Initial Environmental Examination

Project Number: 41924-014
July 2015

Nam Ngiep 1 Hydropower Project
(Lao People's Democratic Republic)

Initial Environmental Examination of Preliminary Works for the Houay Soup Resettlement Area

Prepared by Earth System on behalf of Nam Ngiep 1 Power Company Limited for the Asian Development Bank

Initial Environmental Examination of Preliminary Works for the Houay Soup Resettlement Area

FINAL

Prepared for

NAM NGIEP 1
POWER COMPANY

By

EARTH SYSTEMS
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June 2015

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Contents

0 EXECUTIVE SUMMARY

0.1 Introduction

NNP1 has received a concession agreement (CA) from the Government of the Lao PDR to build and operate the "Nam Ngiep 1 Hydropower Project" (NN1HP) in Central Lao PDR.

This Initial Environmental Examination (IEE) has been prepared by Earth Systems on behalf of the Nam Ngiep 1 Power Company (NNP1) to identify and assess the potential environmental and social impacts of the proposed Preliminary Works for the Houay Soup Resettlement Area (HSRA) (hereafter 'the HSRA Preliminary Works).

The HSRA is located on the right bank of the Nam Ngiep River, directly downstream of the Project re-regulation dam. A Draft IEE for the development of the HSRA was prepared by Lao Consulting Group in September 2014. This report is now subject to significant revision and is expected to be completed in August 2015.

To maintain the resettlement schedule, HSRA Preliminary Works are required. This includes:

- The construction and maintenance of:
  - two (2) barge landings (left and right bank)
  - a 1.1km New Temporary Access Road
  - a 3.1 km Existing Road Upgrade;
  - one (1) bridge abutment (left bank); and
- The operation of a barge during the HSRA construction phase.

0.2 Key Findings

Key findings of this IEE include:

- The proposed HSRA Preliminary Works footprint totals 10.23 ha and is located on the land of Ban Hat Gniun (including Ban Hatsaykham sub-village). The area is relatively remote and the Works do not affect any village settlements or permanent structures. The HSRA Preliminary Works will have only minor impacts on swidden agriculture areas owned by individual villagers including young / old fallow areas (6.66 ha) and cultivated land (0.46 ha).
- Consultation activities conducted with villagers from Ban Hatsaykham and Ban Hat Gniun has confirmed villager's acceptance of the HSRA Preliminary Works. Land and asset surveying for the HSRA has been conducted however compensation negotiations are on-going
- No National Biodiversity Conservation Areas (NBCAs) or international protected areas (i.e. Ramsar Wetlands) will be impacted by the HSRA Preliminary Works. The Nam Ngiep Nam Mang National Protected Forest is located in close proximity to the Works but it not directly impacted.
- No Critical habitat or Natural habitat will be cleared or impacted by the HSRA Preliminary Works. Approximately 6.85 ha of Modified habitat will be cleared, mostly consisting of young fallow.
- A small number of the globally Endangered *Anisoptera costata* may be removed or disturbed, but this is highly unlikely to impact the local, regional or global population, as the species is secure

elsewhere in the region. No threatened fauna species will be directly impacted, although small-scale impacts to vegetation / habitat may indirectly affect fauna in the area.

- The Barge Landings and the Bridge Abutment will be built on the banks of the Nam Ngiep River. The temporary roads will cross three (3) streams. A barge will operate on the Nam Ngiep River. These activities and ancillary infrastructure (i.e. work camps) have the potential to impact hydrology, water quality and aquatic habitat and aquatic biodiversity / fisheries. Major incidents (i.e. oil spills, capsized barges) concerning the barge crossing, while unlikely, could potentially lead to significant impacts.
- A number of the facilities (i.e. Bridge Abutment and New Temporary Access Road) will be utilised / upgraded for the permanent access to the HSRA. However other facilities (i.e. Barge landings and Existing Road Upgrade) will only be used until permanent access to the HSRA is established. These facilities will require appropriate decommissioning.

0.3 Key Recommendations

Management and mitigation measures for the NN1HP construction are outlined in NNP1's Environmental and Social Management and Monitoring Plan for the Construction Phase (ESMMP – CP) (ERM Dec 2013). The ESMMP-CP considers road and ancillary construction and provides comprehensive measures to avoid or minimise impacts for the HSRA Preliminary Works. Relevant measures from the ESMMP-CP are required to be implemented.

Before commencement of this HSRA Preliminary Works it is recommended that NNP1:

- Complete compensation activities for all components of the HSRA Preliminary Works;
- Ensure that the contractor prepares a Site Specific Environmental and Social Monitoring Plan (SS-ESMMP) addressing requirements outlined in this IEE.

1 INTRODUCTION

This Initial Environmental Examination (IEE) has been prepared by Earth Systems on behalf of the Nam Ngiep 1 Power Company (NNP1) to identify and assess the potential environmental and social impacts of the proposed HSRA Preliminary Works for the Houay Soup Resettlement Area (HSRA) (hereafter 'the HSRA Preliminary Works).

1.1 Background

NNP1 has received a concession agreement (CA) from the Government of the Lao PDR to build and operate the "Nam Ngiep 1 Hydropower Project" (NN1HP) in Central Lao PDR. The NN1HP involves the construction of a hydropower dam (272MW) and re-regulation dam (18MW) on the Nam Ngiep River.

Up to 750 households from seven (7) villages are expected to require relocation. The HSRA is the designated resettlement site and is located on the right bank of the Nam Ngiep just below the NN1HP's re-regulation dam (see Figure 1-1). Resettlement is due to commence in early 2016.

The HSRA was included as part of the Project's Environmental Impact Assessment (EIA) (KEPC et al 2012), Social Impact Assessment (SIA) (KEPC et al 2012) and Resettlement Action Plan (RAP) (KEPC et al 2012). These documents were approved by the Ministry of Environment and Natural Resources (MONRE) and an environmental compliance certificate (ECC) was issued.

The EIA, SIA and RAP were revised by NNP1 in 2014 to ensure compliance with ADB's Safeguards Policy (2009). The revised SIA (NNP1 2014) and Resettlement and Ethnic Development Plan (REDP) (NNP1 2014) provided additional assessment and management measures for the development of the HSRA. However the revised EIA (ERM May 2014) did not provide similar detail. The HSRA design has also been updated. As a result, the ADB has requested that an Initial Environmental Examination (IEE) of the HSRA be conducted. This is currently being prepared, as an addendum to the Project's EIA and is expected to be completed in September 2015.

In the interim, preliminary works are required to ensure the timely commencement of the main HSRA construction works, expected in November 2015. This IEE has been prepared to provide an assessment and management / mitigation measures for the HSRA Preliminary Works. This IEE is an Addendum to the approved EIA and its safeguard measures are consistent with the updated EIA (ERM, 2014) which abides by ADB Safeguard Policy Statement (2009).

1.2 Objectives and Scope of the IEE

The objectives of this investigation are to:

- Characterize physical, social and biological features associated with the HSRA Preliminary Works;
- Assess the potential environmental and social impacts of the HSRA Preliminary Works during construction and operations; and
- Propose corrective actions to avoid, minimise and mitigate the identified impacts during construction and operations.

1.3 HSRA Preliminary Works Developer and IEE Consultant

1.3.1 Nam Ngiep 1 Power Company

NNP1 is owned by Kansai Electric Power Co. Inc. (Kansai Electric); the Electricity Generating Authority of Thailand (EGAT) International Co. Ltd; and Lao Holding State Enterprise. The Company is headquartered in Vientiane, Lao PDR. The owners of NNP1 have extensive experience in the design, construction and operation of large-scale hydroelectric power projects.

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1.3.2 Contractors

Obayashi Corporation (OC) is the Head Contractor for the NN1 HPP. Chalern Savan Road and Bridge Construction Co Ltd will construct the HSRA Preliminary Works infrastructure.

1.3.3 Earth Systems

The Earth Systems Group is a multidisciplinary environmental and social consulting firm. Earth Systems has been operating in Lao PDR for more than 15 years and is a registered EIA consultant with the Department of Environmental and Social Impact Assessment, MONRE.

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1.4 Methodology

Earth Systems undertook the following activities to complete this investigation:

- Literature review drawing on the NN1HP EIA (ERM 2014) and studies conducted for the Draft HSRA IEE (LCG 2014) to provide background information on the HSRA Preliminary Works area;
- Detailed desk-based analysis of the proposed HSRA Preliminary Works utilizing high-resolution satellite imagery (2014);

- Consultation with local government (PONRE) and local communities to gain necessary permissions and collect background information about the area;
- Conduct of rapid consultations and field exercises with representatives from local communities to collect information on the physical, biological, social and cultural characteristics of the HSRA Preliminary Works area;
- Mapping of land use and biodiversity values potentially affected by the HSRA Preliminary Works; and
- Preparation of the IEE Report utilising the ADB IEE format.

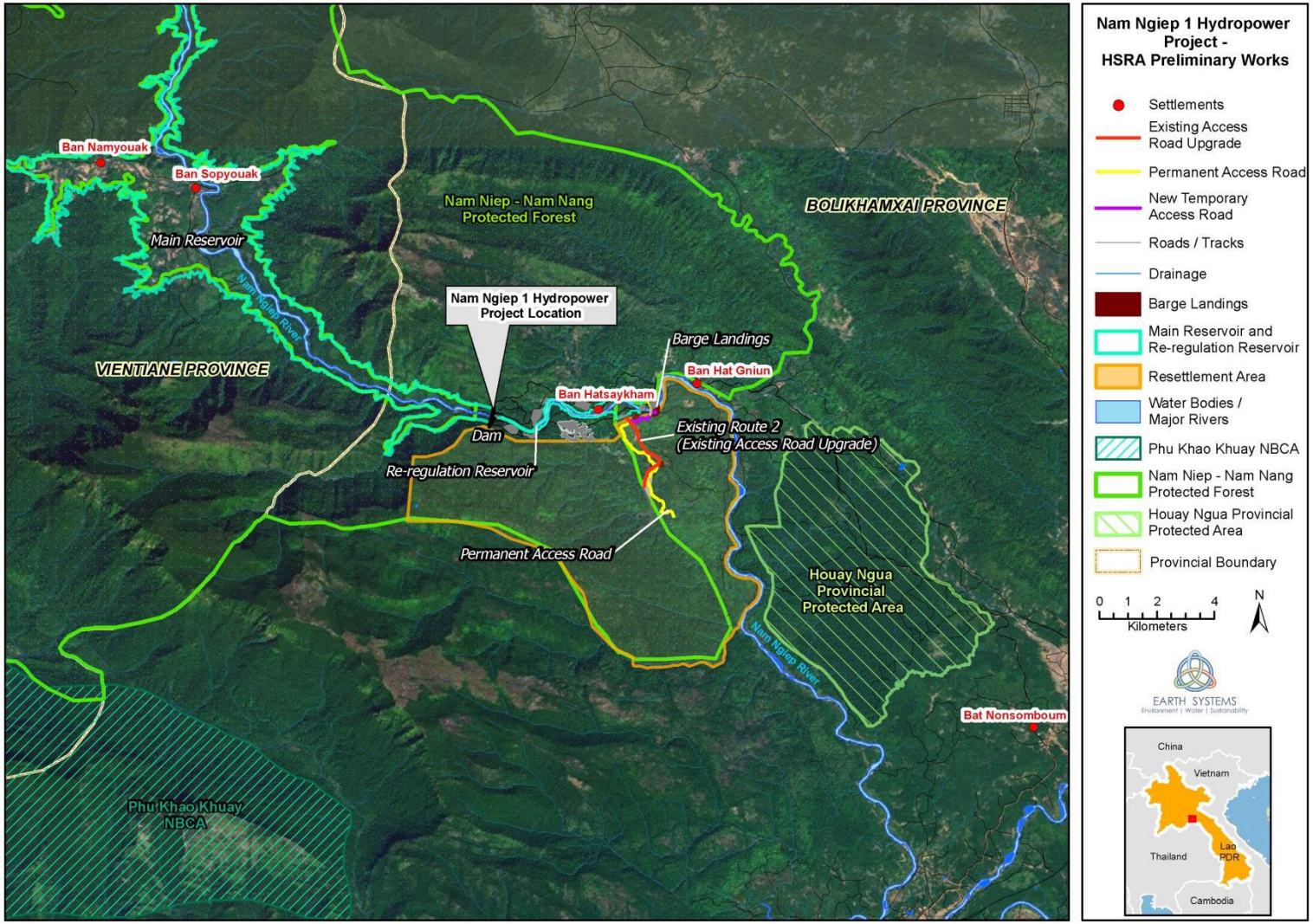

Figure 1-1 HSRA Preliminary Works Location

2 DESCRIPTION OF THE HSRA PRELIMINARY WORKS

2.1 HSRA Preliminary Works Location

The NN1HP is located in Xaysomboune and Bolikhamsay provinces, central Lao PDR. The HSRA (and HSRA Preliminary Works) is located on the right bank of the Nam Ngiep River, directly downstream of the NN1HP re-regulation dam in Bolikhan district, Bolikhamsay Province (see Figure 1-1).

2.2 HSRA Preliminary Works Description

HSRA Preliminary Works are outlined in Figure 2-1 and include:

- New Temporary Access Road (1.1 km) - Unpaved compacted road with surface shaping and drainage ditch. The road will be cut through a sloped area and will run in parallel with a small ephemeral stream (Houay Kee Hia) above. A pipe culvert will be installed where the stream crosses the road.
- Existing Access Road Upgrade (3.1 km) – An existing rural track which will be upgraded to an unpaved / paved compacted road (see Plates 2.3 and 2.4). The road passes through a lowland area and crosses one (1) perennial (Houay Soup Noy) and one (1) ephemeral stream (Houay Na). In a number of places the road will be backfilled and gravel pavement will be used. A v-shaped drainage system will be installed. Gabion boxes will be placed in sensitive areas. Pipe culverts will be installed in four locations.
- Barge landings (Left and Right banks) – The left bank landing will connect to the existing NN1HP road infrastructure. The right bank landing will connect to the proposed temporary access road. Stone / compacted gravel landings will be established on the left and right banks of the Nam Ngiep River. The sites will be excavated and large stones will be used to construct the landing and for slope protection. A 10 cm gravel pavement will be used to surface the landing. (See Plates 2.1 and 2.2);
- Bridge Abutment – An abutment for the permanent bridge will be constructed on the left bank. This will include an earth / rock fustrum slope with stone masonry reinforcement (see Plates 2.5 and 2.6).

A barge will be operated across the Nam Ngiep River, between the two Barge landings. The type of barge and its operation will be confirmed once tendering for this service has been completed.

Ancillary infrastructure will include:

- The development of work camp / stock yard, borrow area and batching facilities at the TCM / Song Da camp site on the left bank of the Nam Ngiep. Existing quarries will also be utilised.[1]
- The development of a work camp and stockyard on the old UXO camp site within the HSRA; and
- The development of two (2) new borrow areas - Borrow pit #1 near the re-regulating dam and borrow pit #2 in the HSRA.

[1] These facilities are included under the Main Project EIA and ESMMP-CP.

2.3 HSRA Preliminary Works Design

2.3.1 Design Characteristics

A Detailed Works Program (DWP) has been developed for the HSRA Preliminary Works (Charleurn May 2015). Design information for the components of the HSRA Preliminary Works is outlined in Table 2-1.

Table 2-1 HSRA Preliminary Works Components

Components / Design Features	Description
New Temporary Access Road	
Type	Unpaved / Compacted
Length	1.1km
Width	3.5m
Right of Way (RoW)	10 m
Site Clearance	3,900m^2
Soil Cutting	8,932m^3
Surface shaping (Tractor)	3,300m^2
Pipe Culvert installation; Dia. 400mm	1 x 36m
Existing Access Road Upgrade	
Type	Unpaved (part gravel) / Compacted
Length	3.1km
Width	3m
Right Of Way (RoW)	10m
Install Pipe culvert Dia. 40mm (4 locations)	12m
Back filll and Compaction, Total Length over 4 Areas=400m, Width=3m	998.96m^3+
Gravel Pavement, Total Length over 4 Areas=400m, Thickness=10cm	112m^3+
Install gabion boxes 4m width, 22m long	92m
Both Sides Slope protection by Big Stone	1 Large Stone
Re-surface the Route with 3m width, 400m long and Compaction, including V-shaped drainage system either side 2750m	7,920m^2
Left Bank Barge landing (Hatsaykham Side)	
Type	Stone / compacted gravel
Area	80 m^2
Site Clearance	960m^2
Surface Excavation	2,224m^3
Gravel Pavement (t=10cm thickness) with compaction	40m^3
Slope Protection by Big Stone (in place materials)	1 Large Stone

Components / Design Features	Description
Making drainage by stone Masonry (in place materials)	1 Large Stone
Right Bank Barge landing (Houay Soup Side)	
Type	Stone / compacted gravel
Area	120 m^2
Site Clearance	635m^2
Surface Excavation	236m^3
Backfill by excavated soil and Compaction	362m^3
Gravel Pavement (t=10cm thick) and Compaction	49.60m^3
Bridge Abutments	
Type	Earth / Rock Fustrum Slope
Width	7m at crest, 11m at base
Length	approximately 34m
Materials	Earth / Rock with Stone masonry reinforcement (10m)
Ancillary	
Workers Camp / workforce	Work camp / stockyard for road construction will be located in the HSRA at the old UXO camp site. Workforce is estimated at 20 workers. Work camp / stock yard, borrow area and batching plant for bridge abutment will be located on TCM / Song Da camp site.
Borrow Pits	Two (2) new borrow areas will be developed in the HSRA. An existing borrow area near TCM will also be utilised.

2.4 HSRA Preliminary Works Schedule

The construction of the HSRA Preliminary Works is expected to commence in July 2015. Operation of the barge and use of the preliminary access facilities are expected to commence in July 2015 and continue until permanent access to the HSRA is completed (expected in Q1 2016). This will include conversion of the preliminary access road to form a section of the permanent access road and the decommissioning of the Barge landings (left and right bank) and the remainder of the temporary access road.

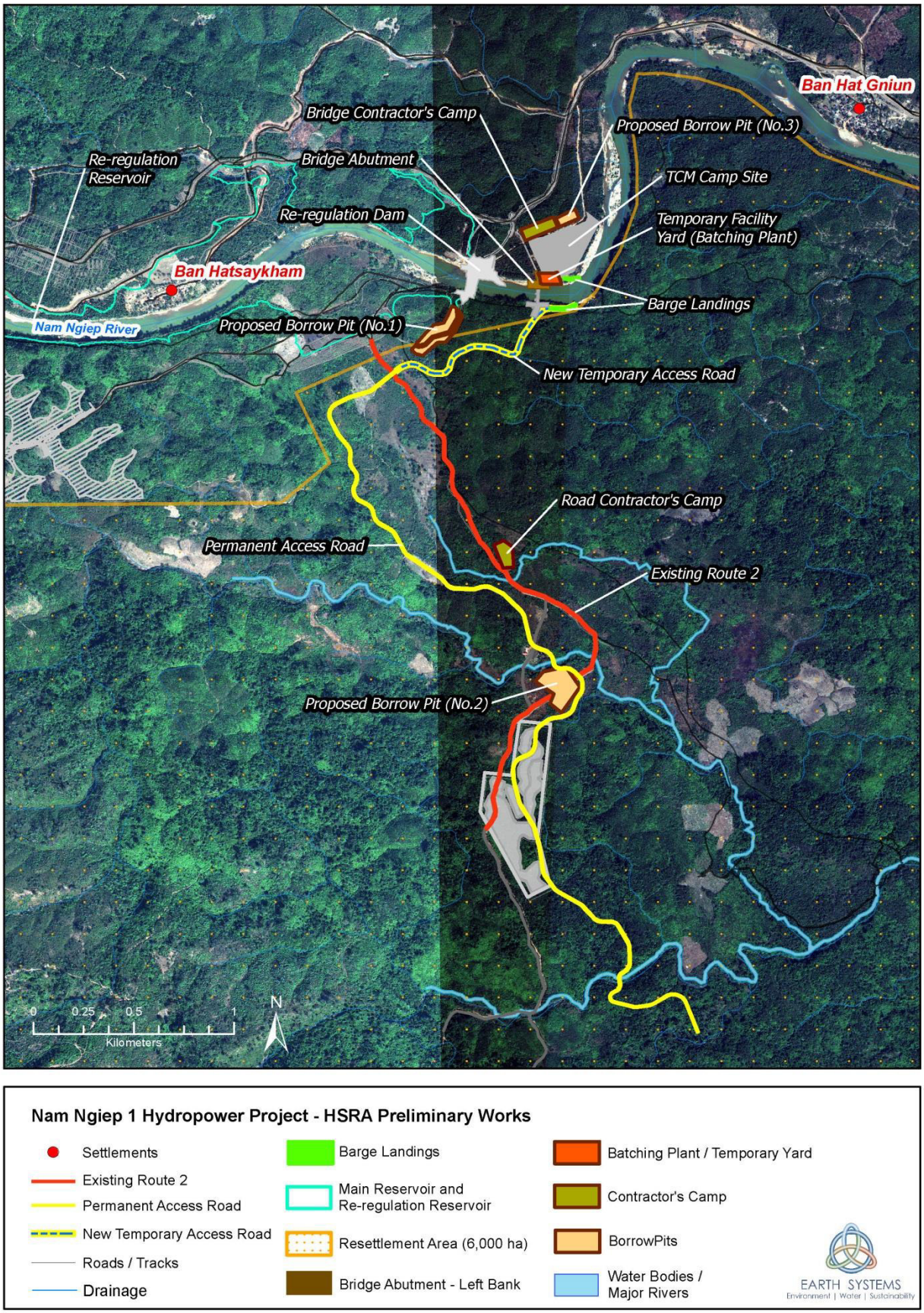

Figure 2-1 HSRA Preliminary Works Layout

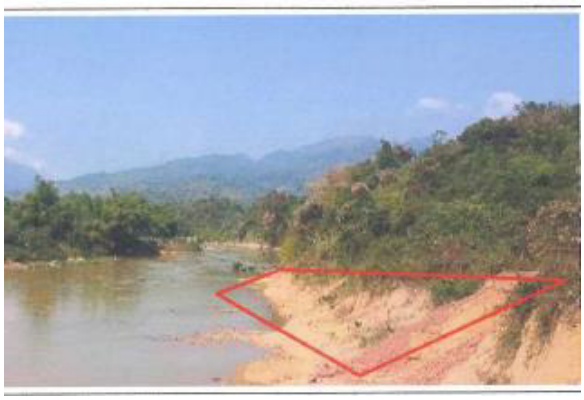

Plate 2-1: Left bank Barge landing location

Plate 2-2: Right bank Barge landing location

Plate 2-3: Existing access route

Plate 2-4: Proposed upgraded access road

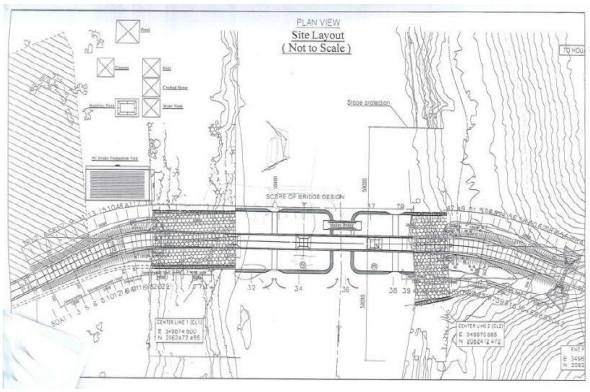

Plate 2-5: Permanent bridge design showing left bank abutment (on the right) (Source NNP1)

Plate 2-6: Example of the proposed Bridge Abutment

2.5 HSRA Preliminary Works Alternatives

2.5.1 Alternative Access Route

An alternative access route location was considered (see Figure 2-2). This involved the construction of the barge landing and access road upstream of the re-regulation dam and dyke.

The preferred barge crossing and access route alternative, as outlined above, is located close to the permanent bridge and the majority of the temporary access road route is intended to be used for the permanent access road – thus limiting environmental and social impacts associated with road construction.

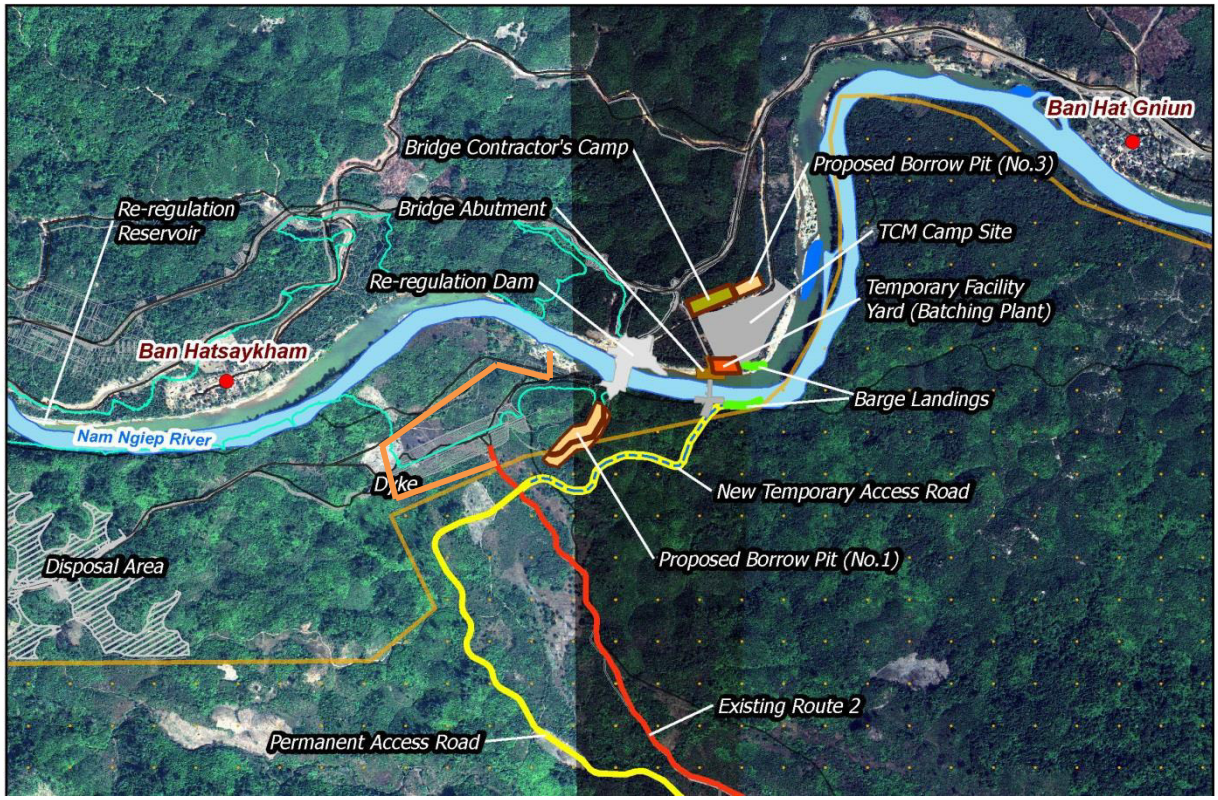

Figure 2-2 Alternative Route (in orange) (source NNP1)

2.5.2 No Project Alternative

The 'no project' alternative (i.e. no temporary barge and access road development / upgrades) would result in limited access to the HSRA during the wet season and would prevent timely development of resettlement infrastructure and resettlement of NN1HP affected people.

3 DESCRIPTION OF THE ENVIRONMENT

3.1 Physical Components

3.1.1 Atmosphere and Climate

The HSRA - HSRA Preliminary Works is located in Bolikhamxay Province. The region is typified by a south-western monsoon climate of pronounced wet and dry seasons. The wet season occurs between May and October with rainfall ranging from 3.7 to 67.5 mm per month. Average daily maximum temperatures occur most often in April (37°C), with the heat usually abating by mid-May. The northeast monsoon brings overall cooler and drier conditions from early November to March, with the driest and coldest months generally in December and January. Maximum temperatures during the dry season range from 25 to 36°C from November to April. Overnight temperatures can drop to 11°C. Historic meteorological data for the Nam Ngiep Basin from 1971 to 2000 indicates an average annual rainfall of 1,870 mm (NNP1PC Technical Report 2007). The seasonal variation of monthly rainfall follows the general pattern of the Southeast Asia monsoon, with about 90% of rainfall during the six month wet season from May to October.

3.1.2 Topography

The HSRA Preliminary Works area is located on the banks and flood plain of the Nam Ngiep River. The topography is characterised by lowland areas and undulating hills up to 285 metres above sea level. A number of perennial and ephemeral streams are present in the area (see Section 3.1.4).

3.1.3 Soils and Erosion

Information on soil characteristics in the HSRA Preliminary Works area was obtained from the National Agriculture and Forestry Institute (NAFRI). Acrisol soils dominate the area. Acrisols form on old landscapes in humid tropical climates. The age, mineralogy, and extensive leaching of these soils generally lead to poor fertility and often elevated aluminium concentrations. Acrisols in Lao PDR tend to be highly dispersive and therefore easily eroded. Evidence of soil erosion in the area was observed, particularly in areas where vegetation has been disturbed (i.e. on the left bank near the TCM camp).

3.1.4 Hydrology

The Nam Ngiep River is the dominant hydrological feature in the HSRA Preliminary Works area. A number of streams are also present:

- Houay Keehia (ephemeral);
- Houay Na (ephemeral); and
- Houay Soup Noy (perennial).

Plates 3.1 to 3.4 show these waterways and their flow in June 2015.

3.1.5 Surface and Ground Water Quality

Recent water quality monitoring on Nam Ngiep River for the Project's access road construction monitoring indicated that water quality in the Nam Ngiep was generally good for the majority of parameters (NN1P Annual Report 2014) – see Appendix A.

In general, the physical parameters of pH levels, and EC, DO, Temperature and ORP concentrations were all within acceptable ranges and within Project standards. However, turbidity and TSS were moderately elevated, as can be expected during the rainy season. Oil and grease were found in samples from both upstream and downstream of the main dam site but concentrations were below Project guidelines.

On-going water quality monitoring for the construction phase of the NN1HP indicates that surface water in tributary streams tends to be of high quality for the majority of measured parameters.

Surface water in the catchment has been found to be near neutral pH (ranging from slightly acidic to slightly alkaline), with low electrical conductivity, high concentrations of dissolved oxygen, and very low concentrations of dissolved metals. Total metal concentrations of iron are often elevated, with low concentrations of dissolved iron.

Tributaries of the Nam Ngiep tend to have moderate to high concentrations of pathogens, generally measured as Total coliform, faecal coliform, and E. Coli.

Streams traversing vegetated areas tend to have low levels of Total Suspended Solids / Turbidity, though sediment loading increases during the rainy season and may be a significant issue downstream of areas cleared of vegetation or where earthworks have been recently conducted.

Plate 3-1: Nam Ngiep (Bridge Abutment)

Plate 3-2: Houay Keehia (New Temporary Access Road)

Plate 3-3: Houay Na (Existing Access Road Upgrade)

Plate 3-4: Houay Soup Noy (Existing Access Road Upgrade)

3.1.1 Protected Areas and Forests

The HSRA Preliminary Works footprint does not affect any internationally or nationally protected areas (e.g. Ramsar sites). However the Existing Access Road Upgrade is located in close proximity to the Nam Ngiep-Nam Mang National Protected Forest (PFA) (see Figure 1.1). PFA's are located in watershed areas / catchments and are managed to protect forest and water resources and reduce soil erosion.

3.1.2 Vegetation / Habitat Types

Three vegetative habitat types were identified within and around the footprint of HSRA Preliminary Works, with all three classified as *Modified habitat* (i.e. ADB Safeguard Policy Statement 2009).

- Old fallow,
- Young fallow; and
- Bamboo-dominated forest.

The field survey results indicated that all three habitat types were significantly altered by human activity (e.g. upland agriculture) and other disturbance (e.g. fragmentation, weeds and altered fire regimes), and should therefore be considered as *Modified habitat*. No *Natural habitat* types (i.e. with lesser levels of disturbance), were identified within or in close proximity to the HSRA Preliminary Works components.

Old Fallow

Old fallow is where secondary regrowth dominates; where native and non-native species have regenerated for at least 7 years after disturbance. The forest may retain structural and floristic similarities to the Natural habitats (e.g. canopy, understory), but is not readily classified as a particular recognised forest type. Although old fallow forest has been highly modified and is considered Modified habitat, it retains many native species and provides habitat for wildlife. Bamboo is common within the mid-storey (e.g. *Oxytenanthera albociliata*) and frequently occurs in large stands or clumps. Old fallow in the HSRA Preliminary Works area is species rich, with most species common and widespread throughout Lao PDR and Southeast Asia (see Table 3-1).

Plate 3-5: Old Fallow (New Temporary Access Road)

Plate 3-6: Old Fallow (New Temporary Access Road)

Table 3-1 Common species canopy, mid-storey, and understory in old fallow within HSRA Preliminary Works footprints

Structural Component	Scientific Name	
Canopy Tree height 5 - 10 m	*Anisoptera costata*	*Lagerstroemia sp.*
	Cratoxylum formosum var. pruniflorum	*Ormosia pinnata*
	Crypteronia paniculata	*Peltophorum dasyrrhachis*
	Haldina cordifolia	*Vitex pierrei*
	Irvingia malayana	*Vitex tripinnata*
Mid-storey Plant height ≥ 1.3 - 4.99 m	*Aporosa ficifolia*	*Grewia paniculata*
	Artocarpus chaplasha	*Maesa ramentacea*
	Cephalostachyum virgatum	*Mallotus barbatus*
	Ficus hispida	*Oxytenanthera albociliata*
	Glochidion sphaerogynum	*Vitex tripinnata*
Understorey or ground cover Plant height ≤ 1.3	*Acacia pluricapitata*	*Caryota mitis*
	Alpinia galangal	*Eurycoma longifolia*
	Ancistrocladus tectorius	*Halopergia blumei*
	Aralia armata	*Lygodium flexuosum*
	Ardisia elliptica	*Scleria terrestris*
		Selaginellla sp.

Young fallow

Young fallow occurs where land has been recently cleared (<7 years) and native and non-native species have begun to establish the site. Young fallow is highly modified, but may provide habitat for native species and was found to be relatively species rich in the HSRA Preliminary Works area (see Table 3-2).

Plate 3-7: Young Fallow (New Temporary Access Road)

Plate 3-8: Young Fallow (Existing Road Upgrade)

Table 3-2 Common or dominant species of young fallow within HSRA Preliminary Works footprints

Structural Component	Scientific Name	
Canopy Tree height 5 - 10 m	*Crataeva nurvala*	*Ormosia pinnata*
	Cratoxylum formosum var. pruniflorum	*Peltophorum dasyrrhachis*
Mid-storey Plant height ≥ 1.3 - 4.99 m	*Aporosa ficifolia*	*Macaranga denticulate*
	Artocarpus chaplasha	*Maesa ramentacea*
	Cephalostachyum virgatum	*Mallotus barbatus*
	Crataeva nurvala	*Nauclea orientalis*
	Cratoxylum formosum var. pruniflorum	*Ormosia pinnata*
	Duabanga grandiflora	*Oxytenanthera albociliata*
	Ficus hispida	*Peltophorum dasyrrhachis*
	Glochidion sphaerogynum	*Spondias lakhonensis*
	Grewia paniculata	*Trewia nudiflora*
	Lagerstroemia sp.	
Understorey or ground cover Plant height ≤ 1.3	*Acacia pluricapitata*	*Ixora stricta*
	Alpinia galangal	*Lygodium flexuosum*
	Ancistrocladus tectorius	*Maesa ramentacea*
	Aporosa ficifolia	*Mimosa diplotricha*
	Aralia armata	*Mimosa pigra*
	Ardisia elliptica	*Mimosa pudica*
	Cardiospermum halicacabum	*Passiflora foetida*
	Caryota mitis	*Ricinus communis*
	Chromolaena odorata	*Scleria terrestris*
	Crotalaria assamica	*Scoparia dulcis*
	Cyperus rotundus	*Selaginellla sp.*
	Eurycoma longifolia	*Senna hirsute*
	Evolvulus nummularius	*Senna occidentalis*
	Halopergia blumei	*Senna tora*
	Imperata cylindrical	*Solanum torvum*

Bamboo-dominated Forest

Bamboo-dominated forest occurs where land had been cleared and bamboo had regrown to form the dominant plant species within the mid-storey and understorey, with few other species present. To qualify as bamboo-dominated forest, the bamboo stands had to be greater than 0.1 ha. This definition should not be confused with *Natural habitat*. Bamboo-dominated forest in the HSRA Preliminary Works area has established dominance following major disturbance to the natural vegetative community and is thus classified as *Modified habitat*. Often this type of habitat occurred within the Nam Ngiep riparian zone.

Plate 3-9: Bamboo Forest (New Temporary Access Road)

Plate 3-10: Bamboo Forest (Existing Road Upgrade)

3.1.3 Land Use, Habitat Distribution and Quality

In total, 10.23 ha of land will be affected by the HSRA Preliminary Works (see Table 3-3)

In addition to the three *Modified habitat* types within the footprints of the HSRA Preliminary Works components, two other land use types were observed (cleared land, roads/tracks).

All habitat and land use types have been highly modified and are of poor quality. Old and young fallow represent the best habitat for flora and fauna, but this habitat is still highly disturbed and is of poor to moderate quality (e.g. canopy cover, connectivity).

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Table 3-3 Land use and habitat types within the HSRA Preliminary Works Footprint

Land Use / Habitat Type	Existing Access Road Upgrade	Jetty Area – Left Bank	Jetty Area – Right Bank	New Temporary Road	Bridge Abutment	Borrow Areas	Bridge Contractors Camp & Facility yard / Batching	Road Contractors Camp	Total
Cultivated Land	0.12			0.03		0.30			0.46
Old Fallow (mixed with Bamboo)	0.05			0.20	0.09	1.11			1.45
Young Fallow (mixed with Bamboo)	0.78		0.09	0.63		2.87		0.85	5.21
Bamboo dominated forest (modified)			0.04		0.16	0.00			0.20
Cleared Land		0.08				0.49	1.47		2.03
Road / Tracks	0.79					0.09			0.88
Total	**1.74**	**0.08**	**0.12**	**0.86**	**0.25**	**4.85**	**1.47**	**0.85**	**10.23**

Source: ES analysis (2005) of satellite imagery (imagery dated January 2014)

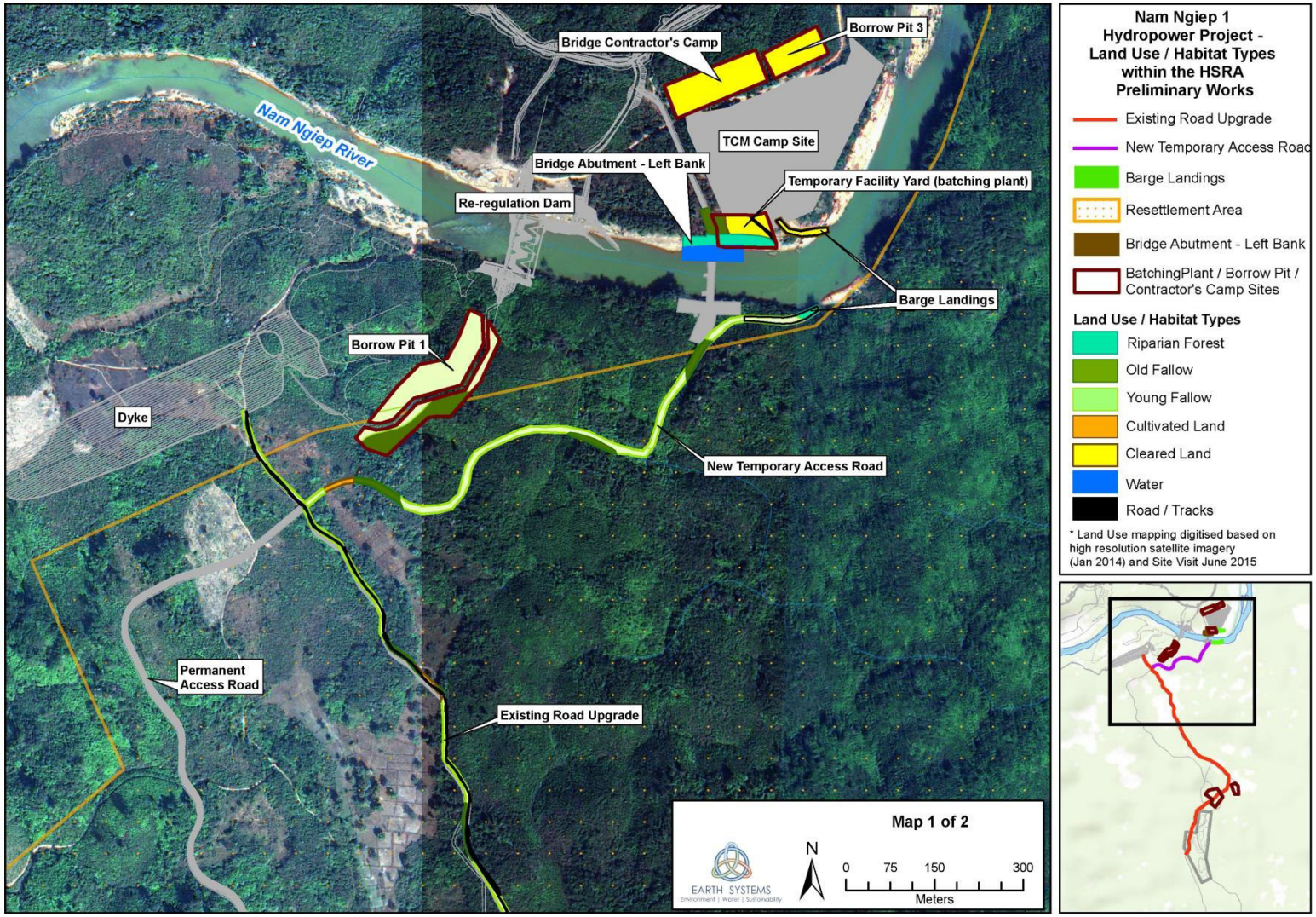

Figure 3-1 Land use and habitat types within the HSRA Preliminary Works footprint (A)

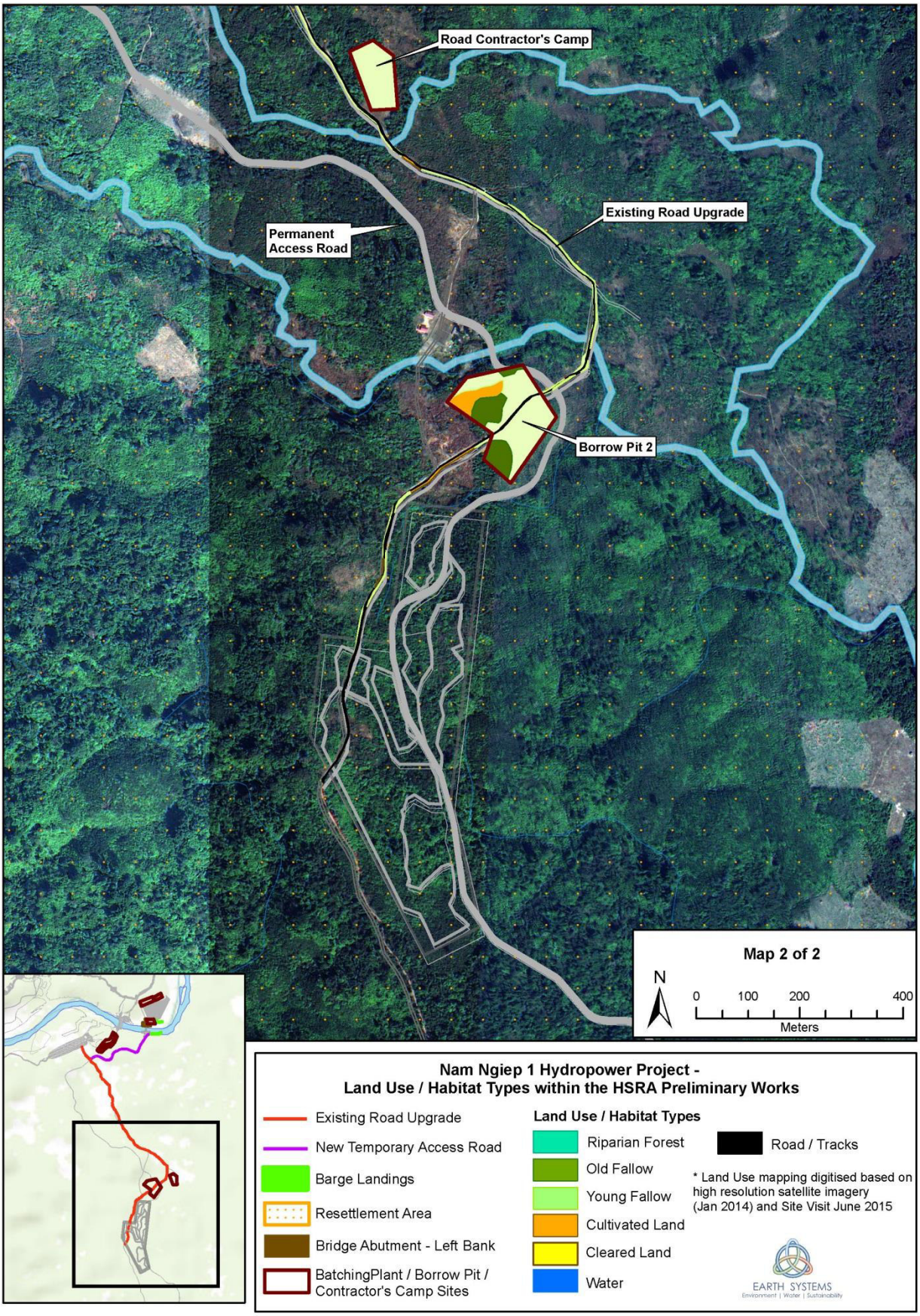

Figure 3-2 Land use and habitat types within the HSRA Preliminary Works footprint (B)

3.1.4 Terrestrial Flora

Fifty-four species of flora were recorded within the three habitat types identified within and near to the HSRA Preliminary Works footprints for the roads and Barge landings (Table A 1). These species were considered as being common or dominant species within their respective habitat types. Most species are common, widespread or secure within the region surrounding the HSRA Preliminary Works and/or Lao PDR. However, the majority of these species have not been assessed for their global conservation significance (i.e. IUCN Red List).

Three globally invasive species were identified within the HSRA Preliminary Works footprint (*Chromolaena odorata, Imperata cylindrica, Mimosa pigra*), while *Imperata cylindrical* is native to Asia it has become a particularly invasive weed in areas where it historically did not occur, such as Lao PDR (ISSG, 2015). The other two species are native to South and Central America. These three species are especially efficient at colonising areas that have been disturbed by fire, clearing, selective harvesting and other anthropogenic sources of disturbance. All three have been nominated as being among 100 of the world's most invasive plant species (ISSG, 2015).

A few economic and ecologically important species were identified in the surveyed areas (e.g. *Pterocarpus macrocarpus*). Only one globally threatened species was recorded within the surveyed footprints. *Anisoptera costata* is globally Endangered as it normally occurs on pristine land and is removed for agricultural conversion (IUCN, 2015). There is some discrepancy with respect to its history in Lao: Ashton (1998) does not consider *A. costata* as a native of Lao PDR while Inthakoun and Delang (2008) list it among natives. The large tree is native to the Mekong, South-east Asia region.

A. costata distribution has not been mapped across the globe, or the region, but was assessed for its security during the last decade by international and Laos specialists. *A. costata* is found across several ecological zones, has low habitat specificity, occurs in moderately common vegetative communties; however humans have had a high impact on the species (Phongoudome et al. 2004). The conclusion of this Laos assessment was that *A. costata* is lower risk, conservation dependent and nearly threatened, predominantly due to its ability to grow in different ecoregions and habitats. During surveys for this HSRA Preliminary Works, *A. costata* was found in highly modified and disturbed habitat. It is unlikely that the loss of a few *A. costata* trees would represent a significant impact on the local, regional or global population and thus is not a high priority for the HSRA Preliminary Works.

3.1.5 Terrestrial Fauna

Fifty species of fauna were identified by direct and indirect observation methods in and around the HSRA Preliminary Works component footprints (Table A 2) (Earth Systems June 2015). Most species are common and widespread in Lao PDR, South-east Asia and/or globally. Considering the modified nature of the habitat it is unsurprising that the majority of species are common. Similarly, many of the species are disturbance-tolerant and a few are non-native, non-indigenous or introduced.

The common myna (*Acridotheres tristis*) is a highly successful invader of disturbed areas, including urban and city centres and was found near both villages and within or near to each of the HSRA Preliminary Works footprints surveyed (Table A 2). The common myna has been nominated as being among 100 of the world's most invasive species (ISSG, 2015). Although the common myna is a native to Lao PDR, its geographic distribution has increased significantly, possibly due to an affinity to *Modified habitat*.

Two globally threatened species were identified near the villages and the footprints of the HSRA Preliminary Works components (Table 3-4, Table A 2). The king cobra (*Ophiophagus hannah*) is globally Vulnerable because it is considered rare wherever it occurs, although it is widely distributed. King cobras are considered as Potentially 'At Risk' in Lao PDR and are commonly hunted for their skin, meat and for the Chinese medicine trade. Although the cobra can occur in a variety of habitats (as in this study), it prefers undisturbed habitat (IUCN, 2015).

The Vulnerable Chinese softshell turtle (*Pelodiscus sinensis)* is considered by the IUCN (2015) as not native to Laos. There is limited information regarding the species, but its spread across South-east Asia is believed to have been influenced by the historic and current food and medicine trade, hence its native range is difficult to delineate. The turtle is now cultivated in farms, and it is the wild population that is Vulnerable.

Other significant fauna may be potentially at risk or little is known of their range and abundance in Laos includes the Japanese quail (*Coturnix japonica*) and Asiatic reticulated python (*Python reticulatus*). These species are common to the broader region (i.e surrounding districts) around the HSRA Preliminary Works and therefore their conservation and management is not a priority for the HSRA Preliminary Works.

Table 3-4 Globally and Lao PDR significant fauna recorded within habitat in and surrounding HSRA Preliminary Works component footprints

Common English Name	Scientific Name	Lao Name	IUCN Red List Status	Lao PDR Status
Japanese quail	*Coturnix japonica*	Nok khoum	NT	LKL
Wire-tailed swallow	*Hirundo smithii*	Nok aen	LC	PARL
Common wild pig*	*Sus scrofa*	Mou pah	LC	LKL
Asian leaf turtle	*Cyclemys dentata*	Tau nbai mai	LR/NT	PARL
King cobra	*Ophiophagus hannah*	Ngou chong ang	VU	PARL
Chinese sofshell turtle*	*Pelodiscus sinensis*	Pa pha	VU	
Asiatic reticulated python	*Python reticulatus*	Ngou leum	N/A	PARL

Key: * - Introduced, not native; VU – Vulnerable; NT – Near Threatened; LR – Lower Risk; LC – Least Concern; N/A – Not Assessed; LKL – Little Known in Lao PDR; PARL – Potentially At Risk in Lao PDR

3.1.6 Aquatic Habitat

The Nam Ngiep River is one of the Mekong's main tributaries and flows in a southerly direction for approximately 160 km, joining the Mekong River near Paksan. The Nam Ngiep and other nearby rivers and tributaries provide ample habitat for permanent and migratory species adapted to the seasonal flows of the river. During the wet season the rivers are fast flowing and moderately deep (4-5 m), whereas during the dry, they are dominated by low water levels (2-3 m), riffle zones and dry river banks exposing some of the sand and gravel river bed. Local villagers use the Nam Ngiep and its tributaries regularly for fishing, livestock watering, swimming, washing and other activities.

Streams in the HSRA Preliminary Works area on the right bank of the Nam Ngiep River are predominantly lined by fallow, intermixed with bamboo. Although most tributaries are ephemeral, some streams do not completely dry up during the dry season. Small pools of water have been observed and these may form refuges for a plethora of aquatic biodiversity (e.g. macro- and micro-invertebrates). Many microinvertebrates (during different life stages) can become dormant in the moist river/stream bed. Small fish may remain in these small pools or aquatic species may use the still conditions as a spawning site (e.g. frogs).

3.1.7 Aquatic Biology

Several fish surveys have been undertaken within the Nam Ngiep and its tributaries during the last 20 years, upstream and downstream of the greater Nam Ngiep 1 HPP area (i.e. Kottelat 2014 - refer to *NNP1 EIA 2014*). There are over 100 species of fish within the Nam Ngiep River and surrounding waterways. Migratory species such as Asian red-tailed catfish (*Hemibagrus wyckioides*) and mud carp

(*Cirrhinus molitorella*) are common to the region. Several species have been introduced to the area, including the highly invasive common carp (*Cyprinus carpio*).

Recent surveying conducted by Earth Systems (June 2014 – refer IEE of the 22 kV TL and Ban Houay Soup Distribution Line) identified 14 fish species that are known to inhabit waters of the Nam Ngiep near Ban Hatsaykham (see Table 3-5). Surveying of streams in the HSRA conducted by LCG (May 2014) identified 22 fish species, many of which are not considered native to Lao PDR (see Table 3-5). Overall, most species are common and widespread to the region, as well as the greater Mekong area.

Two of the fish species, *Balantiocheilos melanopterus* (silver shark) and *Bangana behri*, are globally threatened and while *Balantiocheilos melanopterus* is Endangered (IUCN, 2015), it is not native to Lao PDR. *Balantiocheilos melanopterus* is native to Thailand and therefore it may have been introduced intentionally or accidentally. It is also possible that the shark has migrated into the area due to favourable environmental conditions. *Bangana behri* has become Vulnerable due to fishing pressure and alterations in stream morphology and has experience significant population declines in the past decade (IUCN, 2015). Other aquatic species identified in vicinity of the HSRA Preliminary Works included crustaceans, insects and reptiles. Of particular interest, was that the globally Vulnerable Asiatic softshell turtle (*Amyda cartilaginea*) was identified in the HSRA. The turtle's population is relatively secure and widespread in protected areas, but the consumption trade of tons per day is counteracting any gains achieved in protected areas.

Table 3-5 IUCN Near Threatened and threatened fish species, as well as introduced fish identified as inhabiting the Nam Ngiep River near the HSRA Preliminary Works villages and various streams in the Houay Soup Resettlement Area (HSRA)

Scientific Name	Lao Name	English Common Name	IUCN Red List Status	Family	Nam Ngiep		Various streams
					Hat Gniun	Hatsaykham	HSRA
Anabas testudineus	Pa kheng	Climbing perch	DD	Anabantidae			✓
*Balantiocheilos melanopterus**	Pa boc	Silver shark	EN	Cyprinidae	✓		
Bangana behri	Pa wa		VU	Cyprinidae	✓	✓	
*Hypsibarbus suvattii**	Pa park		DD	Cyprinidae		✓	
*Tor sinensis**	Pa daeng		DD	Cyprinidae	✓	✓	
*Bagarius yarrelli**	Pa khae		NT	Sisoridae	✓	✓	
*Channa marulioides**	Pa kuan saiy	Emperor snakehead	LC	Channidae	✓		
*Channa micropeltes**	Pa kachone	Giant snakehead	LC	Channidae			✓
*Mystus cavasius**	Pa kagnengeng	Gangetic mystus	LC	Bagridae			✓
*Mystus nemurus**	Pa kod	Yellow catfish	LC	Bagridae	✓		✓
*Ompok bimaculatus**	Pa seuam		NT	Siluridae	✓		✓
*Mastacembelus armatus**	Pa lat	Spiny eel	LC	Mastacembelidae			✓

Source: Earth Systems village level surveys, 2014; LCG surveying 2014

*Introduced or species beyond their normal range; IUCN Status Red List Categories: EN – Endangered, VU – Vulnerable, NT – Near Threatened, DD – Data Deficient, LC – Least Concern

3.2 Social and Cultural Components

3.2.1 Communities

There are two settlements in close proximity to the HSRA –Ban Hat Gniun and Ban Hatsaykham (a sub-village of Ban Hat Gniun). Both settlements are located on the left bank of the Nam Ngiep River (see Figure 1-2). Individuals from Ban Hat Gniun and to a lesser extent, Ban Hatsaykham, utilise land in the HSRA Preliminary Works area for upland agriculture (see Section 3.2.2). Basic demographic information is provided in Table 3.6 below.

Table 3-6 Demographic and ethnic parameters of villages in the HSRA Preliminary Works Area

Village (Ban)	Demographic (2011)*					Demographic (2015)^					Ethnicity (% of people)*		
	Households	No. of People	No. of Females	Males: Females	Population Growth (2008 to 2011)	Households	No. of People	No. of Females	Males: Females	Population Growth (since SIA surveying 2011)	Lao Loum	Hmong	Khmu
Hat Gniun*	67	371	157	1.36	-6%	74	401	177	1.27	8%	100		
Hatsaykham (sub-village)	33	218	108	1.02	32%	39	287	147	0.95	32%	5	95	
Total	**100**	**589**	**265**	**1.22**	**-**	**113**	**688**	**324**	**1.12**	**-**	**-**	**-**	**-**

Source: *NN HPP SIA; ^ES Village Surveying

3.2.2 Land Resource Use

A summary of land use and habitat within the HSRA Preliminary Works area is provided in Section 3.2.3. The main land use / habitat in the HSRA Preliminary Works area is upland agriculture / fallow. According to recent land and asset surveying conducted by NNP1 SMO, the majority of these areas are owned by individuals from Ban Nat Gniun. Shifting rice cultivation is a common form of agriculture in the HSRA Preliminary Works area. Other crops found in nearby are cassava, pineaples, and legumes. Several recent shifting cultivation plots were witnessed along the eixisting temporary access road particulary at the resettlement site. The local residents also use this area for animal grazing. Cows and buffalos graze freely.

A summary of land owernership, land use and status of compensation process is provided in Table 3-7.

Table 3-7 Status of Land Ownership, Use and the Compensation Process

Component	Ownership	Current Use	Compensation Status
Bridge Abuttment	NNP1	TCM Contractor Camp	Completed
Ferry Landing (Left Bank)	NNP1	TCM Contractor Camp	Completed
Ferry Landing (Right Bank)	Individual (Ban Hat Gniun)	Old fallow and young fallow	Land and assets survey completed.
New Temporary Access Road	Individual (Ban Hat Gniun)	Upland agriculture / fallow	Land and assets survey completed.
	NNP1	Dyke	Completed

Component	Ownership	Current Use	Compensation Status
Existing Temporary Access Road	Individual (Ban Hat Gniun)	Lowland agriculture, Upland agriculture / fallow.	Land and assets part completed.

3.2.3 Forest Resource Use

Village surveying in Hat Gniun and Hatsaykham (ES 2015) indicate that while fallow areas in the HSRA Preliminary Works area are used for the collection of NTFPs and TFPs, other more intact forest areas (i.e.within the Nam Ngiep - Nam Nagn National Protected Area) are primary sources of forest products. These areas are also used by villages for hunting small animals.

3.2.4 Water Resource Use

According to surveying conducted by Lao Consulting Group (2014), most fishing in the vicinity of the Houay Soup Resettlement Area occurs in the Nam Ngiep River. Currently little use is made of the small streams in the Houay Soup area. Some fish are collected, particularly at the end of the wet season, but during the dry season the stream flows are much smaller and small volumes of shrimp, snail and crab are gathered. Fishermen and women reported going to Houay Soup approximately once per month during the wet season and catching ~4-5 kg per trip, and approximately 3-4 times per month during the dry season (especially November and December) and catching ~10 kg per trip. Fishing spots are reportedly dispersed up and down the Houay Soup Noi and Houay Soup Ngai. Some fishermen reported the confluence of these streams (downstream of the HSRA Preliminary Works) as a key area.

Some water is used for very small scale irrigation along the Houay Soup.

3.2.5 Cultural Heritage

No sites of cultural significance were identified in the area during field exercises with village guides from Ban Hat Gniun and Ban Hatsaykham.

4 SCREENING OF POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

This section provides an assessment of potential environmental and social impacts associated with the HSRA Preliminary Works. Management and mitigation measures outlined in NNP1's *Environmental and Social Management and Monitoring Plan – Construction Phase* (ESSMMP-CP) (NNP1 2014), are considered relevant to the HSRA Preliminary Works and where appropriate, have been referenced. Additional measures have been outlined where required.

4.1 Environmental Impacts and Mitigation Measures

4.1.1 Terrestrial Biodiversity

Issues and Findings

- No National Biodiversity Conservation Areas or international protected areas will be impacted by the HSRA Preliminary Works. The HSRA Preliminary Works will located in close proximity to the Nam Ngiep-Nam Mang National Protected Forest and will improve access.
- No Natural habitat will be cleared or impacted by the HSRA Preliminary Works. Approximately 6.85 ha of Modified habitat will be cleared, mostly consisting of young fallow.
- A small number of the globally Endangered *Anisoptera costata* may be removed or disturbed, but this is highly unlikely to impact the local, regional or global population, as the species is secure elsewhere in the region.
- No threatened fauna species will be directly impacted, although any species near to the HSRA Preliminary Works and its construction may be indirectly affected by disturbance from the workforce (e.g. noise, dust, sediment; vehicle collision; hunting).

Management and Mitigation

The primary management measures to protect terrestrial biodiversity will include:

- Prohibition of hunting and NTFP gathering by construction workers; and
- Minimising the area of vegetation clearance (i..e. clear delineating boundaries and ensuring personnel clear accordingly.

NNP1 will implement these and other more comprehensive management and mitigation measures outlined in the ESMMP-CP and applicable sub-plans including:

- SP10: Biodiversity Management;
- SP07: Vegetation Clearing;
- SP08: Landscaping and re-vegetation; and
- SP16: Training and Awareness.

The Contractor will be required to prepare an SS-ESMMP covering these aspects prior to commencement of any works.

4.1.2 Invasive Vegetation

Issues and Findings

- Non-native and particularly invasive species have already been introduced to the HSRA Preliminary Works area and surrounds. These include: *Chromolaena odorata, Imperata cylindrical* and *Mimosa pigra*. These species (and others) may become more widespread due to the disturbance caused by the HSRA Preliminary Works
- The introduction of new construction vehicles to the area may also bring seed from other areas, introducing new invasive species prone to establishment in disturbed areas.

Management and Mitigation

To minimise the negative impact of exotic weeds on biodiversity, it is recommend that:

- Vehicles entering the HSRA Preliminary Works Area from outside the region should be washed prior to their utilisation to minimise the introduction of exotic species; and
- Areas cleared of vegetation should be revegetated with native species as soon as possible following site disturbance (e.g. with native grasses to minimise maintenance requirements in the ROW).

NNP1 will implement these and other more comprehensive management and mitigation measures outlined in the ESMMP-CP and applicable sub-plans including: SP08: Landscaping and re-vegetation. The Contractor will be required to prepare an SS-ESMMP covering these aspects prior to commencement of any works.

4.1.3 Hydrology

Issues and Findings

- The Barge Landings and Bridge Abutment will be constructed on the banks of the Nam Ngiep River. A barge will operate between the two Barge landings (see Section 4.1.8). Hydrology of the river will not be impacted;
- The New Temporary Road and Existing Temporary Road Upgrade will cross one (1) perennial stream and two (2) ephemeral streams. HSRA Preliminary Works design includes the installation of culverts in these areas to ensure flow is maintained. There is the potential for short term hydrological impacts during construction.
- Clearing of vegetation for HSRA Preliminary Works infrastructure may speed the movement of surface run-off. Road compaction, side ditches, slope protection and other measures (i.e. gabion boxes) have been includes into the HSRA Preliminary Works design to address this.

Management and Mitigation

The design of road infrastructure includes infrastructure for effective stormwater management. These measures will be implemented and their effectiveness monitored.

NNP1 will implement these and other more comprehensive management and mitigation measures outlined in the ESMMP-CP and applicable sub-plans including SP02 Water Availability and Pollution Control. The Contractor will be required to prepare an SS-ESMMP covering these aspects prior to commencement of any works.

4.1.4 Erosion and Sediment Transportation

Issues and Findings

- Vegetation clearance and earth works are required for the construction of the HSRA Preliminary Works infrastructure and poor management of these activities may lead to high levels of erosion and sediment transportation. Sensitive areas include:
    - Barge landings which require vegetation removal and significant excavation during construction. Once complete, these landings will at times be submerged by the Nam Ngiep and be prone to erosion. Landings will also create a backwater effect leading to bank scouring.
    - Excavation and vegetation removal for the New Preliminary Access Road and its close proximity to the Houay Keehia; and
    - Existing Access Road Upgrade in a predominately lowland area and crossing a number of streams where construction activities (i.e. culverts) are required.
    - Borrow area number 2, located in close proximity to the Houay Soup Ngai.
- HSRA Preliminary Works design includes a number of management and mitigation measures including controlled vegetation clearance; adequate siting and management of spoil areas; slope protection (including revegetation where necessary); open side ditches to direct run-off; rip-rap at the inlet and outlets of culverts.

Management and Mitigation

Key management measures are expected to include:

- Implementation of large riprap on the NN river bank at barge landings where vegetation has been cleared;
- Minimise vegetation removal around waterways to the extent possible;
- Implementing instream works following at least 2 days of drier conditions.
- Effective stormwater and sediment management control for cleared areas; and
- Rehabilitate spoil areas and unsealed surfaces as soon as possible.

NNP1 will implement these and other more comprehensive management and mitigation measures outlined in the ESMMP-CP and applicable sub-plans, including:

- SP01: Erosion and Sediment Control;
- SP02 Water Availability and Pollution Control
- SP07: Vegetation Clearing;
- SP08: Landscaping and re-vegetation; and
- SP11: Spoil Disposal.

The Contractor will be required to prepare an SS-ESMMP covering these aspects prior to commencement of any works.

4.1.5 Water Quality

Issues and Findings

- Nutrients and Pathogens: A work camp will be established to house the ~20 workers required for the road components of the HSRA Preliminary Works. The now disused UXO clearance work camp site will be utilised. This is located in close proximity to the Houay Soup Ngai.

Another camp for the bridge construction will be established on the existing TCM / Song Da site .The camp facilities are a potential source of nutrients and pathogens from inadvertent discharge into drainage channels and the Houay Soup Ngai and Nam Ngiep River.

- Hazardous and Non-hazardous Waste: The HSRA Preliminary Works design includes a batching area and temporary stockyard (located in the TCM camp area on the Nam Ngiep river); . These areas are a potential source of hazardous and non-hazardous waste. If not properly managed, potential impacts include discharges to downstream watercourses during the rainy season or infiltration of surface soils and contamination of groundwater aquifers. Use of excavators and additional equipment for construction provides some potential for hydrocarbon input to watercourses from leakage or spillage.

Management and Mitigation

NNP1 will ensure appropriate design and implementation of grey and black water storage and/or treatment facilities. The effectiveness of these facilities will be monitored.

NNP1 and its contractors are required to transport, store, handle and dispose of all hazardous and non-hazardous materials and waste as per SP05 and SP06 (refer to Section 4.1.7)

NNP1 will implement these and other more comprehensive management and mitigation measures outlined in the ESMMP-CP and applicable sub-plans, including SP02 Water Availability and Pollution Control are implemented

Sub-plans applicable to avoiding or minimising impacts to water quality include:

- SP02: Water Availability and Pollution Control;
- SP05: Waste Management;
- SP06: Hazardous Material Management;
- SP14: Construction of work camps; and
- SP20: Emergency Preparedness.

The Contractor will be required to prepare an SS-ESMMP covering these aspects prior to commencement of any works.

4.1.6 Aquatic Habitat and Biology

Issues and Findings

- No Ramsar Wetland sites will be impacted, since none occur near the HSRA Preliminary Works.
- More than 20 IUCN listed fish are known to occur in the area, with one IUCN threatened aquatic species historically identified in the Re-Regulation Dam area and a further two IUCN threatened aquatic species historically identified in the streams in the HSRA.
- The proposed Barge landings and Bridge Abutment will affect small areas on the banks of the Nam Ngiep River. The proposed New Temporary Access Road and Access Road Upgrade will cross a number of perennial / ephemeral streams. Construction of these facilities (i.e. vegetation removal and earthworks) has the potential to impact aquatic habitat. However these areas are relatively small and with proper management, impacts would be expected to be minimal.
- Aquatic habitat may be indirectly impacted if water quality is impaired during construction. If not adequately managed, the most significant potential impact to aquatic habitat is expected to be increased sediment loading in nearby streams and rivers. Additional potential water quality

impacts that would affect aquatic habitat include potential for hydrocarbons from spillage as well as nutrient loading from other facilities (i.e. toilets).

Management and Mitigation

NNP1 will ensure that management and mitigation measures for erosion and sediment control and water quality outlined above will be implemented. These measures are expected to help minimise impacts on aquatic resources.

Potential impacts to aquatic habitat will be managed through implementation of management and mitigation measures for water quality. NNP1 will implement management and mitigation measures specified in the ESMMP-CP and applicable sub-plans, including SP02: Water Availability and Pollution Control. The Contractor will be required to prepare an SS-ESMMP covering these aspects prior to commencement of any works.

4.1.7 Hazardous and Non-hazardous Waste

Issues and Findings

- Hazardous materials that may be used or associated with HSRA Preliminary Works construction include petroleum products such as oils, fuels, and grease; and grey and black water from septic systems. Hydrocarbons and other potentially hazardous and non-hazardous waste may impact water quality, terrestrial and aquatic habitat and soil capability. There is potential for hazardous material discharge to the environment during material storage and handling as well as during vehicle or equipment maintenance.
- Non-hazardous waste will be generated at the workforce accommodation facility and from residual materials at construction sites. Non-hazardous waste includes: construction materials; and general waste (e.g. plastic bottles, wrappers, etc.). Non hazardous materials impact the environment if not properly disposed of and may be carried into watercourses, impacting downstream environments.

Management and Mitigation

NNP1 will require contractors to adhere to transport, storage, handling and disposal requirements outlined in SP05 and SP06. Key measures include:

- Storage of hazardous materials in rainproof facilities with primary containment (110% volume).
- Emergency response including requirement for having appropriate clean up equipment (e.g. saw dust) at handeling and storage areas;
- Integrated system for separating hazardous and non-hazardous waste and disposing of each as per project requirements.

NNP1 will implement management and mitigation measures specified in the ESMMP-CP and applicable sub-plans for hazardous and non-hazardous waste, including:

- SP05: Waste management;
- SP06: Hazardous Material Management; and
- SP02: Water Availability and Pollution Control.

The Contractor will be required to prepare an SS-ESMMP covering these aspects prior to commencement of any works.

4.1.8 Operation of the Barge

Issues and Findings

- A barge will be operated across the Nam Ngiep River between the proposed Barge landings. This operation will involve the transport of large machinery, hazardous materials and the daily workforce. There is potential for incidents to occur during barge loading, crossing and unloading which may result in personal injury, loss of assets and pollution of the Nam Ngiep (i.e. lost loads).
- Other potential impacts associated with the operation of the barge include the use and management of hydrocarbons (oil and diesel) for the running and maintenance of the barge.

Management and Mitigation

It is also recommended that NNP1 require additional safety measures to be put in place for the barge operation (i.e. safety equipment; before departure safety protocol etc ..).

NNP1 will implement management and mitigation measures specified in the ESMMP-CP and relevant sub-plans including:

- SP02 Water Availability and Pollution Control;
- SP06 Hazardous Material Management;
- SP14: Traffic and Access;
- SP15 Training and Awareness; and
- SP 17: Emergency Preparedness.

The Contractor will be required to prepare an SS-ESMMP covering these aspects prior to commencement of any works.

4.1.9 Decommissioning of Temporary Infrastructure

Issues and Findings

- A number of the HSRA Preliminary Works facilities (i.e. Bridge Abutment and the New Temporary Access Road) will be utilised / upgraded for the permanent access to the HSRA. An assessment of potential environmental and social impacts of permanent access is being conducted as part of the Main HSRA IEE.
- The proposed Barge landings and Existing Road Upgrade will be used until permanent access to the HSRA is established, after which, these facilities will require decommissioning.

Management and Mitigation

NNP1 will implement management and mitigation measures specified in the ESMMP-CP regarding decommissioning of temporary infrastructure and sites including landscaping and visual characteristics (Vol 1). The Contractor will be required to prepare an SS-ESMMP covering these aspects prior to commencement of any works.

Additional recommended measures include:

- Upon decommissioning, rip soil surface to a depth of > 0.5m to reduce compaction (during the dry season);
- Grade decommissioned roads to be compatible with surrounding landscape (with respect to drainage), during the dry season; and
- Plant decommissioned facilities with native species early in the first rainy season following decommissioning.

4.2 Social Impacts and Mitigation Measures

4.2.1 Loss of Land, Assets and Livelihoods

Issues and Findings

- Loss of land and assets is expected to be minimal. The construction of the HSRA Preliminary Works will require the use of existing NNP1 land and the requisition of land and assets belonging to residents from Ban Hat Gniun and Ban Hatsaykham. The majority of this land has been identified as upland agriculture / fallow forest.
- Land and asset surveying for the HSRA (including the proposed New Temporary Access Road (AR) has been conducted however compensation is yet to be completed. Similar surveying and compensation is yet to be conducted for the proposed upgrade of the Existing Road Upgrade Note – The use of this road is expected to cease once the permanent access road is completed.
- Due to the small scale of the HSRA Preliminary Works, no significant negative impacts to livelihoods of local residents are expected. Local residents will benefit from improved access to the HSRA area.

Management and Mitigation

NNP1 will complete compensation activities before commencement of activities in accordance with the NNP1 Resettlement and Ethnic Development Plan (REDP, Chapter 14).

4.2.2 Access to the Right Bank and HSRA

Issues and Findings

- The HSRA Preliminary Works will improve access to the Right Bank including upland fields, the HSRA and areas of the Nam Ngiep-Nam Mang National Protected Forest.

Management and Mitigation

No management and mitigation measures are required beyond implementation of road safety measures outlined in the ESMMP-CP and SP14 traffic and access. The Contractor will be required to prepare an SS-ESMMP covering these safety aspects prior to commencement of any works.

4.2.3 Archaeology and Cultural Heritage

Issues and Findings

- No sites of cultural significance have been identified in the HSRA Preliminary Works area.
- The chance find of artefacts during construction remains a possibility. It is recommended that the HSRA Preliminary Works's "Chance Find Procedure" is utilised during construction.

Management and Mitigation

NNP1 will implement the Chance Find Procedure developed as part of the ESMMP-CP.

4.2.4 UXO

Issues and Findings

- The Bolikhamxay Province is considered one of the 10 heaviest UXO contaminated provinces (Statement by the Delegation of Lao PDR on Victim Assistance, Intercessional Meeting of

States Parties to the Convention on Cluster Munitions, Geneva, 2013), however the HSRA Preliminary Works Area was not as heavily bombed as for neighbouring Districts.

- UXO clearance was completed for the Preliminary Access Development in early 2015. Residual UXO risk, although unlikely, still remains.

Management and Mitigation

NNP1 will ensure that construction workers are trained in the potential risks associated with disturbance of UXO, as outlined in ESMMP-CP, sub plan SP13: Unexploded Ordinance Survey and Disposal.

4.2.5 Noise and Air Quality and Vibration

Issues and Findings

- The main sensitive receptors for air, noise and vibration are the settlements of Ban Hatsaykham and Ban Hat Gniun. Both these settlements are located on the left bank of the Nam Ngiep and at least 500 metres from the proposed construction activities and are not expected to experience air, noise and / or vibration impacts as a result of the HSRA Preliminary Works. Another sensitive receptor is the TCM / Song Da Camp, located on the left bank of the Nam Ngiep and in close proximity to proposed left bank works.
- The HSRA Preliminary Works workforce may be exposed to moderate levels of noise and dust generated during construction activities.

Management and Mitigation

Work will be conducted during day-light hours to minimise the impact of nuisance level noise impacts.

Due to the distance from sensitive receptors and specified works being conducted, impacts to air quality and vibration are expected to be negligible.

NNP1 will implement these and other more comprehensive management and mitigation measures outlined in the NN1 HPP ESMMP-CP, sub-plan SP04: Noise and Vibration. NNP1 will monitor the site every six months is accordance with ESMMP-CP requirements.

4.2.6 Workforce

Issues and Findings

It is anticipated that about 20 workers will be engaged for the construction of the HSRA Preliminary Works. While small, the presence of the migrant workforce during the construction period presents a number of potential impacts to the environment and surrounding communities including:

- Increased pressure on non-timber forest products, timber forest products, terrestrial species (hunting) and aquatic species (fishing / collection);
- Increased risk of traffic related safety issues (vehicle strikes);
- Increased risk of introduced diseases including sexually transmitted diseases; and
- Increased risk of conflict due to insensitivity of workforce to local culture and environmental values.

Issues and Findings

Key measures will include:

- Prohibition of hunting, fishing and natural resource gathering;
- Driver training and enforcement of safe driving regulations (i.e. speed limits); and

- Workforce training and enforcement of culturally sensitive practises.

NNP1 will implement these and other more comprehensive management and mitigation measures outlined in the ESMMP-CP and applicable sub-plans, including SP16: Training and Awareness and SP18 Public safety.

5 INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PLAN

5.1 Institutional Arrangements

Senior Management at NNP1 is responsible for the ongoing implementation of management and monitoring activities throughout the life of the NN1HP.

5.1.1 Environmental and Social Department (ESD)

NN1PC has established an Environmental and Social Department which is responsible for implementing the monitoring and reporting program in compliance with the NN1HP Concession Agreement and the ESMMP-CP

The ESD NN1PC consists of two divisions:

1. Social Management Office (SMO NN1PC) which is (in part) responsible for land acquisition compensation works and social monitoiring;
2. Environmental Management Office (NN1PC EMO) which is responsible for all other environmental monitoring aspects.

5.1.2 NN1PC Technical Department

The Technical Department (NN1PC TD) plays an important role in ensuring NN1HP compliance with its environmental and social obligations. The Department liaises with statutory bodies and head contractor to perform in accordance with all the applicable technical standards and regulations. The Technical Department also strives to enhance the performance of the contractors by following the construction plans and implementing routine inspections.

5.1.3 Other Monitoring Institutions

Other institutions involved in environment and social monitoring of the road construction works include:

- Ministry of Natural Resources and Environment (MONRE);
- MONRE's Environmental Monitoring Unit;
- Resettlement Management Unit;
- Independent Monitoring Agency; and
- Asian Development Bank Monitoring Team.

5.2 Environmental and Social Management and Monitoring Plan-Construction Phase (ESMMP-CP)

An Environmental and Social Management and Monitoring Plan-Construction (ESMMP-CP) was prepared for the Nam Ngiep 1 HPP by ERM-Siam in December 2013. The ESMMP-CP was prepared to address environmental and social compliance of NNP1 during the construction phase.

Under the ESMMP-CP, a number of sub-plans were developed to provide management and mitigation strategies across the breadth of environmental and social impacts. These include:

- Erosion and Sediment Control;
- Water Availability and Pollution Control;
- Emissions and Dust Control;
- Noise and Vibration;
- Waste Management;
- Vegetation Clearing;
- Landscaping and Re-Vegetation;
- Protected Area Management;
- Biodiversity Management;
- Unexploded Ordinance (UXO) Survey and Disposal;
- Traffic and Access;
- Public Safety;
- Damage to Properties and Facilities; and
- Cultural Resources.

Management and mitigation measures detailed in these sub plans are expected to be incorporated into the Contractor SS-ESMMP and implemented where relevant for the HSRA Preliminary Works.

5.3 Management and Monitoring Program

A management and monitoring program has been developed, based on existing structures of environmental and social management for the NN1HP.

A summary of relevant management and monitoring measures are detailed in Table 5-1 below.

Table 5-1 Environmental and Social Monitoring Plan

Potential impact area	Issue / impact	Significance	Relevant ESMMP-CP Sub-Plan and/or additional measures	Monitoring	Location	Frequency
Construction and Operation						
Terrestrial Biodiversity	Impact on terrestrial vegetation, terrestrial fauna, forest resources	Minor	SP10: Biodiversity Management SP07: Vegetation Clearing; SP08: Landscaping and re-vegetation; and SP16: Training and Awareness.	Owner to verify	Bridge abutment (left bank), Barge landings and roads; and ancillary components.	Bi-weekly
Invasive Vegetation	Non-native and/or invasive species further distribution/introduction	Minor	SP08: Landscaping and re-vegetation	Owner to verify	Bridge abutment (left bank), Barge landings and roads; and ancillary components.	Bi-weekly
Hydrology	Construction on river banks, road construction over minor water courses, surface run-off over cleared areas	Moderate	SP02 Water Availability and Pollution Control	Owner to verify	Bridge abutment (left bank), Barge landings and roads; and ancillary components.	Bi-weekly
Erosion and Sediment Transportation	Cleared vegetation and earth works leading to erosion and sedimentation transportation into surrounding waterways	Moderate	SP01: Erosion and Sediment Control; SP02 Water Availability and Pollution Control SP07: Vegetation Clearing; SP08: Landscaping and re-vegetation; and SP11: Spoil Disposal.	Owner to verify	Bridge abutment (left bank), Barge landings and roads; and ancillary components.	Bi-weekly
Water Quality	Nutrients, pathogens, hazardous and non-hazardous waste	Moderate	SP02: Water Availability and Pollution Control; SP05: Waste Management; SP06: Hazardous Material	Owner to verify	Bridge abutment (left bank), Barge landings and roads; and ancillary components.	Bi-weekly

Potential impact area	Issue / impact	Significance	Relevant ESMMP-CP Sub-Plan and/or additional measures	Monitoring	Location	Frequency
			Management; SP14: Construction of work camps; and SP20: Emergency Preparedness.			
Aquatic Habitat and Biology	20IUCN listed aquatic species, water quality, aquatic habitat destruction from vegetation clearance and earth works	Minor	SP02: Water Availability and Pollution Control	Owner to verify	Bridge abutment (left bank), Barge landings and roads; and ancillary components.	Bi-weekly
Hazardous and Non-hazardous Waste	Discharge of hazardous and non-hazardous waste to the environment	Minor	SP05: Waste management; SP06: Hazardous Material Management; and SP02: Water Availability and Pollution Control.	Owner to verify	Bridge abutment (left bank), Barge landings and roads; and ancillary components.	Bi-weekly
Operation of the Barge	Personal injury, loss of assets and pollution	Minor	SP02 Water Availability and Pollution Control; SP06 Hazardous Material Management SP15 Training and Awareness SP17: Emergency Preparedness	Owner to verify	Barge crossing	Bi-weekly
Loss of Land, Assets and Livelihoods	Land acquisition from residents	Minor	Resettlement and Ethnic Development Plan (REDP, Chapter 14)	Owner to verify	Bridge abutment (left bank), Barge landings and roads; and ancillary components.	Before construction commences
Archaeology and Cultural Heritage	Cultural significance, artefacts	Minor	Resettlement and Ethnic Development Plan (*"Chance Find Procedure"* – Chapter 5)	Owner to verify	Bridge abutment (left bank), Barge landings and roads; and ancillary components.	Monthly

Potential impact area	Issue / impact	Significance	Relevant ESMMP-CP Sub-Plan and/or additional measures	Monitoring	Location	Frequency
UXO	UXO contaminated land, unexploded ordinances	Minor	SP13: Unexploded Ordinance Survey and Disposal	Clearance confirmed	n/a (completed)	n/a (completed)
Noise, Air Quality and Vibration	Workforce and settlement exposure	Minor	SP04: Noise and Vibration	Owner to verify	Work-camps and nearby villages.	Biannually
Workforce	Pressure on non-timber forest products, timber forest products, terrestrial species and aquatic species. Traffic related safety issues, conflict, introduction of diseases	Minor	SP16: Training and Awareness; and SP18 Public safety	Owner to verify	Work-camps and nearby villages.	Weekly
Decommissioning						
Decommissioning of Temporary Infrastructure	Environmental and social impacts of permanent access	Moderate	Decommissioning of temporary infrastructure and sites including landscaping and visual characteristics (Vol 1)	Owner to verify	Barge landings and existing access road	Once – decommissioning phase

6 PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

6.1 Objectives of Public Consultation and Disclosure

Consistent with the greater NN1HP, the goal of public consultation and disclosure for the HSRA Preliminary Works is to improve decision-making, build understanding to ensure the long-term viability of the NN1HP and to enhance potential NN1HP benefits.

Specific objectives of the consultation and disclosure process are to:

- Ensure that Project affected communities and other stakeholders are well informed of the HSRA Preliminary Works, its environmental and social impacts, and management measures;
- Ensure stakeholder feedback on the HSRA Preliminary Works 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 HSRA Preliminary Works.

6.2 Consultation Activities

Numerous consultations have been conducted with Project stakeholders regarding the HSRA – including project affected people in Ban Hatsaykham and Hat Gniun. These stakeholders have agreed to the proposed HSRA. Results of these consultations are outlined in the NNP1 EIA (2014), SIA (2014) and REDP (2014).

Consultations conducted specifically for the assessment of the HSRA Preliminary Works are outlined below.

6.2.1 Meeting with PONRE

Earth Systems met with representatives of PONRE on 2nd June 2015 and introduced the HSRA Preliminary Works. The proposed HSRA Preliminary Works were presented. PONRE reported that, they understand that the construction of these activities will be necessary to ease access for Houay Soup resettlement activities in the near future. PONRE expressed no concern over the environmental and social impacts because the land in these areas are degraded and developed for other purposes such as shifting cultivation and recent establishment of worker's camp (TCM, MVDC, etc) just adjacent to the Bridge Abutment and Barge Landing area (left bank).

6.2.2 Consultation with Hat Saykham and Hat Gniun Villages

Between 3rd and 5th June 2015 Earth Systems conducted field assessment of the HSRA Preliminary Works. This included consultation with the village chiefs of Ban Hatsaykham and Hat Gniun. The two village chiefs confirmed that NNP1 has completed land survey along the new road alignment and existing road. The affected households have participated in the survey on their land parcels and all have certified areas to be affected. However,compensation negotiations are still on-going.

Additional consultations with villagers from Hatsaykham and Hat Gniun were conducted on the 23rd June 2015. Both meetings included approximately 30 men and women (see Appendix C – Consultation Register). During these meetings, the proposed HSRA Preliminary Works components and the findings of the IEE were summarized. Key feedback included:

- Villagers in Hat Gniun have requested that the same compensation rates provided for the Project's main access road are applied.
- Villagers in Hatsaykham welcome the improved access to the area, however have requested that NNP1 strictly implement road safety measures as many households use

7 CONCLUSION

The assessment of the IEE concludes that the HSRA Preliminary Works is important so as to enable the planned resettlement for the Nam Ngiep Hydropower Project to be conducted in a timely manner.

Negative social and environmental impacts from the HSRA Preliminary Works are expected to be low due to the area already being cleared and the lack of social structures in the footprint area.

The compensation process is required to be completed before commencement of construction activities.

Monitoring and management of the HSRA Preliminary Works will be required to ensure that Nam Ngiep environmental and social standards are implemented.

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9 APPENDICES

Appendix A: Water Quality Results

Table 1 - 2014 Surface Water Quality Monitoring Results

Site	Description	Location (Coordinates)	Monitoring Month	pH (units)	DO (mg/L)	Temp (°C)	EC (µs/cm)	ORP (mV)	TSS (mg/L)	Turbidity (NTU)	Oil / Grease (mg/l)
NA	**Lao PDR's Drinking water standards#%**			**6.5-8.5**	**-**	**35**	**<1000**	**-**		**<10**	**-**
NA	**Lao PDR's Ambient water quality standards@%**			**5-9**	**>6.0**	**-**	**-**	**-**	**-**	**-**	**10**
NN1	Nam Ngiep – Dam Site (upstream)	Lat: 18.401614	Feb	8.3	6.6	22.1	**91.6**	**-**	**-**	**n/a**	**n/a**
			Mar	5.8	6.6	28.6	**97.8**	**-**	**-**	62.3	<5
			1st May	7.9	8.7	25.9	95.2	214	*	*	*
			20th May	6.6	NA	21.6	98.5	342	263	296	6.81
		Long: 103.644887	25th June	7.3	10	18.1	72.6	212	272	36.1	3.9
			22nd Jul	8	16.1	18.1	62.8	195	168	262	3.7
			11th Aug	7.57	5.3	23	64.7	268	170	185	4.3
			15th Sep	6.43	8.7	24.2	67.7	225	**1,088**	**1,115**	15.5
			Oct	7.3	6.6	22.3	87.9	191	29.4	49.2	<5
			Nov	7.9	8.2	22.7	105	NA	53	20	<5
			Dec	8.2	9.5	19.6	154	NA	12	11.9	0.375
NN2	Nam Ngiep –upstream of N. Xao	Lat: 18.648827	Feb	7.3	6.9	23.8	92.6	**-**	**-**	NA	NA

			Mar	6.1	7	24.8	100.5	-	-	11.9	<5
			1st May	7.7	8.4	26.5	85.6	261	*	*	*
			20th May	7.8	NA	22.4	88.8	305	255	347	15.38
		Long: 103.59711	25th June	7.4	9	18.1	74.6	208	145	236	3.1
			22nd Jul	6.8	8.9	17.3	48	309	368	453	2.8
			11th Aug	7.62	11.5	23.6	50	228	154	160	3.7
			15th Sep	6	8.3	24.5	55.2	188	**1,075**	**1,180**	11.5
			16th Sep	6.8	6.8	24	73.1	186	187	197	12.7
			Oct	7.2	7.8	22.2	88.1	262	36.5	51.2	<5
			Nov	7.5	7.3	20	95	176	20	38	0.125
			Dec	8.5	10	20.5	149	192	2.83	19.6	0.5625
NN3	Nam Ngiep – downstream of N. Xao	Lat: 18.64125	Feb	7.1	7.4	23	92.5	-	-	NA	NA
			Mar	5.9	6.6	24.1	100	-	-	32.4	<5
			1st May	7.7	8.1	26.3	87.2	260	*	*	*
			20th May	7.8	NA	22	91.1	309	233	297	12.06
			25th June	7.3	8.8	18.5	59.4	218	147	195	3.3
			22nd Jul	6.5	4.1	17.5	65.3	375	317	403	2.4
		Long: 103.600811	11th Aug	7.54	12.2	24	67	229	125	142	3.5
			16th Sep	6.7	9.4	24.3	75.3	195	167	198	14.9
			Oct	7.2	6.6	22.7	88.5	258	33.7	49.8	<5
			Nov	7.6	7	20.7	84	205	24.4	36	0.25
			Dec	8.3	9.8	20.7	139	199	4.8	18.4	0.3125

Source: Refer to CA – Annex C – Appendix 2 Standard, 1.8 Drinking Water Quality Standards, Physical-Chemical Parameters

@ Source: Refer to CA- Annex C – Appendix 2 Standard, 1.11 Ambient Surface Water Quality Standards

% These values differ from Effluent Standards (Refer to CA – Annex C – Appendix 2 Standards, 1.13 Effluent Standards, that will apply to quarterly monitoring for effluents.

* Samples provided to MONRE Lab could not be analysed

Appendix B: Biodiversity

Table A 1 Flora identified near and within the footprint of HSRA Preliminary Works components (access road, existing road, Barge landings and bridge), including habit, habitat and international conservation significance (IUCN)

Scientific Name	Family	IUCN Red List Status	Habit	Habitat			Component			
				Fallow	Bamboo	Bamboo/ Fallow	Access Road	Existing Road	Barge landings	Bridge
Acacia pluricapitata	Caesalpinioideae	LC	C	✓	✓	✓	✓	✓	✓	
Alpinia galangal	Zingiberaceae		H	✓	✓		✓	✓		
Ancistrocladus tectorius	Ancistrocladaceae		C	✓	✓		✓	✓		
Anisoptera costata	Dipterocarpaceae	EN	T	✓			✓			
Aporosa ficifolia	Euphorbiaceae		TL	✓	✓	✓	✓	✓	✓	✓
Aralia armata	Alariaceae		TL	✓	✓		✓	✓		
Ardisia elliptica	Primulaceae		S	✓	✓	✓	✓	✓	✓	
Artocarpus chaplasha	Moraceae		T	✓	✓	✓	✓	✓	✓	✓
Cardiospermum halicacabum	Sapindaceae		V	✓					✓	✓
Caryota mitis	Arecaceae		H	✓	✓	✓	✓	✓	✓	
Catimbium bracteatum	Zingiberaceae		H	✓				✓		
Cephalostachyum virgatum	Poaceae		B	✓	✓		✓	✓		
*Chromolaena odorata**	Asteraceae		H	✓			✓	✓	✓	✓
Crataeva nurvala	Caparaceae		TL	✓		✓			✓	✓
Cratoxylum formosum var. pruniflorum	Guttiferae	LR/LC	T	✓	✓	✓	✓	✓	✓	
Crotalaria assamica	Papilionoideae	LC	H	✓					✓	
Crypteronia paniculata	Crypteroniaceae		T	✓				✓		
Cyperus rotundus	Cyperaceae	LC	H	✓					✓	✓
Duabanga grandiflora	Lythraceae		T	✓		✓			✓	✓
Eurycoma longifolia	Simaroubaceae		TL	✓	✓	✓	✓	✓	✓	
Evolvulus nummularius	Convolvulaceae		PH	✓					✓	✓

Scientific Name	Family	IUCN Red List Status	Habit	Habitat			Component			
				Fallow	Bamboo	Bamboo/ Fallow	Access Road	Existing Road	Barge landings	Bridge
Ficus hispida	Moraceae		TL	✓	✓	✓	✓	✓	✓	✓
Glochidion sphaerogynum	Euphorbiaceae		TL	✓	✓		✓	✓		
Grewia paniculata	Titliaceae		T	✓	✓		✓	✓		
Haldina cordifolia	Rubiaceae		T	✓			✓	✓		
Halopergia blumei	Maranthaceae		H	✓	✓		✓	✓		
*Imperata cylindrical**	Poaceae		H	✓			✓	✓		
Irvingia malayana	Irvingiaceae	LR/LC	T	✓				✓		
Ixora stricta	Rubiaceae		TL	✓		✓	✓	✓	✓	
Lagerstroemia sp.	Lythraceae		T	✓		✓	✓	✓	✓	✓
Lygodium flexuosum	Schizaeaceae		F	✓	✓		✓	✓		
Macaranga denticulata	Euphorbiaceae		TL	✓			✓	✓		
Maesa ramentacea	Primulaceae		TL	✓	✓	✓	✓	✓	✓	
Mallotus barbatus	Euphorbiaceae		TL	✓	✓	✓	✓	✓	✓	✓
Mimosa diplotricha	Mimosoideae		PH	✓					✓	✓
*Mimosa pigra**	Mimosoideae		H	✓					✓	✓
Mimosa pudica	Mimosoideae	LC	PH	✓					✓	✓
Nauclea orientalis	Rubiaceae		T	✓		✓			✓	✓
Ormosia pinnata	Papilionoideae		T	✓				✓		
Oxytenanthera albociliata	Poaceae		B	✓	✓		✓	✓		
Passiflora foetida	Passifloraceae		C	✓					✓	✓
Peltophorum dasyrrhachis	Caesalpinioideae		T	✓	✓	✓	✓	✓	✓	
Ricinus communis	Euphorbiaceae		H	✓					✓	✓
Scleria terrestris	Cyperaceae	LC	H	✓	✓		✓	✓		
Scoparia dulcis	Plantaginaceae		H	✓					✓	✓

Scientific Name	Family	IUCN Red List Status	Habit	Habitat			Component			
				Fallow	Bamboo	Bamboo/ Fallow	Access Road	Existing Road	Barge landings	Bridge
Selaginellla sp.	Selaginellaceae		H	✓	✓	✓	✓	✓		
Senna hirsuta	Caesalpinioideae		H	✓					✓	✓
Senna occidentalis	Caesalpinioideae		H	✓					✓	✓
Senna tora	Caesalpinioideae		H	✓					✓	✓
Solanum torvum	Solanaceae		H	✓					✓	✓
Spondias lakhonensis	Anacardiaceae		T	✓						✓
Trewia nudiflora	Euphorbiaceae		T	✓		✓			✓	✓
Vitex pierrei	Verbenaceae		T	✓			✓			
Vitex tripinnata	Verbenaceae		TL	✓	✓		✓	✓		

Key: * Introduced, non-native or non-indigenous species; EN – Endangered; LC – Least Concern; LR – Lower Risk; T – Tree; TL – Treelet; H – Herb; PH – Perennial Herb; C – Creeper; V – Vine; S – Shrub; B - Bamboo

Table A 2 Fauna identified near villages and HSRA Preliminary Works components (access road, existing road and Barge landings), including international conservation significance (IUCN)

Common English Name	Scientific Name	Lao Name	Family	IUCN Red List Status	Lao PDR Status	Presence near Villages		Presence near Components		
						Had Saykham	Had Yeun	Access Road	Existing Road	Barge landings
Amphibians										
Burmese squat frog	*Calluella guttulata*	Eung	Microhylidae	LC		✓	✓	✓	✓	✓
Black-spectacled toad	*Duttaphrynus melanostictus*	Khan khak	Bufonidae	LC		✓	✓	✓	✓	✓
Asian grass frog	*Fejervarya limnocharis*	Khiat noi	Dicroglossidae	LC		✓	✓	✓	✓	✓
Spotted narrow-mouthed frog	*Kalophrynus interlineatus*	Sa ae	Microhylidae	LC		✓		✓	✓	✓
Beautiful pygmy frog	*Microhyla pulchra*	To sa ae	Microhylidae	LC		✓	✓	✓	✓	✓
Chloronate huia frog	*Odorrana chloronota*	Khiat takheo	Ranidae	LC		✓	✓	✓	✓	
White-lipped tree frog	*Polypedates leucomystax*	Ka pad	Rhacophoridae	LC		✓	✓	✓	✓	✓
African bull frog*	*Pyxicephalus adspersus*	Kop	Pyxicephalidae	LC		✓	✓	✓	✓	✓
Birds										
Common myna*	*Acridotheres tristis*	Nok ieng	Sturnidae	LC		✓	✓	✓	✓	✓
Japanese quail	*Coturnix japonica*	Nok khoum	Phasianidae	NT	LKL		✓	✓	✓	
Rufous woodpecker	*Celeus brachyurus*	Nok sai	Picidae	LC		✓		✓	✓	
Greater coucal	*Centropus sinensis*	Nok kod	Cuculidae	LC		✓	✓	✓	✓	✓
Greater racket-tailed drongo	*Dicrurus paradiseus*	Nok seo hang gnao	Dicruridae	LC		✓		✓	✓	✓
Common flameback	*Dinopium javanense*	Nok hon khouane	Picidae	LC		✓		✓	✓	
Little egret	*Egretta garzetta*	Nok gnang khao	Ardeidae	LC		✓	✓	✓	✓	
Red junglefowl	*Gallus gallus*	Kai pah	Phasianidae	LC		✓	✓	✓	✓	✓
Stork-billed kingfisher	*Pelargopsis capensis*	Nok ten sio	Alcedinidae	LC		✓		✓	✓	✓
Wire-tailed swallow	*Hirundo smithii*	Nok aen	Hirundinidae	LC	PARL	✓	✓	✓	✓	✓
Banded kingfisher	*Lacedo pulchella*	Nok ten	Alcedinidae	LC		✓		✓	✓	✓

Common English Name	Scientific Name	Lao Name	Family	IUCN Red List Status	Lao PDR Status	Presence near Villages		Presence near Components		
						Had Saykham	Had Yeun	Access Road	Existing Road	Barge landings
White-rumped munia	*Lonchura striata*	Nok pid	Estrildidae	LC		✓	✓	✓	✓	✓
Golden-throated barbet	*Megalaima franklinii*	Khon dok noi	Megalaimidae	N/A		✓	✓	✓	✓	
Common tailorbird	*Orthotomus sutorius*	Nok ka chip	Sylviidae	LC		✓	✓	✓	✓	
Green-billed malkoha	*Phaenicophaeus tristis*	Nok son hok	Cuculidae	LC		✓		✓	✓	
Sooty-headed bulbul	*Pycnonotus aurigaster*	Nok khouak	Pycnonotidae	LC		✓	✓	✓	✓	✓
Lesser yellownape	*Picus chlorolophus*	Nok sai	Picidae	LC			✓	✓	✓	
Changeable hawk-eagle	*Nisaetus cirrhatus*	Leo moum	Accipitridae	LC		✓	✓	✓	✓	✓
Oriental turtle dove	*Streptopelia orientalis*	Nok khau tou	Columbidae	LC		✓	✓	✓	✓	✓
Mammals										
Greater bandicoot rat	*Bandicota indica*	Nou phouk	Muridae	LC		✓	✓	✓	✓	✓
Irrawaddy squirrel	*Callosciurus pygerythrus*	Ka len	Sciuridae	LC		✓	✓	✓	✓	
Squirrel	*Callosciurus sp.*	Ka hok dik	Sciuridae	N/A		✓	✓	✓	✓	
Indian munkjac	*Muntiacus muntjak*	Fan	Cervidae	LC		✓	✓	✓	✓	
House mouse*	*Mus musculus*	Nou wai	Muridae	LC		✓	✓	✓	✓	✓
Gairdner's shrewmouse	*Mus pahari*	Nou wai deng	Muridae	LC		✓	✓	✓	✓	
Big-eared horseshoe bat	*Rhinolophus macrotis*	Chia bee	Rhinolophidae	LC		✓	✓	✓	✓	
Common wild pig*	*Sus scrofa*	Mou pah	Suidae	LC	LKL	✓	✓	✓	✓	
Reptiles										
Malayan pit viper	*Calloselasma rhodostoma*	Nou ka ba	Viperidae	LC		✓	✓	✓	✓	✓
Emma Gray's forest lizard	*Calotes emma*	Ka pom	Agamidae	N/A		✓	✓	✓	✓	✓
Asian leaf turtle	*Cyclemys dentata*	Tau nbai mai	Geoemydidae	LR/NT	PARL		✓	✓	✓	
Radiated ratsnake	*Elaphe radiata*	Ngou sa	Colubridae	N/A		✓	✓	✓	✓	✓
Tokay gecko	*Gekko gecko*	Kap kae	Gekkonidae	N/A			✓	✓	✓	✓
Common house gecko	*Hemidctylus frenatus*	Chee kiem	Gekkonidae	LC			✓	✓	✓	✓

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Cobra species	*Naja sp.*	Ngou hau	Elapidae	N/A		✓	✓	✓	✓	✓
King cobra	*Ophiophagus hannah*	Ngou chong ang	Elapidae	VU	PARL	✓	✓	✓	✓	
Chinese sofshell turtle*	*Pelodiscus sinensis*	Pa pha	Trionychidae	VU			✓	✓	✓	
Lizard	*Pseudocalotes poilani*	Ka pom	Agamidae	N/A		✓	✓	✓	✓	✓
Asiatic reticulated python	*Python reticulatus*	Ngou leum	Pythonidae	N/A	PARL	✓	✓	✓	✓	
Diamond-backed water snake	*Sinonatrix aequifasciata*	Ngou pah	Natricidae	LC		✓	✓	✓	✓	✓
Sun skin lizard	*Sphenomorphus maculatus*	Chee ko	Scincidae	N/A		✓	✓	✓	✓	✓
White-lipped pitviper	*Cryptelytrops albolabris*	Ngou kheo	Viperidae	LC		✓	✓	✓	✓	✓
Zamenis	*Zamenis sp.*	Ngou sing	Colubridae	N/A		✓	✓	✓	✓	✓

Key: * Introduced, non-native or non-indigenous species; VU – Vulnerable; LC – Least Concern; NT – Near Threatened; LR – Lower Risk; N/A – Not Assessed; LKL – Little Known in Lao PDR; PARL – Potentially At Risk in Lao PDR