

CHAPTER 6: EXISTING BIOLOGICAL ENVIRONMENT

6.1 INTRODUCTION

Malaysia is among the seventeen countries in the world, which due to their level of biodiversity have been identified as “Mega-diverse Countries”. The classification focuses on plant-diversity and requires that the country i.a. has in excess of 5,000 endemic plants within its borders. Other definitions of e.g., “biodiversity hotspots” exists based on similar principles. The Island of Borneo, which is generally recognised as one of the oldest habitats in the world, is home to about 15,000 plants, 221 species of terrestrial mammals and 420 species of resident birds (<http://borneoproject.org/borneo/biodiversity-conservation/>).

6.1.1 Land Use Change

The biological environment surrounding the proposed transmission line consists of both natural elements and elements caused by anthropogenic activities. Originally, the area was covered by lowland dipterocarp forest with its variations from the hillslopes to the stream brinks and at least the smaller rivers were clear with a diverse balance between the different aquatic strata.

Human activities have changed this. The proposed transmission line will transverse a territory which has been occupied by the Iban tribe since the 19th century (King 1976, Anggo and Laja 2018). Using the river as their main mode of transportation, the Ibans have collected both timber and non-timber forest produce and farmed the land closer to the river for many generations before logging operation took place. Commercial logging started in the Rajang and Baleh river basin in 1960s (Tuen et al 2018), and had by the 1980s infiltrated deep into the forest interior thus providing additional access to the local people to farm, hunt and collect jungle produce farther away from the river.

Thus, both the local community and commercial logging companies have contributed to land use change in the region. The local communities have combined hunting/ gathering with riverine fisheries and shifting agriculture, mostly for annual crops mixed with some scattered fruit trees. Where the situation warranted it, the communities also established areas for wet paddy cultivation.

As a result of these activities, the wildlife habitat comprise many types of forest; primary forest patches occur where the terrain is too steep and difficult for logging and shifting agriculture, secondary forest at different stages of regeneration from farming and logging activity, and farms and agroforest comprising a mix of planted trees and natural vegetation closer to human settlements.

The landforms near Btg. Baleh is more undulating than along Rajang, wherefore there have been fewer longhouses and bazaars. Instead, a growing timber industry has since the 1960' harvested the forest at an unsustainable rate. The remaining disturbed forest has been left to struggle for natural regeneration through a multi-stage succession of different species or the forest companies have attempted to bring the areas into economic use through establishment of industrial tree plantations. These, however, have not reached the project site even though this conversion has been contractually agreed upon. The areas converted to timber plantations are still situated at some distance from Btg. Baleh and Btg. Rajang.

For this assessment, a clear distinction has been made between land cover and land use. Landcover is what meets the eye, whereas land use is the purpose of the area seen from the human society's point of view. The land cover may thus be disturbed dipterocarp forest whereas the land use could be fallow, community forest reserve, wildlife sanctuary, timber concession, unconverted tree crop plantation, etc.

6.1.2 Previous Surveys and Species Inventories

Not much published report is available on the vertebrate fauna of Rajang and Baleh river basin, especially the area affected by the Project. Comprehensive survey of terrestrial fauna has not been done but early explorers, for example Charles Hose, have collected mammal and bird specimens opportunistically as they travelled up the Btg. Rajang to explore the interiors of Sarawak (Cranbrook and Leh, 1983).

The earliest comprehensive survey of herpetofauna of Btg. Baleh was done by Inger in 1962-63. From three streams (Ensurai, Sekentut, Serbong) at Nanga Tekalit, Inger collected 31 species of amphibians with 9 species accounting for 90% of the individuals sampled (Inger, 1969). The three streams at Nanga Tekalit were sampled again in 1970 and 1984 (Inger 2009). Twenty years later, sampling at Segaham revealed the presence of 20 species of amphibian (Inger and Voris, 1993).

Wildlife surveys carried out in the upper reaches of Btg. Rajang in conjunction with Bakun Dam SEIA identified 27 species of frogs, 42 species of mammals and 187 species of birds (CTTC 1995). As part of a study on the impact of hunting on wildlife densities, Bennett *et al.* (1995) reported the presence of Bornean gibbon, red langur, pig-tailed macaque, barking deer and mousedeer at Nanga Gaat in the upper reaches of Btg. Baleh.

The logged forest of Upper Baleh (located about 60 km east of the Baleh HEP Dam) has been the subject of a recent scientific expedition organized by Universiti Malaysia Sarawak (UNIMAS) in November 2015. Based on this expedition 95 species of birds, including 18 protected and 7 totally protected species, were recorded (Tuen *et al.* 2018). Eight feeding guilds were identified with insectivore being the most abundant (Pang *et al.* 2017). Thirty-nine species of birds are endemic to Borneo and 23 species are threatened (Myers 2016). The list of mammals detected during this expedition was reported by Faisal *et al.* (2019). The survey yielded 39 species of mammals, including 16 species of bats and two species of rodents from trapping efforts, and 21 species of small- to medium-sized mammals through sightings.

A UNIMAS study commissioned and supported by SEB between 2014 and 2017, found 178 species of bird from Pelagus National Park (PNP) and 182 species from Upper Baleh. The study also recorded 33 species of bats from PNP and 23 from Baleh while 29 species of mammals were recorded using camera traps in PNP and 30 in Baleh. A total of 55 species of herpetofauna was recorded in PNP (SEB, unpublished report). The PNP is located about 19 km north of the transmission line when it crosses Btg Rajang near the confluence of Btg Baleh, and is the only relatively undisturbed forest near the project area.

Caldecott (1986) studied wildlife utilization by the local communities along the Btg. Rajang river basin and reported 19 species are commonly hunted and 37 species kept as trophies and pets. Hunters in Upper Baleh and Pelagus hunted using traditional methods (using snares, nets and traps) and firearms, mainly shotguns (Yi and Mohd-Azlan 2018), and most of the times accompanied by dogs. A total of 28 species of mammals were reported to be hunted, mainly for subsistence purposes, for sale and for crop protection. These include Bearded Pig, Sambar Deer, Barking Deer, Porcupines, Sun Bear, civets and various species of felids.

6.2 TERRESTRIAL FLORA

6.2.1 Land Cover: Vegetation Types and Features

Landcover differs from land use as the former is what meets the eye of the observer while land use is what humans intend to use the area for. Land use may thus be that the area is meant to be used for oil palm plantation but landcover may be camp areas, cleared areas, oil palm on terraced land, oil palm on drained swamp, patches of uncleared original vegetation, etc.

An easement of 2x25 m will be acquired and cleared for the transmission line. Any clearing of any vegetation category, and notably mature, primary forest, will result in fringe impacts, i.e., fringe vegetation that suddenly is exposed to sun and wind will react to this change of meso-climate. For the mature, primary forest vegetation there will most often be a die-back as the trunks are exposed. The fragmentation may interrupt pollination and seed dispersal, just as the subterranean web of interactions may be disrupted. The area of influence is thus larger than the mere 2x25 m easement. Spatial extent of impact may vary due to slope, soil, vegetation etc.

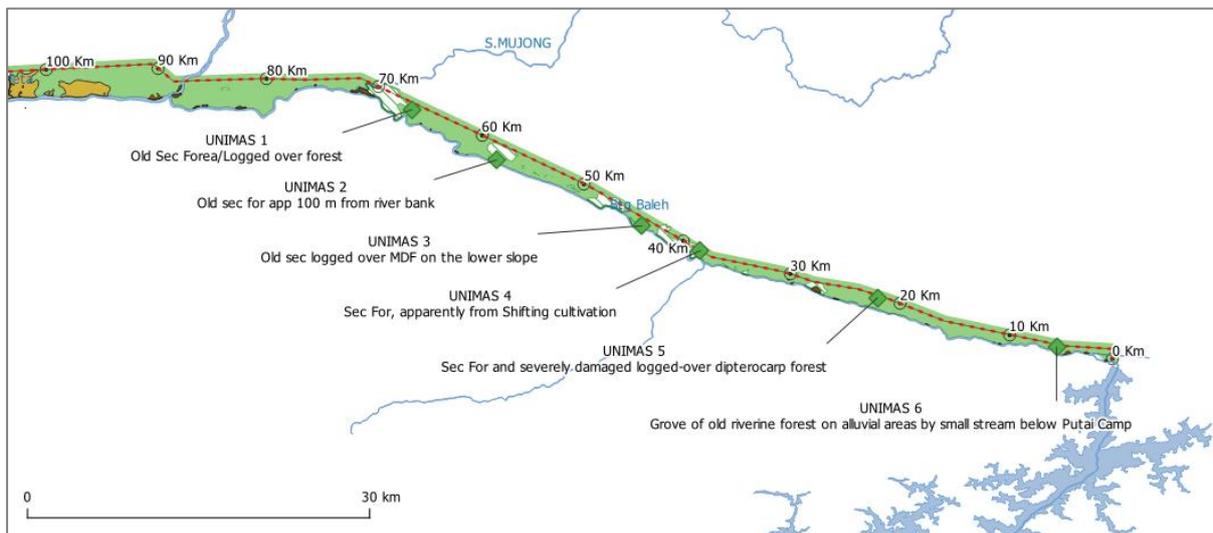
Land cover has thus been mapped in an area covering from Btg. Rajang/ Btg. Baleh as the southern border till a line 500 m north of the anticipated route alignment for the transmission line. Land cover mapping has primarily been based on satellite imageries (Google Earth, ALOS PALSAR and Sentinel 2) supported by verification during the social and land use investigations. Verification has also been supported by LIDAR orthophotos. The direct area of influence for soil, habitat and biodiversity is estimated to be the entire slopes on which the transmission line is being built, from the hill crest to the Btg. Rajang. To cater for possible further interaction through pollination, seed dispersal and wildlife habitats, the study area has been increased to cover 500 m north of the transmission line.

The transmission alignment along Btg. Baleh is in close proximity to the alignment for the main access road to Baleh HEP. Several parallels concerning land cover may thus be drawn between the two projects. The transmission line is in general slightly uphill from the access road. Vegetation types and impacts will therefore to a large degree be similar.

Due to travel limitations during the COVID-19 pandemic, field surveys have been restricted. Inter-district travel was not allowed due to the imposition of MCO and CMCO by the SDMC from November 2020 till June 2021. The current assessment therefore makes use of survey data from the 2010 EIA (UNIMAS) for the main

access road on the northern bank of Btg. Baleh. An assessment of the historical satellite imageries from 2010 indicates that active shifting cultivation and forest harvest activities for the most has decreased in intensity. The 2010 data for secondary forest and fallow areas may therefore be assumed to have further developed along the natural succession towards primary species.

The SEB has in 2020 implemented a LIDAR survey, which has also provided ortho-photos of the 2x25 m corridor, which at that time was considered. This corridor is almost identical with the final corridor, but some small deviations occur. The land cover maps created for this report includes information from the LIDAR survey, bearing in mind this only covered a fraction of the area of influence/study.



For colour code and symbology see **Figure 6.2.2** below

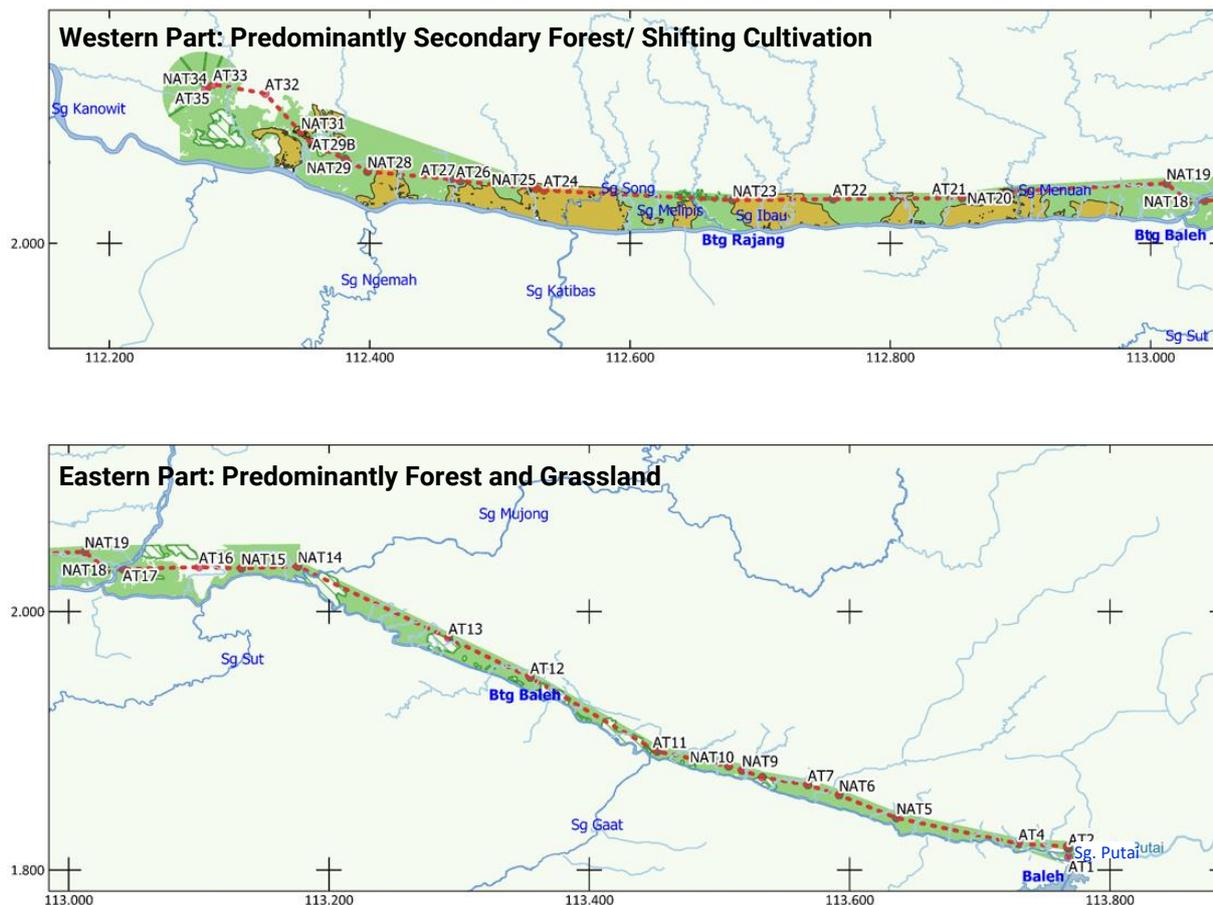
Figure 6.2.1: Flora Sampling, EIA for “Projek Jalan Ke Empangan Baleh, Bahagian Kapit, Sarawak”, 2010

The landcover has for this study is classified into the following category, symbology and colour codes:

<ul style="list-style-type: none"> • Bare Land • Forest • Grass and Bush-land • Paddy fields • Pond • Shifting Cultivation • Pepper • Oil Palm 	<ul style="list-style-type: none"> --- Alignment ■ Bare land ■ Forest ▨ Grass and Bushes ■ Paddy ■ Pond ■ Shifting Cultivation ■ Pepper ■ Oil Palm
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Figure 6.2.2: Land Cover Mapping Symbology

Landcover distribution along the transmission line clearly falls into two areas: The area along Btg. Baleh is dominated by remnant/secondary forest occasionally mixed with patches of grass and bushes whereas the area along Btg. Rajang primarily is a mix of the same depleted forest and shifting cultivation at all stages. Refer to **Appendix 6.2.1** for details of the land cover.



Source: Google Earth mosaic 2010-2019, Sentinel 2 2020

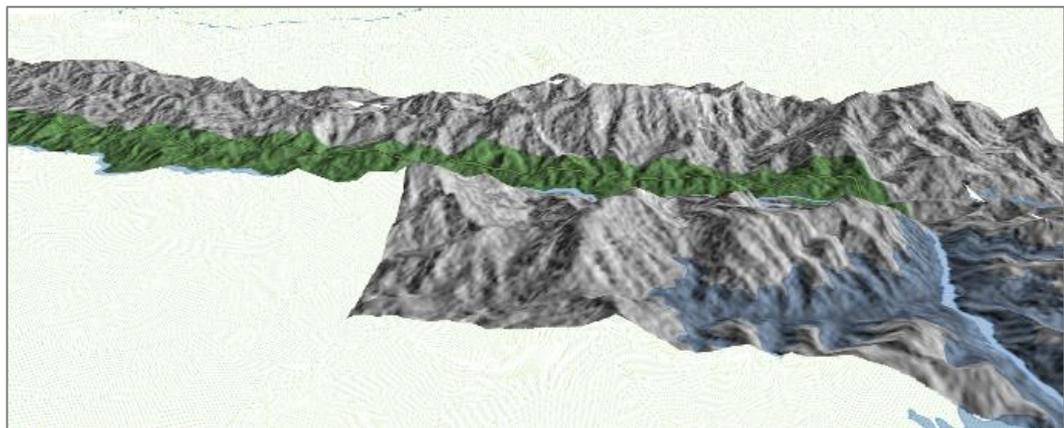
Figure 6.2.3: Overview of Land Cover

The area distribution of the land cover categories has been measured for the entire study area as well as exclusively within the 2x25 m transmission corridor to be cleared, i.e., the ROW.

Table 6.2.1: Land Cover Areas

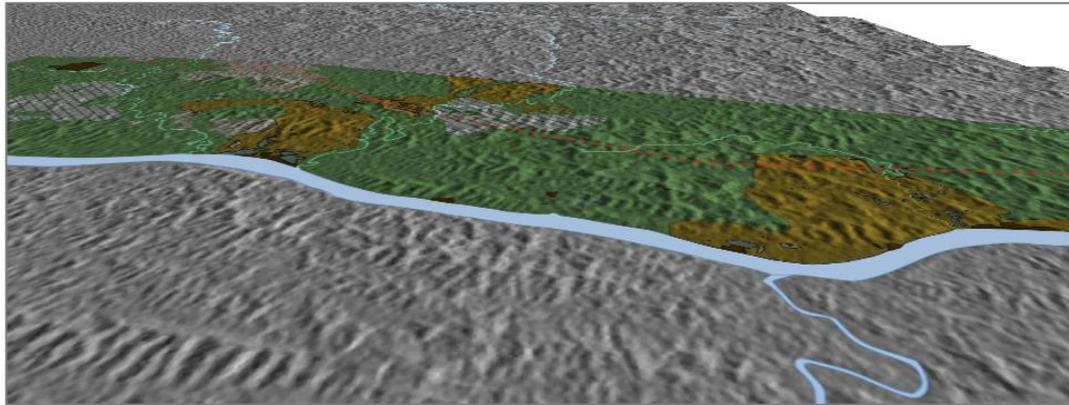
Land Cover	Study Area	ROW	
	Ha	Ha	%
Forest	35,213.20	657.7	76.22
Bare Land	740.9	4.3	0.5
Grass and Bushes	2,725.50	56.5	6.55
Ponds	16.6	0.4	0.05
Shifting Cultivation	10,975.10	94.5	10.95
Paddy	177.2	3.2	0.37
Pepper	5.7	0.1	0.01
Oil Palm	2749.2	46.2	5.35
Total	52,603.4	862.9	100

There is a clear correlation between the land cover and the topography. **Figure 6.2.4** shows the rugged terrain near the dam site while **Figure 6.2.5** shows the gentler terrain near Btg. Rajang. It should be noted that the vertical scale in both figures is exaggerated two-fold for clarity. There are few settlements in the rugged terrain to the east, wherefore there are few areas of shifting cultivation or tree-crops.



*Note: Vertical Scale is multiplied by 2 for clarity
Selected section near the dam and powerhouse Site*

Figure 6.2.4: Topography along Btg. Baleh



Note: Vertical Scale is multiplied by 2 for clarity
Selected section at west end of the transmission line

Figure 6.2.5: Topography along Btg. Rajang

Points have been mapped where the transmission line cross land-cover classifications. These points are all listed in the table below and repeated on most maps together with their geographical coordinates. See also pictorial illustration of the same chainage in **Section 6.2.2**.

Table 6.2.2: Landcover Delineation under the Transmission Line

Starting Point			To Point	Land Cover
Point	Longitude	Latitude		
1	113.7682	1.8096	2	Forest
2	113.5387	1.8707	3	Grass and Bushes
3	113.5312	1.8723	4	Forest
4	113.4411	1.8982	5	Grass and Bushes
5	113.4282	1.9058	6	Forest
6	113.4189	1.9112	7	Grass and Bushes
7	113.4114	1.9157	8	Forest
8	113.3849	1.9312	9	Grass and Bushes
9	113.3632	1.9439	10	Forest
10	113.2981	1.9764	11	Grass and Bushes
11	113.2980	1.9765	12	Forest
12	113.2119	2.0176	13	Grass and Bushes
13	113.1918	2.0271	115	Forest
115	113.1242	2.0337	114	Tree Crop
114	113.1226	2.0337	113	Forest

Starting Point			To Point	Land Cover
Point	Longitude	Latitude		
113	113.1216	2.0338	112	Tree Crop
112	113.1029	2.0343	111	Forest
111	113.0970	2.0343	110	Tree Crop
110	113.0850	2.0340	109	Forest
109	113.0659	2.0335	108	Tree Crop
108	113.0594	2.0333	107	Forest
107	113.0516	2.0331	106	Tree Crop
106	113.0502	2.0330	105	Forest
105	113.0493	2.0330	104	Tree Crop
104	113.0473	2.0330	14	Forest
14	112.9943	2.0453	15	Bare Land
15	112.9936	2.0453	16	Forest
16	112.9207	2.0415	17	Shifting Cultivation
17	112.9197	2.0415	18	Forest
18	112.9004	2.0405	19	Grass and Bushes
19	112.8985	2.0404	20	Paddi
20	112.8978	2.0403	21	Grass and Bushes
21	112.8970	2.0403	22	Shifting Cultivation
22	112.8953	2.0402	23	Grass and Bushes
23	112.8950	2.0402	24	Shifting Cultivation
24	112.8944	2.0402	25	Grass and Bushes
25	112.8938	2.0401	26	Shifting Cultivation
26	112.8870	2.0393	27	Forest
27	112.8869	2.0392	28	Shifting Cultivation
28	112.8867	2.0392	29	Forest
29	112.8862	2.0392	30	Shifting Cultivation
30	112.8829	2.0387	31	Forest
31	112.8110	2.0346	32	Shifting Cultivation
32	112.8074	2.0346	33	Forest
33	112.7338	2.0339	34	Shifting Cultivation
34	112.6804	2.0334	35	Forest
35	112.6675	2.0340	36	Grass and Bushes

Starting Point			To Point	Land Cover
Point	Longitude	Latitude		
36	112.6672	2.0340	37	Forest
37	112.6660	2.0341	38	Grass and Bushes
38	112.6649	2.0341	39	Forest
39	112.6635	2.0342	40	Grass and Bushes
40	112.6629	2.0342	41	Forest
41	112.6611	2.0343	42	Grass and Bushes
42	112.6603	2.0344	43	Forest
43	112.6583	2.0345	44	Grass and Bushes
44	112.6581	2.0345	45	Forest
45	112.6576	2.0345	46	Grass and Bushes
46	112.6572	2.0345	47	Forest
47	112.6557	2.0346	48	Grass and Bushes
48	112.6549	2.0346	49	Forest
49	112.6528	2.0348	50	Grass and Bushes
50	112.6519	2.0348	51	Forest
51	112.6513	2.0348	52	Bare Land
52	112.6510	2.0348	53	Forest
53	112.6423	2.0353	54	Grass and Bushes
54	112.6412	2.0354	55	Forest
55	112.6399	2.0354	56	Grass and Bushes
56	112.6397	2.0354	57	Forest
57	112.6377	2.0355	58	Bare Land
58	112.6376	2.0355	59	Forest
59	112.6371	2.0356	60	Grass and Bushes
60	112.6348	2.0357	61	Forest
61	112.5949	2.0377	62	Bare Land
62	112.5941	2.0378	63	Forest
63	112.5905	2.0380	64	Shifting Cultivation
64	112.5423	2.0405	65	Bare Land
65	112.5414	2.0405	66	Shifting Cultivation
66	112.5234	2.0426	67	Bare Land
67	112.5228	2.0427	68	Shifting Cultivation

Starting Point			To Point	Land Cover
Point	Longitude	Latitude		
68	112.5208	2.0429	69	Bare Land
69	112.5202	2.0430	70	Shifting Cultivation
70	112.5176	2.0432	71	Forest
71	112.5100	2.0440	72	Bare Land
72	112.5093	2.0441	73	Forest
73	112.4259	2.0529	74	Bare Land
74	112.4251	2.0530	75	Forest
75	112.4226	2.0532	76	Bare Land
76	112.4221	2.0533	77	Forest
77	112.4208	2.0534	78	Shifting Cultivation
78	112.4054	2.0548	79	Forest
79	112.3569	2.0792	80	Paddi
80	112.3544	2.0806	81	Shifting Cultivation
81	112.3541	2.0809	82	Paddi
82	112.3534	2.0814	83	Shifting Cultivation
83	112.3518	2.0824	84	Paddi
84	112.3516	2.0826	85	Shifting Cultivation
85	112.3507	2.0832	86	Paddi
86	112.3482	2.0849	87	Shifting Cultivation
87	112.3462	2.0868	88	Forest
88	112.3453	2.0877	89	Shifting Cultivation
89	112.3432	2.0900	103	Forest
103	112.3298	2.1047	102	Tree Crop
102	112.3257	2.1091	90	Forest
90	112.3244	2.1106	91	Tree Crop
91	112.3015	2.1191	92	Forest
92	112.2871	2.1216	93	pond
93	112.2868	2.1217	94	Forest
94	112.2853	2.1220	95	Pond
95	112.2851	2.1220	96	Forest
96	112.2845	2.1221	97	Pond
97	112.2841	2.1222	98	Forest

Starting Point			To Point	Land Cover
Point	Longitude	Latitude		
98	112.2840	2.1222	99	Tree Crop
99	112.2804	2.1228	100	Paddy
100	112.2783	2.1222	101	Tree Crop
101	112.2748	2.1203	0	

6.2.2 Chainage of Land Cover Variation

Appendix 6.2.1 includes 55 land cover maps as indicated in Figure 6.2.6.

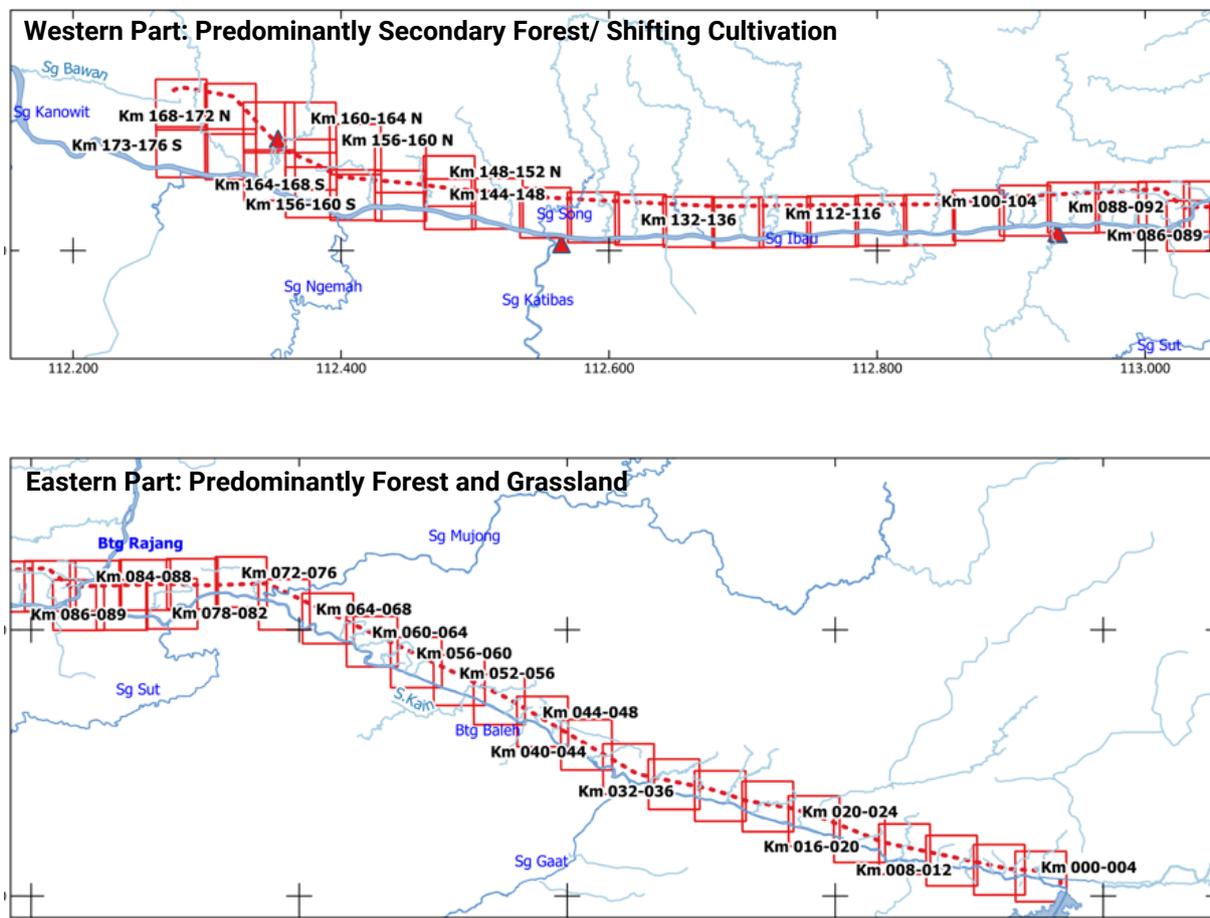
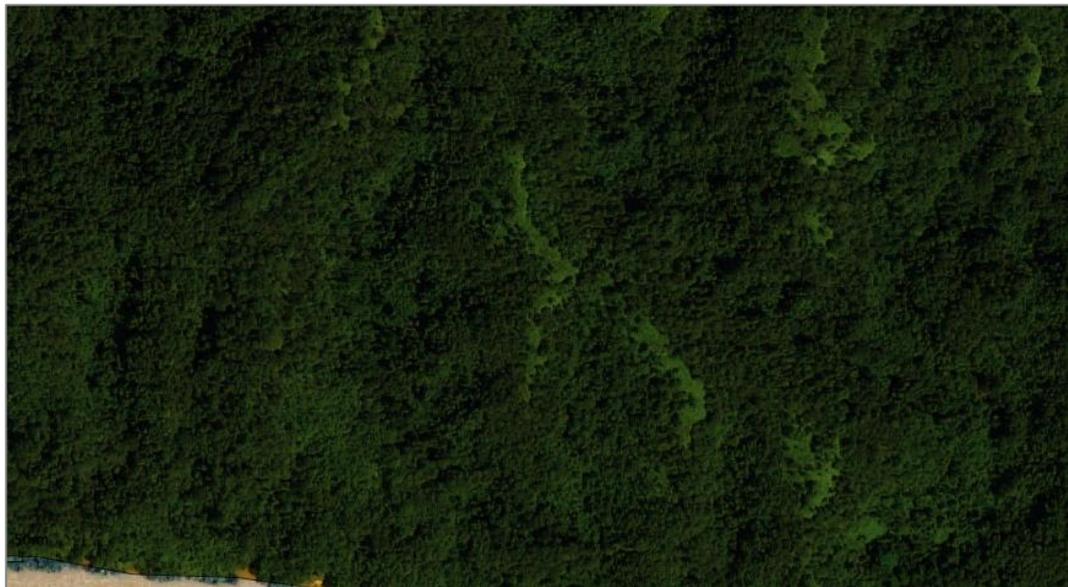


Figure 6.2.6: Layout of Land Cover Maps in Appendix 6.2.1

Each map shows landcover within the study area with the 2x25 m ROW highlighted. The points where the transmission line crosses from one land cover category into another are shown in the maps too with numbering referring to the listing in **Table 6.2.2**.

6.2.2.1 Forest

All forest areas near the transmission line have been disturbed one way or another. The primary vegetation type is mixed dipterocarp forest with some riverine adjustments where the tributaries cross through the study area. However, shifting cultivation or various forms of timber harvesting have removed old stands and left the area as patchy secondary forest or at best regenerating primary forest. There are numerous remnant patches of old-growth dipterocarp forest on more inaccessible slopes and hill-tops, especially in the upper part of the transmission line along Btg. Rajang. Such areas have been identified as high-chlorophyll density areas using the normalised differential vegetation index derived from spectral analysis of 2020 Sentinel 2 data and shown in the land cover maps (**Appendix 6.2.1**) as dark green pixelated patches. The forest classification will also include smaller areas of shifting cultivation or tree crops.



Source: Google Earth, 2013

Figure 6.2.7: Open, Regenerating Forest Vegetation with Patches of Old Growth

The remnants of the primary forest and the regenerating dipterocarp forest includes various dipterocarps such as *Dipterocarpus* spp, *Shorea* spp and *Hopea* spp. Some of these have multiple functions for both timber production and as provider of fruits and other non-timber forest products to the local communities in addition to supporting the wildlife with fodder and nesting places. Of particular interest is the *Dipterocarpus oblongifolius* (Ensurai). While this species, which is commonly found along water courses by the IUCN is classified as ‘Least Concern’ it is protected under state legislation. Another protected group of species

commonly found in the area are the Engkabangs, notably *Shorea macrophylla*. This species, which by the IUCN also is classified at 'Least Concern', has traditionally played a major role for the local communities as the fruits – illipe nuts – are collected and sold in the market for production of oils, soap, or high-quality chocolate.

Rattan is still collected, notably *Korthalsia sp*, *Daemonorops sp* and some species of *Calamus*.



Source: Google Earth, 2013

Figure 6.2.8: Newly Harvested Forest

The areas near Btg. Baleh are rich in the protected figs (*Ficus spp.*), which play an important role for wildlife but which otherwise can be bothersome for local farmers and forest managers as they easily spread in plantations and the strangling habits of the *Ficus benjamina*. While all figs (*Ficus spp.*) due to their fodder value for wildlife, are protected under Sarawak legislation, they are classified 'Least Concern' by the IUCN.

Other protected species reported during the social surveys are *Eurycoma longifolia* (Tongkat Ali) and *Goniothalamus velutinus* (Kayu Hujan Panas), both of which play prominent medical and spiritual roles for the local communities.

6.2.2.2 Oil Palm Plantation and Pepper Garden

Oil Palm is primarily found in two patches near the Mapai Substation and near the Baleh confluence. The plantations at Mapai are terraced and part of a larger plantation area to the north.

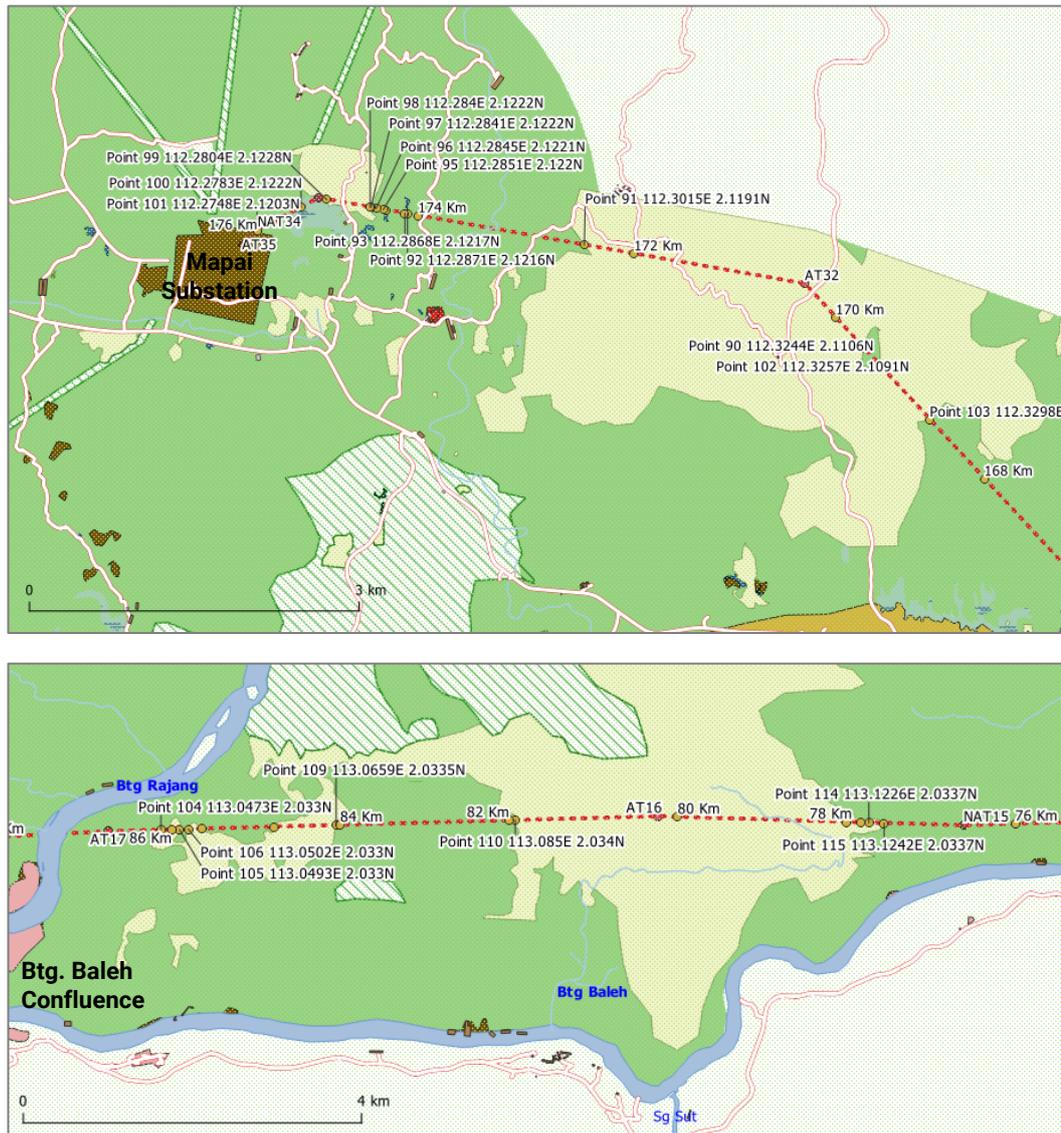


Figure 6.2.9: Oil Palm Plantations near Mapai Substation (top) and Btg. Baleh Confluence (bottom)

The oil palm plantations are mature but with several open patches along the contours (**Figure 6.2.10**).



Source: Google Earth, 2013

Figure 6.2.10: Oil Palms near Mapai Substation

Other patches of crops scattered within the areas are tiny, household level areas of perennial crops, such as rubber, pepper, cocoa and banana.



Source: Google Earth, 2013

Figure 6.2.11: Enlarged Satellite Imagery of a Pepper Garden



Source: Chemsain, 2020

Figure 6.2.12: Pepper Plantation

Oil palm plantation and pepper gardens cover 46.2 ha (5.4%) and 0.1 ha (0.01%) within the area to be cleared, respectively.

There are no reports of any protected or endangered flora species within the oil palm plantations or other tree crops.

6.2.2.3 Grass and Bushes

Some areas, which have been cleared during shifting cultivation or forest harvesting have not regenerated into secondary forest but have not developed beyond a grass phase (**Figure 6.2.13**) dominated by Lalang grass (*Imperata cylindrica*). Some wet, low-lying areas have also been overgrown by an almost permanent cover of grasses and sedges. Grass areas cover 56.5 ha or 6.5% of the 2x25 m corridor to be cleared. Due to their transient nature as part of a natural succession, which repeatedly has been re-initiated by slash and burn agriculture, these areas are not likely to be home to any significant populations of high-conservation value primary plant species. The areas will temporarily form an open habitat for herbivores, reptiles, and birds.



Source: Google Earth, 2013

Figure 6.2.13: Grassland

6.2.2.4 Ponds



Source: Google Earth, 2013

Figure 6.2.14: Impounded Water and Household Level Fish Pond

There are very few ponds or areas of impounded water in the study area and in total they only cover less than a hectare within the clearing corridor. There are no commercial level fish ponds within the study area, i.e., the ponds only provide fish for the owner's own household needs. The impounded water is mostly a result of

road building that blocks the natural drainage. This may result in smaller semi-natural lakes, which may attract waterfowl, amphibians and a variety of plants suited for this habitat.

6.2.2.5 **Shifting Cultivation**



Source: Google Earth, 2013

Figure 6.2.15: Various Stages of Shifting Cultivation

Btg. Rajang is, near the transmission line, lined with Iban longhouse communities, who traditionally have practiced shifting cultivation up to three to five kilometres from the river, depending on the topography.

Shifting cultivation included traditionally clearing/burning followed by three years of cultivation (first hill rice, then vegetables and corn) which again was followed by up to twenty years of natural regrowth of secondary forest species. The system required large areas and it required the farmer would spend several days away from home to work his field because distances were too far. Nowadays, the system has deteriorated with shorter and shorter fallow periods and concentrating the activities nearer the villages (longhouses). This cultivation practice has left the area with very few over-mature trees, which are known to be important for seed production, wildlife, and canopy epiphytes. Fruit trees such as durian are planted and some forest species such as the protected *Koompasia* trees (Tapang and Menggaris) have been purposely left standing due to spiritual beliefs and Tapang's (*Koompasia excelsa*) attractiveness to honey-bees. The regrowth is in most areas quite young, indicating a short fallow period. Valuable timbers or protected species are thus not likely to be found in significant numbers in these areas. However, there

are scattered attempts to establish tree crops, either rubber or oil palm. These areas are at household level and very small.

The shifting cultivation areas cover 94.5 ha or 11% of the total 863 ha to be cleared under the transmission line. As shifting cultivation is a cycle including several years of fallow, the areas classified as 'Shifting Cultivation' will include a major proportion of secondary forest or '*Belukar*'. Some patches, which are inaccessible or otherwise unsuitable for cultivation are also included under this classification.

There are scattered fruit trees such as durian and rambutan throughout the shifting cultivation areas as these are planted partially as demarcation of user rights. Some large *Koompasia* trees (Tapang and Menggaris) can be found towering over the secondary forest throughout the area. While being valuable timber species, they tend to break and split upon felling. Furthermore, the Tapang trees are known for their association with large nests of honeybees, a trait that carries a higher value for the local communities than the timber value. The *Koompasias* are by the local population associated with strong spiritual beliefs, which locally protect them from being felled.

There are inside the areas classified as shifting cultivation, several small patches of permanent cropping, such as pepper, rubber, banana, and oil palm.

6.2.2.6 Bare Land

There are areas along road works (cut and filled slopes) and within shifting cultivation areas that are temporarily bare of any vegetation. While these areas will recover their vegetative cover, other areas will be cleared instead as part of the cyclic shifting cultivation practice. The proportion may thus fluctuate around the same extent of area. Denuded areas are also found near all settlements, but these is of more permanent nature. The total denuded area is small, only about 4.3 ha of the ROW belongs to this grouping.



Source: Google Earth, 2013

Figure 6.2.16: Bare land along Road and in Farming Area

6.2.2.7 Paddy (Wet Rice Cultivation)

There is a limited area used for wet paddies in the study area. However, since the transmission line mostly is on high ground, there is little conflict between the ROW and paddy fields. The exception is an area near Nanga Tada Resettlement Scheme where the transmission line crosses a larger wet area, which is partly used for rice cultivation. Of the 177 ha categorised as paddy fields within the study area, only 3.2 ha are within the transmission line ROW.



Source: Google Earth, 2013

Figure 6.2.17: Off-Season Paddy Areas

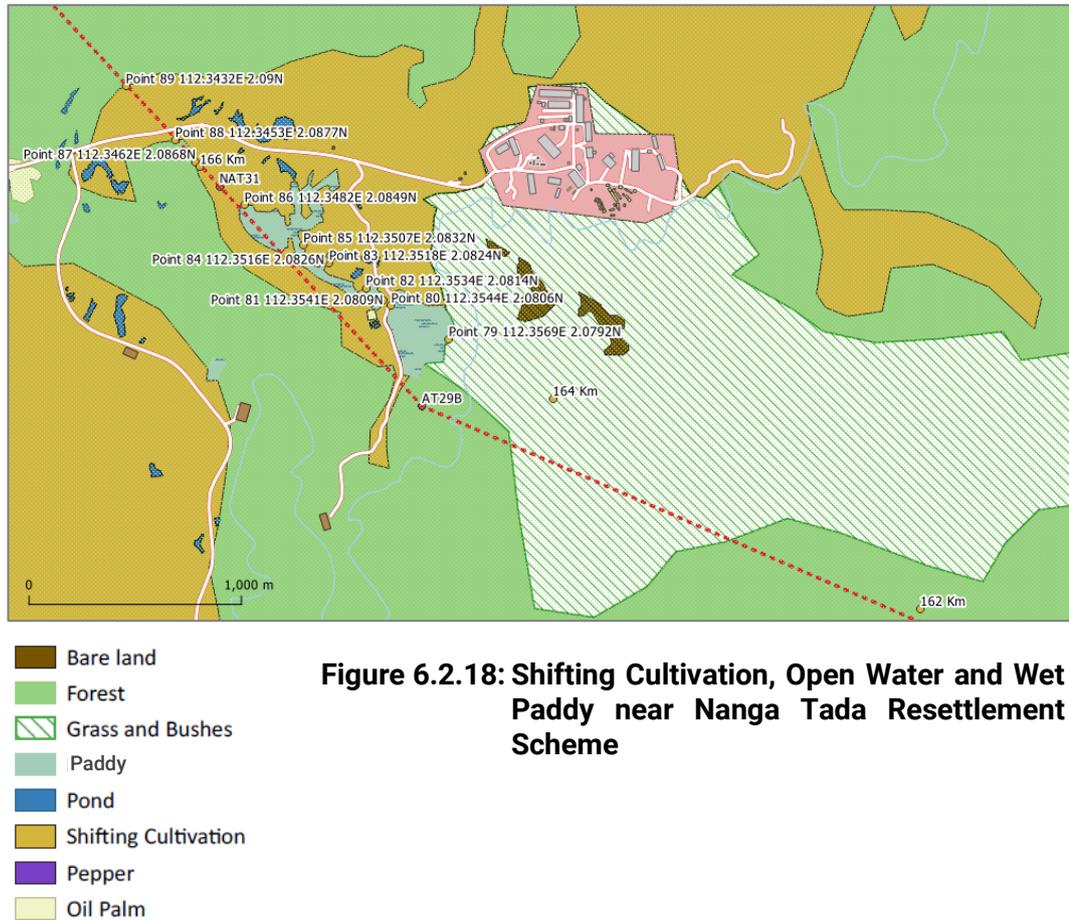
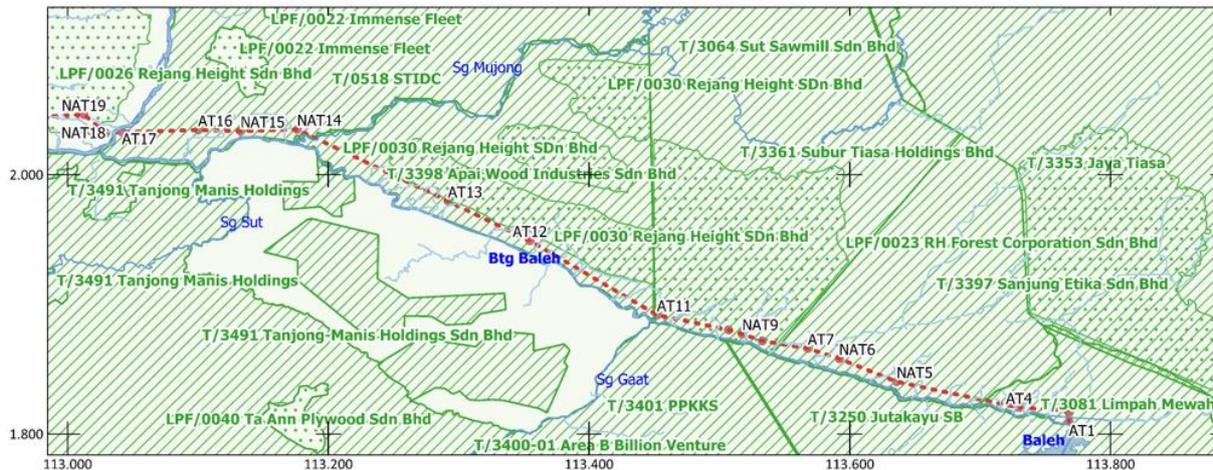


Figure 6.2.18: Shifting Cultivation, Open Water and Wet Paddy near Nanga Tada Resettlement Scheme

6.2.2.8 Invasive Species

The transmission line project *per se* will not introduce any non-native species or new vegetation species, which may be a threat to the natural habitats. The transmission line may introduce plantings in the form of turfing or leguminous cover crops on exposed slopes. These species are commonly used on roadsides and in oil palm plantations and are not known to spread uncontrollable into neighbouring natural vegetation. It is common that seeds of e.g., tomatoes and chillies may germinate where the workers have camped, but this will be of little consequence if of any at all.

Cutting a line through the forest vegetation will re-set natural succession and thus make the area prone to invasion of light demanding pioneer species including those species used in industrial forest plantations. Although there is a general move towards planting local species, spread of exotic species such as acacias and to some degree eucalyptus may locally become an issue.



- Forestry Concessions**
- Timber Licence
 - LPF Licence for Planted Forest
 - Tributary
 - River
 - Alignment

Figure 6.3.1: Forestry Concessions

Source: Forest Department Sarawak 2021

The entire project area is covered by or bordering to various forestry licence areas, mostly areas approved for conversion to planted forest but also some timber licences, i.e., natural forest management (Figure 6.3.1 above and Appendix 6.3.1). The forest management companies have in several cases overlapping timber and plantation concessions in their areas.

Timber license areas overlapping with the transmission line are listed in Table 6.3.1 below.

Table 6.3.1: Timber Licences

Licence No	Licence Holder Forest Management Unit
T/3673	Masja Plantation Services Sdn Bhd
T/3243	Skyline Trading Sdn Bhd
T/3397	Sanjung Etika Sdn Bhd
T/0518	Sarawak Timber Industries Development Corporation – STIDC <i>(Proposed Pila Mujong FMU)</i>
T/3361	Subur Tiasa Holdiongs Sdn Bhd <i>(Mujong Melinau FMU)</i>
T/3080	Ninjas Development Sdn Bhd <i>(Proposed Putai FMU)</i>
T/3250	Jutakayu Sdn Bhd <i>(Proposed Pulang-Entunau FMU)</i>
T/3398	Apai Wood Industries Sdn Bhd

Source: Forest Department Sarawak, 2021

Table 6.3.2 Licences for Planted Forest near the Transmission Line

Licence No	Licence Holder
LPF/0030	Rejang Height Sdn Bhd
LPF/0026	Rejang Height Sdn Bhd
LPF/0022	Immense Fleet

Source: Forest Department Sarawak, 2021

Forestry concessions are contracts to manage land and specific forestry resources on behalf of the Government, i.e., the areas are not alienated to the forestry companies. The loss of resources is primarily a loss to the Government, represented by the Forest Department Sarawak (FDS). The concessionaires may then subsequently seek redress from the FDS for loss of resources, they had contractual rights to harvest.

The concessionaires are required to cede areas classified as under Native Customary Rights (NCR) and those used for local water catchments. These concessions have not been available to the ESIA consultant.

The Project Proponent shall, prior to entering any concession area by his consultants or contractors notify and seek permission from the concessionaire.

Apart from the small operation at 112.7868°E 2.0344°N, shown in **Figure 6.2.8**, there seems not to be any active forestry activities at the ROW. Most harvesting or conversion/replanting activities are north of the ridges just to the north of the transmission line.

There are several logging roads crossing the project site bringing logs from the interior to log ponds and jetties at Btg. Rajang. There are occasionally smaller camps associated with these log ponds, but they do not interfere with the actual ROW as they all are on the banks of Btg. Rajang or Btg. Baleh. There are, however, no forest industries in the study area.

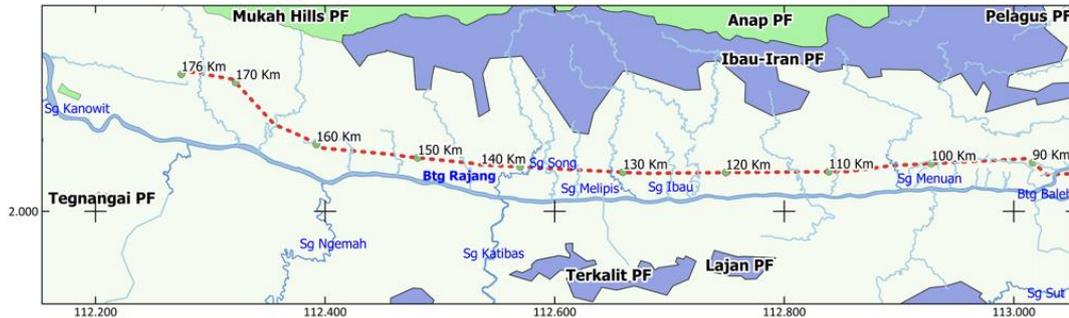
In case there are commercial logs in the areas to be cleared within a concession area, the concessionaire will be the one that has the rights/ duties to perform “salvage logging” under specific regulations by the FDS.

Salvage Logging is a forest harvest operation where the minimum diameter cutting limit is substantial lower than during normal harvest in order to salvage as much as possible commercial timber. The list of harvestable species is also expanded for the same reasons. Reduced impact logging techniques may still be imposed on the operation, which will be overseen by the FDS.

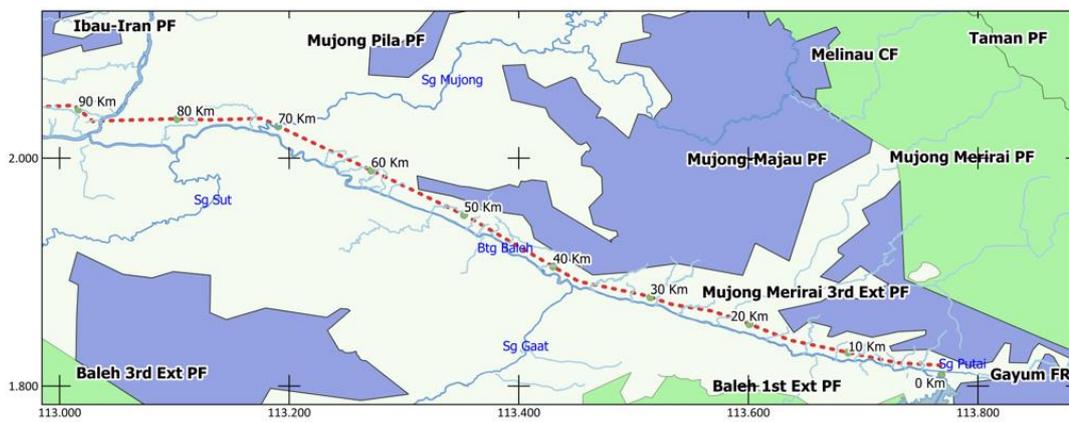
6.3.2 Protected Areas

There are no gazetted, legally protected areas, i.e., national parks, wildlife sanctuaries, nature reserves, within the transmission line area of influence apart from catchment and water intake protection. The Pelagus National Park is located about 19 km north of the transmission line. The multinational Heart of Borneo Initiative is about 25 km south of the transmission line at its nearest point.

Western Part: Predominantly secondary forest/shifting cultivation



Eastern Part: Predominantly Forest and Grassland



Source: Forest Department Sarawak, 2021

Figure 6.3.2: Permanent Forest Estate (PFE)

Figure 6.3.2 (and Appendix 6.3.2) shows the status of the PFE near the transmission line. Green areas are gazetted as part of the PFE, while the light blue areas are areas currently proposed to be gazetted. These are mostly areas that are currently covered by licences to plant forest. The figure shows that the transmission line does not traverse neither gazetted nor proposed areas of the PFE. The line comes closest at km 55, where it is within 300-400 m from the corner of a proposed area.

The Project Proponent and his contractors/consultants shall, prior to entering any part of the PFE, obtain permission from the FDS.

The areas of the PFE, bordering the transmission line are listed in Table 6.3.3.

Table 6.3.3: Permanent Forest Estate (PFE) near the Transmission Line

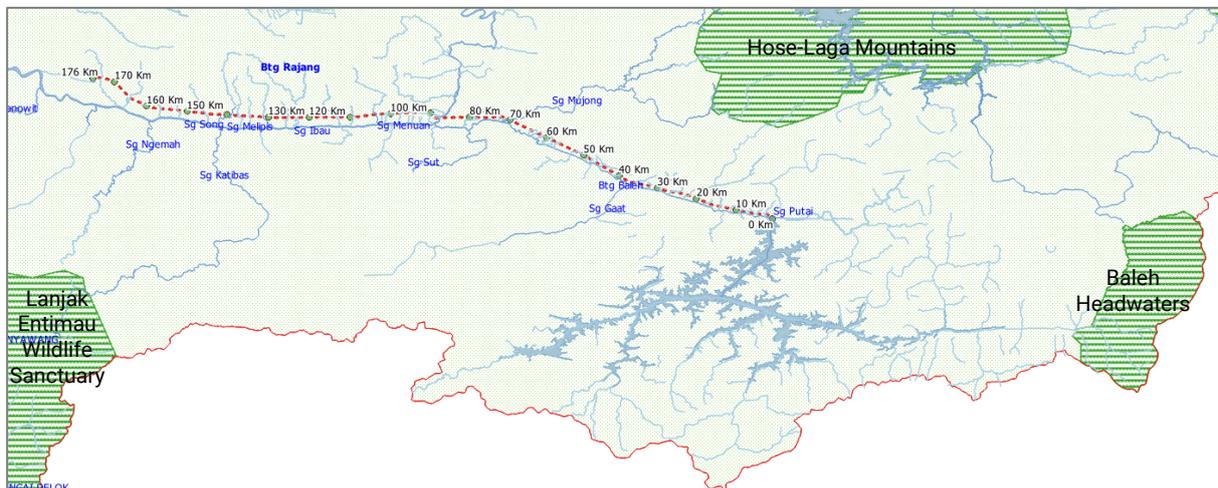
Name of PFE	Gazettement Status
Baleh Protected Forest (1 st extension)	Gazetted
Mujong-Majau Protected Forest	Proposed
Mujong Merirai Protected Forest (3 rd and 4 th Extensions)	Proposed
Gayum Forest Reserve (1 st Extension)	Proposed
Ibau-Iran Protected Forest	Proposed

Source: Forest Department Sarawak, 2021

The entire area upstream of Kapit is under catchment protection for Kapit Water Intake, while areas 8 km upstream of Nanga Entawau, Nanga Beguang and Nanga Dap are protected under the 8-km buffer zone for the intakes.

These protections are entirely for protection of water quality at the intakes and no hindrance for the proposed infrastructure development.

The Project does not traverse any “Key Biodiversity Areas” as defined on Integrated Biodiversity Assessment Tool (IBAT)-Alliance (**Figure 6.3.3**). Neither is any area within the site classified under the IUCN management categories.



Green: Key Biodiversity Areas

Figure 6.3.3: IBAT Key Biodiversity Areas

6.4 TERRESTRIAL FAUNA

This section presents the existing terrestrial fauna (species of birds, mammals, amphibians and reptiles) that are found in the area that may be affected by the construction and operation of the transmission line. Terrestrial invertebrate of interest is the Rajah Brooke Birdwing, this large and beautiful butterfly is favourite among insect enthusiast for display as well as for trade. A check of IUCN Red List 2021 shows that this butterfly is not categorised as threatened species.

6.4.1 Methodology

6.4.1.1 Sampling Points

The sampling points for primary data collection was selected to be as close as possible to the transmission line route, and placed in what looked to be undisturbed forest based on examination of google image. However, many of these targeted sites were not accessible and therefore not sampled. At locations that could be reached, fauna survey was conducted mostly in the morning (8:00 am to 11:00 am) or evening (4:00 pm to 6:00 pm) to take advantage of time when diurnal birds and mammals were most active and therefore easier to spot. At these sites, all species of birds, mammals, amphibians, and reptiles seen and heard were recorded. A brief description of the wildlife habitat at each sampling point is given in **Table 6.4.1** and shown in **Figure 6.4.1** (a – d).

Table 6.4.1: Description of Wildlife Habitat at Each Sampling Point

Location	Date/time	GPS Location	Description
TLP1	1 Dec 20, 5:00 PM, cloudy	N02° 07' 00.1", E112° 16' 06.9"	Mapai Substation. About 55 hectares was cleared in 2013 for the substation. Now, the area immediately surrounding the substation is covered by regenerating shrub and grass. Surrounding this area are secondary forests at different of growth, cultivated areas and agroforestry.
TLP2	2 Dec 20, 9:30 AM, cloudy	N02° 04' 44.9", E112° 21' 16.0"	Near Rh Billy. Undulating terrain with old secondary forests on the hill, young secondary forest and cultivated areas (small oil palm plantations, pepper) on lower ground and gentler slopes closer to the access road, and agroforestry closer to the longhouse. There is also a small stream, about 1 meter wide, with muddy bottom and slow flowing water.

Location	Date/time	GPS Location	Description
TLP3	2 Dec 20, 2:30 PM, sunny	N02° 01' 45.6", E113° 09' 48.7"	Along the road to Nanga Merit about 1 km from Btg. Baleh bridge. Very hilly. Wildlife habitat is a mixture of mainly old secondary forest resulting from past logging and paddy farming activities, some agroforestry and a paddy farm nearby. A few abandoned farm houses were checked for bats.
TLP4	2 Dec 20, 5:00 PM, cloudy	N01° 57' 39.5", E113° 18' 14.7"	Along the Baleh HEP access road. The sampling point is on a hilly area and surrounded by mixed secondary and logged forests. The area is about 800 m north of the Btg. Baleh. There is a small stream, about 1 meter wide, with rocky bottom and swift flowing water.
TLP5	3 Dec 20, 9:00 PM, sunny	N02° 01' 2.85", E113° 02' 18.8"	The observation area is on a hilly area surrounded by mixed secondary forests, logged forests and agroforest. The area is near the confluence of the Btg. Baleh and Btg. Rajang. This site is about 19 km south of Pelagus National Park.
TLP6	3 Dec 20, 10:30 AM, sunny	N01° 57' 1 0.9", E113° 19' 31.1"	Along the Baleh HEP access road. The sampling point is on a hilly area surrounded by mixed secondary and logged forests, about 600 m from the Btg. Baleh.
TLP7	3 Dec 20, 1:30 PM, sunny	N01° 59' 23.7", E113° 14' 47.3"	Along the Baleh HEP access road. The sampling point is on a hilly area surrounded by mixed secondary and logged forests, about 1 km north of Btg. Baleh. A fig tree was bearing fruit which attracted many frugivorous birds. There is a small pond with grass and fern growing at the water edge.
TLP8	3 Dec 20, 3:30 PM, sunny	N02° 01' 06.0", E112° 48' 51.4"	At Sg. Belawai, about 1 km from confluence with Btg. Rajang. The type of forest is agroforest where there are durian, engkabang, dabai and langsung trees. There is also a longhouse along Sg. Belawai.
TLP9	4 Dec 20, 09:00 AM, cloudy	N02° 01' 08.8", E112° 43' 10.2"	At Sg. Ibau, about 800 meters from the confluence with Btg. Rajang. The type of forest is agroforest where there are durian, dabai, langsung and engkabang trees. There are also longhouses along Sg. Ibau.

Location	Date/time	GPS Location	Description
TLP10	4 Dec 20, 10:30 AM, cloudy	N02° 01'57.7", E112° 31' 38.2"	At Sg. Iran, about 1 km from the confluence with Btg. Rajang. Forest type is agroforest where there are durian trees, dabai, langsung, engkabang, and rubber trees. There are also longhouses along Sg. Iran.
TLP11	4 Dec 20, 12:30 PM, sunny	N02° 01' 31.6", E112° 33' 07.3"	At Sg. Song, about 1 km from the confluence with Btg. Rajang. Agroforest, with durian trees, dabai, langsung, and rubber trees. There are also longhouses along Sg. Song.

6.4.1.1.1 *Bird Survey*

Point count technique was used in this survey, in which birds were detected based on sighting and vocalisation. This technique is deemed to be less stressful to birds and allow the researcher to cover larger area. At each sampling points, the GPS location, terrain and main habitat features were recorded. A binocular (Nikon 7x42mm) was used to aid in detection and identification. All birds seen or heard were identified to species level following field guidebook on the birds of Borneo (Myers 2016).

6.4.1.1.2 *Mammal Survey*

All mammals seen and heard at the sampling point was recorded. A binocular was used as aid in detection and identification. Animal tracks, faeces, wallows and scratch marks were also noted if present. Wild pigs, deer, mousedeer, porcupine and otter can be identified from their tracks and diggings. All mammals were identified to species level following field guidebook on mammals of Borneo (Phillipps and Phillipps 2018).

6.4.1.1.3 *Amphibian and Reptile Survey*

Amphibian and reptile survey was done by visual encounter survey, in which all individuals encountered were identified and recorded. This was done opportunistically in conjunction with the bird and mammal survey. Each time a frog or reptile was encountered, the microhabitat in which they occur was noted. Identification and taxonomy of amphibians was according to Inger et al. (2017) while that of reptile followed Das (2004).

6.4.1.1.4 Local knowledge and Stakeholders

Some local people were interviewed to determine what other mammal and bird species occur in their area, and how important wildlife are to them. These were from Kanowit (Rh. Awin at Mapai, Rh. Sauh at Kabah, Rh. Kubu and Rh. Aji at Nanga Tada, Rh. Sait Nanga Dap), (Song (Mr. Serajin from Rh. Iran), Kapit (Mr. Bana and Mr. Anjoh from Rh. Bina, Kpg. Nanga Yong – see **Plate 6.4.1** and **Plate 6.4.2**) and Baleh (Mr. Nabau from Rh. Bajai, Kpg. Nanga Kain). Local people, especially hunters and elders of the community, can contribute significantly to the knowledge on diversity and abundance of nocturnal mammals because of their long association and experience with the forest.

Following the restructuring of FDS and SFC (Sarawak Forest Corporation) announced by the Chief Minister in January 2020, the task of protecting wildlife and its habitat was given to SFC. This being the case, SFC was consulted to determine find out if there is any plan to gazette totally protected area along the transmission line route as well as to find out the latest update on conservation status of birds, mammals, amphibians and reptile species in Sarawak. Sarawak Biodiversity Centre (SBC) was also consulted but was informed that their main concern was on medicinal plants and traditional knowledge. WWF participated in an expedition to Upper Baleh in 2015 together with researchers from UNIMAS and FDS, to gather data for the preparation of a proposal to gazette an area into Baleh National Park. This Park was gazetted in November 2017 and is located about 60 km east of the Putai end of the transmission line.



Plate 6.4.1: Interview with Mr. Bana and Mr. Anjoh



Plate 6.4.2: Rh. Aji, Nanga Tada - interviewing Tr. Aji Anak Dinggai

6.4.1.2 **Study Limitations**

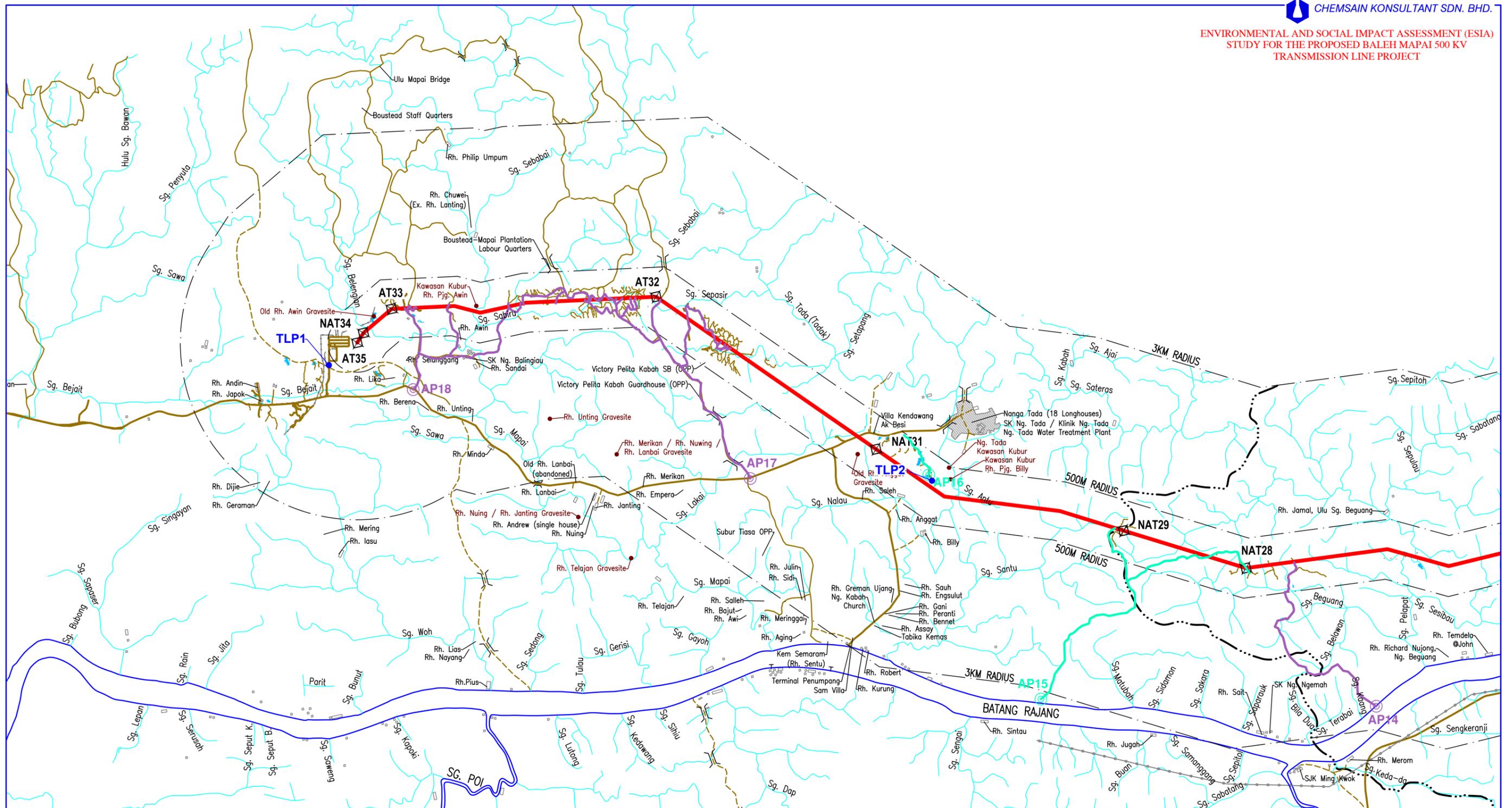
Most of the mature or well regenerating forest sites further up the Btg. Balleh were inaccessible due to lack of roads, rugged terrain, steep slopes and dense vegetation.

Time for fieldwork was limited due to the Covid-19 pandemic and MCO / CMCO imposed by the authorities. Within this constraint the consultant had to choose between more sampling points or a thorough survey of one or two points. The former was chosen. A complete survey targeting all potential species would require methodologies, e.g., mist netting, and time spans not available during the ESIA study.

The main method used for bird survey was observation, with additional information obtained through interview with the local people. Observation method is best done by combining bird vocalisation with sighting because it is fast and offer no stress to the bird compared to mist-netting, for example. The reason why less species was detected during the current survey is because the effort spent at each site was different from the literature. The literature combines observation method with mist netting and took place over a period of 4 days.

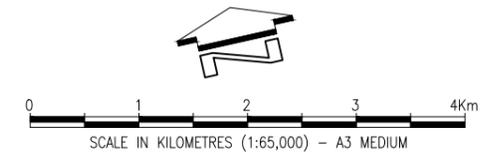
Nocturnal animals (bats, rats, frogs) were not surveyed because the survey was done during the day. Some fruit bats (e.g., Short-nosed Fruit Bat) however roost inside abandoned buildings so these can be spotted during the day. The preferred method for surveying rats is using baited cage trap but capture rate in tropical forest seldom exceed 5% so this method was not used. In addition, it requires deployment of a lot of traps (at least 50) for several days at different transects to be effective. Survey of frogs was carried out opportunistically if there is any stream or stagnant water body at or near the sampling site. Some frogs can be heard calling in the afternoon, especially just before rain but many species were probably missed because they only come out at night.

Available literature was based on sampling sites which were quite far away from the transmission line route. The nearest site reported in the literature for potentially present species was Pelagus National Park, which was approximately 19 km from the nearest transmission line route. The transmission line area of influence may extend into the habitat for species such as the endangered White-crowned Hornbill and critically endangered (CR) Sunda Pangolin, both of which have been recorded in Pelagus National Park which is a more secure and relatively undisturbed habitat compared to the one through which the transmission line passes.



LEGEND:

-  PROPOSED TRANSMISSION LINE ROUTE
-  PROPOSED ANGLE TOWER (AT1 - AT35)
-  RIVERS
-  ROADS
-  DIVISIONAL BOUNDARY
-  EXISTING TRANSMISSION LINE
-  BRIDGE
-  ACCESS ROADS (OPERATING LOGGING / PLANTATION ROAD)
-  ACCESS ROADS (COMMUNITY ACCESS ROAD / ABANDONED LOGGING TRACK)
-  FAUNA SURVEY SAMPLING LOCATIONS - (TLP1-TLP11)



SOURCE: Adapted from

SERIES T738 SHEET 5914 EDITION 1-PPNM	SERIES T738 SHEET 6014 EDITION 1-PPNM	SERIES T738 SHEET 6114 EDITION 1-PPNM	SERIES T738 SHEET 6214 EDITION 1-PPNM
SERIES T738 SHEET 6314 EDITION 1-PPNM	SERIES T738 SHEET 6413 EDITION 1-PPNM	SERIES T738 SHEET 6414 EDITION 1-PPNM	SERIES T738 SHEET 6513 EDITION 1-PPNM

GRID
-The inner crosses indicate the Latitude and Longitude

FAUNA SURVEY SAMPLING LOCATIONS

FIGURE: 6.4.1a

6.4.2 Wildlife Habitat

Between Mapai and Kapit, most of what looked like forest from a distance or on Google Map (latest version available is 2016) were in fact agroforest, a term used to describe habitat that comprised of fruit trees (durian, engkabang, langsung, rambutan, dabai, cempedak) and untapped rubber trees growing among wild trees. Sampling sites along Btg. Rajang near Kanowit, Song and Kapit have more agroforest than sites along the Btg. Baleh.

6.4.2.1 Avifauna

A total of 217 species of birds are potentially present in the project area (refer **Appendix 6.4.1**). This is based on a long-term field survey, using both observation and mist netting method, conducted at Pelagus and Upper Baleh between 2014 and 2017.

The local people that were interviewed (all are from Iban tribe since they are the overwhelming majority in the project area) seem not able to distinguish birds to species level, except a few species that are fairly large, distinct and common (e.g., Argus pheasant as *ruai*, Hill myna as *tiong*, Spotted Dove as *tekukur*) or feature prominently in their folklore and tradition (e.g., Rufus piculet as *ketupong*). Most of the birds were identified as a group. For example, they identify egrets and herons as *bangau*, partridges as *sangayan* or *sempidan*, eagles as *lang*, woodpeckers as *belatok*, pigeons as *punai*, munia as *pipit*, bulbul as *empulu*, tailorbirds as *jeruit*, babblers as *enkechong*. The fact that the locals can only identify one species of hornbill (Black hornbill) meant that hornbills are probably less common in their area.

From the list of 217 potentially present species, 84 are considered as species of high conservation value because they are either threatened or near-threatened under IUCN 2021, totally protected or protected under WLPO 1998, endemic to Borneo or listed under CITES Appendix I and II (**Table 6.4.2**). Threatened species include two (2) critically endangered species (Helmeted Hornbill and Straw Headed Bulbul), two (2) endangered (White-crowned Hornbill and Greater Green Leafbird) and nine (9) species which are categorised as vulnerable (**Table 6.4.2**). These threatened species experienced decreasing population in their range due to habitat loss and degradation as well as collection from the wild for pet trade. An example of species that experienced severe decline due to demand as song bird is the Straw-headed Bulbul, which is categorised as Critically Endangered and Listed in Appendix 1 of CITES. Eleven (11) avifauna species are totally protected

and 51 are protected under the Sarawak WLPO 1998. WLPO 1998 list all CITES Appendix I and II species as totally protected and protected species in Sarawak.

Out of these 84 high conservation values species, only 24 were recorded during the current survey. Protected species includes two (2) swiftlets, three (3) kingfishers, four (4) woodpeckers, two (2) eagles, White-rumped Shama, Hill Myna, Straited Heron and Common Sandpiper, the latter two (2) water birds were encountered at stations accessed via river (Sg. Iran, Sg. Song, Sg. Belawai, Sg. lbau). The only migratory species recorded was the Arctic Warbler. Interestingly, no hornbills were sighted in the project area.



Plate 6.4.3: Blue-Eared Barbet at TLP7



Plate 6.4.4: Red Crowned Barbet at TLP2



Plate 6.4.5: Crested Serpent Eagle at TLP10b



Plate 6.4.6: Buff-neck woodpecker at TLP7



Plate 6.4.7: Dusky Munia, a Bornean endemic, at TLP7

Plate 6.4.8: Pacific Swallow at TLP2

Table 6.4.2: List of Selected Value Avifauna Species Potentially Present and Recorded at the Project Site During the Survey

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	WLPO 1998	Endemic	Migratory	CITES Appendix	Local Value
Phasianidae											
<i>Argusianus argus</i>	Great Argus	Ruai	x		x	VU	TP			II	decorative (feathers)
<i>Coturnix chinensis</i>	Blue-breasted Quail		x		x	LC	P			NL	
Columbidae											
<i>Treron capellei</i>	Large Green Pigeon	Punai	x		x	VU				NL	food
<i>Ducula aenea</i>	Green Imperial Pigeon	Pergam	x	8	x	LC	TP			NL	food
Apodidae											
<i>Collocalia esculenta</i>	Glossy Swiftlet	Layang-layang	x	1, 2, 3, 5, 7, 8, 10	x	LC	P			NL	
<i>Aerodramus maximus</i>	Black-nest Swiftlet	Layang-layang	x			LC	P			NL	birdnest
<i>Aerodramus salangana</i>	Mossy-nest Swiftlet	Layang-layang	x	4, 6	x	LC	P			NL	
<i>Aerodramus fuciphagus</i>	White-nest Swiftlet	Layang-layang	x		x	LC	P			NL	birdnest
<i>Apus nipalensis</i>	House Swift	Layang-layang	x		x	LC	P			NL	
Cuculidae											
<i>Phaenicophaeus diardi</i>	Black-bellied Malkoha	Cenok	x	3, 6		NT				NL	
Ardeidae											
<i>Ixobrychus sinensis</i>	Yellow Bittern	Pucong kuning	x			LC	P			NL	
<i>Ixobrychus cinnamomeus</i>	Cinnamon Bittern	Pucong bendang	x			LC	P			NL	
<i>Butorides striata</i>	Striated Heron	Pucong keladi	x	8, 10	x	LC	P			NL	
<i>Casmerodius albus</i>	Great Egret	Bangau besar	x			LC	P			NL	
<i>Mesophoyx intermedia</i>	Intermediate Egret		x			LC	P			NL	
<i>Egretta garzetta</i>	Little Egret	Bangau kecil	x		x	LC	P			NL	
Scolopacidae											
<i>Actitis hypoleucos</i>	Common Sandpiper	Kedidi pasir	x	9, 10, 11	x	LC	P			NL	

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	WLPO 1998	Endemic	Migratory	CITES Appendix	Local Value
Accipitridae											
<i>Spilornis cheela</i>	Crested Serpent Eagle	Helang berjambul	x	8, 10	x	LC	P			II	
<i>Spilornis kinabaluensis</i>	Kinabalu Serpent Eagle	Helang	x			VU	P	x		II	
<i>Macheiramphus alcinus</i>	Bat Hawk	Helang	x		x	LC	P			II	
<i>Nisaetus cirrhatus</i>	Changeable Hawk Eagle	Helang	x		x	LC	P			II	
<i>Ictinaetus malayensis</i>	Black Eagle	Helang	x			LC	P			II	
<i>Accipiter trivirgatus</i>	Crested Goshawk	Helang	x		x	LC	P			II	
<i>Ichthyophaga humilis</i>	Lesser Fish-eagle	Helang	x		x	NT	P			II	
<i>Haliastur indus</i>	Brahminy Kite	Helang merah	x	8	x	LC	P			II	
Strigidae											
<i>Ninox scutulata</i>	Brown Boobook	Burung hantu	x			LC	P			NL	
<i>Otus rufescens</i>	Reddish Scops Owl	Burung hantu	x		x	LC	P			NL	
<i>Otus brookii</i>	Rajah Scops Owl	Burung hantu	x		x	LC	P			NL	
<i>Otus bakkamoena</i>	Collared Scops Owl	Burung hantu	x		x	LC	P			NL	
Trogonidae											
<i>Harpactes duvaucelii</i>	Scarlet-rumped Trogon	Kesumba	x	6, 10		NT				NL	Iban augury
<i>Harpactes diardii</i>	Diard's Trogon	Kesumba	x			NT				NL	Iban augury
<i>Harpactes kasumba</i>	Red-naped Trogon	Kesumba	x			NT				NL	
Bucerotidae											
<i>Rhinoplax vigil</i>	Helmeted Hornbill	Enggang	x			CR	TP			I	decorative (feathers)
<i>Buceros rhinoceros</i>	Rhinoceros Hornbill	Enggang badak	x			VU	TP			II	decorative (feathers)
<i>Anthracoceros malayanus</i>	Black Hornbill	Enggang hitam	x		x	VU	TP			II	decorative (feathers)
<i>Anorrhinus galeritus</i>	Bushy-crested Hornbill	Enggang belukar	x			NT	TP			II	decorative (feathers)

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	WLPO 1998	Endemic	Migratory	CITES Appendix	Local Value
<i>Berenicornis comatus</i>	White-crowned Hornbill	Enggang	x			EN	TP			II	decorative (feathers)
<i>Acerosundulatus</i>	Wreathed Hornbill	Enggang gunung	x			VU	TP			II	decorative (feathers)
Picidae											
<i>Sasia abnormis</i>	Rufous Piculet	Belatok kecil	x	11	x	LC	P			NL	Iban augury
<i>Dinopium afflesii</i>	Olive-backed Woodpecker	Belatok	x			NT	P			NL	
<i>Micropternus brachyurus</i>	Rufous Woodpecker	Belatok	x			LC	P			NL	
<i>Meiglyptes grammithorax</i>	Buff-rumped Woodpecker	Belatok	x			LC	P			NL	
<i>Meiglyptes tukki</i>	Buff-necked Woodpecker	Belatok	x	7	x	LC	P			NL	
<i>Picus mineaceus</i>	Banded Woodpecker	Belatok merah	x	4, 11	x	LC	P			NL	
<i>Picus puniceus</i>	Crimson-winged Woodpecker	Belatok mas	x			LC	P			NL	
<i>Mulleripicus pulverulentus</i>	Great Slaty Woodpecker	Belatok berjalur	x			VU	P			NL	
<i>Blythipicus rubiginosus</i>	Maroon Woodpecker	Belatok	x	6, 9, 10	x	LC	P			NL	Iban augury
<i>Reinwardtipicus validus</i>	Orange-backed Woodpecker	Belatok ranum	x			LC	P			NL	
<i>Dendrocopos canicapillus</i>	Grey-capped Pygmy Woodpecker	Belatok	x			LC	P			NL	
Ramphastidae											
<i>Megalaima henricii</i>	Yellow-crowned Barbet	Takor	x	3, 8, 12		NT				NL	
<i>Calorhamphus fuliginosus</i>	Brown Barbet	Takor	x	9, 10		LC		x		NL	
Alcedinidae											

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	WLPO 1998	Endemic	Migratory	CITES Appendix	Local Value
<i>Ceyx rufidorsa</i>	Rufous-backed Kingfisher	Pekaka api	x	5, 10, 11		LC	P			NL	
<i>Alcedo peninsulæ</i>	Malay Blue-banded kingfisher	Pekaka	x			NT	P			NL	
<i>Alcedo meninting</i>	Blue-eared Kingfisher	Pekaka bintik-bintik	x			LC	P			NL	
<i>Alcedo atthis</i>	Common Kingfisher	Pekaka citcit kecil	x			LC	P			NL	
<i>Lacedo pulchella</i>	Banded Kingfisher	Pekaka	x			LC	P			NL	Iban augury
<i>Pelargopsis capensis</i>	Stork-billed Kingfisher	Pekaka dendang	x			LC	P			NL	
<i>Halcyon coromanda</i>	Ruddy Kingfisher	Pekaka	x			LC	P			NL	
<i>Actenoides concretus</i>	Rufous-collared Kingfisher	Pekaka	x			LC	P			NL	
<i>Todiramphus chloris</i>	Collared Kingfisher	Pekaka sungai	x			LC	P			NL	
Falconidae											
<i>Microhierax fringillarius</i>	Black-thighed Falconet	Falko Rajawali	x			LC	P			II	
Psittaculidae											
<i>Psittacula longicauda</i>	Long-tailed Parakeet	Bayan nuri	x	8	x	NT	P			NL	
<i>Loriculus galgulus</i>	Blue-crowned Hanging Parrot	Serindit	x	8	x	LC	P			NL	pet
Pittidae											
<i>Pitta arquata</i>	Blue-banded Pitta	Burung pacat	x			LC	TP	x		NL	
<i>Pitta granatina</i>	Garnet Pitta	Burung Pacat Kepala merah	x			NT	TP			NL	food
<i>Pitta moluccensis</i>	Blue-winged Pitta	Burung pacat sayap biru	x			LC	TP			NL	food
Calyptomenidae											
<i>Calyptomena viridis</i>	Green Broadbill	Takau selawit	x			NT				NL	
Oriolidae											

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	WLPO 1998	Endemic	Migratory	CITES Appendix	Local Value
<i>Oriolus xanthonotus</i>	Dark-throated Oriole		x			NT				NL	
Pityriaseidae											
<i>Pityriasis gymnocephala</i>	Bornean Bristlehead		x			NT		x		NL	
Corvidae											
<i>Platylophus galericulatus</i>	Crested Jay	Gagak Jerit	x	10		NT				NL	Iban augury
Monarchidae											
<i>Terpsiphone paradisi</i>	Asian Paradise-Flycatcher	Burung Sambar Ekor panjang	x			LC	P			NL	
Dicaeidae											
<i>Prionochilus xanthopygius</i>	Yellow-rumped Flowerpecker	Sepah puteri	x	8, 10		LC		x		NL	
Irenidae											
<i>Chloropsis sonnerati</i>	Greater Green Leafbird	Burung Daun besar	x			EN				NL	
<i>Chloropsis cyanopogon</i>	Lesser Green Leafbird	Burung Daun kecil	x	4, 6		NT				NL	
Estrildidae											
<i>Lonchura fuscans</i>	Dusky Munia	Pipit perang	x	7	x	LC		x		NL	
Pycnonotidae											
<i>Pycnonotus zeylanicus</i>	Straw-headed Bulbul	Barau-barau	x			CR				II	
Phylloscopidae											
<i>Phylloscopus borealis</i>	Arctic Warbler		x			LC			x	NL	
Zosteropidae											
<i>Yuhina everetti</i>	Chestnut-crested Yuhina		x			LC		x		NL	
Sturnidae											

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	WLPO 1998	Endemic	Migratory	CITES Appendix	Local Value
<i>Gracula religiosa</i>	Hill Myna	Tiong	x	10, 11	x	LC	P			II	pet
Muscicapidae											
<i>Copsychus malabaricus</i>	White-rumped Shama	Murai rimba	x	2, 3, 9, 10	x	LC	P			NL	pet, Iban augury
<i>Cyornis caeruleus</i>	Large-billed Blue Flycatcher	Burung Sambar	x			VU				NL	
<i>Cyornis superbus</i>	Bornean Blue Flycatcher	Burung Sambar Biru Borneo	x			LC				NL	
<i>Cyornis brunneatus</i>	Brown-chested jungle Flycatcher	Burung Sambar	x			VU				NL	
<i>Enicurus ruficapillus</i>	Chestnut-naped Forktail	Burung Sambar	x			NT				NL	
Total Count			84	24							

Notes:

IUCN Category of Threatened Species (IUCN 2021)

- CR: Critically Endangered
- EN: Endangered
- VU: Vulnerable
- LC: Least Concern
- NT: Near-Threatened
- DD: Data deficient
- NE: Not Evaluated

Sarawak WLPO 1998

- P: Protected Species, include all CITES I species (fine RM10,000 and imprisonment 1 year)
- TP: Totally protected Species (fine RM25,000 and two years jail)

CITES

I: Appendix I listing (Threatened species)

II: Appendix II listing (not threatened species but whose trade must be controlled in order to avoid use that is incompatible with their survival)

NL: Not listed in any Appendices

Numbers in "Observed" column refers to the sites where the birds were recorded during this study.

6.4.2.2 *Mammal*

A total of 85 species of mammals are potentially present based on a previous long-term study at Pelagus and Upper Baleh conducted by UNIMAS, and include 43 species of non-volant mammals detected using camera and cage traps and 42 species of bats recorded using both mist nets and harp traps (**Table 6.4.3**). Rodents and bats are the dominant mammal order in the region, but they are difficult to spot because they are nocturnal and usually require equipment (mouse traps, mist nets and harp traps) for capture. Only four species (Bornean Colugo, Bornean Yellow Muntjac, Bornean Porcupine, and Bornean Horsehoe Bat) are endemic to Borneo.

In the current survey, 18 species were reported as present by locals and 9 observed during sampling on site. The most commonly observed mammal was Plantain Squirrel and this can be attributed to the presence of both wild and planted fruit trees, some of which were bearing fruit during the sampling period. Plantain squirrel is also regarded as pest by the farmers.

Some of the larger mammals reported in **Table 6.4.3** are reported by the local people. They can recognize these mammal species because of their size and habits which make them easy to see, and also because they are targeted by hunters. Hunters prefer to shoot wild pig and deer (Sambar deer, barking deer) because of their larger size, but they will hunt or trap mousedeer, civets, monkeys, porcupine, bearcat and pangolin. Many of these ended up for sale in Kapit market.

According to the locals, the hunters have to go quite far inland in order to hunt, meaning these mammals are not present within the project area. This is supported by the lack of tracks, faeces, scratch marks or wallowing signs in all the sampling points. Both Long-tailed and Pig-tailed macaques were reported to damage or disturb crops planted by the residents of Rh. Bina at Kampong Nanga Yong, which is on the opposite side of the Btg. Rajang where the transmission line passes through.

The Pangolin (*Manis javanica*) was uplisted to critically endangered in 2014. This is due to high demand for its scale in China where it is believed to have medicinal properties. The locals have traditionally hunted pangolins for local consumption but in the last 20 years the high price Chinese traders have been willing to pay for pangolin scales has contributed to rapid decline in pangolin population in its range.

The Bay Cat, endemic to Borneo, was thought to be extinct because it has not been sighted or reported by researchers for a long time but was finally recorded using

camera trap in 2003 (Mohd-Azlan and Sanderson, 2007). This species is threatened by habitat loss and hunting and categorised as Endangered.

Nine other mammal species (Sun Bear, Bear cat, Hose's Civet, Sambar Deer, Bearded Pig, Tuft Ground Squirrel, Pig-tailed Macaque, White-fronted langur, Ridley's Roundleaf Bat) are categorised as Vulnerable. These species are threatened by habitat loss and hunting. The preferred game animals for every local hunter are the Bearded Pig and Sambar Deer, and hunting is the main reason why these two species are categorised as Vulnerable. Despite of this, both species are not protected under WLPO 1998.

In terms of traded animals, the porcupine and Marble Cat are listed in Appendix I of CITES. As mentioned previously, the pangolin scales are heavily traded internationally because of its perceived medicinal value in Chinese traditional medicine. The Marble Cat and the other mammal species listed in Appendix II are all traded as pet animal and therefore such trade need to be regulated internationally.



Plate 6.4.9: Short-nosed fruit bats in an abandoned hut at TLP13



Plate 6.4.10: Civets for sale at Kapit market



Plate 6.4.11: A pangolin (kept by a local) at TLP1. The pangolin is listed as Critically Endangered by IUCN 2021 and protected by WLPO 1998.



Plate 6.4.12: A local cleaning the head of wild pig at a longhouse in Upper Baleh.

Table 6.4.3: List of Mammals Potentially Present and Recorded During the Survey

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	SWLPO	Endemic	CITES	Local Value
Family: Felidae										
<i>Catopuma badia</i>	Bay Cat	Kucing merah	x			EN	TP		II	food
<i>Pardofelis marmorata</i>	Marbled Cat	Kucing dahan	x			NT	TP		I	food
<i>Prionailurus bengalensis</i>	Leopard Cat	Rimau dahan	x			LC	P		II	food
Family: Ursidae										
<i>Helarctos malayanus</i>	Sun Bear	Beruang	x			VU	P		I	
Family: Viverridae										
<i>Arctictis binturong</i>	Bear cat	Binturong	x			VU	P		III	food
<i>Arctogalidia trivirgata</i>	Small-toothed Palm Civet	Musang	x			LC	P		NL	food
<i>Hemigalus derbyanus</i>	Banded Palm Civet	Musang	x			NT	P		II	food
<i>Paguma larvata</i>	Masked Palm Civet	Musang	x		x	LC	P		III	food
<i>Paradoxurus hermaphroditus</i>	Common Palm Civet	Musang	x		x	LC	P		III	food
<i>Viverra zangalunga</i>	Malay Civet	Musang	x			LC	P		NL	food
<i>Diplogale hosei</i>	Hose's Civet	Musang	x			VU	P		NL	food
Family: Herpestidae										
<i>Herpestes brachyurus</i>	Short-tailed Mongoose		x			NT	P		NL	food
<i>Herpestes semitorquatus</i>	Collared Mongoose		x			NT	P		NL	food
Family: Mustelidae										
<i>Martes flavigula</i>	Yellow-throated Marten		x			LC			III	
<i>Mustela nudipes</i>	Malay Weasel		x			LC			NL	
Lutrinae	Otters	Memerang	x		x	EN/ VU/ NT	P		II	food
Family: Prionodontidae										
<i>Prionodon linsang</i>	Banded Linsang		x			LC			II	food
Family: Lorisidae										

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	SWLPO	Endemic	CITES	Local Value
<i>Nycticebus coucang</i>	Sunda Slow Loris	Ukang	x			EN				
Family: Cynocephalidae										
<i>Galeopterus borneanus</i>	Bornean Colugo		x			LC	P	x		
Family: Tragulidae										
<i>Tragulus kanchil</i>	Lesser Mouse-deer	Pelandok	x			LC			NL	food
<i>Tragulus napu</i>	Greater Mouse-deer	Pelandok	x			LC			NL	food
Family: Cervidae										
<i>Muntiacus atherodes</i>	Bornean Yellow Muntjac	Kijang	x			NT		x	NL	food
<i>Muntiacus muntjac</i>	Common Barking Deer	Kijang	x			LC			NL	food
<i>Rusa unicolor</i>	Sambar Deer	Rusa	x			VU			NL	food
Family: Suidae										
<i>Sus barbatus</i>	Bearded Pig	Babi hutan	x			VU			NL	food
Family: Hystricidae										
<i>Hystrix brachyura</i>	Common Porcupine	Landak	x		x	LC	P		NL	food
<i>Hystrix crassispinis</i>	Bornean Porcupine	Landak	x		x	LC	P	x	NL	food
<i>Trichys fasciculata</i>	Long-tailed porcupine	Landak	x		x	LC	P		NL	food
Family: Tupaiidae										
<i>Tupaia glis</i>	Common Treeshrew	Tupai tanah	x	3, 7, 8, 9, 11	x	LC	P			
<i>Tupaia tana</i>	Large Treeshrew	Tupai tanah	x	3, 10	x	LC	P			
<i>Tupaia minor</i>	Lesser Treeshrew	Tupai tanah	x	4, 5, 6	x	LC	P			
Family: Sciuridae										
<i>Callosciurus notatus</i>	Plantain squirrel	Tupai		1, 2, 3, 5, 6, 8, 9, 10, 11	x	LC				food
<i>Exilisciurus exilis</i>	Plain Pigmy Squirrel	Tupai/Pukang (Iban)	x							
<i>Ratufa affinis</i>	Giant squirrel	Tupai	x	4, 6, 8	x	NT	TP			food
<i>Sundasciurus tenuis</i>	Slender Squirrel	Tupai	x	5, 7, 9, 11	x	LC				

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	SWLPO	Endemic	CITES	Local Value
<i>Callosciurus prevostii</i>	Prevost's Squirrel	Tupai	x	3, 4, 6, 8, 9, 10	x	LC				food
<i>Sundamys muelleri</i>	Muller's Rat	Tikus	x							
<i>Rheithrosciurus macrotis</i>	Tufted Ground Squirrel	Tupai/Engkera mpu (Iban)	x		x	VU	TP		NL	
Family: Cercopithecidae										
<i>Macaca fascicularis</i>	Long-tailed macaque	Kera	x	3, 4	x	LC	P		II	food, pet
<i>Macaca nemestrina</i>	Pig-tailed Macaque	Berok	x		x	VU	P		II	food, pet
<i>Presbytis frontata</i>	White-fronted Langur	Lontong	x			VU	TP		NL	food, pet
<i>Presbytis rubicunda</i>	Red Langur Monkey	Lontong	x		x	LC	TP		NL	food, pet
Order: Pholidota										
Family: Manidae										
<i>Manis javanica</i>	Sunda Pangolin	Tenggiling	x		x	CR	P		I	food, scale
Family: Pteropodidae										
<i>Cynopterus brachyotis</i>	Lesser Short-nosed Fruit Bat	Kelawar	x	3		LC	P		NL	
<i>Dyacopterus spadieus</i>	Dayak Fruit Bat	Kelawar	x			NT	P		NL	
<i>Chironax melanocephalus</i>	Black-capped Fruit Bat	Kelawar	x			LC	P		NL	
<i>Balionycteris maculata</i>	Spotted-winged Fruit Bat	Kelawar	x			LC	P		NL	
<i>Megaerops ecaudatus</i>	Temminck's Tailless Fruit Bat	Kelawar	x			LC	P		NL	
<i>Penthetor lucasii</i>	VU: Vulnerable+A118:B132	Kelawar	x							
<i>Rousettus amplexicaudatus</i>	Geoffroy's Rousette	Kelawar	x							
<i>Macroglossus minimus</i>	Long-tongued Nectar Bat	Kelawar	x			LC	P		NL	
<i>Eonycteris spelaea</i>	Cave Nectar Bat	Kelawar	x			LC	P		NL	
Family: Rhinolophidae										
<i>Rhinolophus luctus</i>	Great Woolly Horseshoe Bat	Kelawar	x			LC	P		NL	

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	SWLPO	Endemic	CITES	Local Value
<i>Rhinolophus sedulus</i>	Lesser Woolly Horseshoe Bat	Kelawar	x			LC	P		NL	
<i>Rhinolophus tricolor</i>	Treefoil Horseshoe Bat	Kelawar	x			LC	P		NL	
<i>Rhinolophus acuminatus</i>	Acuminate Horseshoe Bat	Kelawar	x			LC	P		NL	
<i>Rhinolophus pusillus</i>	Least Horseshoe Bat	Kelawar	x			LC	P		NL	
<i>Rhinolophus borneensis</i>	Bornean Horseshoe Bat	Kelawar	x			LC	P	x	NL	
<i>Rhinolophus sp.</i>	Unidentified Horseshoe Bat	Kelawar	x			LC	P		NL	
Family: Hipposideridae										
<i>Hipposideros ridleyi</i>	Ridley's Roundleaf Bat	Kelawar	x			VU	P		NL	
<i>Hipposideros dyacorum</i>	Dayak Roundleaf Bat	Kelawar	x			LC	P		NL	
<i>Hipposideros ater</i>	Dusky Roundleaf Bat	Kelawar	x			LC	P		NL	
<i>Hipposideros sabanus</i>	Least Roundleaf Bat	Kelawar	x			LC	P		NL	
<i>Hipposideros diaderma</i>	Diadem Roundleaf Bat	Kelawar	x			LC	P		NL	
<i>Hipposideros galeritus</i>	Cantor's Roundleaf Bat	Kelawar	x			LC	P		NL	
<i>Hipposideros cervinus</i>	Fawn Roundleaf Bat	Kelawar	x			LC	P		NL	
<i>Hipposideros sp.</i>	Unidentified Roundleaf Bat	Kelawar	x			LC	P		NL	
Family: Megadermatidae										
<i>Megaderma spasma</i>	Lesser False Vampire Bat	Kelawar	x			LC	P		NL	
Family: Nycteridae										
<i>Nycteris tragata</i>	Malayan Slit-faced Bat	Kelawar	x			LC	P		NL	
Family: Emballonuridae										
<i>Emballonura alecto</i>	Greater Sheath-tailed Bat	Kelawar	x			LC	P		NL	
Family: Vespertilionidae										
<i>Tylonycteris robustula</i>	Greater Bamboo Bat	Kelawar	x			LC	P		NL	
<i>Tylonycteris pachypus</i>	Lesser Bamboo Bat	Kelawar	x			LC	P		NL	

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	SWLPO	Endemic	CITES	Local Value
<i>Glischropus tylopus</i>	Tick-thumb Pipistrelle	Kelawar	x			LC	P		NL	
<i>Pipistrellus ceylonicus</i>	Dark Brown Pipistrelle	Kelawar	x			LC	P		NL	
<i>Pipistrellus tenuis</i>	Least Pipistrelle	Kelawar	x			LC	P		NL	
<i>Pipistrellus petersi</i>	Peters's Pipistrelle	Kelawar	x			DD	P		NL	
<i>Pipistrellus sp.</i>	Unidentified Pipistrelle	Kelawar	x			LC	P		NL	
<i>Kerivoula papilosa</i>	Papillose Woolly Bat	Kelawar	x			LC	P		NL	
<i>Kerivoula intermedia</i>	Small Woolly Bat	Kelawar	x			NT	P		NL	
<i>Kerivoula pellucida</i>	Clear-winged Woolly Bat	Kelawar	x			NT	P		NL	
<i>Kerivoula minuta</i>	Lesser Woolly Bat	Kelawar	x			NT	P		NL	
<i>Kerivoula hardwickii</i>	Hardwicke's Woolly Bat	Kelawar	x			LC	P		NL	
<i>Myotis ater</i>	Black Myotis	Kelawar	x			LC	P		NL	
<i>Myotis muricola</i>	Whiskered Myotis	Kelawar	x			LC	P		NL	
<i>Murina suilla</i>	Brown Tube-nosed Bat	Kelawar	x			LC	P		NL	
Total Count			85	9	18			4		

Notes:

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- EN: Endangered
- VU: Vulnerable
- NT: Near-Threatened
- DD: Data deficient
- LC: Least Concern

Sarawak WLPO 1998

- P: Protected Species, include all CITES I species (fine RM10,000 and imprisonment 1 year)
- TP: Totally Protected Species (fine RM25,000 and two years jail)

CITES

I: Appendix I listing (Threatened species)

II: Appendix II listing (not threatened species but whose trade must be controlled in order to avoid use that is incompatible with their survival)

NL: Not listed in any Appendices

Numbers in "Observed" column refers to the sites where the mammals were recorded during this study.

6.4.2.3 *Amphibian*

Amphibians are among the most threatened vertebrate species globally, estimated to be about 1/3 of the described species. Unlike birds and mammals, amphibians are relatively immobile and among the most sensitive to habitat loss and degradation.

Based on research carried out by UNIMAS at Pelagus and Upper Baleh region, 64 species of amphibian are potentially present in the project area (**Table 6.4.4**) and 34 of these are endemic to Borneo. Only two (2) species have been categorised as Vulnerable and another two (2) species as Near Threatened in IUCN 2021. In Sarawak the WLPO 1998 has not listed any frogs as protected species but frogs that occur in the 42 totally protected areas in Sarawak are protected. None of the frogs listed in **Table 6.4.4** have been listed in CITES Appendices, indicating that frogs in general have not been extensively traded on the international market.

Although the region has a relatively long history of fieldwork (the late Dr. Inger was working at the Ng Gaat area way back in 1962-63) and existence of several field guides on the taxa, many specimens collected by UNIMAS Professor Indraneil Das have not been described.

During the survey for the transmission line project, only five (5) species were reported by the local people and seven (7) species were encountered in the field. The Marsh Frog, Rough Sided Frog and Four-lined Tree Frog are very vocal and can be heard clearly before they are seen. Grass Frogs were spotted hopping across the road during night drive. These are species that have adapted to disturbed habitats. No restricted forest species were recorded during the survey.

One (1) species, the Giant River Frog is commonly collected by the local community for their own consumption. Occasionally, these are sold in the market in Kapit and Song for RM20-25/kg.

6.4.2.4 *Reptile*

At least 50 species of reptiles are potentially present in Pelagus and Upper Baleh area, of which 15 are endemic to Borneo (**Table 6.4.5**). Only one species, Asiatic Soft-shelled Turtle is a threatened species (Vulnerable). In Sarawak, as in the rest of Asia, this turtle is harvested for food and pet trade. The others are categorised as least concern or have not been evaluated. The endemic Bornean Earless Monitor is being threatened through targeted collection but has not been evaluated

under IUCN category or included in CITES list. It is currently a totally protected species in Sarawak.

Ten (10) species of reptile were recorded during the survey for the transmission line project (**Table 6.4.5**) and comprise of one (1) crocodile, eight (8) lizards and one (1) snake. The Water monitor and Reticulated Python are protected under the SWLPO 1998, while the Saltwater Crocodile are reported as present in Btg. Rajang and Btg. Baleh and their major tributaries. In previous trips to Kapit, pythons were seen to be offered for sale at the local market, together with other wildlife.

Table 6.4.4: List of Amphibians Recorded at the Sampling Points

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	Endemic	CITES	Local Value
AMPHIBIAN									
Bufoidea									
<i>Ansonia leptopus</i> (Günther, 1872)	Brown Slender Toad	Kodok	x			LC	Endemic		
<i>Ansonia longidigita</i> Inger, 1960	Long-fingered Slender Toad	Kodok	x			LC	Endemic		
<i>Ansonia minuta</i> Inger, 1960	Dwarf Slender Toad	Kodok	x			LC	Endemic		
<i>Ansonia spinulifer</i> (Mocquard, 1890)	Spiny Slender Toad	Kodok	x			LC	Endemic		
<i>Ingerophrynus divergens</i> (Peters, 1871)	Forest Toad	Kodok	x			LC			
<i>Pelophryne signata</i> (Boulenger, 1894)	Short-legged Dwarf Toad	Kodok	x			LC	Endemic		
<i>Phrynoidis asper</i> (Gravenhorst, 1829)	River Toad	Kodok	x			LC			
<i>Phrynoidis juxtasper</i> (Inger, 1964)	Giant River Toad	Kodok	x		x	LC			
<i>Rentapia everetti</i> (Boulenger, 1896)	Everett's Tree Toad	Kodok	x			LC	Endemic		
<i>Rentapia hosii</i> (Boulenger, 1892)	Brown Tree Toad	Kodok	x			LC			
Ceratobatrachidae									
<i>Alcalus baluensis</i> (Boulenger, 1896)	Kinabalu Dwarf Mountain Frog	Katak	x			LC	Endemic		
Dicroglossidae									
<i>Fejevaryia limnocharis</i> (Gravenhorst, 1829)	Asian Grass Frog	Katak	x	1, 2, 4	x	LC			food
<i>Limnonectes ibanorum</i> (Inger, 1964)	Rough-backed River Frog	Katak	x			LC	Endemic		
<i>Limnonectes ingeri</i> (Kiew, 1978)	Inger's Wart Frog	Katak	x	4, 5, 6, 8, 10		LC	Endemic		
<i>Limnonectes kuhlii</i> (Tschudi, 1838)	Kuhl's Creek Frog	Katak	x			LC			
<i>Limnonectes leporinus</i> (Andersson, 1923)	Giant River Frog	Katak	x	1, 8, 9, 10	x	LC	Endemic		food
<i>Limnonectes malesianus</i> (Kiew, 1984)	Peat Swamp Frog	Katak	x			NT			

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	Endemic	CITES	Local Value
<i>Limnonectes palavanensis</i> (Boulenger, 1894)	Smooth Guardian Frog	Katak	x			LC			
<i>Limnonectes paramacrodon</i> (Inger, 1966)	Lesser Swamp Frog	Katak	x			NT			
<i>Occidozyga baluensis</i> (Boulenger, 1896)	Seep Frog	Katak	x			LC	Endemic		
<i>Occidozyga laevis</i> (Günther, 1858)	Yellow Bellied Puddle Frog	Katak	x			LC			
Megophryidae									
<i>Leptobrachella juliandringi</i> Eto, Matsui, and Nishikawa, 2015	Dring's Dwarf Litter Frog	Katak	x			LC	Endemic		
<i>Leptobrachella parva</i> Dring, 1984	Rough-sided Dwarf Litter Frog	Katak	x			LC	Endemic		
<i>Leptobrachella serasenae</i> Dring, 1983	Serasan Dwarf Litter Frog	Katak	x			NE			
<i>Leptobrachium abbotti</i> (Cochran, 1926)	Lowland Litter Frog	Katak	x			LC	Endemic		
<i>Leptobrachella gracilis</i> (Günther, 1872)	Sarawak Slender Litter Frog	Katak	x			LC	Endemic		
<i>Leptolalax picta</i> Malkmus, 1992	Painted Slender Litter Frog	Katak	x			LC	Endemic		
<i>Pelobatrachus edwardinae</i> Inger, 1989	Edwardine's Horned Frog	Katak	x			LC	Endemic		
<i>Megophrys nasuta</i> (Schlegel, 1858)	Bornean Horned Frog	Katak	x			LC			
Microhylidae									
<i>Chaperina fusca</i> Mocquard, 1892	Saffron-bellied Frog	Katak	x			LC			
<i>Kalophrynus intermedius</i> Inger, 1966	Intermediate Sticky Frog	Katak	x			LC	Endemic		
<i>Kalophrynus meizon</i> Zug, 2015	Bornean Big Sticky Frog	Katak	x			NE	Endemic		
<i>Kalophrynus subterrestris</i> Inger, 1966	Burrowing Sticky Frog	Katak	x			LC	Endemic		
<i>Microhyla petrigena</i> Inger and Frogner, 1979	Kapit Rice Frog	Katak	x			LC	Endemic		
<i>Kalophrynus subterrestris</i> Inger, 1960		Katak	x						
Ranidae									
<i>Abavorana luctuosa</i> (Peters, 1871)	Mahogany Frog	Katak	x			LC			

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	Endemic	CITES	Local Value
<i>Amnirana nicobariensis</i> (Stoliczka, 1870)	Cricket Frog	Katak	x			LC			
<i>Chalcorana raniceps</i> (Peters, 1871)	White-lipped Frog	Katak	x	2, 7, 11	x	LC			
<i>Meristogenys phaeomerus</i> (Inger and Gritis, 1983)	Kapit Torrent Frog	Katak	x			LC	Endemic		
<i>Meristogenys poecilus</i> (Inger & Gritis, 1983)	Bornean Torrent Frog	Katak	x			LC	Endemic		
<i>Odorrana hosii</i> (Boulenger, 1891)	Poisonous Rock Frog	Katak	x			LC			
<i>Pulchrana picturata</i> (Boulenger, 1920)	Spotted Stream Frog	Katak	x			LC			
<i>Pulchrana signata</i> (Günther, 1872)	Striped Stream Frog	Katak	x			LC			
<i>Pulchrana glandulosa</i>	Rough-sided Frog	Katak	x	1, 2, 4, 5, 7					
<i>Pulchrana baramica</i>	Marsh Frog	Katak	x	2, 4					
<i>Staurois guttatus</i> (Günther, 1858)	Black-spotted Rock Frog	Katak	x			LC	Endemic		
<i>Staurois latopalmatus</i> (Boulenger, 1887)	Rock Skipper	Katak	x			LC	Endemic		
<i>Staurois parvus</i> Inger and Haile, 1959	Lesser Rock Skipper	Katak	x			VU	Endemic		
<i>Staurois tuberilinguis</i> Boulenger, 1918	Green Spotted Rock Skipper	Katak	x			LC	Endemic		
Rhacophoridae									
<i>Kurixalus chaseni</i> (Günther, 1858)	Friiled Tree Frog	Katak	x			NE			
<i>Nyctixalus pictus</i> (Peters, 1871)	Cinnamon Frog	Katak	x			NT			
<i>Philautus hosii</i> (Boulenger, 1895)	Hose's Bush Frog	Katak	x			LC	Endemic		
<i>Philautus ingeri</i> Dring, 1987	Inger's Bush Frog	Katak	x			VU	Endemic		
<i>Philautus macroscelis</i> Boulenger, 1894	Mossy Bush Frog	Katak	x			LC	Endemic		
<i>Philautus petersi</i> (Boulenger, 1900)	Peter's Bush Frog	Katak	x			LC			
<i>Philautus tectus</i> (Boulenger, 1895)	Obscure Bush Frog	Katak	x			LC	Endemic		
<i>Polypedates leucomystax</i> (Gravenhorst, 1829)	Four-lined Tree Frog	Katak	x	1, 2, 3, 8, 9, 11	x	LC			

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	Endemic	CITES	Local Value
<i>Polypedates macrotis</i> (Boulenger, 1891)	Dark-eared Treefrog	Katak	x			LC			
<i>Polypedates ottilophus</i> (Boulenger, 1893)	File-eared Tree Frog	Katak	x			LC			
<i>Leptomantis cyanopunctatus</i> Manthey and Steiof, 1998	Blue-spotted Tree Frog	Katak	x			NE	Endemic		
<i>Rhacophorus harrissoni</i> Inger and Haile, 1959	Brown Tree Frog	Katak	x			LC	Endemic		
<i>Rhacophorus gauni</i> (Inger, 1966)	Short-nosed Tree Frog	Katak	x			LC	Endemic		
<i>Rhacophorus nigropalmatus</i> Boulenger, 1895	Wallace's Flying Frog	Katak	x			LC			
<i>Rhacophorus pardalis</i> Günther, 1858	Harlequin Flying Frog	Katak	x			LC			
Total Count			64	7	5		34		

Table 6.4.5: List of Reptiles Recorded at the Sampling Points

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	WLPO 1998	Endemic	CITES	Local Value
REPTILES (Lizards)										
Crocodylidae										
<i>Crocodylus porosus</i>	Saltwater Crocodile	Buaya	x		x		P		II	
Agamidae										
<i>Bronchocele cristatella</i> (Kuhl, 1820)	Green crested lizard	Cicak	x	1, 2, 3, 9	x	NE			NL	
<i>Draco cornutus</i> Günther, 1864	Horned Flying Lizard	Cicak	x			DD		x	NL	
<i>Draco melanopogon</i> Boulenger, 1887	Black-bearded Flying Lizard	Cicak	x			NE			NL	
<i>Draco quinquefasciatus</i> Hardwicke & Gray, 1827	Five-banded Flying Lizard	Cicak	x			NE			NL	
<i>Draco sumatranus</i>	Common Flying Lizard	Cicak	x	2, 5, 7, 8, 10	x					

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	WLPO 1998	Endemic	CITES	Local Value
<i>Gonocephalus bornensis</i> (Schlegel, 1848)	Bornean Angleheaded Lizard	Cicak	x			NE		x	NL	
<i>Gonocephalus grandis</i> (Gray, 1845)	Great Angle-headed Lizard	Cicak	x	1, 2, 3	x	LC			NL	
<i>Phoxophrys nigrilabris</i> (Peters, 1864)	Black-lipped Shrub Lizard	Cicak	x			NE		x	NL	
Anguidae									NL	
<i>Dopasia buettikoferi</i> (Lidth De Jeude, 1905)	Bornean Glass Lizard	Cicak	x			NE		x	NL	
Eublepharidae									NL	
<i>Aeluroscalabotes felinus</i> (Günther, 1864)	Asian Cat Gecko	Cicak	x			NE			NL	
Gekkonidae									NL	
<i>Cyrtodactylus consobrinus</i> (Peters, 1871)	Peters' Bow-fingered Gecko	Cicak	x			NE			NL	
<i>Cyrtodactylus malayanus</i> (de Rooji, 1915)	Borneo Bow-fingered Gecko	Cicak	x			NE		x	NL	
<i>Cyrtodactylus pubisulcus</i> Inger, 1957	Inger's Bow-fingered Gecko	Cicak	x			NE		x	NL	
<i>Cyrtodactylus quadrivirgatus</i> Taylor, 1962	Four-striped Forest Gecko	Cicak	x			NE			NL	
<i>Gekko monarchus</i> (Schlegel in: Dumeril & Bibron, 1836)	Spotted House Gecko	Cicak	x	3	x	NE			NL	
<i>Gekko smithi</i> (Gray, 1842)	Smith's Giant Gecko	Cicak	x	3, 5, 6, 8, 10		NE			NL	
<i>Ptychozoon kuhli</i> Stejneger, 1902	Kuhl's Flying Gecko	Cicak	x			NE			NL	
Lanthanotidae									NL	
<i>Lanthanotus borneensis</i> Steindacher, 1877	Borneo Earless Monitor	Cicak	x			NE	TP	x	NL	
Scincidae									NL	
<i>Dasia vittata</i> Edeling, 1864	Striped Tree Skink	Cicak	x			NE		x	NL	
<i>Eutropis multifasciata</i> (Kuhl, 1820)	Common Sun Skink	Cicak	x	1, 3, 4, 5, 6, 7, 9, 10	x	NE			NL	
<i>Mabuya rudis</i>	Brown mabuya	Cicak	x	2, 4, 6, 8						
<i>Tropidophorus beccarii</i> Peters, 1871	Beccari's Water Skink	Cicak	x			NE		x	NL	
<i>Tropidophorus brookei</i> (Gray, 1845)	Brook's Water Skink	Cicak	x			NE		x	NL	
<i>Tropidophorus micropus</i> Lidth De Jeude, 1905	Short-legged Water Skink	Cicak	x			NE		x	NL	

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	WLPO 1998	Endemic	CITES	Local Value
<i>Tropidophorus sebi</i> Pui, Karin, Bauer & Das, 2017	Baleh Water Skink	Cicak	x			NE		x	NL	
Varanidae										
<i>Varanus rudicollis</i> Gray, 1845	Rough-necked Monitor	Biawak	x			NE	P		II	
<i>Varanus salvator</i> (Laurenti, 1768)	Water Monitor	Biawak	x	1, 6, 10, 11	x	LC	P		II	
SQUAMATA (Snakes)										
Colubridae										
<i>Ahaetulla prasina</i> (Boie, 1827)	Oriental Whipsnake	Ular	x	1, 2		LC			NL	
<i>Amphiesma sarawacense</i> (Günther, 1872)	Sarawak Keelback	Ular	x			LC			NL	
<i>Boiga cynodon</i> (Boie, 1827)	Dog-toothed Cat Snake	Ular	x			LC			NL	
<i>Boiga dendrophila</i> (Boie, 1827)	Mangrove Snake	Ular	x			NE			NL	
<i>Boiga drapiezii</i> (Boie, 1827)	White-spotted Cat Snake	Ular	x			LC			NL	
<i>Boiga jaspidea</i> (Duméril, Bibron & Duméril, 1854)	Jasper Cat Snake	Ular	x			LC			NL	
<i>Calamaria grabowskyi</i> Fischer, 1885	Grabowsky's Reed Snake	Ular	x			LC		x	NL	
<i>Coelognathus flavolineatus</i> (Schlegel, 1837)	Yellow-striped Trinket Snake	Ular	x			LC			NL	
<i>Gonyosoma oxycephalum</i> (Boie, 1827)	Red-tailed Green Ratsnake	Ular	x			LC			NL	
<i>Lycodon subcinctus</i> Boie, 1827	Malayan Banded Wolf Snake	Ular	x			LC			NL	
<i>Xenochrophis trianguligerus</i> (Boie, 1827)	Red-sided Keelback Water Snake	Ular	x			LC			NL	
Elaphidae										
<i>Calliophis bivirgata</i> (Boie, 1827)	Blue Malaysian Coral Snake	Ular	x			NE			NL	
<i>Naja sumatrana</i> Müller, 1890	Sumatran Spitting Cobra	Ular	x			LC	P		II	
Lamprophiidae										
<i>Psammodynastes pictus</i> Günther, 1858	Painted Mock Viper	Ular	x			NE			NL	
Natricidae										

Family/Species	Common Name	Local Name	Potentially Present	Observed	Local Knowledge	IUCN Status	WLPO 1998	Endemic	CITES	Local Value
<i>Hebius flavifrons</i> (Boulenger, 1887)	Sabah Keelback	Ular	x			LC		x	NL	
<i>Hebius sarawacense</i> (Günther, 1872)	Sarawak Keelback	Ular	x			NE		x	NL	
Pythonidae										
<i>Malayopython reticulatus</i> (Schneider, 1801)	Reticulated Python	Ular sawa	x		x	LC	P		II	food
Viperidae										
<i>Tropidolaemus subannulatus</i> (Gray, 1842)	Bornean Keeled Green Pit Viper	Ular	x			LC				
Xenodermidae										
<i>Xenodermus javanicus</i> Reinhardt, 1836	Dragon snake	Ular	x			LC				
TESTUDINES (Turtles)										
Trionychidae										
<i>Dogania subplana</i> (Geoffroy Saint-Hilaire, 1809)	Malayan Softshell Turtle	penyu	x		x	LC	P		II	food
<i>Amyda cartilaginea</i> (Boddaert, 1770)	Asiatic Softshell Turtle	penyu	x		x	VU	P		II	food
Total Count			50	9	10			15		

Notes:
IUCN Category of Threatened Species (IUCN 2021)

- CR: Critically Endangered
- EN: Endangered
- VU: Vulnerable
- NT: Near-Threatened
- DD: Data deficient
- NE: Not evaluated
- LC: Least Concern

Sarawak WLPO 1998

- P: Protected Species, include all CITES I species (fine RM10,000 and imprisonment 1 year)
- TP: Totally protected Species (fine RM25,000 and two years jail)

CITES

I: Appendix I listing (Threatened species)

II: Appendix II listing (not threatened species but whose trade must be controlled in order to avoid use that is incompatible with their survival)

NL: Not listed in any Appendices

Numbers in "Observed" column refers to the sites where the amphibian and reptiles were recorded during this study.

6.4.3 Species Potentially Present and Observed

6.4.3.1 Avifauna

Out of the 217 potentially present species, only 84 were observed during the current assessment, which was conducted at 11 sites along the proposed transmission line (**Table 6.4.2**). The most common birds are those that inhabit disturbed habitats, such as bulbuls, barbets, spiderhunters and sunbirds, babblers and warblers. Many of these birds are also very vocal and hence easily detected and identified.

6.4.3.2 Mammals

From the 85 species of mammals potentially present, 18 species were reported as present by locals and 9 observed during sampling on site (**Table 6.4.3**). The squirrels and treeshrews were the most commonly encountered group during the survey. This is attributed to the presence of both wild and planted fruit trees, some of which were bearing fruit during the sampling period. Plantain squirrel is also regarded as pest by the farmers. The Long-tailed Macaque was spotted at station 3 and 4 (**Table 6.4.3**). Many of the mammal species that are potentially present were not recorded during the survey because they either are nocturnal (bats) or require different techniques (rats require baited cage traps) for survey to be effective. Other medium to large mammals are very secretive and have in scientific surveys recorded using camera traps, which have not been available during this survey.

6.4.3.3 Amphibians

Review of the literature showed that 64 species are potentially present in the study area (**Table 6.4.4**). This was the result of numerous surveys along small streams conducted normally between 7 pm to 10 pm over a stream transect distance of 200-400 meters, depending on terrain and accessibility. During the survey for the transmission line project, only five (5) species were reported by the local people and seven (7) species were encountered in the field. The Marsh Frog, Rough Sided Frog and Four-lined Tree Frogs are very vocal and can be heard clearly before they are seen. Grass Frogs were spotted hopping across the road during night drive. These are species that have adapted to disturbed habitats. No restricted forest species were recorded during the survey.

6.4.3.4 Reptile

Out of the 50 species of reptiles present in Pelagus and Upper Baleh area, ten (10) species were recorded during the survey for the transmission line project (**Table 6.4.5**) and comprise of eight (8) lizards and one (1) snake. The Water monitor and Reticulated Python are protected under the SWLPO 1998. In general reptiles are difficult to spot and require dedicated search and trapping techniques (pit fall traps and sticky traps) over an extended period. Local people are also not really interested in reptiles and most of them refer to reptiles by their generic name, such as turtles, snakes and lizards.

6.4.4 Wildlife Utilization by Local People

The local community comprise mostly Ibans. Their livelihood revolves around the environment surrounding them, ranging from collection of jungle produce to hunting of wildlife. Most of the jungle produce and wildlife are for self-consumption (Yi and Mohd-Azlan, 2018), but some especially wild pigs, deer and civets found their way to Kapit market for sale. However, not all the wildlife and jungle produce sold in Kapit are from the project area and may even be from as far away as Long Singut in upper reaches of Btg. Baleh. The list of wildlife that are often hunted is given in **Table 6.4.6**. This is based on information given by the locals and from what is seen in the local market (*tamu*) in Kapit.

Birds play an important role in the life of the Iban community. The daily tasks they engaged in such as farming, fishing, hunting and house building are guided by the augural birds. The presence of Rufous-backed Kingfisher in their house may cause the longhouse to be destroyed by fire. Other augural birds are Rufous Piculet (Iban name is *ketupong*), Banded Kingfisher (*embuas*), Scarlet-rumped Trogon (*beragai*), Diard's Trogon (*papau*), Crested Jay (*bejampong*), Maroon Woodpecker (*pangkas*) and White-rumped Shama (*nendak*). Some larger species of birds were hunted for their meat. The hornbills not only supplying the community with meat, but their feathers have aesthetic values.

Table 6.4.6: List of Mammals, Birds and Herpetofauna that are Part of Local Livelihood

Wildlife	Local Name	Use
Mammals		
Wild pig	Babi	Main game species, hunted for food and sale
Sambar deer	Rusa	Main game species, hunted for food and sale
Barking deer	Kijang	Main game species, hunted for food and sale
Mouse deer	Pelandok	Opportunistically hunted for food and sometimes for sale
Porcupine	Landak	Opportunistically hunted for food and sometimes for sale
Civets (all types)	Musang	Opportunistically hunted for food and sometimes for sale
Wild cats	Jelu mayau	Opportunistically hunted for food and sometimes for sale
Pangolin	Tenggiling	Trapped, meat for self-consumption, scales for sale
Otters	Ringin memerang	Opportunistically trapped or shot for food, self-consumption
Sun bear	Beruang	Opportunistically shot for food, self-consumption
Bearcat	Entulun	Opportunistically shot for food, self-consumption
Long-tailed macaque	Kera	Opportunistically hunted for food and sometimes for sale, partly as pest control
Pig-tailed macaque	Nyumboh	Opportunistically hunted for food and sometimes for sale, partly as pest control
Rats	Tikus	Trapped and killed as pest control
Squirrels	Tupai	Trapped and killed for food as well as pest control
Birds		
Rufous piculet	Ketupong	Augury bird
Banded kingfisher	Embuas	Augury bird
Scarlet-rumped Trogon	Beragai	Augury bird
Diard's Trogon	Papau	Augury bird
Crested Jay	Bejampong	Augury bird

Wildlife	Local Name	Use
Maroon Woodpecker	Pangkas	Augury bird
White-rumped Shama	Nendak	Augury bird, trapped as pet
Partridges, Pheasant	Sangayan, sempidan	Trapped for food and pet
Argus pheasant	Ruai	Sometimes trapped for food, feathers for decoration
Hornbills	Kenyalang	Feathers for decoration, traditional dance costume
Hill myna	Burong tiong	Trapped for pet
Spotted dove	Tekukur	Trapped for food and pet
Pegions	Puna	Trapped for food and pet
Blue-crowned Hanging Parrot	Entalik	Trapped for pet
Frogs		
Giant River Frog	Pamak	Collected for self-consumption and sometimes for sale
Reptile		
Soft-shelled Turtle	Kura kura	Collected for self-consumption and sometimes for sale
Reticulated Python	Ular sawa	Collected for self-consumption and sometimes for sale
Borneo Short-tailed Python		Collected for self-consumption and sometimes for sale

6.4.5 Critical Habitat Assessment

Client is assessing environmental risks to biodiversity using Performance Standard 6 (PS6; IFC 2012a) and the associated Guidance Note 6 (GN6; IFC 2012b).

PS6 requires the identification of critical habitat based on at least one of the following criteria:

1. Habitat of significant importance to Critically Endangered (CR) and / or Endangered (EN) species;
2. Habitat of significant importance to endemic and / or restricted-range species;

3. Habitat supporting significant global concentrations of migratory species and / or congregatory species;
4. Highly threatened and / or unique ecosystems; and/or
5. Areas associated with key evolutionary processes.

In this assessment, criterion 1 is used to assess whether the area affected by transmission line project is a critical habitat for Sunda pangolin and Helmeted hornbill, both CR category species. The threshold value for this criterion is that it supports $\geq 0.5\%$ of the global population and ≥ 5 reproductive units of a CR or EN species (IFC GN72a). Criteria 2, 3, 4 and 5 are not applicable to the transmission line project.

6.4.5.1 Sunda Pangolin (Uplisted to CR in 2014)

6.4.5.1.1 Sunda Pangolin Habitats

The Sunda Pangolin is widely distributed but occur in low abundance across mainland and insular Southeast Asia, mostly at altitudes below 1000 m above sea level (Challender et al. 2019). In Sarawak, it has been recorded in mixed dipterocarp forest and riverine forest at Lanjak Entimau (Azlan and Engkamat 2013), logged forest of Baleh National Park (Mohd Azlan et al. 2019) and as high as 1200 m above sea level at Mount Penrissen, Sarawak (Kaicheen and Mohd Azlan 2018). In Sabah it has been recorded in Maliau Basin and Imbak Canyon (Bernard et al. 2013), Sipitang, Tabin, Ulu Kalumpang, Malua, Danum Valley, Sepilok Kabili, Lower Kinabatangan and even in forest patches near Universiti Malaysia Sabah (Challender et al. 2019). In Peninsular Malaysia, pangolins were even detected in oil palm plantations (Azhar et al. 2013).

6.4.5.1.2 Global Population Estimation

Analysis of 2294 camera trapping data with 162 Sunda Pangolin detections showed very low occupancy and detection probability at 0.04 and <0.01 , respectively (Khawaja et al. 2019). As such, it was not possible to use camera trap data to estimate Sunda Pangolin population.

According to IFC GN65:

“Where estimates of species’ global population and / or local population are not available (or not obtainable by reasonable means through a field assessment in the case of the local population), the client is expected to use expert opinion

to determine the significance of the potential critical habitat with respect to the global population.”

The only population data available is for Singapore (1068 individuals), and with a forest habitat area of 159 km², this gives a density of 6.7 individuals/km². This value is very high because Singapore has very low exploitation rate and the population data includes released animals. Brunei also have low exploitation rate, and the density value for Singapore is applied. In other countries where overexploitation is rampant, the density is expected to be much lower and a value of 1.34 individuals/ km² has been used on the basis that exploitation has reduced the population down to 20% of what it was about 25 years ago (Challender et al. 2019). The global population is estimated by multiplying each country’s forested area by the factor of 1.34 for Malaysia, Indonesia, Thailand, Myanmar, Lao DPR, Vietnam and Cambodia (**Table 6.4.7**).

Table 6.4.7: Estimates of Sunda Pangolin Population Within Its Native Country

Native Country	Forest (km ²)	Density, Ind/km ²	Estimated population
Malaysia	208900	1.34	279926
Indonesia (Kalimantan, Sumatra, Java)	532940	1.34	714139.6
Thailand	145200	1.34	194568
Myanmar	322220	1.34	431774.8
Vietnam	129310	1.34	173275.4
Cambodia	104470	1.34	139989.8
Laos	161420	1.34	216302.8
Brunei	2780	6.72	18681.6
Singapore	159	6.72	1068
Total	1607399		2169726

Note: For Indonesia, Sunda Pangolin are not found in Sulawesi and Irian Jaya which are on the other side of Wallace Line.

6.4.5.1.3 Estimation of Sunda Pangolin in Area Affected by Transmission Line

Guidance Note GN59 states “the project should identify an **ecologically appropriate area** of analysis to determine the presence of critical habitat for each species with regular occurrence in the project’s area of influence, or ecosystem, covered by Criteria 1-4. The client should define the **boundaries of this area** taking into account the distribution of species or ecosystems (within and sometimes extending beyond the project’s area of influence) and the ecological patterns,

processes, features, and functions that are necessary for maintaining them. These boundaries may include catchments, large rivers, or geological features”.

Based on the above, the ecologically appropriate area of analysis is hill mixed dipterocarp forest (HMDF), since Sunda Pangolin has been recorded up to altitude of 1200 m above sea level. Sarawak has a total land area of 124000 km² of which 73500 km² is HMDF, giving a percentage of 59.3%. The boundaries of the HMDF for this project is limited to Rajang River basin (which include Baleh River Basin), an area of 49600 km². If 59.3% of this is HMDF, then the area of affected habitat is $0.593 \times 49600 = 29400 \text{ km}^2$.

The population of Sunda Pangolin in the affected habitat is calculated by multiplying 29400 by the estimated density of 1.34 individuals/km², which is 39396 individuals. This is roughly equal to 1.82% of the global population and exceeds the threshold value of 0.05% of global population as stipulated in GN72a. What this means is that HMDF is a critical habitat for Sunda Pangolin.

In **Section 6.2.1** of this report, the area of influence (defined by Rajang and Baleh rivers as its southern limits and 500 meters from the proposed transmission line route as its northern limits) is estimated to be 526 km² and the population of Sunda pangolin in it is estimated to be 705 (0.03%) individuals compared to the global population of 2.6 million.

6.4.5.2 *Helmeted Hornbill (Uplisted to CR in 2015)*

6.4.5.2.1 *Helmeted Hornbill Habitats*

Helmeted Hornbill have been recorded in Borneo, Sumatra, Peninsular Malaysia and southern Thailand (Poonswad et al. 2013). The bird is found in large expanses of primary Sundaic rainforest, i.e., closed-canopy growth dominated by large dipterocarp trees. It is a low-density species, even in prime habitat (Lum & Poonswad, 2005). It extends into adjacent mature secondary forest, but avoids open areas, disturbed forest and peat swamps (Kinnaird & O'Brien, 2007; Lum & Poonswad, 2005; Poonswad et al., 2013). It appears to prefer hilly terrain away from the coast (300 – 1,100 m, occasionally to 1,500 m) but there are significant strongholds in some lowland forest areas.

Its population density varies from 0.19 to 2.6 birds/km² depending on habitat quality and latitude. Variation in species encounter rates can be even greater within a small geographic area (e.g., 0.04 – 1.25 individuals/km in south Thailand). Hunting has been shown to have a huge impact on Helmeted Hornbill populations.

In Malaysian Borneo, population density differed greatly from 2.5 birds/km² in nonhunted sites to 0.3 birds/km² at hunted sites (Bennett et al., 1997; Johns, 2004). There is a lack of data for Kalimantan, Sarawak and north Sumatra. Hence its global population is unknown.

6.4.5.2.2 Global population of Helmeted Hornbill

For the purpose of estimating global population of Helmeted Hornbill, the population densities estimates shown in **Table 6.4.8** is used. Density values are taken from the literature (Jain et al. 2018).

Table 6.4.8: Estimates of Global Population of Helmeted Hornbill

Country	Density, Birds/Km ²	Forest Area, Km ²	Estimated Population
Brunei	0.83	2780	2307
Southern Thailand	1.11	17964	19940
Kalimantan	0.72	222482	160187
Sumatra	1.35	97111	131100
Sabah and Sarawak	0.81	80264	65014
Peninsular Malaysia	1.85	46387	85816
Total		466988	464364

Source: Jain et al. 2018

6.4.5.2.3 Helmeted Hornbill Habitat Affected by the Transmission Line

The preferred habitat of Helmeted Hornbill is undisturbed HMDF. The original hill dipterocarp forest in the project area has been logged and cultivated, leaving patches of the original forest on very steep slopes. Again, using the Rajang River basin as boundaries for HMDF affected by the transmission line, and the factor of 0.27 (27% of Borneo land area has intact forest, Gaveau et al 2014), the preferred habitat for Helmeted hornbill is 0.27 x 29400 = 8200 km².

Using the population density of 0.81 bird/km² the number of birds that present is estimated to be 6641. This translates to 1.4% of the global population (464364), which indicates that HMDF is a critical habitat for Helmeted hornbill.

6.4.5.2.4 Other CR and EN Species (Criteria 1)

For Straw Headed Bulbul (CR), the global population is estimated at 1000-2499, mainly in large protected areas in Malaysia and small population in Singapore (BirdLife International, 2018). Population density data that can be used to estimate

local population is not available. For White-crowned Hornbill, Greater Green Leafbird, Bay Cat and Slow Loris (EN), critical habitat analysis has not been conducted because there is not enough data which could be used to estimate the global population as well as population in the affected area.

6.4.5.2.5 *Endemic or Restricted Range Species (Criteria 2)*

A number of species are identified as endemic to Borneo (including a lot of amphibians and reptiles). However, there is not enough research and information on these species to be able to conduct critical habitat analysis on them.

6.5 AQUATIC FLORA AND FAUNA

6.5.1 Focal Rivers

As mentioned in **Section 5.8**, the transmission line crosses several minor streams and creeks as well as eleven major tributaries to Btg Rajang and Btg Baleh.

River	Tributaries
Btg. Rajang	1. Sg. Menuan 2. Sg. Belawai 3. Sg. Ibau 4. Sg. Entangai 5. Sg. Song 6. Sg. Iran 7. Sg. Kabah 8. Sg. Mapai
Btg. Baleh	1. Sg. Putai 2. Sg. Merirai 3. Sg. Mujong

To this comes the major crossings of Btg. Rajang and Btg. Baleh themselves.

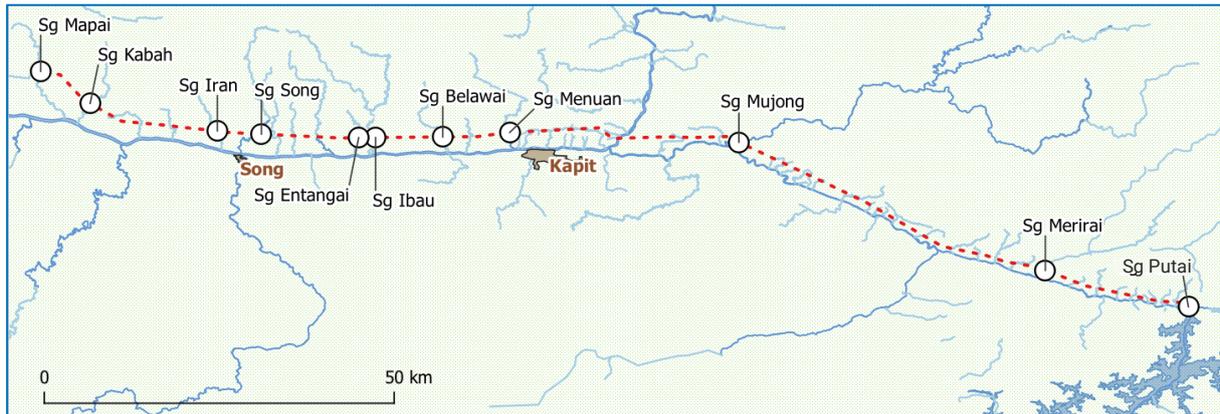


Figure 6.5.1: Crossings of Major Tributaries

6.5.2 Habitat Description

Riverine vegetation is in most sites intact, meaning the rivers are shaded and the banks stable. The eleven rivers mentioned above have all cut themselves through the hilly hinterland and are now flowing in a more docile manner whereas the many smaller creeks and streams coming down the slopes from the mountain ranges lining Btg. Rajang and Btg. Baleh flow more rapidly.

There are no significant macro vegetation – reeds, grasses, algae - within the water anywhere and no rapids within the study area. All major tributaries suffer from heavy loading of suspended solids due to human activities upstream. Incremental TSS loading from the – temporary – erosion that may come during the construction of the transmission towers will thus be of little significance for the habitat.

Of particular interest is the frequent occurrence of Ensurai (*Dipterocarpus longifolius*) and figs on the river banks, particularly in the Baleh area. These trees play an important role for the riverine habitat by shading and by providing fruit for the fish populations. They are for this reason protected by law.



Plate 6.5.1: Sg. Kabah with Large Ensurai Tree

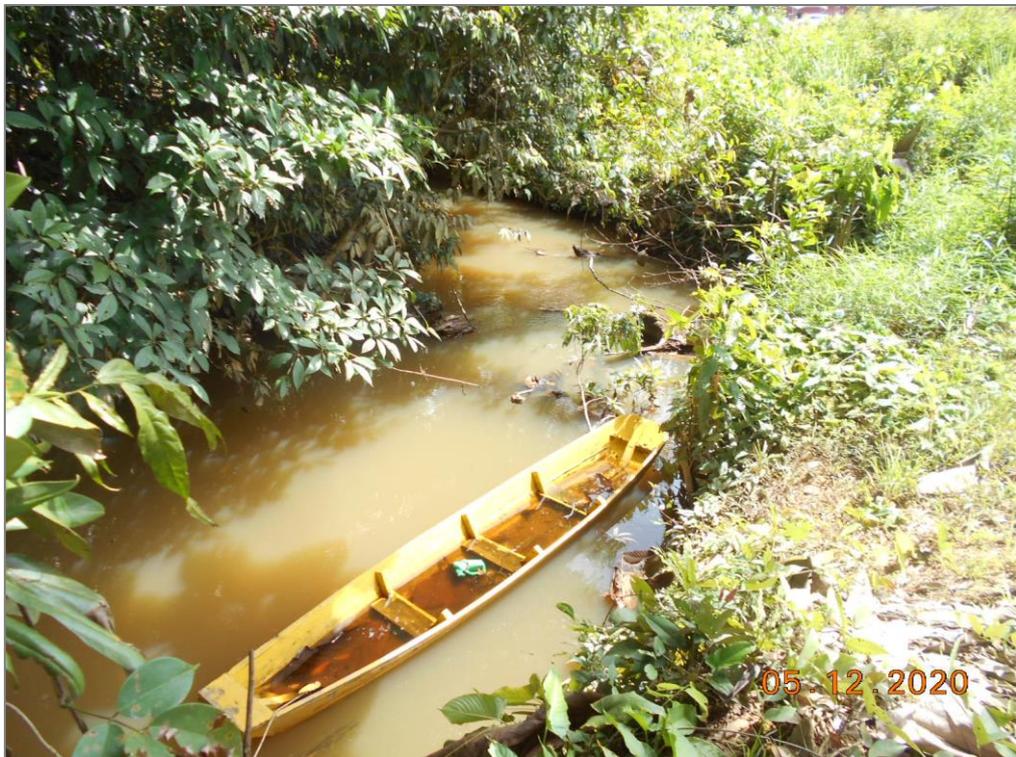


Plate 6.5.2: Sg. Balingiau



Plate 6.5.3: Sg. Tada



Plate 6.5.4: Sg. Mapai



Plate 6.5.5: Sg. Sebnut

6.5.3 Fish

The commercial species Empurau (*Tor tambroides*), Semah (*Tor tambra*), Tengadak (*Barbonymus schwanenfeldii*), Baong (*Mystus spp.*), Tapah (*Wallago leerii*), and Labang (*Pangasius nieuwenhuisii*) are present throughout the area and are the target for local fisheries (**Table 6.5.1**).

6.5.4 Fisheries

Only six fishing activities have officially been recorded. The activities are listed in **Table 6.5.1**. The species caught have been Empurau, Semah, Tengadak, Baong, Tapah, Labang. Apart from Empurau, these are the same species as are the target for the Tagang schemes in the area. Empurau is frequently caught in both Bakun and Murum reservoirs, i.e., it exists in the associated tributaries.

Aquaculture is rare in the area. The fishes reared are Tilapia Merah (*Oreochromis niloticus*), Baong (*Mystus spp.*), Kalui (*Osphronemus goramy*), Jelawat (*Leptobarbus hoevenii*), and Patin (*Pangasianodon spp.*), (See **Table 6.5.2**).

6.5.5 Threatened or Protected Species

The Empurau fetches very attractive prices in the cities and as export. There is thus a risk of this species being threatened by overfishing.

There are no local reports on any particularly rare or protected species in the rivers. The Baleh HEP SEIA (CKSB, 2013) lists 43 species potentially present in the area below the dam. Of these, only *Hemibagrus planiceps* is by IUCN listed as vulnerable while *Channa bankanensis* and *Rasbora ennealepis* are listed as Near-threatened (see **Table 6.5.3**).

Table 6.5.1: River Fisheries

Location	No. of Fishermen	Means of capture	Species	Catch 2018 Kg	Income 2018 MYR	Catch 2019 Kg	Income 2019 MYR
Sg. Gaat, Bukit Mabong	4	Pukat, Pancing, Jala	Semah, Tengadak, Baong	400-500	1,000 - 3,000	400-500	1,000 - 3,000
Sg. Tiau, Bukit Mabong	4	Pukat, Pancing, Jala	Semah, Tengadak, Baong	300-400	1,000 - 3,000	300 - 400	1,000 - 3,000
Sg. Baleh, Bukit Mabong	4	Pukat, Pancing, Jala	Empurau, Semah, Tengadak, Baong, Tapah, Labang	400 - 600	1,000 - 3,000	400 - 600	1,000 - 3,000
SK Katibas, Song	8	Pukat, Pancing, Jala	Empurau, Semah, Tengadak, Baong	400 - 600	1,000 - 3,000	400 - 600	1,000 - 3,000
Hilir Balui Sg. Rejang, Belaga	8	Pukat, Pancing, Jala	Semah, Tengadak, Baong, Labang, Tapah	300 - 500	1,000 - 3,000	300 - 500	1,000 - 3,000
Empangan Bakun, Hulu Balui, Belaga	10	Pukat, Pancing, Jala	Empurau, Semah, Tengadak, Baong, Labang	300 - 800	1,000 - 4,000	300 - 800	1,000 - 4,000

Source: Department of Agriculture, 2021

Table 6.5.2: Commercial Fish Ponds

Breeder	Species	Facility	Production 2018 Kg	Turnover 2018 MYR	Production 2019 Kg	Turnover 2019 MYR
Jimban Anak Jalay	Tilapia Merah, Keli Afrika	Earth pond	68	<1,000	728	>1,000 - 4,000
Julia Anak Anang	Tilapia Merah, Keli Afrika	Earth pond	50	<1,001	563	>1,000 - 4,001
Jamba Anak Garit	Tilapia Merah, Keli Afrika	Earth pond	61	<1,002	524	>1,000 - 4,002
Yong Kee Hua	Tilapia Merah, Baong, Kalui	Earth pond	680	4,000 - 8,000	1,745	4,000 - 10,000
Irene Etok	Tilapia Merah, Jelawat, patin	Earth pond	55	<1,004	630	>1,000 - 4,004

Source: Department of Agriculture, 2021

Table 6.5.3: List of fish species in non-flooded, potentially inundated, and below proposed dam areas. (x = present and - = absent).

Family	Species	Below Dam	IUCN
Ambassidae	<i>Parambassis wolffii</i>	x	LC
Bagridae	<i>Bagrichthys macracanthus</i>	-	
	<i>Hemibagrus planiceps</i>	x	VU
	<i>Hemibagrus wyckii</i>	x	LC
	<i>Leiocassis armatus</i>	-	
	<i>Leiocassis micropogon</i>	-	
	<i>Mystus nemurus</i>	x	LC
Balitoridae	<i>Gastromyzon fasciatus</i>	x	LC
	<i>Gastromyzon megalepis</i>	x	LC
	<i>Gastromyzon punctulatus</i>	-	
	<i>Gastromyzon sp.</i>	x	No listing
	<i>Homaloptera nebulosa</i>	-	
	<i>Homaloptera orthogoniata</i>	-	
	<i>Homaloptera stephensoni</i>	x	LC
	<i>Nemacheilus saravacensis</i>	x	DD
	<i>Nemacheilus spiniferus</i>	x	LC
	<i>Parhomaloptera microstoma</i>	x	LC
Chandidae	<i>Channa bankanensis</i>	x	NT
	<i>Channa lucius</i>	x	LC
Clariidae	<i>Clarias leiacanthus</i>	x	LC
	<i>Clarias meladerma</i>	x	LC
Cyprinidae	<i>Babonymus collingwoodii</i>	x	No listing
	<i>Barbonymus balleroides</i>	-	
	<i>Barbonymus schwanefeldii</i>	x	LC
	<i>Chela sp.</i>	-	
	<i>Cyclocheilichthys apogon</i>	x	LC
	<i>Cyclocheilichthys enoplos</i>	-	
	<i>Hampala bimaculata</i>	x	LC
	<i>Labiobarbus leptocheilus</i>	-	
	<i>Lobocheilos bo</i>	x	No listing
	<i>Lobocheilos hispidus</i>	x	No listing
	<i>Luciosoma setigerum</i>	x	LC
<i>Nematabramis everetti</i>	x	LC	

Family	Species	Below Dam	IUCN
	<i>Osetochilus enneaporos</i>	x	No listing
	<i>Osetochilus hasseltii</i>	x	No listing
	<i>Osetochilus intermedius</i>	-	
	<i>Osetochilus melanopleurus</i>	-	
	<i>Osetochilus sp.</i>	x	No listing
	<i>Parachela hypophthalmus</i>	-	
	<i>Paracrossochilus acerus</i>	x	LC
	<i>Paracrossochilus vittatus</i>	x	LC
	<i>Puntius binotatus</i>	x	No listing
	<i>Puntius everetti</i>	x	LC
	<i>Rasbora argyrotaenia</i>	x	DD
	<i>Rasbora bankanensis</i>	-	
	<i>Rasbora borneensis</i>	-	
	<i>Rasbora caudimaculata</i>	x	LC
	<i>Rasbora cephalotaenia</i>	x	LC
	<i>Rasbora ennealepis</i>	x	NT
	<i>Rasbora reticulata</i>	x	LC
	<i>Rasbora sarawakensis</i>	x	LC
	<i>Tor douronensis</i>	x	DD
	<i>Tor tambroides</i>	x	DD
Mastacembelidae	<i>Mastacembelus notophthalmus</i>	x	LC
Palaemonidae	<i>Macrobrachium rosenbergii</i>	x	LC
Pangasiidae	<i>Pangasius micronemus</i>	x	LC
Siluridae	<i>Kryptopterus apogon</i>	x	No listing
Sisoridae	<i>Glyptothorax major</i>	x	LC
	<i>Glyptothorax platypogon</i>	-	
	<i>Glyptothorax platypogonoides</i>	-	
Total		43	

Source: Chemsain Konsultant Sdn Bhd, 2013: SEIA for the Proposed Baleh Hydroelectric Project, Kapit Division, Sarawak

IUCN Category of Threatened Species (IUCN 2021)

- CR: Critically Endangered
- VU: Vulnerable
- DD: Data deficient
- LC: Least Concern
- EN: Endangered
- NT: Near-Threatened
- NE: Not evaluated

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