



Burapha Agro-Forestry Expansion Project

Desktop Critical Habitat Assessment

prepared for

Burapha Agro-Forestry Co, Ltd.

by

Earth Systems



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CONTENTS

1. INTRODUCTION	1-14
1.1 Objectives.....	1-14
1.2 The Project.....	1-14
1.3 MIGA/IFC Performance Standards.....	1-15
2. BACKGROUND	2-16
2.1 Land Acquisition Process.....	2-16
3. METHODOLOGY	3-19
3.1 Study Area.....	3-19
3.2 Habitat Mapping.....	3-19
Desktop Critical Habitat Assessment.....	3-24
3.2.1 Literature and Database Review.....	3-24
3.2.2 Field surveys.....	3-25
3.2.3 Stakeholder Consultation.....	3-25
3.2.4 Determination of Critical Habitat.....	3-26
3.3 Ecosystem Services Assessment.....	3-29
3.4 Impact and Risk Assessment.....	3-29
4. RESULTS.....	4-32
4.1 Protected Areas and Key Biodiversity Areas.....	4-32
4.1.1 Protected Areas.....	4-32
4.1.2 Key Biodiversity Areas.....	4-33
4.2 Existing Threats to Biodiversity.....	4-36
4.2.1 Existing Threats to Aquatic Biodiversity.....	4-36
4.2.2 Existing Threats to Terrestrial Biodiversity.....	4-36
4.3 Natural and Modified Habitat.....	4-37
4.3.1 Habitat cleared between 2018-2023.....	4-37
4.3.2 Natural Habitat Within PFAs.....	4-43
4.4 Critical Habitat Screening and Assessment.....	4-48
4.4.1 Mammal.....	4-52
4.4.2 Herpetofauna.....	4-58
4.4.3 Bird.....	4-63
4.4.4 Fish.....	4-65
4.4.5 Criterion 4: Highly Threatened and / or Unique Ecosystems.....	4-70
4.4.6 Criterion 5: Areas Associated with Key Evolutionary Processes.....	4-71
4.5 Priority Ecosystem Services.....	4-72
4.6 Impact Assessment.....	4-76

4.6.1	Critical Habitat Qualifying Mammals	4-76
4.6.2	Critical Habitat Qualifying Birds.....	4-78
4.6.3	Critical Habitat Qualifying Herpetofauna.....	4-78
4.6.4	Critical Habitat Qualifying Fish.....	4-79
4.6.5	Areas Associated with Key Evolutionary Processes	4-80

5. CONCLUSIONS AND RECOMMENDATIONS.....5-81

FIGURES

Figure 2-1:	Burapha’s existing plantation and land holding areas.....	2-18
Figure 3-1	Burapha Critical Habitat, Natural Habitat and Ecosystem Services Assessment Study Area.....	3-19
Figure 3-2	LULC classification workflow	3-22
Figure 4-1	National Protected Areas and Key Biodiversity Areas in the vicinity of Burapha Operations and Future Expansion PFAs.....	4-35
Figure 4-2	Forest loss 2000-2019 (Source: Hansen/UMD/Google/USGS/NASA).....	4-37
Figure 4-3	LULC classification of land earmarked for clearing for Burapha Na-An Plantation in 2019 (prior to clearance).....	4-41
Figure 4-4	NDVI of land cleared for Burapha Na-An Plantation in 2019 (prior to clearance).....	4-41
Figure 4-5	LULC classification of land earmarked for clearance for Burapha Namhai Nalang Plantation in 2020 (prior to clearance)	4-42
Figure 4-6	NDVI of land cleared for Burapha Namhai Nalang Plantation in 2020 (prior to clearance).....	4-42
Figure 4-7	Land use Land Cover in Phou Yeuy PFA retrieved using visual interpretation of satellite imager (Sentinel 31/01/2023).....	4-45
Figure 4-8	Land use Land Cover in Nongpet Naseng PFA retrieved using visual interpretation of satellite imager (Sentinel 31/01/2023).....	4-46
Figure 4-9	Land use Land Cover in Phoupadam PFA retrieved using visual interpretation of satellite imager (Sentinel 31/01/2023).....	4-47
Figure 4-10	<i>Nomascus leucogenys</i> potential Critical Habitat within the EAAA	4-53
Figure 4-11	Northern white-cheeked gibbon (<i>Nomascus leucogenys</i>) mother with child (Edwin Butler/Shutterstock.com).....	4-52
Figure 4-12	<i>Elephas maximus</i> potential Critical Habitat within existing plantations and concession PFAs in the EAAA.....	4-55
Figure 4-13	Asian elephant (<i>Elephas maximus</i>) (Logan Welsh/Shutterstock.com).....	4-54
Figure 4-14	<i>Tadarida latouchei</i> potential Critical Habitat within the EAAA.....	4-56
Figure 4-15	<i>Hipposideros khaokhouayensis</i> potential Critical Habitat within the EAAA	4-58
Figure 4-16	Phou Khao Khouay Leaf-nosed Bat (<i>Hipposideros khaokhouayensis</i>) (iNaturalist, https://www.inaturalist.org/photos/33536162).....	4-57
Figure 4-17	Siamese Crocodile (<i>Crocodylus siamensis</i>) (iNaturalist).....	4-59
Figure 4-18	Environmental Suitability for <i>Laotriton laoensis</i> (Chunco et al., 2013)	4-60
Figure 4-19	<i>Laotriton laoensis</i> potential Critical Habitat within the EAAA	4-61

Figure 4-20 *Laotriton laoensis* (shutterstock/photo ID: 333384278).....4-60

Figure 4-21 *Tropidophorus laotus* potential Critical Habitat within the EAAA.....4-63

Figure 4-22 Laotian water skink (*Tropidophorus laotus*) (Ian Dugdale, Jan 29, 2020, some rights reserved. CC BY 4.0. <https://inaturalist.nz/observations/38085346>).....4-62

Figure 4-23 *Emberiza aureola* potential Critical Habitat within the EAAA.....4-65

Figure 4-24 Yellow-breasted Bunting (*Emberiza aureola*).....4-64

Figure 4-25 *Schistura sigillata* and *Schistura ephelis* potential Critical Habitat within the EAAA.....4-66

Figure 4-26 *Laocypris hispida* potential Critical Habitat within the EAAA.....4-67

Figure 4-27 *Pseudecheneis sympelvica* potential Critical Habitat within the EAAA4-68

Figure 4-28 *Pangasius sanitwongsei* potential Critical Habitat within the EAAA4-69

Figure 4-29 *Cirrhinus microlepis* potential Critical Habitat within the EAAA.....4-70

TABLES

Table 1-1 Summary of Findings of the Preliminary Critical Habitat Assessment 1-11

Table 2-1 Step 2 of the land acquisition process based on Department of Forestry forest cover definitions.....2-16

Table 3-1 National classification system for habitat and land use in Lao PDR.....3-20

Table 3-2 Current Forest and Potential forest definitions in Lao PDR.....3-20

Table 3-3: Spatial data used in Land Use Land Cover mapping and Normalized Difference Vegetation Index (NDVI) Analysis.3-21

Table 3-4: Parameters used in the GIS analysis of classification of Natural and Modified Habitats.....3-23

Table 3-5 Stakeholder consultation list3-25

Table 3-6: Critical Habitat criteria, thresholds and guidelines outlined in IFC PS6 (IFC 2012; 2019)3-26

Table 3-7: Criteria for Assessment of Magnitude of Impacts.....3-30

Table 3-8: Impact Assessment Matrix.....3-31

Table 3-9: Risk Assessment Matrix.....3-31

Table 4-1 Land Use / Habitat Type cleared for Burapha plantation 2018-20234-37

Table 4-2 Mean NDVI values.....4-40

Table 4-3 Land Use Land Cover Classification for Burapha Concession PFAs.....4-44

Table 4-4 Critical Habitat Screening.....4-50

Table 4-5 Priority Ecosystem Services Assessment.....4-73

ACRONYMS AND ABBREVIATIONS

Acronym	Full Term
Aoi	Area of Investigation
AOO	Area of occupancy
CHA	Critical Habitat Assessment
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DBH	Diameter at Breast Height
EAAA	Ecologically appropriate area of analysis
EOO	Extent of occurrence
ES	Ecosystem services
ESIA	Environmental and Social Impact Assessment
GBIF	Global Biodiversity Information Facility
GIS	Geographic Information System
GN	Guidance Note
GoL	Government of Lao PDR
HCV	High Conservation Value
HEC	Human Elephant Conflict
IBAT	Integrated Biodiversity Assessment Tool
IFC	International Finance Corporations
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
LULC	Land Use Land Cover
MIGA	Multilateral Investment Guarantee Agency
MTP	Mekong Timber Plantation
NDVI	Normalized Difference Vegetation Index
NP	National Park
NPA	National Protected Area
NTFP	Non-timber forest products
PFA	Production Forest Area
PKK	Phou Khao Kouay
PS6	Performance Standard 6
SMA	Special Management Area
TFP	Timber forest products
ToR	Terms of Reference
UC	Upland Crop
UTM	Universal Transverse Mercator
WCS	Wildlife Conservation Society
WWF	World Wide Fund for Nature

EXECUTIVE SUMMARY

This Preliminary Critical Habitat Assessment has been prepared by Earth Systems on behalf of Burapha Agro-Forestry Co., Ltd (Burapha or the Company). As per the Terms of Reference (ToR), this document forms the first phase of the Critical Habitat Assessment of Burapha's concession Production Forest Areas in the Vientiane and Xayaboury Provinces (Lao, PDR) regarding the Multilateral Investment Guarantee Agency (MIGA's) Performance Standards on Environmental and Social Sustainability (MIGA, 2013) and International Finance Corporations (IFCs) Performance Standard 6 (PS6) and associated Guidance Note (GN6) on Biodiversity Conservation and Sustainable Management of Living Natural Resources (IFC, 2012, 2019).

Burapha has existing agroforestry plantations within the Vientiane Prefecture and the provinces of Vientiane, Xayaboury and Saysomboun of mostly eucalyptus and acacia hybrid. Burapha has intentions to scale up their development and production efforts through clearance of degraded forest areas and development of commercial agroforestry plantations within Burapha concessions.

The purpose of this assessment is to understand what biodiversity sensitivities are present within or in proximity to Burapha's concession areas, and what the overall biodiversity related impacts of the Project are. In line with the requirements of MIGA's Performance Standards, and IFCs PS6, this assessment aims to identify the extent of Natural and Modified Habitats, and provide a preliminary assessment of the presence and extent of Critical Habitat using criteria outlined in PS6 and Guidance Note 6 (IFC, 2012; IFC 2019). The assessment also aims to identify priority ecosystem services and potential Project-related impacts and recommends mitigation and management measures.

Natural Habitat and Modified Habitat

Under Burapha policies and procedures, Burapha targets areas for plantations as either being 'degraded' or 'barren' forest lands as defined in the Lao Forestry Law 2019. The law defines degraded forestland *as forestland area that has been heavily and continuously disturbed for many years and will take a number of decades to regenerate naturally. Degraded forestlands have a tree crown cover of no more than 10%, and a standing tree volume of no more than 20m³/ha, measuring only those trees of over 10 cm in diameter.* Barren forestland refers to forestland areas where forests have been heavily and continuously disturbed for many years causing the areas to become covered by grass (for example cogon grass and, bamboo grass) and shrubs, where trees cannot regenerate naturally.

Additionally, irrespective of the definition of forest types acquired, any forest remnants, tall trees, wetlands and stream buffers are protected under its Special management Area Policy. As a result, Burapha plantations are not contiguous but have interspersed SMAs for conservation. These provide important ecological and social benefits.

By definition comparison the PS6 has two related definitions, Natural Habitat (NH) and Modified Habitat (MH). The IFC definitions of Natural Habitat and Modified Habitat are as follows:

- ▶ "Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species components" (IFC, 2019); and
- ▶ "Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition" (IFC, 2019).

Although Modified Habitat as per PS6 may have similar characteristics to degraded and barren forest lands as defined by GoL, if 'degraded land' is considered to still contain the main characteristics and functions of a native

ecosystem, it can still be considered Natural Habitat. Degraded land may still revert to Natural Habitat (as defined by PS6) over time depending on the extent of anthropogenic disturbance in the surrounding area and pool of species available for recolonisation.

Land cleared for Burapha plantations between 2018-2023 (last five years at the request of MIGA) was analysed to determine whether Natural Habitat, as defined in PS6, has been lost as a result of Project activities. Approximately 2,854 ha of land has been cleared for Burapha plantations in the last five years, predominantly comprised of Upland Crop (1,254.97 ha), Young Fallow <5 years (805.20 ha), Old Fallow >5 years (636.06 ha), Bamboo (66.76 ha), existing plantations (82.57 ha), and other agriculture (6.09 ha). No areas of primary forest were cleared.

All habitats in the Study Area have experienced some level of anthropogenic disturbance, however if a habitat was considered to still contain the main characteristics and functions of a native ecosystem, it was designated as Natural Habitat. There is no distinct cut-off point between when regenerating forest previously modified from historic agricultural practices, becomes 'Natural Habitat'. So, to assist, additional parameters were used to determine whether regenerating vegetation should be classified as 'Natural' or 'Modified', including:

- ▶ Vegetation density / condition using Normalised Differential Vegetation Index (NDVI) analysis;
- ▶ Signs of anthropogenic disturbance (roads, settlements etc.);
- ▶ Distance from forest edge;
- ▶ History of swidden agriculture; and
- ▶ Photographs taken prior to clearance of the plantation.

As PFAs are designated for agriculture and commercial plantations, levels of disturbance in these areas is high and swidden cycles are short, generally three to seven years. Some areas are cleared annually for cash crops and with each successive burn the soil fertility, vegetation cover and seed bed deteriorate. Due to the high pressures on PFA land it is unlikely that a succession of regenerating forest becoming a functioning self-propagating forest ecosystem would occur within a fallow cycle. Therefore, only areas of in-tact forest (with some levels of disturbance) are considered Natural Habitat. All other types of land cover which are used for plantations (e.g., fallow forest, upland crop) can be considered Modified Habitat. As Burapha avoids clearing natural forest for plantations (and preserves it for SMAs), no areas of Natural Habitat were determined to have been lost as part of historical clearance for Burapha plantation establishment activities. However, areas of natural habitat may still be impacted by increased accessibility due to road upgrades, increased fire risk, and impacts to water quality.

However, Critical Habitat, which is an area supporting globally significant concentrations of species threatened with extinction, species with restricted ranges, or migratory/congregatory species, may occur in both areas of Natural Habitat, and degraded 'Modified' habitat. Even remnant patches of forest and seasonal wetlands in surrounding areas may support species which trigger Critical Habitat (see below for CH qualifying species).

GIS analysis identified approximately 83,000 ha of Natural Habitat remaining within Burapha's concession PFAs which totals to 264, 177 ha. Burapha's plans to expand their plantations to 60,000 ha within these three PFAs, in addition to other drivers of forest clearance in the area (e.g., commodity prices, soil quality), is likely to put additional pressure on remaining Natural Habitat, as locals may encroach on nearby forested areas to compensate for that lost to plantations and the reduced availability of land. Given that almost 50% of the remaining Natural Habitat within concession PFAs is within Nongpet-Naseng PFA, expansion into this PFA is likely to have the most significant impact to remaining Natural Habitat.

Preliminary Critical Habitat Assessment

Both the existing plantations and future expansion appear to be within Critical Habitat. These species are shown in Table 1-1 and discussed below.

Existing plantations

One species was found to qualify for Critical Habitat under Criterion 1a in existing plantations, three species are likely to qualify under Criterion 1-3 if found to be present in the area, and a further three will possibly qualify in the Study Area if found.

Species Qualifying under PS6 Criterion 1-3 for existing plantations:

- ▶ Asian elephant;

Species likely to qualify under PS6 Criterion 1-3 if found to be present in the Study Area:

- ▶ Northern white-cheeked gibbon;
- ▶ La Touche's free-tailed bat;
- ▶ Phou Khao Khouay leaf-nosed bat

Species which possibly qualify under PS6 Criterion 1-3 if present in the Study Area:

- ▶ Siamese crocodile;
- ▶ Yellow-breasted Bunting; and
- ▶ *Pseudecheneis sympelvica*.

With the exception of the Asian elephant whose presence has been confirmed, further surveys will be required to determine the presence or absence of the above-mentioned species and will inform any necessary offset requirements. If found to be present in the areas surrounding existing plantations, in addition to ensuring a net gain of CH, species-specific measures should be put in place to ensure there are no additional impacts to these species.

Future plantations

One species triggers CH in proposed expansion areas, eight species are likely to qualify if present, and four species possibly qualify if found to be present.

Species Qualifying under PS6 Criterion 1-3 within expansion PFAs:

- ▶ Asian elephant;

Species likely to qualify under PS6 Criterion 1-3 if found to be present in the expansion PFAs:

- ▶ Northern white-cheeked gibbon;
- ▶ La Touche's Free-tailed Bat;
- ▶ Phou Khao Khouay leaf-nosed bat
- ▶ Laotian water skink;
- ▶ Giant pangasius;
- ▶ Small scaled mud carp;
- ▶ *Schistura ephelis*, and
- ▶ *Schistura sigillata*.

Four species will possibly qualify under Criterion 1-3 if present within expansion PFAs:

- ▶ Laos warty newt;
- ▶ Yellow-breasted Bunting;
- ▶ *Laocypris hispida*;
- ▶ *Pseudecheneis sympelvica*

If found in expansion PFAs, areas that are considered Critical Habitat for the above species should be avoided in Burapha's expansion plans. In the unlikely event that Critical or Natural Habitat cannot be avoided, Burapha will

need to quantify those impacts and ensure that no net loss for Natural Habitat and net gain for Critical Habitat is achieved through the provision of offsets.

Given the size of the Production Forest Areas (PFAs), undertaking a valid CHA is challenging as it is not possible to undertake a site-specific CHA. As a result, it is likely that more species have reached the requisite thresholds to trigger CH than would normally occur. Burapha's plantations are widespread throughout the landscape and occur in three provinces which include a variety of aquatic and terrestrial habitat types. The plantations form a mosaic pattern, and predominantly occupy the ridge lines of ephemeral first and second order streams. If a CHA were undertaken for each discrete plantation, it is unlikely that all the above-mentioned species would qualify for Critical Habitat due to varying ranges across the landscape, and differing ecological requirements, which may be restricted to certain parts of the Study Area. Additionally, species may be restricted to habitats which are unlikely to be suitable for plantations (e.g., limestone caves, wetlands).

Even if all Critical Habitat is avoided, there is potential for the Project to directly or indirectly impact CH qualifying species. The key impacts to CH qualifying species include:

- ▶ The upgrade of access roads into PFAs may increase accessibility to difficult to access forested areas, particularly in Nongpet-Naseng PFA. Increased accessibility may lead to additional degradation of habitat for CH species such as Northern White-cheeked Gibbon and La Touche's Free-tailed Bat which rely on intact evergreen forest, as well as species decline through hunting and trading, which is commonly practiced in the PFAs.
- ▶ Future plantations within the home-range of elephants may also contribute to the already high levels of Human Elephant Conflict in the areas surrounding Nam Pouy NPA.
- ▶ Potential impacts on herpetofauna and fish would relate to downstream impacts such changes in hydrology, polluted runoff and ineffective implementation of watercourse buffers.

Table 1-1 Summary of Findings of the Preliminary Critical Habitat Assessment

Species Name	Common name	IUCN Red List Status	Criterion 1	Criterion 2	Criterion 3	CH triggered for existing Plantations	CH triggered for expansion PFAs
Mammals							
<i>Elephas maximus</i>	Asian Elephant	Endangered	Qualifying	N/A	N/A	Yes	Yes
<i>Nomascus leucogenys</i>	Northern White-cheeked Gibbon	Critically Endangered	Likely Qualifying	N/A	N/A	Yes	Yes
<i>Hipposideros khaokhouayensis</i>	Phou Khao Khouay Leaf-nosed Bat	Vulnerable	Likely Qualifying	Likely Qualifying	N/A	Yes	Yes
<i>Tadarida latouchei</i>	La Touche's Free-tailed Bat	Endangered	Likely Qualifying	N/A	N/A	Yes	Yes
Reptiles							
<i>Crocodylus siamensis</i>	Siamese Crocodile	Critically Endangered	Possibly Qualifying	N/A	N/A	Yes	No
<i>Tropidophorus laotus</i>	Laotian Water Skink	Endangered	Likely Qualifying	Likely Qualifying	N/A	No	Yes
<i>Cyrtodactylus pageli</i>	-	Least Concern	N/A	Likely Qualifying	N/A	No	No

Species Name	Common name	IUCN Red List Status	Criterion 1	Criterion 2	Criterion 3	CH triggered for existing Plantations	CH triggered for expansion PFAs
Amphibians							
<i>Laotriton laoensis</i>	Laos Warty Newt	Endangered	Possibly Qualifying	Unlikely	N/A	No	Yes
Birds							
<i>Emberiza aureola</i>	Yellow-breasted Bunting	Critically Endangered	Possibly Qualifying	N/A	Possibly Qualifying	Yes	Yes
Fish							
<i>Laocypris hispida</i>	-	Data Deficient	Possibly Qualifying	Possibly Qualifying	N/A	No	Yes
<i>Pangasius sanitwongsei</i>	Giant Pangasius	Critically Endangered	Likely Qualifying	N/A	Likely Qualifying	No	(Potential for downstream impacts)
<i>Schistura ephelis</i>	-	Data Deficient	Likely Qualifying	Likely Qualifying	N/A	No	Yes
<i>Schistura sigillata</i>	-	Data Deficient	Likely Qualifying	Likely Qualifying	N/A	No	Yes
<i>Pseudecheneis sympelvica</i>		Data Deficient	Possibly Qualifying	Possibly Qualifying	N/A	Yes	Yes
<i>Cirrhinus microlepis</i>	Small Scaled Mud Carp	Vulnerable	Not Qualifying	N/A	Likely Qualifying	No	Yes

Priority Ecosystem Services

Type I Priority Ecosystem Services for local beneficiaries are likely to be Regulating Services (Soil Erosion Regulation, Air Quality Regulation and Hydrological Services) and Supporting Services (Nutrient Cycling and Soil formation). Land acquired by Burapha does not appear to be important for provisioning services for local communities (e.g., hunting, TFP / NTFP collection), and areas identified as having cultural or spiritual significance to local communities are excluded from the land acquisition process.

Type II Priority Ecosystem Services, those on which the Project is reliant, include water supply for the for the plywood mill, sawmill and nursery, Regulating Services (Soil Erosion Regulation, Air Quality Regulation) and Supporting Services (Nutrient Cycling and Soil formation) which are necessary for healthy growth of plantations.

Project activities, such as land clearing and upgrade of access roads for new plantations may negatively impact Priority Ecosystem Services. However, active management of Burapha's Special Management Areas (SMA's) may provide benefits to Priority Regulating and Supporting services through the maintaining of riparian buffer zones and protection of areas from fire for the life of the plantation.

Recommendations

By using the results of this assessment to implement a biodiversity focused approach to land acquisition, in addition to increased management of Special Management Areas (SMA's), the company also has the opportunity to create a positive environmental legacy in an area where threats to biodiversity are extremely high.

Based on the results of this assessment, the following recommendations for Burapha's current operations and future expansion are:

1. Targeted surveys should be conducted to gain an understanding of the presence / absence of species which qualify for CH within the concession PFAs. In particular, a primatologist should conduct targeted surveys for *Nomascus leucogenys* in Nongpet Naseng PFA.
2. Findings of field surveys to be conducted as part of Phase 2 of the CHA, and ongoing stakeholder engagement will be used to update this report and inform any necessary offset requirements for existing plantations.
3. Incorporate findings of this assessment into the Land Acquisition Process to avoid expanding into in areas which may contain Critical Habitat. Where Critical Habitat cannot be avoided, targeted surveys for CH qualifying species should be conducted by a specialist and should inform any necessary offset requirements.
4. Implement a wildlife reporting system that includes provision of detailed biodiversity related information for sighting of any fauna species of interest.
5. Avoid acquisition of land in Nongpet-Naseng PFA with limited accessibility and adjacent to forested areas to avoid impacts to Natural Habitat through fragmentation and increased accessibility.
6. Develop a Management Plan to protect and enhance biodiversity values contained within the Special Management Areas (SMA's). This may include measures such as;
 - a. Enhancing connectivity to forested areas to allow for species migration;
 - b. Implementation of an Invasive Species Management Plan; and
 - c. Planting of species which are known to be important habitat for any CH qualifying species in the area such as fruit trees for *Nomascus leucogenys* and foraging habitat for bat species.
7. Conduct a further assessment of Natural and Modified habitat within PFAs.
8. Conduct community consultations to confirm Priority Ecosystem Services for local beneficiaries.

1. INTRODUCTION

The Land Degradation Neutrality Fund SLP of Luxemburg (LDN), and other potential lenders (the Guarantee Holders or GHs) are seeking MIGA guarantees for their investments into Burapha Agro-Forestry Co., Ltd (Burapha). Burapha intends to expand their existing agro-forestry plantations by 60,000 ha and increase capacity for manufacturing of plywood and timber products. This document presents the desk top Critical Habitat Assessment (CHA) that has been prepared by Earth Systems on behalf of Burapha. As per the Terms of Reference (ToR), this document forms the first phase of the CHA of Burapha's concession areas in Vientiane Prefecture and the provinces of Vientiane, Xayaboury and Saysomboun. Lao, PDR. It provides a preliminary assessment of the presence and extent of Natural, Modified and Critical Habitat and type of ecosystem services within the Project Study Area. The Study Area includes areas within and adjacent to Burapha's existing and potential plantation areas, with a focus on Production Forest Areas which have potential to be converted to commercial agroforestry plantations. This preliminary phase included a desk top analysis plus consultation with relevant stakeholders, as well as a site visit. The subsequent phase will fill gaps in knowledge through targeted field surveys and further stakeholder consultation.

The current phase is preliminary as it comprises a desktop analysis of existing information supported by field visits in consultation with MIGA biodiversity specialist in March 2023. The subsequent phase will fill gaps in knowledge through targeted field surveys and further stakeholder consultation.

1.1 Objectives

The purpose of this document is to understand what biodiversity sensitivities are present within or in proximity to Burapha's concession areas, and what the overall biodiversity related impacts of the Project are. In line with the requirements of MIGAs Performance Standards on Environmental and Social Sustainability (MIGA, 2013) this assessment aims to identify the extents of Natural and Modified Habitat and provide a preliminary assessment of the presence and extent of Critical Habitat using criteria outlined in PS6 and Guidance Note 6 (IFC, 2012; IFC 2019). Similarly, in line with PS6, this assessment aims to identify priority ecosystem services, potential Project-related impacts to priority ecosystem services and recommends mitigation and management measures.

1.2 The Project

The plantations cover approximately 6159 ha of private land acquired under various land lease agreements with farmers and village cooperations, and concession land from the Government of Laos (GoL). Burapha's plantations are all Forest Stewardship Council (FSC) certified. Burapha implements a seven-year plantation cycle and an agroforestry model, whereby local villagers are given the option to practice intercropping with annual crops such as rice during year 1-2, and cattle-grazing from years 3 to 7. Burapha's concessions are mostly eucalyptus and acacia hybrid. Some of the existing and all the expansion sites will be located in three Production Forest Areas (PFAs, Figure 2-1) which cover natural and planted forests designated for supply of timber forest products (TFPs) non-timber forest products (NTFPs) as commodities to meet requirements of national and socio-economic development. As stated above, Burapha plan to scale up their development and production efforts through development of commercial agroforestry plantations in degraded forest areas of these concessions. There is potential for accessing up to 60,000 ha within these PFAs and Burapha plan to plant 1,000 ha in 2023.

Burapha also operates a plywood manufacturing mill in Hinheup District Vientiane Province, approximately 100 km northwest of Vientiane Capital. The raw timber is sourced from both Burapha's plantations and other holdings (if chain-of-custody sustainability criteria are met). Burapha also own a sawmill and furniture factory at Nabong, Xaythani District Vientiane Capital to process wood grown in the Company's plantations as well as timber purchased from outside entities.

1.3 MIGA/IFC Performance Standards

Burapha has committed to comply with MIGA's Policy on Environmental and Social (E&S) Sustainability (2013) which are equivalent to International Finance Corporations (IFCs) Performance Standard 6 (PS6) and associated Guidance Note (GN6) on Biodiversity Conservation and Sustainable Management of Living Natural Resources (IFC, 2012, 2019).

PS 6 and associated Guidance Note 6 describe three classes of habitat to which the performance standard applies: Modified habitat, Natural Habitat, and Critical Habitat. Modified habitats are those that have been altered by human activity and largely comprise non-native species, such as agricultural land and plantations. Natural Habitats comprise species of largely native origin, and whose primary ecological functions have not been altered. Areas of "high biodiversity value" are termed Critical Habitat and are designated on the presence of one or more of five main criteria. The determination of Critical Habitat however is not necessarily limited to these criteria and in some circumstances, modified habitats retain significant biodiversity value and can be defined as Critical Habitat.

Performance Standard 6 requires certain conditions to be met if a project affects Natural or Critical Habitat.

The client will not significantly convert or degrade natural habitats, unless all of the following are demonstrated:

- ▶ No other viable alternatives within the region exist for development of the project on modified habitat;
- ▶ Consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of conversion and degradation; and
- ▶ Any conversion or degradation is mitigated according to the mitigation hierarchy.

In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible.

In areas of Critical Habitat, the project will not implement any project activities unless all of the following are demonstrated:

- ▶ No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical.
- ▶ The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values;
- ▶ The project does not lead to a net reduction in the global and/or national/regional population of any Critically Endangered or Endangered species over a reasonable period of time; and
- ▶ A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client's management program.

2. BACKGROUND

2.1 Land Acquisition Process

Under Burapha policies and procedures, Burapha targets areas for plantations as either being ‘degraded’ or ‘barren’ forest lands as defined in the Lao Forestry Law 2019. The law defines degraded forestland *as forestland area that has been heavily and continuously disturbed for many years and will take a number of decades to regenerate naturally. Degraded forestlands have a tree crown cover of no more than 10%, and a standing tree volume of no more than 20m³/ha, measuring only those trees of over 10 cm in diameter.* Barren forestland refers to forestland areas where forests have been heavily and continuously disturbed for many years causing the areas to become covered by grass (for example cogon grass and, bamboo grass) and shrubs, where trees cannot regenerate naturally.

There are three steps to Burapha’s land acquisition process as it relates to Biodiversity:

1. Remote sensing of satellite imagery is used to determine a preliminary Area of Investigation (Aoi) which is potentially suitable for acquisition; “*slope over 35 degrees as well as natural forest and permanent agricultural land are identified and provisionally set aside*” as part of this process.
2. Suitable areas (refer to Table 2-1) are surveyed by drone to create orthomosaic imagery to determine with added precision the Exploration Area which is to be surveyed by foot.
3. Burapha personnel, representatives from Ministry of Agriculture and Forestry (MAF), Ministry of Natural Resources and Environment (MoNRE) village authorities, and farmers deemed to be familiar with the area conduct a field survey of the exploration area. The team collects information on vegetation type, land use and land users within the Exploration Area.

After land is identified and made available after consultations, the Forestry Department of Burapha undertake additional field and drone surveys in preparation for land clearing and planting.

Table 2-1 Step 2 of the land acquisition process based on Department of Forestry forest cover definitions

National Classification System		Level	Regeneration status	Biodiversity-based acquisition decision	Next step
Level 1	Level 2				
Potential Forest	Bamboo and Regenerating vegetation	<4 years	Acquire	Assess social impact	
		5 years	- If contiguous to other swidden land: acquire - If contiguous to natural forest and/or isolated: do not acquire	If suitable, assess social impact	
		6 years		If suitable, assess social impact	
		7 years		If suitable, assess social impact	
		>7years	Do not acquire	N/A	

Source: Burapha Agro Forestry Land Acquisition Process Manual (2019)

Burapha currently applies protection status to a range of sensitive environments within or adjacent to its plantations. These areas are termed Special Management Areas (SMA) and include:

- ▶ Archaeological, cultural and spiritual sites;
- ▶ Buffer zones along water courses;
- ▶ Steep lands above 35 degrees;

- ▶ Wetlands;
- ▶ Stands of existing native trees; and
- ▶ High Conservation Value (HCV) areas.



Plate 2-1: Special Management Area (Riparian Buffer Zone) 7/2/2023 (UTM 47N: E: 808699, N: 2052105)

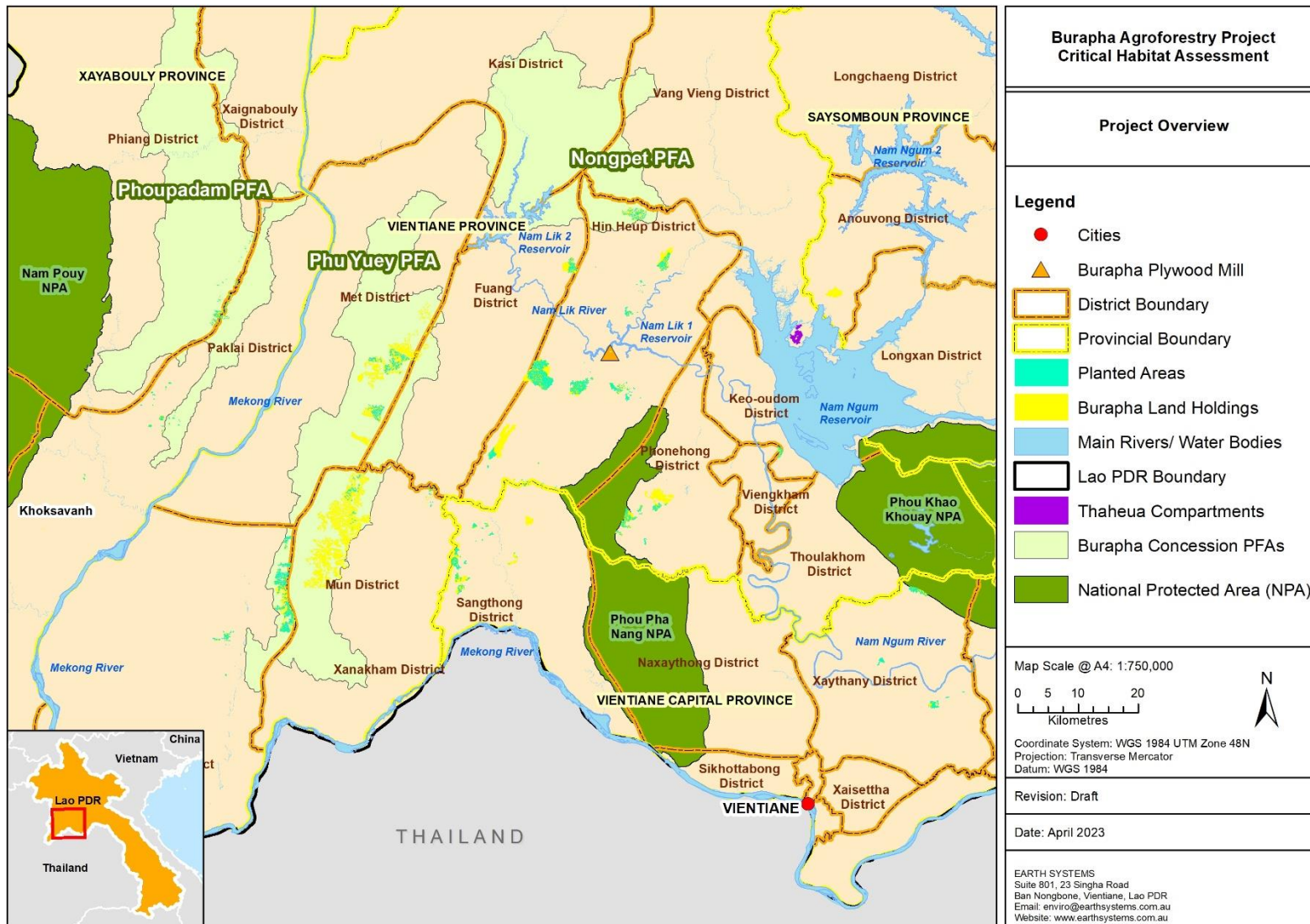


Figure 2-1: Burapha's existing plantation and land holding areas.

3. METHODOLOGY

3.1 Study Area

Collectively the three Concession PFAs, existing plantations and supply plantations are referred to as the Project Area while the Study Area refers to the Project Area and surrounding areas that may be impacted by the Project (See Figure 3-1 below). This includes:

- ▶ Burapha’s existing plantations and future expansion PFAs;
- ▶ Forested areas and National Protected Areas with connectivity to existing plantations and PFAs; and
- ▶ Aquatic habitats within, upstream and downstream of the proposed development areas;
- ▶ Villages nearby to existing plantations and PFAs.

Key terminology used in this assessment includes:

- ▶ *concession PFAs* which refer to the three PFAs under management by Burapha;
- ▶ *existing plantations* which refer to the areas planted by Burapha in the past five years (since 2018); and
- ▶ *supply plantations* which have previously provided timber to the Burapha Mill, with the possibility of doing so in the future.

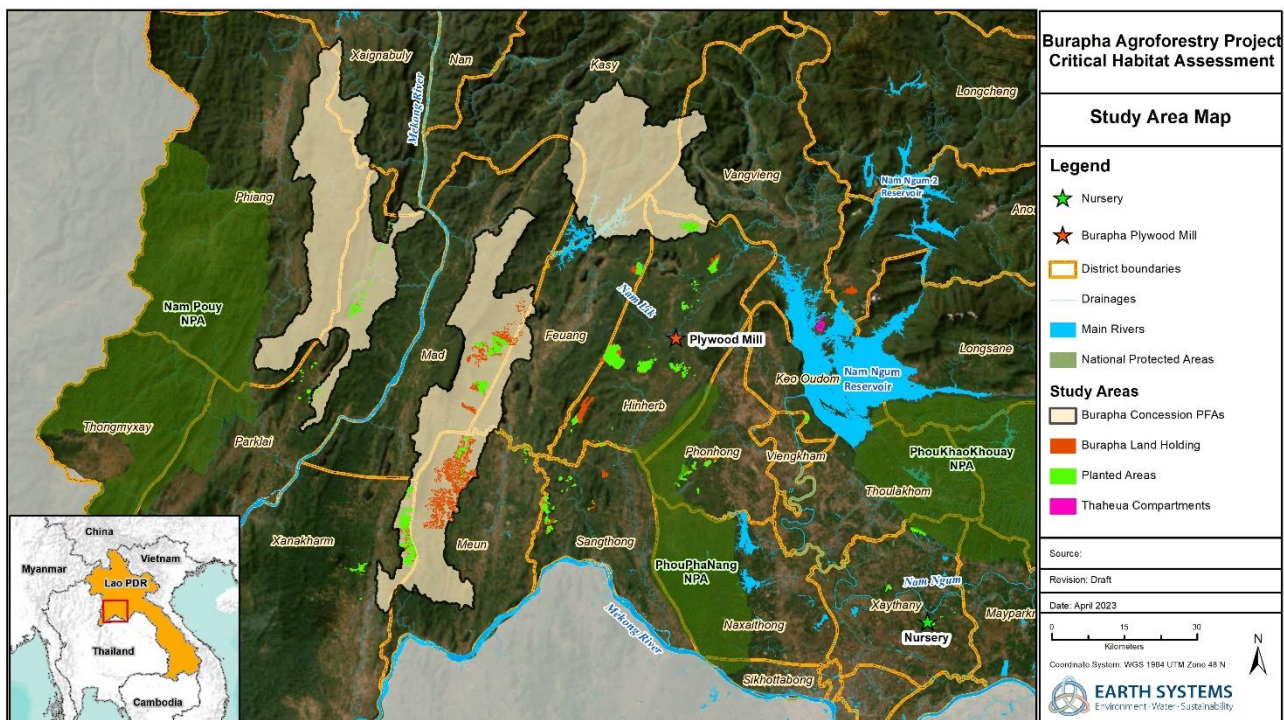


Figure 3-1 Burapha Critical Habitat, Natural Habitat and Ecosystem Services Assessment Study Area.

3.2 Habitat Mapping

To quantify potential impacts of the Project on Critical, Natural and Modified Habitats, Major Land Use Land Cover (LULC) types were mapped within the Study Area. LULC types were classified using the National Level Classification System for Lao PDR Level 2 classification of habitats (Table 3-1 and Table 3-2).

LULC types were mapped in existing plantations using visual interpretation of high-resolution satellite imagery captured prior to their clearance in 2018, 2019, 2020, 2021 and 2022, ariel drone photography of all three PFAs in

2019, and publicly available land cover maps (Table 3-3). LULC types in the concession PFAs were mapped using supervised classification (the Maximum Likelihood Classifier) of high-resolution satellite imagery captured in 2023 (Table 3-3). This process is summarised in Figure 3-2.

Table 3-1 National classification system for habitat and land use in Lao PDR

IPCC* Definition	National Level Classification System for Lao PDR	
	Level 1	Level 2
Forest Land	Current Forest	Evergreen Forest
		Mixed Deciduous Forest
		Dry Dipterocarp Forest
		Coniferous Forest
		Mixed Coniferous and Broadleaved Forest
		Forest Plantation
	Regenerating Vegetation (Potential Forest)	Bamboo
		Regenerating Vegetation
Grassland	Other Vegetated Areas	Savannah
Wetlands		Scrub
		Grassland
Cropland	Cropland	Swamp
		Upland Crop
		Rice Paddy
		Other Agriculture
Settlements	Non-Vegetated Areas	Agriculture Plantation
		Urban
Other Land	Other Land	Barren Land and Rock
		Other Land
Wetlands	Water	Water
Other	Other	Cloud
		Cloud Shadow

Source: Ministry of Agriculture and Forestry, Lao PDR

* IPCC - Intergovernmental Panel on Climate Change

Table 3-2 Current Forest and Potential forest definitions in Lao PDR

Current Forest	Potential Forest
Stand DBH: minimum of 10cm Crown density: minimum of 20%	Lands previously forested, but presently not meeting the definition of "Current Forest" due to various disturbances, and expected to be restored to "Current co

Current Forest	Potential Forest
Minimum area of 0.5ha.	Continuously left Forest" undisturbed, status if and not permanently being used for other purposes (i.e. residential, agriculture etc.). It also does not include Upland Crop (UC), despite its common nature as a cropping stage of shifting cultivation cycle, based on de facto land use at the time of observation.

Source: Ministry of Agriculture and Forestry, Lao PDR, 2018

Table 3-3: Spatial data used in Land Use Land Cover mapping and Normalized Difference Vegetation Index (NDVI) Analysis.

Name	Format	Date	Source
Sentinel-2 Imageries (10 m spatial resolution)	Tiff	12 Jan 2018	The Copernicus Open Access Hub: https://scihub.copernicus.eu/dhus/#/home
		06 Feb 2019	
		1-11 Feb 2020	
		21-25 Feb 2021	
		02 March 2022	
		31 Jan 2023	
National Land Use Land Cover	Shapefile	2015	Forest Inventory and Planning Division, Ministry of Agriculture and Forestry
Crop Land Cover	Tiff	2019	Department of Agricultural Land Management, Ministry of Agriculture and Forestry
High Resolution Imagery (1 m spatial resolution)	Tiff	2019	Burapha
Very-high resolution historical imageries	Tiff	2014 - 2022	GoogleEarth

Normalized Difference Vegetation Index (NDVI) Analysis

NDVI is a common method to quantifying vegetation greenness based on the spectral reflectance of the ground surface feature. The NDVI value is derived from the calculation on per-pixel basis of the normalized difference between the red band (0.665 µm) and near infrared band (0.842 µm). NDVI value ranges between -1 to +1. A Higher value of NDVI infers the presence of healthy vegetation in the area while its lower value is the indicator of sparse vegetation. Negative NDVI values normally correspond to non-vegetation areas /barren land and water areas.

NDVI can be used to measure vegetation density (canopy cover) and condition (canopy 'greenness') and differentiate between habitat types (Achard and Blasco, 1990; Senay and Elliot, 2002). Studies in Lao PDR have found regenerating forest areas to reach the same NDVI value as forested areas approximately eight years following swidden (Liao et al., 2015; Yamamoto et al, 200). To investigate whether NDVI could be used to measure vegetation recovery / used as a proxy for 'habitat health' in the Study Area, mean NDVI values for areas of young fallow, old fallow and natural forest were compared. NDVI statistics were extracted for each young and old fallow area mapped prior to plantation development between 2018 to 2022 (average sample size / year = 78). As no plantations were developed in areas of natural forest, NDVI statistics for natural forest were extracted for 80, 1 hectare quadrats randomly placed in the three Protected Areas in the Study Area (Phou Khao Khouay NP, Phou Pha Nang NPA and Nam Pouy NPA).

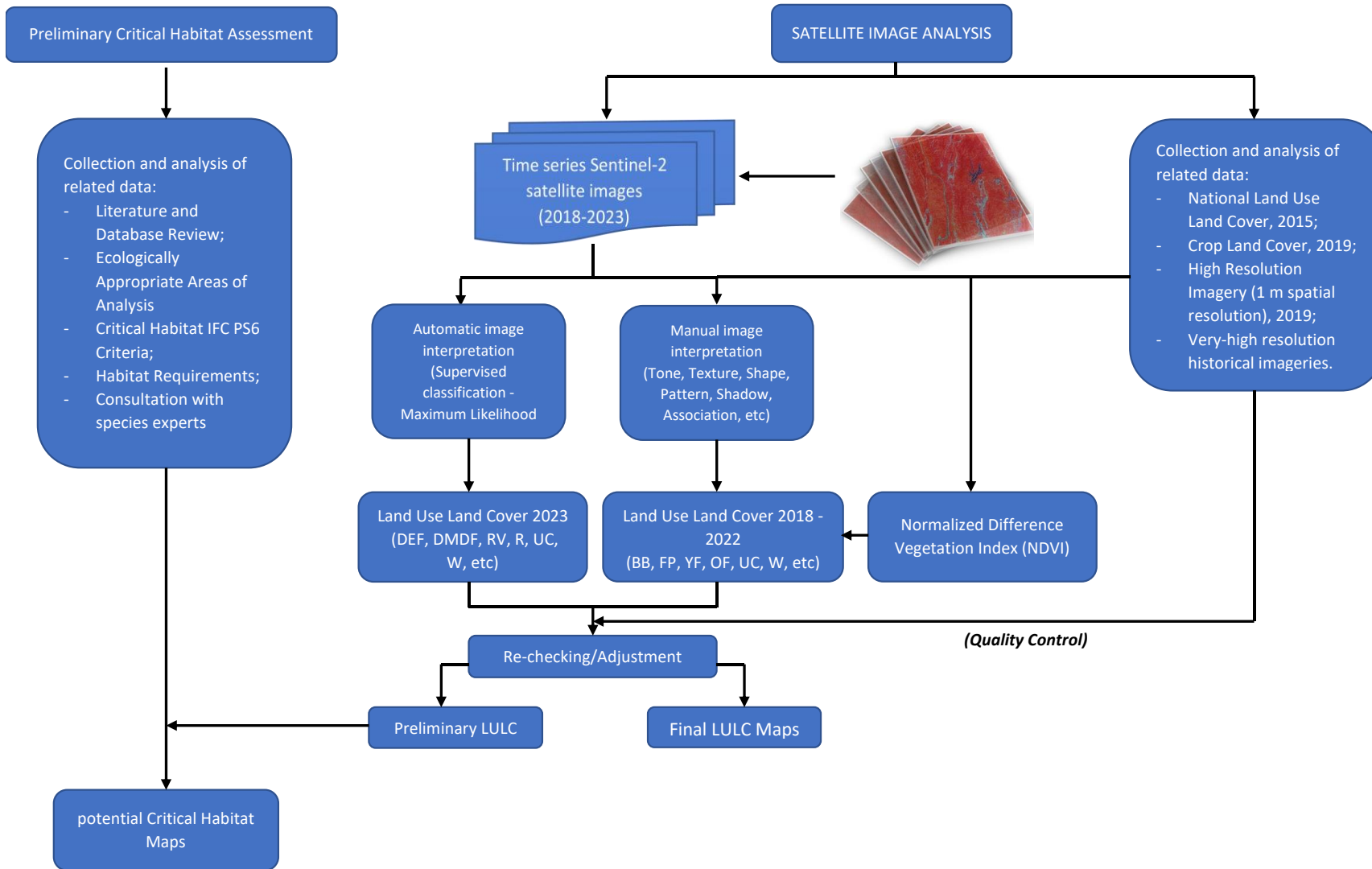


Figure 3-2 LULC classification workflow

Classification of Natural and Modified Habitat

Natural Habitat and Modified Habitat has been identified using the IFC PS6 Guidance Note (IFC, 2019). The IFC definitions of Natural Habitat and Modified Habitat are as follows:

- ▶ “Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area’s primary ecological functions and species components” (IFC, 2019); and
- ▶ “Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area’s primary ecological functions and species composition” (IFC, 2019).

As per the IFC PS6 Guidance Note the determination of Natural Habitat and Modified Habitat has been made using scientific analysis of the best available information (IFC, 2019). All habitats in the Study Area have experienced some level of anthropogenic disturbance, however if a habitat was considered to still contain the main characteristics and functions of a native ecosystem, it was designated as Natural Habitat.

An assessment of Natural Habitat and Modified Habitat was undertaken based on desktop GIS analysis using several metrics related to the condition of vegetation and level of disturbance (Table 3-4), including:

- ▶ Vegetation density / condition using Normalised Differential Vegetation Index (NDVI) analysis;
- ▶ Signs of anthropogenic disturbance (roads, settlements etc.);
- ▶ Distance from forest edge;
- ▶ History of swidden agriculture; and
- ▶ Photographs taken prior to clearance of the plantation.

Reconnaissance surveys conducted in March 2023 were undertaken to verify desktop work (see Section 3.2.2 below).

Table 3-4: Parameters used in the GIS analysis of classification of Natural and Modified Habitats

Classification	Definition
Habitat Type	
Mixed Deciduous Forest	Defined as the deciduous tree species represent more than 50% of the stand. The forest storeys are not as dense as those of evergreen types and most of the seedlings and saplings are deciduous trees. Most often bamboo occurs in this type of forest.
Evergreen Forest	Defined as a multi storey forest consisting of more than 50% trees of evergreen species. Most of the trees have long and cylindrical boles, many of them with a big buttress. Usually, the height of the trees of the upper storey is more than 30 m. The dense second storey prevents most of the light from reaching the ground floor. Another typical characteristic of this forest type are climbers and lichen on the tree stems. Bamboo is usually not found except when the canopy has been opened.
Regenerating Forest	Defined as the previously forested areas in which the crown density has been reduced to less than 20% because of logging or heavy disturbance, If the area is left to grow undisturbed it will become forest again.
Bamboo Forest	Defined as the area covered with bamboo more than 80%. Abandoned upland crop is often recovered by bamboo. Bamboo brakes may vary in height from 2 m to 25 m depending on their species.
Upland Crop	Defined as an area where the forest has been cut and burnt for temporary cultivation of rice and other crops. Area that have been abandoned for more than 2 years should be classified as Regenerating Vegetation.
Rice Paddy	Defined as an area permanently being used for rice cultivation. Old paddy that has been abandoned for more than one year should not be classified as Rice Paddy

Classification	Definition
Other Agriculture	Defined as the agricultural land being used for production of other crops than rice and agriculture plantation, i.e. various kinds of vegetables such as sugarcane, millet, cotton, and etc.
Roads/Tracks	Roads or tracks
Water	Natural or man-made water body
Recency of Clearing for Swidden Agriculture	
High Impact	Concession PFAs: Upland crop area, recently cleared / currently being cultivated Existing Plantations: upland crop, cleared <6 months prior to plantation development
Moderate Impact	Concession PFAs: Young swidden, cleared <2-7 years ago Existing Plantations: swidden, cleared <2-7 years prior to plantation development
Low Impact	Concession PFAs: Old fallow, cleared >7 years ago Existing Plantations: Old fallow, cleared >7 years prior to plantation development
Surrounding Anthropogenic Disturbance / Distance from Forest Edge	
High Disturbance	Surrounding habitat predominantly impacted by swidden, agriculture, etc. Forest edge > 500 m from plantation area
Moderate Disturbance	Surrounding habitat has been moderately impacted by anthropogenic disturbance. Forest edge 150-500 m from plantation area
Low Disturbance	Surrounding habitat has a low level of anthropogenic disturbance. Forest edge < 150 m from plantation area
IFC Habitat Classification	
Natural Habitat	Low Impact, Low Disturbance
Modified Habitat	Moderate-High Impact, Moderate to High Disturbance

NDVI: Normalised Differential Vegetation Index

Source: Global Forest Resources Assessment (FRA, 2020)

Desktop Critical Habitat Assessment

As defined by IFC (2019) “Critical habitats are areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes”. Both Natural and Modified Habitat may be classified as Critical Habitat.

The Phase 1 Critical Habitat screening is considered preliminary as no detailed habitat or species specific has been undertaken and there is not sufficient data available regarding species distributions and populations within the Study Area to inform a full assessment.

This preliminary assessment of Critical Habitat includes (1) a desktop analysis of available literature and databases, (2) reconnaissance surveys conducted in March 2023 (3) stakeholder consultation and (4) a screening of species and habitats against IFC PS6 criteria for preliminary determination of Critical Habitat.

The Phase 1 preliminary assessment will be validated and updated using species records during the Phase 2 assessment which may include a range of targeted field-based surveys where relevant.

3.2.1 Literature and Database Review

Candidate biodiversity values (e.g. species, sub-species, sub-populations and habitats) that may occur within the Study Area (refer to Figure 3-1) were identified based on a review of the available literature and existing baseline data, however, there is a general paucity of up to date literature in Lao PDR. Areas of high biodiversity value in the

surrounding areas including protected or designated areas, habitats of high biodiversity value and species of conservation concern have been investigated. Existing baseline data from Burapha included:

- ▶ Wet and dry season field surveys Conducted in Nong Pet, Phu Yuey PFAs between 2020-2022;
- ▶ High Conservation Value (HCV) Assessment. Earth Systems, 2017;
- ▶ NDVI Remote Sensing Analysis. Historical Vegetation Cover Characteristics of Burapha Plantations 2016 to 2021. Lao Consulting Group, 2022; and
- ▶ Burapha Mill Project ESIA – Earth Systems, 2016.

Additional biodiversity values were identified using the Integrated Biodiversity Assessment Tool (IBAT) which draws together information from a number of sources including the International Union for Conservation of Nature (IUCN) Red List of Threatened Species and Key Biodiversity Areas (KBAs). The following ecological information relevant to each candidate biodiversity feature was obtained from published literature, databases, records and stakeholder consultation:

- ▶ Estimates of population size at global and national levels;
- ▶ Estimates of population density at global and national levels;
- ▶ Ranges of extent of occurrence (EOO) at global and national levels;
- ▶ Distribution maps of the species ranges;
- ▶ Area of occupancy (AOO) at global and national levels;
- ▶ Reproductive units of a species at global and national levels (i.e. number of breeding pairs); and
- ▶ Reliable records of species distribution and numbers and reproductive units within known protected areas relevant to the area of analysis and the surrounding landscapes.

Candidate features were then screened against IFC’s criteria to determine Critical Habitat-qualifying species as outlined below (IFC 2012; IFC 2019;).

3.2.2 Field surveys

Walkover surveys were undertaken in March 2023 in consultation with MIGA biodiversity specialist to characterise the extent of habitat types within the Study Area. Existing plantations and future expansion areas within Phu Yuey and Nongpet-Naseng PFA, as well as non-PFA land holdings and third-party supplier plantations were visited.

3.2.3 Stakeholder Consultation

Stakeholder consultation was undertaken to inform and validate the analysis of biodiversity values within the Study Area and to collect relevant information related to identified biodiversity values. Consultations were undertaken with:

- ▶ Local experts on terrestrial and aquatic biodiversity in Lao PDR; and
- ▶ Non-Government Organisations that operate locally with Lao PDR including the Wildlife Conservation Society (WCS) and World Wide Fund for Nature (WWF).

The list of stakeholders consulted and details of consultations are summarised in Table 3-5.

Table 3-5 Stakeholder consultation list

Stakeholder Group	Stakeholder Contact	Organisation	Reason for Inclusion	Correspondence Type
Non-Governmental / International Organisation	Santi Saypanya	WCS Laos	Key stakeholder for biodiversity with a good network and knowledge of biodiversity and conservation initiatives in Lao PDR	Video conference

Stakeholder Group	Stakeholder Contact	Organisation	Reason for Inclusion	Correspondence Type
	Chris Hallam	WWF Lao PDR	Key stakeholder for biodiversity with a good network and knowledge of biodiversity and conservation initiatives in Lao PDR.	Video conference
Recognised species specialist	Bryan Stuart	North Carolina Museum of Natural Sciences	Key source of information for Laos warty newt	Email correspondence
	Somphouthone Phimmachak	National University of Laos	Key source of information for Laos warty newt	Email correspondence
	Thong Vu Dinh	Institute of Ecology and Biological Resources	Key source of information for bat species	Email correspondence (pending response)

3.2.4 Determination of Critical Habitat

This preliminary assessment of Critical Habitat based on desktop analysis and field surveys is described below. Additional field surveys across the Study Area may be required to validate species distribution data and records or sightings based on stakeholder information to confirm the presence and extent of Critical Habitat. Given the size of the Production Forest Areas (PFAs) and the fact that the location of management units within the PFAs are unknown at present, undertaking a valid CHA is challenging as it is not possible to undertake a site-specific CHA. As a result, it is likely that more species will reach the requisite thresholds to trigger CH than would normally occur.

Ecologically Appropriate Areas of Analysis

The scale at which Critical Habitat is assessed depends on underlying ecological processes and biodiversity features for the habitat in question, and therefore must not focus solely on the project site (Guidance Note (GN)58: IFC, 2019). The determination of Critical Habitat should be based on an ecologically appropriate area of analysis (EAAA) which is '*an area with a definable boundary within which the character of biological communities and/or management issues have more in common with each other than they do with those in adjacent areas*' (IFC, 2012).

The assessment has been undertaken at the species level. For each species qualifying for consideration, relevant EAAAs were identified. Some EAAAs are similar for some species, however where appropriate differing EAAAs were defined for separate species. A range of data sources including satellite imagery, GIS maps of physical and biological features (such as topography, watersheds, vegetation types, etc.) and human landscape features (such as settlements, roads, etc.) were reviewed. Taxon-specific surveys undertaken during Phase 2 may increase understanding of species presence and distribution in the Study Area which may lead to updates and refinement of some EAAAs.

Critical Habitat IFC PS6 Criteria

Critical Habitat can be identified using the Critical Habitat criteria outlined in IFC PS6, these are summarised in Table 3-6. Four of the five criteria are characterised by defined quantitative thresholds (Criteria 1-4) and one criterion with a qualitative threshold (Criterion 5). Candidate features were screened against these criteria and thresholds to determine critical habitat features.

Table 3-6: Critical Habitat criteria, thresholds and guidelines outlined in IFC PS6 (IFC 2012; 2019)

Criteria	Critical Habitat Thresholds and Guidance
1. Critically Endangered (CR) / Endangered (EN) Species	Thresholds: a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species ($\geq 0.5\%$ of the global population AND ≥ 5 reproductive units of a CR or EN species).

Criteria	Critical Habitat Thresholds and Guidance
	<p>b) Areas that support globally important concentrations of an IUCN Red-listed VU species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds under (i).</p> <p>c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.</p> <p>Guidance:</p> <ul style="list-style-type: none"> Species threatened with global extinction and listed as CR and EN on the IUCN Red List of Threatened Species shall be considered as part of Criterion 1. The inclusion of species that are listed nationally/regionally as CR or EN in countries that adhere to IUCN guidance shall be determined on a project-by-project basis in consultation with competent professionals.
<p>2. Endemic/ Restricted Range Species</p>	<p>Threshold:</p> <p>a) Areas that regularly hold $\geq 10\%$ of the global population size AND ≥ 10 reproductive units of a species.</p> <p>Guidance:</p> <ul style="list-style-type: none"> The term endemic is defined as restricted-range and restricted-range refers to a limited extent of occurrence (EEO). For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an EEO $< 50,000 \text{ km}^2$. For marine systems, restricted-range species are provisionally being considered those with an EEO $< 100,000 \text{ km}^2$. For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (for example, rivers), restricted range is defined as having a global range of $\leq 500 \text{ km}$ linear geographic span (i.e., the distance between occupied locations furthest apart).
<p>3. Migratory/ Congregatory Species</p>	<p>Threshold:</p> <p>a) Areas known to sustain, on a cyclical or otherwise regular basis, $\geq 1\%$ of the global population of a migratory or congregatory specie at any point of the species lifecycle.</p> <p>Guidance:</p> <ul style="list-style-type: none"> Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem). Congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis.
<p>4. Highly Threatened and/or Unique Ecosystems</p>	<p>Thresholds:</p> <p>a) Areas representing $\geq 5\%$ of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN.</p> <p>b) Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.</p> <p>Guidance:</p> <ul style="list-style-type: none"> The IUCN is developing a Red List of Ecosystems, following an approach similar to the Red List for Threatened Species. The client should use the Red List of Ecosystems where formal IUCN assessments have been performed. Where formal IUCN assessments have not been performed, the client may use assessments using systematic methods at the national/regional level, carried out by governmental bodies, recognized academic institutions and/or other relevant qualified organizations (including internationally recognised NGOs).
<p>5. Key Evolutionary Processes</p>	<p>Guidance:</p> <ul style="list-style-type: none"> This criterion is defined by the physical features of a landscape that might be associated with particular evolutionary processes; and/or Subpopulations of species that are phylogenetically or morphologically distinct and may be of special conservation concern given their distinct evolutionary history. <p>Examples of spatial features associated with key evolutionary processes:</p> <ul style="list-style-type: none"> Landscapes with high spatial heterogeneity are a driving force in speciation, as species are naturally selected based on their ability to adapt and diversify.

Approach to Criteria 1 to 3: Critical and Endangered Species / Endemic Restricted Species / Migratory or Congregatory Species

The IFC thresholds for Criteria 1 to 3 are based on percentages of global and national population sizes, combined with the minimum numbers of reproductive units. There are often instances where a species' population is largely unknown, and in these cases the first three criteria may be assessed with percentages of global distribution ranges.

For each species assessed the population size, EOO and AOO were obtained or calculated, and the proportion represented by the EAAA for that species was calculated. These outputs were then screened against the significance thresholds defining critical habitat outlined in Table 3-6. For CR, EN and VU or endemic species for which population distribution is not well understood, an assessment of the importance of the broader landscape was made based on literature review, professional judgement and where possible expert opinion.

The assessment of each species against the threshold criteria was preferentially based on the proportion of the species' global population or reproductive units estimated to occur within the EAAA, however owing to limited population data, often the proportion of species' global distribution range overlapping with the EAAA was assessed against the criteria. Where some information was lacking or unclear a precautionary approach was taken.

This assessment also considered any subspecies and sub-populations that are individually assessed on the IUCN Red List of Threatened Species (IUCN, 2023).

Approach to Criterion 4: Highly Threatened and Unique Ecosystems

Guidance Note 6 indicates that the CHA should use the Red List of Ecosystems (IUCN-CEM, 2016) where formal IUCN assessments have been performed, however where formal IUCN assessments have not been performed, the CHA may use assessments using systematic methods at the national/regional level, carried out by governmental bodies, recognized academic institutions and/or other relevant qualified organizations (including internationally recognized NGOs) (IFC, 2019).

The IUCN Red list of Ecosystems follows a similar approach to the IUCN Red List of Threatened Species (IUCN-CEM, 2016; IFC, 2019). The IUCN Red List of Ecosystems uses the following criteria outlined in Bland et al. 2017 to assess globally threatened ecosystems:

A: Reduction in geographic distribution over any of the following time periods

- *A1: Over last 50 years (CR ≥ 80% decline, EN ≥ 50% decline, VU ≥ 30% decline)*
- *A2a: Over the next 50 years (CR ≥ 80% decline, EN ≥ 50% decline, VU ≥ 30% decline)*
- *A2b: Any past, present or future 50-year period (CR ≥ 80% decline, EN ≥ 50% decline, VU ≥ 30% decline)*
- *A3: Since 1750 (CR ≥ 90% decline, EN ≥ 70% decline, VU ≥ 50% decline)*

B: Restricted geographic distribution. Condition 1: Restricted distribution, Condition 2: Evidence of ongoing or future decline, threat or few locations:

- *B1: Small EOO AND threats*
- *B2: Small AOO AND threats*
- *B3: Very small (generally fewer than 5) AND prone to the effects of human activities or stochastic events within a very short time period = VU*

C: Environmental degradation. Observed or predicted decline relative to the amount of decline required until collapse.

D: Biotic disruption. Observed or predicted decline relative to the amount of decline required until collapse.

E: probability of collapse. Applied using a process-based ecosystem simulation model:

- *CR ≥ 50% in 50 years*
- *EN ≥ 20% in 50 years*
- *VU ≥ 10% in 100 years*

However, the IUCN Red list of Ecosystems is still under development and no formal assessments have been undertaken for terrestrial habitats within Lao PDR. Therefore, the assessment of Criterion 4 relied on assessments carried out by governmental bodies, recognized academic institutions and internationally recognized NGOs as per GN 6 (IFC, 2019).

Approach to Criterion 5: Key Evolutionary Processes.

Guidance Note 6 (IFC, 2019) identifies two key factors defining the presence of key evolutionary processes: the physical features of a landscape or seascape, and subpopulations of species that are phylogenetically or morphologically distinct. Such areas may typically be geographically isolated in some way (currently or historically), have high levels of endemism and be highly heterogeneous spatially.

While Criterion 4 considers the ecosystem itself, Criterion 5 is defined by the physical features of a landscape that might be associated with particular ecological and evolutionary processes. In the majority of cases, this criterion will be triggered in areas that have been previously investigated and are already known or suspected to be associated with unique evolutionary processes (IFC, 2012, MIGA, 2013). While systematic methods to measure and prioritise evolutionary processes in a landscape do exist, they are typically beyond a reasonable expectation of studies conducted by the private sector (GN83: IFC, 2019). Examples of spatial features associated with evolutionary processes include:

- ▶ Landscapes with high spatial heterogeneity that are a driving force in speciation, as species are naturally selected based on their ability to adapt and diversify;
- ▶ Environmental gradients, also known as ecotones, that produce transitional habitat, which has been associated with the process of speciation and high species and genetic diversity;
- ▶ Edaphic interfaces: specific juxtapositions of soil types (for example, serpentine outcrops, limestone, and gypsum deposits), which have led to the formation of unique plant communities characterized by both rarity and endemism;
- ▶ Connectivity between habitats (for example, biological corridors) that ensure species migration and gene flow; and
- ▶ Sites of demonstrated importance to climate change adaptation for either species or ecosystems.

3.3 Ecosystem Services Assessment

“Where a project is likely to adversely impact ecosystem services, as determined by the risks and impacts identification process, the client will conduct a systematic review to identify priority ecosystem services. Priority ecosystem services are two-fold: (i) those services on which project operations are most likely to have an impact and, therefore, which result in adverse impacts to Affected Communities; and/or (ii) those services on which the project is directly dependent for its operations (e.g., water). When Affected Communities are likely to be impacted, they should participate in the determination of priority ecosystem services in accordance with the stakeholder engagement process as defined in Performance Standard 1” (GN24. IFC, 2019).

An initial screening of the ecosystem services and identification of priority services for either local beneficiaries (Type I) and/or the Project (Type II) was conducted alongside the Critical Habitat Assessment. The screening was based on a literature review and included areas that were identified to have significant social, economic or cultural importance to local communities.

3.4 Impact and Risk Assessment

The preliminary assessment of potential impacts and risks to Critical Habitat-qualifying features from the proposed Project was conducted in line with international standards e.g. requirements of IFC Performance Standard 1 – Assessment and Management of Environmental and Social Risks and Impacts.

Impacts describe the negative actual or clearly predictable outcomes of the Project that result in changes to environmental or social values due to the Project being implemented under ‘normal operational conditions’ (i.e. business as usual).

Risks describe the adverse effects that may occur due to unplanned or unexpected events associated with the Project, despite best efforts to avoid or mitigate impacts. A key distinction from the impact assessment process is that the identified risks may or may not eventuate.

The methodology to assess impacts and risks used the source, pathway and receptor approach. This approach requires a source, a receptor and a pathway linking the two to be present in order for an impact or risk to exist. Key definitions include:

- ▶ **Sources and likely causes:** the origin of a contaminant or agent that is capable of causing change to an environmental or social value;
- ▶ **Pathway:** the route along which a contaminant or agent moves through the environment to affect change; and
- ▶ **Receptor:** an entity or value that is impacted/benefited or placed at risk by a contaminant or agent affecting change.

The assessment of potential impacts and risks associated with the Project was an iterative process and involved the following general steps:

1. Identification of project activities or sources of impact;
2. Identification of related environmental and social receptors;
3. Assessment of impacts (based on magnitude and sensitivity) and risks (based on likelihood and consequence) associated with Project activities on identified receptors;
4. Development of management and mitigation measures appropriate to avoid, reduce, mitigate or compensate for adverse impacts or reduce likelihood / consequence of risks;
5. Re-evaluation of the potential impacts and risks after management and mitigation measures have been applied to inform the assessment of residual impacts;

Criteria for the assessment of the magnitude of impacts are provided in Table 3-7, species sensitivity was assessed on a species-by-species basis using professional judgement and consideration was given to species conservation status, habitat use, requirements and tolerance levels in the Project Area. The impact assessment matrix for the assessment of impacts to sensitive receptors is summarised in Table 3-8.

Table 3-7: Criteria for Assessment of Magnitude of Impacts

Magnitude	Impact
Negligible	The impact is below detectable limits
Minor	Minor deterioration (nuisance or minor disturbance/loss) or harm to receptors in the receiving environment (e.g. not easily measurable).
Moderate	Moderate / measurable deterioration or harm to receptors in the receiving environment (e.g. the impact is of low/medium conservation significance).
Major	Substantial deterioration or harm to receptors in the receiving environment (e.g. the impact is of high conservation significance)

Table 3-8: Impact Assessment Matrix

Significance			Sensitivity Rating			
			1	2	3	4
			Very low	Low	Medium	High
Magnitude	4	Major	4 Low	8 Moderate	12 High	16 High
	3	Moderate	3 Low	6 Moderate	9 Moderate	12 High
	2	Minor	2 Low	4 Low	6 Moderate	8 Moderate
	1	Negligible	1 Very Low	2 Low	3 Low	4 Low

Table 3-9: Risk Assessment Matrix

Likelihood		Consequence				
		1	2	3	4	5
		Very low	Low	Medium	High	Extreme
		Very minor risk	Minor risk with short-term consequences	Medium risk requiring ongoing management	Major risk / high environmental loss	Major risk / long-term, very environmental loss
5	Constant Is expected to occur in most circumstances	5 Moderate	10 Moderate - High	15 Moderate - High	20 High	25 High
4	Frequent Will probably occur in most circumstances	4 Moderate	8 Moderate	12 Moderate - High	16 Moderate - High	20 High
3	Occasional Might occur at some time	3 Low	6 Moderate	9 Moderate	12 Moderate - High	15 Moderate - High
2	Rare Could occur at some time	2 Low	4 Moderate	6 Moderate	8 Moderate	10 Moderate - High
1	Improbable May occur in very exceptional circumstances	1 Low	2 Low	3 Low	4 Moderate	5 Moderate

4. RESULTS

4.1 Protected Areas and Key Biodiversity Areas

As per Guidance Note 20 (IFC, 2019) *"In circumstances where a proposed project is located within a legally protected area or an internationally recognized area, the client will (...):*

- ▶ *Demonstrate that the proposed development in such areas is legally permitted;*
- ▶ *Act in a manner consistent with any government recognized management plans for such areas;*
- ▶ *Consult protected area sponsors and managers, Affected Communities, Indigenous Peoples and other stakeholders on the proposed project, as appropriate; and*
- ▶ *Implement additional programs, as appropriate, to promote and enhance the conservation aims and effective management of the area."*

National Protected Areas and internationally recognised areas of biodiversity significance within the Study Area are shown in Figure 4-1 and discussed in detail below.

4.1.1 Protected Areas

Burapha Plantations are located near three National Protected Areas (NPAs):

- ▶ Nam Pouy NPA;
- ▶ Phou Pha Nang NPA; and
- ▶ Phou Khao Khouay NPA.

Nam Pouy NPA was determined to be of high priority for elephant conservation by GOL at a national elephant conservation meeting (WWF-Laos, 2015) and the GOL are currently preparing the Nam Pouy Management Plan with the aim of halting the decline of the endangered elephants, gibbons and other mammal species in the park (Nguyen, 2021). Nam Pouy NPA was also identified as one of the three priority landscapes for conservation by WWF Laos in their 2021-2025 Strategic Plan (WWF-Laos, 2022). The priority sites were selected based on their conservation significance, and level of pressure on biodiversity. Nam Pouy NPA is located, at its closest point, less than 1km west of Phou Padam PFA (see Figure 4-1).

Phou Pha Nang NPA consists of mostly degraded, semi-evergreen forest. While there is little information available on the NPA's biodiversity, it is known to support some conservation significant fauna species, including the critically endangered northern white-cheeked gibbon and Asian elephant (Duckworth et al., 1999; Duckworth, 2008). Phou Pa Nang NPA is located approximately 30km east of the Phu Yuey PFA, and 30km south of Nongpet-Naseng PFA. Several of Burapha's existing plantations border this NPA (see Figure 4-1).

Phou Khao Khouay NPA consists of tropical montane evergreen, dry evergreen dipterocarp, mixed deciduous and mixed coniferous forest (Lucas et al., 2013) that provides habitat for a variety of threatened flora and fauna species, including the northern white-cheeked gibbon, the green peafowl and Asian elephants (Woo-Shin Lee et al. 2017, Tsechalicha et al., 2014). The NPA contains three major river systems (Nam Yong, Nam Leuk and Nam Mang) and numerous streams which drain in the north-south and easterly directions from the NPA. Phou Khao Khouay NPA is situated just 40 km to the northeast of Vientiane and is a popular location for outdoor activities like hiking, camping and canoeing. There are 72 villages located within a radius of up to 5 km from the Phou Khao Khouay NPA boundaries. Two of these are located inside the protected area. The NPA has a long history of encroachment and direct threats to the NPA include in migration and settlement within the NPA, slash and burn cultivation, widespread hunting, forest fires, unmanaged livestock grazing, illegal logging and timber cutting, unsustainable non-timber forest product harvesting and infrastructure development (DFRC, 2010). These activities continue to contribute to habitat degradation and loss of biodiversity. This NPA is approximately 50km southeast of Nongpet-Naseng PFA and one of Burapha's existing plantations which was developed in 2012/2013 borders this NPA (see Figure 4-1).

The Burapha Land Acquisition Manual (2019) prohibits the Company from encroaching upon Village, District, Provincial, or National Protection and Conservation Areas. However, historically, consultation activities have not always been suitably robust and land tenure or land management responsibility and boundary definitions are disputed; leading to plantation establishment that overlaps the boundary of the Phu Pha Nang NPA and three plantations established within the Phu Inthin Provincial Protection Area (Earth Systems, 2016). These land boundary disputes have since been resolved and there are no plantations located within the current NPA boundaries.

4.1.2 Key Biodiversity Areas

KBAs are critical sites for global biodiversity identified by the KBA Partnership, comprised of 13 international conservation organisations (KBA Partnership, 2021). Sites are assessed against 11 criteria related to threatened biodiversity, geographically restricted biodiversity, ecological integrity, biological processes and irreplaceability. These criteria were based on existing Important Bird and Biodiversity Areas (IBA) criteria and all existing IBAs qualify as KBAs.

The Study area is located near five Key Biodiversity Areas:

- ▶ Mekong River from Luang Prabang to Vientiane;
- ▶ Mekong Channel near Pakchom;
- ▶ Nam Ngum Reservoir;
- ▶ Nam Pouy NPA (discussed above); and
- ▶ Phou Khao Khouay NPA (discussed above).

Mekong River from Luang Prabang to Vientiane

The Mekong River from Luang Prabang to Vientiane KBA adjoins the eastern arm of the Phouphadam PFA and is within 5 km of the southern and eastern boundaries of the Phou Yeuy PFA (Figure 4-1). Waterways in both of these PFAs drain into Mekong River from Luang Prabang to Vientiane KBA. This KBA was identified in 2008 as it met the following criteria for the identification of Important Bird and Biodiversity Areas (IBAs, KBA Partnership, 2023a):

- ▶ Criterion A3: Sites with significant breeding assemblages of bioregion-restricted bird species (*Sturnia malabarica* and *Saxicola jerdoni*); and
- ▶ Criterion A4: Globally significant concentrations of congregatory species (*Glareola lacteal* and *Vanellus duvaucelii*).

The site was reviewed in 2020, as part of the Critical Ecosystem Partnership Fund (CEPF) Ecosystem Profile for the Indo-Burma Hotspot (CEPF, 2020), and was reconfirmed as a KBA and selected as a 'Priority KBA' for investment in species-focused conservation by CEPF.

The KBA comprises a c. 300 km section of the Mekong channel upstream of Vientiane. The upper section (c. 150 km), upstream of Ban Vang, is situated entirely within Lao PDR, while the lower section (c. 160 km), between Ban Vang and Ban Thadua, forms the international border with Thailand. The KBA contains a high proportion of mosaic stretches, and significant stretches of open sandy islands. The bird communities of mosaic stretches are considered to be of the highest conservation value of all those along the upper Lao Mekong channel and include species such as River Lapwing (*Vanellus duvaucelii*), Wire-tailed Swallow (*Hirundo smithii*) and Jerdon's Bushchat (*Saxicola jerdoni*). The open sandy islands are important for Small Pratincole (*Glareola lacteal*), and the KBA is thought to support greater than 1% of the Asian biogeographic population of this species (KBA Partnership, 2023b).

Mekong Channel near Pakchom

The Mekong Channel near Pakchom KBA is 5 km south of the Phou Yeuy PFA, which contains tributaries that drain to the KBA (Figure 4-1) and was identified as a KBA based on the following criteria and thresholds for the identification of IBAs (KBA Partnership, 2023a):

- ▶ Criterion A3: Sites with significant breeding assemblages of bioregion-restricted bird species (*Saxicola jerdoni*); and
- ▶ Criterion A4: Globally significant concentrations of congregatory species (*Glareola lactea*).

The site was reviewed in 2020 (as part of the CEPF Ecosystem Profile for the Indo-Burma Hotspot, CEPF, 2020) and was reconfirmed as a KBA and selected as a 'Priority KBA' for investment in species-focused conservation by CEPF.

The stretch of the Mekong River within the site forms the international border with Thailand. The site supports a range of riverine habitats, including the Mekong mainstream and braided river channels, sand and shingle bars, exposed bedrock and vegetated islands, and is an outstanding example of this mosaic of riverine habitats, with some significant stretches of open sandy islands. The larger sandbanks are covered in *Homonoia riparia* scrub.

Nam Ngum Reservoir

The Nam Ngum Reservoir KBA is 12 km south-east of the Nongpet Naseng PFA, which contains waterways that drain to the reservoir (Figure 4-1). One Burapha non-PFA land holding and a third party supplier are located on the tributaries of the reservoir approximately 2km upstream of the reservoir. The site was identified in 2018 as it met the following KBA criteria:

- ▶ Criterion A1: Sites hold a significant proportion of the global population size of a species facing a high risk of extinction and so contribute to the global persistence of biodiversity at genetic and species.; and
- ▶ Criterion B1: Sites qualifying as KBAs under criterion B1 hold a significant proportion of the global population size of a geographically restricted species and so contribute significantly to the global persistence of biodiversity at the genetic and species level.

These criteria were triggered by the following fish species: *Laocypris hispida*, *Osphronemus exodon*, *Rhinogobius albimaculatus*, *Schistura coruscans*, *Schistura ephelis*, *Schistura personata* and *Schistura sigillata* (KBA Partnership, 2023c).

The site was reviewed in 2020, as part of the CEPF Ecosystem Profile for the Indo-Burma Hotspot (CEPF, 2020), and was reconfirmed as a KBA. It was not assessed as a 'Priority KBA' by CEPF, but a 'Priority Corridor' (the Mekong River and Major Tributaries) bisects the KBA.

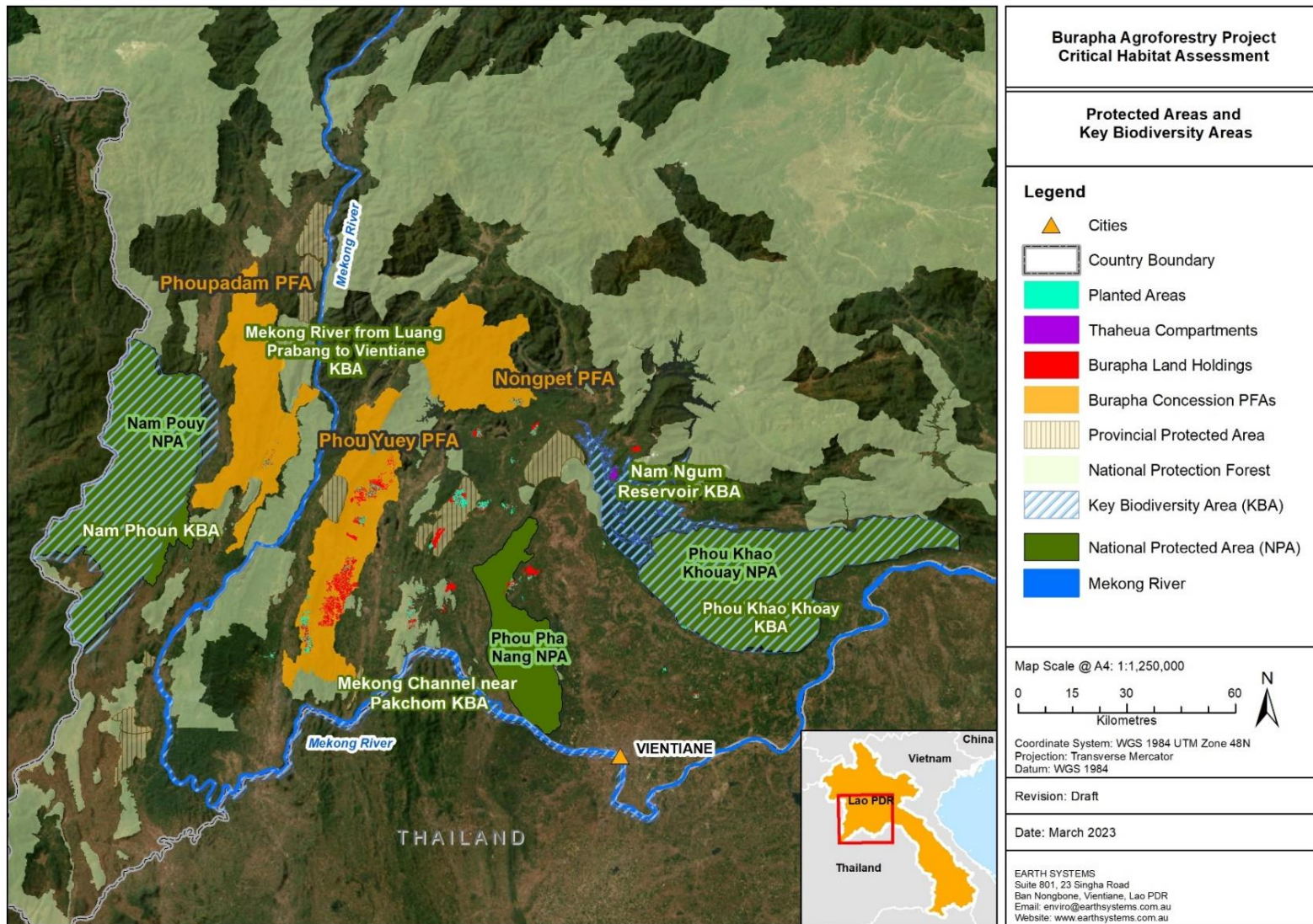


Figure 4-1 National Protected Areas and Key Biodiversity Areas in the vicinity of Burapha Operations and Future Expansion PFAs

4.2 Existing Threats to Biodiversity

4.2.1 Existing Threats to Aquatic Biodiversity

Aquatic habitats in the Study Area face various threats that degrade their biodiversity and ecosystem service value. Impacts to aquatic habitats surrounding and within the Burapha Concession PFAs are largely the result of upstream dams, agricultural activities and mining activities.

Damming occurs extensively within northern Laos along the Mekong River and its tributaries, and upstream in China with substantial impacts to hydrology, water quality, and aquatic habitat composition. Dams and grouping of dams affect fish migrations, river hydrology, and sediment transfers which can have impacts on riparian vegetation up to 1000 km from the dam (Soukhaphon et al., 2021). Downstream deep-water habitats are substantially threatened by dams and are further exacerbated by increased sedimentation from surrounding agricultural activities. Such activities can also result in increased nutrient loading with potential to cause eutrophication and low dissolved oxygen content. Recent efforts by the Laotian Government to ensure food security and support the economic development of rural communities have resulted in increased agricultural activities, particularly for cassava (Soukhamthat & Wong, 2016).

4.2.2 Existing Threats to Terrestrial Biodiversity

The principal threats to the biodiversity in the southern reaches of the Vientiane and the Xayaburi provinces include illegal trade of wildlife, indiscriminate hunting practices, and habitat loss due to conversion of land for shifting cultivation and logging. The Burapha PFAs are situated within the Luang Prabang Montane Rain Forests eco-region where more than 70% of original montane vegetation has been converted to scrub or degraded forest. Existing vegetation within and surrounding the Burapha Concession PFAs has been extensively disturbed and fragmented due to shifting cultivation and establishment of permanent agricultural and settlement areas. The rate of deforestation in the concession PFAs, and even in protected areas, is very high, however, forest loss in Nongpet-Naseng PFA is significantly lower than the rest of the Study Area as can be seen in Figure 4-2. Recent speculation of a future increase in the value of cassava has resulted a spike in the encroachment of swidden areas upon vegetated areas, including in national parks.

Over-harvest of wildlife has been identified as one of the main contributors to the decline of wildlife species in Northern Lao PDR (Johnson et al., 2005). Hunting is often opportunistic and indiscriminate; the use of snares can invertedly trap species which are prohibited for hunting and are particularly effective in capturing mammals and ground-dwelling birds. Specific species may also be targeted for their values for medicinal purposes, for instance bear and serow bile are in relatively high demand in Northern Laos (Davis & Glikman, 2020). Trade of prohibited species in the region for curio production, food and medicine varies seasonally with poaching of mammals and birds occurring during winter, and amphibians, insects and reptiles occurring during the summer months (Banjade et al., 2020).



Figure 4-2 Forest loss 2000-2019 (Source: Hansen/UMD/Google/USGS/NASA).

4.3 Natural and Modified Habitat

4.3.1 Habitat cleared between 2018-2023

Habitat mapping identified eight land use / habitat types in land cleared for Burapha plantations between 2018-2022: Bamboo, Forest Plantation, Other Agriculture, Old Crop, Young Fallow (<5 years), Old Fallow (>5 years), Roads/Tracks and Upland Crop (refer to Table 3-4 for a description of habitat types). The 2854 ha of land cleared for Burapha plantations in the last five years was predominantly comprised of Upland Crop (1255ha), Young Fallow <5 years (805 ha), Old Fallow >5 years (636 ha), Bamboo (67 ha), plantations (83 ha), and other agriculture (6 ha, Table 4-1). All removed habitat types were determined to be Modified Habitat, as discussed below.

Table 4-1 Land Use / Habitat Type cleared for Burapha plantation 2018-2023

Habitat Cleared	Area Cleared (ha)					Total (ha)
	2018	2019	2020	2021	2022	
Bamboo	-	18.10	36.05	12.61	-	66.76
Forest Plantation	3.78	4.47	-	16.33	57.98	82.57
Other Agriculture	-	-	-	3.24	2.85	6.09
Young Fallow (<5 years)	106.85	73.20	226.70	313.21	85.25	805.20
Old Fallow (>5 years)	205.02	112.42	89.18	192.72	38.72	632.06
Roads/Tracks	-	-	0.02	0.66	-	0.68
Upland Crop	102.90	29.12	369.29	381.90	371.75	1,254.97
Total (ha)	418.55	237.32	721.24	920.66	556.55	2,854.33

Although forested areas, and regenerating forest >7 years are excluded as part of Burapha's land acquisition process, there is no distinct cut-off point between when, if ever, regenerating forest becomes 'Natural Habitat'. Fallow forest is a regenerating vegetative community that is re-establishing, generally after clearance for shifting / swidden cultivation. In Lao PDR, the interval between two successive utilizations of a swidden area ranges from one to seven years, and that interval is generally decreasing, particularly in areas of higher population densities (Kenney-Lazar, 2013; Liao et al., 2015). Some areas are cleared annually for cash crops and with each successive burn the soil fertility, vegetation cover and seed bed deteriorate. Due to the high pressures on PFA land it is unlikely that a succession of regenerating forest becoming a functioning self-propagating forest ecosystem would occur within a fallow cycle.

Fallow forest develops through primary succession dominated by herbaceous flora, while secondary succession is dominated by woody vegetation that range from shrubs to tall trees (Rerkasem et al., 2009). Fallow forests were classified as young (<5 years) and old (>5 years) based on structural composition. Young fallow is generally comprised of one or two strata of vegetation and old fallow may have three strata (MacNamara et al., 2012). The fallow phase between cycles of swidden agriculture allows for some restoration of soil fertility and the provision of non-timber forest products (NTFPs), timber forest products (TFPs) and other ecosystem services (e.g. carbon sequestration, water filtration, erosion control) and habitat for native flora and fauna (Ziegler et al., 2009; Brunn et al., 2009).

Young fallow is dominated by the mid-storey and understorey strata, with only fast-growing species exceeding 2 to 3 m height (Earth Systems, 2016). MacNamara et al., (2012) found that primary forest species can occur in frequently and infrequently cleared/disturbed sites, suggesting resilience in some species to regenerate after disturbance and recolonise agricultural areas. The older fallow has a more natural vegetative structure, but species richness is reduced compared to the natural forest floristic assemblage (Earth Systems, 2016). Species richness of fallow forest in Lao PRD was found to decrease by up to 28% with increasing number of prior crop-fallow cycles up to three prior cycle rotations (Souvuu, 2009), and soils decline in fertility with each additional crop cycle, even with long fallow durations (Wood et al., 2017).

Land use cover prior to clearance for selected plantations is shown in Figure 4-3 and Figure 4-5. Burapha's plantations are located in areas of high disturbance and accessibility and have little connectivity to forested areas. Despite the relatively high species richness in old fallow forest, the floristic composition differs considerably from the natural forest types it has replaced. Most mammal and bird species are uncommon or transient in fallow forest due to the lack of food and breeding habitat and canopy structure to provide cover for refuge. It is unlikely that fallow forests of up to seven years within these areas would regenerate into an ecosystem which resembles the original values prior to disturbance, and land is often cleared for cropping purposes when it shows some level of soil recovery. Pre-clearance photos and 2019 aerial photography is shown in Plate 4-1 to Plate 4-6; regenerating forests were found to be dominated by bamboo, or non-native species such as banana trees (see Plate 4-1).

Areas of regenerating forest were found to have been recently cleared within 6 months prior to development for plantations as can be seen in Plate 4-7 and Plate 4-10. It is unclear whether these areas were cleared in anticipation of Burapha's development, or whether the areas were deemed suitable for acquisition based on their recent clearance. In order to avoid opportunistic clearance of Natural Habitat by local communities, Burapha should also avoid areas in which potential Natural Habitat (as per PS6) has recently been cleared.



Plate 4-1 Saenchaleun plantation, Phu Yuey PFA, 29/7/2020. (UTM 47N E: 794017, N: 2024179)

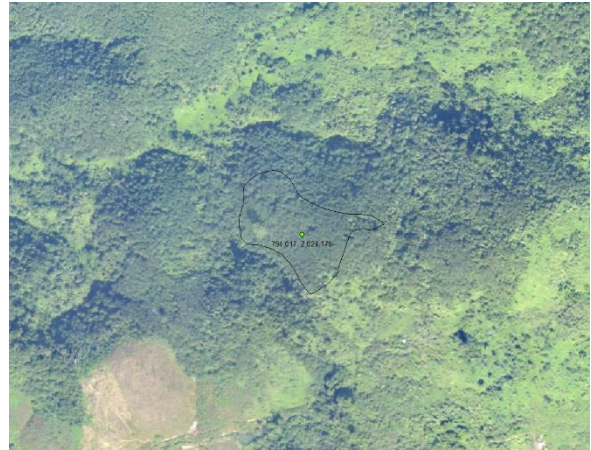


Plate 4-2 Aerial photography at Saenchaleun plantation, Phu Yuey PFA, 2019. (UTM 47N E: 794017, N: 2024179)



Plate 4-3 Nonnakaep plantation, Phu Yuey PFA 29/7/2020. (UTM 47 N, E: 793872, N: 2019857)



Plate 4-4 Aerial photography at Nonnakaep plantation, Phu Yuey PFA, 2019. (UTM 47 N, E: 793872, N: 2019857)



Plate 4-5 Nongpet PFA (UTM 48 N, E: 217255, N: 2084709)

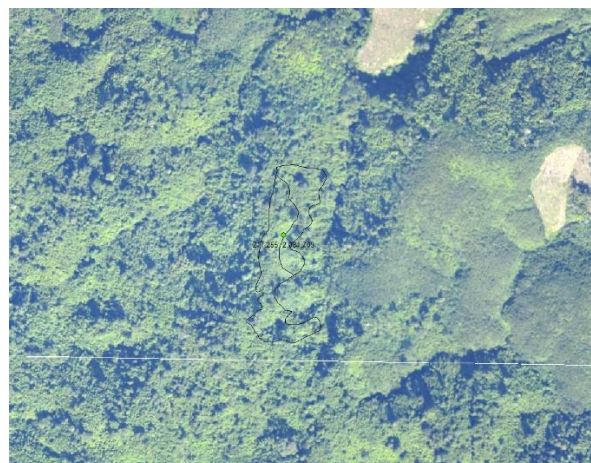


Plate 4-6 Aerial photography at Nongpet PFA, 2019 (UTM 48 N, E: 217255, N: 2084709)



Plate 4-7 Na-an plantation, Nongpet PFA, 29/7/2020 (UTM 48N, E: 218219, N: 2085691)

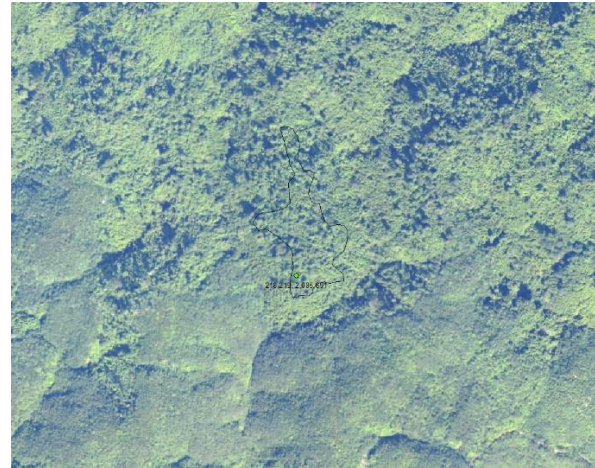


Plate 4-8 Aerial photography at Na-an plantation, Nongpet PFA, 2019 (UTM 48N, E: 218219, N: 2085691)



Plate 4-9 Na-an plantation, Nongpet PFA, 29/7/2020 (48 N, E: 215894, N: 2085394)

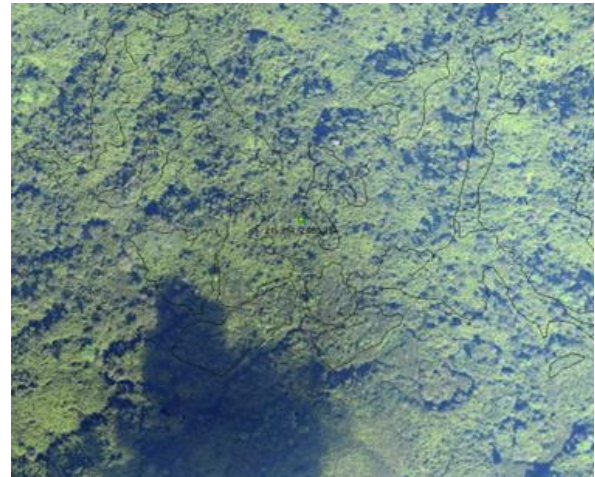


Plate 4-10 Aerial photography at Na-an plantation, Nongpet PFA, 2019 (48 N, E: 215894, N: 2085394)

NDVI analysis

NDVI values for old fallow areas had similar values to both young fallow and natural forest areas in all years analysed (Table 4-2). Two-tailed t- test's found no significant difference between young fallow and old fallow NDVI or old fallow and natural forest ($p > 0.05$). Therefore, NDVI could not be used as an indicator of natural / modified habitat in the Study Area. Examples of NDVI analysis for existing plantations (prior to clearance) are shown in Figure 4-4 and Figure 4-6.

The NDVI values for 2019, 2020 and 2021 were significantly lower than 2018 and 2022 due to unusually high rainfall in the dry season. Therefore, NDVI values should not be compared across years.

Table 4-2 Mean NDVI values

Habitat Type	Mean					Standard Deviation				
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Young Fallow	0.65	0.81	0.76	0.76	0.50	0.03	0.03	0.05	0.04	0.04
Old Fallow	0.65	0.84	0.81	0.79	0.52	0.03	0.02	0.03	0.03	0.04
Natural Forest	0.58	0.76	0.72	0.73	0.43	0.04	0.05	0.06	0.05	0.04

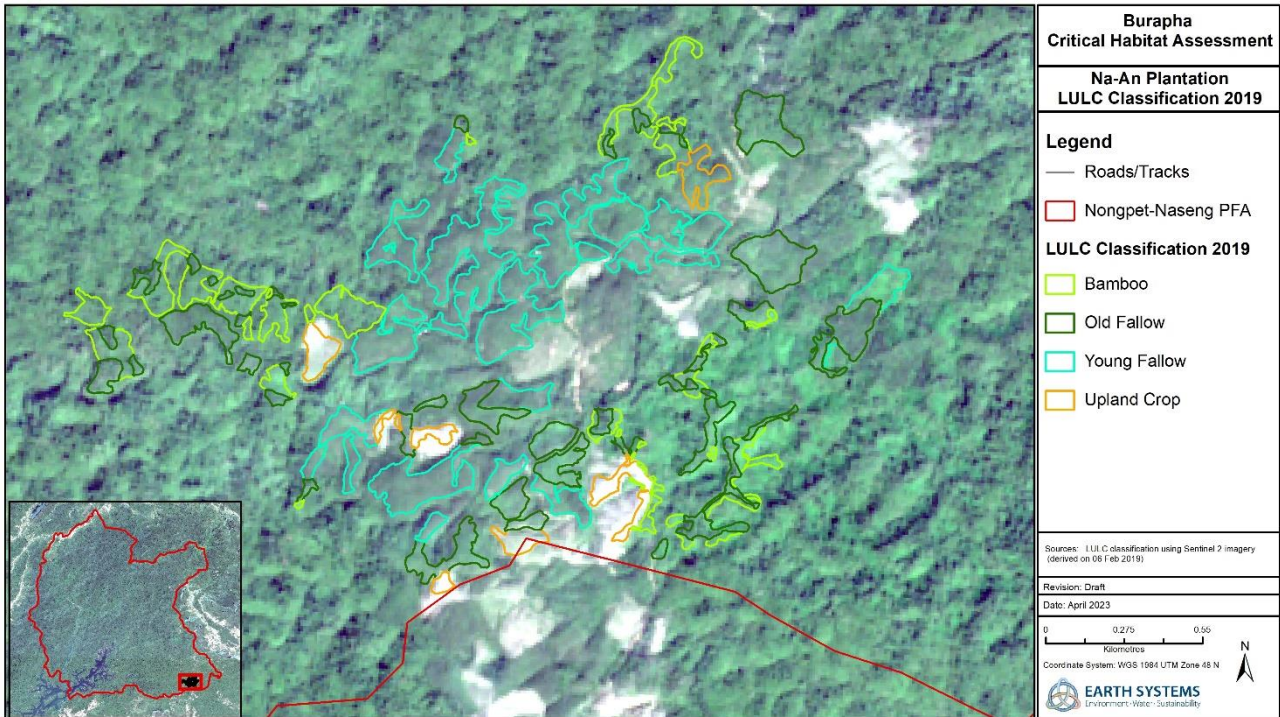


Figure 4-3 LULC classification of land earmarked for clearing for Burapha Na-An Plantation in 2019

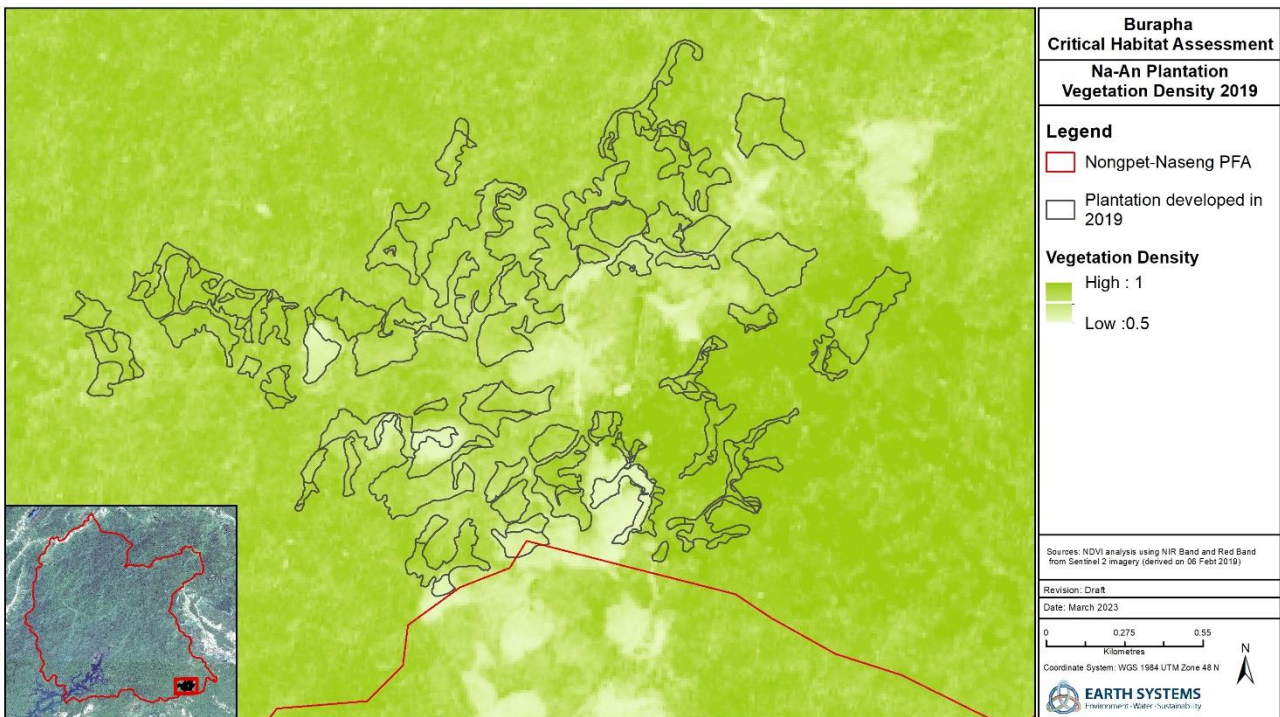


Figure 4-4 NDVI of land earmarked for clearing for Burapha Na-An Plantation in 2019

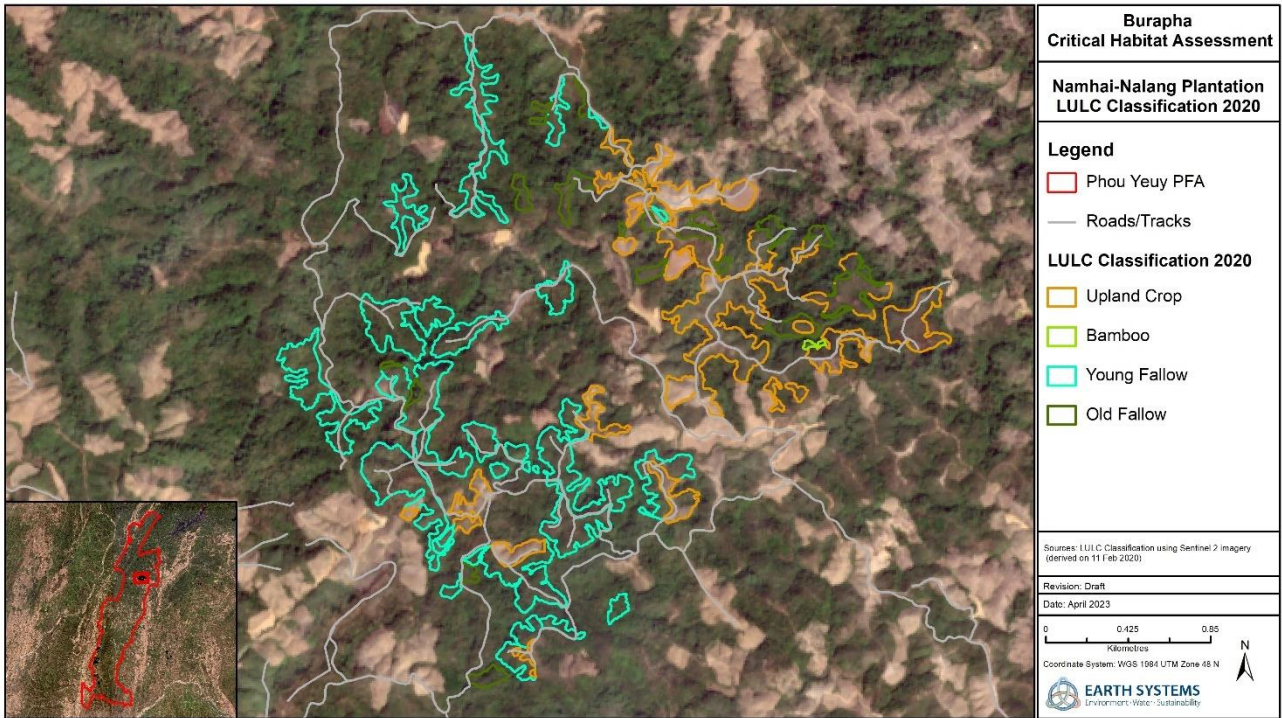


Figure 4-5 LULC classification of land earmarked for clearance for Burapha Namhai Nalang Plantation in 2020

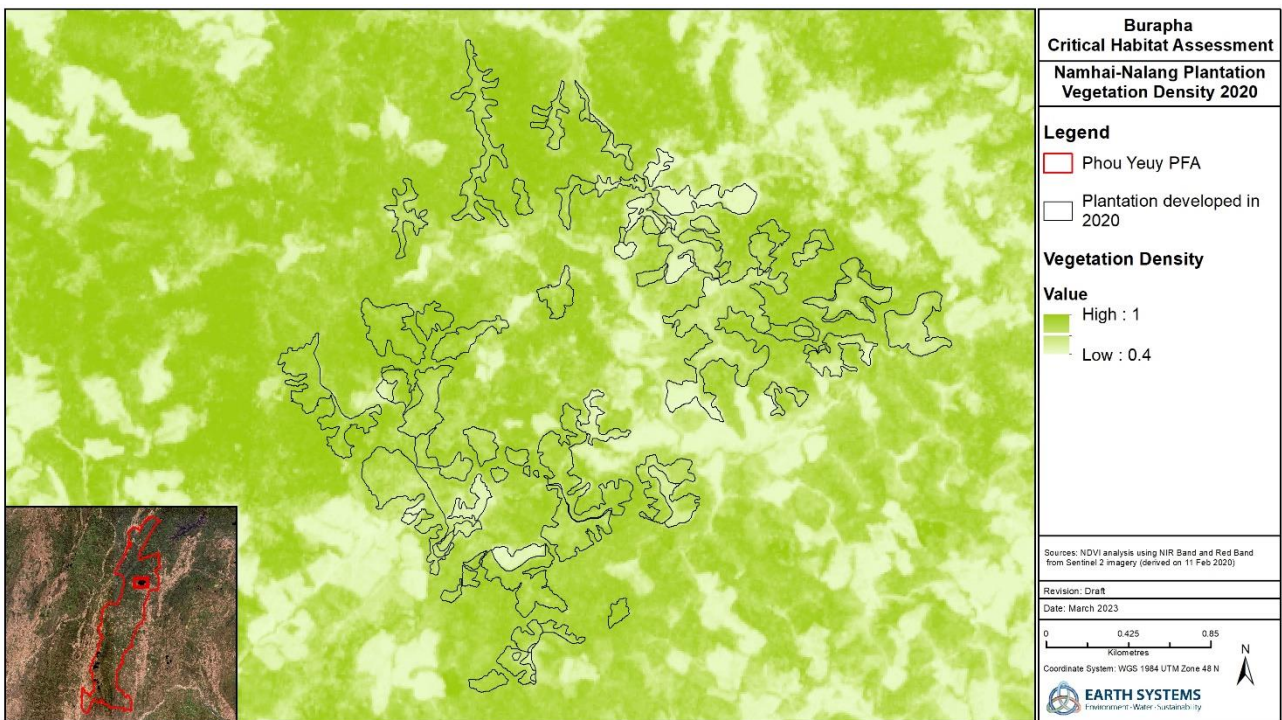


Figure 4-6 NDVI of land earmarked for clearing for Burapha Namhai Nalang Plantation in 2020

4.3.2 Natural Habitat Within PFAs

The LULC based on visual interpretation of satellite imagery within the PFAs is shown in Figure 4-7, Figure 4-8 and Figure 4-9. The PFAs are dominated by regenerating vegetation, lowland rice paddies and upland crop (Plate 4-4-11). Some areas of in-tact forest still remain (Plate 4-4-12), mainly on mountain ridge-lines and areas with low accessibility, particularly in Nongpet PFA, where accessibility is low compared to the Phou Yuey and Phou Phadam PFAs.

Levels of disturbance are high, and swidden cycles are short within the concession PFAs due to their use for agriculture and commercial plantations. It is unlikely, due to the high pressures on the land within these areas that succession of regenerating forest into a functioning ecosystem within the fallow cycle would occur. Therefore, only areas of in-tact forest (with some levels of disturbance) were determined to be Natural Habitat.

Preliminary LULC for the Production Forest Areas is summarised in Table 4-3, however further ground truthing will be required to confirm these results. Approximately 83 000 ha of Natural Habitat remain within the three Production Forest Areas, which equates to 15.7% of the total area covered by the PFAs. A higher proportion of Natural Habitat remains in Nongpet-Naseng PFA (59.1%) compared to Phou Yeuy (24.1%) and Phou Pha Dam PFA (19.1%), and almost 50% of the remaining forested area in all three PFAs is within Nongpet-Naseng PFA. Given the very high pressures on land and extensive land clearance that is ongoing within PFAs (refer to Section 4.2), the areas identified as currently supporting Natural Habitat, may be become degraded and no longer be assessed as such when Burapha identifies areas for plantation in the future.



Plate 4-4-11 Phou Yuey Production Forest Area, May, 2020 (UTM 47N, E: 794073.54, N: 2021185.50)

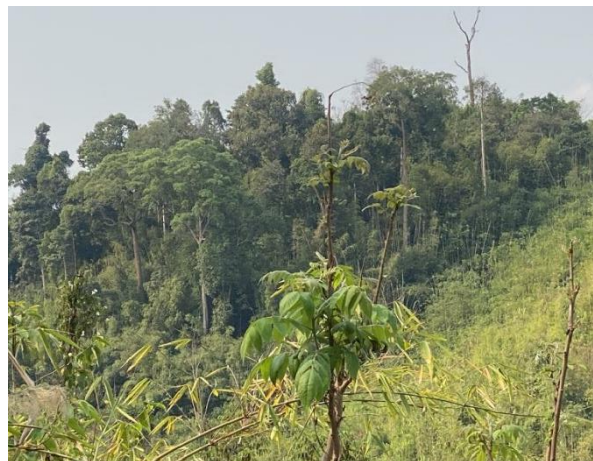
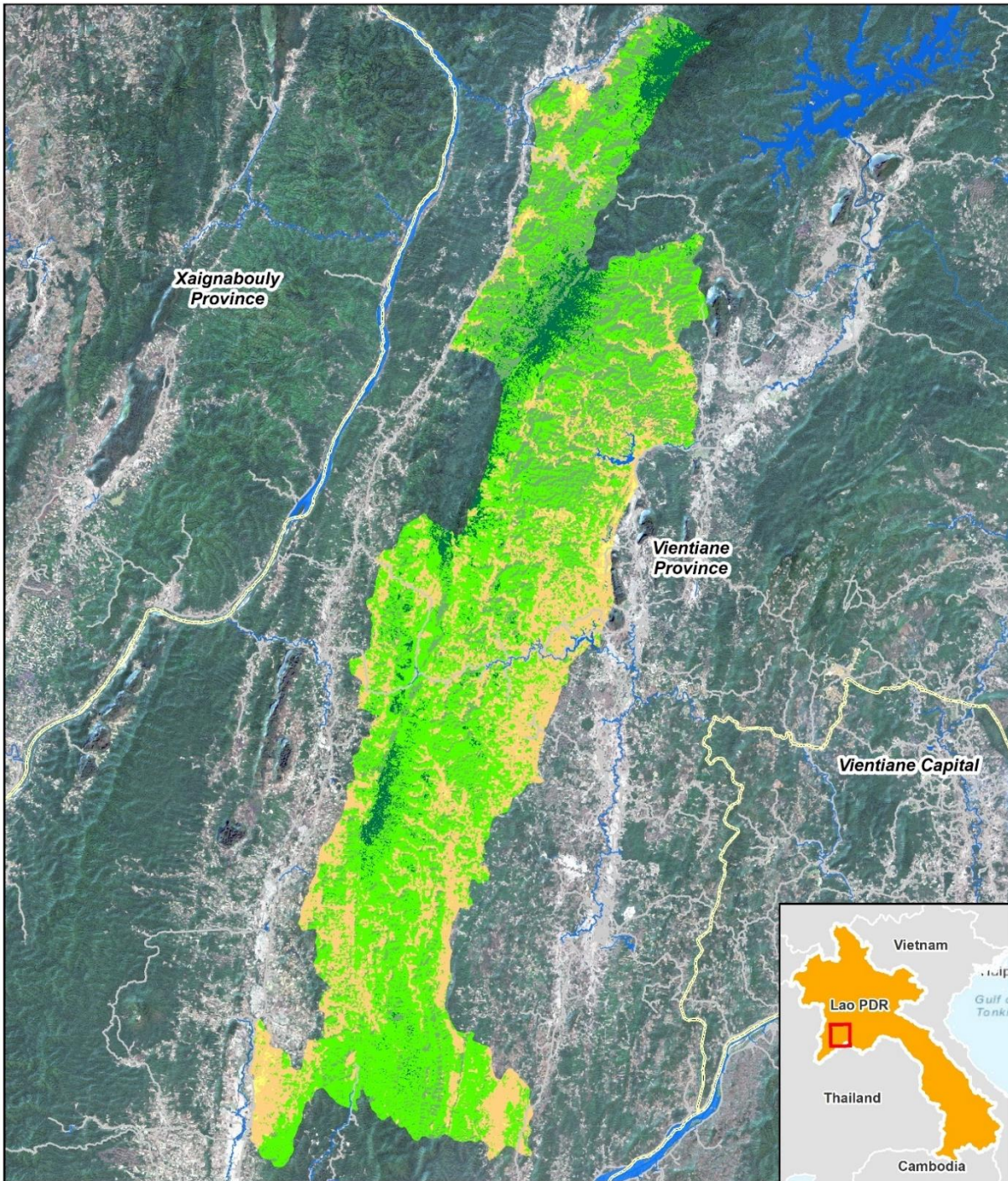


Plate 4-4-12 Remnant Forest Phou Yuey Production Forest Area (UTM 48N, E: 183606, N: 2063421)

Table 4-3 Land Use Land Cover Classification for Burapha Concession PFAs

Vegetation/Habitat types	Nongpet-Naseng PFA		Phou Yeuy PFA		Phou Pha Dam PFA		Total	
	Area (Ha)	% Area	Area (Ha)	% Area	Area (Ha)	% Area	Area (Ha)	% Area
Natural Habitats								
Disturbed Evergreen Forest	7,838.6	11	5,991.5	6	-	-	13,830.2	2.6
Disturbed Mixed Deciduous Forest	32,790.3	48	18,167.9	18	18,164.6	19	69,122.8	13.1
Sub-Total	40,629.0	59.1	24,159.4	24.1	18,164.6	19.1	82,953.0	15.7
Modified Habitats								
Upland Crop	2,243.5	2.9	28,634.1	28.6	35,881.8	37.7	66,759.5	12.6
Other Land	224.7	-	-	-	-	-	224.7	0.04
Regenerating Vegetation	23,120.7	33.6	47,143.8	47.1	41,056.2	43.1	111,320.7	21.1
Water	2,553.2	3.7	247.1	0.2	71.7	0.1	2,872.0	0.5
Sub-Total	28,142.1	40.2	76,025.1	75.9	77,009.6	80.9	181,176.8	34.3
Total	68,771.1	100	100,184.5	100	95,174.2	100	264,129.9	100




<p>Burapha Critical Habitat Assessment</p>	<p>Legend</p>	<p>Revision: Draft</p>
<p>Phou Yeuy Land Use Land Cover</p>	<p>Phou Yeuy PFA</p>	<p>Date: February 2023</p>
<p>0 2 4 8 Kilometres</p> <p>Coordinate System: WGS 1984 UTM Zone 48N Projection: Transverse Mercator Datum: WGS 1984</p>	<p>Drainages</p> <p>Main Roads</p> <p>Provincial Boundaries</p>	<p>Author : Earth Systems</p>
<p>LULC Classification</p> <ul style="list-style-type: none"> Disturbed Evergreen Forest Disturbed Mixed Deciduous Forest Regenerating Vegetation Rice Paddy Upland Crop Water <p>Sources: LULC classification using Sentinel imagery derived on 31 Jan 2023</p>		 <p>EARTH SYSTEMS Environment · Water · Sustainability</p> <p>EARTH SYSTEMS Suite 801, 23 Singha Road Ban Nongbone, Vientiane, Lao PDR Email: enviro@earthsystems.com.au Website: www.earthsystems.com.au</p>

Figure 4-7 Land use Land Cover in Phou Yeuy PFA retrieved using visual interpretation of satellite imager (Sentinel 31/01/2023)

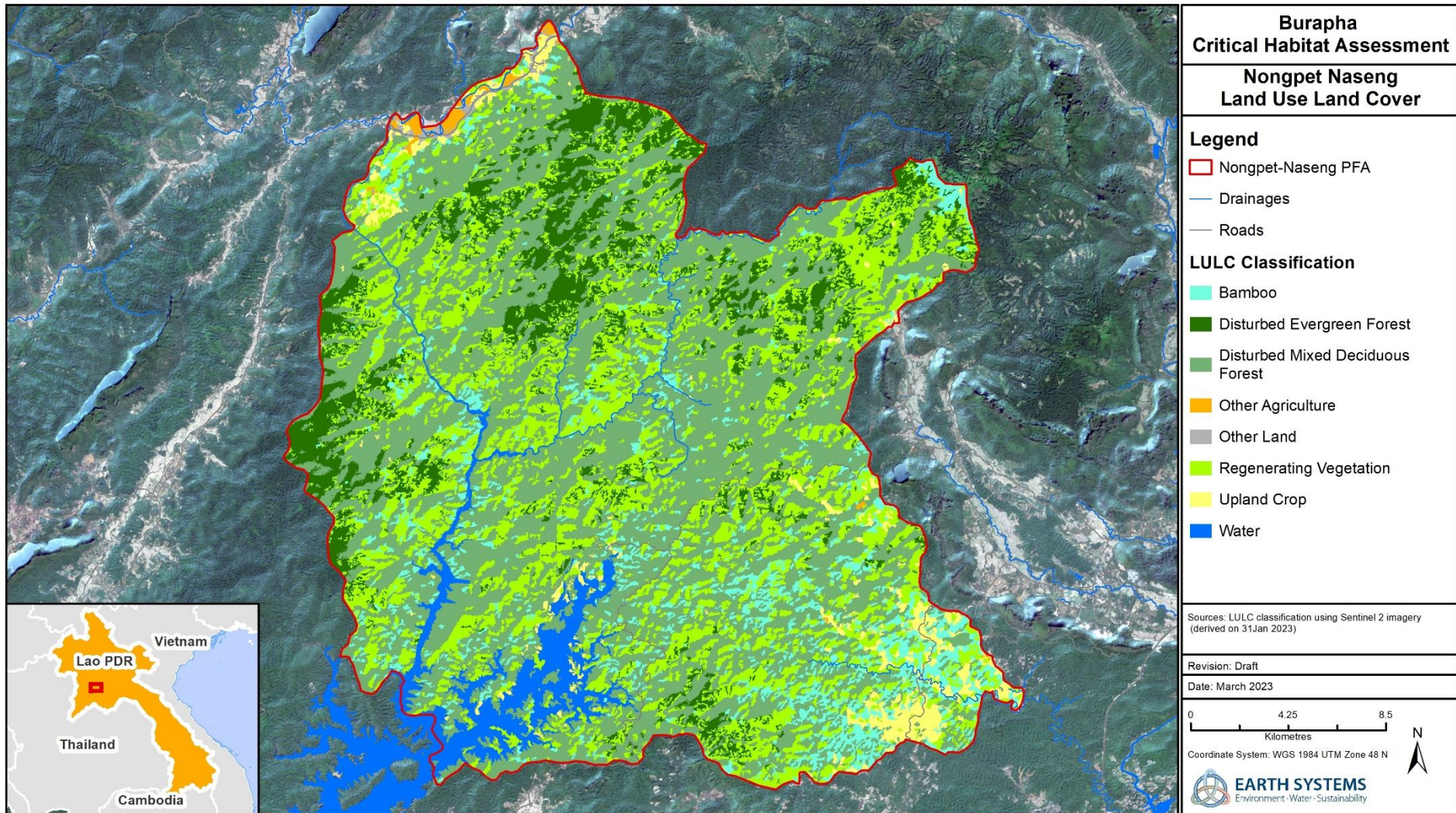
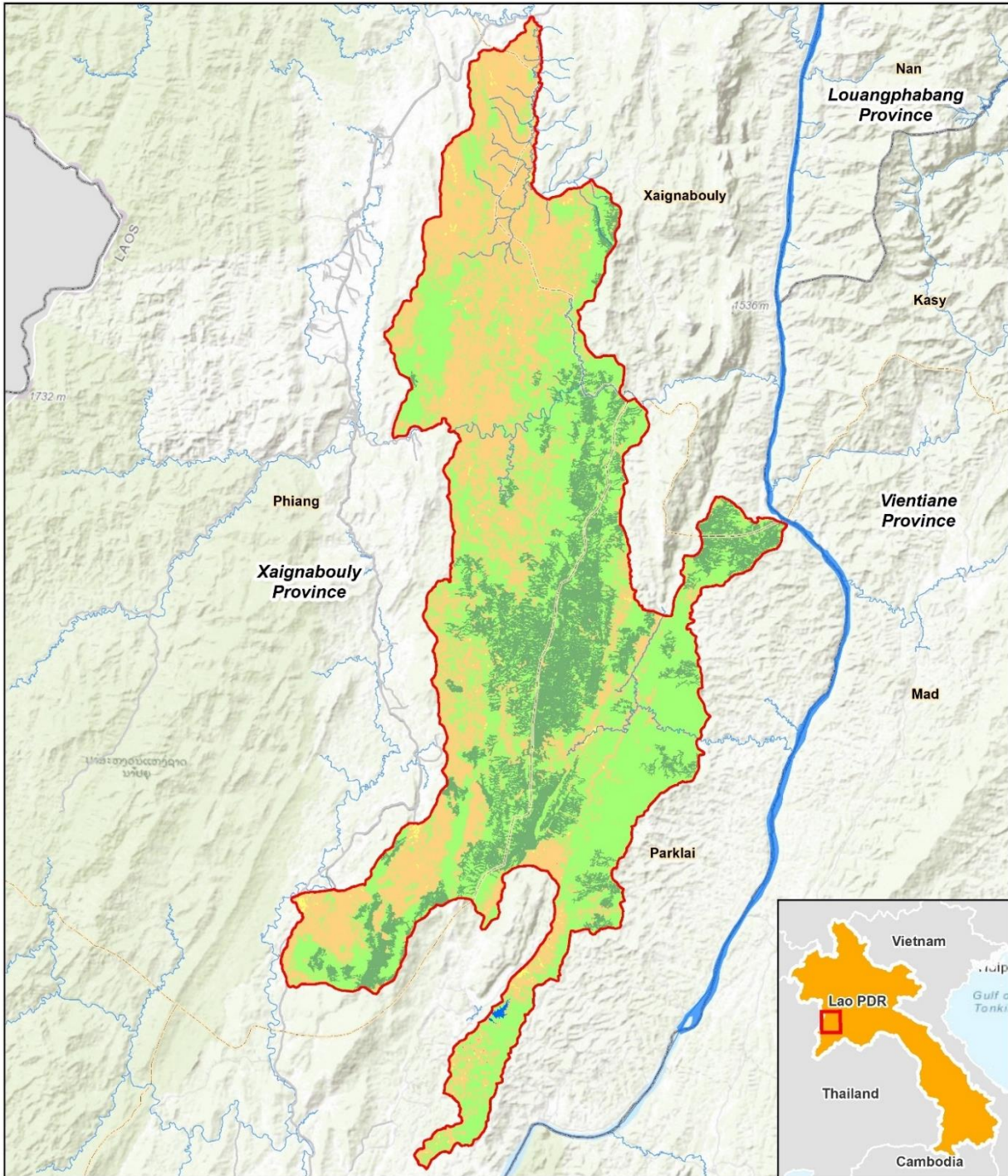


Figure 4-8 Land use Land Cover in Nongpet Naseng PFA retrieved using visual interpretation of satellite imager (Sentinel 31/01/2023)




<p>Burapha Critical Habitat Assessment</p>	<p>Legend</p> <ul style="list-style-type: none"> Phouphadam PFA Main Roads Drainages Provincial Boundaries District Boundary 	<p>LULC Classification</p> <ul style="list-style-type: none"> Disturbed Mixed Deciduous Forest Regenerating Vegetation Rice Paddy Upland Crop Water 	<p>Revision: Draft</p>
<p>Phouphadam Land Use Land Cover</p>	<p>Sources: LULC classification using Sentinel imagery (derived on 31 Jan 2023)</p>	<p>Date: February 2023</p>	<p>Author : Earth Systems</p>
<p>0 2 4 8 Kilometres</p> <p style="text-align: center;">N</p> <p>Coordinate System: WGS 1984 UTM Zone 48N Projection: Transverse Mercator Datum: WGS 1984</p>	<p style="text-align: center;">  EARTH SYSTEMS <small>Environment Water Sustainability</small> EARTH SYSTEMS Suite 801, 23 Singha Road Ban Nongbone, Vientiane, Lao PDR Email: enviro@earthsystems.com.au Website: www.earthsystems.com.au </p>		

Figure 4-9 Land use Land Cover in Phouphadam PFA retrieved using visual interpretation of satellite imager (Sentinel 31/01/2023)

4.4 Critical Habitat Screening and Assessment

Given that some of the information required to definitively classify each species as Critical Habitat (e.g., estimation of global and local population sizes) is unknown as there is a general paucity of information and recent survey data in Lao PDR, species were classified using the following categories based on the available information and expert opinion.

- ▶ **Qualifying:** Available information is clear enough to state that this species meets all of the thresholds for CH;
- ▶ **Likely:** good evidence that:
 - The feature is present in the EAAA; AND
 - The feature is present at levels that meets/approaches the threshold;
- ▶ **Possible:**
 - Low evidence that the feature is present in the EAAA but if confirmed likely to meet the threshold; OR
 - Good evidence that the feature is present in the EAAA but unclear if it would meet the threshold;
- ▶ **Unlikely:** reasonable evidence that the species does not meet the threshold;
- ▶ **Not qualifying:** Available information is clear enough to state that the species will not meet any of the thresholds for CH.

Pending further surveys, some of the areas adjacent to existing plantations and future expansion areas appear to support Critical Habitat. These species are shown in Table 4-4 and discussed below.

Existing plantations

One species was found to qualify for Critical Habitat under Criterion 1a in existing plantations, three species are likely to qualify under Criterion 1-3 if found to be present in the area, and a further three will possibly qualify in the Study Area if found.

Species Qualifying under PS6 Criterion 1a for existing plantations:

- ▶ Asian elephant;

Species likely to qualify under PS6 Criterion 1-3 if found to be present in the Study Area:

- ▶ Northern white-cheeked gibbon;
- ▶ La Touche's free-tailed bat;
- ▶ Phou Khao Khouay leaf-nosed bat

Species which possibly qualify under PS6 Criterion 1-3 if present in the Study Area:

- ▶ Siamese crocodile;
- ▶ Yellow-breasted Bunting; and
- ▶ *Pseudecheneis sympelvica*.

With the exception of the Asian elephant whose presence has been confirmed, further surveys will be required to determine the presence or absence of the above-mentioned species and will inform any necessary offset requirements. If found to be present in the areas surrounding existing plantations, in addition to ensuring a net gain of CH, species-specific measures should be put in place to ensure there are no additional impacts to these species.

Future plantations

One species triggers CH in proposed expansion areas, eight species are likely to qualify if present, and four species possibly qualify if found to be present.

Species Qualifying under PS6 Criterion 1a within expansion PFAs:

- ▶ Asian elephant;

Species likely to qualify under PS6 Criterion 1-3 if found to be present in the expansion PFAs:

- ▶ Northern white-cheeked gibbon;
- ▶ La Touche's Free-tailed Bat;
- ▶ Phou Khao Khouay leaf-nosed bat
- ▶ Laotian water skink;
- ▶ Giant pangasius;
- ▶ Small scaled mud carp;
- ▶ *Schistura ephelis*; and
- ▶ *Schistura sigillata*.

Four species will possibly qualify under Criterion 1-3 if present within expansion PFAs:

- ▶ Laos warty newt;
- ▶ Yellow-breasted Bunting;
- ▶ *Laocypris hispida*;
- ▶ *Pseudecheneis sympelvica*

If found in expansion PFAs, areas that are considered Critical Habitat for the above species should be avoided in Burapha's. In the unlikely event that Critical or Natural Habitat cannot be avoided, Burapha will need to quantify those impacts and ensure that no net loss for Natural Habitat and net gain for Critical Habitat is achieved through the provision of offsets.

Given the size of the Production Forest Areas (PFAs), undertaking a valid CHA is challenging as it is not possible to undertake a site-specific CHA. As a result, it is likely that more species have reached the requisite thresholds to trigger CH than would normally occur. Burapha's plantations are widespread throughout the landscape and occur in three provinces which include a variety of aquatic and terrestrial habitat types. The plantations form a mosaic pattern, and predominantly occupy the ridge lines of ephemeral first and second order streams. If a CHA were undertaken for each discrete plantation, it is unlikely that all the above-mentioned species would qualify for Critical Habitat due to varying ranges across the landscape, and differing ecological requirements, which may be restricted to certain parts of the Study Area. Additionally, species may be restricted to habitats which are unlikely to be suitable for plantations (e.g., limestone caves, wetlands).

Table 4-4 Critical Habitat Screening

Species Name	Common name	IUCN Red List Status	Criterion 1	Criterion 2	Criterion 3	CH triggered for existing Plantations	CH triggered for expansion PFAs
Mammals							
<i>Elephas maximus</i>	Asian Elephant	Endangered	Qualifying	N/A	N/A	Yes	Yes
<i>Nomascus leucogenys</i>	Northern White-cheeked Gibbon	Critically Endangered	Likely Qualifying	N/A	N/A	Yes	Yes
<i>Hipposideros khaokhouayensis</i>	Phou Khao Khouay Leaf-nosed Bat	Vulnerable	Likely Qualifying	Likely Qualifying	N/A	Yes	Yes
<i>Tadarida latouchei</i>	La Touche's Free-tailed Bat	Endangered	Likely Qualifying	N/A	N/A	Yes	Yes
Reptiles							
<i>Crocodylus siamensis</i>	Siamese Crocodile	Critically Endangered	Possibly Qualifying	N/A	N/A	Yes	No
<i>Tropidophorus laotus</i>	Laotian Water Skink	Endangered	Likely Qualifying	Likely Qualifying	N/A	No	Yes
<i>Cyrtodactylus pageli</i>	-	Least Concern	N/A	Likely Qualifying	N/A	No	No

Species Name	Common name	IUCN Red List Status	Criterion 1	Criterion 2	Criterion 3	CH triggered for existing Plantations	CH triggered for expansion PFAs
Amphibians							
<i>Laotriton laoensis</i>	Laos Warty Newt	Endangered	Possibly Qualifying	Unlikely	N/A	No	Yes
Birds							
<i>Emberiza aureola</i>	Yellow-breasted Bunting	Critically Endangered	Possibly Qualifying	N/A	Possibly Qualifying	Yes	Yes
Fish							
<i>Laocypris hispida</i>	-	Data Deficient	Possibly Qualifying	Possibly Qualifying	N/A	No	Yes
<i>Pangasius sanitwongsei</i>	Giant Pangasius	Critically Endangered	Likely Qualifying	N/A	Likely Qualifying	No	(Potential for downstream impacts)
<i>Schistura ephelis</i>	-	Data Deficient	Likely Qualifying	Likely Qualifying	N/A	No	Yes
<i>Schistura sigillata</i>	-	Data Deficient	Likely Qualifying	Likely Qualifying	N/A	No	Yes
<i>Pseudecheneis sympelvica</i>	-	Data Deficient	Possibly Qualifying	Possibly Qualifying	N/A	Yes	Yes
<i>Cirrhinus microlepis</i>	Small Scaled Mud Carp	Vulnerable	Not Qualifying	N/A	Likely Qualifying	No	Yes

4.4.1 Mammal

Northern White-cheeked Gibbon (*Nomascus leucogenys*)

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Nomascus leucogenys</i>	Critically Endangered	1a	Likely
Justification			
<p>This species is found in tall primary and degraded evergreen and semi-evergreen forest (Rawson et al., 2020). In Lao PDR, it occurs in the northern parts, east of the Mekong River. The EAAA for the northern white-cheeked gibbon was identified using the species know range within the Study Area, and habitat requirements (see Figure 4-11).</p> <p><i>Nomascus leucogenys</i> is threatened by deforestation for agricultural development in lowland and mountainous areas and timber extraction from remaining habitat areas. This species is also under threat from hunting for food and traditional medicine and poaching of young individuals for illegal pet trade (Duckworth, 2008).</p> <p>This species is listed in CITES Appendix I and is legally protected in Lao PDR. In Lao PDR, the species has been recorded in Phou Khao Khoay (MAF, 2011) and Phou Pha Nang NPAs (Duckworth, 2008). Although not considered to be first tier priorities, Phou Khao Khoay is considered second tier priority for the conservation of this species (MAF, 2011), however more recent studies of this species presence within these NPAs have not been undertaken.</p> <p>The global population for this species is unknown, however, the EAAA contains 23% of the estimated Global Extent of Occurrence for this species, therefore this species is considered likely to qualify for CH under Criterion 1a if confirmed as present in the EAAA.</p> <p>Existing plantations outside of PFAs have not been identified as occurring within 500 m of CH for this species, and no suitable habitat for this species has been identified as being removed for existing Burapha plantations (Figure 4-11). However, it is possibly that plantations in Nongpet-Naseng PFA may be located near CH for this species.</p>			



Edwin Butler/Shutterstock.com Photo ID: 2109994835

Figure 4-10 Northern white-cheeked gibbon (*Nomascus leucogenys*) mother with child

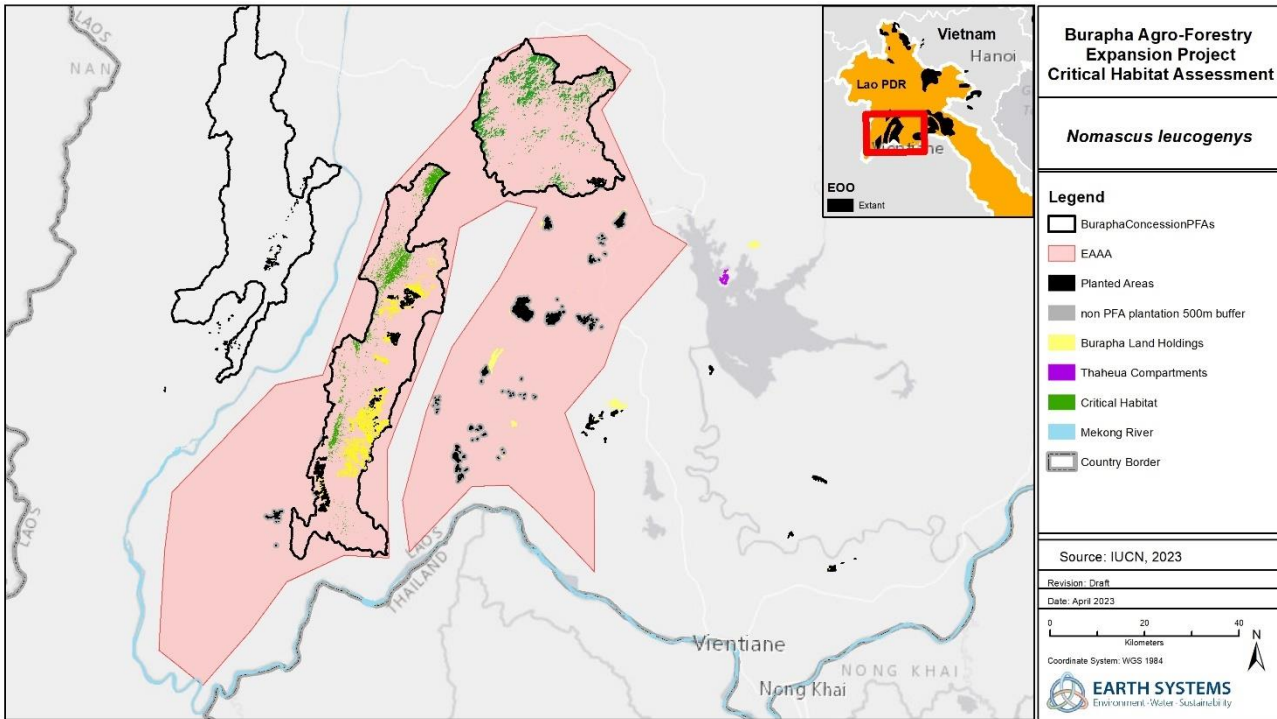


Figure 4-11 *Nomascus leucogenys* potential Critical Habitat within the EAAA

Asian Elephant (*Elephas maximus*)

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Elephas maximus</i>	Endangered	1a	Qualifying
Justification			
<p>In Lao PDR elephants are widely, but patchily distributed in small numbers within forested areas. They inhabit grassland, tropical evergreen forest, semi-evergreen forest, moist deciduous forest, dry deciduous forest and cultivated and secondary forests and shrubland. However, it is unclear which, if any, of these habitat types represent optimal suitable habitat for elephant as many landscapes have been subject to human modification.</p> <p>They have well defined home ranges and show fidelity to their established home ranges. Home range sizes likely depend not only on availability of forage, but also of water, needed for drinking, bathing and wallowing. More recently home ranges are being influenced by the level of disturbance and other development activities (e.g. roads, fences, canals etc.).</p> <p>The area would need to support 150 individuals (>0.5% of the global population) and >5 reproductive units to meet the qualifying criteria for CH, taking the lower estimation of global population of wild elephants (30,000). The population in Nam Phouy NPA is estimated to be between 30-60 individuals (C. Hallam, WWF,,Pers. Comm, March 20, 2023). Although this species does not meet the threshold for CH based on population, considering it is one of the most significant remaining elephant populations in Lao PDR it is still considered to qualify for CH.</p> <p>Elephants in Nam Phouy range outside the national park at several locations and have been recorded within the southern and northern extent of Phoupadam PFA (C. Hallam, WWF,,Pers. Comm, March 20, 2023). In 2022, elephants were observed in the southern extent of the NPA, within 2km of Phoupadam PFA (WWF, unpubl. Data). Given the wide-ranging nature of elephants, two plantations located within 10 km of the NPA may also be within the range of the group of elephants in the south of Nam Pouy NPA. Further stakeholder engagement will be required to confirm the presence of elephants in the vicinity of these plantations and within PFAs.</p>			



Source: Logan Welsh/Shutterstock.com Photo ID: 1800805585

Figure 4-12 Asian elephant (*Elephas maximus*)

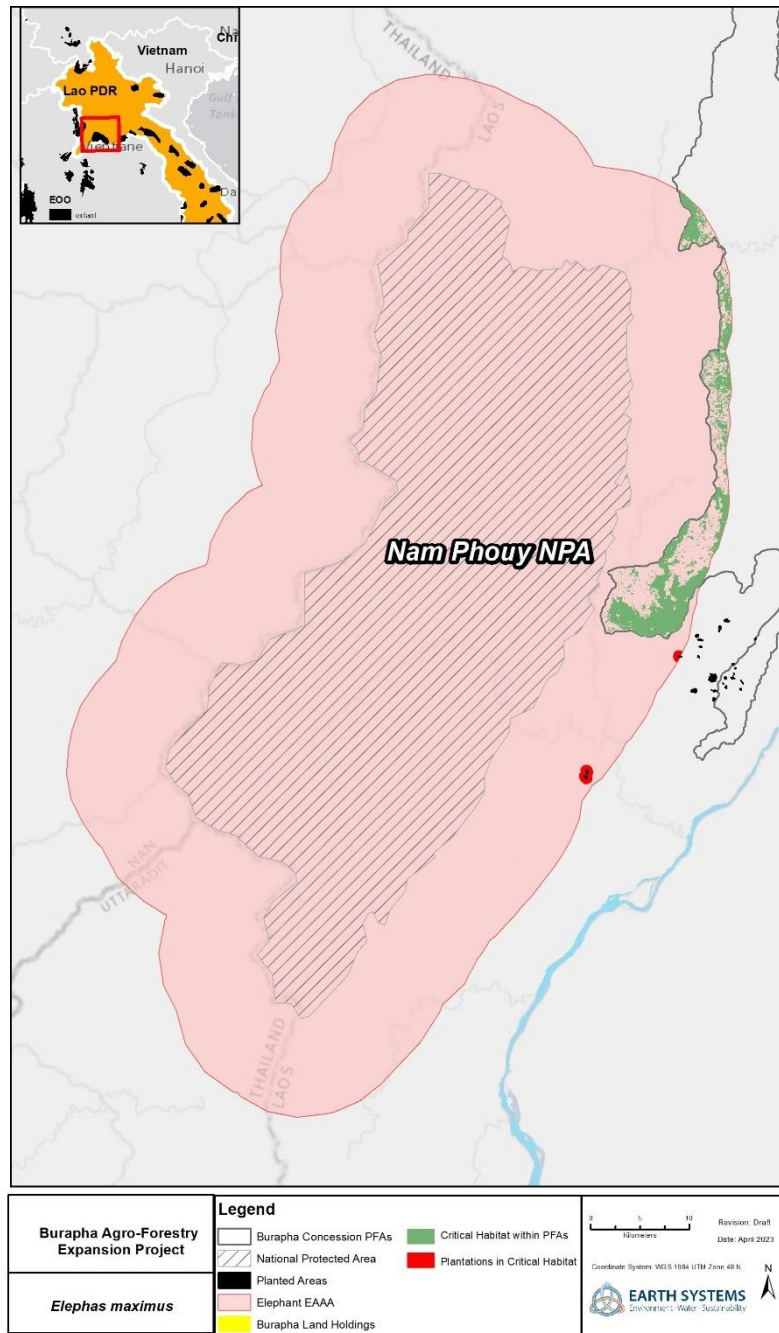


Figure 4-13 *Elephas maximus* potential Critical Habitat within existing plantations and concession PFAs in the EAAA

La Touche's Free-tailed Bat (*Tadarida latouchei*)

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Tadarida latouchei</i>	Endangered	1a	Likely

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
Justification			
<p>This species roosts in caves and forages in the surrounding forest, including heavily disturbed and primary forests (Thong, 2020). The primary threat to this species is disturbance of cave habitats, and hunting for food in Lao PDR is a secondary threat (Thong, 2020). As caves themselves are unsuitable for plantations, it is highly unlikely that Burapha’s plantations would encroach on roosting habitat. However, plantations are located in areas where caves may be present, and therefore may be within foraging habitat for this species.</p> <p>The EAAA for <i>T. latouchei</i> encompasses the extent of the species known EOO within a 50 km radius around Burapha’s existing plantations and future expansion areas. The range of other <i>Tadarida</i> species is over 30 km (Marques et al., 2004), however taking a conservative approach a 50 km radius was used.</p> <p>The global population is estimated to be 200 individuals, therefore the presence of just 1 individual of this species and >5 reproductive units would be required to meet the threshold for CH under Criterion 1a (0.5% of the global population size and >5 reproductive units). Given that 14.21% of this species Global EOO falls within the EAAA, and the presence of >5 individuals is likely, this species is considered likely to qualify for CH under Criterion 1a.</p> <p>This species has not been recorded in Laos in over 10 years due to lack of targeted surveys, therefore further expert consultation and surveys would be required to confirm this species presence and actual range and habitat usage within the Study Area.</p>			

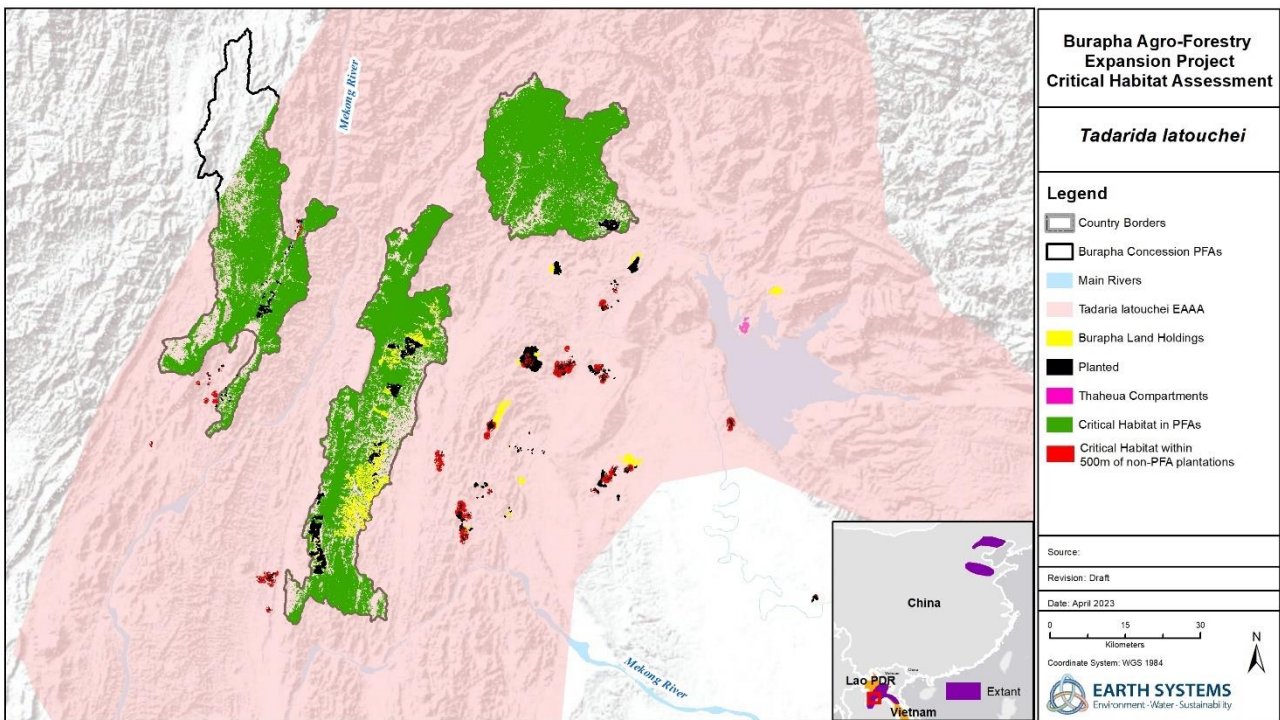


Figure 4-14 *Tadarida latouchei* potential Critical Habitat within the EAAA

Phou Khao Khouay Leaf-nosed Bat (*Hipposideros khaokhouayensis*)

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Hipposideros khaokhouayensis</i>	Vulnerable	1b	Likely
Justification			
<p>In Lao PDR, these bats have been captured in patches of intact and disturbed evergreen forest. Capture sites in Vang Vieng were near large limestone outcrops with caves in the vicinity, however capture sites in Phou Khao Khouay NPA were not near limestone outcrops or large caves (Douangboubpha, 2020). Roost sites for this species are not known, however Nongpet Naseng PFA is likely to contain suitable foraging habitat for this species.</p> <p>The key threat to this species is likely to be habitat loss in PKK NPA, which lacks management (Douangboubpha, 2020). Most bat species in Laos PDR are also threatened by hunting for food (Douangboubpha et al., 2012).</p> <p>To date this species is known only from central Lao PDR in Phou Khao Khouay NPA and Ban Nampe (11 km northeast of Vang Vieng) and Cat Ba Island in Vietnam. It is locally common both in Phou Khao Khouay NPA and Cat Ba Island, however surveys for this species have not been undertaken since 2006, therefore its current presence and/or abundance in PKK is uncertain. The global population of this species is estimated at 8000-10000 individuals (Douangboubpha, 2020). Given that 63.4% of the species' EOO is within the EAAA, it is likely that a significant population of this species would occur within the EAAA, if confirmed to be present in the Study Area. It is therefore considered to be likely that this species meets the thresholds for CH under Criterion 1b.</p>			



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Figure 4-15 Phou Khao Khouay Leaf-nosed Bat (*Hipposideros khaokhouayensis*)

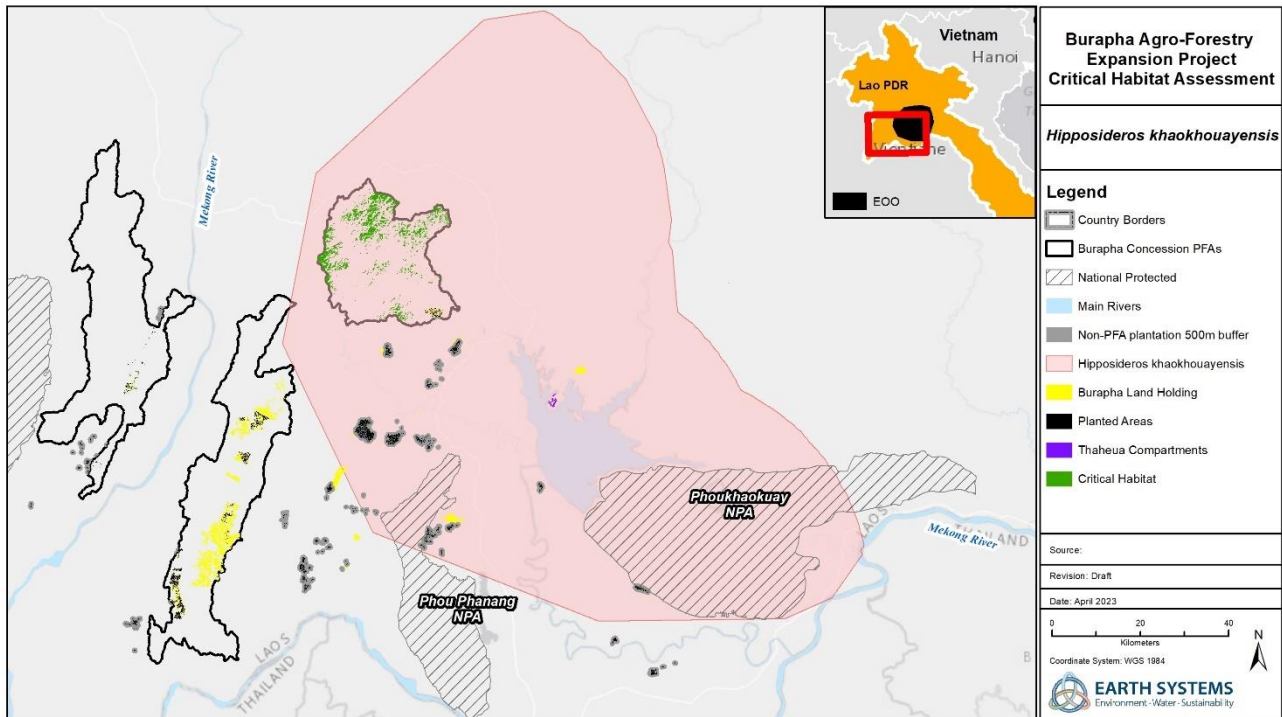


Figure 4-16 *Hipposideros khaokhouayensis* potential Critical Habitat within the EAAA

4.4.2 Herpetofauna

Siamese crocodile (*Crocodylus siamensis*)

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Crocodylus siamensis</i>	Critically Endangered	1a	Possibly Qualifying
Justification			
<p><i>Crocodylus siamensis</i> occurs in a wide range of lowland freshwater habitats, including slow-moving rivers and streams, lakes, seasonal oxbow lakes, marshes and swamps (Smith, 1931).</p> <p><i>C. siamensis</i> is probably now extirpated from the Lao Mekong and many other wetlands (Bezuijen et al., 2012). However, local officials believe that crocodiles in the Phou Khao Kouay NPA are wild and persist (Bezuijen et al., 2013), although the last confirmed sighting in Phou Khao Kouay NPA was in 2001. Most wetlands in Lao PDR remain unsurveyed for crocodiles and it seems likely that other <i>C. siamensis</i> localities will be documented.</p> <p>The EAAA includes Burapha plantations in the Northernmost extent of this species IUCN range on the Nam Ngum, and an additional plantation 6 km upstream, to its confluence with the Mekong 30 km downstream. The Phou Khao Kouay NPA, where this species is reported to persist has also been included in the EAAA, where a third plantation (developed in 2012/2013) lies in its buffer zone.</p> <p>The population estimate for this species is 500-1000 mature individuals, therefore, taking a conservative approach, 3 individuals (0.5% of the global population), and 5 reproductive units would be required to meet the threshold for CH under Criterion 1a. Given the information listed above, if found to be in the area, this species would meet the threshold for CH. However, given the lack of recent evidence of this species presence within the Study Area, further stakeholder consultation would be required to confirm this species presence in the EAAA.</p> <p>Although possibly qualifying within the Study Area, it is highly unlikely that this species would be found within the three concession PFAs, therefore, additional surveying for this species in the PFAs is not required.</p>			



Source: iNaturalist. No Rights Reserved. <https://www.inaturalist.org/observations/147815716>

Figure 4-17 Siamese Crocodile (*Crocodylus siamensis*)

Laos warty newt (*Laotriton laoensis*)

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Laotriton laoensis</i>	Endangered	1a	Possibly Qualifying
Justification			
<p>This species inhabits pools within the headwaters of streams. These streams flow through a variety of disturbed and undisturbed habitats, including evergreen forest, shrubs, grassland, and rice fields. The species is known from 1,160 to 1,430 m asl (IUCN SSC Amphibian Specialist Group, 2014).</p> <p>Since 2008, this species has been protected under Lao Law (Category I), however, is still threatened by overharvest for consumption and medicinal purposes (Bachhausen, 2017). It's bright orange colouring and diurnal nature makes this species extremely susceptible to harvesting (Phimmachak et al., 2012). In November 2022, this species was added to CITES (Appendix II) (S. Bryan, pers. comm.).</p> <p>In 2013, WCS Lao program team conducted surveys for the species in central Lao PDR which failed to detect the species in Nam Et-Phou Louey and Phou Khao Khouay NPAs. However, the newt is known to occur outside of protected areas, including the Kasi district in which the northern half of Nongpet-Naseng PFA is located (P. Somphouthone, Pers. comm. 4 April, 2023).</p> <p>Ecological niche modelling conducted by Chunco et al. (2013) found areas of suitable habitat for this species within the Study Area, particularly within Nongpet Naseng PFA (refer to Figure 4-18 and Figure 4-20). As 5.15% of this species EOO falls within the EAAA, therefore it is possible this species could qualify for Critical Habitat, however its presence within the Study Area would need to be confirmed.</p>			

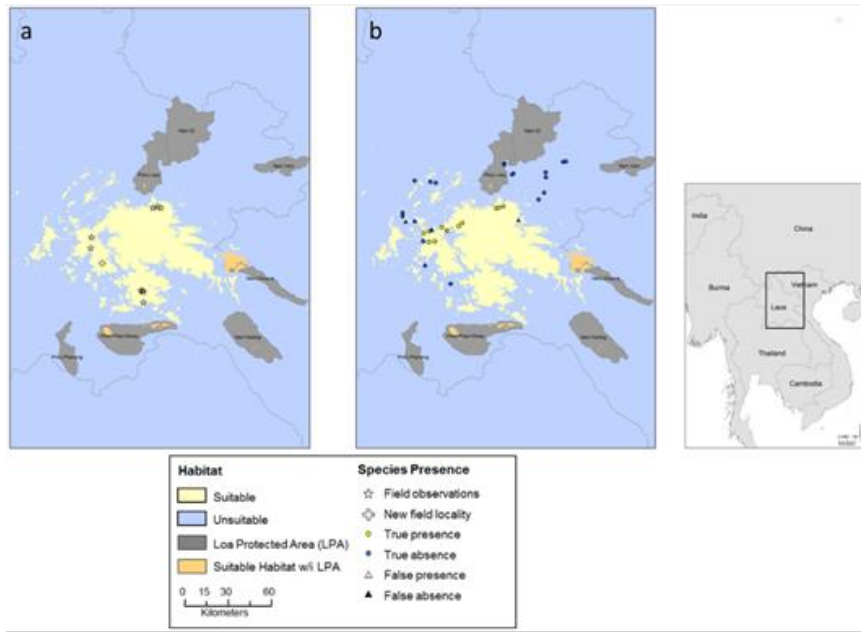


Figure 4-18 Environmental Suitability for *Laotriton laoensis* (Chunco et al., 2013)



Source: shutterstock/photo ID: 333384278

Figure 4-19 *Laotriton laoensis*

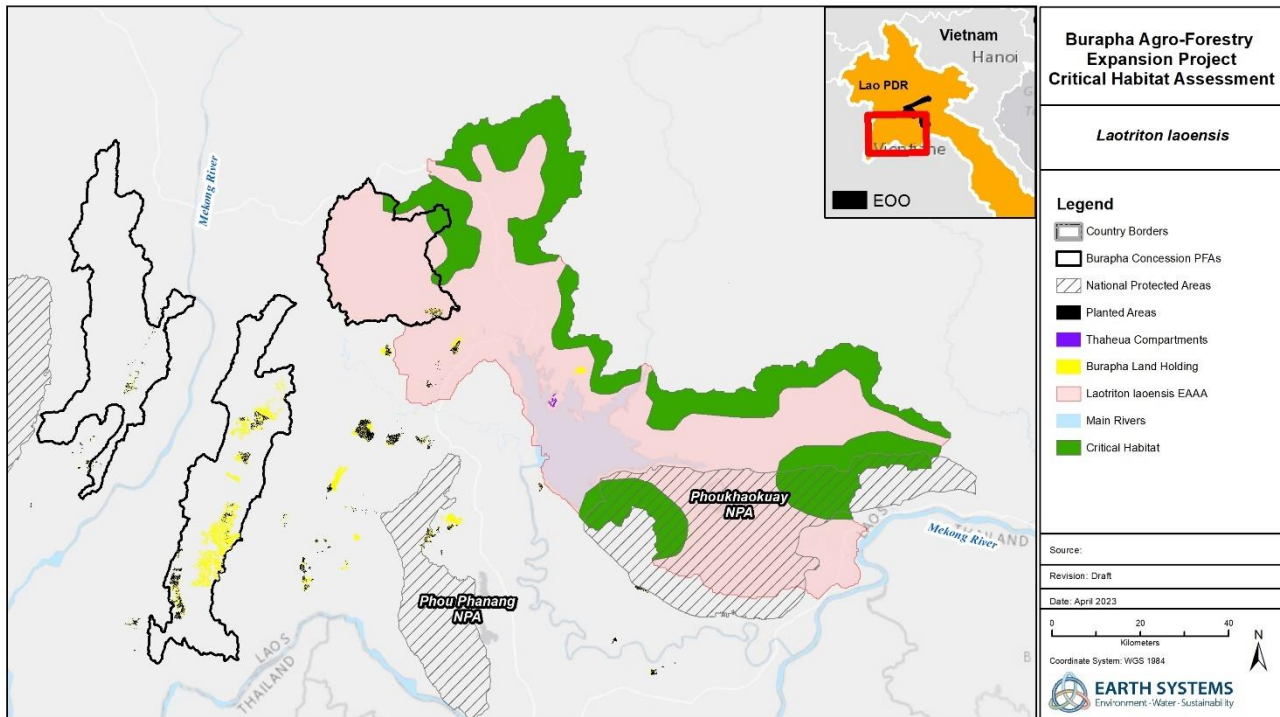


Figure 4-20 *Laotriton laoensis* potential Critical Habitat within the EAAA

Cyrtodactylus pageli

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Cyrtodactylus pageli</i>	Least Concern	2	Qualifying
Justification			
<p>This species has been recorded in limestone caves within forested areas (both primary and secondary) and it is considered that it needs forest cover to persist.</p> <p>Given that 100% of this species' EOO is within the EAAA this species is considered to meet the threshold for CH under Criterion 2, however, it is highly unlikely that Burapha's operations would encroach on limestone caves therefore this species is unlikely to be impacted by existing or future plantations.</p>			

Laotian water skink (*Tropidophorus laotus*)

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Tropidophorus laotus</i>	Endangered	1a and 2	Likely Qualifying
Justification			
<p>This species is found near rocky hill streams in primary and secondary forest at low to mid elevations. The known Lao localities all lie along tributaries of the Mekong, close to the main river (Sumontha et al., 2021). This species has also been recorded in the Nam Lik reservoir, downstream of the Nongpet-Naseng PFA in 2015, and along the Mekong channel between Phoupadam and Phou Yuey PFAs in 2011-2012 (GBIF, 2023). The most recent record of this species within the Study Area was in 2015, however this may reflect a lack of surveying rather than absence. Current presence is still uncertain, therefore further expert consultation and surveying may be required.</p>			

The EAAA for this species encompasses the sub catchments in which species has a known range within the Study Area, and/or has been recorded in the past, extending 50 km downstream from the known EOO.

Although population numbers for *T. laotus* are unknown, approximately 69% of this species extremely restricted global EOO falls within the EAAA, and its presence has been confirmed through previous records. Therefore, if any sites are confirmed within the EAAA, it would trigger CH under Criterion 1a and 2.



Source: Ian Dugdale, Jan 29, 2020, some rights reserved. CC BY 4.0. <https://inaturalist.nz/observations/38085346>

Figure 4-21 Laotian water skink (*Tropidophorus laotus*)

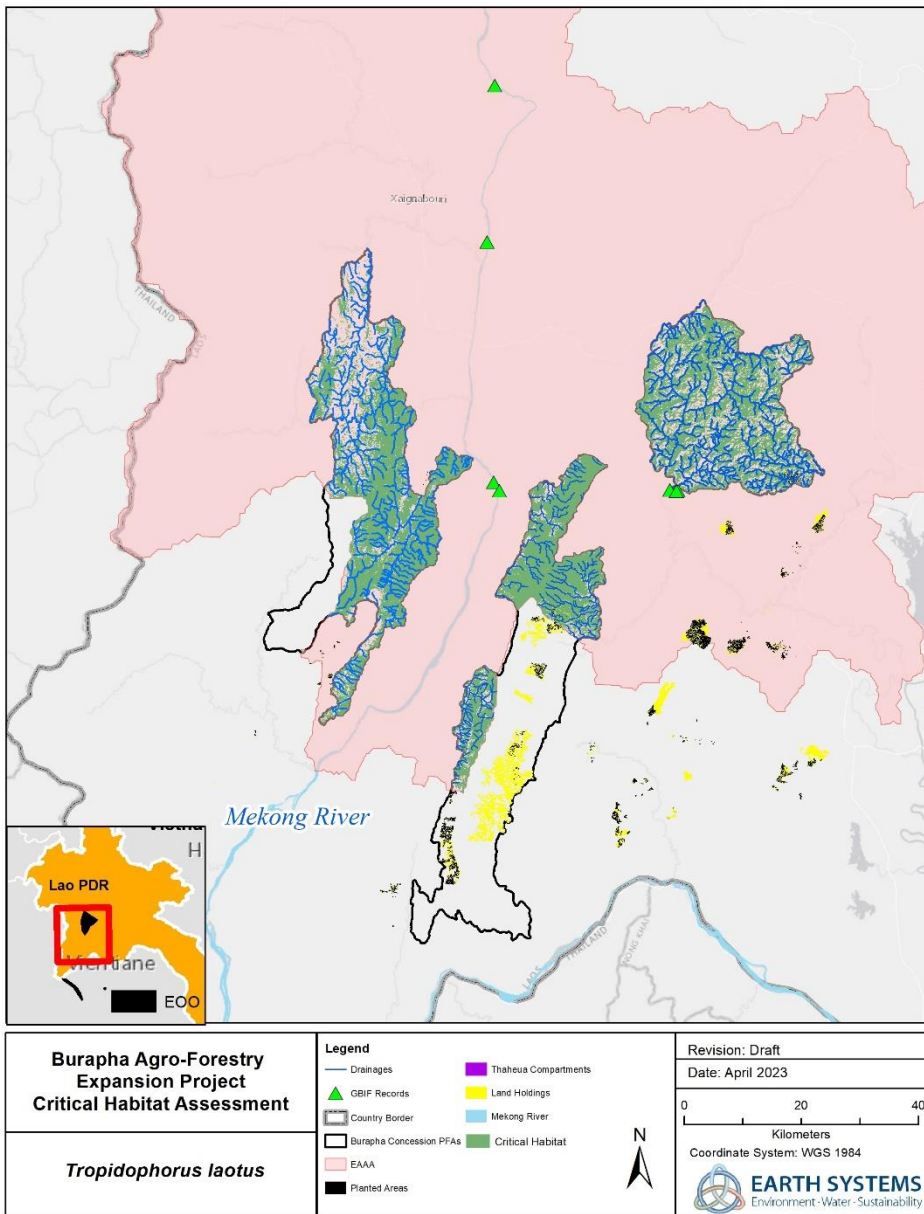


Figure 4-22 *Tropicophorus laotus* potential Critical Habitat within the EAAA

4.4.3 Bird

Yellow-breasted Bunting *Emberiza aureola*

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Emberiza aureola</i>	Critically Endangered	1a and 3	Possibly Qualifying
Justification			

This species winters in a relatively small region in South and South-East Asia, which includes eastern Nepal, north-eastern India, Bangladesh, Myanmar, southern China, Cambodia, Lao PDR, Vietnam and Thailand (Byers et al., 1995). It winters in large flocks in cultivated areas, rice fields and grasslands, preferring scrubby dry-water rice fields for foraging and reedbeds for roosting. Presence of relatively intact floodplain wetland seems to be important for this species.

Declines in this species population is likely to be driven by excessive trapping during migration and at wintering sites (Birdlife International, 2017).

Where found, the species typically occurs in flocks from tens to several hundred individuals in recent years, although larger congregations were documented in the past in Lao PDR (Duckworth, unpubl. data, as cited in Samphors et al., 2022). There are records of this species within the Study Area as recently as 2022 (GBIF, 2023), however, the validity of these records is uncertain.

The European population is estimated at 120-600 mature individuals. If sites are known wintering grounds this species could trigger CH under Criterion 1a and Criterion 3. However, it's current presence in the area is uncertain, as the most recent records have not been verified.



Source: iNaturalist. June 2022. Yellow-breasted Bunting (*Emberiza aureola*). No Rights Reserved.
<https://www.inaturalist.org/observations/120611442>

Figure 4-23 Yellow-breasted Bunting (*Emberiza aureola*)

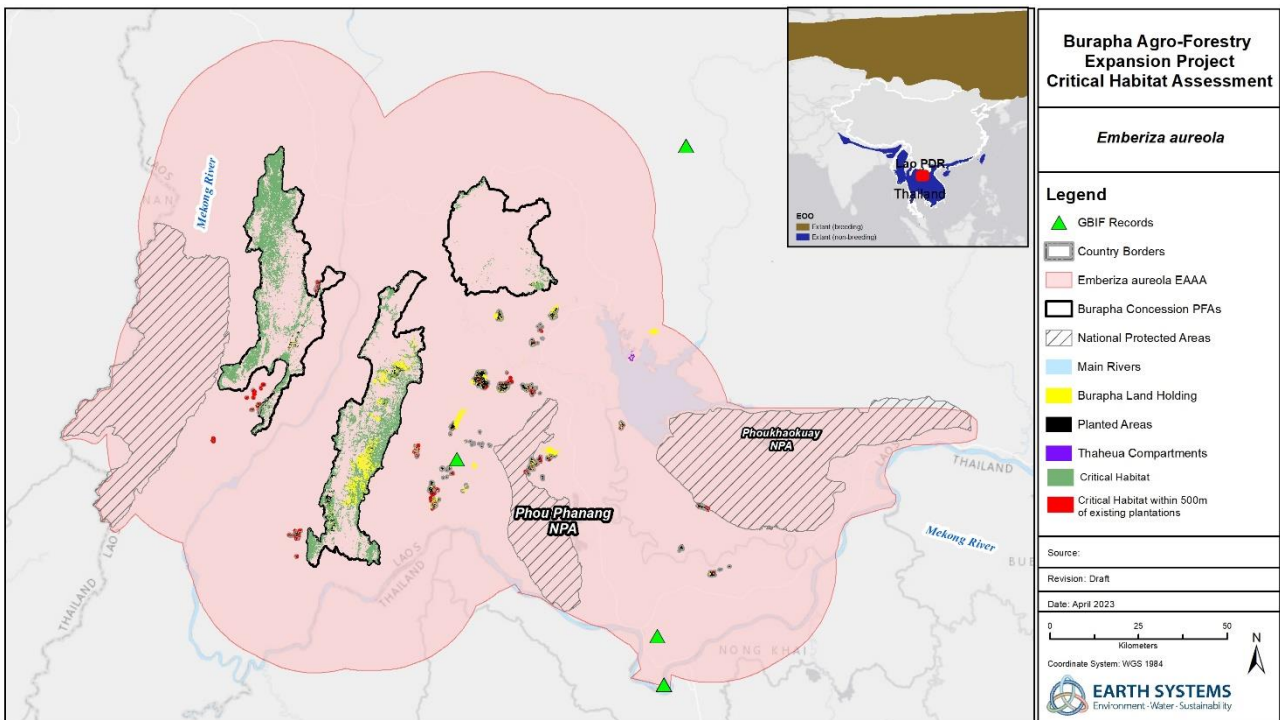


Figure 4-24 *Emberiza aureola* potential Critical Habitat within the EAAA

4.4.4 Fish

Schistura sigillata and *Schistura ephelis*

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Schistura sigillata</i> and <i>Schistura ephelis</i>	Data Deficient	1 and 3	Likely Qualifying
Justification			
<p><i>Schistura sigillata</i> and <i>Schistura ephelis</i> have been assessed together due to their similarities in habitat requirements and range. <i>S. sigillata</i> is found in streams with moderate to fast water, in riffles over gravel (Kottelatt, 2000). Similarly, <i>S. ephelis</i> is found in riffles among stones (Kottelatt, 2000). Both species are known from the Nam Ngum, and Nam San drainages (Kottelatt, 2000; Kottelatt, 2017; Kottelatt, as cited in Kottelatt 2017 p.703). It is uncertain whether these species still occur in the Study Area since they have not been recorded since the early 2000s.</p> <p>In 2018, <i>Schistura sigillata</i> and <i>Schistura ephelis</i> were assessed as KBA Qualifying in the Nam Ngum Reservoir under Criterion B1 (>10% of the global population size and >10 Reproductive units of any geographically restricted species). For this reason and given that 100% of the two species' EOOs fall within the EAAA, these species are considered likely to qualify for CH under Criterion 2 if confirmed to be present in the Study Area.</p> <p>These species' known range overlap with the Nongpet and Phu Yuey PFAs. Any future plantations in Burapha's land holdings situated on the Nam Ngum 1 Reservoir, or use of MTP's Taheua plantations, may fall within waterways which are considered CH for this species.</p>			

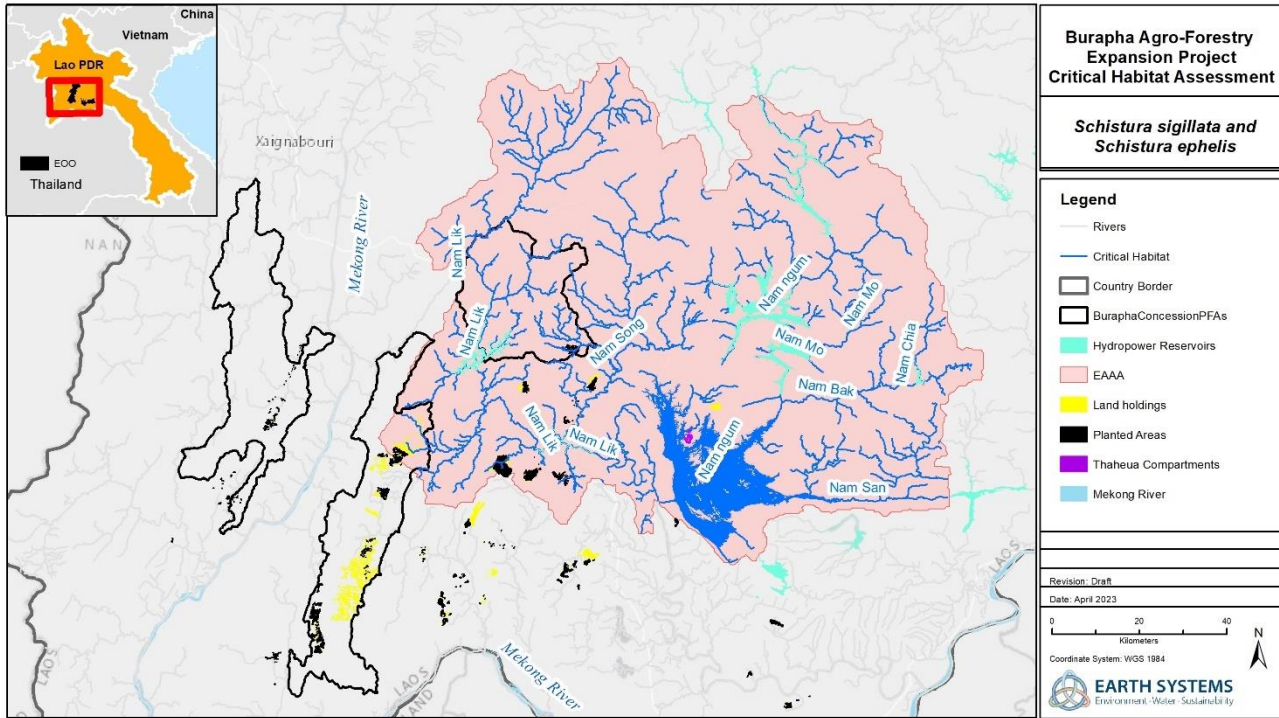


Figure 4-25 *Schistura sigillata* and *Schistura ephelis* potential Critical Habitat within the EAAA

Laocypris hispida

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Laocypris hispida</i>	Vulnerable	1 and 2	Possibly Qualifying
Justification			
<p>This species was found in riffles in clear water (Kottelat 2000); however, it is uncertain whether the extensive dam development within the Nam Ngum basin has impacted this species (Kottelat, 2012).</p> <p>In 2018, <i>Laocypris hispida</i> was assessed as KBA Qualifying in the Nam Ngum Reservoir under Criterion B1 (>10% of the global population size and >10 Reproductive units of any geographically restricted species). 47% of this species EOO falls within the EAAA, however further surveying will be required to confirm this species presence within the EAAA.</p> <p>This species is highly unlikely to be found in waterways in Burapha’s concession PFAs, however any future plantations in Burapha’s land holdings near the Nam Ngum 1, or use of MTPs Thaheua plantations also situated on the Nam Ngum 1 Reservoir may fall within waterways which may be considered CH for this species.</p>			

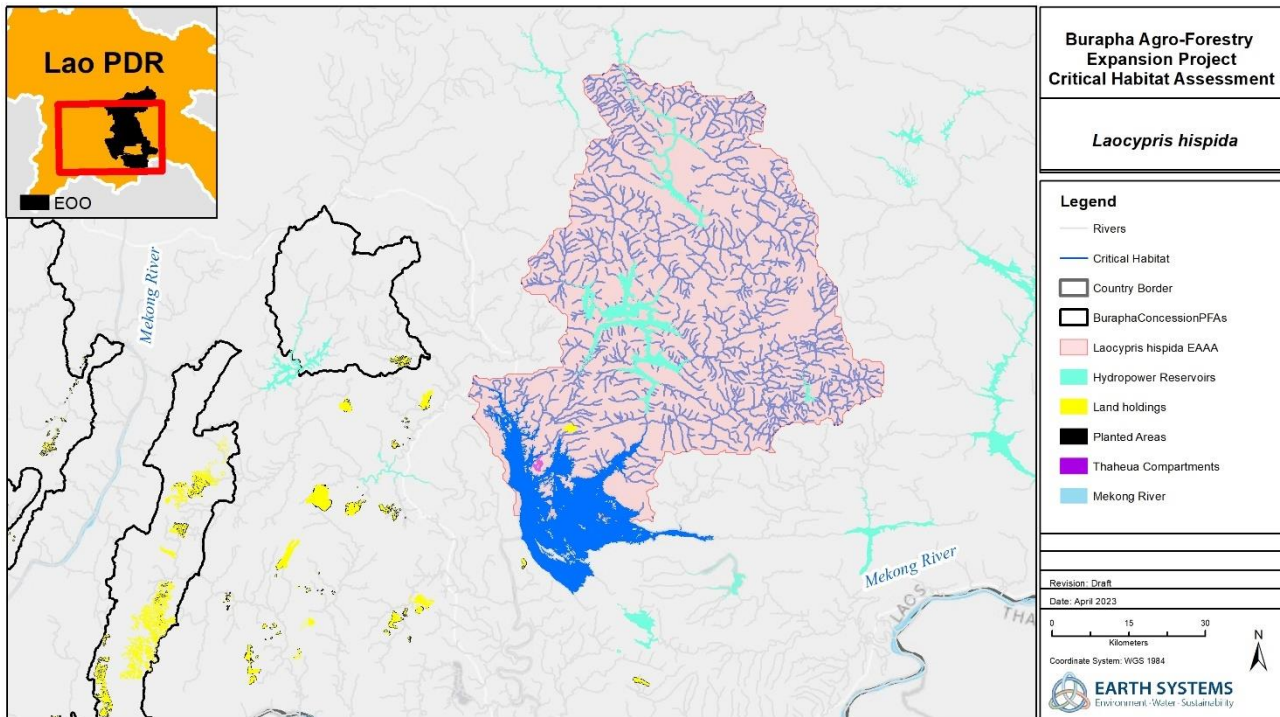


Figure 4-26 *Laocypris hispida* potential Critical Habitat within the EAAA

Pseudecheneis sympelvica

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Pseudecheneis sympelvica</i>	Data Deficient	1 and 2	Possibly Qualifying
Justification			
<p>The species is known from the Nam Theun, Nam Lik, and upper Nam Ngum and Nam Ngiap at the edge of the Plain of Jars in Lao PDR, and is found in rivers, strong rapids, or on rocks at the edge of waterfalls. It seems to have a very fragmented and localised distribution, but this may reflect the difficulty to sample its habitat and that some areas are still unexplored (Kottelatt, 2012b).</p> <p>It is not clear whether the river still supports this species as it is now heavily regulated, however given that 42% of this species extremely restricted EOO occurs within the EAAA, this species would qualify for Critical Habitat, although further assessment to determine its presence should be undertaken.</p>			

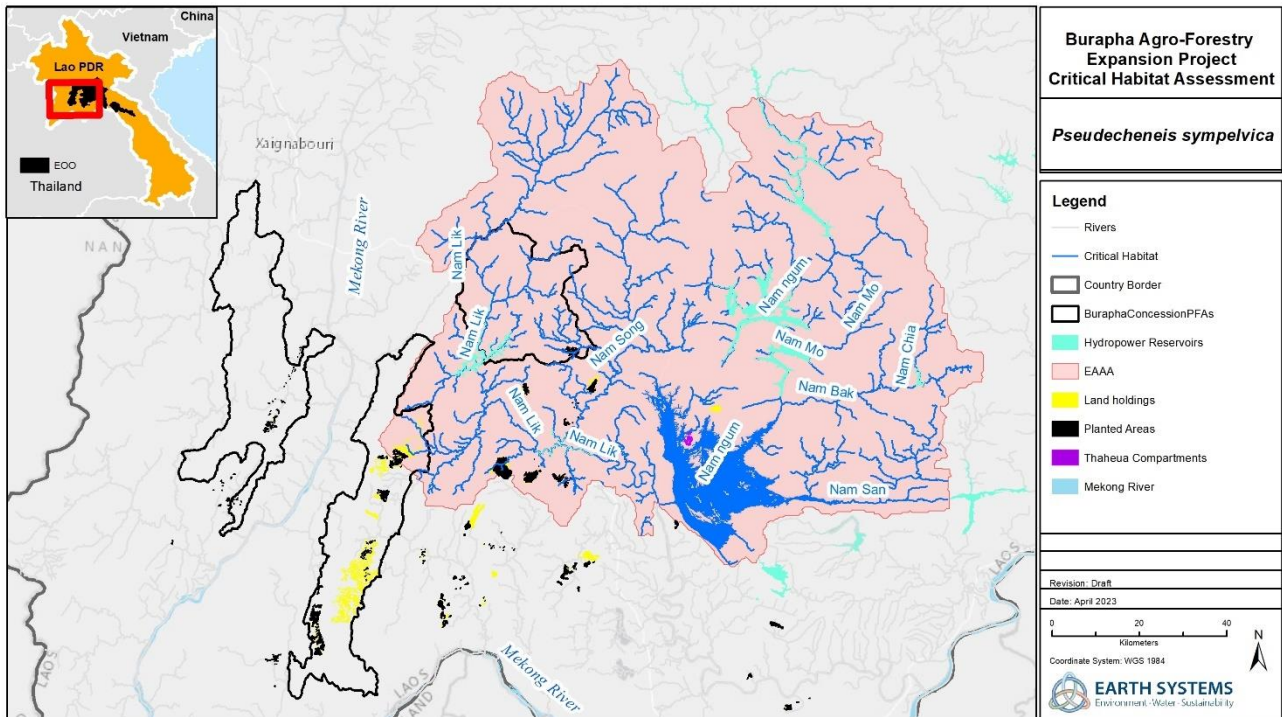


Figure 4-27 *Pseudecheneis sympelvica* potential Critical Habitat within the EAAA

Giant Pangasius (*Pangasius sanitwongsei*)

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Pangasius sanitwongsei</i>	Critically Endangered	1a and 3	Likely Qualifying
Justification			
<p>This species appears to encompass two distinct subpopulations within the Mekong mainstream. One population occurs from the upper Mekong delta (i.e., just downstream of the Cambodian-Vietnamese border) to the Khone Falls (southern Lao PDR). The other population is confined to the Mekong mainstream above the Khone Falls, but is mainly distributed along the stretch from Vientiane to the border between the Lao PDR, Thailand and Myanmar (Poulsen, 2001). Both sub-populations spawn in the upper sections of their respective stretches during May to July. Larvae and juveniles drift downstream until they reach their nursing areas.</p> <p>Local knowledge surveys indicate this species is rare both above and below the Khone Falls. Given that 8% of the species EOO is within the EAAA, its limited range, rarity and migratory behaviour in the study area it is considered likely that this species would meet the thresholds for Criteria 1 and 3.</p> <p>Given the migratory nature of this species, it is likely to have been affected by the construction of dams and the destruction of rapids and reefs as part of the Upper Mekong Navigation Improvement Project (Jenkins et al, 2009). Further expert input and surveys may be required to confirm this species current presence within the EAAA, as this species was last assessed on the IUCN Red List in 2009.</p>			

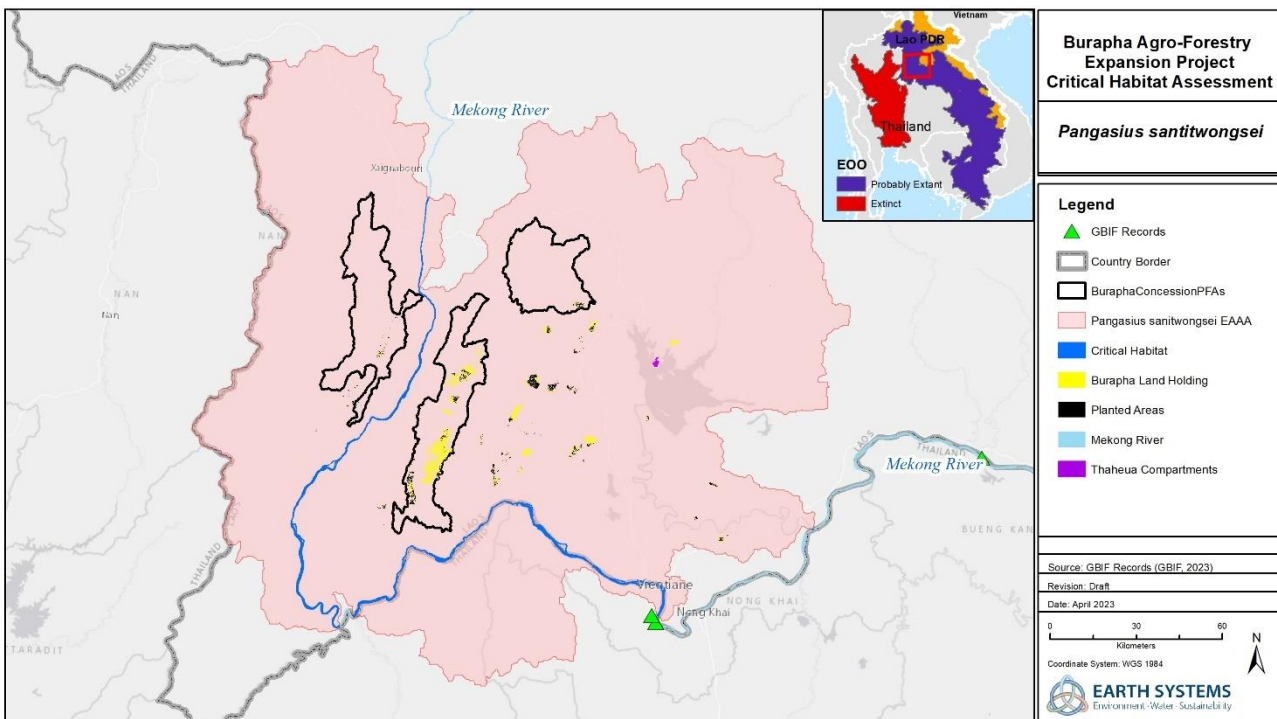


Figure 4-28 *Pangasius sanitwongsei* potential Critical Habitat within the EAAA

Cirrhinus microlepis

Species	Status (IUCN Red List of Threatened Species)	Critical Habitat Criterion	Qualifying
<i>Cirrhinus microlepis</i>	Vulnerable	3	Likely Qualifying

Justification

This species inhabits large rivers and lowland floodplains (Rainboth, 1996), occurring in riffles and deep slow reaches. *C. microlepis* migrates from Xayaboury in Lao PDR to Chiang Saen in Thailand between March and August.

The main threats to this species are likely to be pollution, dams and overfishing (Baird, 2011). This species was reported to occur by locals within in Phou Yeuy PFA (Feung District) during 2022 wet season studies, however has not been confirmed through field surveys.

5% of this species EOO falls within the EAAA, however its former range in the Chao Phraya Basin has been extirpated, so this is likely to be an underestimate. Given that 5% of this species EOO falls within the EAAA, and this species has been reported to occur within the Study Area, this species is considered likely to qualify for CH under Criterion 3, however is unlikely to meet the threshold for Criterion 1.

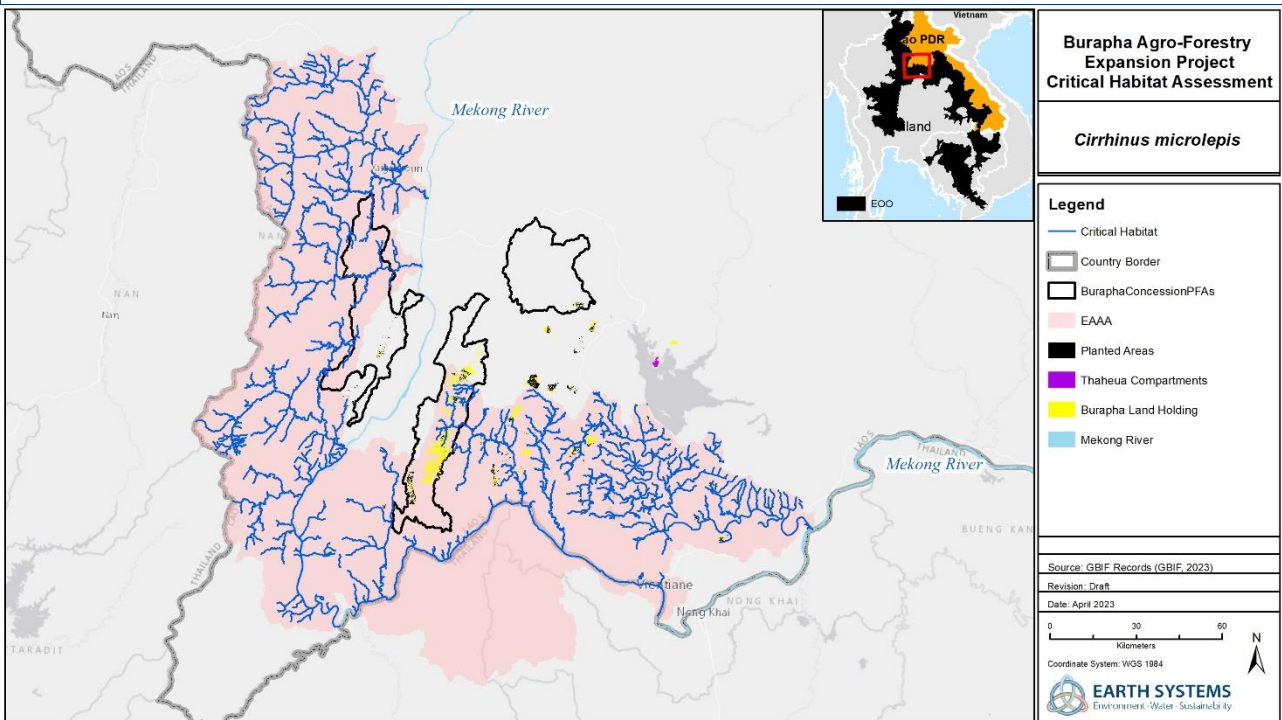


Figure 4-29 *Cirrhinus microlepis* potential Critical Habitat within the EAAA

4.4.5 Criterion 4: Highly Threatened and / or Unique Ecosystems

Terrestrial ecosystems

The Study Area occurs within the Luang Prabang Montane Rain Forests eco-region (Wikramanayake et al., 2002). This eco-region covers a large area of approximately 27,700 square miles (44,600 km), including parts of Lao PDR, Vietnam and Thailand. It primarily comprises areas above 800 m in north central Lao PDR. A variety of forest types occur in this region including evergreen forest, mixed conifer-hardwood forests, open montane forests, and open conifer forests. It supports globally important populations of mammals and over 540 bird species (Wikramanayake, 2023). The principal threats to this eco-region include illegal trade of wildlife and habitat loss due to conversion of land for shifting cultivation, logging and plantations. More than 70 percent of this ecoregion's original montane vegetation has been converted to scrub or degraded forest (Wikramanayake et al., 2023).

The Study Area is rich in limestone karst outcrops. In Lao PDR, ecoregional analyses have also identified Central Indochina Limestone karst as being of high international significance for conservation (Rao et al. 2008). Limestone karsts are sedimentary rock outcrops which provide a multitude of climatic conditions and ecological niches, such as limestone caves and fissured cliffs, which results in high species diversity and endemism (Clements et al., 2006). Limestone Karst habitats are under threat from unsustainable exploitation, primarily from limestone quarrying, which leads to population declines in site-endemic taxa. Consequently, 31 species known from karst habitats in Southeast Asia are globally threatened, although this number is likely underestimated (Clements et al., 2006).

As the Study Area overlaps with areas 'determined to be of high priority for conservation by regional or national systematic conservation planning' (refer to Section 4.1.1) it likely qualifies for Critical Habitat under threshold b for Criterion 4 (GN80: IFC, 2019). One PFA, Phouphadam, is less than 1 km from the high priority Nam Phouy NPA / Nam Phoun Key Biodiversity Area, and the establishment of agroforestry plantations to the west of this PFA may impact this ecosystem as discussed in Section 4.6.

Aquatic ecosystems

One of the most important and influential ecological features in the Study Area is the Mekong River and its associated tributaries. The Mekong is a 4,200 km long, free-flowing river that flows through six countries: China, Myanmar, Thailand, Lao PDR, Cambodia and Vietnam. It has the second highest fish diversity (after the Amazon River) and is the most productive inland fishery (WWF-Laos, 2022). Its catchment area is over 800,000 km² and comprises 12 habitat types, including wetlands, peat swamps, subterranean streams, and crater lakes, which support a diverse range of aquatic and terrestrial flora and fauna. The Mekong River and its watershed have been identified by The World Wildlife Fund (WWF) on 'The Global 200' list of priority ecoregions. That is, the ecoregions that 'harbour exceptional biodiversity and are representative of its ecosystems' (Olson & Dinerstein, 2002).

The Study Area is within two freshwater ecosystems known for their high levels of endemism; the Khorat Plateau (Mekong) and the Lower Lancang (Mekong) (Abell et al., 2008). The Khorat Plateau (Mekong) freshwater ecoregion includes the Mekong lowlands, consisting of tropical and subtropical upland rivers (Abell et al., 2008; Thieme, 2014). The ecoregion supports high levels of endemism, with almost 50 endemic fish species identified and several monotypic genera; *Laocypris* (*L. hispida*, DD), *Troglocyclocheilus* (*T. khammouanensis*, VU), *Terateleotris* (*T. aspro*, EN, IUCN, 2023). The ecoregion also contains several critically endangered fish including the Mekong giant catfish (*Pangasianodon gigas*) and Mekong giant salmon carp (*Aptosyax grypus*, IUCN, 2023).

The Lower Lancang (Mekong) freshwater ecoregion is characterised by tropical and subtropical floodplain rivers and wetland complexes (Abell et al., 2008). It has relatively low fish diversity, but a high ratio of endemism among hill-stream specialized genera of the families Cyprinidae, Balitoridae, Sisoridae, and Gobiidae (M. Kottelat pers. comm. 2006, cited in WWF/TNC, 2019).

While aquatic ecosystems in the Study Area are unlikely to qualify for Critical Habitat under Criterion 4, they may qualify under Criterion 5, *Areas Associated with Key Evolutionary Processes*, due to their high level of endemism, as discussed in section below.

4.4.6 Criterion 5: Areas Associated with Key Evolutionary Processes

Although key evolutionary processes may operate at various spatial scales, in the context of PS6 these are usually considered at a relatively fine scale rather than broad biogeographic regions. No quantitative significance thresholds exist for this criterion, so there is a reliance on expert opinion and qualitative value judgement.

The Study Area is located near three KBAs with high levels of endemism: the Mekong Channel near Pakchom, the Mekong River from Luang Prabang to Vientiane and Nam Ngum Reservoir. The eastern arm of the Phouphadam PFA adjoins the 'Mekong River from Luang Prabang to Vientiane' KBA, the Phou Yeuy PFA is 5 km north of two KBAs; the 'Mekong River from Luang Prabang to Vientiane' and 'Mekong Channel near Pakchom' and the Nongpet Naseng PFA is 12 km north-west of the Nam Ngum Reservoir KBA.

As areas of high endemism often contain flora / fauna with unique evolutionary histories, the Study Area may qualify for Critical Habitat under Criterion 5 due to the high level of endemism associated with the Khorat Plateau and Lower Lancang freshwater ecoregions (discussed above). As all PFAs overlap with waterways that drain into aquatic KBAs, the establishment of plantations in these will impact these areas, as discussed in Section 4.6.

4.5 Priority Ecosystem Services

Priority ecosystem services are two-fold and can be defined under either or both of the following categories:

- ▶ **Type I** – Those services on which project operations are most likely to have an impact, and, therefore, which result in adverse impacts to affected communities; and
- ▶ **Type II** – Those services on which the project is directly dependent for its operations.

An initial review of ecosystem services which could be priority services for either local beneficiaries (Type I) and/or the Project (Type II) are presented in Table 4-5.

Type I Priority Ecosystem Services for local beneficiaries are likely to be Regulating Services (Soil Erosion Regulation, Air Quality Regulation and Hydrological Services) and Supporting Services (Nutrient Cycling and Soil formation). Land acquired by Burapha does not appear to be important for provisioning services (e.g., hunting, TFP/NTFP collection) for local communities, and areas identified as having cultural or spiritual significance to local communities are excluded from the land acquisition process.

Priority Ecosystem Services for the Project (Type II) are likely to be Provisioning Services (Water Supply and Use), Regulating Services (Soil Erosion Regulation and Air Quality Regulation) and Supporting Services (Nutrient Cycling and Soil formation).

Consultations with local villages identify exclusion areas that villages rely on for ecosystems services such as waterways, village forests, aquatic systems for fisheries etc, which minimises Project impacts on provisioning services. Although Project activities and expansion may still impact on Priority Ecosystem Services such as soil erosion regulation and nutrient cycling, active management of Burapha's Special Management Areas may provide benefits to Priority Regulating and Supporting services through the maintaining of riparian buffer zones and protection of areas from fire for the life of the plantation.

Table 4-5 Priority Ecosystem Services Assessment

Ecosystem Service	Description	Priority Ecosystem Service (Type I, Type II)	Justification
Provisioning Services			
Agricultural Production	Environmental income derived from harvesting and selling natural resources is an essential income stream for rural communities in Lao PDR (Van Der Meer Simoa et al., 2019). Agriculture, particularly rice farming, also provides food security for many rural communities.	-	As part of Burapha’s land acquisition process (2019), land is not acquired if deemed to be important for village livelihoods or an individual’s only available land for practicing agriculture or livestock grazing, although exceptions can be made if the respective landowner still wishes to sell their land. Intercropping is practiced in Burapha plantations in years 1-2, and livestock grazing is permitted in plantation areas in years 7-8.
Hunting	Local communities may hunt in Project areas for subsistence and income.	-	Hunting is widespread throughout the Study Area and is generally conducted in remaining forested areas within PFAs. Areas selected for Burapha plantations are therefore unlikely to be important to local communities for hunting. Due to their widespread mosaic distribution, hunting is not controlled within Special Management Areas of Burapha plantations.
TFP collection	Timber Forest Products provide construction materials and firewood for local communities.	-	Burapha’s plantations are on degraded lands and are unlikely to be in areas important for TFP collection.
NTFP collection	Non-Timber Forest Products (e.g., fruits and vegetables, mushrooms, medicinal plants, construction materials) are essential for income and subsistence within Lao PDR (Phounvisouk et al., 2013).	-	NTFP collection is generally carried out in community forests and forested areas within PFAs. It is unlikely that Burapha plantations would encroach on irreplaceable areas of NTFP collection. NTFP collection is permitted within Special Management Areas of Burapha plantations, which would otherwise likely be removed for agricultural or other forestry activities. Burapha is likely to have a positive impact on NTFP resources within the landscape.
Water Supply and Use	Communities may rely on rivers / streams in the area for various purposes such as washing, bathing, or other domestic work. Projects may also rely on water in various aspects of operations.	Type II	Burapha plantations are located on ephemeral first and second order streams and water is not used in the plantations themselves, however water is used for Burapha’s plywood mill and is abstracted from the Nam Lik river at a maximum rate of 150m ³ per day. The abstraction point on the Nam Lik is above a regulating dam, therefore Burapha’s water use for the plywood mill is unlikely to impact water supply provided by the Nam Lik River. At Nabong village, Vientiane Prefecture,) approximately 10,560m ³ of water is extracted from bores each month from December to June to supply the nursery; and about 35m ³ of bore water per day to service the sawmill when the wood drying kilns are operating. The Nam Ngum river is located about 2km from these facilities. Residents of communities close to the sawmill and nursery mainly drink from

Ecosystem Service	Description	Priority Ecosystem Service (Type I, Type II)	Justification
			bottled water but use the Nam Nam Ngum and its tributaries for fishing and bathing/ laundry (Earth Systems, 2016).
Regulating Services			
Soil Erosion Regulation	Plants and vegetation have plant root networks that act to stabilise the ground, this provides an important ecosystem service by preventing soil erosion and maintaining soil levels. This in turn promotes soil fertility through biological processes (e.g. nitrogen fixation) and prevents sedimentation of water courses. In Lao PDR soil erosion is increasing due to shifting cultivation practices (Lestrelin et al., 2012).	Type I and II	Agricultural and plantation crops require stable soils for successful production.
Air Quality Regulation	Natural environments help regulate the composition of the atmosphere, but they also have local effects on air quality, which can be beneficial for human populations. One of the most important ways that vegetation serves to reduce adverse air quality is by stabilising soils and thus reducing dust generation. Additionally, trees and other natural vegetation have a large surface area on their leaves with an affinity for capturing particulate matter. Captured particulate matter is then washed from the foliage during rainfall events.	Type I	Clearing for Burapha's plantations and creation access roads has the potential to impact community and environmental health by increasing fugitive dust generation.
Hydrological Services	Hydrological services are regulating services which are provided by flow dependent environments such as floodplains, wetlands and rivers. Flow-dependent environments generate a disproportionately high level of biodiversity and benefits to human wellbeing relative to their extent.	Type I	Downstream water quality impacts resulting from increased erosion and sedimentation, and risk of improper use of herbicides and fertilisers may impact water quality and biodiversity in receiving waterways, particularly in the wet season.
Supporting Services			
Nutrient Cycling	Nutrient cycling includes processes such as nitrogen fixation, phosphorus supply by mycorrhizal fungi and litter decomposition (Ghaley, 2014). In various forest ecosystem types, forests play a critical role in building and maintaining soil fertility. Trees take up nutrients from the soil to enable their growth and return nutrients back to the soil as they decay (Jenkins and Schaap, 2018).	Type I and Type II	Both local communities and Burapha's plantations rely on nutrient cycling for successful agricultural yields and plantations, respectively.

Ecosystem Service	Description	Priority Ecosystem Service (Type I, Type II)	Justification
Soil formation	Soil formation is a long-term process occurring over thousands of years through the degradation of and build-up of organic material in the ground layer.	Type I and Type II	Soil formation occurs predominately in vegetated landscapes and is fundamental for successful agricultural production in the long term by providing soil in which agricultural and plantation crops can grow.
Cultural Services			
Sites of Cultural or Spiritual Value	Cultural services can include spiritual, cultural, recreational, and aesthetic values provided by an environment.	-	Burapha's land acquisition process excludes areas with cultural significance to local communities. Therefore, it is highly unlikely that Burapha's plantations will occur in areas which provide cultural services to beneficiaries.

4.6 Impact Assessment

The following impact assessment assesses potential Project-related impacts on Critical Habitat-qualifying features and identifies those features that are of high priority for targeted biodiversity mitigation and management for the Project.

4.6.1 Critical Habitat Qualifying Mammals

Habitat Loss and Degradation

Impact Summary

The most significant impact to Critical Habitat qualifying mammals will be the loss and degradation of habitat.

Nam Phouy NPA has an estimated elephant population of 30-60 Asian elephants, one of the only viable and significant elephant populations remaining in Lao PDR. Elephants in Nam Phouy range outside the national park at several locations and have been recorded within the southern and northern extent of the Phoupadam PFA (C. Hallam, WWF, pers. comm). While elephants are wide ranging, they also have well defined home ranges and show fidelity to their established home range. Elephants can inhabit degraded habitats including cultivated and secondary forests and shrubland. Clearance of habitats within this PFA would result in the loss of elephant habitat that is likely used for foraging and forms part of this groups home range, resulting in a reduction in food availability and impacts to movement patterns. The loss of this habitat would contribute to the broader threat of habitat loss and fragmentation that has resulted in the compression of elephant herds in Protected Areas. Decreases in available elephant habitat results in increased conflict between humans and elephants leading to fatalities on both sides. Human elephant conflict (HEC) is the number one cause of mortality for Asian elephants in the wild (Williams et al., 2020). HEC is already considered a significant issue in areas surrounding Nam Phouy NPA (C. Hallam, WWF, pers. comm, 30 March, 2023) and habitat loss will cause an escalation in HEC in the adjoining landscape. Given the above information the impact of habitat loss and degradation on elephants is considered to be high.

The northern white-cheeked gibbon relies predominantly on tall primary and degraded evergreen and semi-evergreen forest. GIS analysis has identified the presence of suitable habitat within Phou Yuey and Nongpet Naseng PFAs. These two PFAs fall almost entirely within this species EAAA and many existing plantations are also within the EAAA. The Project's impacts on gibbon habitat is considered to be low given the existing level of disturbance in the area.

The Phou Khao Khouay leaf-nosed bat is associated with patches of intact and disturbed evergreen forest. Its roosting sites are unknown but captures in PKK NPA were not near limestone outcrops or large caves whereas La Touche's free-tailed bat roosts in caves and forages in the surrounding forest. La Touche's free-tailed bat is known to tolerate heavily disturbed forests, therefore habitat loss and degradation for this species is considered to be low. Buraphas plantations are unlikely to encroach on evergreen forests used by the Phou Khao Khouay leaf-nosed bat therefore habitat loss and degradation for this species is considered to be negligible.

Mitigation and Management

Key mitigation and management measures which should be implemented to avoid impacts to CH mammal species are:

- ▶ Avoid development of PFA areas identified and mapped as elephant and gibbon habitat (Figure 4-11, Figure 4-13,);
- ▶ Implement 1km 'no development' buffer zones around elephant habitat to avoid HEC;
- ▶ Conduct biodiversity monitoring pre and post development within areas to be impacted and clearly demarcate construction zones.

Residual Impact

With application of the above mitigation and management measures the impact to elephant habitat would be reduced to moderate. Given the proximity of Phoupadam PFA to Nam Phouey NPA the impact would not be reduced further.

Increased Accessibility

Impact Summary

Habitat clearance and the creation of roads and access tracks associated with the Project may facilitate access to surrounding areas particularly where the PFA borders on NPAs. This may lead to the degradation of natural habitats in areas surrounding the PFA through increased exploitation of TFPs and NTFPs, clearance for agriculture, creation of tracks and hunting. However, impacts associated with increased accessibility are difficult to quantify.

There is a moderate-high risk that increased accessibility may lead to increases in elephant poaching and further impacts to elephant habitat through degradation. Asian elephants are poached for a variety of products including meat and skin, making beads, pendants and powder etc. largely driven by demand from China (Williams et al., 2020).

There is considered to be a moderate impact from increased activity, roads and tracks associated with existing plantations in proximity to Phou Khao Khouay NPA contributing to accessibility and degradation of Critical Habitat for the Phou Khao Khouay leaf-nosed bat. Increased accessibility to Nongpet-Naseng PFA may negatively impact Critical Habitat for the northern white-cheeked gibbon. There is also considered to be a moderate risk that increased accessibility may have led to increased hunting for food and traditional medicines as well as the capture of young animals for the illegal pet trade with respect to the northern white-cheeked gibbon.

Mitigation and Management

Suggested measures to reduce the impacts of increased accessibility include:

- ▶ Conduct environmental awareness raising amongst Project staff.
- ▶ Prohibit Project staff from the natural resource collection, hunting, fishing and buying, selling or trading wildlife.
- ▶ Implement measures e.g. structures / barriers along roads in proximity to NPAs to minimise the potential for new roads to be constructed further into protected areas.
- ▶ Promote development of livelihoods that do not rely on unsustainable exploitation of natural resources by continuing to provide work opportunities to local villagers at the plantations and plywood mill.
- ▶ Avoid planting and road upgrades in already difficult-to-access areas of Nongpet-Naseng PFA.

Residual Impact

With implementation of mitigation measures poaching and impacts to elephant habitat still may occur at some time. Given the significance of the population and requirement for ongoing monitoring and management the residual impact is considered to be moderate.

As the plantation in proximity to Phou Khao Khouay NPA was developed in 2012-2013 Phou Khao Khouay leaf-nosed bat from increased accessibility have already occurred and as such the impact remains at moderate. Impacts to the northern white cheeked gibbon due to increased accessibility in Nongpet-Naseng PFA are likely to be high, given that this PFA remains relatively difficult to access and has a higher proportion of remaining intact forest. The above-mentioned mitigation measures may in part reduce the likelihood of further impacts to these species.

4.6.2 Critical Habitat Qualifying Birds

Habitat Loss and Degradation

Impact Summary

The proposed Project will likely result in habitat loss and degradation of wintering habitat for the Critical Habitat-qualifying, yellow-breasted bunting. It winters in large flocks in cultivated areas, rice fields and grasslands, preferring scrubby dry-water rice fields for foraging and reedbeds for roosting. This species' wintering habitat is already reduced due to agricultural intensification and excessive trapping during migration particularly at wintering sites has significantly reduced the population. This species winters across a relatively broad area including central and eastern Nepal, Bangladesh, northeast India, southeast Asia, southeast China and Taiwan. As such, the Project related impact associated with the loss of potential wintering habitat in Lao is considered to be low.

Mitigation and Management

No specific mitigation measures are considered necessary in relation to habitat loss and degradation of wintering habitat for the yellow-breasted bunting.

Residual Impact

Given the widespread availability of similar wintering habitat in the surrounding areas, the loss of potential wintering habitat associated with the Project is anticipated to have a low impact.

4.6.3 Critical Habitat Qualifying Herpetofauna

Aquatic Habitat Loss and Degradation

Impact Summary

Burapha's planned activities are not considered to directly impact on Siamese crocodile habitat. However, the Siamese crocodile is reported to persist within Phou Khao Khouay NPA and existing plantations in the Phou Khao Khouay NPA buffer zone may have had a low impact on downstream aquatic habitat that could support the Siamese crocodile. It is unclear whether this species still persists in the NPA, as it was last reported in to be seen in 2011, and the last confirmed sighting was in 2001, however recent surveys have not been conducted to verify its presence.

The known Lao localities of the Laotian water skink all lie along Mekong tributaries, close to the main river. It is considered unlikely that existing plantations have directly impacted habitat for this species as the nearest plantations are over 5 km from the Mekong. However, plantations have likely contributed to degradation in downstream aquatic habitat for this species. This impact is anticipated to have been low. Phoupadam PFA borders the Mekong in one section and is within 2 km of the Mekong in another section. Development of these areas and impacts to Mekong tributaries could result in direct habitat loss for the Laotian water skink. This impact is considered to be moderate and should be avoided if the Laotian water skink is found to be present.

Mitigation and Management

Targeted surveys for the Laotian water skink within PFA areas less than 5 km from the Mekong River and avoidance of impact to drainages in these areas if found to be present.

Residual Impact

If the above management and mitigation measures are applied the impact to herpetofauna would be reduced to very low.

Increased Accessibility

Impact Summary

Habitat clearance and the creation of roads and access tracks associated with the Project may facilitate access to surrounding areas particularly where the PFA borders on NPA areas. This may lead to the degradation of aquatic habitat in areas surrounding the PFA through increased exploitation of TFPs and NTFPs in riparian habitats and increased collection of aquatic resources.

Increased access associated with the Project could potentially, or may have previously, contributed to unsustainable harvesting of the Laos warty newt. The diurnal behaviour and bright colouring make this species extremely susceptible to harvesting (Phimmachak et al., 2012) and given the high number of individuals that can be harvested in a short time period, this impact is anticipated to be moderate-high.

Mitigation and Management

Refer to Section 4.6.1 for mitigation measures related to increased accessibility.

Residual Impact

With implementation of the above-mentioned mitigation measures the impact of increased accessibility on herpetofauna would be reduced to low-medium.

4.6.4 Critical Habitat Qualifying Fish

Aquatic Habitat Degradation

Impact Summary

One Critical Habitat qualifying fish species (giant pangasius) is found in the Mekong River. As there will be no direct impact to the Mekong River the Project is not anticipated to result in habitat loss for this species, however Phoupadam PFA borders the Mekong in one section and is within 2 km of the Mekong in another section. Development of these areas and impacts to Mekong tributaries could contribute to aquatic habitat degradation through potential downstream impacts to hydrology and water quality.

Water quality in the Mekong River has degraded over the past decade, particularly around Vientiane City (Sor et al., 2021). The Mekong flows through several countries, and has been severely impacted by hydropower dams, fisheries, dumping of waste, toxic runoff from farms. As a result, aquatic species and ecosystems have been significantly impacted. Therefore, the anticipated impact to the Mekong associated with the Project is low.

Three critical habitat qualifying fish species (*Laocypris hispidus*, *Schistura ephelis* and *Schistura sigillata*) are found in the Nam Ngum Reservoir. Development of land holdings near the reservoir, and future use of the MTP plantation as a third-party supplier may impact waterways that drain to the reservoir.

It is likely that downstream aquatic ecosystems in the Nam Ngum Reservoir may be impacted by development of Nongpet Naseng PFA or have been impacted by existing plantations in close proximity to the reservoir. Suspended sediments generated from increased erosion and sediment transport during construction activities and increased sediment and nutrient loads can cause eutrophication which can negatively impact benthic organisms such as dragonfly larvae (Wang et al., 2021). The impact is considered to be low given the low number and size of plantations in proximity to the reservoir.

There is also a moderate risk of contamination to receiving waters that drain to receiving waters (e.g. the Nam Ngum Reservoir) from transport, storage, handling and disposal of hazardous materials or waste (i.e. hydrocarbons, sewage, fertilisers and agro-chemicals) and non-hazardous waste (e.g. refuse) hydrocarbons during construction.

This impact is anticipated to be low given the large surface area of the reservoir and relatively small area likely to be impacted.

Mitigation and Management

Suggested measures to reduce aquatic habitat degradation include:

- ▶ Use stormwater erosion and sediment control facilities to minimise sediment loading in receiving waters;
- ▶ Avoided impacts to drainages where possible;
- ▶ Retain vegetation buffers (5 m minimum on each side) of ephemeral channels draining the Project footprint;
- ▶ Minimise the amount of fertilisers and agro-chemicals used;
- ▶ Select lower toxicity products;
- ▶ Transport, store, handle, and dispose of hazardous materials appropriately;
- ▶ Properly disposed of non-hazardous waste; and
- ▶ Train construction personnel in hazardous and non-hazardous materials management and emergency preparedness and response.

Residual Impact

Following implementation of appropriate mitigation and management measures the residual impact to habitat for Critical Habitat qualifying fish is anticipated to be very low.

4.6.5 Areas Associated with Key Evolutionary Processes

The Study Area may qualify for Critical Habitat under Criterion 5 due to the high level of endemism associated with the Lower Lancang and Khorat Plateau freshwater ecoregions. All three PFA's are within the Lower Lancang freshwater ecoregion and the south-east corner of the Phou Yeuy PFA drains is the Khorat Plateau. The Lower Lancang ecoregion has high ratio of endemism among hill-stream specialized fish genera of the families Cyprinidae, Balitoridae, Sisoridae, and Gobiidae (M. Kottelat pers. comm. 2006, cited in WWF/TNC, 2019). The Khorat Plateau ecoregion also high levels of endemism, with almost 50 endemic fish species identified and several monotypic genera; *Laocypris (L. hispida, DD)*, *Troglocyclocheilus (T. khammouanensis, VU)*, *Terateleotris (T. aspro, EN, IUCN, 2023)*.

While the Project is not anticipated to result in habitat loss for endemic fish species, it may impact the water quality of Mekong tributaries that drain the PFAs and contribute to downstream aquatic habitat degradation.

As discussed in Section 4.6.4, the Mekong River and its tributaries have been severely impacted by hydropower dams, fisheries, dumping of waste and toxic runoff from farms. Given the relatively small area proposed to be developed and the polluted state of waterways, the impact is anticipated to be low.

Mitigation and Management

Suggested measures to reduce aquatic habitat degradation to areas associated with key evolutionary processes are similar to those discussed in Section 4.6.4 above.

Residual Impact

Following implementation of appropriate mitigation and management measures the residual impact to Areas Associated with Key Evolutionary Processes (the Lower Lancang and Khorat Plateau freshwater ecoregions) is anticipated to be very low.

5. CONCLUSIONS AND RECOMMENDATIONS

Natural Habitat Assessment

Burapha's site selection targets degraded habitats, on lands which have historically been used for swidden agriculture and, as per the definition in the Forestry Law of 2019, "will take a number of decades to regenerate naturally". As a second assurance to avoid habitat which may be considered 'natural', regenerating forest >7 years is excluded as part of Burapha's land acquisition process.

Land cleared for Burapha plantations between 2018-2023 was assessed to determine whether Natural Habitat has been lost as a result of Project activities. No areas of natural forest were found to have been cleared, and regenerating forest lost was not considered to have reached sufficient maturity to be considered a functioning ecosystem given high levels of anthropogenic disturbance, particularly the increasingly reduced fallow cycles in plantations and surrounding areas.

The findings of this assessment support Burapha's land acquisition process in regard to the avoidance of habitat that may support a healthy ecosystem and protection of sensitive habitat in Special Management Areas. However, Critical Habitat is not restricted to areas of Natural Habitat, and degraded or 'Modified' habitat, or remnant patches of forest and seasonal wetlands in surrounding areas may support species which trigger Critical Habitat (see below for CH qualifying species). Additionally, areas of natural habitat may still be impacted by fragmentation, increased accessibility due to road upgrades, increased fire risk, and impacts to water quality.

Preliminary analysis identified approximately 83000 ha of Natural Habitat remaining within Burapha's concession PFAs, however this estimate requires additional verification. Burapha's plans to expand their plantations to 60,000 ha within these three PFAs is likely to put additional pressure on remaining Natural Habitat, as local communities may encroach on forested areas to compensate for that lost to plantations and the reduced availability of land. Given that almost 50% of the remaining Natural Habitat within concession PFAs is within Nongpet-Naseng PFA, expansion into this PFA is likely to have the most significant impact to remaining Natural Habitat.

Preliminary Critical Habitat Screening

The species found to be likely to trigger, or possibly trigger Critical Habitat under IFC PS6 criteria for existing plantations are as follows:

- ▶ Asian elephant;
- ▶ Northern white-cheeked gibbon;
- ▶ La Touche's free-tailed bat;
- ▶ Phou Khao Khouay leaf-nosed bat
- ▶ Siamese crocodile;
- ▶ Yellow-breasted Bunting; and
- ▶ *Pseudecheneis sympelvica*.

With the exception of the Asian elephant, further consultation and surveys will be required to determine the presence or absence of the above-mentioned species within the Study Area and will inform any necessary offset requirements. If found to be present in the areas surrounding existing plantations, in addition to ensuring a net gain of CH, species-specific measures should be put in place to ensure there are no additional impacts to these species.

The species found to be likely to trigger, or possibly trigger critical habitat under IFC PS6 criteria relevant to future plantations are:

- ▶ Asian elephant;
- ▶ Northern white-cheeked gibbon;
- ▶ La Touche's Free-tailed Bat;
- ▶ Phou Khao Khouay leaf-nosed bat

- ▶ Laotian water skink;
- ▶ Laos warty newt;
- ▶ Yellow-breasted Bunting;
- ▶ Giant pangasius;
- ▶ Small scaled mud carp;
- ▶ *Laocypris hispida*;
- ▶ *Pseudecheneis sympelvica*
- ▶ *Schistura ephelis*; and
- ▶ *Schistura sigillata*.

Areas that are considered Critical Habitat for the above species should be avoided in Burapha's expansion plans. In the unlikely event that Critical or Natural Habitat cannot be avoided, Burapha will need to quantify those impacts and ensure that no net loss for Natural Habitat and net gain for Critical Habitat is achieved through the provision of offsets.

Given the size of the Production Forest Areas (PFAs) and the fact that the location of management units within the PFAs are unknown at present, undertaking a valid CHA is challenging as it is not possible to undertake a site-specific CHA. As a result, it is likely that more species reached the requisite thresholds to trigger CH might occur. Burapha's plantations are widespread throughout the landscape and occur in three provinces which include a variety of aquatic and terrestrial habitat types. The plantations form a mosaic pattern, and predominantly occupy the ridge lines of ephemeral first and second order streams. If a CHA were undertaken for each discrete plantation, it is unlikely that all of the above-mention species would qualify for Critical Habitat due to varying ranges across the landscape, and differing ecological requirements, which may only be found only in certain parts of the Study Area. Additionally, species may be restricted to habitats which are unlikely to be suitable for plantations (e.g., limestone caves, wetlands).

Even if all Critical Habitat is avoided, there is potential for the Project to directly or indirectly impact CH qualifying species. The key impacts to CH qualifying species include:

- ▶ The upgrade of access roads into PFAs may increase accessibility to previously difficult to access forested areas, particularly in Nongpet-Naxeng PFA. Increased accessibility may lead to additional degradation of habitat for CH species such as Northern White-cheeked Gibbon and La Touche's Free-tailed Bat which rely on in-tact evergreen forest, as well as direct persecution of these species through hunting.
- ▶ Future plantations within the home-range of elephants may also contribute to the already high levels of HEC in the areas surrounding Nam Pouy NPA.
- ▶ Potential impacts on herpetofauna and fish would relate to downstream impacts such changes in hydrology, polluted runoff and lack of watercourse buffers.

Priority Ecosystem Services

Type I Priority Ecosystem Services are likely to be Regulating Services (Soil Erosion Regulation, Air Quality Regulation and Hydrological Services) and Supporting Services (Nutrient Cycling and Soil formation). Land acquired by Burapha does not appear to be important for provisioning services (e.g., hunting, TFP/NTFP collection), and areas identified as having cultural or spiritual significance to local communities are excluded from the land acquisition process.

Type II Priority Ecosystem Services, those on which the Project is reliant on Provisioning Services (Water Supply), Regulating Services (Soil Erosion Regulation, Air Quality Regulation) and Supporting Services (Nutrient Cycling and Soil formation) which are necessary for healthy growth of plantations.

Project activities, such as land clearing and upgrade of access roads for new plantations may negatively impact Priority Ecosystem Services. However, active management of Burapha's Special Management Areas may provide

benefits to Priority Regulating and Supporting services through the maintaining of riparian buffer zones and protection of areas from fire for the life of the plantation.

Recommendations

The results of this preliminary assessment provide the company with an opportunity to create a positive legacy in an area where threats to biodiversity are extremely high. Based on the results of this assessment, the following recommendations for the Burapha Expansion Project are:

1. Targeted surveys should be conducted to gain an understanding of the presence/absence of species which qualify for CH within the concession PFAs. In particular, a primatologist should conduct targeted surveys for *Nomascus leucogenys* in Nongpet Naseng PFA.
2. Findings of field surveys to be conducted as part of Phase 2 of the CHA, and ongoing stakeholder engagement will be used to update this report and inform any necessary offset requirements for existing plantations.
3. Incorporate findings of this assessment into the Land Acquisition Process to avoid expanding into areas which may contain Critical Habitat. Where Critical Habitat cannot be avoided, targeted surveys for CH qualifying species should be conducted by a specialist and should inform any necessary offset requirements for future plantations.
4. Avoid acquisition of land in Nongpet Naseng PFA with limited accessibility and adjacent to forested areas to avoid impacts to Natural Habitat through fragmentation and increased accessibility.
5. Implement a wildlife reporting system that includes provision of detailed biodiversity related information for sighting of any fauna species of interest.
6. Develop a Management Plan to protect and enhance biodiversity values contained within the Special Management Areas. This may include measures such as;
 - a. Enhancing connectivity to forested areas to allow for species migration;
 - b. Implementation of an Invasive Species Management Plan; and
 - c. Planting of species which are known to be important habitat for any CH qualifying species in the area such as fruit trees for *Nomascus leucogenys* and foraging habitat for bat species.
7. Conduct a further assessment of Natural and Modified habitat within PFAs.
8. Conduct community consultations to confirm Priority Ecosystem Services for local beneficiaries.

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