for construction works, for reservoir inundation and as a result of degradation and disturbance to ecosystems. Approximately 1,170km² of land (including approximately 28,000ha of forest), primarily on the Nakai Plateau, will be affected in this way. Indirect impacts on terrestrial biodiversity are expected to occur as a result of increased population and improved access to the area. The reservoir will make some areas, including the NNT NPA more easily accessible particularly for hunting, increasing the vulnerability of wildlife.

73. On the Nakai Plateau, all forests, savannah, grasslands and wetlands within a 450km² area (40% of the Plateau) will be inundated and vegetation lost. 57% of this land cover is considered disturbed habitat. In the remaining area, 50% of forests are in relatively good condition. No endangered or endemic tree species are however expected to be lost and from a provincial and national perspective, the impact of lost forest species and habitats is not considered significant. As waters rise, resident and visiting wildlife, including birds, will need to find new habitats and territories. A large number of islands will form on the western end of the Nakai Reservoir and some animals might find refuge on these islands. However these habitats will not be large enough to accommodate all animals. Some animals, including some mammals and reptiles, might become stranded and vulnerable to hunting. The seasonal migration of large mammals, such as elephants, from the NNT NPA to the Phou Hin Poun NPA will be disturbed by the presence of the reservoir, resulting in potential conflicts between animals and the local human population.

74. Other areas of vegetation which will require clearance include 0.1-0.15km² to facilitate construction of the Nakai Dam, 27km² for construction of the new alignment of Road 8B, and 1.5km² for the Regulating Pond. All vegetation will also be removed along the 27km length of the Downstream Channel affecting rice paddies, secondary forests and a small wetland. Habitats along the 12km stretch of the Nam Theun below the Nakai Dam until the Nam Phao confluence will be affected as a result of reduced discharge and there will be encroachment of vegetation into the river channel. The nearby forest should not be affected but the reduced flow may impact terrestrial wildlife that depend on fish in this stretch of the river. Impacts on terrestrial biodiversity in the Xe Bang Fai are mainly attributable to increased discharge and associated loss of land particularly riverine forests. Increased discharge particularly during the dry season may also affect the migration of mammals and other wildlife across the river. Finally, the main impact of the transmission lines will be from the clearance of vegetation for towers and maintenance access roads. The transmission lines pass through a mixture of agricultural land, scrub and degraded forest; 62km of the 500kV line pass through lowland dry evergreen forest, secondary succession mixed deciduous and dry dipterocarp forest.

75. **Mitigation** of impacts on terrestrial biodiversity includes a wildlife management and protection programme in the NNT NPA to compensate for the losses caused by the Project.

NTPC will provide US\$6.5 million during construction and a further US\$1 million for each year of its operating concession to support this management (total US\$31.5 million). The Project will also restore a similar area of currently degraded forest under a compensatory forestry programme. The programme will focus on forest areas where crown cover is less than 20% including areas within the NNT NPA, areas earmarked for sustainable forestry in the Nakai Plateau Resettlement Area and forest areas on the Plateau outside the area affected by inundation. Degraded forest areas will be improved through a combination of natural regeneration, enrichment planting (using native species) and other techniques as necessary, supported by detailed surveys of degraded areas, consultations with local people, development of management plans, tree nursery and monitoring. Furthermore, a plan will be developed for the management of animal relocation from the Nakai Plateau to reduce potential conflicts with the local population and prevent wildlife vulnerability to hunting. An elephant programme currently under development will assess elephant population size, migratory patterns and resource use to help provide recommendations on management strategies to prevent elephant-human conflict. Construction areas and associated vegetation clearance will be minimised to the area needed for efficient activity. In the Nam Theun downstream of the Nakai Dam, mitigation will be based on management of the riparian flow. An analysis of riparian release and its impact on downstream ecosystems has been conducted to support this. Impacts associated with the transmission lines will be mitigated primarily through the selection of alignments that minimise the amount of vegetation disturbed or cleared.

3. Threatened Species

76. Threatened species may be impacted as a result of increased human populations on the Nakai Plateau, destruction of habitats as a result of construction and reservoir inundation and increased access to habitats where species occur. The increased human population on the Nakai Plateau, particularly during construction, will engender hunting pressure on wildlife. The value of wildlife for communities on the Plateau is considerably greater than that of domestic livestock. Clearance of vegetation and reservoir inundation will remove habitats and also cause species to drown, be displaced or stranded on islands. Some habitats of the Asian elephant will be lost through inundation of their mineral licks and forage areas. The white-winged duck is likely to disappear from the area, if no appropriate attention is given to it. The reservoir will improve accessibility to the NNT NPA and with it, the potential for increased hunting pressure and trade in endangered species in the NPA.

77. The Nakai Reservoir will only inundate 40% of the Nakai Plateau. The remaining area, within which 50% of forests are in relatively good condition, may be sufficient habitat to maintain viable populations of most of the Plateau fauna. Elephants move seasonally between different parts of the Plateau and therefore require special mitigation.

78. **Mitigation:** Specific conservation programmes for the Asian elephant and White-winged duck will be established. Furthermore, a survey of wildlife on the Nakai Plateau will be conducted during the construction phase. If any of 16 key bird and mammal species¹ are determined to be present on the Plateau during this survey, a full-scale study of these species may be arranged in order to develop management programmes through for example the

¹ 6 mammal species (Sunda Pangolin, Sun Bear, Asian Small-clawed Otter, Clouded Leopard, Tiger, Asian Elephant) and 10 bird species (Siamese Fireback, White-winged Duck, Wreathed Hornbill, Tawny Fish Owl, Wood Snipe, Grey-headed Lapwing, Black Kite, Small Pratincole, Greater Spotted Eagle, Grey Heron) have been selected based on research by WCS and IUCN as key species for protection. Their presence on the plateau is not currently known. If their populations are well managed, other species will also be protected because of the habitats they share.

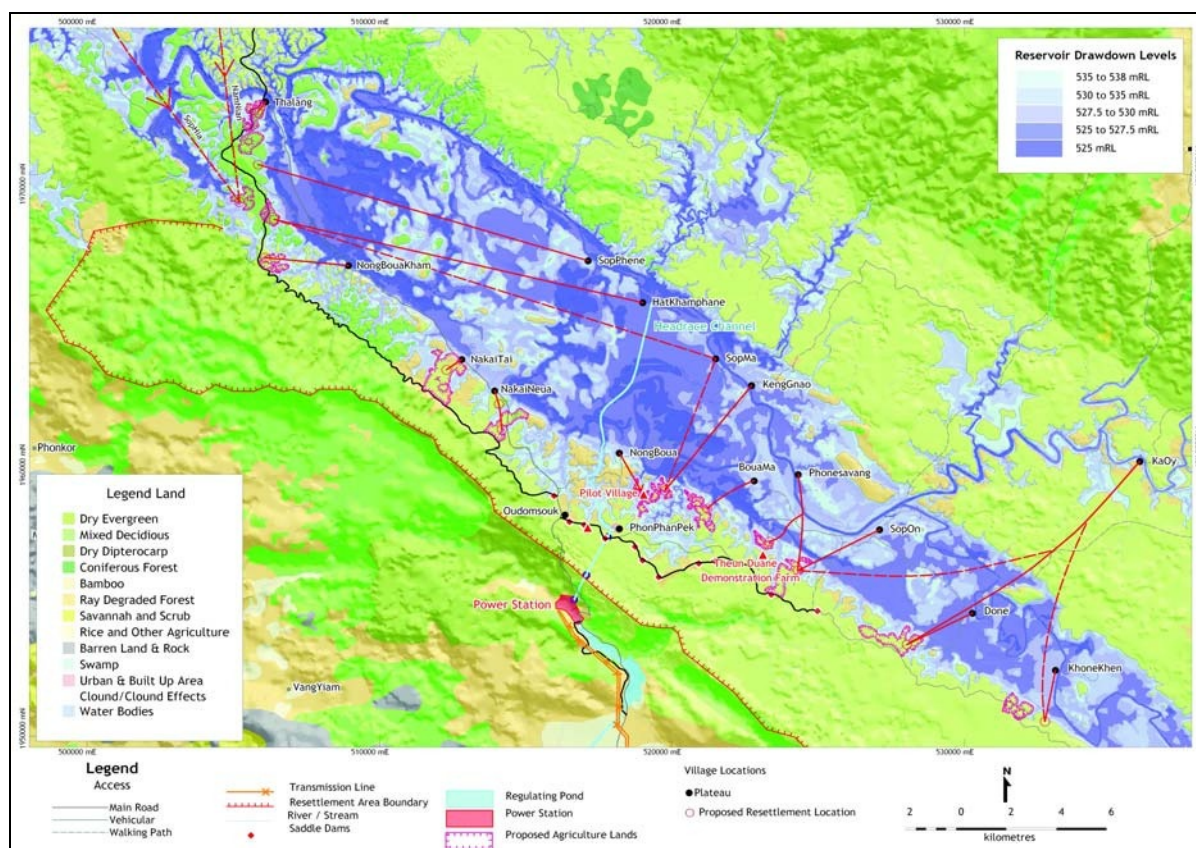
protection of key habitats, resources and population dynamics on the Plateau and in the NNT NPA. In addition, wildlife (particularly indicator species such as elephants, primates and hornbills) will be monitored to detect actual changes and trends in population and enable further management. Construction impacts will be minimised through careful location of workcamps and implementation of Head Construction Contractor Environmental Management and Monitoring Plans (HCCEMMPs).

C. Environmental Impacts Associated with Resettlement Sites

79. The proposed resettlement area of approximately 210km² lies on the southwest side of the proposed reservoir (Figure E.1). The establishment of these resettlement sites and the livelihood activities of the resettled people may result in a number of impacts on existing land and natural resources including:

- (i) Loss and disturbance of natural habitats;
- (ii) Erosion and degradation of soil;
- (iii) Overexploitation of wildlife and aquatic resources and human wildlife interactions;
- (iv) Deterioration of water quality resulting from fertilizer use and poor wastewater disposal;
- (v) Increase in population attracted by new infrastructure and economic opportunities; and
- (vi) Necessary shift from subsistence livelihoods to a market economy.

Figure E.1. Proposed resettlement area and its environmental characteristics



Source: Final Draft EAMP, November 2004

80. **Mitigation** measures will include a range of infrastructure services and management controls in the resettlement villages such as proper waste treatment facilities and disposal, prohibiting shifting cultivation in the resettlement area, protection of susceptible soil surfaces with seeding and/or mulch and sustainable management of 100km² of the resettlement area by the Nakai Plateau Forest Association.

D. Impacts on Social Environment

81. Social impacts are anticipated in 5 key areas, namely the Nakai Plateau, downstream Nam Theun below the Nakai Dam, in the NNT NPA, along the Xe Bang Fai and in Project Lands (e.g. Power Station, Regulating Pond, Downstream Channel, Residence Nam Theun, work camps, quarries, spoil disposal sites, transmission lines, roads etc.). Social impacts in each of these areas and proposed mitigation are summarised in Table E.3 and discussed in Sections V.D.1 – V.D.5. Social impacts associated with construction works (e.g. health effects) are examined in more detail in Section V.F. Under the Project's resettlement policy, all affected persons will be appropriately compensated for any adverse impacts. The intention is that they should be better off than they were before the Project.

Table E.3 Summary of Social Impacts and their Mitigation

Direct and Indirect Impacts of the Project	Key Areas affected					Proposed Mitigation (General – not directly associated with the impacts)
	1	2	3	4	5	
<ul style="list-style-type: none"> Relocation of estimated 1,128 households (~6,224 people) Loss of land and changed livelihoods Resource access restrictions and altered livelihood Social stress caused by resettlement and displacement Potential in-migration leading to competition for resources (infrastructure and natural resources), reduced capacity of local authorities and marginalization of ethnic groups Influx of people (during construction and operation) could create inflation, price increases and shortages of essential goods and services due to increased demand Changes in ecology and accessibility to rivers for people dependent on aquatic resources for nutrition Changes in water quality and water flow resulting in the introduction or elimination of water-borne disease 	√					<ul style="list-style-type: none"> Full compensation for lands, resources and livelihoods lost or changed with aim that they should be better off than before the Project Livelihood packages, fisheries and forestry development Improved land tenure Improved institutional capacity for local, regional and national institutions for implementing resettlement and livelihood development plans Exclusive rights for resettlers in relation to natural resource management Health, education and community development initiatives for resettlers Monitoring of erosion along Xe Bang Fai and provision of compensation as needed Specific measures to ensure benefits for women and potentially vulnerable groups Culturally sensitive consultation and mitigation for ethnic minorities Mitigation framework for monitoring and implementation of measures to enhance Project benefits in Xe Bang Fai and other downstream areas (e.g. irrigation potential and capacity building) Human trafficking, HIV/AIDS, drug use awareness and preventive education
	√	√		√	√	
	√	√	√	√		
	√					
	√					
	√			√		
	√			√	√	
	√	√			√	

Direct and Indirect Impacts of the Project	Key Areas affected					Proposed Mitigation (General – not directly associated with the impacts)
	1	2	3	4	5	
<ul style="list-style-type: none">Health impacts including increased STDs (esp. spread of HIV/AIDS), drug use, alcoholism, poor sanitation, spread of other communicable diseases and human trafficking (see further under Section V.F)Improved access to markets, schools and health facilitiesIncreased irrigation potential	√	√		√		programmes for communities, workers and spontaneous settlers (a Public Health Plan and a Human Trafficking Awareness Plan have been prepared)
	√			√	√	
Impact Areas: 1. Nakai Plateau; 2. Nam Theun below Dam; 3. NNT NPA; 4. Project Lands; and 5. Xe Bang Fai						

1. Nakai Plateau

82. The key social impacts in this area will be relocation of approximately 1,128 households; loss of 560 ha of rice fields, 139ha of other crops and vegetables, forest land and fishing grounds; associated social stress; and changes in lifestyles and livelihoods this will cause. Residents of the Plateau will also be affected by construction activities including disturbance, increased pressure on resources and services, possible inflation due to increased demand, health risks (e.g. HIV/AIDS) and human trafficking risks associated with influx of workers and camp followers (approx. 800 workers with perhaps an additional 3,200 followers) and marginalization of vulnerable ethnic minorities. Construction impacts are examined in more detail in Section V.F.

83. **Mitigation:** The proposed Resettlement Area is situated on the southwest shore of the Nakai Reservoir as shown in Figure E.1 above. Efforts have been made to select resettlement sites within existing traditional and spiritual territories and to ensure cultural continuity and familiarity. Of the 17 villages to be moved, ten will be relocated 3.5km or less from their existing site. One will be moving 4.8km whilst four villages will move between 10-15km. Two villages will remain at their present location: in Ban Oudomsouk, only a third of houses will need to be relocated whilst in Phonphanpek, only agricultural land and no houses will be affected. The resettlement sites comply with village desires to be near to the future reservoir, an all weather road, their present locations, the forest, and land that can be used to grow rice. Approximately 650 ha of land will be converted to sustainable, irrigated agricultural land. The ways Project affected people have influenced the resettlement process through consultation and participation is indicated in Appendix 3.

84. The Resettlement Action Plan (RAP) for the Nakai Plateau (contained in the SDP) has been designed to ensure that all resettled families are significantly better off after relocation: the projected income target is US\$1,200 (2002 value) per household per year. NTPC is also committed to ensuring that all relocated households have income levels above the Lao PDR poverty line of US\$800 within 4 years of relocation. Provisions will include livelihood options for agriculture, commercial forestry, reservoir fisheries and animal husbandry. Each relocated family will be provided with at least 0.5ha of cleared land for crops, vegetable gardens, fruit trees and some rice fields plus seedlings, tools, agricultural and labour training amongst other things. A full range of infrastructure will also be provided including irrigation supply, domestic water supply, electricity, schools and community facilities. The legal entitlements of affected people are laid out in NTPC's Concession Agreement, an extract of which is presented in Appendix 4. The Ethnic Minority Development Plan (contained in the SDP) describes issues

associated with the relocation of ethnic groups particularly those more vulnerable to the change and details the mitigation measures to be adopted.

85. The Project will also fund a health programme for the benefit of resettled people to compensate for any non-mitigatable adverse health impacts. Health monitoring will take place twice a year per person in all resettled communities. There will also be concentrated campaigns on HIV/AIDS for resident communities and the Project workforce. Training, equipment and supplies will be provided to local health workers.

86. A Pilot Village was established in 2002-3 in order to test assumptions about the feasibility of the resettlement programme, verify predictions and develop solutions to problems in advance of relocation. Three hamlets were moved and the experience gained has enabled the refinement of future resettlement plans. Figure E.2 provides a comparison between housing in the pilot village and the current standard on the Nakai Plateau.

Figure E.2. A Comparison of Pilot Village housing (left) with current standard on the Nakai Plateau (right)



Source: Final Draft EAMP, November 2004

2. Nam Theun below Nakai Dam

87. No permanent villages lie along the Nam Theun from below the Nakai Dam until Ban Katok some 50km downstream, and no land is cultivated up to the headpond of the Theun-Hinboun Hydroelectric Project. Fishermen and hunters from nearby villages do however use this stretch of the Nam Theun. Fish diversity and abundance is expected to be impacted by reduced flows in this stretch of the Nam Theun with consequent impact on fishing practices, catches and local livelihoods. The extent of such impacts is currently being assessed in a Riparian Release Study and results will be incorporated into the Final EAMP and SDP. During construction, villages along road 8b will be affected by increased disturbance from construction traffic (travelling between quarry sites for example) and social and health impacts associated with approximately 800 construction workers and perhaps an additional estimated 3,200 followers (see further in Section V.F.).

88. **Mitigation:** A riparian study is being finalised to help better assess impacts and develop a strategy for appropriate management and compensation in this section of the river (Results expected late November 2004). Compensation for lost fisheries will be implemented in the fishers villages, which are somewhat distant from the river. Construction management plans will be implemented to mitigate impacts during construction.

3. Nakai-Nam Theun National Protected Area (NNT NPA)

89. As described in Section III.C, the communities living in the NNT NPA are the most impoverished in the Project area. Improvement of their livelihoods is currently hampered by their remoteness. Although the Project will not directly impact these communities, significant social implications are likely. Creation of the Nakai Reservoir will improve access for communities living in the NNT NPA, and access to the NNT NPA for outsiders. Without careful management, this could increase pressure on timber and wildlife resources and also encourage increased agricultural production to supply the demand on the Plateau from construction workers and their followers. If sustainable utilization of resources can be achieved, the reservoir will however enable better access to markets, health facilities and other services for NPA communities contributing to an improvement in their livelihoods. In the absence of sustainable land management in the NPA, increased sedimentation could affect the operations of the Project.

90. **Mitigation:** The Project has committed to provide US\$31.5 million of financial assistance and management support for the conservation of biodiversity and improvement of livelihoods of the communities residing in the NNT NPA. US\$6.5 million will be provided during the construction period and then a further US\$ 1 million/year throughout NTPC's operating phase (25 years). GOL has prepared a Social and Environmental Management Framework and 1st Operational Plan (SEMFOP) for the NNT NPA. This will be implemented, and funds administered by a Watershed Management Protection Authority (WMPA). The coverage and implementation of this plan is described in further detail in Section IX, but essentially, its objectives are to effectively protect the watershed, wildlife and biodiversity values; safeguard the well being, traditional livelihoods and culture of its human inhabitants; and improve their livelihoods by focusing on poverty reduction through environmentally sustainable development.

4. Xe Bang Fai

91. Impacts in the Xe Bang Fai will largely be restricted to Project operation. 7,096 households in 89 mainstream villages lie in areas potentially affected. Of these however, 19 villages are only impacted by backwater effects, and approximately 66 villages lie in the Xe

Bang Fai hinterland from which residents seasonally travel to fish in the Xe Bang Fai. Adverse impacts can be divided into four zones:

- (i) *Upstream of Upper Xe Bang Fai:* Project impacts are limited but the area may experience higher water levels as a result of backwater effect.
- (ii) *Upper Xe Bang Fai:* This area, containing 12 villages with 852 households, will experience the greatest impacts of additional discharges including loss of riverbank gardens, erosion of riverbank impacting fixed assets and other productive lands and impacts on fisheries.
- (iii) *Middle Xe Bang Fai:* 12 villages with 704 households will experience similar impacts to those in the Upper Xe Bang Fai but to a lesser extent.
- (iv) *Lower Xe Bang Fai:* 53 villages in 5,003 households live in this area. Negative impacts include flooding of lower riverbank gardens and possible changes to fisheries.

92. Communities along the Xe Bang Fai also have the potential to derive considerable benefits from the Project including increased potential for dry season irrigation and reduced pumping costs. Annual flooding currently results in damage to wet season crops; this is pushing communities towards dry season irrigation and the food security it provides. The Project will supply an additional 7,000 million m³ of water to the Xe Bang Fai facilitating the expansion of irrigated land.¹ The benefits from this additional flow are potentially greater for communities in the middle and upper Xe Bang Fai because their pumps currently run dry in the dry season. Other positive benefits resulting from higher flows include a reduction in vertical pumping distance from the river to irrigated fields (estimates suggest this represents a <28% saving in pump costs during the dry season); higher groundwater levels with consequent reduced abstraction costs and improved river transport during the dry season.

93. **Mitigation:** all Project-affected people will be fully compensated for impacts on property and/or livelihood. Erosion levels along the Xe Bang Fai will be monitored during operation and mitigation and compensation agreed on a case-by-case basis. Villagers will also be able to alert District Compensation Committees of any abnormal erosion rates or affected infrastructure / livelihoods. A comprehensive baseline survey of fish stocks began in 2001 and will continue through Project operation to determine Project impacts on fisheries and any mitigation needed.

5. Project Lands Resettlement, Acquisition and Compensation

94. The Project will require exclusive use of up 2,565 ha for the construction of project infrastructure, including the Power Station site, Regulating Dam and Pond, Downstream Channel, quarries, spoil disposal sites, Nakai saddle dams, access roads and the transmission lines. Of this, 519.8 ha comprise productive assets that will be permanently lost and 842.61 ha that will temporarily be used during construction. Only limited acquisition of houses is expected for Project Lands (mainly in Ban Oudomsouk on the Nakai Plateau due to saddle dams) and in circumstances where a household is displaced, relocation will only be a short distance and within village boundaries. Other land, buildings and productive assets in the Project Lands will need to be acquired with associated compensation to current owners and users.

95. Few productive assets exist at the Nakai dam site and its access roads although some swidden fields and NTFP collection activities will be interrupted. Approximately 13ha of paddy

¹ This indirect Project impact will require further investment, outside the Project, to realize the agricultural productivity potential. A World Bank rural development project is currently assessing this potential.

and productive gardens will be affected at the Pha Phen (Phou Phako) quarry site including its access roads. For other Project roads neither resettlement nor significant compensation is anticipated. Similarly, construction of transmission lines is expected to result in loss of very little, relatively small parcels of land required for the towers with appropriate compensation. The Nakai construction camp, intake structure and saddle dams will mainly impact Oudomsouk village and associated assets as indicated above and households affected in this way will be eligible for the resettlement, compensation and livelihood programs described for the Nakai Plateau in the SDP.

96. The water release from the power station was originally planned to flow into the Nam Kathang. Baseline studies and consultation however indicated that this could result in erosion and water quality impacts, large scale resettlement and loss of land and assets. The Downstream Channel, Regulating Dam and Regulating Pond were therefore integrated into the Project design to prevent and minimise these impacts. As a result, there are no villages located on the actual alignment of the Downstream Channel or in the area to be inundated by the Regulating Pond. 17 villages and approximately 1064 households are however located in the corridor of the Downstream Channel, spoil disposal locations, access roads and the 115 and 500kV transmission lines and assets belonging to these households may potentially be affected. For example, the Regulating Pond will inundate a number of vegetable and banana gardens, fields and some huts; the Regulating Dam and proposed operators village also lie directly next to the village of Ban Keovilay and its fields. The Downstream Channel will traverse productive rice paddy land for approximately 8km of its 27km length. Households along the route will however benefit from increased potential irrigation and higher groundwater levels (requiring less pumping energy) consequent of higher dry-season flows.

97. **Mitigation:** NTPC is making every effort to minimise the need for direct resettlement, land/asset acquisition and compensation in Project Lands. Significant social impacts have already been avoided through the inclusion of the Regulating Dam and Downstream Channel. Routes and locations of other Project Lands are currently being carefully planned so as to minimise social disturbance. To this effect, a detailed on-the-ground survey has been underway since June 2004 to confirm all potentially affected land, buildings and assets previously identified through interpretation of satellite imagery. The survey also includes consultation with potentially affected people to identify land uses and assets and determine appropriate compensation measures. The approach to compensation has been defined within a Project Lands Resettlement and Compensation Framework (part of the SDP) and in principle; compensation will be in replacement of assets or livelihoods of equal value if the direct impacts are significant (in-kind replacement for land/assets or direct replacement to enable the project affected person to achieve the same level of imputed income). Where assets or livelihoods lost is only a relatively small percentage of a family's total livelihood or income or when specifically requested by the Project-affected person, cash compensation will be given as an alternative.

6. Vulnerable Populations

98. The 1998 census found that approximately 23% of affected households on the Nakai Plateau fell into the vulnerable category. Households may be vulnerable for a variety of reasons, including poverty levels, ethnicity (e.g. particular the adaptability of ethnic groups to sedentary agriculture) and household characteristics (e.g. households headed by a widow, female, handicapped person or male over 60 years of age, single person households and households with a handicapped person). The majority of households to be resettled live below the official poverty line.

99. **Mitigation:** All vulnerable households will be monitored and given special consideration in the resettlement and compensation process. Income levels will also be closely monitored during implementation and economic vulnerability will be considered in the overall livelihood planning process. To ensure that ethnic minority concerns are addressed, constant interaction between minority groups and the Resettlement Management Unit and other agencies will be necessary and will be encouraged. Specialist international and national professional support will be used.

7. Social Stress

100. The social impacts described have the potential for causing social, psychological and physiological stress amongst affected people, particularly those to be relocated. This in turn can lead to problems such as alcoholism and drug abuse and place stress on social, cultural and family structures. The sources of stress may include:

- (i) Problems associated with the resettlement process and potential community discord;
- (ii) Risk of impoverishment relating to difficulties in adapting to new livelihood systems;
- (iii) Potential exploitation by others in the relocation / compensation process; and
- (iv) Possible conflicts within or between communities, or with government agencies.

101. Measures have and will continue to be taken to mitigate these potential causes of stress and concern. A key aspect of this has been the adoption of a participatory approach to resettlement and compensation. Studies show that close involvement and understanding of the process minimises the likelihood of negative consequences. Participatory rural appraisal techniques have been employed to familiarize village leaders and the community at large with the Project and to find out their opinions and expectations.

102. The strengthening of community institutions will also play an important part in minimizing social disruption and discord. Responsive and accessible village administration is essential in ensuring that affected households have the community support they need in times of stress. A detailed programme will be put in place for the establishment of appropriate village committees and for the transition of some settlements from informal hamlets to official administrative units.

E. Impacts on Physical Cultural Resources

103. The Nakai Reservoir will affect a number of physical cultural resources (PCR) within the inundation area including sites of spiritual significance and 26 cemeteries. These resources are part of the cultural traditions of the villages in this location and will require appropriate spiritual ceremonies prior to any impact. Methodologies will be agreed with communities, relevant government authorities and an internationally recognized specialist. Construction activities in Project Lands also has the potential to impact a number of PCRs including disturbance to religious amenity to religious sites, physical damage to religious structures, historic sites (e.g. temples, historic lime kilns) and cemeteries and theft of moveable objects and artefacts (e.g. from within temples). Special care will also need to be taken to protect sites of prehistoric and spiritual value around the Pha Phen (Phou Phako) quarry site.

104. **Mitigation:** The results of the most recent PCR survey (carried out in 2004) have been used to develop a management plan which includes a) community awareness programs, b) relocation of PCR, c) appeasement ceremonies, d) securing moveable PCR, e) conducting

archaeological salvage operations, f) conducting additional risk assessments, and g) a procedure for dealing with chance finds. Survey results and management measures are also being integrated into resettlement plans.

F. Environmental and Social Impacts during Construction Works

105. In addition to land acquisition described in Section V.D.5 above, physical construction works in all Project Lands could lead to environmental and social impacts if mitigation measures are not appropriately implemented. Because exact locations, specific designs and precise techniques and work methods have not yet been finalized, detailed, quantitative assessment of many construction impacts is not possible at this stage. The Head Construction Contractor is developing a Head Construction Contractor Environmental Management and Monitoring Plan (HCCCEMMP) that would form the basis to carry out more detailed analyses and implement appropriate management plans as these issues become better defined (see Appendix 1 for a list of sub-plans contained in the HCCCEMMP). A preliminary identification of impacts and their mitigation is however presented in *Table E.4*. Construction impacts associated with quarry sites, work camps, road construction / upgrading and transmission lines are discussed in more detail thereafter.

Table E.4. Summary of Key Impacts during Construction and their Mitigation

Impact Type	Source of Impact	Proposed Mitigation
Environmental Impacts		
Biological Diversity	<ul style="list-style-type: none"> See Section V.B 	<ul style="list-style-type: none"> See Section V.B
Water Quality	<ul style="list-style-type: none"> Erosion from areas disturbed by construction activities Wastewater discharges (from construction sites and from construction camps) Spills and leakage of fuels, chemicals Pesticides and herbicides used in site clearance Contamination as a result of inappropriate waste disposal 	<ul style="list-style-type: none"> HCC is required to prepare several plans including an Erosion and Sediment Control Plan and a Water Quality Monitoring Plan. Good site management practices Treatment facilities to remove oils and grease from water to be discharged Prevention / control of spills Provision of wastewater treatment facilities for all wastewater from construction camps and other construction facilities Strictly controlled use of synthetic chemicals for vegetation clearance
Air Quality	<ul style="list-style-type: none"> Emissions from vehicles and equipment operating at construction sites and passing through settlements Dust generated by construction activities at quarry sites, concrete batch plants, construction sites, dust on roads and passing traffic Burning of waste 	<ul style="list-style-type: none"> Maintenance of vehicles and stationary equipment in good working order Spraying water on roadways to control dust Limiting area where dust could be generated through good site management practices and work scheduling Burning of waste will only be carried out in designated areas away from settlements Burning of materials that could cause toxic fumes will not be allowed HCC will prepare an Emissions and Dust Control Plan
Noise	<ul style="list-style-type: none"> Excavation and other construction activities including quarrying, concrete batch plant and crushers Explosives used for dam construction and tunnelling Vehicle noise 	<ul style="list-style-type: none"> Maintenance of vehicles and stationary equipment in good working order Installation of noise mufflers on all engines Explosives will only be used during daylight hours when wildlife is less active Little or no explosives used underwater so as to

Impact Type	Source of Impact	Proposed Mitigation
	<ul style="list-style-type: none"> Associated impacts on wildlife and human populations 	<ul style="list-style-type: none"> prevent harm to fish / aquatic species HCC will prepare a Noise Control Plan
Disposal of Spoil	<ul style="list-style-type: none"> Estimated 15million m³ of spoil will be generated during construction of e.g. Downstream Channel, Headrace Channel and intake tunnels Disposal could destroy habitats, generate dust and affect surface water quality 	<ul style="list-style-type: none"> Where possible, spoil will be reused in construction of roads, rim bunds, sediment traps, landscaping and resettlement village construction Final sites for disposal to be determined through environmental studies and consultations and incorporated into HCC Spoil Disposal Plan
Social Impacts		
Disruption to livelihoods	<ul style="list-style-type: none"> Materials sourcing Noise Traffic through settlements Closure / restrictions to use of land or transport routes 	<ul style="list-style-type: none"> Development and implementation of HCCEMMP to include management of noise, traffic, dust and interactions with local people Account will be taken of social impacts when identifying materials sourcing locations such as land acquisition which will be mitigated through the SDP
Health	<ul style="list-style-type: none"> Increased likelihood of accidents (human and livestock) as a result of increased traffic Contamination of drinking water STDs Pestilence 	<ul style="list-style-type: none"> Implementation of a Project Staff Health Management Programme Appropriate waste and wastewater management and disposal Traffic control measures Minimise breeding grounds for pests in the HCC Construction Camps.

1. Quarry Sites

106. Limestone aggregate, sand, laterite and sandstone are needed for road base, concrete structures (e.g. dams, Power Station, Intake Structure, tunnels and Downstream Channel). 15 potential quarry sources have been identified although final sites will be determined based on a closer comparison of environmental and social impacts. These impacts include visual intrusion because of removal of a significant part of some hills, noise (and its associated impacts on wildlife and people), sedimentation (and associated impacts on water quality), impacts on PCR and impacts associated with the transport of material to work sites.

107. **Mitigation** will include protection against erosion, sedimentation, air quality and noise as laid out in *Table E.1.* and preparation (by the HCC) of a Quarry Management Plan as part of the HCCEMMP. EIAs of quarry sites will be undertaken 6 months prior to the start of construction. At the end of exploitation, the quarries used will be rehabilitated.

2. Work Camps

108. Four zones have been identified for possible location of construction work camps to accommodate the anticipated 4000 workers the Project will require (see Figure 3 in Appendix 5). Based on experience from the Theun Hinboun hydroelectric Project, these camps could attract up to four times as many camp followers. Total additional people in the area could therefore reach 20,000. Potential impacts arising from the workforce and the spontaneous development it will attract include pressure on land and natural resources (e.g. hunting), generation of solid and liquid wastes and increased public health risks (including an increase in prevalence of sexually transmitted diseases such as HIV/AIDS). Without treatment, wastewater could cause water quality problems in adjacent water bodies, which could affect fish populations and human health. Inappropriate solid waste disposal could lead to contamination of soil, groundwater and rivers and the spread of pests and communicable diseases.

109. **Mitigation** of impacts will be outlined in the HCCEMMP and Construction Work Camps Plan including bans on construction worker hunting, fuel gathering and collection of NTFPs, implementation of a Project Staff Health Management Programme to educate and provide health services to the workforce and appropriate waste and wastewater management. In addition, GOL will implement strict regulations to prevent hunting and will strictly license new businesses conditional on their appropriate disposal of wastewater, waste and sanitary conditions. Solid waste collection and proper disposal outside of the reservoir area will be established. NTPC is currently investigating how impacts could be further reduced by minimising the number of camp followers. Experience from other recent projects in the area is being used to examine options for NTPC e.g. maximising employment from settlements in the Project area and bussing workers to work sites.

3. Construction/upgrading of Roads

110. The Project will upgrade approximately 106km of existing public roads and construct 56km of new roads. In addition, access roads and tracks (some temporary) will be needed for construction, operation and maintenance. Neither resettlement nor significant compensation is anticipated. Potential impacts include clearance of vegetation, erosion and sedimentation, dust during construction, car interactions with people, livestock and wildlife, induced development and increases in population, and increased access; this could generate negative impacts through increased hunting of wildlife and timber extraction but will also benefit affected populations by providing them better access to markets, schools, health and other services.

111. **Mitigation** will include construction controls as detailed previously e.g. on erosion, air emissions and noise etc., design alignments to minimise impacts on vegetation, provision of road signage and enforcement of maximum speeds.

4. Transmission Lines

112. Impacts from the three Project transmission lines (500kV, 115kV and 22kV) will occur predominantly during construction and will include clearing of vegetation for easements and access roads. This is discussed in Sections V.B.2 and V.D.5. During operation, impacts will be limited to electromagnetic radiation, visual impacts and impacts associated with access and maintenance of the lines. Electric and magnetic field calculations for the transmission lines have been compared to guidelines endorsed by the International Commission on Non-Ionizing Radiation Protection. Electric and magnetic field are expected to be within the guidelines, for all exposure characteristics with the exception of the “up to 24 hours per day” exposure category, which is exceeded by the predicted electric field of the 500kV transmission line only.

113. **Mitigation** during construction will be incorporated into the HCCEMMP and its Vegetation Clearing Plan. The Pest Management Plan also limits the use of herbicides for site clearance. For health impacts associated with electromagnetic radiation, mitigation measures will ensure no human habitation within the easement of the transmission line: no public health impact is therefore anticipated.

VI. ENVIRONMENTAL AND SOCIAL ASSESSMENT OF THE THAI TRANSMISSION LINE

A. Introduction

114. NTPC is responsible for delivering electricity to the Lao Thai border north to the town of Savannahket (138km 500kV transmission line). To supply the electricity into the EGAT system, an additional double circuit 500kV transmission line, approximately 161.2km in length, will be constructed from the Lao-Thai border to a new substation at Roi Et, Thailand. Planning and construction of this additional transmission line is the responsibility of EGAT. EGAT is not receiving any financial support from ADB or WB for the construction of this transmission line, necessary for the transmission of the power generated by the Nam Theun 2 Project.

115. Thai law on environmental assessment requires an Environmental Impact Assessment (EIA) for transmission lines that pass through an area of Class 1B watershed and an Initial Environmental Examination (IEE) to be prepared if the line passes through a new forest reserve. On this basis, the Office of Natural Resources and Environmental Policy (ONEP) have confirmed that no EIA or IEE is required under Thai law as the route of the transmission line has been changed in order to avoid a forestry reserve.

116. With respect to social issues, EGAT has powers under the EGAT Act of 1968, to purchase, occupy and use land or property to construct transmission lines under, above, along or across land belonging to any person. For this, EGAT pays fair and just compensation at prevailing market rates for land acquired and/or used. EGAT's corporate plan explicitly requires public participation and seeks public acceptance of projects.

117. The transmission line is scheduled for approval by the Thai Cabinet in December 2004. EGAT indicated that land acquisition and any further environmental surveys (e.g. detailed forestry survey, land survey, and IEE study) would commence thereafter.

118. For the purpose of funding agency due diligence, an ADB mission visited the proposed alignment in June 2003. The route will require a 60-metre wide right of way (ROW) along its 161.2km length, amounting to 9.7km² of land. Eighty percent of the proposed ROW is currently under paddy with some other crops under cultivation. The remaining 20% is under fruit orchards (mainly mango and coconut), eucalyptus plantations and some areas of forest (both public and private) between Moei Wadi and Amphur Wan Yai of Mukdahan (Mekong crossing). The line passes close to villages but only 1 house currently lies on the alignment.

119. Construction of around 300 transmission line towers will require permanent acquisition of 12 ha of ROW land with an estimated 2000 plots in private ownership. Only land under towers is permanently acquired. The EGAT Act 1968 requires this land to be compensated at full replacement value. Remaining land in the ROW remains the property of the land owner but with restricted use (no structures or trees over 3m in height). Any affected trees are compensated at a rate that takes into account the disruption in income associated with the trees. Environmental impacts are likely to be associated with some clearance of natural vegetation and habitats. Construction across rivers may require special management for erosion control and slope stabilization. Health impacts on people living or working in the vicinity of the cable line associated with electro-magnetic radiation will also need to be considered.

120. The ADB mission concluded that it was satisfied that EGAT could prepare satisfactory plans associated with resettlement and a copy of such plans shall be requested by ADB for

review when available. With respect to environmental impacts, the ADB will continue to monitor the final decision from the Royal Forestry Department and the Ministry of Natural Resources and Environment regarding the requirement for an IEE. Should an IEE be prepared, a copy will be requested.

VII. CUMULATIVE IMPACT ASSESSMENT

A. Introduction and Scope

121. Given the potential for Project impacts to have wider implications when considered in the context of other development trends, the international funding institutions have requested a Cumulative Impact Assessment (CIA) in order to analyse the combined impacts of a number of projects, either implemented together or in a sequence and of future developments and plans, in relation to the Nam Theun 2 Project. The scope of the CIA includes effects other (future) developments have on the type and magnitude of Nam Theun 2 impacts (added impacts); and impacts of development in other sectors that are induced by the Nam Theun 2 Project (induced impacts).

122. The geographical coverage of the CIA includes the Mekong Basin, Nam Theun/Nam Kading, Xe Bang Fai and Hinboun basins and the linear development zone of transmission lines and roads. In addition, border areas are covered in relation to social development, transport and biodiversity.

123. Two development scenarios have been assessed based on a 5-year and 20-year planning horizon. These scenarios cover a number of sectors by examining the present situation, existing plans and development trends. Sectors covered are: hydropower, transport, irrigation, water supply and sanitation, urban development, fisheries, forestry, industry, social development (including ethnic minorities, health, education and social disparity), and conservation (biodiversity issues). Of all these sectors, hydropower is the most planned and has the greatest potential to affect the whole Mekong Basin in terms of active (seasonal) storage of water. This results in increased dry season and decreased wet season flows. Other assumed sector developments are discussed in more detail in Appendix 6.

B. Cumulative Impacts of Anticipated Regional Development

124. A preliminary summary of anticipated cumulative impacts of Nam Theun 2 when combined with the anticipated developments in other sectors described above over a 5 and 20 year planning horizon are presented in Table G.1.

Table G.1. Cumulative Impacts of Anticipated Regional Developments Including Nam Theun 2 Project

Impact Zone	5-year scenario	20-year scenario
Nakai plateau	<p>Impacts dominated by Nam Theun 2 Project activities. Some additional impacts envisaged due to improved access following the construction phase and temporary population increase.</p> <p>Key impacts will be increased pressure on wildlife (e.g. from hunting and logging due</p>	<p>Situation stabilized but significantly changed compared to current baseline. Transport communications will be significantly improved and new activities will have been attracted to the reservoir (e.g. commercial fisheries and tourism). Anticipated situation is:</p> <ul style="list-style-type: none"> (i) Sanitation and water supply improved (ii) Oudomsouk population higher than

Impact Zone	5-year scenario	20-year scenario
	to an influx of people and better access to the area), increased health risks (STDs including HIV/AIDS) and increasing frequency and severity of vehicular accidents.	<p>during the Project construction period by some 140-150%</p> <p>(iii) Commercial fisheries will be established</p> <p>(iv) Health conditions improved with reduced incidence of malaria and food and water borne diseases, and shift from communicable towards non-communicable diseases</p> <p>(v) Health and education services improved but struggling to keep up with demand due to population increase</p> <p>(vi) Increased employment in service sector including tourism</p> <p>(vii) Increased cultural integration on the Plateau with blurring of ethnic identities</p>
NNT NPA	<p>(i) Reservoir will affect fish migration in the Nam Theun</p> <p>(ii) Better protection of biodiversity and forest resources through SEMFOP but also increased threats linked to road construction and population increase on the Vietnamese side of the border</p> <p>(iii) Improved delivery of social services including access to education, availability of medicines, possible reductions of malaria and nutritional problems</p> <p>(iv) Some integration of ethnic minorities but not to the same extent as on the Plateau</p> <p>(v) Some improvement in poverty alleviation</p> <p>(vi) Improved management and enforcement efforts in the NNT NPA may increase pressure on other NPAs</p>	<p>(i) Change in fish biodiversity and production dependent on type of fish population that establishes in the reservoir</p> <p>(ii) Increased threat to biodiversity due to population increase on the Vietnamese side of the border and increased exploitation of the NPA</p> <p>(iii) Further improvements in social services including immunisation coverage, hygiene and nutrition, health centres and functioning village schools</p> <p>(iv) Considerable out-migration and labour migration to urban areas due to natural population increase</p> <p>(v) Process of integration with lowland Lao culture will have proceeded further and led to assimilation of small Vietic groups</p> <p>(vi) Significant reduction of poverty in terms of food security, better market access and employment</p>
Xe Bang Fai Basin and Surrounding Districts	<p>Impacts of Nam Theun 2 Project operation have started to be felt. New Road 12 will also have significant impacts. Cumulative impacts are likely to be:</p> <p>(i) Increased untreated wastewater due to higher population around Gnommalat and Mahaxai</p> <p>(ii) Commercialisation and intensification of agriculture in Mahaxai and Gnommalat, but only moderate expansion in irrigated rice area</p> <p>(iii) Increased logging in undisturbed forest and other areas</p> <p>(iv) Considerable expansion of Gnommalat and Mahaxai settlements characterised by lack of planning</p> <p>(v) Increased prevalence of STDs (e.g. HIV/AIDS) and vehicular accidents more common</p> <p>(vi) Capacity of the various district</p>	<p>No new large-scale hydrological changes are foreseen, but the transport corridors and accompanying urbanization will be a significant development in relation to cumulative impacts. Situation likely to be:</p> <p>(i) Reduced problem of oxygen depletion due to less organic matter in the reservoir and improved wastewater treatment</p> <p>(ii) Localised eutrophication and increased levels of pesticides in rivers and fish due to intensified agriculture</p> <p>(iii) Reduced biodiversity and fish production due to disturbed spawning cycles caused by changed hydrological regime. However increased flooding may increase flood plain and back swamp production of fish</p> <p>(iv) Improved sanitation, health services and awareness on health issues. Water-borne illnesses and intestinal parasitic infestations substantially reduced and</p>

Impact Zone	5-year scenario	20-year scenario
	<p>services considerably strengthened due to Nam Theun 2 Project support</p>	<p>mortality from malaria and dengue fever strongly reduced</p> <p>(v) Substantial growth of Mahaxai and Gnommalat (perhaps by 200%) and of Thakhek (by 140-150%). Growth in service sector including tourism and expansion of cement industry in Mahaxai creating employment</p> <p>(vi) Some assimilation of ethnic minority groups in urban areas will have occurred, but cultural identity will be retained in rural areas</p>
<p>Nam Theun, Nam Kading and Nam Hinboun basins and surrounding districts</p>	<p>Nam Kading and Nam Hinboun will experience the combined impacts of Nam Theun 2 and Theun-Hinboun Extension Projects, in addition to the developments caused by improvement of Road 8 corridor, and increased cross-border trade and population movement. Predicted impacts are:</p> <p>(i) Reduced discharge in Nam Kading (below Theun Hinboun dam) in the flood season. With the Theun-Hinboun Extension, cumulative impact will be diversion of a larger part of the flood into the Nam Hinboun further reducing flows in the Nam Kading</p> <p>(ii) Reduced flood periods affecting fish migratory behaviour</p> <p>(iii) Increased threats to biodiversity due to population increase and increased trans-border traffic. The WCS wildlife conservation project will however tend to counteract this</p> <p>(iv) Remaining and limited forested areas increasingly encroached upon but participatory village forestry will have been introduced</p> <p>(v) Increase in irrigated areas and irrigation schemes along Nam Hinboun</p> <p>(vi) Population of Lak Xao increased to 17,000 - 18,000, partially due to in-migration</p> <p>(vii) Gradual integration of ethnic groups into mainstream economy will be accelerated slightly due to Nam Theun 2 related activities, population influx, increased urbanisation, improved infrastructure and growth in service sector. Vulnerable Vietic groups will be under particular pressure of integration.</p>	<p>No further hydropower expansion planned in the basin. Development will be dominated by increase in transport related activities and impacts and developments on the Plateau. Situation likely to be:</p> <p>(i) Increased pressure experienced in Nam Kading NPA, Phou Hin Poun NPA and Nam Chat/Nam Pan Provincial Conservation Forest due to increased pressure of cultivation, logging and hunting and as a result of improved protection of NNT NPA</p> <p>(ii) Rural-urban migration trend reinforced and size of Lak Xao increased to 27,000 – 28,000</p> <p>(iii) Full assimilation of smaller ethnic groups, in or near Lak Xao (including some Vietic groups), losing their ethnic identity</p> <p>(iv) Hmong cultural traditions and language are likely to continue despite changes in the socio-economic conditions</p>
<p>Mekong River Basin (Scenarios include all)</p>	<p>Dominant factor will be some additional development of hydropower in Yunnan (China) and Lao PDR. The impacts are calculated to be:</p>	<p>Dominant impact will be further development of hydropower in Yunnan (China) and Lao PDR. Impacts are calculated to be:</p> <p>(i) Dry season discharge at Savannakhet</p>

Impact Zone	5-year scenario	20-year scenario
hydropower developments in the basin including Yunnan)	<ul style="list-style-type: none"> (i) Dry season discharge at Savannakhet may increase by 45%. During floods, discharge reduced by 7% (ii) Water levels at Phnom Penh will be lower during floods and increased during the dry season. Average annual maximum level of Tonle Sap lake will also be reduced (iii) Changes in flow pattern will have a small negative impact on floodplain and Tonle Sap lake fisheries as these are favoured by high wet season water levels (iv) Changes in flow pattern will however have a small positive impact by damping damaging flood incidents and by increased dry season water level that will support irrigation and reduce salt intrusion in the Mekong Delta 	<ul style="list-style-type: none"> may increase by 135%. During floods, discharges may reduce by 22% (ii) Water levels at Phnom Penh will be lowered further during floods and increased further during the dry season. Average annual maximum level of Tonle Sap lake will be further reduced. (iii) Changes in flow pattern will have a significant negative impact on floodplain and Tonle Sap lake fisheries (iv) Changes in flow patterns will however have a significant positive impact by damping damaging flood incidents and by increasing dry season water levels that will support irrigation and reduce salt intrusion in the Mekong Delta

125. The CIA also examined the specific contribution of the Nam Theun 2 Project to the downstream changes in the Mekong described above. The Nam Theun 2 Project alone is predicted to result in an increase (of c. 8%) in dry season discharge at Savannakhet while reducing flood discharges by 2%. The Nam Theun 2 reservoir is also expected to cause only minimum retention of sediments.

126. The CIA concluded that the Nam Theun 2 Project alone will have an insignificant¹ negative impact on the Mekong floodplain and on all aspects of the Tonle Sap lake including fish production. It recommends a number of best practice actions mitigate and compensate impacts of developments and predicts the results of these actions on the 5-year and 20-year scenarios. These recommendations will be considered by GOL and jointly discussed and implemented with the donor community and international agencies such as the Mekong River Commission.

C. Sectoral Environmental Assessment of the Hydropower Sector

127. The Lao Hydropower Development Strategy was developed based on a series of studies on the power sector undertaken over the last 10 years. Many of these studies, have incorporated environmental and social criteria in choosing alternative hydropower development plans and discussed the environmental and social issues related to development in the sector. A Sectoral Environmental Assessment for the Lao Hydropower Sector has been undertaken to consolidate, update and expand this previous work in order to clarify the broader issues faced by hydropower development in Lao PDR and develop strategic priorities for improving the management of environmental and social issues within the sector. Broad recommendations relevant to all potential developments in the sector include water and land related mitigation measures, compensatory programmes including catchment protection, forestation plans, fisheries development plans, social and ethnic minority development plans and nature

¹ Significance is based on whether or not the induced impacts of Nam Theun 2 are within the range of normal fluctuation.

protection measures. Strengthening the capacity of GOL and its agencies to understand and take account of environmental and social issues is also recommended.

VIII. ECONOMIC ASSESSMENT

128. In terms of environmental and social impacts, perhaps the most significant Project impacts are the inundation of the Nakai Plateau and trans-basin transfer of 220 m³/s of water (annual average) from the Nam Theun into the Xe Bang Fai. The diversion of water will significantly alter the discharge regime in both the Nam Theun (flow reduction) and the Xe Bang Fai (flow increase). These characteristics imply a significantly different distribution of the environmental and social costs and benefits across the impacted areas of the project.

129. For the purpose of economic valuation, Project impacted areas have been divided into 5 distinct areas namely the Nam Theun downstream of the Nakai Dam; the NNT NPA; the Nakai Plateau; the Xe Bang Fai; and the Mekong River. The economic assessment also distinguishes between costs and benefits that are strictly local or national in nature and those of global significance (e.g. expected benefits from the maintenance of forest coverage and biodiversity in the NNT NPA).

130. Preliminary estimated costs and benefits of Project impacts in each area are presented in Table H.1. These are based on an Environmental and Social Cost-Benefit Analysis being completed for the Project. The concept of *total economic value* has been used which includes both use and non-use values. The results indicate that the environmental and social impacts of the Project are estimated to yield significant positive benefits both at the local and global levels, ranging from US\$15-30 million at the local level, to approximately US\$ 85 million at the global level.

**Table H.1. Preliminary economic assessment of environmental and social impacts
(Present value terms; Million US\$)**

Areas	Local (US\$ mill)		Global (US\$mill)		Remarks
	Cost	Benefit	Cost	Benefit	
Nam Theun downstream of the Nakai Dam	N.I.	N.I.	N.I.	N.I.	<ul style="list-style-type: none"> Costs result from potential loss of fisheries Results from a Riparian Release study are expected in late November 2004.
NNT NPA	N.I.	17.0 – 36.0	N.I.	50	<ul style="list-style-type: none"> Local benefits result from improved and maintained income levels due to better resource management and development of new economic activities (e.g. eco-tourism). Global benefits arise from maintenance of the carbon sink value of the NPA
Nakai Plateau	4.4 – 5.4	8.5 – 11.5	0	35	<ul style="list-style-type: none"> Local costs result from loss of existing economic activities on the Plateau. Local benefits result from the higher levels of income expected from the livelihood programmes Global benefits result from reduced emissions of Greenhouse Gases from the Project compared to the best alternative energy source (combined cycle gas)
Xe Bang Fai	6.8 – 9.4	0.25	0	0	<ul style="list-style-type: none"> Local costs mainly derive from the estimated loss of fisheries. Results of hydrology study are still to be incorporated.

Areas	Local (US\$ mill) Cost	Benefit	Global (US\$mill) Cost	Benefit	Remarks
					<ul style="list-style-type: none"> Benefits do not include potential for significant increase in irrigation and agricultural production. To be realized, these benefits require additional investments not supported by the Project.
Mekong	N.I.	N.I.	N.I.	N.I.	<ul style="list-style-type: none"> Results from the cumulative impact assessment are expected in August 04.
TOTAL	11.2-14.8	26 – 48	N.I.	85	
N.I. = None identified or quantified at the time of report preparation					

131. As indicated in *Table H.1*, the values presented remain preliminary in nature and do not reflect all costs and benefits. Results from three significant studies (Nam Theun Riparian Release study, Xe Bang Fai hydrology study and Cumulative Impact Assessment) remain to be included. The expected considerable irrigation potential along the Xe Bang Fai is also not included. This indirect Project impact will require further investment, outside of the Project, to realize the agricultural productivity potential. A WB rural development project is currently assessing this potential. Finally, there remains some uncertainty whether livelihood programmes will be able to deliver the targeted income levels for resettled households however NTPC will extend the duration of the livelihood programmes, if it becomes clear that income targets are not met.

IX. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLANS

A. Introduction

132. The management of environmental and social impacts and measures to mitigate them are encompassed in a set of plans prepared under the Project. The three key plans are the Draft Environmental Management Plan (EMP) (contained within the EAMP), Draft Social Development Plan (SDP) and Draft Social and Environmental Management Framework and 1st Operational Plan (SEMFOP). Their scope and objectives are summarised in *Table I.1*. A list of all mitigation programmes and plans to be implemented during Project construction and operation is presented in Appendix 1.

Table I.1: Overview of Environmental and Social Management Plans

Plan	Objectives	Content
EMP	To ensure effective implementation of mitigation, management and monitoring measures to address all identified environmental impacts, during construction and operation	(i) Detailed breakdown of mitigation requirements, responsibilities, schedules and costs (ii) Determines obligations of the Head Construction Contractor and the required contents of its EMMP (iii) Describes responsibilities and mechanisms for implementation and monitoring
SDP	To present a detailed analysis of the social implications of the Project on affected people and lay out in detail necessary mitigation measures including the resettlement plan and compensation framework for Project affected people on the Nakai Plateau, Xe Bang Fai and	(i) Detailed baseline of households, livelihoods, assets and lands to be affected by the Project and projection of the number of households likely to be eligible for resettlement and compensation packages during the resettlement period (ii) Detailed baseline and analysis of ethnic groups, trends, livelihoods and vulnerabilities (iii) Detailed description of the proposed resettlement, livelihood and compensation packages including how

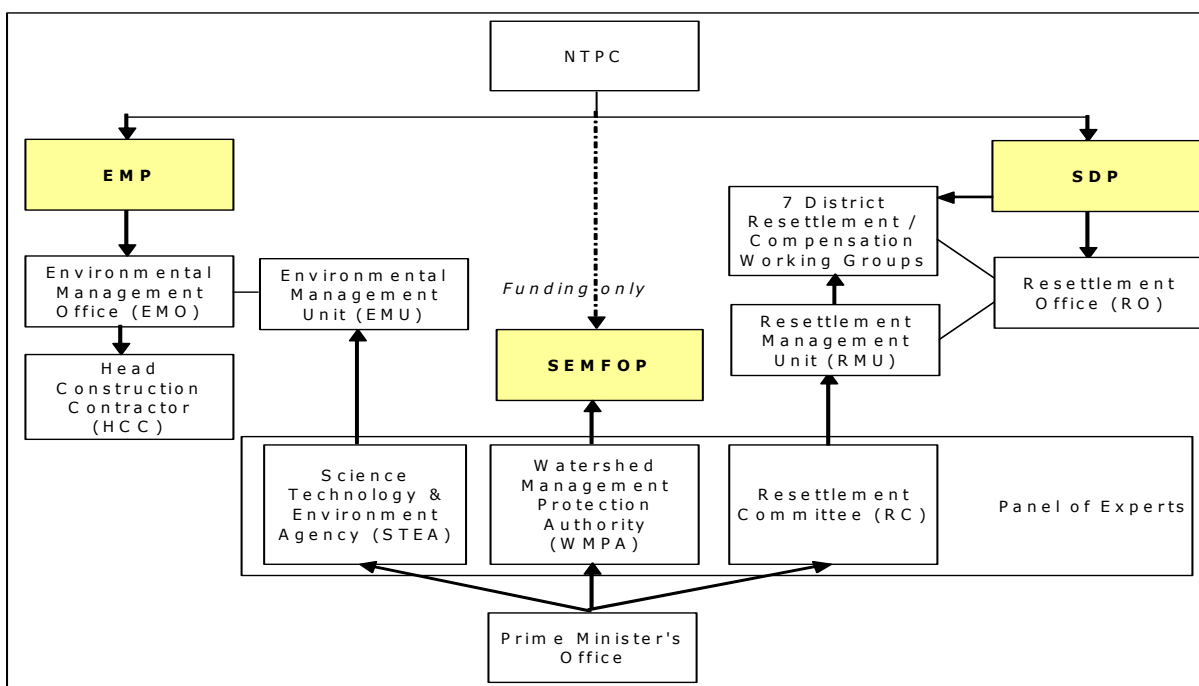
Plan	Objectives	Content
	other Project Lands.	<p>affected people have contributed towards their design through participatory planning</p> <p>(iv) Definition of timing, responsibilities and costs for each package and entitlement</p> <p>The SDP presents the above information for three affected areas namely Plateau / Reservoir, Xe Bang Fai and Project Lands. For each area, an Ethnic Minority Development Plan and a Resettlement/Compensation Action Plan and/or Framework are being developed.</p>
SEMFOP	To provide a management framework and 1 st operational plan for effective protection of the Nam Theun Watershed Area, ^a NNT NPA, NNT HNN Corridor and NNT PHP Corridor. Management activities include wildlife and biodiversity, safeguarding the well-being, traditional livelihoods and culture of human inhabitants and improving livelihoods by focusing on poverty reduction through environmentally sustainable development.	<p>(i) Consolidated baseline data on the environmental and social (including livelihood and ethnic) characteristics of the watershed</p> <p>(ii) Detailed description of the institutional and management framework and operational plan for the Watershed Management and Protection Authority (WMPA) for its first 6 years of operation (from 1st February 2004 – 30th April 2010).</p> <p>(iii) Technical and management activities to mitigate and manage any impacts including:</p> <ul style="list-style-type: none"> • Forest and Land Use Planning, Allocation and Management • Participatory Protected Area Management • Resource access restriction and Livelihood Development for Conservation • The SEMFOP includes an Ethnic Minority Development Plan and a Process Framework to address possible impacts from access restrictions to resources

^a The Nam Theun 2 watershed area consists of the NNT NPA, NNT HNN Corridor and NNT PHP Corridor.

133. In addition, the environmental and social management and mitigation requirements for the Project are laid out in Schedule 4 of the Concession Agreement that was signed on 3rd October 2002 between GOL and NTPC. The Concession Agreement acknowledges that the above Environmental and Social Plans have been developed and agreed to by GOL and NTPC. Schedule 4 outlines the social and environmental obligations of NTPC and GOL for social and resettlement (Part 1); for management of Project-related environmental impacts (Part 2); and for environmental and social management in the NNT NPA (Part 3). The contents of the 3 management plans described in the Concession Agreement will be updated to incorporate any changes in the plans made in response to ongoing studies, consultation and the appraisal process of international financing institutions.

B. Institutional Responsibilities

134. The overall framework of institutional responsibilities for implementing the social and environmental management plans is presented in Figure I.1. Implementation responsibilities are then discussed below.

Figure I.1. Overview of Institutional Responsibilities

1. Key Organizational Responsibilities for EMP Implementation

135. The key organizations responsible for implementation of the EMP are the Environmental Management Office (EMO) of NTPC, the Head Construction Contractor (HCC), and the Environmental Management Unit (EMU) of GOL. NTPC's EMO is responsible for technical planning, implementation and monitoring of all environmental mitigation and compensation measures under NTPC's responsibility. The EMO is also responsible for ensuring that the HCC fully meets its contractual and environmental management obligations. The EMO will report to the EMU of GOL on a monthly basis and will work in close cooperation with the EMU and other GOL agencies as necessary. The HCC will be responsible for implementing measures to avoid or minimise environmental and social / health impacts during construction including definition and implementation of the detailed management plans (HCC-EMP). The HCC will also be required to apply international standard Quality Assurance (QA) procedures and an environmental management system in full compliance with ISO 14001. This will be subject to the monitoring by the Panel of Experts and the International Advisory Group (see further below).

136. Under the direction of the Science, Technology and Environment Agency (STEA) of the Prime Minister's Office, GOL has established an Environmental Management Unit (EMU) responsible for implementing and managing the environmental components of the Concession Agreement. The EMU is designed specifically for the Project and consists of representatives from the Ministry of Industry and Handicraft's Hydropower Office, EDL, the Khammouane Provincial Office and the District Offices of Nakai and Gnommalat. The EMU is responsible for implementing some of the mitigation measures outside the NNT NPA e.g. promoting the removal of biomass from the Nakai Reservoir prior to inundation, strictly enforcing hunting and wildlife trade regulations on the Plateau and ensuring good environmental management at spontaneous settlements. The EMU will also review reports of monitoring programmes during construction and operation.

2. Key Organizational Responsibilities for SDP Implementation

137. The Project is the largest and most complex development involving resettlement with which GOL has been involved. In response, a comprehensive resettlement organizational structure has been established comprising of the following:

- (i) **Resettlement Committee (RC):** established by Prime Minister's Office its members include all three affected Provinces and is chaired by the Governor of Khammouane Province (where most resettlement and related activities will occur). It has overall responsibility for guiding and managing the resettlement and compensation process.
- (ii) **Resettlement Management Unit (RMU):** under the overall responsibility of the RC, the RMU is responsible for working with NTPC and amongst other things, planning and implementing the resettlement process; organizing public consultations; carrying out socio-economic surveys; ensuring the allocation of resettlement budgets and provision of guidance and training to District Resettlement Working Groups, ensuring the participation of the Lao Women's Union and participating in the Grievance Procedure. The RMU has seven technical and administrative units including those responsible for infrastructure, livelihoods and training, social services, consultation, land asset surveys and titling and compensation monitoring and evaluation.
- (iii) **District Resettlement (or Compensation) Working Groups (DRWGs):** have been established in the seven districts to be affected by the Project and are responsible for implementing, in cooperation with villagers and under the technical supervision of the RMU and RO, the relocation, rehabilitation, compensation and development activities specific to their districts. Staff are drawn from local district staff.
- (iv) **NTPC Resettlement Organization (RO):** Working in close cooperation with the RMU and RC, NTPC has established this organization to be responsible for all social and resettlement activities of NTPC including the development and implementation of the resettlement and compensation actions described in the SDP. The RO will be particularly concerned with the delivery of village infrastructure such as roads, water and electricity distribution systems, housing and schools. However the RO is also fully concerned with livelihoods and all other community and social issues related to the Project.

3. Key Organizational Responsibilities for SEMFOP Implementation

138. The Prime Minister's Office has established and mandated the Watershed Management and Protection Authority (WMPA) to implement the SEMFOP, using funds provided by NTPC. The WMPA will be responsible for coordinating and managing all activities in the watershed area, including:

- (i) Conservation, maintenance and promotion of biological diversity coupled with the development of a national park appropriate for scientific research and tourism;
- (ii) Building and strengthening the capacity of the WMPA;
- (iii) Facilitating improved livelihoods for inhabitants of the Nam Theun 2 Watershed Area to reduce poverty through environmentally sustainable development; and
- (iv) Protecting and rehabilitating forest cover in the Nam Theun 2 Watershed Area to assure adequate water discharge with low suspended sediment.

4. Panel of Experts

139. An environmental and social Panel of Experts (POE) is mandated to provide independent review of, and guidance on the treatment of environmental and social issues associated with the Project. Among other duties, as provided in the Concession Agreement, the POE will provide reports to NTPC and GOL stating whether environmental and social safeguards and funding agency guidelines have been complied with. The POE will recommend remedial action if it determines any non-compliance with these guidelines.

5. International Advisory Group

140. An international Advisory Group (IAG) was appointed by the President of the WB in 1997 to provide independent review of, and guidance on the overall aspects of the Project including environmental and social issues. Among other duties, the IAG will provide reports to the President and Board of Executive Directors of the WB concerning the preparation and implementation of the Project. The IAG made its first visit to Lao PDR for Nam Theun 2 in May/June of 1997 with subsequent visits in 1998, 2001 and 2004. A member of the IAG also visited Lao PDR in 2003.

6. Institutional Capacity

141. A high level of responsibility has been vested with the various GOL organizations and special units outlined above. The EMP, SDP and SEMFOP therefore incorporate measures (including financing) to support and strengthen these organizations. Emphasis will be placed on training and skill development in core environmental, natural resource protection, social, ethnic minority and community participation disciplines as well as development and training of relevant GOL officials in management skills, finance and accounting, English language, monitoring, data collection, analysis and management information systems. Capacity building under this Project will have medium and long-term benefits for environmental management and resettlement procedures in GOL generally. A detailed capacity building programme has been prepared and its implementation initiated as a result of an institutional capacity assessment supported by ADB.

C. Financing

142. NTPC has agreed to comply with, implement alone or jointly with another party, and bear the cost of the environmental and social commitments laid out in the Concession Agreement. NTPC is therefore responsible for covering the cost of all mitigation and management measures including the financing of GOL agencies established for the purpose of the Project. NTPC has committed to provide a minimum of over US\$88 million for the implementation of environmental and social mitigation and management measures. This does not include the further US\$60 million which NTPC has committed in order to include the Regulating Dam, the Downstream Channel, and the aeration weir into the Project infrastructure to prevent extensive resettlement and environmental impacts. A budget breakdown for construction and operation is summarised in Table I.2 below. NTPC has to provide letters of credit to GOL as security should for example the POE deem that NTPC has failed to comply with the environmental and social commitments and to mitigate or compensate against any unforeseen Project impacts.

Table I.2: Summary of Environmental and Social Budget Commitments^a

	Budget Commitment (in million US\$) ^b		
	Construction & commissioning (up to c.2010) ^c	Commercial Operation	TOTAL ^{b&c}
Social Measures <i>Includes resettlement and compensation measures, livelihood programs and institutional capacity building on Nakai Plateau, Project Lands and Xe Bang Fai</i>	33.8	11.4 ^d + 7.5 ^f	52.8
Environmental Measures <i>Includes fish studies, water quality monitoring, wildlife programs, public education and institutional strengthening</i>	3	0.8 ^d	3.8
Watershed Management (SEMFOP)	6.5	25 ^e	31.5
TOTAL	43.3	~ 44.7^{d&e}	~ 88.1^{c&d}
Notes: ^a The budget presented reflects an increase of approx. US\$54.8 million from the budget presented in the 2002 Concession Agreement. Additional social measures for Nakai Plateau and Xe Bang Fai have been added. ^b Figures have been rounded for ease of reference and therefore do not sum exactly in the Total column ^c This budget excludes a) construction of Regulating Dam, Downstream Channel and aeration weir to mitigate environmental and social impacts of using the Nam Kathang (c. US\$60 million) and NTPC environmental and social staff costs (c. US\$6-8 million) ^d These budgets cover the 1 st 5 years of commercial operation only ^e NTPC will provide US\$1 million per year throughout the project concession period (25 years). ^f US\$7.5 million is to be provided over the 25 year concession period towards a Social and Environment Remediation Fund			

D. Monitoring

143. Monitoring will determine whether the mitigation measures undertaken by NTPC and other agencies responsible for implementation of activities are respecting the financial obligations of the Company and achieving their objectives. Monitoring will be carried out both internally and externally in accordance with Schedule 4 of the Concession Agreement.

144. For environmental impacts, external monitoring will be undertaken during construction and for the first three years of operation. This may be extended if NTPC, GOL or the POE deems it necessary. Internal monitoring will be managed and implemented by the EMO who will regularly review the status of Project impacts and make recommendations to NTPC to rectify any failure in meeting its environmental obligations. The EMO will also report regularly to the EMU. The EMU will monitor the performance of the HCC and NTPC. It will make recommendations to GOL on any steps needed to rectify problems. Furthermore, GOL, in consultation with NTPC, will engage an independent monitoring agency (funded by NTPC) to externally monitor and evaluate the environmental measures implemented. This will be done on an annual basis and at other times as required by GOL. The agency will report its findings to GOL and NTPC.

145. For Social impacts, internal monitoring by NTPC (RO) will focus on the physical progress of resettlement /compensation implementation on the Nakai Plateau and other Project areas

against the schedule in the SDP. The RO will be responsible for monitoring the construction of infrastructure associated with resettlement and will report quarterly to the RMU and the RC. Independent external monitoring will also be carried out by a third party, focusing on changes in social and economic conditions of individual households. A set of indicators will be developed for affected households and villages including income levels, sources of income, food sufficiency, basic health and education conditions and women's status. The well being of ethnic minority groups on the Nakai Plateau and the Xe Bang Fai areas will be closely monitored. Such external monitoring will be carried out for the duration of SDP implementation, which is likely to extend over 9 years.

146. To ensure that the basic rights of Project-affected peoples are protected, concerns adequately addressed and entitlements delivered, a grievance procedure will be implemented. A senior provincial official will head a Project Grievance Committee which will also include members from the Justice Department, Lao Women's Union, the Ethnic Council and from the Resettlement Committee. If an affected person is not satisfied with the compensation package or if, for any reason the compensation does not materialize according to the agreed schedule, he or she has the right to make a claim to the Committee who has the capacity to deal with such complaints.

E. Adaptive Management

147. NTPC recognizes that changes may need to be made to the methods used to address and implement the impact management and monitoring objectives determined for the Project. An Adaptive Management approach will therefore be adopted for environmental and social management components. Generally, adaptive management involves the monitoring and evaluation of actual performance of a particular management programme or activity and responds to that evaluation with appropriate changes. This is an iterative process, repeated for as long as it takes for an environmental or social system to stabilize after an impact. Adaptive management will be applied to all Project-impacted areas and for all Project impacts. Examples of major applications of the adaptive management approach include the riparian release from the Nakai dam into the Nam Theun, the management of wildlife populations on the Nakai Plateau and the establishment of the Pilot Village on the Plateau. Lessons learned from the latter have already been integrated into the resettlement and compensation approach laid out in the SDP.

X. PUBLIC CONSULTATION AND DISCLOSURE

A. Overview

148. The Public Consultation and Disclosure (PCD) process has been guided by the requirements of the ADB, AFD, WB and GOL. Its overriding goals have been to ensure transparency in decision-making and provide for stakeholder involvement in selecting resettlement sites, designing the Project and determining appropriate remedial measures for impacted people and communities. More specifically the objectives are to:

- (i) Ensure stakeholder concerns are incorporated in Project design and planning;
- (ii) Increase public awareness and understanding of the Project; and
- (iii) Enhance positive development initiatives through the direct involvement of affected people.

B. Public Consultation activities

149. Stakeholder consultation activities for this Project began in 1995 and by October 2004, there have been almost 400 public consultation and participation meetings and briefings. This Project was the first time that a large scale public consultation process was undertaken in Lao PDR and substantial capacity and understanding on stakeholder involvement in decision making has been built and strengthened as a result. The stakeholders consulted, their interests and their involvement to date, are summarised in *Table J.1*. Most recently, detailed public consultation with impacted people and communities was carried out between May and July 2004 and national and international stakeholder workshops were then held in August and September 2004. This consultation has provided constructive proposals from local villagers and other stakeholders about the project and in particular about the resettlement and compensation programme, providing an excellent basis on which to make improvements to the SDP. Safeguard documents and project management plans have been revised to reflect these proposals. Consultations with affected people in Project Lands are ongoing and will be complete in April 2005.

Table J.1 Project Stakeholders, their interests and involvement in PCD

Stakeholders	Interests and Experience	Consultation Process to Date
Nakai Plateau villagers to be relocated or otherwise affected: approx. 7,186 people in 1,375 households (as at 2003 census)	Positive with respect to their resettlement and the proposed livelihoods. Currently involved in demonstration farms and pilot village relocation	Preliminary consultation in 1995 Intensive consultation 1997-1999 in all villages Pilot village consultation from 2001 Establishment of an Information Centre in Nakai Village Resettlement Committees organized Further detailed consultations about the SDP, compensation, resettlement and livelihood options May – July 2004
Villagers along the proposed downstream channel: ~198 families	Positive towards irrigation potential but concerned over impacts of flooding & livelihood	Consultation about impacts held in 1997 Further, detailed consultations about mitigation plans and compensation options were carried out in 2004
Villagers along the proposed transmission lines	Interest in fair and prompt compensation	Consultation about impacts held in 1997 Further, detailed consultation about mitigation plans were carried out in 2004
Villagers with assets under other Project Construction Lands	Yet to be consulted in detail about Project impacts	Detailed design and impacts in process of being determined Consultation process commenced in 2004 but basic information already available from RMU
Villagers along Xe Bang Fai (89 villages, about 7,096 families)	Positive towards irrigation potential but concerns over increases in flooding and impacts on livelihood	Consultation about impacts held in 1997 Further, detailed consultation about mitigation plans were carried out in 2004
Villagers in the NNT NPA and adjoining corridors and areas neighbouring these	Consultations are currently underway	Socio-economic surveys completed Further consultation on the draft SEMFOP undertaken in 2004
Villagers along Nam Theun downstream of Nakai dam	Consultations recently completed as part of riparian release study	Socio-economic surveys recently completed.
Local Authorities	Representation in decision-making process and capacity building	Ongoing consultation and meetings since 1997, assessment of capacity and inclusion of key institutions such as the RMU and DRWG
Provincial Organizations	Representation in decision-making process and capacity building	Ongoing consultations and meetings since 1997,

Stakeholders	Interests and Experience	Consultation Process to Date
National Government (Ministries & STEA)	National legal and policy framework, Project viability, financing and representation in decision-making	inclusion in RC Ongoing consultation and meetings since 1995, inclusion in RC, STEA part of National Level Consultation National stakeholder workshop in September 2004
Mass Organizations (LWU, LNF)	Representation in decision-making process and capacity building	Ongoing consultation and meetings since 1997, inclusion in key institutions such as the RMU, DRWGs and VRCs National stakeholder workshop held in Vientiane, September 2004
NGOs	International standards for social and environmental aspects, Project viability	Involved in some local and all national consultation meetings, reviewed documents and undertook site visits, including in 2003 National and international stakeholder workshops in August/September 2004
Panel of Experts	International standards for social and environmental aspects, Project viability	Carried out site visits and consultations since 1996 and reviewed all relevant documents
International Advisory Group	Overall soundness and viability of Project, including environmental and social aspects	Carried out site visits and consultation since 1997 and reviewed all relevant documentation
Donors and Financial Institutions	International standards for social and environmental aspects, Project viability	Involved in all national and international consultation meetings, reviewed documents and site visits since 1995
Embassies	International standards for social and environmental aspects, Project viability	Involved in all national consultation meetings, reviewed documents and site visits since 1995
Thai stakeholders (EGAT, private sector, government)	International standards for social and environmental aspects, Project viability	Involved in negotiations of the PPA, all national consultation meetings, reviewed documents and site visits. Also participated in international stakeholder workshop held in Bangkok in August 2004

150. The PCD programme has and continues to progress in a three-step approach:

- (i) **Step 1: Information Collection and Dissemination:** This step has aimed to raise awareness. First, data were collected on the human and physical characteristics of the current environment in order to predict Project impacts. Thereafter, information has been disseminated to stakeholders regarding Project features and potential changes to the social and physical environment.
- (ii) **Step 2: Eliciting Stakeholder Concerns:** Comments have been sought from stakeholders in response to information gathered and disseminated during Step 1. Discussions on alternatives and proposed mitigation measures have been encouraged throughout the PCD process. Issues for stakeholders that may previously have been overlooked or are outstanding are given a forum for review. This steps has represented a needs assessment and has provided a basis from which decisions have been – and will continue to be made.
- (iii) **Step 3: Active *Involvement in Project Design and Implementation*:** Based on the discussions held in Step 2, stakeholder input has been sought in determining mitigation measures to address Project impacts. The process of stakeholder involvement and identification will continue during Project implementation. This

process provides for cyclical feedback, so as to improve Project design and its proposed implementation based on the views of stakeholders.

151. Techniques used have reflected the diversity of individuals and groups involved. They include:

- (i) Use of visual representations including pictures, diagrams and posters;
- (ii) Face-to-face communication including small group and general village meetings, and participatory rural appraisal techniques, especially where levels of literacy are recognized as being low;
- (iii) The translation into the Lao language of Project documents and summaries;
- (iv) Use of local NTPC Project Information Centres (PIC) at Vientiane, Thakhek, and Nakai; and
- (v) Direct contact with stakeholders through electronic or written media, group and individual briefings, radio and television interviews, distribution of detailed Project information, organization of symposium and forums, and site visits for international stakeholders.

152. Efforts have been made to remain sensitive to language, gender and ethnicity issues. While the majority of ethnic groups residing in the Project area can speak Lao, language checks are made before discussions, especially for women and the elderly; the consultation team also includes members from local ethnic minorities speaking local languages. The participation of women in consultation has received special attention because they tend to be less educated than men or have less exposure to the outside world. The participation of women has been encouraged by for example organizing women's only groups; the Lao's Women's Union (LWU) has played a central role in such local consultations. To ensure that all ethnic groups, including vulnerable minorities, can fully participate in and actively influence project design, separate discussions have been held for different ethnic groups to enable small groups to speak freely. Traditional and local religious leaders have also been engaged to ensure that local beliefs are respected and taken into consideration in project design and mitigation.

C. Public Disclosure

153. Throughout Project planning, copies of key reports and draft Project environmental and social documents have been made available. Information has, and continues to be disseminated via the Project website at www.namtheun2.com including the Study of Alternatives, EAMP, SDP and SEMFOP upon which this Summary ESIA is based. The first draft of the EAMP, and its subsequent updates, has for example been disclosed to the public since 1997. The Advanced Draft of the EAMP, SDP, and SEMFOP were made available on the Project website in April 2004 and an Advanced Draft of this Summary ESIA was posted there in July 2004 in preparation for pre-appraisal consultations. Lao-language posters and other media were also prepared to support local level consultations.

154. The EAMP, SDP and SEMFOP have been revised following consultations at local, national, regional and international levels in 2004. Local level consultations on the advanced draft EAMP, SDP and SEMFOP were undertaken in June 2004 and were targeted at the villagers to be resettled or compensated on the Nakai Plateau and in the Xe Bang Fai. National level consultation focused on national NGOs and mass organizations, GOL authorities involved in implementation activities and the general public. For GOL organizations involved in implementation (including STEA who is responsible for GOL approval on environmental and resettlement aspects), there was an interactive review and training process. Regional and

international public meetings were held in Vientiane, Bangkok, Tokyo, Paris and Washington in August/September 2004 and discussed the draft results of the EAMP, SDP and SEMFOP with a range of interested parties including donors, international NGOs and other stakeholders. A summary of the concerns and issues raised during the international stakeholder workshops and related responses is presented in Table C.2 in Appendix 3. Full records of consultation meetings are available in moderators' reports.

155. The EAMP, SDP, SEMFOP and this Summary ESIA are being made available for public review before appraisal by the International Financial Institutions, including access on bank and Project websites. They are being made available for 120 days before the Boards of Executive Directors of the ADB and WB begin consideration of the Project for approval. At this time, GOL implementers will have a full translation of the revised documents. Disclosure to local affected people will be through an information and outreach programme with documentation in Lao being made available and using appropriate tools for illiterate and ethnic minority members of affected communities. After appraisal and Board decisions by the ADB and WB, any required revisions will be made after which the final documents will be made available to the various stakeholders. Of particular importance are the GOL and Project affected people who will receive a full Lao translation and partial Lao translations respectively. The Project affected people will also have the services of an information and outreach programme.

D. Project Planning Responses to Stakeholder Concerns

156. Feedback from stakeholders has influenced or been incorporated into Project planning and design. For example, the following Project design features are attributed to public consultations:

- (i) Location of the Power Station to avoid any resettlement;
- (ii) Inclusion of the Downstream Channel as an alternative to channelling water down the Nam Kathang and routing the Channel to minimise resettlement and social impacts and maximise development potential. As a result of consultations with directly affected people, the Channel is designed partly above ground level; helping to minimise width and land requirements. Irrigation outlets from the raised channel will also enhance gravity-fed irrigation opportunities in the Gnommalat area;
- (iii) Construction of the Regulating Pond to minimise fluctuations in daily discharge into the Xe Bang Fai to minimise erosion;
- (iv) Bank protection at the confluence of the Downstream Channel and the Xe Bang Fai to reduce erosion;
- (v) Inclusion of aeration structures to improve water quality in Regulating Pond and Downstream Channel;
- (vi) Guaranteed minimum flow in the Downstream Channel to help sustain fish populations that may develop;
- (vii) Commitment to shut down operation before natural over bank flooding in the upper Xe Bang Fai; and
- (viii) Location and composition of resettlement areas, house designs, compensation measures, village composition and livelihood models to ensure that affected people are appropriately compensated and better off than they were before the Project.

157. Feedback received during village level consultation and the international stakeholder workshops in 2004 has also been used to improve Project design and implementation planning.

Village level consultations on Nakai Plateau and in the Xe Bang Fai completed in 2004 revealed that the majority of concerns and requests had already been addressed in the SDP. However, a number of other important issues were also raised that have not previously been included; for example requests for larger agricultural areas, modifications to house designs, location of gardens, supplying toilets for villages (Xe Bang Fai) bridges over the Xe Bang Fai and dyke protection (Xe Bang Fai). NTPC are currently investigating the feasibility of these additional requests and they will be considered if feasible and in accordance with GOL and NTPC policy. A summary of how stakeholder views have influenced Project planning is given in Appendix 3.

XI. CONCLUSION

158. Generating approximately US\$1.9 billion in revenues (in nominal terms) for the GOL over the 25-year concession period, the Project is considered to be an essential element of Lao PDR's development framework to alleviate poverty.

159. The EAMP and SDP conclude that the net benefits of the Project justify the impacts and their corresponding economic value. The safeguard documents acknowledge that the Project is expected to have significant, and in some cases irreversible, adverse environmental and social impacts including loss of biological diversity, inundation of the Nakai Plateau, changed hydrological regime in several rivers, riverbank erosion, resettlement, changed livelihoods and health implications. These adverse impacts have however been reduced to the extent possible through Project design, extensive participation of Project affected people in the development of resettlement and compensation plans and their extent will be further managed and mitigated through implementation of the EMP, SDP and SEMFOP and other related programs.

160. Notwithstanding these negative impacts on environmental and people, the Project is also expected to bring benefits including dedicated protection of the globally significant biodiversity in the NNT NPA, improved access to markets, education and healthcare for populations on the Nakai Plateau and NNT NPA and significantly increased dry season irrigation potential in the area surrounding the Downstream Channel and Xe Bang Fai. The overall aim of the Project's social mitigation strategy is to ensure that all affected persons are better off than before the Project. Long term and potentially nation-wide indirect benefits are anticipated as a result of enhanced capacity and skills that the Project will develop as a result of its capacity building programs and direct employment of staff.

161. NTPC is committed to ensuring that adverse impacts are minimized, direct Project benefits maximized and all relevant funding agency and GOL safeguards fully applied. It is also committed to enhancing national and international best practice in hydropower development, impact prevention, mitigation and management upon which future projects in Lao PDR and worldwide, can draw. NTPC have therefore already, and will continue, to invest the necessary Project funds, technical knowledge and staff effort into delivering this commitment.

ENVIRONMENTAL AND SOCIAL MITIGATION MEASURES AND MANAGEMENT PLANS DURING CONSTRUCTION AND OPERATION

Construction Management and Mitigation Plans	Mitigation programs during Construction & Operation	Mitigation Programs during Operation
<ul style="list-style-type: none"> (i) Erosion and Sediment Control Plan (ii) Spoil Disposal Planning and Management Plan (iii) Quarry Management Plan (iv) Water Quality Monitoring Plan (v) Chemical Waste / Spillage Management Plan (vi) Emergency Plan for Hazardous Materials (vii) Emissions and Dust Control Plan (viii) Noise Control Plan (ix) Physical Cultural Resources (x) Landscaping and Revegetation Plan (xi) Vegetation Clearing Plan (xii) Waste Management Plan (xiii) Reservoir Impoundment Management Plan (xiv) Environmental Training for Construction Workers Plan (xv) On-site Traffic and Access Management Plan (xvi) Explosive Ordnance Survey and Disposal Plan (xvii) Construction Work Camps (xviii) Manual of Best Practice in Site Management of Environmental Matters (xix) Project Staff Health Plan 	<ul style="list-style-type: none"> (i) Control of Synthetic Chemical Use for Pest Management (ii) Water Quality Management & Monitoring Program (iii) Resettlement Action Plan and Ethnic Minorities Development Plan for the Nakai Plateau (iv) Compensation Framework and Ethnic Minorities Development Plan for Xe Bang Fai (v) Project Lands Resettlement Plan and Compensation Framework (vi) Social and Environment Management Framework and 1st Operational Plan (SEMFOP) 	<ul style="list-style-type: none"> (i) Control of riparian release into Nam Theun (ii) Management of the reservoir and associated fish populations (iii) Aeration of water downstream of power station in downstream channel and Nam Kathang (iv) Protecting downstream channel fisheries (v) Prevention of Increased Flooding at Mahaxai on Xe Bang Fai (vi) Monitoring and control of scouring and erosion of river channel in Xe Bang Fai (vii) Protection of downstream channel (viii) Wildlife Management and Protection Program (ix) Management of endangered and threatened species (x) Control and enforcement of access and hunting (xi) Public education concerning environmental issues (xii) Plantation forestry program on Nakai Plateau (xiii) Restrictions to shifting cultivation (xiv) Funding support for implementing agencies

MOST THREATENED WILDLIFE SPECIES RECORDED IN THE NNT NPA

Scientific Name	Common Name	Global Threat Status		At Risk in Lao PDR
		Critically Endangered	Endangered	
<i>Amblonyx cinereus</i>	Oriental Small-Clawed Otter	-	-	√
<i>Arctictis binturong</i>	Binturong	-	-	√
<i>Bos gaurus</i>	Gaur	-	-	√
<i>Bos javanicus</i>	Banteng	-	√	√
<i>Cuon alpinus</i>	Dhole	-	-	√
<i>Elephas maximus</i>	Asian Elephant	-	√	√
<i>Felis chaus</i>	Jungle cat	-	-	√
<i>Lutrogale perspicillata</i>	Smooth-Coated Otter	-	-	√
<i>Manis javanica</i>	Sunda Pangolin	-	-	√
<i>Manis pentadactyla</i>	Chinese Pangolin	-	-	√
<i>Miniopterus schreibersii</i>	Common Bent-Winged Bat	-	-	√
<i>Neofelis nebulosa</i>	Clouded Leopard	-	-	√
<i>Panthera pardus</i>	Leopard	-	-	√
<i>Panthera tigris</i>	Tiger	-	√	√
<i>Pseudoryx nghetinhensis</i>	Soala	-	√	√
<i>Pygathrix nemaeus</i>	Douc Langur	-	√	√
<i>Rhinoceros sondaicus</i>	Rhinoceros sp.	√	-	-
<i>Dicerorhinus sumatraensis</i>				
<i>Ursus malayanus</i>	Sun Bear	-	-	√
<i>Ursus thibetanus</i>	Asiatic Black Bear	-	-	√
<i>Aceros nipalensis</i>	Rufous-necked hornbill	-	-	√
<i>Aceros undulates</i>	Wreathed hornbill	-	-	√
<i>Anser anser</i>	Greylag goose	-	-	√
<i>Buceros bicornis</i>	Great hornbill	-	-	√
<i>Cairina scutulata</i>	White-winged Duck	-	√	√
<i>Ciconia nigra</i>	Black stork	-	-	√
<i>Ducula aenea</i>	Green imperial pigeon	-	-	√
<i>Ichthyophaga humilis</i>	Lesser fish eagle	-	-	√
<i>Ichthyophaga ichthyaetus</i>	Grey-headed Fish Eagle	-	-	√
<i>Milvus migrans</i>	Black kite	-	-	√
<i>Pavo muticus</i>	Green Peafowl	-	-	√
<i>Rheinardia ocellata</i>	Crested argus	-	-	√
<i>Vanellus duvaucelii</i>	River lapwing	-	-	√
<i>Cuora galbinifrons</i>	Indochinese box turtle	√	-	√
<i>Cuora trifasciata</i>	Chinese three-striped box turtle	√	-	-
<i>Indotestudo elongata</i>	Elongated tortoise	-	√	√
<i>Manouria impressa</i>	Impressed tortoise	-	-	√
<i>Platysternon megacephalum</i>	Big-headed turtle	-	√	√
<i>Pyxidea mouhotii</i>	Keeled box turtle	-	√	√
<i>Sacalia quadriocellata</i>	Four-eyed turtle	-	√	-
Notes:				
(i) Species falling into IUCN categories “Vulnerable” or “Near Threatened” are not marked or included in this summary table. Details of these and other species of national conservation significance are listed and discussed in the Environmental Assessment and Management Plan (EAMP).				
(ii) Global Threat Status is recorded in IUCN 2003 Red List of Threatened Animals. National status follows Duckworth <i>et al.</i> 1999.				

SUMMARY OF STAKEHOLDER CONCERNS

Table 3.1 Stakeholder Concerns and their Influence on Project Planning

Topic	Stakeholder concerns	Influence on Project Planning
Benefits for Lao	Logging in the NNT NPA	Project will contribute a total of US\$31.5 million to the management and conservation of the NNT NPA to protect its natural resources.
EIA process	Slow progress of Project development	The Project is being developed in line with ADB and WB policies, so takes time
Erosion	Erosion effects and control mechanism in the Downstream Channel	The majority of Downstream Channel will be lined and the confluence with the Xe Bang Fai protected to help minimise erosion.
Fisheries	Impacts on the downstream families who are dependent on fisheries	Aquatic resources and socio-economic surveys will quantify the loss of livelihood. Proactive compensation plans are presented in the Xe Bang Fai strategy of the SDP.
Flooding	Increased flooding in the Xe Bang Fai in the wet season and less water in the dry season	The Project will reduce then stop generation to prevent any additional over bank flooding. In the dry season, a reliable water resource will be available in the Xe Bang Fai for irrigation.
Geology	Impact of the Reservoir on geology	Geology of the Nakai Plateau has been assessed and it was concluded that there should be no impacts in terms of stability and water tightness.
Health	Health impacts during construction	Project will implement three health programmes (regional, resettlers and construction workers) to strengthen local health facilities and to educate communities on potential health risks.
Land uses	Compensation for loss of land and assets	Survey is being conducted to identify how much land is required for construction activities (project lands). Project affected people will then each be consulted and able to choose the type and modality of compensation. The results of consultation will be presented in final versions of the SDP (Volume 4). Compensation for relocated persons (on Nakai Plateau) is described further down in this Table.
Natural habitats	Hectares lost and gained as a result of the Project	The natural habitats accounting study quantified the area and habitat types that will be lost or conserved as a result of the Project
NPA	Resettlement sites or the reservoir encroaching on the NNT NPA	Proposed resettlement area is on the southern side of the reservoir and the boundary for the NNT NPA is EI. 538. Therefore neither the inundation of the reservoir nor the resettlement area will have direct impact on the NNT NPA
PCD	Communities understanding the nature of the impacts	The PCD process utilizes appropriate media and language, taking into consideration the needs of vulnerable groups such as women and ethnic minorities
Study of Alternatives	Power supply options within Thailand need to be determined	Study of Alternatives analyzed the generating options and demand in Thailand. Concluded that demand was strong enough to accommodate 3,300MW of exports from Lao PDR and, on environmental impact, fuel availability and capacity grounds, hydropower development in Lao PDR provides a better solution than gas or coal-fired generating potential
	Need to study other alternatives for short and long-term development of Lao PDR	Study of Alternatives analyzed other candidate power expert schemes in Lao PDR and concluded that the Project ranked as one of the most attractive proposals
Technical Design	Impacts of reduced flow downstream of the dam	A riparian release study has been carried out to evaluate the impacts of reduced flows and spills downstream of the Nakai dam, and make recommendations on management options for the flow regime and channel modifications to minimise impacts.

Topic	Stakeholder concerns	Influence on Project Planning
Transmission lines	Minimization of resettlement and compensation downstream of power station	A downstream channel will be constructed instead of releasing water into the Nam Kathang, reducing the number of households that would be affected, plus providing opportunities for gravity irrigation
	Minimization of resettlement and compensation for new roads	Construction and upgrading of roads will follow existing road alignments and avoid inhabited areas
	Minimization of resettlement and compensation regarding water releases from the Power Station	A regulation pond will be constructed to regulate the flows (caused by peak production) and thus avoid unnecessary negative impacts along the Xe Bang Fai communities
	Improved navigation and access from and to markets at Nakai	Navigation channel in the reservoir to ensure that boat traffic will be in-impeded by the rise and fall of the reservoir.
Water quality	Safety of the transmission towers and compensation for loss of houses or fields	Towers are designed to be structurally safe and withstand adverse weather conditions. Analysis of magnetic and electric fields has been carried out. Baseline survey will identify those persons eligible for compensation.
	Remaining biomass in the Nakai Reservoir	Ongoing satellite imagery interpretation and ground truthing will assess the current biomass in the inundation area and recommend measures to target the removal of remaining biomass to help improve water quality.
Wildlife	Water quality downstream of the Power Station for domestic users	A monitoring programme will assess whether any adverse changes in groundwater and surface water quality are potentially harmful to human health. NTPC will provide alternative sources of household water, especially in villages where surface water is indicated as their primary domestic water source and this water is not suitable for human consumption.
	Fate of rare animals	Various wildlife programmes are being established to monitor and conserve threatened and endangered species. In particular, programmes will initially focus on protection of the 2 key species: Asian elephant and white-winged duck.
Issues related specifically to resettlement on Nakai Plateau:		
Site selection	Majority expressed desire to remain on Nakai Plateau, not to move to paddy land in lowlands	Resettlement Planning now focusing on Nakai Plateau and relocation to downstream areas not considered.
House designs	Desire to remain within village area, that is within spirit boundaries and land-use boundaries	Most relocation sites are located inside, or as close as possible, to traditional spirit and land-use boundaries.
	Desire for improved services and electricity	Improved health and education services to be provided and all sites to be provided with electricity and new roads.
	Desire, especially by women, for village layout to resemble existing kinship relationships	Villages, headed by the VRC, will be responsible for planning the location of houses according to kinship relations, clans and ethnic affiliations, as demonstrated in the pilot village.
Livelihood model	Most households stated that they would like to have a 'modern' or Lao style house on poles with a separate kitchen area	Several rounds of discussions and drafting designs of houses has been carried out with villages and modification to structures and sizes been made accordingly.
	Those with large houses requested to have the option of relocating old houses or salvaging materials	Options for house design and salvaging of materials are included in resettlement schedule and budget, and allowances for differences in house size and for the formation of new houses for families that plan to split.
	All villagers were interested in obtaining paddy land as part of the livelihood model	Initial drafts of the model in 1997 did not include such provisions due to the cost and difficulties in obtaining suitable paddy land beside the reservoir. However, the Project will ensure that where irrigation is available, paddy cultivation will

Topic	Stakeholder concerns	Influence on Project Planning
		be experimented, constraints identified and all efforts made to develop wet season paddy as part of the irrigated agriculture areas or in drawdown zones.
Rituals	<p>All villagers expressed their desire to continue collection of NTFPs and have access to forests for grazing</p> <p>Villagers were interested in fishing as an important source of food and for sale once the reservoir is inundated</p> <p>Villagers requested assistance and training as well as equipment for the new livelihood scenarios</p> <p>Request for rituals to be held for moving villages and houses</p> <p>Auspicious day to commence relocation</p>	<p>Villages will allow grazing in managed resettlement forest areas and the drawdown zone. Access to NTFPs in the NPA (controlled use areas) will be allowed under appropriate management regimes.</p> <p>A fishing plan has been designed to ensure that fish resources remain in the hands of the Plateau settlers and not in those of outsiders.</p> <p>Training, education and necessary equipment will be provided to assist villagers in any changes to existing livelihood systems – improved agricultural tools, seeds, nets etc.</p> <p>Provisions made in moving allowances for individual and collective rituals to be carried out by local ritual experts.</p> <p>Local ritual experts and elders to decide on the actual date to commence relocation in conjunction with RMU staff.</p>
Village composition	<p>All villages with the exception of Sop Hia and Nam Nian expressed a desire to be relocated as a whole</p> <p>The Vietic Groups in Sop Hia and Nam Nian wishes to be relocated separately to the Tai</p> <p>A few households have expressed a desire to relocate in areas outside the resettlement sites, with relatives in the lowlands or by making their own arrangements</p>	<p>With the exception of Sop Hia and Nam Nian, no villages are to be split up on the Nakai Plateau.</p> <p>Tai households are to be relocated separated at a site in Bolikhamxai Province. Special considerations are being made for the small Vietic groups to have a separate village.</p> <p>Provisions have been made for a one-off cash payment for these families wishes to 'self-relocate' but follow-up will be carried out through monitoring of initial relocation and adjustment.</p>
Pilot village relocation	<p>Layout of Nong Boua in cluster formation</p> <p>Temporary relocation in allotted fields ahead of permanent resettlement</p>	<p>Several layouts were presented to villagers and after extensive consultations it was decided that the village would be a cluster form and divided into four sub-groupings based on clan.</p> <p>Several villagers have moved in advance of the actual resettlement and built field houses in anticipation of the actual move – this allows a start up of the livelihood model in advance.</p>

Table 3.2: Concerns and Issues Raised During 2004 International Stakeholder Workshops

Concerns and Issues	Organisations	Responses
Many promises made by donors and the Thai Government for the Pak Mun project in NE Thailand were not fulfilled and affected persons were not properly compensated. Why the situation will be different in the case of Nam Theun 2?	Terra, Thailand and Representatives of Concerned Groups for Pak Mun.	NTPC consultation process is more comprehensive and transparent and involves all stakeholders. In the case of Nam Theun 2, the Concession Agreement is legally binding for NTPC with income targets.
Fisheries impacts may have not been sufficiently studied in particular for the downstream Xe Bang Fai	Terra and Independent experts, Thailand	GoL invited representatives of Thai villagers affected by the Pak Mun project in Thailand to attend the Vientiane Workshop and to visit the site.
		Comprehensive studies of the Project impacts on the fisheries have been undertaken. The Project is committed to properly compensate the affected

Concerns and Issues	Organisations	Responses
area and tributaries		people living along the affected portion of the Xe Bang Fai as well as those living in the hinterland, and who also rely on the Xe Bang Fai for fisheries.
Not enough time was given to review the documents prior to the workshop.	Friends of the Earth, Japan	The documentation has been posted on NTPC website since May 2004 onwards and earlier versions have been available since 2002. Further opportunities for comments will be available during the appraisal process. (NTPC)
Logging on the Nakai Plateau has degraded the environment and affected the livelihoods of the people there from 1996 onwards.	Mekong Watch, Japan	Logging was undertaken on the Plateau since the mid-1980s and was discontinued in 1999. The WB has undertaken since two missions to check the status of logging on the Nakai Plateau and concluded that there has been no logging in the community forest areas or in the NBCA. (NTPC and WB)
Concerns about the livelihood model. 1) How will the resettlers be able to grow rice? 2) Where are the markets for cash crops? 3) Where are the grazing areas located?	Japan Volunteer Centre	<p>(i) Villagers have decided to stay on the Nakai Plateau and this has implications for their livelihoods. Resettlers are not encouraged to grow rice but the cultural importance of rice and food security are recognised. However, in the long-term, alternative crops on irrigated terrace will be developed. (NTPC)</p> <p>(ii) Studies are being carried out at present in order to identify the best cash crops for commercial markets in the region. (NTPC)</p> <p>(iii) Grazing areas will include the drawdown zone of the reservoir and in the resettlement zone. (NTPC)</p>
Project cost unclear and there is inconsistency in the data as presented in the report: 1) Surface inundated unclear (650 or 450 ref. SESIA?) 2) Number of people to resettled unclear (5,700 -6,200)	Friend of the Earth, France	<p>(i) Maximum or full supply level (538 masl.) will be 450 sq km. The reference to the 650 sq km., which represents the total area of zone 1, will be removed. (NTPC)</p> <p>(ii) The number of people to be resettled is estimated based on population surveys and projected numbers. The present estimate is 6,200 people, which includes Project Construction Lands. (NTPC)</p>
Number of people affected downstream unclear (40,000 – 150,000) 3) Livelihood options have not been sufficiently tested and this involves a high risk for the plan.		<p>(iii) Livelihood options have been tested and developed since 1996 in the demonstration farms and later in the pilot village. (NTPC)</p> <p>(iv) Relevant sections of the CA and a summary of the PPA are already public documents(NTPC)</p>
4) Request full disclosure of PPA and CA for public review.		
(i) Studies used for the development of alternatives fisheries in the XBF and of the Reservoir fisheries?	World Wildlife Fund (WWF), France	(i) Reports (experiences) from Nam Ngum and Ubon Rattana reservoirs form the basis for the analysis of reservoir fisheries, is presented in Ch. 24 of the SDP. XBF fisheries is still being analysed and will be completed before appraisal. (NTFP)
(ii) What is the relation to WCD?		(ii) The WCD Report does not have any legal status but is a document considered useful by donors and planners for hydropower

Concerns and Issues	Organisations	Responses
		development. Lessons learnt and recommendations have been taken into consideration in the revision of safeguard documents. (WB/ADB)
<p>Nam Ngum fisheries experience has shown that it is necessary to exclude outsiders in order to ensure benefits to the local people.</p> <p>Monks should participate in the social development of the Nakai Plateau</p> <p>Concerns about the risk of sedimentation in the reservoir and dust generation in the drawdown zone.</p>	<p>CNRS, France</p> <p>Friends of Laos Association, France</p> <p>Fin-enviro Paris</p>	<p>The reservoir fisheries association intends to ensure that benefits reach affected communities. A decree will give exclusive rights to resettlers. (NTPC)</p> <p>Cultural and religious concerns will be taken into account during the resettlement and there are provisions for improving existing temples and establishing new structures at the new sties. (NTPC)</p> <p>The sedimentation in the reservoir is anticipated to be very limited due to the protection of the forest cover in the watershed. The drawdown zone is likely to become a grazing zone during the dry season.</p>

Source: Final Draft EAMP, November 2004.

Note: Presented in this table is a selection of items raised of relevance to environmental and social impacts and mitigation. Full records of all issues raised and discussed are available in moderators' reports and in news releases that have been produced for each workshop

LEGAL ENTITLEMENTS FOR AFFECTED PEOPLE ON THE NAKAI PLATEAU

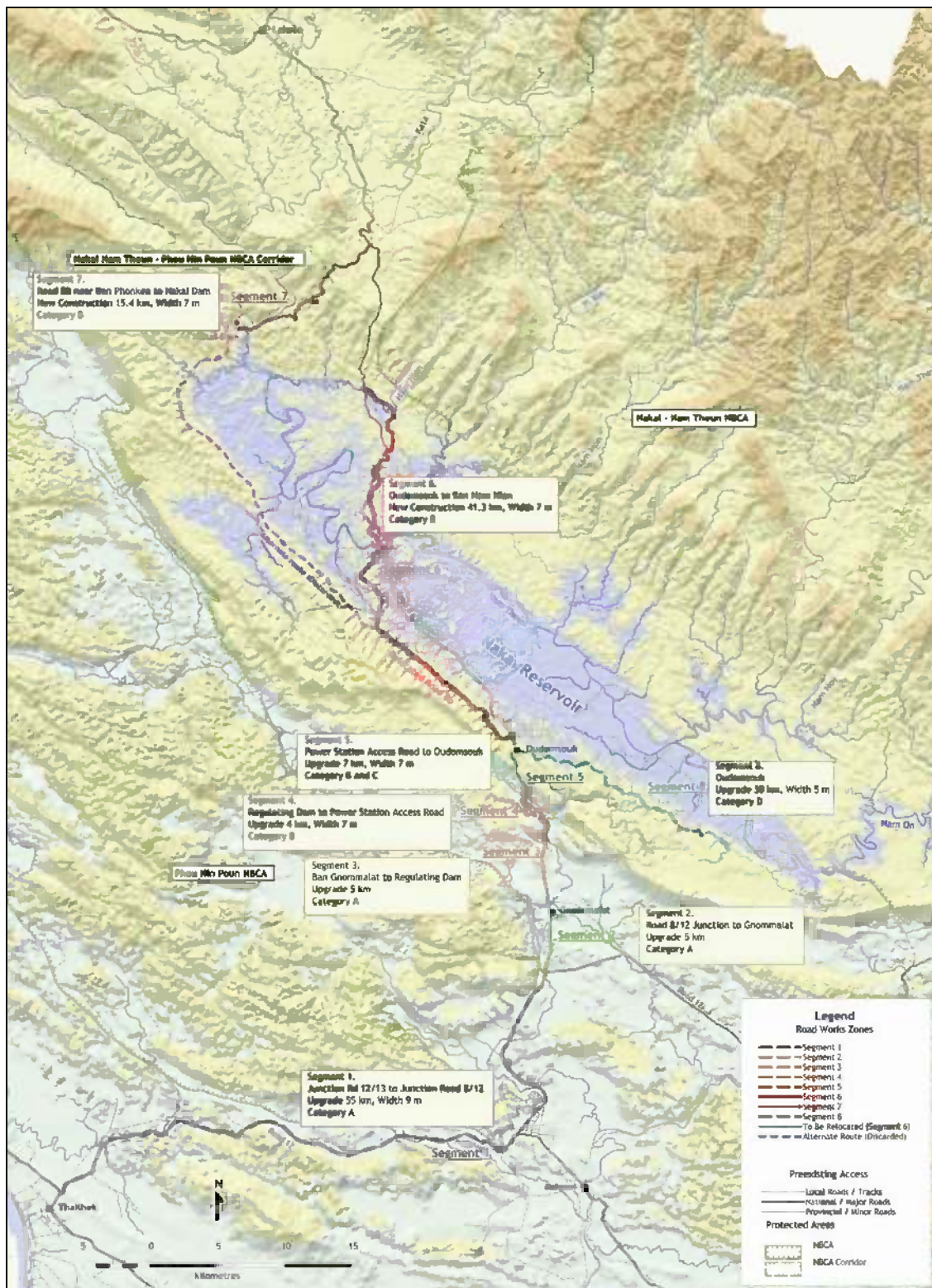
1. Project Affected People (PAP) on the Nakai Plateau are entitled to the following entitlements according to Schedule 4, Part 1 of NTPC's Concession Agreement:

- (i) Housing
 - (a) The labour and transportation cost associated with the dismantling of existing house and constructing new one
 - (b) Provision of new materials for construction of new house
 - (c) Electrical wiring and basic fixtures
 - (d) Minimum housing area not less than existing area or 42m², whichever is the greater
 - (e) Households of 7 or more persons containing two families have the option to have two houses
 - (f) Sheds, other outbuildings and fencing will be provided to the household
- (ii) House/Farm Land
 - (a) 0.5 ha per household
 - (b) Up to 0.15 ha of Riceland per household in off village location, to be developed / allocated on a community basis. In the event less land is available, other livelihood options will provide replacement
 - (c) Land provided with survey, and joint title to husband and wife
 - (d) House to be constructed in location acceptable to owner
- (iii) Infrastructure
 - (a) Irrigation water to the house / farm lot boundary and distribution system
 - (b) Irrigation to rice lands
 - (c) Year-round household water supply
 - (d) Electricity to the house
 - (e) Road access to house/farm lot
 - (f) School access within 3km
 - (g) Clinic access within 5km
- (iv) Services
 - (a) Transportation of all household assets to new location
 - (b) Health check of all household members prior to and after move
 - (c) Access to Resettlement Management Unit (RMU) for advice
 - (d) Access to Grievance Procedure for complaints
- (v) Cash
 - (a) One-time allowance to cover moving time, disturbance of US\$ 15 / person
 - (b) Compensation for fruit trees lost at district prevailing market prices in case no acceptable replacement trees provided, compensation for standing crops at market prices
- (vi) Production Assistance
 - (a) Effective access to a range of feasible production and income generation options to meet pre-determined household income target, including production forest and Reservoir fisheries
 - (b) Tools to work the farm and forest land

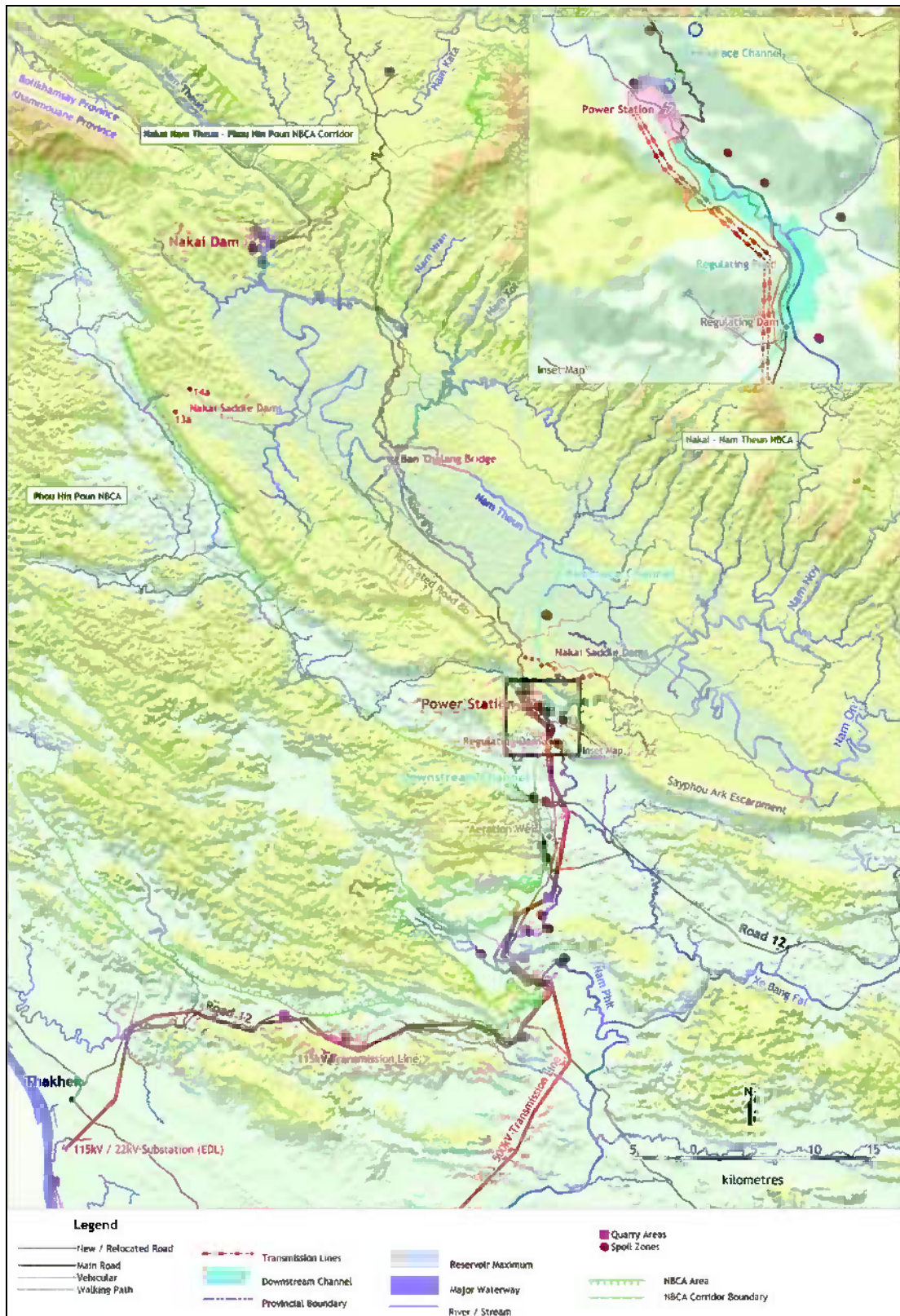
- (c) Planting materials for 3 years after preparation of farm lot, including fruit tree saplings
 - (d) Fertilizer and other agro-chemicals for 3 years after preparation of farm lot
 - (e) Training in farming, forest management and fisheries techniques
 - (f) Agricultural advice for 5 years after preparation of farm lot
 - (g) Access to identified forests for collection of NTFPs
 - (h) Access to identified Reservoir drawdown areas
 - (i) Skills training for wage labour jobs
 - (j) Household budgeting training
 - (k) Income support programme during implementation period at 440kg of rice per person
 - (l) Households with economically inactive members and other vulnerable households to participate in the production benefits from communal forests through provision of a basic needs allowance as determined by the village
- (vii) Departees: Those wishing to permanently leave the District and not move to a resettlement site will receive a one-time payment for the value of land, trees, production and structures lost, plus transportation and disturbance allowances.

MAPS OF CONSTRUCTION WORKS AND ASSOCIATED SITES

Figure 1: Road Construction and Improvements

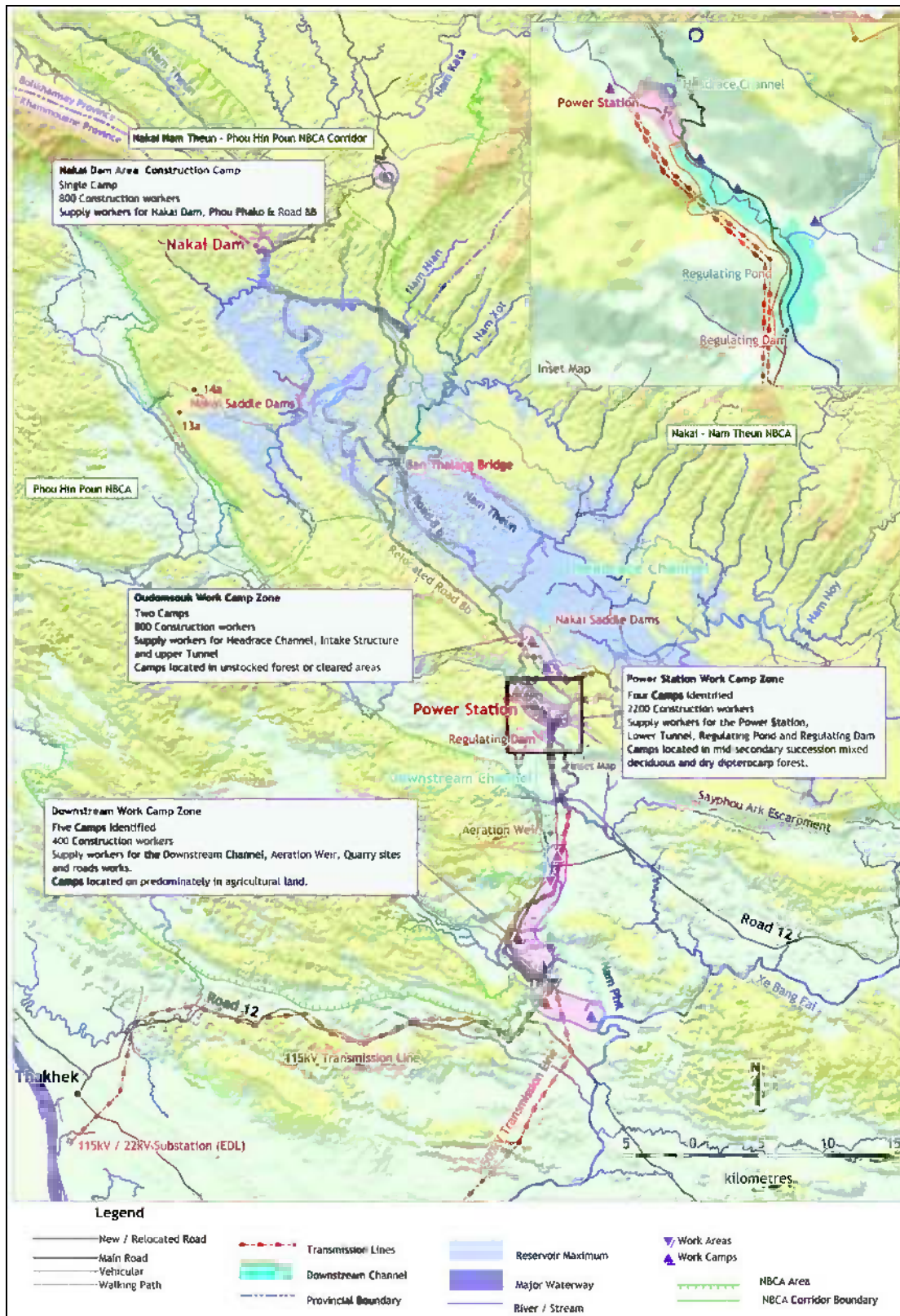


Source: Final Draft EAMP, November 2004

Figure 2: Location of Quarries and Spoil Disposal Areas

Source: Final Draft EAMP, November 2004

Figure 3: Location of Construction work camps and work areas



Source: Final Draft EAMP, November 2004

ASSUMED SECTOR DEVELOPMENTS USED IN THE CUMULATIVE IMPACT ASSESSMENT

1. Sector developments are based on an analysis of existing development trends and plans with an emphasis on aspects that may combine with impacts caused by the Nam Theun 2 Project.

2. **Hydropower** is the most planned sector with long-term development plans for the region. Hydropower development in Yunnan Province in China is likely to have the greatest impact on hydrology in the Mekong Basin with a potential installed capacity of 15,600 MW and active storage of 23,200 million m³ by 2025. A number of projects are planned in Lao PDR, of which Nam Theun 2 is the largest. The most important parameter for the downstream flow changes is active (seasonal) storage which results in increased dry season flow and decreased wet season flow. No significant hydropower development is planned for Thailand. It is unlikely that Cambodia will develop larger projects in the Mekong Basin in the next 20 years and only a few projects are planned on tributaries in Vietnam. The predicted development is shown in Table 1 together with predicted active storage volume. Nam Theun 2 is expected to account for 12% of active storage capacity in the Mekong Basin in 2010 and for 7% in 2025.

Table 1. Existing and Predicted Active Storage Volume (million m³) in the Mekong Basin

Year	China	Lao PDR	Thailand	Cambodia	Vietnam	Total	NT2-portion
2004	257	5,194	4,606	N/A	779	10,836	-
2010	10,524	12,949	4,606	N/A	789	28,868	12%
2025	23,193	22,608	4,606	N/A	3,480	53,887	7%

3. **Transport** is a dynamic growth sector in the region. Considerable funds are being channelled into this sector with the goal of linking all major towns in the country. There are plans for several important transportation corridors linking Lao PDR to Thailand and Vietnam, including the East-West Corridor (Road No. 9) with a bridge at Savannakhet, Road No. 8 in Bolikhamxai to the Vietnamese border and Road 12 in Khammouane. Many of these roads link up with roads to be upgraded by the Nam Theun 2 Project.

4. **Irrigation** by far the largest and most intensively cultivated irrigated dry season rice areas are found in the Mekong Delta. By 2000, these double-cropped areas constituted around 87% of the total area of dry season irrigated rice in the Mekong Basin. Lao PDR and Cambodia have the largest percentage wise expansion potential for dry season irrigated rice (could be doubled). From the local perspective, the Xe Bang Fai basin is the most promising in terms of irrigation potential.

5. **Water supply and sanitation.** Estimates for increased water consumption show a need for three times the existing supply by 2025 when up to 80 million people may inhabit the Lower Mekong Basin (55 million at present). In the Nam Theun 2 Project area, several towns have plans to expand or establish water supply and sanitation projects to cope with growing demand.

6. **Urban development.** Trends in the local context are concerned with population increase due mainly to in-migration from rural areas or from outside the Project area to the towns of Thakhek, Mahaxai and Gnommalat in Khammouane Province and Lak Xao in Bolikhamxai Province. Along with urbanization come the challenges of town planning, water supply and sanitation.

7. **Fisheries.** This is a key development sector both locally and in the Mekong region. Future hydropower development and subsequent changes in water flow and quality will affect this sector in the short and long-term. At present in the Lower Mekong Basin, fish and aquaculture yields are increasing but this may not be sustainable with present methods and technology. The Nakai Reservoir is expected to give rise to new fisheries.

8. **Forestry** includes both commercial logging and utilisation of forests by local communities for harvesting of NTFPs and traditional products. Forest cover in the Mekong Basin is dwindling with an estimated total cover of 34.4%, Lao PDR having approximately 40%, which is likely to decline to 30% given present trends. Commercial logging in the Project Area has been extensive and there is currently overcapacity in the timber-processing industry. A number of plans deal with reforestation and the establishment of plantations.

9. **Industry** as a sector, industry is concentrated in towns, the most important in the Project Area being Savannakhet where there are a number of light industries established. Wood processing is presently the most important industry in Bolikhamxai and Khammouane Provinces. Establishment of a cement factory at Mahaxai is the most important industrial development planned in the Project area. Other potential industries include oil refineries, textiles, canning and construction materials.

9. **Mining.** The development of the mining sector is part of the economic growth pattern but is also a potential source for local water pollution through waste and processing water discharges. Tin, zinc and lead are being extracted in the Nam Pathen Valley on a tributary of the Hinboun and this may be contributing to increased turbidity and heavy metal concentrations in the water. Some gypsum mining in Donghene District and large scale mining of gold and copper are taking place in Xepon District, Savannakhet Province. Further developments in the future may prove to be economically viable.

10. **Social development** covers a number of sub-sectors or themes: health, education, ethnic minorities and social disparity. In terms of health and education, the existing services are weak in terms of lack of skills, materials, equipment and funding. The spread of HIV/AIDS and other STDs is of concern as mobility, urbanization and immigration increase. There is also a trend towards increased social disparity between households in communities (advantages of human, material and financial resources lead to advantages in employment opportunities), between rural and urban areas (growing gap in services and wealth) and between men and women (trends favour men). In addition, ethnic minorities are being integrated and assimilated as a result of socio-economic change, cultural contact and loss of traditional livelihoods.

11. **Conservation.** Several areas in the Project area are classified as having very high biodiversity value for Southeast Asia in particular the NNT NPA and the Vu Quang National Park in Vietnam. There have been a number of positive developments in terms of policy, ratification of international agreements and conventions, the establishment of 20 NPAs in Lao PDR and the development of conservation management plans. However, there are clear trends that illegal hunting and trading in wildlife is seriously threatening many endangered species and the biodiversity of many NPAs as enforcement of regulations is currently weak.