

Initial Environmental Examination Report

Nam Theun 2 Hydropower Project Regulating Dam Spillway and Nam Kathang Crossing

Prepared for

NAM THEUN 2 POWER COMPANY

By



EARTH SYSTEMS Environment - Water - Sustainability

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Executive Summary

Brief Project Description and Justification

Nam Theun 2 Power Company (NTPC) proposes to construct and operate a free flowing spillway on the Nam Theun 2 (NT2) Regulating Dam to discharge water from the Regulating Pond to the Nam Kathang in the event of extreme flooding events. Construction of the spillway will require extension of the irrigation canal that currently provides an outlet for irrigation water to the eastern side of the Regulating Dam (left bank of Nam Kathang).

Following heavy flooding during the 2011 rainy season, NTPC ordered two independent updates of the Nam Kathang hydrology at the Regulating Pond site. The results indicate that the discharge capacity of the Regulating Dam is currently insufficient to accommodate floodwaters from 1,500 to 10,000 year average return interval (ARI) events. Without development of further discharge capacity, a significant flood event may overtop the Dam, compromising the integrity of the structure and putting at risk the lives and livelihoods of downstream inhabitants.

When major floods enter the Regulating Pond, the Powerhouse is stopped (even with no flooding of Xe Bang Fai) and the Downstream Channel (DSC) is used to evacuate 315 m³/s, in compliance with the Concession Agreement (schedule 23). In the rare event that the proposed spillway becomes operational (i.e. > ~1,500 year ARI), the volume of water discharged to the Nam Kathang will mimic the natural flow of the River, minus the flow discharged in the DSC (i.e. water input to the Regulating Pond will be solely from the Nam Kathang catchment and not from Nakai reservoir, therefore discharge to the River will equal catchment input minus the discharge to the DSC).

The dam crest, which is currently used by local villagers for crossing to the Nam Kathang left bank during the rainy season, will no longer be available. NTPC will therefore construct a submersible bridge that will provide for Nam Kathang crossing for all but high flow events (> 36 m³/s). It is anticipated that the bridge will be submerged for approximately 15 days per year, and often for short durations at a time. A temporary bridge will be implemented for use during the spillway construction phase that will accommodate villagers (on the eastern side) and construction vehicles (on the western side) of the bridge and access tracks. The interface will be divided by a fence to keep villagers and construction vehicles separated, and safety mechanisms will be implemented to avoid potential accidents.

Regulatory Compliance

NTPC will construct and operate the Project in compliance with the Project Concession Agreement (2002) by adhering to applicable components of the Agreement, the Lao Laws, and the most up to date and applicable Environmental and Social Safeguard Policies or Guidelines.

During operations, the on-going management, monitoring and reporting measures currently undertaken by NTPC will apply to the construction areas and downstream in the Nam Kathang ensuring on-going compliance with environmental and social components of the Concession Agreement as well as Lao PDR statutory requirements (refer to Section 6).

With respect to discharge to the Nam Kathang, operation of the spillway will adhere to Concession Agreement requirements, as per the Table 0-1. Compliance Agreement Number 2 (refer to Table 0-1) cannot be fulfilled, since the new spillway cannot discharge water when the Water Level is below the Full Supply Level (FSL). Nevertheless, this requirement is considered secondary and "of no further importance for safety of the structure" according to the LTA (cf. their letter ref 154082-220-LTR-178). All the other requirements are met, which is considered leading to a safe situation by the DSRP, the Government of Laos (GOL) Engineer and the Lenders Technical Advisors.

No.		Concession Ag	greement Requirements	Future Discharge Capacity (m ³ /s)					
	ARI (years)	Gates Situation	Reg. Pond Water Level	Flood Value (m³/s)	Downstream Channel	Existing Gates	New Spillway	Total	
1	1,000	1 closed	Maximum Water Level (179.5 masl)	1,600	315	1,038	740	2,093	
2	5,000	Open	Full Supply Level (178.0 masl)	1,915	315	1,245	0^	1,544	
3	5,000	1 closed	Maximum Water Level (179.5 masl)	1,915	315	1,035	740	2,093	
4	10,000	Open	Maximum Water Level (179.5 masl)	2,062	315	1,250	740	2,305	

Table 0-1 Concession Agreement Requirements and Proposed Discharge Capacity for the Regulating Pond

Source: Nam Theun 2 Power Company (personal communication)

`This requirement notes a maximum water level lower than FSL leading to no discharge for the new spillway.

Impacts

The Regulating Pond, proposed spillway and the main components of associated infrastructure (irrigation channel, spoil areas, topsoil reclamation area, etc.) are located on existing NTPC Category 1 Lands¹. The NTPC Project facilities (including the 400 bed RNT Camp) and three (3) villages - Ban Sangkeo, Ban That and Ban Lao, with a total of 597 households and 2,923 people have been identified within a 3.0 km radius of the Project site. An additional two (2) villages with a total of 261 households and 1,785 people are located further downstream on the Nam Kathang within less than a 10 km radius of the Project site (GOL 2013).

The primary impact of Project implementation will be a reduced risk of significant impact to downstream inhabitants of the Regulating Pond and users of the Nam Kathang in that the Regulating Dam would be able to accommodate extreme flood events by discharging sufficient Nam Kathang catchment water to the River to safeguard its structural integrity.

The management and mitigation of potential social and environmental impacts are addressed under Chapters 5 and 6. The potential environmental and social impacts are listed below:

- Increased erosion derived from construction activities and from spoils deposition areas and associated sediment transport and deposition in the Nam Kathang, during construction and in the aftermath of construction, until control facilities and revegetation activities are established;
- Impacts to water quality in Nam Kathang associated with construction activities, potentially
 including hydrocarbons and additional hazardous or non-hazardous waste spillage associated with
 construction equipment in or near the Nam Kathang; nutrients and pathogens associated with the

¹ NTPC Category 1 Lands are defined as lands which the Project has exclusive occupancy rights.

workforce accommodation facility; and increased turbidity of Nam Kathang associated with erosion and sediment transport;

- Impairment of habitat for aquatic species and/or direct mortality of aquatic species associated with impacts to water quality;
- Impacts to beneficial uses of the Nam Kathang if water quality and aquatic biodiversity are impaired;
- Potential impacts to threatened flora in the primary spoils deposition area, including two juvenile individuals of *Afzelia xylocarpa* and one individual juvenile *Hopea odorata*;
- Potential increased pressure on non-timber forest products, timber forest products, terrestrial species (hunting) and aquatic species (fishing / collection) resulting from immigration of construction workforce (50 people);
- Other potential impacts associated with the construction workforce such as increased risk of introduced diseases including sexually transmitted diseases and conflict due to insensitivity of workforce to local culture and environmental values;
- Increased dust and noise for villagers and NTPC employees in the vicinity of the construction areas; and
- Reduction in number of days the Nam Kathang can be safely crossed during the rainy season (with prohibition of crossing the Dam crest during the rainy season), in the event that the submersible bridge is under water. This impact, however, is mitigated by the fact that no structures were available for crossing the Nam Kathang prior to implementation of the Nam Theun 2 Project.

Potential impacts to land and vegetation are considered minor to insignificant. All but a small fraction of the works will be conducted on highly disturbed land, primarily spoils areas from the NT2 category 1 Lands. Paths or tracks leading to the location of the permanent crossing already exist, and no vegetation shall be removed (except common herbaceous and shrub species where the temporary crossing will be built – refer to Section 5.3). There are no anticipated impacts for terrestrial animals and plants native to the region.

Environmental and Social Management and Monitoring

The framework for environmental and social management and monitoring for this current Project will be consistent with that previously established and conducted for the greater NT2 Project.

NTPC has developed an Environmental Management System (EMS) that established the framework for management, mitigation and monitoring requirements during Project construction. A major component of the EMS was the development of an *Environmental Monitoring and Management Plan* (HCEMMP). The HCEMMP (2006) details mitigation measures and monitoring protocol that are compliant with statutory and institutional requirements for the Project. NTPC will re-institute Volumes A and B of the HCEMMP (refer to Section 5.4.2) and will require the Construction Contractor to re-develop Volume C based on mitigation measures that are site specific to the current Project.

As per re-development of Part C of the HCEMMP, Contractors will develop Site Specific Environmental Plans (SSEPs) that incorporate those design elements / mitigation measures of HCEMMP Volume 2 Sub-Plans that reflect the physical, environmental and social character of each construction site.

A number of entities will monitor construction and/or operation of the Project (refer to Section 6), including:

- The Owner Engineer and Construction Contractor;
- NTPC Health, Safety, and Environment Department;

- The Environmental Management Unit (EMU); and
- Lender's Technical Advisers.

Public Disclosure and Consultation Process

A series of initial consultations have been conducted. These included meetings with provincial and district level representatives, village meetings and surveys, and site visits. The purpose of these engagements was to introduce the Project to stakeholders and potentially affected people; collect information in and downstream of the Project area; and seek feedback from key stakeholders (refer to Section 7).

At each consultation, a description of the Project was provided. Participants were given an opportunity to provide comments, advice and information, and to ask questions relevant to the Project. Standard forms were used to record discussions. All comments and questions received during public consultation have been addressed in this IEE (Section 7).

Proposed Mitigation Measures

Mitigation Measures for the effective management of potential environmental and social impacts include:

- 1. Ensure that there is no cessation of flow in Nam Kathang during construction to protect the viability of downstream aquatic habitat;
- Ensure villagers of Ban Sangkeo, Ban That and all other villages bordering the Nam Kathang are contacted 3 to 4 months in advance of the spillway becoming operational to provide information regarding the updated flood warning system. It should be noted that the new spillway will discharge water only after the existing gates are fully open (i.e. when the flow in the Nam Kathang riverbed is already approximately 1,250 m³/s);
- 3. Ensure that villagers of Ban Sangkeo, Ban That and all other villages bordering the Nam Kathang are warned when a flood occurs and are prevented from crossing the permanent Nam Kathang crossing before its submersion.
- 4. Design and build the permanent submersible crossing to prevent access to cars or light trucks that may otherwise accelerate the potential of resource extraction from the left bank of Nam Kathang (e.g. timber, non-timber forest products, hunting, etc.).
- 5. Prohibit construction personnel from fishing local waters, hunting, collecting forest resources, and trade, transport and consumption of wildlife products;
- 6. Conduct major earthworks and implement erosion and sedimentation facilities during the dry season and revegetate all disturbed landforms during the first weeks of the rainy season;
- 7. Ensure that spoils are not placed within 50 metres of the Nam Kathang and downstream channel, as per the CA and EMMP.
- 8. Identify, clearly mark, and construct fencing around the three threatened trees (two species) in the primary spoils deposition area. These individuals, at the edge of the riparian vegetation, are expected to be outside of the spoils deposition area, but could be impacted during permanent bridge construction or spoils deposition. If impacts are unavoidable, these trees should be transplanted to a suitable location outside of the proposed Project footprint;
- 9. Progressively rehabilitate and plant disturbed areas as soon as their use is no longer required (during appropriate seasons as per recommendation #6);
- 10. Ensure aspects of the Owner Engineer and Construction Contractor Environmental Management and Monitoring Plans are updated according to Project specific features, including development of Site Specific Environmental Management and Monitoring Plans that incorporate all requirements of the Concession Agreement, Owner's Requirements and the EMMPs.

1 Introduction

This Initial Environmental Examination Report (IEE) of proposed works conducted for the Nam Theun 2 Power Project Regulating Dam and associated ancillary infrastructure (hereafter the 'Project') has been prepared by Earth Systems on behalf of Nam Theun 2 Power Company (NTPC).

1.1 Brief Project Summary and its Justification

Regulating Dam Spillway

NTPC proposes to construct and operate a free flowing spillway on the Nam Theun 2 (NT2) Regulating Dam to discharge water in the event of extreme flooding events. The spillway and associated infrastructure will be located on NTPC Category 1 Lands.

Following heavy flooding during the 2011 rainy season, NTPC ordered two independent updates of the Nam Kathang hydrology at the Regulating Pond site (EDF, 2012 and Entura, 2013). The update concluded that the peak flood values for the Nam Kathang catchment (which drains to the Regulating Pond) were underestimated.

The results indicate that the discharge capacity of the Regulating Dam is currently insufficient to accommodate floodwaters from 1,500 to 10,000 year average return interval (ARI) flood events. Without development of further discharge capacity, a 1,500 – 10,000 year ARI flood event may overtop the Regulating Dam, compromising the integrity of the structure and putting at risk the lives and livelihoods in the villagers located downstream. NTPC (and consulting engineers) have thus designed a free-flowing spillway in the abutment section (eastern) of the NT2 Regulating Dam that will discharge floodwater from the Nam Kathang catchment into the Nam Kathang below the Regulating Dam.

Irrigation Canal

As per the NT2 Project *Concession Agreement* (2002), NTPC has provided an irrigation canal that extends to the left bank of the Nam Kathang. Construction of the spillway will require an extension of the irrigation canal from the Regulating Dam, whereby the canal will be constructed subsurface beneath the spillway for discharge to the eastern side of the Regulating Dam.

Nam Kathang Crossing

Villagers of Ban Sangkeo (and Ban Lao to a lesser extent) commonly cross the Nam Kathang near the Regulating Pond to access the left bank for a variety of purposes such as crop cultivation, harvesting and collecting of timber and non-timber products, fishing, hunting and cattle herding. The River is easily crossed during the dry season. However, when the flow of the River increases during the rainy season, the Regulating Dam crest is commonly used to cross the Nam Kathang. The crossing of the Regulation Dam crest during the wet season and construction period will no longer be tolerated due to safety reasons.

NTPC has therefore proposed to construct a permanent submersible bridge for access to the left bank. A temporary bridge will also be built for the construction vehicles and to accommodate pedestrian crossing during the construction phase of the Project.

1.2 Presentation of the Project Developer and EIA Consultant

Nam Theun 2 Power Company

Nam Theun 2 Power Company (NTPC) is a limited liability company that was incorporated under Lao law on August 28, 2002. NTPC was formed by the Lao Government and the private shareholders to build and operate the Nam Theun 2 Power Project (NT2 Project) for the first 25 years of its operation. NTPC operates on behalf of the shareholders (and owners of NTPC), which are comprised of Electricite de France (EDF), the Lao Holding State Enterprise (LHSE), owned by the Lao Government, and the Electricity Generating Public Company of Thailand (EGCO).

The shareholders of NTPC, including the parent companies and associated companies within the respective group, have extensive experience in the design, construction and operation of large-scale hydroelectric power projects.

The contact details for NTPC are as follows:

Mr Daniel Paschini **Nam Theun 2 Power Company Limited** Unit 09, Nongbone Village 23 Sangha Road, Xaysettha District P.O. Box 5862, Vientiane, Lao PDR T: (856-20) 2222 1104 E: daniel.paschini@namtheun2.com W: www.namtheun2.com

Earth Systems

The Earth Systems Group is a multidisciplinary environmental and social consulting firm which develops and implements innovative and effective environment, water and sustainability solutions throughout the world. Established in 1993, they have successfully completed over 500 major projects in Australia, Asia, Africa, South America, North America and the Pacific.

Earth Systems has been operating in Lao PDR for more than 15 years completing a range of environmental and social consultancy projects including EIAs for some of the country's most significant mining and hydropower projects. Earth Systems' impact assessment expertise includes managing multi-disciplinary teams composed of a range of international and local experts in preparing international standard environmental and social impact assessments that meet national regulatory and, if required, investment bank requirements for project permitting.

The contact details for Earth Systems are as follows:

Mr Tom Callander **Earth Systems** Suite 502, 23 Singha Road Ban Nongbone Vientiane, Lao PDR P: +856 (0) 21 454-434 E: <u>enviro@earthsystems.com.au</u> W: <u>www.earthsystems.com.au</u>

1.3 Methodology

The Initial Environmental Examination was undertaken through conduct of the following actions:

- **Kick-off meeting** with NTPC personnel was conducted on December 12, 2013 to discuss the proposed Project justification, design, timeline and Company expectations.
- Literature Review of available secondary information applicable to the Project Area was undertaken. Primary information was sourced from NTPC and the Government of Lao PDR, both before field surveys were undertaken and during consultations. Additional materials were sourced from previous studies conducted in the region and other relevant sources. The literature review included assessment of the most up-to-date national and regional legislation, planning policy guidance and international standards of best practice. Collectively, this information served to inform the field surveys, consultation, and report preparation.
- Meetings with GOL agencies commenced with a GOL Project Kick-off meetings in Thakhek and Gnommalath on 16th and 17th of December, 2013 to discuss the Project, answer queries and ascertain Provincial GOL expectations. Separate meetings with key Provincial and District line departments / offices were also held to source relevant secondary information.

During the Provincial Kick-off meeting, Khammouane PONRE confirmed that the conduct of an IEE was appropriate for this Project and that PONRE would be the focal point of government consultation (refer to Appendix H)

Site visit and surveys were conducted in December, 2013 and April 2014. The Regulating Dam, proposed spoil depositions areas, soil reclamation areas, and bridge construction areas were visited and evaluated with respect to physical, biological and social implication of their respective construction. A comprehensive survey of vegetative communities and plant species was conducted during the first week of April 2014.

Social surveying was conducted in the villages of Ban Sangkeo, Ban Lao and Ban That in December 2013 and April 2014. This included village level surveying with village chiefs and members of the village committee; and Focus Group Discussions with men and women on key topics including land use; forest resource use, aquatic resource use; access to the left bank of the Nam Kathang and safety during flood events.

- Formal IEE Village / District level consultations were conducted in January 2014 in Ban Sangkeo, Ban Lao and Ban That. Consultations included representatives from the Gnommalath District Government, representatives of the village committees and men and women from each village. During each meeting, separate male and female group discussions were held to facilitate community feedback. Follow-up village consultations were conducted in April 2014 to update villagers on the status of the IEE and confirm contents of minutes from the January consultations.
- Formal IEE Khammouane Provincial consultation was conducted in Thakhek in February. Participants included representatives from relevant provincial and district line departments / offices and village chiefs and Lao Women Union representatives from Ban Sangkeo, Ban Lao and Ban That.
- Meetings with NTPC and internal discussions were conducted throughout the process, with the following NTPC Departments/personnel: Department of Water Quality and Biodiversity, Department of Government Affairs, Health Safety and Environment Department, E&S Division, Technical Department and the NTPC Asset Management Director.
- **Risk Assessment** was conducted to evaluate potential environmental and social impacts derived from Project construction and implementation. The methodology for this risk assessment is based

upon ISO 31000 Risk management - Principles and guidelines, 2009 and ISO/IEC 31010 Risk management – Risk assessment techniques, 2009.

• IEE Analysis and reporting were conducted by assessing baseline conditions, identifying risks during site visits and risk assessment, evaluating potential Project impacts and benefits, and assessment of the proposed Project relative to the NTPC Concession Agreement and national / international statutory requirements.

2 Project Description

2.1 Project Location

The Nam Theun 2 (NT2) Project is located in Khammouane Province in central Lao PDR (refer to Figure 2-1). All of the proposed works for this IEE (herein referred to as the Project) will be conducted at or in the vicinity of the NT2 Regulating Pond, with ancillary works conducted to the immediate south of the Regulating Pond within a maximum distance of 1.5 km from the proposed spillway construction site. The proposed Project Area exists entirely in Gnommalath District, approximately 274 km east of Vientiane, the capital of Lao PDR.

2.2 Brief Project Overview

The NT2 Project, commissioned in March, 2010 was developed via construction of a dam on the Nam Theun and a series of saddle dams on the Nakai Plateau to create a 450km² reservoir on the Nakai Plateau at full supply level, with a total water storage capacity of 3,910 million m³. Water from the reservoir drops 350 m to the Power Station located at the base of the Plateau near the town of Gnommalath in the Xe Bang Fai catchment (see Figure 2-2).

Water discharged from the power station flows approximately 400 metres to the Regulating Pond (approximately 4 km to the Regulating Dam), which stores approximately 8 million m³ of water at full supply level (FSL). The Regulating Pond occurs entirely with the Nam Kathang catchment and thus receives and temporarily contains surface water input from tributaries of the Nam Kathang (Nam Kathang Noy and Nam Kathang Gnai) in addition to operations water from the NT2 Power Station. The Regulating Dam water level is between 169.5 masl (Minimum Operating Level) and 178 masl (Full Supply Level). During normal operation and on average, the pond level is maintained at approximately 175 masl, since this level enables to fulfil the CA environmental and safety requirements (i.e. store temporarily water in the Pond in case of units start, or continue temporarily to release water in the DSC in case of units shutdown). In 2013, the average water level was 174.5 masl.

Water is released from the Regulating Pond via two independently operating controlled release operations, namely:

- Water is discharged to the Downstream Channel (DSC), which conveys operations water via the constructed 27 km long channel to the Xe Bang Fai. The Regulating Pond allows the discharge of water released to the DSC to remain relatively constant, while the water discharged from the NT2 Power Station may vary between 0 and 330 m³/sec. In this manner, the Regulating Pond dampens the effect of variable discharge. The volume of water discharged to the DSC may be decreased (and powerhouse operations reduced or halted) as a result of pending or realised flooding in the Xe Bang Fai, at Mahaxai.
- Water is also discharged into the Nam Kathang River. In compliance with the Project *Concession Agreement* (2002), NTPC is required to discharge the same volume of water into the Nam Kathang downstream of the Regulating Pond that is supplied to the Regulating Pond from the Nam Kathang catchment.

2.3 Project Context

Spillway

Following heavy rains during the 2011 wet season; NTPC ordered two independent updates of the Nam Kathang hydrology at the Regulating Pond site (EDF, 2012 and Entura, 2013). The updates each concluded that the results identified in the *Owner's Requirements* (2005) underestimated the peak flood values for the Nam Kathang at the Regulating Pond (refer to table 2-1).

Average Return Interval (ARI) – Years	Owner's Requirements values, 2005 (m ³ /s)	Updated peak flow values, EDF 2012 (m³/s)	Updated peak flow values, Entura 2013 (m³/s)
100	620	1,088	1,000
1,000	1,000	1,575	1,600
5,000	1,300	1,915	1,900
10,000	1,500	2,062	2,000

Table 2-1 Past and updated hydrologic values for the Nam Kathang at the Regulating Pond

Source: EDF, Regulating Dam – Additional Spillway (October, 2013)

The results from hydrology modelling conducted by EDF and Entura are similar, and indicate that the discharge capacity of the Regulating Dam is currently insufficient to accommodate floodwaters from 1,500 to 10,000 ARI events. At Maximum Water Level, the capacity of the existing discharge gates (including the DSC) is 1,660 m³/s, which corresponds to the peak of a 1,500 year ARI flood. A 1,500 – 10,000 year ARI event may therefore overtop the Regulating Dam, compromising the integrity of the structure and putting at risk the lives and livelihoods of downstream inhabitants.

This assessment demonstrates that it is necessary to increase the discharge capacity of the Regulating Dam to accommodate extreme flood events without damage to the Regulating Dam. As such, NTPC (and consulting engineers) have designed a free-flowing spillway in the abutment section (eastern) of the Regulating Dam that will act independently of the release gates for the DSC and current Nam Kathang discharge facilities.

Nam Kathang Crossing

Villagers in the region cross the Nam Kathang on a daily basis to access the left bank of the river for a variety of purposes (refer to Section 4.4). During the dry season the majority (if not all) of those accessing the left bank cross the shallow Kathang stream water. However, during the rainy season, the Nam Kathang is difficult if not impossible to cross. Residents of nearby villages Ban Sangkeo and Ban Lao (to a lesser extent) have utilised the Regulating Dam crest to reach the left bank of the Kathang. The Regulating Dam crest will no longer be safe to cross following implementation (and during construction) of the Regulating Dam spillway.

NTPC has therefore decided to construct a permanent 'Irish crossing' across Nam Kathang that will provide access to the left bank of the river. A temporary crossing will also be required for the Construction phase to provide access for local villagers and for construction vehicles and equipment associated with spillway construction.



Figure 2-1 – Project Location



Figure 2-2 Project Region (Source: NTPC)

2.4 Regulating Dam Spillway

NTPC contracted EDF to design the Regulating Dam spillway. The following information is sourced from *Regulating Dam – Additional Spillway* (EDF, 2013).

The spillway design will incorporate the following features:

- The crest level of the spillway will be five (5) cm higher (178.05 masl) than FSL of the Regulating Pond (178.00 masl) and thus will not allow for discharge during normal conditions;
- For the proposed spillway crest level elevation, spillage would only occur under extreme flood events (ARI flooding higher than ~1,500 years) and for short durations (anticipated spillage < 4 hours for 10,000 year ARI flood). Refer to Figure 2-3;



Figure 2-3 Regulating Dam flood hydrograph (Entura 2013)

- The spillway will span the majority of the Regulating Dam abutment (earthen portion), with a
 maximum width of approximately 275 m at the crest (refer Figures 2-4 and 2-5). The width of the
 spillway was chosen to maximise the spillway capacity while spreading the volume of the
 discharging water over a greater area to reduce the velocity of spillage that would be realised with
 a narrower channel. The velocity in the channel is expected to be approximately 2 m/s (vegetated
 portion) and 4.3 m/s (concrete / rip rap portion);
- A concrete beam (1m deep x 0.5m wide x 275m long) will be constructed at the top of the spillway crest (with non-grouted rip rap on the Regulating Pond side of the beam) to prevent percolation through the embankment dam and fix the crest level;
- The top 44 metres of the spillway channel will be covered with riprap to reduce the velocity of the spillage and provide flexible erosion protection (e.g. Reno mattress and loose riprap);
- Downslope of the riprap, the channel bed will be vegetated with Bermuda grass, known for its ability to withstand flows and found throughout Thailand and Laos, also named Ya phaek. Fences will be implemented to prevent grazing;

- Vetiver will be planted on the channel's lateral slopes and at the junction with Nam Kathang the steepest portion of the spillway. Vetiver is deep rooted and known for its erosion resistance capacity. Fences will be implemented to prevent grazing; and
- The spillway will be angled slightly toward the left bank (east) to convey low flow spillage away
 from the primary Regulating Dam facilities and to direct water toward a riprap lined channel at the
 spillway / Nam Kathang interface.

When major floods enter the Regulating Pond, the Powerhouse is stopped (even with no flooding of Xe Bang Fai) and the DSC is used to evacuate 315 m³/s, in compliance with the Concession Agreement (schedule 23). In the rare event that the proposed spillway becomes operational (i.e. > ~1,500 ARI), the volume of water discharged to the Nam Kathang will mimic the natural flow of the River, minus the flow discharged in the DSC (i.e. water input to the Regulating Pond will be solely from the Nam Kathang catchment therefore discharge to the River will equal this input minus the discharge to the DSC).



Figure 2-4 Proposed spillway design (EDF, 2013)



Figure 2-5 Project Area with Regulating Dam spillway superimposed

2.5 Ancillary Spillway Construction Components

2.5.1 **Spoils**

Construction of the spillway will require excavation of approximately $200,000 - 220,000 \text{ m}^3$ of spoil, that will be stored in two spoil deposit areas, which are located in Category 1 land (NTPC land) (refer to Figure 2-6):

- The main spoil disposal area is located behind RNT.This area is suitable to store 200,000 to 220,000 m³ of spoil, with a spoil thickness of 2.5 to 3.5m; and
- A secondary spoil area is located in the left part of the future channel (if required).

Spoils deposit areas will be designed, constructed, and revegetated according to NTPC *Concession Agreement* requirements and the Contractor Environmental Management and Monitoring Plan, and particular attention will be paid to erosion and sediment control (EMMP) (refer to Section 5.4.2).



Figure 2-6 Proposed Project spoils deposition areas (Source: NTPC) – refer to Figure 4-1 for context

2.5.2 Irrigation Canal

NTPC has constructed an irrigation canal at the Regulating Dam that conveys water across the Regulating Dam to an outlet on the left bank of the Nam Kathang for future irrigation projects on the Gnommalath Plain. Construction of the spillway will require extension of the irrigation canal and outlet to provide access to irrigation water at left bank of the Nam Kathang.

The final design for the irrigation canal extension is a subsurface concrete canal. This design enables Project compliance with the Concession Agreement (refer to Figures 2-7 and 2-8).



Figure 2-7 Irrigation canal extension (Source NTPC)



Figure 2-8 Cross section of the irrigation canal extension (Source NTPC)

2.5.3 Workforce Accommodation Facility

A construction camp that will house 50 contracted employees will be implemented. NTPC is currently evaluating the Promec area (refer to Figure 2-10) for construction of this temporary facility. Detailed design and determination of the exact sitting of the facility will be finalised in the coming months in consultation with the Contractor. A number of management, mitigation and monitoring measures (refer to Section 5.4) will be implemented to comply with the NTPC Concession Agreement and applicable statutory requirements listed in Section 3.

2.5.4 **Topsoil Reclamation**

Vegetating approximately 90% of the spillway (the remaining 10% will be covered with rip-rap) will require approximately 10,000 m³ of topsoil.

Additional topsoil (approximately 5,000 m³) may be required to successfully establish plants on the spoils deposit surfaces (maximum of 5 ha), particularly on the batters.

An area on the left bank of the Regulating Pond near the log boom has been investigated for topsoil reclamation (refer to Figure 2-9). This area is submerged when the Regulating Pond water level is high. The alluvium that is deposited there is viable substrate for plant growth and would not require disturbance of vegetation during excavation. The top soil volume is sufficient for revegetation activities (20,000 m³ are available). This topsoil is situated between EL 174 and 177 masl.



Figure 2-9 Proposed topsoil reclamation area (Source: NTPC). Refer to Figure 4-1 for context

2.6 Nam Kathang Crossings

2.6.1 **Temporary Crossings**

NTPC will install a temporary crossing for access to the left bank of the Nam Kathang during spillway construction. The bridge over the Nam Kathang will provide access for construction vehicles and villagers, with the respective pathways and bridge divided by a fence. The temporary bridge will be equipped with a secured and separated access (by a physical barrier) over the Nam Khatang for pedestrians. Dedicated health and safety staff will control and safeguard the traffic across the temporary bridge during the construction period. Additional management and mitigation measures to avoid accidents at the construction / pedestrian interface are provided in Section 2.8 and Section 5.4.2.

The bridge will be located immediately south of the spillway (refer to Figure 2-9) and will be 40 metres long and 7.5 metres wide. The construction access portion of the bridge will be approximately six (6) metres wide, with the village access 1.5 metres wide. The temporary bridge will be dismantled after the completion of construction.



Figure 2-10 Project Infrastructure with proposed temporary crossing (Source: NTPC)

2.6.2 **Permanent Crossing**

Currently, inhabitants of Ban Sangkeo use the crest of the Regulating Dam to cross the Nam Kathang during the rainy season. With the construction of the spillway, the use of the regulation dam crest will no longer be tolerated due to hydro safety reasons. NTPC will therefore build a submersible crossing to provide access to the left bank of the Nam Kathang during the dry season and most parts of the wet season.

Design features of the submersible bridge are as follows:

- The submersible bridge will be located 0.4 km downstream of the spillway and 1km from the Nam Kathang gates (refer to Figure 2-12);
- The design of the submersible bridge is intended for use when the Nam Kathang flow is less than or equal to 36 m³/s. Above this flow, the bridge shall be submerged (i.e. for approximately 15 days / year, for a few hours or days each time). Safety measures during operation are discussed in Chapter 5.4.3;
- The bridge will be constructed to withstand flows up to 1,000 m³/s (100-year ARI flood), in compliance with the former Owner's requirements;
- The facility will be designed such that backwater effect is minimised. This bridge will not significantly increase the upstream water level as this would lower the discharge potential of Nam Kathang gates during a flood; and
- The design of the bridge is currently being finalized. The current design will allow safe crossing by
 pedestrians and light vehicles (hand tractors, motor bikes) with a width of 2.25m. Two concrete
 bollards on each side of the crossing will be placed such that they prevent cars from crossing while
 allowing small tractors (hand tractors or Tok-tok) to access the left bank. During flood situations,
 the bridge will be closed by NTPC controlled safety personnel.



Figure 2-11 Permanent submersible bridge cross section

Villagers will access the crossing from the right bank through roads or tracks following the boundaries of RNT. On the left bank, paths already exist and only minor works and brush / shrub clearance will be needed to link the crossing to the east side of the Regulating Dam crest (refer to Plates 2-1 and 2-2).



Plate 2-1 Right bank, existing track



Plate 2-2 Left bank, existing track



Figure 2-12 Location of permanent Nam Kathang crossing (submersible bridge) and access

2.7 Proposed Implementation Schedule

NTPC intends to commence construction of the spillway in November, 2014, during the dry season (preliminary works may be undertaken in August – September 2014). Works are expected to be completed in April 2015, before the onset of the rainy season.

	2014						2015												
ITEM	DESCRIPTION	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
1	Sign Contract					_					-								-
2	Survey for Design	15																	
3	Shop and As-Built Drawings																		
4	Mobilization										G								
5	Temporary Access									-					1				
6	Riprap Production											_							
7	Spillway										-	_	_				_		
	- Excavation									1	_					_			
	- Concrete Beam											-	-		1				
	- Grouting Riprap	i i i												e/			•		
	- Reno Mettress														0.0	_			
8	Vegetation Works														1	_	_		· · · · ·
	- Top soil																	į	
	- Grass Planting																		0
9	Irrigation Canal												_	_			_		
	- Excavation	1									1		_						
	- Concrete Structure											-	_		-	-			
	- Backfill															-			

Figure 2-13: Proposed Implementation Schedule

2.8 Alternatives Analysis

Two primary alternatives were evaluated (in addition to the No Spillway alternative) in determining the Selected Alternative for increasing the discharge capacity of the Regulating Pond. The following section summarises the alternatives considered and those still being assessed.

No Spillway

The No Spillway alternative is not considered a viable option for the Project because of the associated risks it will create for the downstream population and infrastructure.

Regulating Pond Discharge

NTPC considered:

- Adding a gated spillway (comprised of two (2) gates), to complement the four (4) Nam Kathang discharge gates currently operating; and
- Adding a free flowing spillway to the Regulating Dam.

Table 2-2 summarises the primary elements deliberated.

Table 2-2 Summary of spillway alternatives analysis

Criteria and Consequences	Gated Spillway	Free Flow Spillway			
(a) Design criteria: Logs	Log evacuation requiring a gate width >10 m	No constraint			
(b) Design criteria: Failure mode	Minimum 2 gates (to fulfill the (n-1) criteria)	No failure mode			
Consequences (a) + (b)	Structure minimum width: 25m	No specific constraint			
(C) Earth dam living part structure	Massive concrete structure inside dam living part with deep excavations	Only crest erosion protection with wide and shallow excavations			

Criteria and Consequences	Gated Spillway	Free Flow Spillway			
(d) Downstream structure	High velocity concentrated flow: massive concrete U channel (including impervious joints to avoid erosion of the underlying earth material)	Wide spread flow – riprap and grass minimizing potential erosion			
Consequences (c) + (d)	Heavy concrete structures including potential foundations treatments	Wide anti-erosion system			
(e) Consequences on NT2 operation: During construction	Temporary cofferdam (sheet piling) including a highly possible operation level constraint	No constraint			
(f) Consequences on NT2 operations: During operation	Stoplogs required for regular maintenance	No constraint			
Consequences (e) + (f)	Significant consequences on NT2 operations during construction and/or heavy temporary structures	No constraint			
Cost estimate	Disproportionate to the costs entailed in free flow spillway solution				

Source: EDF, CIH (2013)

The free flow spillway was found to be more resistant to erosion, easier to construct, more cost effective, and is therefore the Selected Alternative.

Permanent Crossing

NTPC has evaluated the Nam Kathang below the Regulating Dam to evaluate potential locations for the permanent crossing. Preliminary locations for the permanent crossing are provided in Figure 2-14.



Figure 2-14 Geologic survey cross sections for determination of permanent bridge location

The Owner engineer surveyed the area and concluded that conditions at only one of the surveyed locations is technically suitable (Figure 2-14). This site is located approximately 1 km downstream of the

Regulating Dam (refer to Figure 2-12). This distance is also suitable to prevent backwater from slowing discharge from the Regulating Dam release gates to the Nam Kathang.

This site is also located within a reasonable distance from current crossing areas for local villagers (within 400m of dry season crossing and 1 km of the Regulating Dam – e.g. current rainy season crossing).

Alternative analysis

Two possibilities have been contemplated for the structure: a suspended bridge or a submersible crossing.

A suspended bridge will enable villagers to cross the river all along the year, but will be very difficult to implement because of the topography (height of 8 to 10m), will be much more costly if designed to allow small tractors, and will require yearly maintenance.

A submersible crossing (concrete structure) will not require any maintenance, will easily withstand several hand-tractors at the same time, but will be flooded a few days / year. Safety measures during rainy season appear easy to implement and efficient.

Having considered the options and the risk that a suspension bridge could fall into disrepair and therefore become dangerous, the submersible crossing is considered to be the best solution, while significantly enhancing the pre-NT2 crossing possibilities, since no structure existed.

Temporary Crossing

During construction of the Nam Theun 2 Regulating Dam spillway (November 2014 – April 2015), NTPC will provide temporary access to the left bank of the Nam Kathang River, downstream of the Regulating Dam. This access is designed for construction vehicles (e.g. excavators and dump trucks constructing the spillway) and villagers who commonly cross the Nam Kathang proximal to the proposed temporary access track / bridge construction area.

However, during dry season the Nam Kathang can be crossed by foot. Men and women from Ban Lao (approximately 20 families) and Ban Sangkeo (80 families) cross the river downstream of the Regulating Dam as do villagers of Ban That further downstream at a number of locations. It is anticipated that villagers will continue to cross the Nam Kathang opportunistically at locations other than the temporary bridge.

NTPC has considered two options, a shared bridge option and a dual bridge option.

<u>Shared bridge option</u>: The shared use option includes the construction of a single access track (right bank of Nam Kathang) and bridge to accommodate Project excavators and dump trucks as well as villagers (pedestrians / motorbikes). The bridge would be located immediately south of the spillway and would be 40 metres long and 7.5 metres wide. Project and community use of the bridge would be separated by a physical barrier (fencing). The construction access portion of the bridge would be approximately six (6) metres wide, with the village access 1.5 metres wide.

Designated temporary community access tracks would be identified on the right and left banks to allow safe passage to the east of the construction site and fencing will separate the entire length of the access tracks and bridge for construction vs. pedestrian use.; and

<u>Dual bridge option</u>: The dual bridge option includes the construction of separate bridges, with exclusive use for Project vehicles and villagers respectively.

A Project bridge would be constructed immediately south of the spillway to accommodate construction vehicles. The bridge would be approximately 40 metres long and 6 metres wide.

A Community bridge would be constructed downstream (approximately 10 - 30 metres downstream) of construction access bridge to accommodate villagers accessing the left bank of the Nam Kathang.

Safety Measures

NTPC will implement the following safety measures:

- A fence will divide the construction access from villager access for the length of the shared track and/or bridge (shared bridge option), providing physical separation for the entire length of the interface;
- NTPC will ensure personnel man both ends of the access track / temporary bridge to direct traffic to their designated pathway for the temporary bridge(s) and access tracks.
- Infrastructure will be implemented (i.e. speed bumps and speed limit signs) to ensure that construction vehicles a maintain safe operating speed; and
- Construction personnel will be trained in the conduct of safe operating procedures, including operating a safe speeds and accident prevention;

Alternatives Analysis

Potential impacts as well as management and mitigation measures are similar for the shared bridge and dual bridge options. Primary potential impacts include: compromised safety for villagers and construction personnel, vegetation removal, and impacts to water quality (i.e. sedimentation and hydrocarbon spillage).

The shared bridge option would have a greater length of area where construction vehicles and villagers may be in proximity to each other. However, the management and mitigation measures listed above are considered adequate to avoid potential safety impacts. It is also anticipated that villagers will continue to cross the Nam Kathang at a number of locations downstream of the Regulating Dam (as opposed to using the temporary bridge) as villagers have indicated that during the dry season, a number of crossing areas are available.

The dual bridge option will require additional in-stream construction and riparian vegetation removal, increasing the risk for erosion and sedimentation and hydrocarbon spillage in comparison to the shared bridge option. The reduced footprint of the shared bridge option therefore makes it the preferable option to minimise impacts associated with in-stream construction and is the Select Alternative.

3 Policies and Statutory Requirements

3.1 Corporate Environmental and Social Policies

The Nam Theun 2 Power Company corporate and environmental framework is grounded in its *Quality*, *Health, Safety and Environmental (QHSE) Policy* and its commitment to the principles of an Environmental Management System as defined by ISO 14001:2004.

NTPC is committed to the continual improvement of its quality, health, safety, hydro-safety and environmental performance to achieve the greatest benefit for its stakeholders. NTPC is committed to preventing personal injury and ill-health of its employees, suppliers, contractors, customers, and communities (stakeholders) and to achieving the highest standard of environmental stewardship and protection of the environment for current and future generations.

NTPC is committed to fulfilling its legal and contractual obligations as defined by its Concession Agreement with Lao PDR and national and international policies, guidelines and standards. The company focuses on satisfying the needs of its customers through constant improvement of its quality management system with the requirements of ISO 9001: 2008 and ensures the relevance of its quality objectives to this policy through annual review and revision.

3.2 Concession Agreement

The Project Concession Agreement was signed between GOL and NTPC on 3 October, 2002 for a 25 year period following the onset of commercial operation. All environmental and social obligations in the agreement are binding for the 25 year concession period.

Schedule 4 to the Concession Agreement sets-out the environmental and social obligations of NTPC. Part 2 of Schedule 4, the environmental component, identifies the environmental objectives of the Project outside the Nam Theun 2 Watershed Area to be implemented by NTPC and the GOL, and to be funded by NTPC.

NTPC agrees under the Concession Agreement to comply with and implement at its own cost those Environmental and Social Objectives set out in Schedule 4 which are expressed to be the activities and obligations for which it is responsible except where the Concession Agreement permits the GOL to implement any of those Environmental and Social Objectives in which event the Company's obligation is to provide the funding for that objective for the extent required.

3.3 Policy and Legal Framework in Lao PDR

The key government agency responsible for environmental and social assessment of the Project via the EIA process is the Department for Environmental and Social Impact Assessment (DESIA), Ministry of Natural Resources and Environment (MONRE). The Provincial Department of Natural Resources and Environment in Khammouane has been assigned as the GoL focal point for the Project (refer to Appendix I).

The statutory environmental and social permitting requirements are outlined in a number of relevant laws, decrees and guidelines. Key legislation relevant to the project permitting is provided in Table 3-1.

Table 3-1 Legislation applicable to Project permitting

Title	Date
Environment Protection Law	2012
Decree on Environmental Impact Assessment	2010
Environmental Impact Assessment Guidelines	2012
National Policy on Environmental and Social Sustainability in the Hydropower Sector	2007
Decree on Compensation and Resettlement of People Affected by Development Projects	2005
Technical Guidelines for Resettlement and Compensation	2010
Law on Hygiene, Disease Prevention and Health Promotion	2001
Land Law	2003
Public Involvement Guidelines	2013

3.4 International Standards

NTPC is committed to comply with appropriate international standards and international best practice. Compliance with the following guidelines and standards are required for the purposes of the Project in addition to the requirements of Lao PDR *Environmental Impact Assessment Guidelines* (2012).

Equator Principles

The Equator Principles are a voluntary framework for the assessment and management of environmental and social issues associated with project financing. They provide a means for financial institutions to ensure that the projects they finance are developed in a manner that is socially responsible and consistent with sound environmental management practices.

Financial institutions that have adopted the Equator Principles categorise the risk of a project based on existing IFC environmental and social impact criteria. Before a financial agreement is secured, all high (Category A) to medium (Category B) risk projects are required to complete an Environmental Assessment, which identifies and addresses key environmental and social impacts associated with the project. The Assessment should also propose mitigation and management measures relevant and appropriate to the nature and scale of the proposed project.

ADB Safeguard Policies

• ADB Safeguards Policy Statement (2009).

COFACE

• Hydroelectric power stations and large dams (July, 2003)

World Bank Environmental and Social Safeguard Policies:

- OP/BP 4.01 Environmental Assessment (1999, revised April 2013);
- OP/BP 4.04 Natural Habitats (2001, revised April 2013);
- OP 4.09 Pest Management (1998, revised August 2004);

- OP/BP 4.12 Involuntary Resettlement (2001, revised April 2013);
- OP/BP 4.10 Indigenous Peoples (1991, revised April 2013);
- OP/BP 4.11 Physical Cultural Resources (2006, revised April 2013);
- OP/BP 4.36 Forests (2002, revised April 2013); and
- OP/BP 4.37 Safety of Dams (2001, revised April 2013).

Multilateral Investment Guarantee Agency (MIGA) Environmental and Social Policies:

- Environmental Assessment Policy (Annex B of MIGA's Operational Regulations); and
- Environmental and Social Safeguard Policies on Involuntary Settlement, Indigenous Peoples, Physical Cultural Resources, Natural Habitats, Pest Management and Dam Safety.

IFC Environmental and Social Policies

The IFC Performance Standards and Policy on Environmental and Social Sustainability and the IFC Access to Information Policy are outlined in the IFC Sustainability Framework (2012). Performance standards include:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Resource Efficiency and Pollution Prevention;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- Performance Standard 7: Indigenous Peoples; and
- Performance Standard 8: Cultural Heritage.

3.5 International Conventions, Treaties and Agreements

Lao PDR is a signatory to several international conventions and treaties. Those potentially relevant to the Project are listed below:

- UN Framework Convention on Climate Change (1992) and Kyoto Protocol (2003);
- Convention on the Protection of the Ozone Layer (1985) and The Montreal Protocol on Substances that Deplete the Ozone Layer (1987);
- Convention on Biological Diversity (1996) and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (2004);
- Convention Concerning the Protection of World Cultural Heritage and Natural Heritage (1987);
- ASEAN Agreement on the Conservation of Nature and Natural Resources (1985);
- International Plant Protection Convention (1955);
- International Convention on the Elimination of All Forms of Racial Discrimination (1974); and
- International Covenant on Economic, Social and Cultural Rights (2000).

4 Environmental and Social Setting

4.1 Project Area and Study Limits

The IEE has identified two main areas for examination including the proposed Project footprint and Surrounding Project area. These areas are outlined below.

4.1.1 Project Footprint

The proposed Project footprint exists almost entirely on NTPC concession land and almost exclusively on previously disturbed land (refer to Figure 4-1).

NTPC identified an area previously used for spoils deposition during original NT2 construction as the future location of the workforce accommodation camp (part of Promec area) The area was rehabilitated and returned to the Gnommalath District in 2012. It is anticipated that this area would be reincorporated into NTPC concession area for Project utilisation, pending the outcome of consultation with the Gnommalath District.

4.1.2 Surrounding Project Area

The NTPC Project facilities (including the residential complex for Nam Theun 2 and three (3) villages including Ban Sangkeo (including Sangkeo, Nong Nongsaeng and Kaeo vilay), Ban That (Sangkhout, Nadang, That and Kobong) and Ban Lao have been identified within a 0.5 – 3.0 km radius of the Project site. The Residence Nam Theun (RNT) area accommodates NT2 employees providing residential, office, canteen and recreational facilities. Residents of the three (3) villages located near the Project Footprint utilise the left bank of the Nam Kathang for agriculture, grazing, fishing/hunting and the collection of forest products. These areas are outside of the planned Project footprint.

An additional two (2) villages Ban Mixay (including Napaimai) and Gnommalath Neua are located further downstream on the Nam Kathang before the confluence of the Nam Gnom (GOL 2013).


Figure 4-1 Project Layout

4.2 Physical Components

A detailed assessment of the physical setting of the greater Nam Theun 2 Project Area, including the Nam Kathang catchment (Project Area) is provided in the *Nam Theun 2 EAMP* (2005). The following section summarises the physical components of the Regulating Pond Project Area.

4.2.1 Physical Setting and Topography

The Regulating Pond and Project Infrastructure for associated facilities are situated in the Nam Kathang Noy Valley in the plains south of the Nakai Plateau. The Project Area exists entirely within the Gnommalath District of Khammouane Province, within the Xe Bang Fai Basin. The higher elevations of the catchment are characterised by steep ridges and deeply incised channels. The Xe Bang Fai and its tributaries meander through sandy river valleys in the mid-section of the River and drain into the flatlands in the lower reach.

The Nam Kathang catchment occurs in the transition elevations of the Xe Bang Fai Basin, with the headwaters of the Nam Kathang originating on steep gradients to the south of the Nakai Plateau, extending through the moderate slopes of the Nam Kathang Noy Valley and reaching the Gnommalath Plain where the River converges with the Nam Gnom and discharges into the Xe Bang Fai River.

The transition from the Nam Kathang Noy River Valley to the lowland plains is characterised by numerous limestone outcroppings that form pinnacles and ridges above the alluvium plains.

4.2.2 Geology and Soils

The Project Area occurs on the transition from the Phra Wihan formation of the middle to upper Jurassic period at the northern end and an unnamed formation of the Quaternary age to the south. The Phra Wihan formation is characterised by brown-red / grey-green mudstone and siltstone. The plains to the south are characterised by alluvium and colluvium, with fine to coarse gravel and sand, silt and clay and consolidated to poorly consolidated gravel, sands and clays (EAMP, 2005) intersected by a karstic limestone formation with pinnacles rising to 400 m.

The foundation of the Regulating Pond and Regulating Dam are impervious mudstone and siltstone on the right bank of the Nam Kathang and alluvium terrace with bedrock up to eight metres below the Regulating Pond. The overburden to the south of the Regulating Pond consists of silt, clayey silt with occasional sand and gravelly intervals (EAMP, 2005). There is no geological risk linked to the implementation of the new spillway in the abutment part of the Regulating Dam (cf. DSRP approval).

The soils to the south of the Regulating Pond are primarily Acrisols or Cambisols. Acrisols commonly occur in the wet tropical / monsoonal climate on hilly or undulating topography (often on the eroding slopes of old hills) and are characterised by a clay-rich subsurface horizon below a shallow A-horizon. Cambisols are developed in medium and fine-textured materials, often derived from alluvial and colluvial deposits. Cambisols are young, often fertile soils, commonly utilised for agriculture.

4.2.3 Climate

The climate of the Nam Kathang Noy Valley is tropical, with a pronounced rainy and dry season. Lao PDR climate and seasonal variation is influenced by the southwest and northeast monsoons and tropical cyclones. The southwest monsoon produces a warm and moist airflow from approximately June to mid-October. The northeast monsoon produces cooler temperatures and drier conditions from approximately November through mid-February. The transition periods (mid-February through May and mid-October through November are typically hot and dry.

4.2.4 Precipitation

The southwest monsoon generally occurs from May to September, bringing frequent and heavy rainfall over the Project Area. Tropical cyclones also commonly move into the region from the South China Sea from June through September, bringing high intensity rain events of short duration (refer to Section 4.2.7 and Figure 4-2).

The higher elevations of central Lao (Nakai Plateau) and southern Lao (Bolaven Plateau) are subjected to the highest levels of rainfall in the country, with annual precipitation commonly exceeding 3,000 mm per year (DMS, 2012). Peak rainfall in the Project Area is generally July and August. Regional variation in rainfall is principally a result of orographic lifting, with the south-western air mass forced from the lower plains, increasing relative humidity and precipitation. Though the Project Area receives less rainfall than the Nakai Plateau, the Nam Kathang catchment extends up to the ridge, and brooks/creeks in the Nam Kathang Noy Valley are commonly inundated.

From 1994 to 2002, precipitation at the Gnommalath meteorological station averaged 2,224 mm per year, with maximum average monthly precipitation of 578.5 mm in July and minimum average precipitation of 0.0 mm in January (EAMP, 2005). Rainfall on the Nakai Plateau and the upper slopes of the Nam Kathang catchment are subjected to significantly more rainfall. For example, at the Nakai Tai meteorological station, precipitation averaged 2,979 mm, with average monthly maximum of 763.7 mm and average monthly minimum of 7.2 mm, over the same time period.





4.2.5 Hydrology

The Regulating Pond catchment occurs entirely within the Nam Kathang catchment. The Nam Kathang catchment is a sub-catchment of the Xe Bang Fai Basin, which comprises an area of 9,652 km². The Xe Bang Fai Basin waters drain to the Xe Bang Fai River, a first order tributary of the Mekong River.

Prior to construction of the Regulating Pond, the natural flow of Nam Kathang at the future Regulating Dam site varied between approximately 0.2 m³/s and 38.5 m³/s (mean monthly discharge measure from 1994 to 2002). Mean annual discharge was measured at 10.2 m³/s, with a range in annual discharge from 5.7 m³/s

to 16.8 m³/s. For the same time period the highest discharge equalled 612.9 m³/s (September, 2000) and the lowest equalled 0.0 m³/s (numerous occasions between January to April).

The current hydrology of the Xe Bang Fai Basin has been significantly altered from that which existed before NT2 commissioning. The NT2 inter-basin transfer power project impounds and diverts Nam Theun catchment water to the Xe Bang Fai Basin. However, the hydrology of the Nam Kathang is largely unchanged as a result of NT2 implementation, though its headwaters are intersected and temporarily impounded by the Regulating Pond.

The headwaters of the Nam Kathang catchment naturally drain to the Regulating Pond, where the two primary headwater tributaries joined to form the Nam Kathang prior to construction of the Regulating Pond (Nam Kathang Noi and Nam Kathang Gnai). The Regulating Pond receives the majority of its input from the Nakai Reservoir via discharge from the Project Powerhouse (average annual flow of 220 m³/s).

Water is released from the Regulating Pond via two independently operating controlled release operations, namely: (I) water is discharged to the Downstream Channel (DSC) which conveys operations water via the 27 km long constructed channel to the Xe Bang Fai; and (II) water is discharged to the Nam Kathang River. In compliance with the Project *Concession Agreement* (2002), NTPC is required to discharge the same volume of water into the Nam Kathang downstream of the Regulating Pond that is supplied to the Regulating Pond from the Nam Kathang catchment.

The natural flow is computed by the SCADA system, using real-time water level measurements and operations water discharge is assessed by the volume required for electricity generation.

Once discharged from the Regulation Pond, the Nam Kathang then flows in a southern and south-eastern direction for approximately 8 km until it discharges into the Nam Gnom south of the village of Gnommalath, a river of similar surface water volume as the Kathang. From this confluence, Nam Gnom continues flowing in a south-eastern direction to its discharge point at the Xe Bang Fai, approximately 10 km upstream from the confluence of the DSC and the Xe Bang Fai.

4.2.6 Water Quality

With implementation of the Nam Theun 2 Power Project, the baseline water quality conditions have changed from the pre-NT2 assessment conducted for the *EAMP*, the *Addenda to the EAMP* (NTPC, 2005b) and the *Downstream Implementation Plan* (NTPC, 2008). This assessment considers the baseline conditions for water quality in the Nam Kathang catchment. For this report, the results of NTPC's on-going water quality monitoring program have been assessed from January 2010 through January 2013 for the following monitoring stations (post NT2 Project implementation):

- Stations NKT1 and NKT2; located upstream of the Regulating Pond on Nam Kathang Gnai and Nam Kathang Noy;
- Station REG1; the Regulating Pond (sampled from the surface, middle, and bottom of the Regulating Pond); and
- Stations NKT3 and NKT4, located on the Nam Kathang downstream of the Regulating Pond. NKT4 captures the effects of the RNT on water quality, as the complex occurs on the right bank between Stations NKT3 and NKT4.

The minimum, median and maximum values for each of the measured parameters are provided in Appendix B (refer to Figure 6-1 for monitoring locations). The following summary comprises the baseline conditions for those parameters considered most relevant to surface water hydrology downstream of a hydropower operation with a large reservoir.

• Dissolved oxygen (DO) concentrations in the Nam Kathang downstream of the Regulating Pond are generally high and indicative of good quality water for aquatic organisms (ranging from 5.52

mg/L to 10.45 mg/L for NKT3 and NKT4, with median values of 7.84 mg/L and 7.49 mg/L, respectively. These values are consistent with those measured for Nam Kathang tributaries upstream of the Regulating Pond. DO concentrations ranged to as low as 2.20 mg/L in the Regulating Pond, and were below 5.0 mg/L for approximately 50% of the measurements recorded in the bottom, middle and surface samples. The aeration facilities built at the Regulating Dam (Baffle Blocks) are successfully raising DO to levels desirable for viable aquatic habitat immediately downstream of the Nam Kathang discharge facilities (NKT3).

- Biological oxygen demand (measured as BOD₅) was generally very low, ranging from 0.00 to 6.14 mg/L from January 2010 to December 2013. Low BOD (and COD) reflect low latent potential for utilisation of oxygen in biological and chemical reactions, and indicate that DO levels should remain high.
- pH is lower (more acidic) than would be expected at times in the Regulating Pond and downstream in the Nam Kathang. REG1 pH values ranged from 5.38 to 7.85, with median values of 6.35, 6.40 and 6.67 for the Regulating Pond bottom, middles and surface samples respectively. Downstream Nam Kathang values ranged from 5.35 to 8.69 for NKT3 and 5.76 to 8.53 for NKT4, with median values of 7.14 and 7.15 for the monitoring stations, respectively. pH ranged from 6.25 to 8.35 for NKT1 (Nam Kathang Noy) and 6.12 to 9.40 for NKT2 (Nam Kathang Gnai), with median values of 7.69 and 7.45 for these upstream stations, respectively.
- Turbidity was relatively low for upstream, Regulating Pond and Nam Kathang samples, with median values ranging from 5.39 to 9.38 NTU for the combined monitoring sites. However, maximum turbidity values were higher for the Nam Kathang monitoring stations than for the upstream and Regulating Pond stations. A maximum value of 730 NTU was recorded at NKT4 in June 2011, compared to 298 NTU in August 2011 for NKT3. Subsequent rainy season turbidity has been significantly lower, with maximum values of 76.30 and 62.80 NTU for NKT4 and NKT3, respectively (post-2011).
- Total Ammonia (NH₃-N) exceeded Project guidelines (0.2 mg/L) for upstream, downstream, and Regulating Pond samples at their highest respective concentrations. Maximum total Ammonia concentrations in the Regulating Pond (0.41 mg/L) and downstream of the Regulating Pond (0.34 and 0.29 mg/L for NKT3 and NKT4 respectively) were slightly higher than maximum upstream concentrations of 0.26 mg/L at NKT1 and 0.15mg/L at NKT2. While pH remained within values of 7 to 8, concentrations of un-ionized Ammonia remained below the recommended value for aquatic life (< 0.015 mg/L NH3-N – Canadian Environmental Quality Guidelines, 2010).
- Total phosphorous concentrations exceeded Project guidelines (0.2 mg/L) on a few occasions, with the highest maximum concentrations measured downstream of the Regulating Pond (3.2 mg/L at NKT4).
- Total iron concentrations have been slightly elevated in the Regulating Pond (maximum of 1.21 mg/L) and Nam Kathang (maximum of 1.32 mg/L), occasionally exceeding the Lao PDR ambient water quality guideline of 1.0 mg/L (PM-WREA, 2010). However, dissolved iron concentrations have been comparatively low, and below applicable national and international ambient water quality and discharge guidelines.

4.2.7 Tropical Storms, Cyclones and Flooding

Cyclones move through Lao PDR regularly, bringing heavy rains and often flooding. Seventy-two (72) tropical cyclones were recorded in Lao between 1981 and 2010 (inclusive), an average of 2.4 cyclones per year. All of the cyclones occurred from May to December, with the greater majority occurring in July – October (83%). The tropical cyclones bring short duration high intensity rainfall, with streams and rivers commonly overflowing their banks, and extensive damage to assets, livelihoods and often human mortality.

The intensity and frequency of these cyclones vary. In 2011, five cyclones tracked over Lao, each of which affected the central provinces of Lao PDR, including Tropical Cyclone (TC) Haima (25 June), TC Nock-Ten (31 July), TC Haitang (27 September), TC Nesat (1 October), and TC Nalgue (6 October). For TC Nock-Ten, between 140 and 160 mm of precipitation was recorded over a 24-hour period in the Project Area region (refer to Figure 4-2), with extensive flooding to local rivers. Xe Bang Fai reached levels that had not been previously recorded since gauging was implemented in 1989 (refer to Figure 4-3).



Figure 4-3 Maximum water level in Xe Bang Fai, 1989-2011 (DMH, 2012)

4.3 Biological Components

4.3.1 Protected Areas

The Regulating Pond and the Nam Kathang / Nam Gnom and all potential construction areas associated with this Project are not within any protected areas. The nearest National Protected Area (NPA), the Phou Hin Poun is approximately 5 km to the west of the Project Area.

Three NPAs surround the greater Nam Theun 2 Project Area: the Nakai Nam Theun NPA (area 3,500 km²), the Phou Hin Poun NPA to the west and the Nin Nam Nor NPA to the south. Prime Ministerial Decree 193 of 1993 established two corridor areas (totalling approximately 770 km²) that connect the three NPAs to provide for wildlife migration (refer to Figure 4-4).



Figure 4-4 National Protected Areas and adjacent Wildlife Corridors surrounding the Project Area (NTPC EAMP, 2004)

4.3.2 Vegetation

The majority of Project will be constructed on highly disturbed vegetation or landforms (refer to Figure 4-5). The principal components of the Project footprint (e.g. Regulating Dam spillway, the majority of the spoils deposition sites, workforce accommodation camp, etc.) are historic spoils deposition areas from NT2 Project construction and are sparsely vegetated with native grasses, weed species (e.g. *Chromolaena odorata*), and plants from revegetation activities on spoils batters.

A comprehensive vegetative survey was conducted by Dr Phengsintham for the entire Project footprint in April, 2014. A total of 97 terrestrial plant species (refer to Appendix E) and four (4) distinct vegetative communities were identified during the survey on establishing the Project footprint, including: Mixed Deciduous Forest, Fallow Forest, Riparian Vegetation and Grassland (refer to Appendix E, Table E-1). The vegetative communities for the distinct Project components are as follows:

- Regulating Dam Spillway: Grassland;
- **Primary Spoil Disposal Area**: Fallow Forest (regenerating, with upper canopy), young Fallow Forest (3-4 years old), and Mixed Deciduous Forest toward the Nam Kathang edge of the proposed Project component;
- Secondary Spoil Disposal Area: young Fallow Forest
- Permanent Bridge: Riparian Vegetation
- Access Track (left bank): young Fallow Forest;
- Access Track (right bank): young Fallow Forest;
- Temporary Bridge: Riparian Vegetation
- Topsoil Borrow Area: young Fallow Forest

Table E-1 in Appendix E lists the dominant vegetative species found in each community for each component of the Project per canopy layer (i.e. upper story = 5 - 20 metres; mid – storey = 1 - <5 metres; and Understory = 0 - <1 metre). Table E-2 in Appendix E provides a comprehensive list of all other plant species identified, and identifies where the species were observed according to Project component.

The greater majority of the species have not been assessed by the IUCN. Of the 97 species identified, two are considered threatened according to the IUCN Red List of Threatened Species (2014).

IUCN Listed Species

Two threatened species (IUCN, 2014), comprised of three individuals, were observed in the primary spoils deposition area north of RNT. However, these individuals are in the riparian corridor, and are therefore not expected to be impacted. These species include: two (2) individuals of *Afzelia xylocarpa* (Endangered) and one (1) individual *Hopea odorata* (Vulnerable). However, their proximity to the spoils deposition area and permanent bridge structure will require mitigation to ensure impacts are avoided (refer to Section 5.4.1).

<u>Afzelia xylocarpa</u> – This species grows in dense forest and in transitional areas between evergreen and dry open Dipterocarp forest (IUCN, 2014). Population declines have occurred because the species is valued for its structural integrity and due to habitat loss. The species is found in Cambodia, Lao PDR, Myanmar, Thailand, and Vietnam.

<u>Hopea odorata</u> – This tree usually occurs in lowland riparian forests. Selective logging and loss of habitat have reduced its population throughout its native locations, including Bangladesh, Cambodia, Lao PDR, Malaysia, Myanmar, Thailand and Vietnam.

4.3.3 Terrestrial Biodiversity

The NT2 EAMP identifies wildlife resources that occur in the Nakai Plateau inundation zone (Zone 1), the dividing hills (Zone 2), the resettlement area (Zone 3), and the area downstream of the Nakai Dam (Zone 4), which were considered the major ecosystems that would be affected by NT2 Project implementation. A comprehensive list of terrestrial species and habitat are provided in the EAMP, including threatened species in the region. Thirty-five (35) mammal species, 14 bird species, and 10 reptile species recorded in the NNT NBCA and Nakai Plateau are classified as globally threatened, near-threatened or data deficient according to the IUCN Red List of Threatened Animals (IUCN, 2004).

Very little information is available regarding terrestrial biodiversity in the Regulating Pond Project Area, beyond habitat type (refer to vegetative communities and species, above).

4.3.4 Aquatic Biodiversity

Fish in the Nam Kathang

NTPC conducted surveys for baseline resident fish populations at sampling site NKT5, downstream of the Regulating Dam (refer to Figure 6-1 for monitoring locations) in March 2010 and 2011 during the dry season to identify non-migratory species of the Nam Kathang. Earth Systems conducted Focus Group Discussions during Local Knowledge Surveys (LKS) in Ban Sangkeo, Ban Lao and Ban That to enhance understanding of fish species of the Nam Kathang (April, 2014).

A total of 51 species were identified during the conduct of the combined surveys (46 to the species level and 6 to the Genus level). NTPC identified 32 non-migratory species during 2010 / 2011 dry season sampling. Twenty – six (26) species were identified by villagers during Focus Group Discussion conducted during LKS.

Of the 51 species identified during Nam Kathang surveys, the *IUCN Red List of Threatened Species* (IUCN, 2014) categorises 26 as Least Concern, 14 as Data Deficient, eight (8) as Not Assessed, two (2) as Near Threatened, and one (1) as Vulnerable.

Comprehensive lists of species identified during NTPC surveys (2011 and 2012) and LKS are provided in Appendix C.

IUCN listed fish species

The following describes the three (3) species listed as Near Threatened and Vulnerable (IUCN, 2014).

<u>Ompok bimaculatus (Near Threatened)</u> – There is some uncertainty regarding the taxonomy of this species in Southeast Asia. Ompok bimaculatus occurs in abundance throughout Pakistan, India, Sri Lanka, Bangladesh, Myanmar, and Southeast Asia. "However, evidence has been presented to show that the populations from Southeast Asia are not conspecific with those from India (Kottelat and Lim 1995). Confirmation that the Southeast Asian population is a distinct species (O. siluroides) has been presented by Ng and Hadiaty (2009)" (IUCN, 2014).

Exploitation of this species has resulted in population declines, "however, the difficulty in extrapolating data from a localized study and the taxonomic uncertainties surrounding the populations from throughout the subcontinent make it difficult to definitively consider this species to be in decline." (IUCN, 2014).

<u>Syncrossus beaufortie (Near Threatened)</u> – According to IUCN (2014), "S. beaufortie has been assessed as Near Threatened because of an inferred population decline of 20-29% in the past ten years as a result of removal from the wild, a large number of hydrological changes, including dams, in this area, and high

levels of pollution." The species is found in Cambodia, China, Lao PDR, Thailand and Vietnam in small and medium-sized rivers, generally with swift currents and stony to rocky substrate.

<u>Schistura tabulinaris (Vulnerable)</u> – According to IUCN (2014), "this species has been assessed as Vulnerable due to an inferred population decline of more than 30% ten years in the past and in the future, as a result of a decline in habitat quality and pollution". The species is found in stretches of water with relatively slow current and gravel or sandy substrate. The species is thought to be endemic to the Nam Theun (IUCN, 2014).

Aquatic Macroinvertebrates in the Nam Kathang

NTPC conducted surveys for Macroinvertebrate species in the Nam Kathang downstream of the Regulating Dam in February 2011 (stations NKT4 and NKT5 – refer to Figure 6-1). The monitoring of the abundance, community composition, and biological indices represent a way to identify changes with respect to water quality but also in terms of habitat modification and disturbance. This biological aquatic group is used internationally for assessment of environmental change in watercourses.

Following sampling, NTPC assessed the quality of the water for aquatic species using the following biological indices for macroinvertebrate monitoring: Equability J, BMWPthai (Biological Monitoring Working Party), and ASPT (Average Score per Taxon). The description of these indices and specific results of testing are provided in Appendix D.

In summary, according to macroinvertebrate's indices calculation (BMWPthai and ASPT), the Nam Kathang River does not show any major organic pollution. Populations are primarily dominated by few families e.g. *Chironomidae* and *Baetidae*. These dominant families are commonly observed in rivers worldwide as they are opportunistic. As a main explanation, most of existing natural habitats are not highly diverse and not particularly biogenic.(refer to Section 4.2.6 and Appendix B for specific organic parameter values)

4.4 Socio-economic Components

4.4.1 Introduction

As outlined in Section 4.1, the RNT facility and a number of local communities are located in the Surrounding Project Area (refer to Figure 4-1).

- The Project's RNT complex accommodates approximately 200 NT2 employees, and their family members. The complex includes 2 office buildings, 70 accommodation buildings with 450 beds; a canteen and a number of recreational facilities including soccer field and golf driving range. The RNT has its own water supply and wastewater treatment facilities.
- Three (3) villages including Ban Sangkeo (including Sangkeo, Nong Nongsaeng and Kaeo vilay), Ban That (Sangkhout, Nadang, That and Kobong) and Ban Lao, with 597 households and a total population of 2,923 are located in the immediate vicinity of the Project. Plate 4-1 provides a photo looking north up road 8b from the entry to Ban That to the Project area.
- Two (2) villages: Ban Mixay (including Nafaimai) and Gnommalath Neua, with a total of 261 households and 1,785 people are located downstream on the Nam Kathang before the confluence with the Nam Gnom (GOL 2013).

The sections below provide information on the socio-economic and cultural aspects of the three (3) villages located closest to the Project Footprint. Socio-economic baseline information for this section was sourced through village level surveying conducted in the Project area in December 2013 and April 2014. Gender disaggregated focus group discussions were also conducted in each village in December 2013 to source

more specific information regarding the use of the Nam Kathang and lands, forest and water resources on the left bank of this river.



Plate 4-1 Surrounding Project Area.

4.4.2 Population and Communities

Community Demographics

The three (3) villages closest to the Project Footprint have a total of 2,923 people, 641 families and 591 households (refer to Table 4-1). The gender ratio in the three (3) villages is 1.05 women to men and average population per household is 4.89. Ban Sangkeo is the largest of the three (3) villages with a population of 1,209 living in 255 households. Gender ratio in Ban Sangkeo is 1.05 women to men and average household size is 4.74 people. Ban That has a population of 961 living in 190 households. Gender ratio in Ban That is 1.04 women to men and average household size is 5.05 people. Ban Lao is the smallest, with a population of 753 living in 140 households. The gender ratio in Ban Lao is 1.07 women to every man. Average population per household is 4.95.

1/211 A1					
Village Name	NO. HHS	NO. Families	Female	Male	Total
Ban Sangkeo	255	261	622	587	1209
Ban That	190	216	490	471	961
Ban Lao	152	164	390	363	753
TOTAL	597	641	1,502	1,421	2,923

Table 4-1 Demographics of Villages in the Project Area

Source: ES Surveying 2013 & 2014

Population Growth and Migration

Villages closest to the Project area reported temporary in-migration during the construction period of the Nam Theun 2 Project (2004-2009) when construction workers and their families moved to the area. This included an estimated 15 families in Ban That and 20 families in Ban Sangkeo. Upon completion of Project construction, most of these workers and their families reportedly moved out of the area.

Since 2009, the population in Ban Sangkeo, Ban That and Ban Lao has continued to increase steadily. The most significant increase over this period has occurred in Ban Sangkeo (17 percent) while Ban Lao and Ban That have both experienced increases of approximately 13 percent. The majority of these increases are reportedly the result of in-migration. In Ban Sangkeo most migrants continue to move into the village for economic reasons - mainly to open shops along Road 8b. In Ban That and Ban Lao in-

migration is predominately due to marriage and other family reasons. In Ban Lao, many of these families were described as single female headed households with dependents, moving back to the village to stay with relatives after divorce or the loss of their husbands.

Ethnicity and Religion

Over 90 percent of people in the Ban Sangkeo, Ban That and Ban Lao are Mon-Khmer from the Brou (Makong) ethnic group. The remaining 10 percent are Lao Loum. While traditionally the Brou people practised animism, approximately 90 percent of people in theses Project villages are reportedly Buddhist. More information on ethnicity is provided in Section 4.5.2.

4.4.3 Land Allocation and Ownership

All land in Lao PDR is ultimately owned by the State. The State, however, recognises both private and collective long term land tenure. This ultimate ownership implies that it is the State that defines the conditions under which individuals may claim title to, and dispose of land. The Land Law of 1997 and the "Decree on the promulgation of the Amended Land Law" from 2003 recognises temporary use rights as long as the land is used according to law.

The Government has a range of instruments with which it can allocate land rights and ownership of land and forests such as Land Titles, Temporary Land Use Certificates, Land Lease Contracts, Village Land Map Sheet, Village Land and Forest Management Agreements.

Since 1996, a nation-wide program, under the direction of the Ministry of Agriculture and Forests (MAF), has been aimed at devolving most decisions about land use and land allocation to the village level through its Land and Forest Allocation Program (LAFA). The LAU liaises with villagers to decide on the allocation of land use for village land and they jointly develop a set of rules for the use of the land – outlined in Village Land and Forest Management Agreements.

Despite the fact that the villagers do not own the land, villagers enjoy usufruct rights to use the land for their daily livelihood activities, particularly for agriculture practices and NTFPs collection. It is common that villagers pay land tax for agricultural land. The tax is registered with the village head in addition to the estimated area of the land used. This is often provided as proof of land usage in land compensation claims.

NTPC Project Lands

Land allocation and use in the Project area has undergone significant change over the last decade as a result of the Nam Theun 2 Project. NTPC Category 1 Project Lands in the area total approximately 250 ha including the power station, Regulating Pond, Regulating Dam and residence. Additional land has also been acquired for the downstream canal, access roads and transmission lines (NTPC RAP 2004).

All acquired land has been either compensated in cash or kind under the NTPC Project Land program. Households affected by more than 10% of their household's livelihood system have received livelihood support and every household is certified that their livelihood has been restored to at least pre-project conditions.

Village and Other Lands

Village land allocation exercises were reportedly last conducted in the Project area by the Land and Forest Allocation Program between 2001 and 2004. Original maps developed during these exercises are no longer available or are out of date. Provincial and district governments could not provide village land allocation information.

In the absence of official data, indicative information on village land allocation and use was collected during village level consultations (see Table 4-2). This information indicates that each of the three (3) villages has zones for lowland agriculture production; plantations; and production, protection or regeneration forest.

Village officials in Ban Lao and Ban That reported significant "other land' holdings (36,807 ha and 60,000 ha respectively). These large areas, reportedly mostly mountainous forested areas, could not be confirmed by the district government and therefore have been omitted from Table 4-2.

The Ban That village boundary reportedly extends across to the left bank of the Nam Kathang. Villagers use this area for river bank gardens and lowland rice cultivation. Mountainous areas are also used for upland agriculture (i.e. banana plantations, upland rice, cassava, etc.), NTFP / TFP collection and hunting.

Men and women in Ban Lao and Ban Sangkeo confirmed that families from these villages also use land and resources on the left bank of the Nam Kathang for agriculture, NTFP collection, timber harvesting and hunting. In Ban Sangkeo and Ban That agricultural purposes include upland rice, cassava, banana, vegetables, chilli and tobacco. Villagers in Ban Lao reportedly use these lands for banana cultivation. Villages in Ban Sangkeo also use the banks of the Nam Kathang for the cultivation of vegetables.

	Land Allocation					on (Ha)					
Village Name	Residential	Lowland Ag.	Upland Ag.	Plantations	Production Forest	Protection Forest	Cemetery/Spirit Forest	Regeneration Forest	Concession land	Fish pond	Other
Ban Sangkeo	9	637.5*	6-	95	350	200	-	-	-	5	159
Ban That	15	136	3-	90	199	-	1	315	-	-	٨
Ban Lao	4	140	-	15	15	-	1	-	18	-	٨
Total	28	913.5	9-	200	564	350	2	315	18	5	159*

Table 1-2 I and	Allocation of	Villagoe in	the Pro	iact Araa^
I able 4-2 Lallu	Allocation of	villages ill	lile FIO	ject Area

Source: ES Surveying 2013 & 2014

^ Accurate information on total land areas for each village could not be obtained. Large 'other' land allocations could not be confirmed and have therefore been omitted from the table.

* During follow up consultations in April 2014, village officials in Ban Sangkeo reported significantly more lowland rice land than previously reported in December 2013 (109 ha to 637.5). This new figure was reconfirmed with village officials however could not be confirmed with the district Finance Office.

Proof of Ownership

Methods for proof of ownership or use of agricultural land vary across the three (3) villages. In Ban Sangkeo, 20 percent of families reportedly hold land use certificates and the remainder rely on land tax receipts received upon payment of agricultural land use tax to the district Government. All villagers in Ban Lao and Ban That reportedly use land tax receipts as their primary means of proof of ownership. It is understood that many villagers utilising upland and riverbank areas (i.e. on the left bank of the Nam Kathang) do not pay tax and therefore have no documented proof of the use of this land.

4.4.4 Wealth and Poverty

Perceptions of Wealth and Poverty

In 2002-2003 the national poverty rate was 33.6 percent (LECS 2003). At the same time it was estimated that 40 percent of households living in the Xe Bang Fai downstream area were below the national poverty line (NT2 SEIA 2004). Since then poverty rates across the country have significantly declined (UNDP 2013). This is also likely the case in the Surrounding Project Area.

During village level surveying, respondents were asked to group village households into four (4) categories: very well-off, sufficiently well-off, poor with land and poor with no land. They were then asked to estimate the average annual income of households in those categories. According to the results of this exercise, the vast majority (98 percent) are considered 'sufficiently well-off' with estimated incomes ranging between 11 and 20 million kip per annum. Approximately two (2) percent of households in Ban That and Ban Lao are perceived as 'poor' with estimated incomes less than 8 million kip per family. In Ban Sangkeo nearly five (5) percent of families in the village are considered 'very well-off' with annual family incomes of more than 50 million kip.

Socio economic surveys from the downstream program conducted in 2009, 2012 and 2013 included randomly selected households from Ban Sangkeo, Ban That and Ban Lao. The average consumption and income levels have gradually increased between round 2009 and 2014 as shown in Tables 4-3 and 4-4 below.

Year	N HHs	mean (capita/month	se(mean) (capita/month)	p50 (capita/month)
2009	39	337,049	28,477	276,981
2012	45	400,691	28,635	350,565
2013	42	436,801	44,331	359,511

Table 4-3 Real per Capita Consumption per Month

Source: NTPC Downstream Program 2009, 2012 & 2013

Table 4-4 Real per Capita Income per Month

Year	N HHs	mean (capita/month	se(mean) (capita/month)	p50 (capita/month)
2009	39	401,671	58,312	312,918
2012	45	377,762	40,023	320,045
2013	42	449,182	50,922	401,072

Source: NTPC Downstream Program 2009, 2012 & 2013

Vulnerable People

A total of 58 disadvantaged households were identified during village level surveying - spread fairly evenly across Ban Sangkeo, Ban That and Ban Lao. The majority of these households (51) were identified as single female headed households with dependents and lower than average income. Other disadvantaged households identified included five (5) elderly households with no means of support and two (2) with disabled or infirmed members requiring additional support. No landless households were identified.

4.4.5 Local Economies and Livelihoods

Local economies and livelihoods in villages in the Project Area are typical of many lowland areas in Lao PDR. Communities are dependent on lowland rice cultivation, animal husbandry, fishing in nearby streams, collection of non-timber forest products (NTPFs), timber forest products (TFPs) and to a lesser degree non-agricultural activities. No impacts are expected to result from Project construction and implementation (refer to subsequent Sections for details).

Crop and Vegetable Cultivation

Almost all households in the surveyed villages practice lowland rice cultivation with the exception of 12 houses in Ban Sangkeo. Average lowland rice cultivation per household varies across the three villages ranging from 2.5 ha per household in Ban Sangkeo to approximately 0.9 and 0.7 ha per household in Ban Lao and Ban That respectively.

Ban Sangkeo and Ban That (shared with Ban Tha Od) have irrigation infrastructure servicing 18 ha and 25 ha respectively. Approximately 25 percent (Ban Sangkeo) and 40 percent (Ban That) of households in these villages cultivate irrigated crops, allowing for extra crops and increases in annual yields. Ban Lao reportedly has no irrigation infrastructure.

According to village level surveying a limited amount of households in Ban Sangkeo (5 percent) and Ban That (7 percent) still practice upland rice cultivation on a total of 6 ha and 3 ha respectively. This land is located on the left bank of the Nam Kathang.

Vegetable production is a significant livelihood activity for households in Ban That (60 percent) and Ban Lao (100%). In Ban That, vegetables are primarily cultivated in village settlements; and on the banks and low-lying areas in the immediate vicinity of the Nam Kathang. In Ban Lao, vegetables are grown in small gardens next to households, with no riverbank gardens in this village due to the distance from the Nam Kathang. This includes the cultivation of cassava mixed with the banana plantation in the Northern part of village settlement area. No vegetable cultivation was reported in Ban Sangkeo.

Key cultivation issues reported during village level surveying include limited water resources (or irrigation infrastructure development); insects and other pests threatening the integrity of crops and to a lesser extent, the lack of adequate pest control systems.



Plate 4-2 Lowland rice fields, Ban Sangkeo



Plate 4-3 : Lowland rice fields, Ban Lao





Plate 4-4 Village gardens, Ban Lao

Plate 4-5 : Riverbank gardens, Ban That

Plantations

Ban Sangkeo and Ban That have considerable area (over 90 ha) of plantation land compared to Ban Lao (15 ha). In Ban Sangkeo and Ban That these areas are used primarily for banana plantations tended to by approximately 50 percent of the households in each village. These planation areas are located in the vicinity of Phou Houay Xieng, Phou Ark, Phou That, Phou Houay to the east and northeast of these two villages. In Ban Lao approximately 30% of households reportedly have banana and other fruit tree (e.g. papaya) plantations within their village boundaries, all within the allocated village plantation area.



Plate 4-6 Upland agriculture (banana plantations) on left bank of Nam Kathang near the Regulating Pond.

Animal Husbandry

The vast majority of households in Ban Sangkeo, Ban That and Ban Lao manage small numbers of poultry for household use. A small percentage of households (approximately 23%) raise buffalo (470 head), cattle (693 head), goats (24 head) or pigs (800 head). Buffalo and cattle were observed grazing throughout village lands and on NTPC land (refer to Plate 4-7). According to village level surveying, animal holdings is generally on the rise, due to private sector (i.e. NTPC) and government community development initiatives and population increases in the Project Area. No significant animal husbandry issues such as disease or lack of feed were reported.



Plate 4-7 Cattle and Buffalo grazing on the banks of the Nam Kathang near the Regulating Dam

Forest Resource Use

Most villagers in the Ban Sangkeo, Ban That and Ban Lao still rely on forest resources including Non Timber Forest Products (NTFP) and Timber Forest Products (TFP). These resources are mainly sourced from allocated village forests (production, conservation and regeneration) and other areas outside village boundaries (i.e. left bank of the Nam Kathang) on the mountainous areas (e.g. Phou Ark, Phou Houay Xieng, Phou Houay Thang, Phou That) and some sections of the Nakai NPA. The most common NTFPs collected include materials such as bamboo and rattan and edible resources such as bamboo shoots, rattan shoots, forest vegetables (e.g. mushrooms) and forest fruits (e.g. grape and mango). These resources are collected mainly in the dry season by both men and women for sale and household consumption.

Over 80 percent of households in the surveyed villages reported harvesting commercial timber – mainly in the dry season. Additional focus group discussions conducted during April 2014 confirmed that while sale of timber occurs, most is harvested for household consumption. This activity is mainly carried out by males however during some focus groups discussions, women were reported to be involved. Timber harvesting is common in the forests on the left bank of the Nam Kathang. Timber harvested from this area includes Mai Du, Mai Tae, Mai Kaen, Mai Yang, Mai Peuay, Mai Taeu and Mai Xi. A list of commonly sourced timber products is provided in Appendix G.

Collection of firewood was also reported as an important activity – providing households with the primary fuel source for cooking. This activity is conducted by both men and women. A list of commonly sourced TFPs is provided in Appendix F.



Figure 4-5: Landcover by vegetation type in the Project Area, 2011 (Source NTPC)



Plate 4-8: Bamboo poles, Ban That



Plate 4-9: Timber extracted from Left Bank, Ban Sangkeo

Aquatic Resource Use

Fish and other aquatic resources are an important source of protein and most resources are consumed locally.

Approximately 30% (20% of households in Ban That and 5% in Ban Sangkeo and Ban Lao, respectively) of households in the Project Area reportedly fish and collect other aquatic resources. Important fishing areas for villages in Ban Sangkeo and Ban That include the Nam Kathang and tributaries flowing off the plateau escarpment (i.e. Houay Nadou, Houay Papak, Houay Bit, Houay Pasa, Houay Poung and Houay Dam). Both men and women are reportedly involved in these activities. However, according to respondents, the availability of fish has decreased in the last five (5) years. It is assumed that the decrease is a result of the NT2 Project, population increase in the area, as well as increasing use of destructive fishing techniques.





Plate 4-10: Fishing in the Nam Kathang, Ban That

Plate 4-11: Fish Pond, Ban Lao

A total of 34 aquiculture ponds have been developed in the area including 21 in Ban That, 10 in Ban Sangkeo and 3 in Ban Lao. There is a mixture of private and community ponds. The most common fish raised in these ponds include Tilapia (*Oreochromis niloticus*) and Common Carp (*Cyprinus carpio*).

Non-Agriculture livelihood activities

A number of families in Ban Sangkeo and Ban Lao rely on non-agricultural based livelihoods including small businesses (small shops, restaurants, guest houses etc.) and salaried employment. In Ban Lao approximately 20 families have at least one (1) family member employed at NTPC (e.g. cleaners, cooks, guards and gardeners). There are also a number of in-village shops. Due to its location on Road 8b, Ban Sangkeo has 12 restaurants, 17 shops and two (2) guesthouses – each a small family business. Approximately 15 families in Ban Sangkeo rely on income from salaried work at NTPC. Few non-agriculture livelihood activities were reported in Ban That – mainly confined to small village shops.





Plate 4-12: Restaurant, Ban Sangkeo Plate 4-13: Security Guard from Ban Sangkeo

4.4.6 Water Resources

The Project is situated within the Nam Kathang catchment. Table 4-5 provides an overview of community water resource use.

Surface and ground water within this catchment provide local communities with water for household use (i.e. drinking cooking and bathing) and irrigation of lowland rice crops. According to villages, open bore wells (constructed with support from the NT2 Project) provide the bulk of the domestic water supply however in some cases cannot meet the demand.

The Nam Kathang and tributaries flowing off the plateau escarpment (i.e. Houay Nadou, Houay Papak, Houay Bit, Houay Pasa, Houay Poung and Houay Dam) are also important for agriculture (i.e. river bank gardens) and fisheries.

Additional water from the NT2 Project offers opportunity for more extensive irrigation in the Project area. Outlets have been made available at the Regulating Dam and along the DSC. The GOL is responsible for developing irrigation potential in this area.

Village Name	Drinking	Bathing / Washing	Fishing / Aquiculture	Irrigation
Ban Sangkeo	Bottled water and open well / bore.	Open well/bore and river (Nam Kathang	Nam Kathang and its tributaries and fish ponds	Nam Gnom
Ban That	Bottled water and open well / bore.	Open well/bore and river (Nam Kathang	Nam Kathang and its tributaries and fish ponds	Nam Gnom

Table 1-5	Land Allocation	of Villagos i	in tha	Project Area
1 able 4-5	Lanu Anocation	i oi villages i	in the	Project Area

Village Name	Drinking	Bathing / Washing	Fishing / Aquiculture	Irrigation
Ban Lao	Open well / bore.	Open well / bore.	Houay Keo and fish ponds	Nam Gnom

Source: ES Surveying 2013

4.4.7 Local Infrastructure and Services

The three (3) surveyed villages are located close to Gnommalath District Capital and have good access to district infrastructure and services via a sealed road.

Electricity and Energy

All households have access to grid electricity. Most households still use firewood as their primary source of cooking fuel although some households have started to use charcoal and electricity.

Health

In village health facilities vary between the three (3) villages. Ban Sangkeo has a village clinic. Ban That has a village medicine box and an appointed village health representative. No health services are present in Ban Lao. Villagers have good access to the district hospital located at Gnommalath only 2-3 km away. The area receives regular visits from district health programs (i.e. immunisation and other health support services). The main health issues reported by villagers include fever, gastroenteritis and skin irritations.

Water and Sanitation

Households have access to clean drinking water via a series of open bores that were constructed with the support of the NT2 Project. Villages also consume bottled water. A number of households reportedly use domestic water sourced directly from the Nam Kathang.

All households in the Project area reportedly have access to private sanitation infrastructure including latrines and closed septic tanks in each household.

Education

Each village in the Project area has a primary school. Upper and lower secondary schools are located in Gnommalath. Tertiary education and vocational institutions are located in Thakhek – the provincial capital.

Irrigation

Irrigation infrastructure exists in Ban Sangkeo and Ban That. This infrastructure was built with support from the GOL for the first phase (earth canal) in 1994 and a World Bank supported project between 2010 and 2011 for the second phase, implemented to improve the existing facilities. This includes approximately 8 km of canals, with gravity flow from the Nam Gnom head pond and the provision of irrigated water. Water for this irrigation infrastructure is currently sourced only from the Nam Gnom.

4.4.8 Access to the Left Bank of the Nam Kathang

Focus group discussions in all three (3) villages indicate that land, forest and water resources on the left bank of the Nam Kathang have been used by communities in the area for many years.

Dry season crossing

During dry season the Nam Kathang can be crossed by foot. Men and women from Ban Lao (approximately 20 families) and Ban Sangkeo (80 families) cross the river immediately below the Regulating Dam and walk across the proposed spillway area. Crossings are made regularly (daily in most

cases), to graze livestock, collect NTFPs / TFPs and tend to upland fields and banana plantations. In addition to walking, some families use motorised transportation (e.g. motorbikes and tractors).

Men and women (many families) from Ban That also regularly cross the river during dry season for similar activities. Villagers in Ban That also have river bank gardens and lowland rice fields on the left bank of the river. They do not cross near the Project, instead utilising a number of crossings located closer to the village settlements (see Plate 4-16).





Plate 4-14: Crossing the Nam Kathang near Regulating Dam, Dry Season, Ban Sangkeo

Plate 4-15: Crossing the Nam Kathang, Dry Season, Ban That



Plate 4-16: location of the usual dry season crossings (red) and location of the proposed permanent submersible crossing (yellow)

Wet season crossing

The water level in the Nam Kathang during wet season makes access to the left bank more difficult. Before the NT2 Project was constructed men in the Project area (and some women from Ban That) reportedly swam, tubed or constructed bamboo rafts to cross the river. Women in Ban Sangkeo and Ban Lao did not cross at all.

Since the construction of the NT2 Project, men and women in Ban Sangkeo and Ban Lao have utilised the crest of the Regulating Dam for wet season access (pedestrian access only). While NT2 Project rules do not permit this due to safety reasons, preventing utilisation of the crest has proved difficult and impractical. Men and women in Ban That do not use the Regulating Dam crest because it is too far away. They continue to use traditional ways to cross (e.g. swimming and boating) or use the Gnommalath bridge and associated feeder roads to get as close to their paddy fields as possible.

4.5 Cultural and Historical Components

4.5.1 Village History

Ban Sangkeo, Ban That and Ban Lao have all had a long history with the local area.

Ban Sangkeo was established in the area almost 170 years ago. In 2004 the village was consolidated with Ban Nongsaeng and Ban Keovilay. Approximately eight (8) households were also resettled here as a result of the Nam Theun 2 Project.

Ban That was established about 300 years ago in present day Mahaxay district. The village moved to its present location approximately 100 years ago. In 2006 the village was consolidated with Ban Kootphadong and Ban Kobong.

Ban Lao (also referred to as Ban Lao Nanagarm) was established in the area approximately 300 years ago. At an unknown time, the settlement moved 4 km from its old location to the west of current village settlement area. The original village location is now used for agriculture.

4.5.2 Ethnicity and Language

The majority of people living in the Ban Sangkeo, Ban That and Ban Lao are Brou. Brou are officially known in Lao as Makhong and are clustered in the Mon-Khmer speaking family.

Mon-Khmer ethnic minorities are the first inhabitants of Laos and make up approximately 35% of the national population of Lao PDR. The Brou represent a homogenous ethno-linguistic group ranging from the Vietnamese border to the lowland areas below the Nakai Plateau in Gnommalath and Boualapha Districts, where they are one of the dominant groups (Sparkes 2004). Their homeland was probably in Vietnam near the headwaters of the Nam Pheo (Chamberlain 1997: 17). The Brou are patrilineal and patrilocal and for the most part practice exogamy (women marry into men's lineages).

The Brou communities in the Project area have adopted sedentary lifestyles and customs similar to the Lao-Tai (or Lao Loum). This includes agricultural practices, village administrative structures and religion and customs.

The majority of villagers in the Project area are bilingual speaking both Sô (Brou) and Lao languages. People in Ban Sangkeo and Ban That reportedly speak Sô are their first language. Lao is used in all official engagements and with external parties.

4.5.3 Natural and Cultural Sites

A number of locally important natural and cultural sites have been identified in the immediate vicinity of the Project. These include village cemetery forests, Buddhist temples, village conservation forests, caves, waterfalls and a number of wetlands. None of these sites are located within the Project footprint.

5 Potential Environmental and Social Impacts and Mitigation Measures

5.1 Risk Assessment

A risk assessment was conducted to evaluate potential environmental and social impacts derived from Project construction and implementation (provided in Appendix A). The methodology for this risk assessment is based upon *ISO 31000 Risk management - Principles and guidelines*, 2009 and *ISO/IEC 31010* Risk management – Risk assessment techniques, 2009.

The risk assessment is initially conducted prior to development of management and mitigation measures to identify the most significant potential risks in the absence of mitigation. Following the assessment of the initial risk ranking, proposed controls are identified that would avoid or minimise the identified risk. Measures focus on either reducing the likelihood of occurrence or on decreasing the magnitude of the consequence (or both) in order to reduce the residual risk ranking to acceptable levels.

The Risk Assessment, provided in Appendix A, evaluates a comprehensive list of the anticipated Project impacts. Those impacts that are considered most significant (both positive and negative) are described in greater detail in the following section, with recommended mitigation and management measures provided that are expected to reduce residual impacts to less than significant.

5.2 Broad Context

The greater majority of the Project footprint will be constructed on highly disturbed land. For example:

- The proposed Regulating Dam spillway will be constructed on the Regulating Dam abutment, comprised of spoils from NT2 construction;
- The proposed spoils deposition areas in NTPC Category 1 land, including historic spoils deposition areas from original NT2 construction activity;
- The proposed temporary bridge location for construction vehicles crosses the Nam Kathang in an area nearly devoid of riparian vegetation; and
- The topsoil reclamation area for revegetation activities is alluvial deposit within the confines of the Regulating Pond.

There will be some construction activities that require disturbance of higher value habitat. Construction of the permanent bridge will require removal of some riparian vegetation and all in-stream construction (permanent and temporary bridge) may have implications for downstream receiving waters.

5.3 Summary of Impacts Identified in Risk Assessment

The Risk Assessment identified the following environmental and social benefits and impacts associated with implementation of the proposed Project:

Enhanced Structural Integrity of the Regulating Dam

Construction of the spillway will enhance the geotechnical stability of the Regulating Dam in the event of an extreme flood event (e.g. 1,500 to 10,000 year ARI). The maximum discharge capacity of the current facility to the Nam Kathang is 1,345 m³/s, with all four discharge gates and the restitution gate open (at Maximum Water Level of 179.5 masl). In the case of an extreme flood event, an additional 315 m³/s may be released to the Downstream Channel. Therefore, with the current design, the Regulating Dam can discharge 1,660 m³/s. The updated peak flow values for the 5,000 and 10,000 ARI flood is 1,915 and 2,062 m³/s, respectively. The current facility cannot accommodate peak flood events of this magnitude. Such water volumes from the Nam Kathang catchment may overtop the Regulating Dam, compromising its structural integrity. The Regulating Dam may fail, endangering the lives and livelihoods of downstream inhabitants.

Construction of the spillway will provide for the necessary discharge capacity to contend with the floodwaters generated from extreme events; protecting downstream inhabitants, the going operating capacity of the Project, and will allow the NT2 Project to meet the design criteria of the Regulating Dam as defined by the Concession Agreement¹

Concession Agreement Requirements				Future Discharge Capacity (m³/s)				
ARI (years)	Gates Situated	Zmax (masl)	Flood Value (m ³ /s)	Downstream Channel	Existing Gates	New Spillway	Total	
1,000	1 closed	Max. Water Level	1,600	315	1,038	740	2,093	
5,000	Open	Full Supply Level	1,915	315	1,245	0	1,544	
5,000	1 closed	Max. Water Level	1,915	315	1,035	740	2,093	
10,000	Open	Max. Water Level	2,062	315	1,250	740	2,305	

	Table 5-1 CA	requirements and fu	iture discharge ca	pacity of Regulating) Dam
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Source: NTPC CA

Safety of Downstream Villagers

Implementation of the spillway is not expected to increase the likelihood of drowning for downstream users of the Nam Kathang as the discharge from the Regulating Pond via the spillway will be from the Nam Kathang catchment. Therefore flood levels will be similar to pre-Project flood levels for rain events of similar magnitude. Further, the spillway will only operate under extreme flooding conditions; therefore people are unlikely to be accessing the River during such events.

¹ Refer to Table 5-1. While the second Concession Agreement requirement is not met, fulfilment of the third requirement negates the need for this requirement with respect to structural integrity and discharge capacity of the Regulating Dam: indeed, the safety water level during floods is the Maximum Water Level (i.e. 179.5 masl) and not the Full Supply Level (i.e.178 masl). This conclusion is endorsed by the DSRP and LTA.

However, downstream villagers may be accustomed to the discharge that the Regulating Dam currently releases from the gates. Therefore, addition volumes of water associated with discharge from the spillway may catch people unaware of this potential source for additional water.

Short-term benefit to local economy

The immigration of a workforce for Project construction is expected to lead to increased sales by vendors in the region. There is also potential for hiring construction personnel from local communities, which would create a financial benefit to the community and may lead to skills development (e.g. civil works).

Loss of Land and Livelihood

The proposed Project footprint exists entirely on NTPC concession land, with the exception of the Promec area (to be used as ITD work camp). No lands or assets will be requisitioned or otherwise impacted by Project construction and implementation. There are currently no assets (structures or agriculture) that would be impacted by Project construction or implementation.

NB: Some river embankment areas beside the future spillway channel are and can be used for seasonal cultivations during the dry season. During the wet season, part of those areas are flooded due to natural flood events. These areas will not be impacted by the new spillway operation because when the free flow spillway begins to operate, the flow released in the Nam Kathang through the gates is already 1,200 m3/s and the corresponding water level is largely above the embankment areas (170 masl.– see Plate 5-1)



Plate 5-1: Cat 1 Project Lands (yellow line) and extend of the Nam Kathang (blue lines) when a 1,200 m3/s flood is discharged in the riverbed.

Erosion and Sedimentation

Erosion and sediment transport during construction has perhaps the greatest potential for Project related impact. Construction is scheduled for the dry season, which will alleviate some potential for erosion sediment transport.

Activities likely to promote erosion and sediment transport include:

- Clearing of vegetation for access roads and temporary / permanent bridges;
- In-stream construction associated with bridge construction;
- Excavation and grading activities;
- Spoils stockpiling; and
- Topsoil stockpiling.

Potential Water Quality Impacts

Water quality may be impacted downstream of construction and operations, with the greatest potential for impacts likely during construction. Water quality impacts may occur with respect to the following:

- **Increased sediment transport** and sediment deposition in water courses during construction and operations (refer to above);
- Hydrocarbon pollution associated with construction vehicles operating in-stream or upslope from Nam Kathang, Regulating Pond, and downstream of the workforce accommodation camp. Heavy earthmoving machinery will be used in-stream and adjacent the Nam Kathang. Accidental hydrocarbon spills may occur and may be transported by surface runoff or groundwater to receiving waters.
- Additional hazardous or non-hazardous waste Pollution from accidental spillage of waste generated during construction (refuse) or stored on-site (cement or other construction materials) may pose a risk to water quality;
- Nutrients and Pathogens The site workforce coming from outside the Project area is expected to peak at approximately 50 people during construction. Wastewaters from the accommodation and administration facilities will comprise a potential source of nutrients (e.g. nitrates) and pathogens (e.g. *E. coli*, and/or coliforms) that may be discharged into the environment. Another potential source of pathogens could be from solid waste disposal facilities such as spoils deposition areas and site landfills. These facilities could potentially contaminate downstream waters with pathogens if they are not effectively treated and isolated from surface runoff and groundwater aquifers.

Aquatic Biodiversity

Aquatic habitat and organisms may be impacted as a result of impaired water quality, particularly associated with construction activity.

- Sediment may reduce water quality by making the water turbid (cloudy). Turbidity prevents sunlight from penetrating the water and thus reduces photosynthesis and underwater vegetation;
- Excessive turbidity may inhibit fish and macro-invertebrates from locating prey and in some cases has been shown to damage fish gills;
- Sediment may change the morphology of stream channels, altering natural pool, riffle, run sequences and stream bed textures. These changes can affect aquatic species' ability to spawn / breed, hide from predators and can alter populations of micro-invertebrates or other food sources for aquatic species;

- Increased suspended sediment may inhibit fish migration, reduce foraging behaviour and territoriality for aquatic fauna, alter habitat in such a way that affects shelter for fish fry and parr;
- Increased suspended sediment may negatively impact invertebrate assemblages and abundances which can alter food sources, particularly for juvenile fish; and
- Pollution from hazardous or non-hazardous waste spillage may lead to direct fish kill or may contribute to impaired aquatic habitat.

Access to the Left Bank of Nam Kathang

Access to the left bank (north-eastern) Nam Kathang will be restricted for a number of days during the rainy season as the Regulating Dam crest will not be open to crossing. The permanent bridge is expected to provide for safe crossing of the Nam Kathang until flows reach approximately 36 m³/s.

However, no bridges were available for crossing the Nam Kathang during high flow events prior to construction of the greater Nam Theun 2 Power Project. The pre-NT2 baseline conditions only allowed safe crossing during periods when the Nam Kathang flows were considerably less than 36 m³/s. It is anticipated that the submersible bridge will be under water for 15 days/year, and generally for only hours or a few days at a time. (*pers. communication*: NTPC, December, 2013).

Crossing the Nam Kathang via the Regulating Dam crest will be prohibited as a safety measure. The number of rainy season days that the River is easily crossed will be reduced, while the number of crossing days as compared to pre-NT2 project baseline conditions will increase significantly. As access to the left bank is expected to be difficult for short durations only (NB: the Gnommalath bridge will remain available), impacts to agricultural activity and subsequent food security are expected to be less than significant.

Terrestrial Biodiversity, Timber Forest Products (TFPs) and Non-Timber Forest Products (NTFPs)

The volume of resource extraction from hunting, timber felling and NTFP collection directly correlates to the ease of access and the accessibility of areas to vehicles of adequate size to transport resources. The left bank of Nam Kathang is currently accessible by foot as well as motorbike and tuk-tuk during the dry-season. However, larger vehicles cannot easily access the area, limiting the ease and quantity of resource extraction.

NTPC is currently determining final design for the permanent Nam Kathang submersible bridge. Current planning includes an approximately 40 metre long, 2.25 metre wide structure that would support hand-tractors. The design will include obstacles to prevent cars and trucks from accessing the crossing and a closing mechanism to prevent crossing during flood situations. Providing such access may increase resource extraction of TFP, NTFP, and terrestrial biodiversity (refer to NT2 EAMP and Addenda for species lists) on the left bank. The community has not historically had vehicular access for cars or light trucks.

Short term workforce impacts

While small (50 people), the presence of the migrant workforce during the construction period presents a number of potential impacts to the environment and surrounding communities including: a) increased pressure on non-timber forest products, timber forest products, terrestrial species (hunting) and aquatic species (fishing / collection); b) increased risk of introduced diseases including sexually transmitted diseases; c) increased burden on local services (i.e. health services, water supply, solid waste etc.); and d) increased risk of conflict due to insensitivity of workforce to local culture and environmental values.

Local workforce needs, while providing a short term economic benefit to the local community, increase risks associated with occupation health and safety and community disruption.

Safety Issues associated with the temporary crossing

Villagers and construction personnel using the same access tracks and temporary bridge presents risks for accidents along this interface (construction phase only).

Cumulative Impacts

Cumulative impacts of the Project are expected to be confined to downstream impacts during the construction phase and should largely be confined to increased turbidity and suspended sediment concentration in the Nam Kathang. However, additional cumulative impacts are possible if additional construction occurs in proximity to the Nam Kathang or the Project construction area, including: the potential for additional water quality impacts (e.g. increased hydrocarbons, pathogens) and increased dust and noise.

No other significant projects are known to be scheduled for construction during the same timeline as the Regulating Dam Spillway Project. However, small-scale land disturbing activities will continue near the Nam Kathang as a result of land preparations for seasonal / annual crops. Slash and burn activities will diminish vegetative cover, creating greater potential for erosion and sediment transport, which will provide for a cumulative impact during Project construction. This impact is expected to be minimised via conduct of Project construction during the dry season and implementation of erosion and sediment control measures in advance of the wet season (refer to Section 5.4.2).

5.4 Mitigation Measures

5.4.1 Pre-Construction Phase

Permanent Bridge Structure

NTPC has agreed to design the permanent Nam Kathang bridge structure to preclude vehicles > 2 m wide (e.g. cars or light trucks). Limiting the size of vehicular crossing to foot, motorcycle and tuk-tuk traffic would provide villager access for current utilisation of left bank resources without increasing capacity for resource extraction.

Limitation in the size of the vehicles that may access the left bank of the River will limit extraction of timber, NTFPs, and animals to pre-Project levels.

For this purpose, two (2) concrete posts will be placed on each side of the crossing preventing the passage of vehicles more than 1.9m wide. In addition, the design will include a closing mechanism that will prevent the bridge access during flood events.

Two (2) threatened species (*Afzelia xylocarpa* – two individuals and *Hopea odorata* – one individual) exist in proximity to the footprint for the permanent bridge and the primary spoils deposition area. As they are in the riparian corridor, impacts are not anticipated from spoils deposition. However, construction for the permanent bridge access track could impact these small trees. As each of the individuals is young, they should be identified and protected from construction impacts with clearly identifiable fencing. If impacts are unavoidable, the trees should be transplanted prior to the onset of construction.

Early Warning System

The NTPC's Operating Instructions and Procedures (OIP), Regulating Pond Water Release Warning Communication System (July, 2013) specifies a flood warning system (Regulating Dam Water Release Warning Communication System) for warning downstream villagers of potential flood events resulting from increased discharge from the Regulating Pond. In particular, a siren is activated prior to any gate opening, and can be heard from the neighbourhood villages and RNT.

Due to the updated peak flows, the RWWS should be re-evaluated to determine whether villagers living adjacent the Nam Kathang should receive priority communication of impending activation of the spillway. This may involve re-classifying these villages (e.g. Ban Sangkeo and Ban That) for potential impacts, and creating an education campaign for village GOL representatives and village chiefs regarding potential dangers of conducting activities near the River during extreme events.

Spoils Deposition Areas

The main spoil disposal area is located beside RNT and can accommodate approximately 200,000 to 220,000 m³ of spoils. This area is not flooded and may be used in the following years to extend the RNT.

In case it is needed, a 2nd spoil disposal area is located in the left bank of the spillway channel, where approximately 20,000 m³ of material can be stored.

Spoil disposal areas will be designed according to specifications of the Project Concession Agreement and the EMMP-CP (Part B, Sub-Plan 2: Spoil Disposal Planning and Management Plan). The following design elements will be incorporated into design to mitigate for potential impacts:

- The spoils deposition areas will be designed at less than or equal to 3.5 metres in height (less than 6m as required);
- Batter slopes will not exceed 1.5:1 or as verified by engineering during design and calculation;
- Diversion banks will be design to divert water around spoils;
- Spoils will not be located in areas used for agricultural purposes, were designated for agricultural purposes or were suitable for agricultural purposes;
- Spoils will not obstruct access to gardens or dwellings, or require re-routing of roads and tracks;
- Spoils will be located in areas that do not cause more than negligible increases in the general depth of flooding.
- Spoils will not be located in identified floodways or flood storage area; and
- Applicable native species will be selected for revegetation prior to the onset of construction.

Further measures listed in the EMMP-CP (Part B- Sub Plan 2) and the Concession Agreement will be incorporated in spoils disposal design, construction, and revegetation.

As per the permanent bridge location, two (2) threatened species (*Afzelia xylocarpa* and *Hopea odorata*) occur within the primary spoils deposition area, as mapped. However, as they are in the riparian corridor, impacts are not anticipated from spoils deposition. The juvenile tree should be identified and protected from construction impacts with clearly identifiable fencing. If impacts are unavoidable, the trees should be transplanted prior to the onset of construction.

5.4.2 Construction Phase

Management and Mitigation Framework

Prior to constructing the NT2 Project, NTPC developed an Environmental Management System (EMS) that established the framework for management, mitigation and monitoring requirements during Project construction. A major component of the EMS was the development of an *Environmental Monitoring and Management Plan* (EMMP) that is compliant with the *Owner's Requirements* (April, 2005), specifically Appendix A1 – Owners Environmental Requirements and the NTPC *Concession Agreement* (Schedule 4 Part 2: Environmental Component).

The EMMP (2006) reflects NTPC commitments to ISO 9001 (Quality) and 14001 (EMS) certification and further develops mitigation measures that are compliant with statutory and institutional requirements for the Project. NTPC will re-institute the Volumes A and B of the EMMP (refer to below) and will require the Construction Contractor to re-develop Volume C based on mitigation measures that are site specific to the current Project.

The 2006 EMMP is comprised of:

- Volume A: Master EMMP, which presents the general context of the Plan, organisation and procedures and specifies statutory and institutional requirements for construction phase mitigation;
- **Part B**: Sub Plans, which present the detailed structural and non-structural measures to implement for complying with *Owner's Requirements:*
 - Sub-Plan 1 Erosion and Sediment Control Management Plan;
 - Sub-Plan 2 Spoil Disposal Planning and Management Plan;
 - Sub-Plan 3 Quarry Management Plan;
 - Sub-Plan 4 Water Quality Monitoring Plan;
 - Sub-Plan 5 Chemical Waste / Spillage Management Plan;
 - > Sub-Plan 6 Emergency Plan for Hazardous Materials;
 - Sub-Plan 7 Emissions an Dust Control Plan;
 - Sub-Plan 8 Physical Cultural Resources;
 - Sub-Plan 9 Landscaping and Re-vegetation Plan;
 - Sub-Plan 10 Vegetation Clearing Plan;
 - Sub-Plan 11 Waste Management Plan;
 - Sub-Plan 12 Reservoir Impoundment Management Plan;
 - Sub-Plan 13 Environmental and Social Training for Construction Workers Plan;
 - Sub-Plan 14 On-Site Traffic and Access Management Plan;
 - Sub-Plan 15 Explosive Ordnance Survey and Disposal Plan;
 - Sub-Plan 16 Construction Work Camps;
 - Sub-Plan 17 Manual of Best Practices in Site Management of Environmental Matters; and
 - Sub-Plan 18 Project Staff Health Program.
- **Part C**: Site management plans that describe site-specific measures to be implemented on a siteby-site basis according to the management, mitigation and monitoring requirements relative to the character of the site and the proposed works.

As per re-development of Part C of the EMMP, Contractors will develop Site Specific Environmental Plans (SSEPs) that incorporate those design elements of EMMP Volume 2 Sub-Plans that reflect the physical, environmental and social character of each construction site.

Erosion and Sedimentation

Erosion and sedimentation will be avoided and mitigated as per Sub Plan 1 (Volume B, EMMP), **Erosion** and **Sediment Control Management Plan**. Erosion and Sediment Control Plans will be included in SSEPs developed for each construction area (e.g. spillway, temporary bridges, permanent bridge, access tracks and spoils deposition)

The following erosion control and sediment management measures are recommended for inclusion in the SSEPs and subsequent implementation during construction:

- Where practicable, major earthworks and grading operations should be scheduled for early in the dry season to allow adequate time for implementation and deployment of erosion and sediment control measures. All works are currently scheduled for the dry season;
- In-stream construction activities (bridge and abutment construction) should be conducted during low-flow conditions. With Nam Kathang flows averaging approximately 0.2 m³/s at base flow, the installation of silt curtains should sufficiently contain sediment and minimise downstream transport. With increasing flow, sheet piles or cofferdams are advisable, which are more cost prohibitive;
- Minimise vegetation clearance to the extent possible and preserve vegetation in areas where construction will occur at a later date;
- Preserve vegetation on steep slopes and riparian corridors where possible to filter sheet flow between construction areas and Nam Kathang;
- Construct/Install surface water management infrastructure upslope from active construction areas to minimise and control surface water flow over disturbed areas (e.g. diversion or interceptor drains, temporary berms);
- Implement surface water management infrastructure in construction sites (diversion drains, swales) that divert sheet flow to sediment control facilities (e.g. silt fences, sediment basins, sediment traps, fibre rolls) downslope of active construction areas, particularly for construction upslope of Nam Kathang;
- Install velocity dissipation devices (e.g. riprap) at inlet and outlet of culverts to prevent scour and silt fences and fibre rolls to collect sediment downslope of riprap;
- Consideration should be given to the use of geotextiles and natural matting to assist with erosion control on steep slopes (i.e. 3:1 or greater) where erosion potential is particularly high;
- Progressively revegetate disturbed land areas as soon as they are available for rehabilitation and prioritise high risk erosion areas such as steep slopes and sites close to Nam Kathang; and
- Plant the earthen portion of Regulating Dam spillway with applicable species for erosion control and water velocity dissipation, as per *Nam Theun 2 Emergency Spillway Channel, Options for Vegetative Protection* (NTPC, 2013).

Water Quality

NTPC will mitigate potential construction phase impacts to water quality by ensuring contractor' incorporation of measures described in the following Sub-Plans of the EMMP into SSEPs and by ensuring their implementation:

- Sub-Plan 1 Erosion and Sediment Control Management Plan;
- Sub-Plan 2 Spoil Disposal Planning and Management Plan;
- Sub-Plan 4 Water Quality Monitoring Plan;
- Sub-Plan 5 Chemical Waste / Spillage Management Plan;
- Sub-Plan 6 Emergency Plan for Hazardous Materials;
- Sub-Plan 7 Emissions and Dust Control Plan;
- Sub-Plan 9 Landscaping and Re-vegetation Plan;
- Sub-Plan 10 Vegetation Clearing Plan; and

• Sub-Plan 11 - Waste Management Plan.

In addition, the following measures are recommended for inclusion in SSEP and implementation during construction:

- Sedimentation as per above.
- Nutrients A wastewater treatment system will be required to treat raw sewage associated with the temporary workforce accommodation. The wastewater treatment system should be effective at reducing phosphorous and nitrogen concentrations from the wastewater to suitable levels that will minimise adverse environmental effects and meet Lao PDR and appropriate international standards.
- Pathogens Similarly to nutrient loads, pathogens should be treated at the wastewater treatment facility. The design of the wastewater treatment system will determine how effective the system is at limiting the presence of pathogenic organisms from the discharged wastewater entering nearby waterways. Tertiary treatment of discharged wastewater (i.e. UV or Chlorination system) is effective in reducing pathogenic risk. However these systems require additional cost and maintenance. The wastewater treatment area should be located away from public access and with appropriate clearance to surface and groundwater. The system should be designed by a qualified and experienced wastewater engineer to ensure the most appropriate system is installed for the site and the number of people using the system
- Additional Pollutants Containers of liquid hazardous materials such as fuels, oils and lubricants should be located in bunded areas during site construction works. Bunds should be designed and installed in accordance with appropriate guidelines and have sufficient capacity to hold at least 110% of the maximum volume stored. Temporary shelters should also be constructed, to prevent collection of rainfall within the bunded areas.

Waste Management and Disposal

NTPC will ensure proper waste management and disposal by ensuring contractor' incorporation of measures described in the following Sub-Plans of the EMMP into SSEPs and by ensuring their implementation:

- Sub-Plan 5 Chemical Waste / Spillage Management Plan; and
- Sub-Plan 6 Emergency Plan for Hazardous Materials.

These Sub-Plans specify requirements for management and emergency response, including detailed description of procedures from the following (non-exclusive): storage of hazardous materials; selection of safer chemical types and minimisation of chemical use; registration and labelling of hazardous materials; safe handling procedures and personal protective equipment; refuelling procedures; spill response kit requirements, spill response procedures, emergency contact details, training of personnel, and emergency incident communication processes.

In addition, the measures listed below are recommended for implementation during construction.

The management of the refuelling and maintenance of heavy machinery should include:

- Regular maintenance of vehicles and equipment to prevent hydrocarbon leaks;
- Vehicle and equipment maintenance and refuelling should be conducted in designated areas where contaminated runoff can be contained; and
- Vehicles and equipment should be parked on sealed surfaces where contaminated runoff can be contained.

The management of spills or leaks of liquid hazardous materials should include:

- Stockpiles of loose absorbent material, such as saw dust, should be stored on-site at all times during construction; and
- Hydrocarbon spill kits (e.g. Sorbex) should be stored on-site at all times during construction work for the proposed Project, to be used in the case of hydrocarbon spills outside of bunded areas.

Vegetation Clearing

Very little vegetation will be cleared for Project construction as the majority of work will occur on former spoils disposal areas and existing access roads.

Vegetation clearing mitigation measures will be incorporated into SSEPs. The following components of Sub-Plan 11 – Vegetation Clearing Plan, EMMP, Volume B shall be included:

- Identification of vegetation to be cleared boundaries will be mapped and areas of sensitive vegetation located. Clearing will be restricted to demarked areas;
- No herbicides will be used within 50 m of vegetation not scheduled for removal;
- Burning will not be used as a clearing method and burning of waste material will be conducted in accordance with Sub-Plan 7 – Dust and Emissions Control;
- Herbicide Use will be undertaken in accordance with the requirements of Sub-Plan 5 Chemical Products and Spillage Management; and
- Erosion and sediment controls (as per Sub-Plan 1) will be in place prior to vegetation clearing works.

In addition, the following measures are recommended for inclusion in SSEPs:

- Restrict to vegetative clearance for bridge construction to the minimum area required; and
- Conduct vegetative clearance activity during dry season.

Aquatic Biodiversity

Impacts to aquatic biodiversity are expected to be limited to impacts associated with sedimentation of Nam Kathang (including direct and indirect impacts) and potential impacts from spillage of hydrocarbons or other waste products, discussed in Section 4.3.

Construction phase mitigation measures listed for erosion and sedimentation, water quality and waste management and disposal should mitigate impacts to aquatic biodiversity to less than significant.

Terrestrial Biodiversity

Impacts to terrestrial biodiversity are expected to be limited to indirect effects of minimal habitat removal from vegetation clearance associated with construction of bridges and access roads.

Construction phase mitigation measures listed for vegetative clearance are expected to minimise impacts for terrestrial biodiversity to less than significant.

Spoils

Spoils stockpiling, final landform design, and revegetation strategies will be as per the NTPC Concession Agreement, Schedule 04, Part 2 and will be compatible with the Head Contractor EMMP and EMMP Sub-Pan 02: *Spoils Disposal Planning and Management Plan*.

In summary, spoils deposition areas:

- Will not be located in flood storage areas and surface water drainage diversion will be constructed upslope;
- Will be less than 6 metres high (anticipated to be 2.5 to 3.5 metres high);
- Will have batter slopes that do not exceed 1.5:1 or as verified by engineering design and calculation; and
- Will have silt fences applied on the downslope side of the stockpiles until plants have established.

As per the EMMP, Sub-Plan 02, the SSEP will:

- Adhere to Principles for spoil placement activities (i.e. according to design specifications therein);
- Adhere to *Design of spoil disposal area and establishment activities* (e.g. within designated boundaries and according to detailed design specifications);
- Detail an Erosion and Sediment Design Plan for the specific spoils area;
- Abide by management measures identified in *EMMP Sub-Plan 07 Emissions and Dust Control Plan, Sub-Plan 15 – On-Site Traffic and Access Management* and *Sub-Plan 04 – Water Quality Monitoring Plan;* and
- Spoils sites will be progressively revegetated as spoil placement activities are completed in each component of the spoil disposal area, in accordance with *Sub-Plan 10 Landscaping and Revegetation Plan.*

Topsoil Reclamation and Stockpiling

NTPC will excavate topsoil from the Regulating Pond (left bank), near the Log boom anchor. The top soil volume in this location is sufficient.

Where vegetation removal is required above the FSL of the Regulating Pond (to provide access for excavators and dump trucks), disturbed areas will be planted with suitable native species at the onset of the rainy season.

- Erosion and sediment control measures will be implemented for topsoil stockpiles, including:
- Diversion of surface water drainage around stockpiles; and
- Placement of silt fencing on the down-slope side of stockpiles.

Workforce

Impacts associated with the temporary migrant and local workforce will be managed through the implementation sub-plans 13 - Environmental and Social Training for Construction Workers and Environment; and 18 - Project Staff Health Program.

All workers will be required to complete an environmental and social training program addressing issues such as traffic regulations, illegal logging and collection of non-timber forest products; non-disturbance of communities; hunting and fishing restrictions; waste management; and health and safety. Workers will commit to a code of conduct covering these key issues.

The Project Staff Health Program will include mandatory training on HIV / AIDS / STIs, other disease transmission and workplace accidents and injuries; and monitoring of staff health and safety. Health services will be provided to Project staff on site.

Villagers in the immediate area will also be consulted and made aware of the potential impacts of the migrant workforce through appropriate forums and other means of communication.
Temporary Access and Bridge

The following measures would be implemented to protect the safety of villagers on the access track and bridge:

- A fence will divide the construction access from villager access for the length of the shared track and/or bridge, providing physical separation for the entire length of the interface;
- Infrastructure will be implemented (i.e. speed bumps and speed limit signs) to ensure that construction vehicles maintain safe operating speed;
- Construction personnel will be trained in the conduct of safe operating procedures, including operating a safe speeds and accident prevention; and
- NTPC will ensure personnel man both ends of the access track / temporary bridge to ensure that construction related vehicles and villagers / pedestrians are restricted to their designated pathway of the temporary bridge(s) and access track.

5.4.3 Operational Phase

Access to the left bank

Two (2) concrete bollards will be placed on each side of the crossing, to prevent the passage of vehicles more than 1.9m wide.

Downtream safety and access during annual floods

During heavy flood events, the Nam Kathang crossing facilities (and the Regulating Dam crest) will not be safe points of access for the left bank of the River. NTPC will prohibit access across the Regulating Dam crest.

When water will be released to the Nam Kathang, a siren is activated prior to the gates opening, even for very small discharges (a few m^3/s). This siren can be heard at the area where the permanent Nam Kathang Crossing will be implemented.

As the water level in the Regulating Pond increases, and increased water release to the Nam Kathang is anticipated, the foreman initiates the following procedure for release to the Nam Kathang (via opening the gates) to ensure that increase in Nam Kathang flow downstream of the Regulating Dam is gradual. The following example assumes a natural flow of 50 m³/s to the Regulating Pond:

- At 00 Hours: 00 Minutes, the foreman computes the need for increased discharge;
- At 00 Hours: 00 Minutes, the foreman opens one gate, releasing 5 m³/s;
- At 00 Hours: 15 Minutes, the foreman further opens the gate, releasing 10 m³/s; and
- At 00 Hours: 30 Minutes, the foreman further opens the gate (or opens an additional gate), to increase discharge to 50 m³/s.

This procedure enables people to be aware that the discharge is increasing in the Nam Kathang to avoid potential for drowning (in addition to the siren activation).

NTPC already has a system in place to notify downstream inhabitants in the event of potential flood events. According to the *OIP Regulating Pond Water Release Warning Communication System* (2013); the *Regulating Dam Water Release Warning Communication System* (RWWS) is enacted as soon as unexpected release / spillage at the Regulating Dam is confirmed, when the Flood Forman calculates 15-minute release of above 150 m³/s, or as soon as unexpected release / spillage is at the Regulating Dam is confirmed. The RWWS requires NTPC to notify government counterparts in the Gnommalath District

(District Coordinator) when current Regulating Pond discharge reaches 150 m^3 /s and further notifies the Coordinator for every incremental release equal to or greater than 100 m^3 /s (i.e. 250 m^3 /s, 350 m^3 /s, 450 m^3 /s, etc.). For notification of flood cessation, NTPC notifies GOL only when the release is less than 40 m^3 /s and no heavy rain is forecasted for the next 24 hours.

According to the RWWS, the NTPC Flood Foreman (on-duty at Regulating Dam) notifies the NTPC Flood Manager (on-site). The Flood Manager notifies the Gnommalath District Coordinator. The District Coordinator notifies Downstream Village Coordinators (GOL responsibility). The Downstream Village Coordinators have been selected for 28 villages, including applicable villages on and near Nam Kathang.

Appendix A for the *OIP Regulating Pond Water Release Warning Communication System* lists the 28 villages that are notified in the event of potential flooding downstream of the Regulating Pond and ranks them according to potential impacts from releases exceeding 500 m³/s. It is recommended that the villages bordering Nam Kathang and those that consistently cross Nam Kathang (e.g. Ban Sangkeo, Ban That) be upgraded to 'Limited risk for the village for the release' from the current category ('No impact on this village for the release') because locals used to the current maximum release may be caught off-guard by potential increases.

Additional mitigation measures will be:

- When flows may overtop the structure, a chain will lock the access from right and left banks, in
 order to prevent people from crossing. This chain will be locked upon order from NTPC /
 Operation Dpt (by NTPC contracted person) before releasing a flow of more than 36 m³/s. If
 necessary, a guard will be appointed to enforce safety measures.; and
- The Flood procedure will be reviewed: currently, the crossing is designed to withstand 36 m³/s without being submerged, but the flood state is declared at 40 m³/s. After construction, NTPC will measure the exact flow without submersion and make the Flood Instruction match this figure.

Downstream Safety in case of extreme flood event (more than 1,500 year ARI)

In the event that an extreme storm event leads to discharge from the Regulating Pond, the Nam Kathang waters will rise, with the possibility of a moderate surge in River level following operation of the spillway. Villagers living in proximity to the Nam Kathang and those that utilise the River for its beneficial uses may not be accustomed to such a surge, as the extreme floods are very rare events (once every 1,500 to 10,000 years).

NTPC will manage the floods by opening the Nam Kathang gates first; the new spillway will discharge water only when the gates are fully open and approximately 1,250 m³/s of water is already flowing in the Nam Kathang.

Erosion and Sediment Transport

Although the majority of erosion and sediment transport is expected during the construction phase, the issue will persist to a lesser degree during operations.

The following management measures are recommended for the operations phase:

- Maintain and upgrade (as appropriate) erosion and sediment control facilities on unsealed access roads, spoils deposit batters, and permanent diversion canals;
- Continue revegetation operations until vegetative cover is complete on the spillway face, spoils batters, and along riparian corridors; and
- Monitor revegetation areas for plant establishment, and replant areas where initial planting efforts do not provide for vegetative cover.

6 Environmental and Social Monitoring Plan

The framework for environmental and social management and monitoring for this current Project will be consistent with that established and conducted for the greater NT2 Project.

6.1 Institutional Arragements

Existing institutional arrangements will be utilised for environmental and social management and monitoring. These are summarised below.

6.1.1 Health, Safety and Environment Department

The Environmental Compliance Unit (ECU) within the NTPC Health, Safety and Environment Department will act as the environmental management office for the Project. The ECU is fully staffed and resourced for ongoing monitoring of the greater NT2 Project. Indeed, NTPC has established since 2005 an Environmental Compliance Team which remains intact within the present Health Safety and Environment Department (a part of the IMS Division). There are two Environmental Compliance Inspectors each with over 9 years of experience in monitoring construction works (mostly undertaken by ITD) on the NT2 project.

During the construction of the Regulating Dam spillway, the ECU will be responsible for monitoring the implementation of mitigation measures that will be supervised and carried out by the Owner Engineer and Construction Contractor. The purpose of this monitoring is to ensure compliance with environmental provisions of both the Concession Agreement and Construction Contractors EMMP (refer to Section 6.2). The ECU will work closely with the Environmental Management Unit (EMU) and other GOL agencies, as appropriate.

Prior to the start of the Construction Phase for the current Project, the ECU will:

- Ensure that the relevant environmental mitigation measures are reflected in the Contractor EMMP for the Project (see Section 6.2);
- Hold discussions with the government authorities participating in the Project, such as the EMU, to develop procedures for inter-agency coordination and reporting; and
- Ensure that the Construction Phase activities include appropriate environmental monitoring;

During the Construction and Operating Phases, the ECU will be responsible for implementing and monitoring environmental mitigation measures. The management of environmental concerns will include:

- Developing and implementing the monitoring program;
- Liaising and cooperating with the government authorities given responsibility for implementing GOL's responsibilities;
- Preparing work and cost schedules for the monitoring programmes;
- Conducting appropriate testing to ensure that the environmental mitigation measures are effective;
- Arranging for reporting of the results of the monitoring programmes;
- Maintaining records for reporting to GOL and the EMU;

- Conducting audits to ensure compliance with the Concession Agreement and the procedures of NTPC; and
- Assisting GOL with the public consultation programmes and documenting the feedback for incorporation into programme planning.

Throughout the construction period, the ECU will prepare monthly reports for submission to GOL. These reports will address the following items:

- Progress made to implement the environmental mitigation measures in compliance with both the Concession Agreement and the Contractor EMMP;
- Schedule of implementation of environmental mitigation measures;
- Any difficulties with implementing the environmental mitigation measures and recommendations for correcting the problems; and
- Any aspect that does not conform to the environmental mitigation measures and proposed remedial measures.

6.1.2 Owner Engineer and Construction Contractor

The Owner Engineer and Construction Contractor will be responsible for the development of site specific management plans (see Section 6.2) and the implementation / monitoring of measures to avoid or minimise impacts during construction.

Examples of aspects these measures relate to are:

- Meeting effluent standards and water quality requirements for discharges into surface waters and groundwater;
- Controlling drainage, erosion and sedimentation;
- Protecting physical and cultural resources;
- Landscaping, rehabilitating and re-vegetating the construction areas;
- Managing on-site waste;
- Managing use and storage of chemicals, preventing and developing emergency plans for chemical pollution incidents;
- Controlling noise emissions and dust from construction activities;
- Surveying, detecting, and rendering safe by removal and subsequent destruction (or by in-situ destruction) of unexploded ordnance (UXO);
- Designing and constructing construction work camps;
- Implementing a programme for construction worker education in environmental issues; and
- Implementing a health and safety programme for all persons engaging in construction works.

The Owner Engineer and Construction Contractor will work closely with the ECU and EMU as appropriate.

6.1.3 The Environmental Management Unit (EMU)

MONRE holds the main responsibility for monitoring the implementation of mitigation measures in consultation with other GOL institutions.

MONRE's NT2 Project EMU, established in 2006, will be responsible for GOL monitoring of construction and operation of the Project. The EMU has staffed and fully equipped offices in the Project area to facilitate monitoring of the greater NT2 Project during the operations phase. Additional staffing resources are expected to be required for monitoring of this Project during the construction phase.

The EMU personnel have experience in monitoring construction works and benefitted from the USD 1m funding provided by NTPC for capacity development during the NT2 Project Construction Phase.

Responsibilities of the EMU will include:

- Coordinating the implementation of environmental mitigation measures with GOL and NTPC;
- Allocating responsibilities to other appropriate agencies to assist GOL in meeting their obligations within the Concession Agreement where required;
- Monitoring and supervising the implementation of the environmental mitigation measures for which GOL and NTPC are responsible;
- Advising MONRE and the relevant government agencies on the adequacy of proposed environmental mitigation or compensation measures and recommending changes based on monitoring results;
- Coordinating necessary meetings between the NTPC Environmental Management Office (EMO) and appropriate government agencies; and
- Resolving environmental issues between government agencies and NTPC.

6.1.4 Other Monitoring Institutions

Lenders Technical Advisers

An LTA lead by Parsons Brinkerhoff Australia Pty Ltd conducts site visits twice a year to ensure that environmental impacts of the greater NT2 Project are mitigated in compliance with the Concession Agreement. The construction and operation of the Regulating Dam spillway is covered in the LTA's brief.

The next visits will be organized end November 2014 (one month after the works have begun) and early April 2015 in order for the LTA to check the quality of the works and of the mitigation measures implementation.

The Independent Monitoring Agency

The IMA was established in 2007 to independently monitor implementation of the obligations of the GOL and the Company under the Concession Agreement relevant to the Environmental Measures. The IMA continues to monitor the greater NT2 Project during the operation phase and it is expected that the construction / operation of the new Regulating Dam will be covered during the next IMA monitoring mission.

International Finance Institutions

International Financial Institutions (including the World Bank, Asian Development Bank, European Investment Bank, Agence Française de Développement) also conduct regular supervisions of the greater NT2 project. The construction and operation of the Regulating Dam spillway is expected to be covered in future monitoring.

6.2 Owner Engineer and Construction Contractor EMMP

NTPC obligations regarding environmental and social issues, including monitoring, are provided in the Owner's Requirements, Volume 1, Part 14, Environmental and Social Requirements. Those Owner's Requirements specify the Contractor's obligation to develop a construction phase *Environmental Monitoring and Management Plan, Environmental Monitoring and Management Plan for Preliminary Construction Activities,* and *Preliminary Draft Plan of the Contractor's Environmental Monitoring and Management Plan.*

Prior to constructing the main NT2 Project, NTPC developed an Environmental Management System (EMS) that established the framework for management, mitigation and monitoring requirements during Project construction. A major component of the EMS was the development of an EMMP that was compliant with the *Owner's Requirements*, April, 2005 (specifically Appendix A1 – Owners Environmental Requirements) and the NTPC *Concession Agreement* (specifically, Schedule 4 Part 2: Environmental Component). The EMMP (July, 2006) reflects these requirements and further develops management and monitoring measures to address site specific needs.

As per Project management and mitigation, NTPC will re-institute the Contractor EMMP (Volumes A and B) and will update Volume C.

- Volume A: Master EMMP, which presents the general context of the Plan, organisation and procedures, including monitoring requirements;
- **Part B**: Sub Plans, which present the detailed structural and non-structural monitoring plans in compliance with *Owner's Requirements* (refer to Section 4.3.2);
- **Part C**: Site management plans that describe monitoring measures to be implemented on a siteby-site basis relative to the character of the site and the proposed works.

NTPC will require the Contractor to develop Volume C to address the site-specific requirements for the proposed works. *Site Specific Environmental Plans* (SSEP) will be developed by the Contractor and/or sub-contractors to account for the physical, biological and social character of each construction site and detail the monitoring requirements during construction.

Construction Phase Monitoring

The recommended approach for monitoring during the construction phase is consistent with that applied for construction of the greater NT2 Project, and is summarised in Table 6-1. This framework has been adapted from the NT2 EMMP Version 2, Part A - Appendix 6.

Category and Subject	Monitoring Action	Responsibility	Monitoring Frequency	Monitoring Criteria
	Inspection of drainage control facilities	Contractor	Weekly / daily following storm events	Engineering, maintenance requirements
Construction Areas	Monitor application of design standards for erosion control	Contractor	Weekly / daily following storm events	Drainage control facilities, erosion control facilities and measures (e.g. riprap, batter angles, etc.) and sediment control facilities (e.g. silt fencing, sediment pond and traps).

Table 6-1 Recommended construction phase monitoring framework

Category and Subject	Monitoring Action	Responsibility	Monitoring Frequency	Monitoring Criteria
	Inspection of pollution control facilities and measures implemented	Contractor	Weekly / daily following storm events	Visual inspection of refueling area, chemical and waste storage facilities to ensure proper implementation of engineering (design) and controls (e.g. bunding, rain cover, presence of spill response kit, etc.). Inspect for maintenance requirements
	Water quality sampling of Nam Kathang upstream and downstream of construction areas	Contractor and NTPC	Weekly	Turbidity (NTU), total suspended solids (TSS), pH, Temperature (T), Conductivity, Dissolved Oxygen (DO), Oil/Grease (O/G)
	Monitoring macroinvertebrates in the Nam Kathang (identification to family level and determination NTP of biological indices).		Every two months	Biological indices (J', BMWPthai, and ASPT)
	Sampling and analysis of drainage water from area outlet	Contractor	Weekly	T, pH, EC, TSS, O/G
	Review of weekly monitoring data	Consultant	Weekly	Comprehensive
Erosion and	Ensure implementation of erosion and sediment control measures	Contractor	Weekly	Visual observation; design documentation
Sediment Control	Routine inspection of erosion and sediment control facilities	Consultant	Monthly	For maintenance requirements and upgrade
Workforce Accommodation Camp	Routine monitoring of facility	Contractor	Weekly	General waste management, maintenance of drainage and sanitation facilities and general cleanliness of camps
	Sampling of drainage leaving camp	Consultant and NTPC	Monthly	BOD5, T, pH, DO, TSS, fecal coliform (FC), total coliform (TC), phosphates, nitrates
	Registration of septic tank emptying operations	Contractor	After septic tank cleaning	Date of maintenance
Maintenance Areas	Inspection of pollution control measures implementation	Contractor	Weekly	Refueling areas and practices, bunded storage for hazardous materials, storm water design (hydrocarbon separation facility)
	Ensure presence and maintenance of spill response equipment kit according to products stored	Contractor	Weekly	Presence of spill kits (adsorbents), spill response procedures posted, emergency response team identified and trained
	Registration of used waste generated and disposed of	Contractor	Daily registration by garages and workshops, as applies	Date and volume of waste removal and record of transport to waste facility

Category and Subject	Monitoring Action	Responsibility	Monitoring Frequency	Monitoring Criteria
Non-hazardous Waste Landfill	The existing Gnommalath landfill operated by NTPC will be used so no additional measures for landfill management are required.			
Garbage Collection	Ensure regular collection of garbage from Project Area	Contractor	Weekly	Visual inspection
Hazardous	Ensure appropriate HazMat registration, storage and handling	Contractor	Weekly	Registration, design of storage area (bunded and fenced area), container
Chemicals	Inspection of HazMat management	Consultant	Monthly	quality, labelling, split response kits, safety procedures posted, PPE available, staff trained to respond to spillage
	Ensure areas scheduled for vegetative clearance are clearly demarcated and capture only the area planned for clearance	Contractor	Daily observation during clearing activity	Clearance areas as per design specification and clearly marked prior to clearance
	Monitor and register areas cleared	Contractor	Prior to clearing, following clearing	As per design
Clearing	Ensure burning conducted with respect to standards	Contractor	Daily, when occurring	Implementation of burning program as applies, size of piles, distance to forest, fire equipment and team mobilized. NB: Preference for the disposal of cleared vegetation shall be given to composting, however in the event that there is a demonstrable need for the burning of cleared vegetation this shall be undertaken in a manner that poses no risk to remaining vegetation and that prevailing wind conditions direct smoke away from residential areas.
	Monitor clearing operations and review clearance register	Consultant	Weekly	Monitor for compliance with clearance area design
Revegetation	Monitor revegetation sites to confirm successful establishment of intended vegetation	Contractor	Quarterly, following planting	Native versus non-native species, establishment of exotic invasive species, maintenance requirements (e.g. replanting failed areas, erosion control)
	Availability of planting stock	Consultant	Prior to planting	Adequate stock of intended species is available
Wildlife Conservation	Enforce workforce hunting ban	Contractor	Daily	Incidental observation, control at check-points, presence of arms or workers cooking wildlife meat
	Monitor areas delineated as sensitive natural areas to be avoided	Contractor	Daily	As per clearing criteria
Construction noise and vibration	Monitor construction hours	Contractor	Upon complaint	Visual observation that night time construction restrictions are honored (if applicable)

Category and Subject	Monitoring Action	Responsibility	Monitoring Frequency	Monitoring Criteria
	Ensure trucks and vehicles properly maintained (breaks, engines, etc.)	Consultant	Monthly	Register vehicle servicing and monitor compliance
	Review reported grievances	Consultant	Weekly	Implement and monitor results of Grievance Procedure, Evaluate villager / workforce complaints regarding noise from construction to determine corrective action
Dust from unsealed	Monitor implementation of water on unsealed roads near sensitive receptors	Contractor	Daily, during dry season	Visual observations: number of waterings per day, number of watering trucks
roads	Review reported grievances	Consultant	Weekly	Implement and monitor results of Grievance Procedure, Evaluate villager / workforce complaints regarding dust generation from construction
	Ensure implementation of road signs and speed reduction bumps, as applies	Contractor	Daily	Compliance with design
Road Safety	Ensure respect of signs, speed limits, and parking areas by project drivers	Contractor	Daily	Register non-compliance for project roads and public roads
	Monitoring of traffic safety	Consultant	Daily observations and random control point once a month	Direct observation, systematic monitoring of measures to prohibit alcohol and drug use by drivers, and truck conditions and load
Access	Monitor Regulating Dam crest to ensure access is prohibited to public as well as non-authorised workforce during construction of spillway	Contractor	Daily	Visual observations, retention of guards at check points that monitor foot traffic
	Monitor construction areas for prohibited entry	Contractor	Daily	Monitor all construction areas to ensure non-entry by unauthorized persons
Workforce health	Ensure all workers attend awareness program before working on-site	Contractor	Staff register monitored by HSE officer	Registration of training attendance
awareness program	Monitor construction areas for availability of First Aid Kits	Contractor	Weekly	Review of equipment and location
Injury / Illness reporting	Verity implementation of occupation injury and illness reporting procedure	Contractor	Weekly	Register and compile occupational injuries and illness
Safety PPE and	Verify availability and use of appropriate PPE on site and posted procedures	Contractor	Daily during field visits	Register supply of PPE, visual observation of procedure posted in key sites (e.g. HazMat storage, construction sites, garages, etc.)
	Verify adequate signage and barricades in hazardous construction zones	Contractor	Daily	Visual observations

Category and Subject	Monitoring Action	Responsibility	Monitoring Frequency	Monitoring Criteria
	Review OH&S accident prevention activities	Consultant	Monthly	Review register of PPE, visual observations and questioning of workers during site inspections, number of non-compliances detected and trend

Construction phase monitoring results will be provided to GOL via standard reporting methodology as per current operations phase reporting obligations.

6.3 Operations Phase Monitoring

NTPC has an ongoing monitoring program implemented by its in-house Laboratory (AE Lab) that will apply to the Project Area following the completion of its construction. NTPC Operations phase monitoring will continue for the parameters listed below (as apply to the Regulating Dam operations) as will reporting requirements for the Project. Construction phase monitoring results will be provided in operations phase reports.

Water Quality Monitoring

Water quality monitoring is currently conducted by NTPC on a fortnightly basis. NTPC collects samples from 31 long-term water chemistry sampling stations. Sampling stations are located throughout the greater NT2 Project Area, including: nine (9) from streams in the Nam Theun catchment; nine (9) from the Nakai Reservoir; one (1) from the tailrace channel; one (1) in the Regulating Pond; four (4) in the Downstream Channel; four (4) in the Xe Bang Fai; and six (6) from the Nam Kathang and Nam Gnom.

Monitoring is conducted for field parameters and laboratory water chemistry analyses from surface waters of applicable streams. Reservoir and Regulating Pond samples are collected from throughout the water column (i.e. lower, middle, and surface samples).

Current sampling stations NKT3 and NKT4 (refer to Figure 6-1), located on the Nam Kathang downstream of the proposed Project works are well situated to capture changes in water quality resulting from Project implementation during operations, if applicable.

The parameters currently monitored are also suitable for on-going monitoring of the Nam Kathang (refer to Appendix B).

Macro-invertebrates

NTPC conducts routine hydrobiology sampling to monitor potential changes in macro-invertebrate biodiversity and populations. There are currently 17 Hydro-bio sampling stations, including six (6) in the Nam Theun catchment, five (5) in the Nakai Reservoir, and six in the Xe Bang Fai catchment, which includes two will serve to provide on-going operations phase sampling for this Project. Sampling stations NKT4 (near Ban That) and NKT5 (Nam Kathang upstream from National Road 12) are downstream of proposed construction and operations and within the vicinity of the proposed Project.

During the construction phase, NTPC will conduct 3 campaigns to monitor the macroinvertebrates (Identification to family level and determination of biological indices (J', BMWPthai, ASPTthai). The survey will focus on families sensitive to total suspended solid and turbidity changes. These families could belong to molluscs, *coleoptera* (e.g. *elmidae*) or *trichoptera* (e.g. *hydropsychidae*).

Hydrology Monitoring

Hydrology monitoring is conducted for release from the powerhouse, for natural inflow to the Regulating Pond from the Nam Kathang catchment, for the Regulating Pond itself, and for release from the Regulating Dam into the DSC and Nam Kathang.

Natural inflow to the Regulating Pond is monitored using the water balance method. As the input of water to the Regulating Pond from the powerhouse and the discharge into the DSC and Nam Kathang are quantifiable, the difference in Regulating Pond water level is provided by the Nam Kathang catchment. This calculation (managed by the Shift Engineer) is used to adjust the release of Regulating Pond water into the Nam Kathang. When a calculated inflow differs significantly from the previous calculation, the inflow is confirmed by a second calculation. During the rainy season, the Shift Engineer closely monitors the natural rise in the natural inflow to the Regulating Pond.

According to the magnitude of the natural inflows, three (3) calculation time steps for water balance are considered:

- Natural inflow < 15 m³/s, time step one hour;
- Natural inflow between 15 30 m³/s, time step 30 minutes; and
- Natural inflow between 30 40 m³/s, time step 15 minutes.

When natural inflow is calculated at > 40 m³/s, a flood state is confirmed and the Operating Instruction and Procedure (OIP) for flooding at the Regulating Dam is enacted (refer to Section 5.4.3).

Meteorological Monitoring

Meteorological Monitoring is conducted daily during the rainy season in addition to hydrologic monitoring to further inform the Shift Charge Engineer of potential rapid increases of water input from the Nam Kathang catchment in advance of it discharging to the Regulating Pond.



Figure 6-1 NTPC Water Quality and Hydro-bio Sampling Stations

6.4 Monitoring Budget

6.4.1 Budget for the NTPC ECU

NTPC has sufficient resources to ensure the successful implementation of the environmental and social management and monitoring of the Project as identified in this IEE(two Environmental Compliance Inspectors each with over 9 years of experience in monitoring works on the NT2 project)

The costs associated with the ECU for the Project will be covered under the current HSE Department operational budget for the greater NT2 Project.

6.4.2 Budget for the Environmental Management Unit (EMU)

The EMU is expected to utilise its extensive resources (e.g. office equipment, cars, and monitoring equipment) which have been acquired with the support of NTPC for the monitoring of the construction and operation phases of the main NT2 project.

Additional support to the EMU will be required for monitoring during the nine (9) month mobilisation / construction phase of the Regulating Dam spillway. An agreement is expected to be reached through a Memorandum of Understanding regarding the final budget and work plan prior to the commencement of construction.

A conceptual budget for the EMU is provided in Table 6.2. This includes:

- Per diems for two (2) part time monitoring staff over the 40 week construction period
- Expenses for weekly field monitoring (2 days per week)
- Expenses for communication (i.e. additional communication, printing etc.).

Table 6-2 Conceptual Environmental Management Unit Budget

Management Aspect	Unit	Unit Cost	Unit Amount	Total
Staffing	Per diem	8.00	240	1,920
Ground transportation (driver, fuel, etc.)	Daily car costs	30	80	2,400
Office expenses (communication, printing, etc.)	Weekly office costs (additional)	100	40	4,000
Laboratory Analysis^	NA	0	0	0
TOTAL				8,320

^Laboratory Analyses conducted at NTPC Laboratory (with EMU involvement, if requested)

7 Public Consultation and Information Disclosure

Public consultation and disclosure is a "tool for managing two-way communication between the project sponsor and the public with the goal of improving decision making and building understanding by actively involving individuals, groups, organizations with a stake in the project" (IFC 1998). It is a core aspect of the Government of Lao PDR's (GOL) environmental and social legislation and a key requirement of the NT2 Project's international financial institutions. In addition to these regulatory obligations, an open and consultative approach makes good business sense by reducing costs, reducing risks and enhancing reputation and commercial opportunity.

7.1 Objectives of Public Consultation and Disclosure

Public Consultation

The specific objectives of the stakeholder consultation for the Project are to:

- Ensure that project affected communities and other stakeholders are well informed of the Project, its environmental and social impacts, and management measures;
- Collect relevant information on the project area from key stakeholders for use in the IEE and associated management and mitigation measures as well as development of the Project;
- Enhance existing two way communications between the Developer, the affected communities and other Project stakeholders;
- Ensure stakeholder feedback on the Project and its impacts is gained through simple and effective communication processes; and
- Promote inclusive and informed decision making on the development and management of the Project.

Disclosure

Adequate disclosure regarding the details of the Project to stakeholders has been maintained throughout the IEE process. Key aspects of ensuring adequate disclosure include:

- Providing a description of the Project at the village level during surveying, focal group discussions, and formal consultations;
- Providing local communities with opportunities to ask questions about the Project during all consultations undertaken;
- Providing project description hand-outs at Village, District, Provincial and Central level consultations in both Lao and English languages; and
- Making information available regarding the Project at the NTPC office in Vientiane.

7.2 Stakeholder Identification

Lao legislation defines stakeholders as "any person, legal entity or organisation who/which are interested in, involved in, or have interests in an investment project, an activity or a matter (related to the project) because they are involved in or (are likely to be) affected by the investment project" (MONRE, 2010).

Project Affected People

Project affected people identified during the conduct of the IEE are outlined in Table 7-1:

Table 7-1	Project	Affected	People
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Category	Description
Persons losing land or assets to the Project.	This group includes residents in project affected villages that suffer specific losses of privately held land or assets. Based on the current Project footprint, which is situated predominantly on NT2 Project Lands, individual lands and / or assets will not be impacted.
Villages or groups of households losing joint / community land or assets	This group includes villages or groups of households losing joint or community land and assets to the Project. Based on the current Project footprint, which is situated predominantly on NT2 Project Lands, lands and / or assets owned by villages or groups are unlikely to be impacted.
Villagers in close Proximity to the	Villagers living in close proximity to the Project footprint may experience impacts during the construction and operation phases of the Project. Three (3) villagers including Ban Sangkeo, Ban That and Ban Lao have been identified within a 3 km radius of the Project site.
Project	This category also includes residents who currently cross the Nam Kathang via NT2 Project Lands to access land, forest and fishery resources on the left bank. These include residents from Ban Sangkeo and Ban Lao.
Downstream Nam Kathang water users	This group comprises people that rely on Project affected rivers and streams for water supply and a variety of other purposes (i.e. agriculture and fisheries). A total of 15 (Nam Kathang and Nam Gnom) villages have been identified including Ban Sangkeo and Ban That, located in close proximity to the Project footprint.

Government

Government of Lao PDR stakeholders include:

- Gnommalath District governments and line offices;
- Khammouane Provincial government and line departments; and
- Central Government line agencies.

Other Stakeholders

Other stakeholders: Other stakeholders identified for the Project include:

- Residents of other villages in the Gnommalath District;
- Private companies operating in the vicinity of the Project;
- NGOs and aid projects working within the Project Area; and
- NT2 Project International Financiers and associated monitoring institutions (e.g. Lenders Technical Advisers).

7.3 Summary of Consultation Activities Undertaken

A series of initial consultations have been conducted during the conduct of the IEE. These included meetings with provincial and district level representatives; village meetings and surveying and site visits.

The purpose of these engagements was to introduce the Project; collect information on the Project area; and seek feedback from key stakeholders.

At each consultation, a description of the Project was provided (using presentations and presentation handouts). Participants were given an opportunity to provide comments, advice and information relevant to the project. Standard forms were used to record discussions.

Formal consultations on the preliminary findings of the IEE were conducted between January and April 2014.

During formal village consultations, preliminary findings of the IEE were presented and hand-outs of these presentations provided to participants. Separate male and female group discussions were held to confirm community understanding of the potential impacts and proposed mitigation measures – and to facilitate community feedback. Follow-up village consultations were conducted in April 2014 to update villagers on the status of the IEE and confirm contents of minutes from these consultations.

At the district / provincial level, preliminary findings of the IEE were presented and hand-outs of these presentations provided to participants (including village, district and provincial stakeholders). A feedback forum was led by the Chair of the meeting. The Draft IEE Report was translated into Lao and provided to DONRE prior to the conduct of district / provincial consultations. Copies of the Draft IEE report were also made available at this consultation meeting.

Date	Consultation	Stakeholders			
IEE Kick-off and Field Investigations					
12 Dec, 2013	Project Kick-off Meeting	Nam Theun 2 Power Company			
16 Dec., 2013	Khammouane Provincial Meeting	Resettlement Management Unit for the NT2 Project; Department of Natural Resources and Environment, Department of Energy and Mines, Department of Agriculture and Forestry and Provincial Cabinet office.			
17 Dec., 2013	Gnommalath District Meeting	Resettlement Management Unit for the NT2 Project; Department of Natural Resources and Environment, District Natural Resources and Environment Office, District Energy and Mines Office, District Cabinet office			
17 – 19 Dec., 2013	Village-level Meetings / Surveying	Village authorities and other representatives of Ban Sangkeo, Ban That and Ban Lao.			
17 – 18 Dec., 2013	Village-level Focus Group Discussions	Men and women from Ban Sangkeo, Ban That and Ban Lao.			
16 – 18 Dec., 2013	Site investigations and meetings with NTPC and GOL.	Department of Natural Resources and Environment; Department of Water Quality and Hydrobiology; and District Natural Resources and Environment office.			
1-3 April, 2014	Additional site investigations, village surveying, focus group discussions (NTFPs / TFPs /	District Environment office; District Cabinet; Village authorities and men and women from Ban Sangkeo, Ban			

Table 7-2 Summary	v of Consultations	Conducted dur	ina the IEE Process
	,		

Date	Consultation	Stakeholders
	Fishing)	That and Ban Lao.
IEE Formal Consultations		
10 th January, 2013	Village level Consultations (with District Government involvement).	District Environment office; District Public Work and Transport Office; District Planning and Investment Office; District Lao Front Construction Office; District Health Office; District Natural Resources and Environment office; Department of Natural Resources and Environment; District Government Office; District Agriculture and Forestry; Village authorities and men and women from Ban Sangkeo, Ban That and Ban Lao.
7 th February 2014	District and Provincial Level Consultation.	Provincial and district officials from the Ministry of Natural Resources and Environment, Ministry of Planning and Investment; Ministry of Agriculture and Fisheries; Ministry of Planning and Investment; Ministry of Health; Ministry of Education. Village heads from Ban Sangkeo, Ban That and Ban Lao.
2-3 April 2014	Follow up village consultations to update villagers on EIA process and confirm results of consultations in January.	District Environment office; District Cabinet; Village authorities and men and women from Ban Sangkeo, Ban That and Ban Lao.

7.4 Results of Consultations

Official records from consultation meetings are provided in Appendix H and are summarised below.

7.4.1 Initial Consultations

Provincial and District Government

Table 7-3 Provincial and District Government: Key comments and relevant IEE actions

Comment	How this was addressed in the IEE	IEE Report Section Ref.
Provincial		
IEE Approval - Responsibility for the approval of IEE's has been transferred from MONRE (Central) to PONRE (Province).	Engagement and all official correspondence directed to Provincial DONRE.	Section 7
IEE study should be conducted in accordance with PM Decree 112 on Environmental Impact Assessment.	The IEE has been conducted in accordance with all relevant GOL legislation and international guidelines and policies.	Section 3
IEE Consultation is the most important part of the IEE study and	IEE consultation has followed GOL and international	Section 7

Comment	How this was addressed in the IEE	IEE Report Section Ref.
should be focused at the village and district levels. Past projects (unrelated to NT2) have not followed this process adequately.	financier requirements.	
If the IEE report (including the mitigation and management measures) is well prepared and reported, then the joint district and provincial IEE consultation can be conducted.		
Design should be compliant with the Concession Agreement.	The Project design has been approved by the LTA.	Sections 2, 3.2 and 5
District		
Query regarding location of proposed disposal areas – on NTPC lands or other?	Spoil areas are located on NTPC Category 1 lands. Two additional spoil areas are being considered by the Project.	Section 2
Is the proposed submersible bridge the same as requested by Ban Sangkeo?	Design and location of bridge are yet to be confirmed.	Section 2
Will the Project develop an access road to and from the proposed submersible bridge site?	Design and location of bridge are yet to be confirmed.	Section 2

7.4.2 Formal Draft IEE Consultations

Provincial and District

Table 7-4 Provincial and District Government: Key comments and relevant IEE actions

Comment	How this was addressed in the IEE	IEE Report Section Ref.
Concern about potential downstream flow changes and impacts on community safety.	The purpose of the project is to project the integrity of the Regulating Dam (and safety of downstream communities) in severe flood events. There will be no changes to the volume of flow in the Nam Kathang.	2.4
Can a traditional / wider bridge be constructed?	The submersible bridge is designed to facilitate community access to the left bank of the Nam Kathang. Widening the bridge, and allowing access for larger vehicles is likely to have an impact on natural resources used by the community on the left bank. It is recommended that the bridge width be restricted to prevent cars from crossing.	5.3 and 5.4
What will be the implications for the irrigation outlet? What is the design?	Construction of the spillway will require removal and reconstruction of the irrigation canal and outlet. NTPC is committed to redeveloping the facility and is currently designing the structure for incorporation into Project development. The design is likely to involve a culvert under the crest of the spillway.	2.4 and 2.5

Comment	How this was addressed in the IEE	IEE Report Section Ref.
Please provide more detail on spoil and spoil areas. If possible, it would be good to reuse the spoils in government infrastructure improvement.	This is provided in the IEE. Total spoils are expected to be 200,000 m ³ . The spoil sites are under investigation, taking in to account potential impacts regarding the transportation of the spoils to dumping sites. The height of the spoil sites will not be greater than 6m with erosion control and 20-30m away from residential areas. There will be land levelling and restoration / re-vegetation.	5.4
	The use of spoil soil in any construction or agricultural purposes will be based on the suitability of the soil. Further application of the spoils by third parties will be considered. Any 3 rd party use of spoils will need to be properly managed.	
Any possibility to build a small fish pond / catchment for the villagers from the overflow water?	Construction of a fish pond is not being considered.	-
Disease prevention hasn't been presented – i.e. The prevention of diarrhoea that results from drinking contaminated water.	Health and safety aspects are considered in the IEE. Key issues include community safety during the construction phase (i.e. access to sites, transportation etc.).	5.3 and 5.4
The ESMP section should consider the organisation arrangements for E&S monitoring including the EMO and EMU. A budget should be provided.		
Report update requirements: Inclusion of institutional arrangements for environmental and social management and monitoring. Inclusion of budget for monitoring in the ESMMP section. This will enhance capacity building of the technical staff as well.	Report has been updated	6.1, 6.3 and 6.4
Chair closing remarks: The IEE is very informative and comprehensive including environmental management plans and mitigation measures and detailed public consultations. The IEE requires updating in terms of institutional arrangement, monitoring plan and a budget for monitoring in the ESMMP section.	Report will be updated and submitted to PONRE.	-

Comment	How this was addressed in the IEE	IEE Report Section Ref.
the IEE report before PONRE issues the certificate.		

Village

Table 7-5 Village: Key comments and relevant IEE actions

Comment	How this was addressed in the IEE	IEE Report Section Ref.
Impacts on community water supply / community water use during construction	Surface water hydrology is not expected to be impacted. Water quality mitigation measures are recommended to minimise impacts to downstream receiving waters	5.3 and 5.4
 Water contamination during construction and no access to clean water. For example: The Female group from Ban That expressed concern regarding water-borne diseases from contaminated water; and The Male group from Ban That expressed concern over hydrocarbon spillage in Nam Kathang and impacts on aquatic organisms. 	 Implementation of erosion and sedimentation control facilities; Water treatment prior to discharge from workforce accommodation camps; Water quality control facilities to avoid / minimise potential for hydrocarbons spillage into Nam Kathang. 	5.3 and 5.4
Villager query regarding fishing rights during construction.	The IEE does not address villager prohibition from fishing the Nam Kathang during construction. Villagers will be allowed to fish downstream of construction activity but will have to consult with the contractor when seeking to fish in close proximity to construction activity.	-
Villagers from Ban Sangkeo, Ban Lao and Ban That expressed interest in using Project spoils for village infrastructure construction	The IEE does not indicate that spoils use for village construction is being considered. NTPC are required to dispose of spoils in a manner consistent with the Concession Agreement.	-
Male and female groups voiced concern over impacts on community land use, agricultural plantations, livestock and grazing areas, and cultural traditions	The Project will not impact community lands, agricultural lands, livestock and grazing areas or cultural traditions	5.3
Villagers of Ban That expressed concern over resource extraction	IEE indicates potential for additional resource extraction from temporary construction workforce and due to improved vehicular	Section 5.3

Comment	How this was addressed in the IEE	IEE Report Section Ref.
	 access to left bank of Nam Kathang. IEE recommends prohibition of resource extraction by construction workforce; and IEE recommends limiting the width of the bridge to prevent cars from crossing. 	
Male villagers from Ban Sangkeo and Ban Lao indicate that fair compensation should be provided where impacts affect community / agricultural lands	IEE assessment determines that the Project will not impact community land (including agricultural land), therefore compensation will not be required.	5.3
Villagers from Ban Sangkeo and Ban That request a permanent hanging bridge instead of a submersible bridge for left bank access year-round Villagers from Ban That request construction of more than one bridge for access to the left bank of Nam Kathang.	No crossings existed for the Nam Kathang in the Project Area prior to development of the Nam Theun 2 Project. Provision of the submersible bridge increases community access to left bank, though the bridge may be submerged for approximately 15 days/year.	5.3 and 5.4
Villagers from Ban Lao requested that the Project assist in village hall construction, access roads, primary school construction and bore installation. Villagers from Ban Sangkeo request Project development of a fish pond.	The IEE finds no anticipated impacts to community lands, therefore does not recommend development of community infrastructure.	5.1 and 5.3
Concern regarding accidents due to speeding and increased traffic	 NTPC will: Ensure implementation of road signs and speed reduction bumps, as applicable; Ensure respect of signs, speed limits, and parking areas by project drivers; and Monitoring of traffic safety. 	5.4 and 6.2
Villagers from Ban Sangkeo, Ban Lao, and Ban That (particularly Male groups) indicated perceived benefits to local economy and job opportunity from Project construction. Villager from Ban Sangkeo request local hiring and training.	The IEE briefly discusses the potential fiscal benefit to local communities through increased vendor sales to construction workforce and potential for hiring and skills development of local villagers.	5.3
Villagers from Ban Lao, Ban Sangkeo and Ban That indicate a benefit from construction of the permanent bridge for construction.	IEE discusses benefit of bridge construction in the impact assessment.	2.6 and 5.3



Plate 7-1 Village Consultation in Ban Sangkeo (Male Group), Jan 2014



Plate 7-2 Village Consultation in Ban Sangkeo (Female Group), Jan 2014



Plate 7-3 Village Consultation in Ban Lao (Female Group), Jan 2014



Plate 7-4 Village Consultation in Ban Lao (Male Group), Jan 2014



Plate 7-5 Village Consultation in Ban That (Male Group), Jan 2014



Plate 7-6 Village Consultation in Ban That (Female Group), Jan 2014



Plate 7-7 Provincial / District Consultation in Thakhek, Feb 2014



Plate 7-8 Provincial / District Consultation in Thakhek, Feb 2014



Plate 7-9 Village Consultation in Ban Lao, April 2014



Plate 7-10 Village follow up Consultations in Ban Lao, April 2014



Plate 7-11 Village follow up consultations in Ban Sangkeo, April 2014



Plate 7-12 Village follow up consultations in Ban That, April 2014

7.4.3 Continuing Consultation

Stakeholder Management

NTPC will continue to conduct ongoing open and transparent information disclosure and consultation with stakeholders as the Project progresses in accordance with its obligations under the CA, Lao PDR Law and international standards and best practice (see Section 3).

NTPC's ECU (within the HSE Department) will be responsible for engaging local communities. The ECU will regularly, both formally and informally, consult with and listen to individuals, community representatives, government agencies, and non-profit organisations affected and/or interested in the Company's activities.

The ECU will also act as a conduit for local people to gain information about Project activities, as well as to air any concerns or grievances. The ECU will ensure that community consultations involve a cross-section of local residents (i.e. different ethnicities, a range of ages, gender balance, etc.) to ensure that the opinions and concerns of all groups are considered.

Grievance Management

A Grievance Management Procedure will be re-activated by the Resettlement Management Unit and PONRE with support from NTPC.

The GRP will be reactivated by RMU on past experiences. The RMU funding will continue into 2015 and will be sourced with additional funding to reactivate the former district working group or people who have been involved in the grievance procedures during the Project Lands operations. The past GRP have been entirely operated through GOL with some assistance by NTPC.

A framework for the Grievance Management Procedure is provided in Figure 7-1 below. This procedure will provide four levels (steps) of grievance redress - community, district, provincial and the Lao PDR courts. Each step requires the timely investigation and proposed and costed resolution of the grievance. The procedure encourages the early, efficient and cost effective resolution through collaboration between the company, government and affected parties during the early stages of the grievance process. Levels 1-3 allow for the escalation of grievances if a resolution cannot be reached. The Lao courts provide a final avenue for grievance redress.



Figure 7-1 Grievance Framework (source NTPC SDP 2005)

8 Conclusions

With the onset of extreme storm events, NTPC will shut-down Power generating operations, preventing the discharge of Nakai Reservoir water to the Regulating Pond. Input to the Regulating Pond would then be exclusively derived from the Nam Kathang catchment. The implementation of the Regulating Dam free-flowing spillway would provide for discharge of Regulating Pond water into the Nam Kathang when the Regulating Pond exceeds Full Supply Level. This will protect the geotechnical integrity of the Regulating Dam wall and thus prevent catastrophic dam failure that would jeopardise the lives and livelihoods of those downstream of the Regulating Dam. Thus, the primary impact from Project implementation would be a beneficial one.

In the event of spillway operation, the downstream surface water volume in the Nam Kathang will be equivalent to floodwaters that would naturally occur in such an extreme rain event (i.e. > 1,500 year ARI) because input during flood events will be limited to Nam Kathang catchment water.

Construction of the spillway will require prohibition of Nam Kathang crossing over the Regulating Dam crest, as a safety precaution. NTPC will therefore construct a temporary bridge for the construction period, and a permanent submersible bridge following construction, for villagers. Access for villagers will be provided via this bridge all year long except 15 days, since the design of the bridge is expected to provide for safe crossing when the River is flowing < 36 m^3 /s. A system to lock the access upon order from NTPC will be implemented during the rainy season to prevent people from crossing when the flow is likely to submerge the crossing (NTPC will send a contracted person to close the access prior to opening the gates at a discharge exceeding 36 m^3 /s). If necessary, a guard will be appointed to enforce this measure.

Project related impacts are expected to be minor and will mostly be confined to the construction phase and immediately following construction until landforms have stabilised and vegetation is established. The majority of construction will occur on highly degraded land, namely spoils deposition areas from previous Nam Theun 2 construction work and on currently developed access roads. Some vegetation clearance will be required for construction of the permanent access bridge across the Nam Kathang and vegetation that has established on previous spoils deposition areas will require replanting.

Construction Phase

The potential negative impacts resulting from Project implementation would most likely be associated with Project construction, including the following:

- Elevated erosion of land surfaces from vegetation clearance and earthworks and associated sediment transport and deposition in the Nam Kathang;
- Impaired habitat for aquatic organisms downstream of Project construction, including spawning and rearing habitat;
- Potential direct impacts to aquatic species derived from elevated suspended sediment (e.g. impaired respiratory function (gills), difficulty locating prey); and
- Impacts to beneficial uses of Nam Kathang for downstream users (pending the severity of impacts to aquatic biodiversity and water quality).

If not properly mitigated, additional water quality impacts may include:

• Increased nutrients and pathogens associated with the workforce accommodation facility; and

• Stream pollution from oil/grease from construction vehicles;

Immigration associated with hiring the construction workforce may impact resources in the region, including:

- Increased fishing in local streams, potentially impacting fish populations; and
- Collection of Non-Timber Forest Projects.

NTPC has provided a framework for mitigating potential impacts during construction that are expected to reduce residual impacts to less than significant. NTPC will re-institute the Contractor EMMP, which was developed to mitigate and monitor construction phase impacts in accordance with the Project Concession Agreement and applicable national and international statutory requirements. Volumes A and B of the EMMP (the Master Plan and Sub-Plans, respectively) will be reinstituted, while Volume C – which is comprised of Site Specific Environmental Plans (SSEPs) will be developed to identify mitigation and monitoring strategies for site-specific physical, biological and social characteristics of each construction area to avoid, minimise and mitigate impacts.

NTPC will monitor construction phase impacts. The NTPC Environmental Compliance Unit (ECU) will be responsible for Contractor compliance with the Contractor EMMP and SSEPs.

Operations

During a major flood, the Regulating Dam will dampen the natural flood by evacuating part of the flood in the Downstream Channel (the powerhouse is stopped during such an event).

The discharge flowing in the Nam Kathang riverbed downstream of the Regulating Dam (with less discharge into the Nam Kathang than from a natural flood due to discharge to the DSC), will be evacuated through the existing gates and the future spillway.

A siren is activated prior to the gates opening, even for very small discharges (a few m³/s). This siren can be heard at the area where the permanent Nam Kathang Crossing will be implemented.

NTPC already has a system in place to notify downstream inhabitants in the event of potential flood events. According to the *OIP Regulating Pond Water Release Warning Communication System* (2013); the *Regulating Dam Water Release Warning Communication System* (RWWS) is enacted when Regulating Pond discharge reaches 150 m³/s.

The RWWS requires NTPC to notify government counterparts in the Gnommalath District (District Coordinator) when current Regulating Pond discharge reaches 150 m³/s and further notifies the Coordinator for every incremental release equal to or greater than 100 m³/s (i.e. 250 m³/s, 350 m³/s, 450 m³/s, etc.). For notification of flood cessation, NTPC notifies GOL only when the release is less than 40 m³/s and no heavy rain is forecasted for the next 24 hours.

According to the RWWS, the NTPC Flood Foreman (on-duty at Regulating Dam) notifies the NTPC Flood Manager (on-site). The Flood Manager notifies the Gnommalath District Coordinator. The District Coordinator notifies Downstream Village Coordinators (GOL responsibility). The Downstream Village Coordinators have been selected for 28 villages, including applicable villages on and near Nam Kathang.

Mitigation Measures

MItigation measures for the effective management of potential environmental and social impacts include:

- 1. Ensure that there is no cessation of flow in Nam Kathang during construction to protect the viability of downstream aquatic habitat;
- 2. Ensure villagers of Ban Sangkeo, Ban That and all other villages bordering the Nam Kathang are contacted 3 to 4 months in advance of the spillway becoming operational to provide information

regarding the updated flood warning system. It should be noted that the new spillway will discharge water only after the existing gates are fully open (i.e. when the flow in the Nam Kathang riverbed is already approximately 1,250 m³/s);

- 3. Ensure that villagers of Ban Sangkeo, Ban That and all other villages bordering the Nam Kathang are warned when a flood occurs and are prevented from crossing the permanent Nam Kathang crossing before its submersion.
- 4. Limit the width of the permanent bridge to prevent access to cars and light trucks that may otherwise accelerate potential for resource extraction from the left bank of Nam Kathang (e.g. timber, non-timber forest products, hunting, etc.);
- 5. Prohibit construction personnel from fishing local waters, hunting, collecting forest resources, and trade, transport and consumption of wildlife products;
- 6. Conduct major earthworks and implement erosion and sedimentation facilities during the dry season and revegetate all disturbed landforms during the first weeks of the rainy season;
- 7. Ensure that spoils are not placed within 50 metres of the Nam Kathang and downstream channel, as per the CA and EMMP.
- 8. Identify, clearly mark, and construct fencing around the three threatened trees (two species) in the primary spoils deposition area. These individuals, at the edge of the riparian vegetation, are expected to be outside of the spoils deposition area, but could be impacted during permanent bridge construction or spoils deposition. If impacts are unavoidable, these trees should be transplanted to a suitable location outside of the proposed Project footprint;
- 9. Progressively rehabilitate and plant disturbed areas as soon as their use is no longer required (during appropriate seasons as per recommendation #5);
- 10. Ensure aspects of the Owner Engineer and Construction Contractor Environmental Management and Monitoring Plans are updated according to Project specific features, including development of Site Specific Environmental Management and Monitoring Plans that incorporate all requirements of the Concession Agreement, Owner's Requirements and the EMMPs.

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