CHAPTER 6 : EXISTING ENVIRONMENT

6.1 INTRODUCTION

The description of the existing environment is based on data obtained from field studies and measurements, interviews and observations conducted by the EIA team. This was supplemented with published and unpublished data related to the Project site obtained from various sources. This section contains information pertaining to the physical, biological and social-economic within 5 km radius.

The zone of study for the particular project site is stipulated within 5 km radius as shown in **Figure 6.1**. The impacts and mitigating measures will be further discussed in the **Chapter 7** and **Chapter 8.**

6.2 LANDUSE

Figure 6.2 shows the Landuse Map while and **Table 6.1** shows the summary of landuse activities within 5km radius from the Project site.

Basically, the project site is within area Air Chepam Forest Reserve and Piah Forest Reserve which is secondary forest surrounded with flora and fauna. There are no other activities noted within the impact zone five (5) km surrounding the project area. Plate 6.1 to Plate 6.4 shows the visual land use and surrounding within the project site.

Existing landuse of the proposed site is forest, hill and agricultural areas. Based on Rancangan Tempatan Daerah Hulu Perak 2030 (Gazette No.: 2106) which has been gazetted on 3rd August 2017, the proposed site is located in Blok Perancangan (BP) 5 Kenering, Blok Perancangan Kecil (BPK) 5.4: Air Ganda which zoned as forest (Hutan Simpan Air Chepam) and Blok Perancangan (BP) 8: Lenggong, Blok Perancangan Kecil (BPK) 8.5: Lenggong Agro Valley which zoned as forest (Hutan Simpan Piah).

The proposed Project activity is in accordance with the Rancangan Tempatan Daerah Hulu Perak 2030 and decision of Majlis Mesyuarat

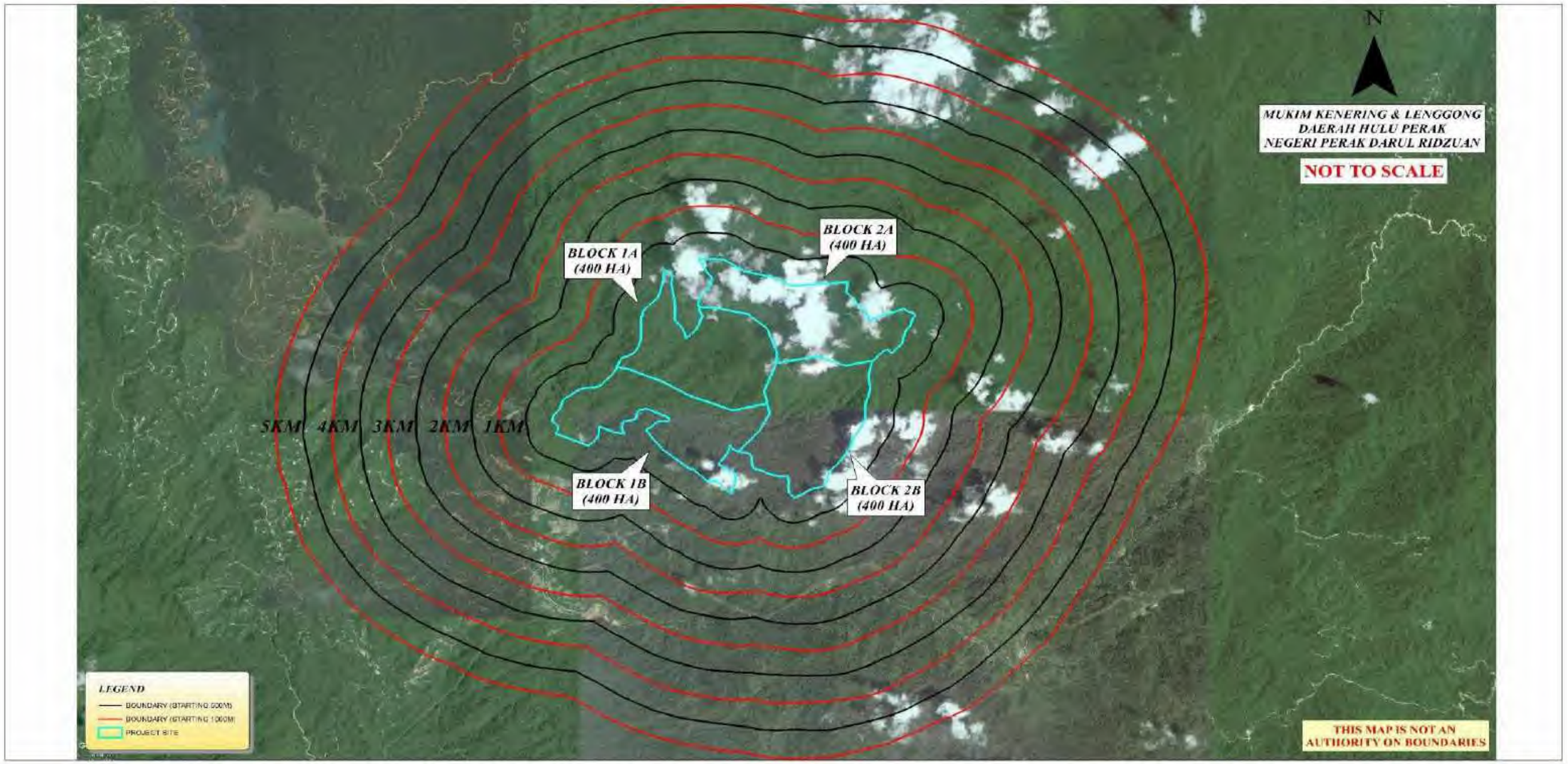
Kerajaan Negeri Perak (Bil. 1700 on 16 May 2012) and Dasar Perindustrian Kayu Negara (NATIP 2009-2020). Zoning approval letter for this Project is shown in **Appendix 1-E.**

Table 6.1 : Landuse Activities within 5km Radius from the Project Site

Radius / Directions	0-1 km	1-2 km	2-3 km	3-4 km	4-5 km
Northern	Forest Reserve Air Chepam	Forest Reserve Air Chepam	Forest Reserve Air Chepam	Forest Reserve Air Chepam	Forest Reserve Air Chepam
North Eastern	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah
North Western	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah Oil Palm Plantation
Southern	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah
South Eastern	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah Kg Teras Kg. Kembok Kg. Piah
South Western	Forest Reserve Piah	Oil Palm Plantation	Oil Palm Plantation Kg Senum Kg. Lalang Pos Poi	Oil Palm Plantation Kg. Kabu Kg. Gerol Kg. Jelwel Kg. Chat	Oil Palm Plantation Kg. Terhem

Western	Forest Reserve Piah	Oil Palm Plantation	Oil Palm Plantation	Oil Palm Plantation	Oil Palm Plantation
Eastern	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah	Forest Reserve Piah Kg. Gentes

POTENTIAL ZONE IMPACT WITHIN 5KM RADIUS



PROJECT PROPONENT	IN COOPERATION WITH	ENVIRONMENTAL CONSULTANT	PROJECT TITLE
HANAMURNI SDN. BHD. B-04-02, Tingkat 4, No. 42, Persiaran Greentown 1, Greentown Business Centre, 30450 Ipoh, Perak Darul Ridzuan. TEL : 012-9163133	ENVIRONMENTAL CONSULTANT AGENCIES (ECA) C – 11 – 24, Komplek Suria Kinrara, Taman Kinrara Seksyen 3, 47100 Puchong, Selangor Darul Ehsan. TEL : 019 - 361 5581/ 019 - 618 4831 EMAIL : ecaholding@live.com	NILAIMAS SERVICES 17-2 & 17-3 Jln Equine 10D, Tmn Equine, 43300 Seri Kembangan, Selangor Darul Ehsan. TEL : 03-8940 9959 FAX : 03-8940 9958 EMAIL : nilaimas.services@gmail.com	PROPOSED RUBBER FOREST PLANTATION ON PARTS OF COMPARTMENT 125, 126, 131 & 132 (BLOCK 1) AND PARTS OF COMPARTMENT 125, 126, 131 & 132 (BLOCK 2) WITH AN AREA OF 1600.00 HECTARES (3953.67 ACRES) AT PIAH FOREST RESERVE, DISTRICT OF HUTAN KUALA KANGSAR, PERAK DARUL RIDZUAN. SOURCE : Google Earth, 2018

Figure 6.1 : Potential Zone Impact within 5 km Radius

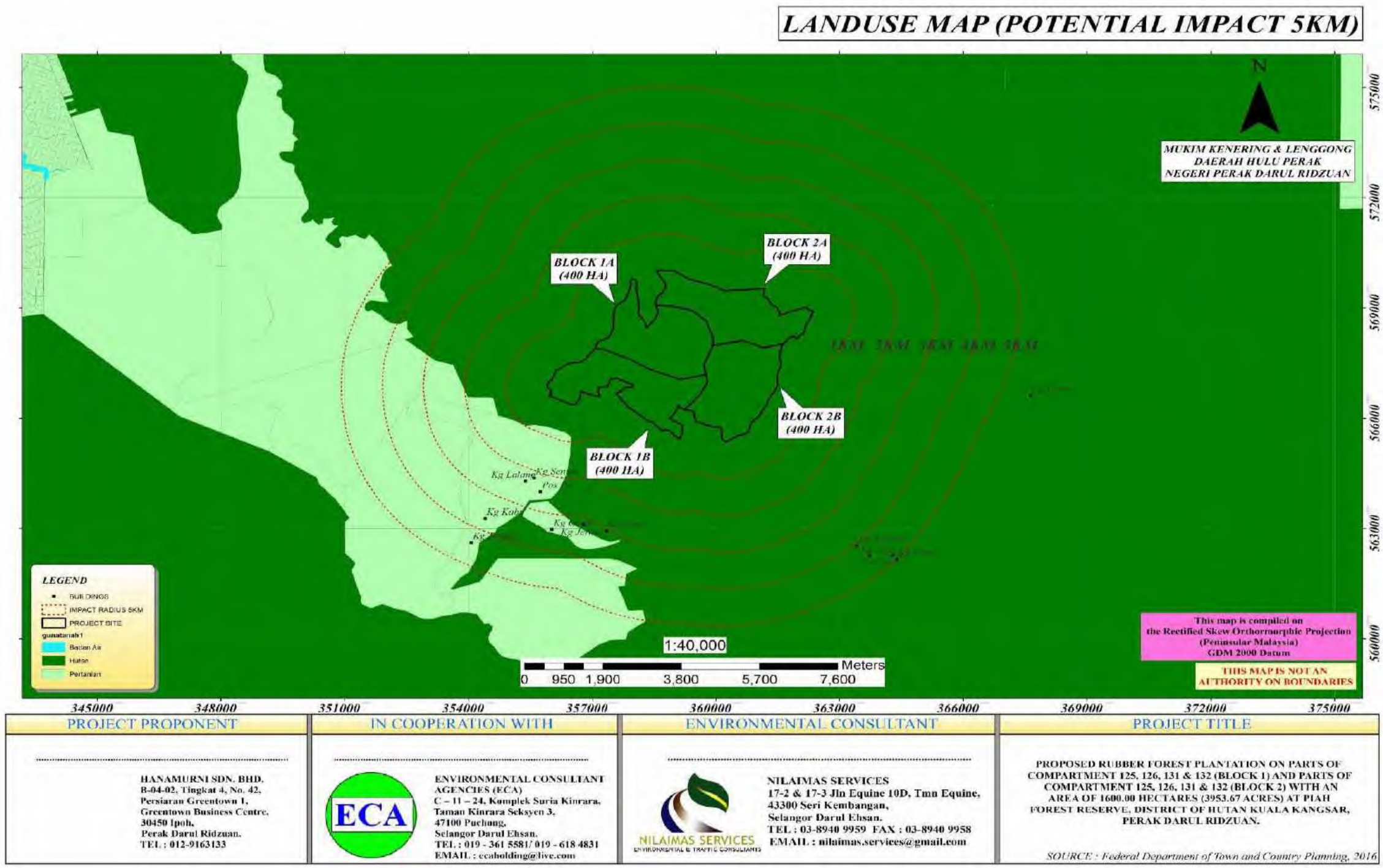


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Figure 6.2: Landuse Map with 5 km Radius of Potential Impact

6.3 TOPOGRAPHY

Figure 6.3 and **6.4** illustrated the Slope Analysis Map and Slope Analysis Map through Tin Perspective View for this Project.

Generally, the elevations of the Project site vary from190m to 890 m above mean sea level (MSL). The elevation mapping is presented in **Figure 6.5**.

Table 6.2 shows the summary of slope analysis of the Project Site. The classification of slope is based on the terrain classes which adapted from Garis Panduan Perancangan Pembangunan di Kawasan Bukit dan Tanah Tinggi (JPBD 2009). Based on the slope analysis, about 73.3% of the area is classified under Class I and II, which indicates slopes lower than 25° that make up the total of 1,171.63 hectares. While, the remaining 26.7% of the area (428.37 hectares) is classified under the slope >25° which is unsuitable for plantation.

Slope more than 25° is not viable for agriculture activities due to high cost of maintenance, high potential of soil erosion and low nutrient source.

Table 6.2 : Slope Analysis of the Project Site

Class Slope	Classification	Slope	Percentage (%)	Area (ha)
I	Moderate	0°-15°	29.80	476.37
II	Moderately Steep	15°-25°	43.50	695.26
III	Steep	25°-35°	23.05	368.41
IV	Very Steep	>35°	3.65	59.96
Total			100	1600

Source: Consultant's Estimation

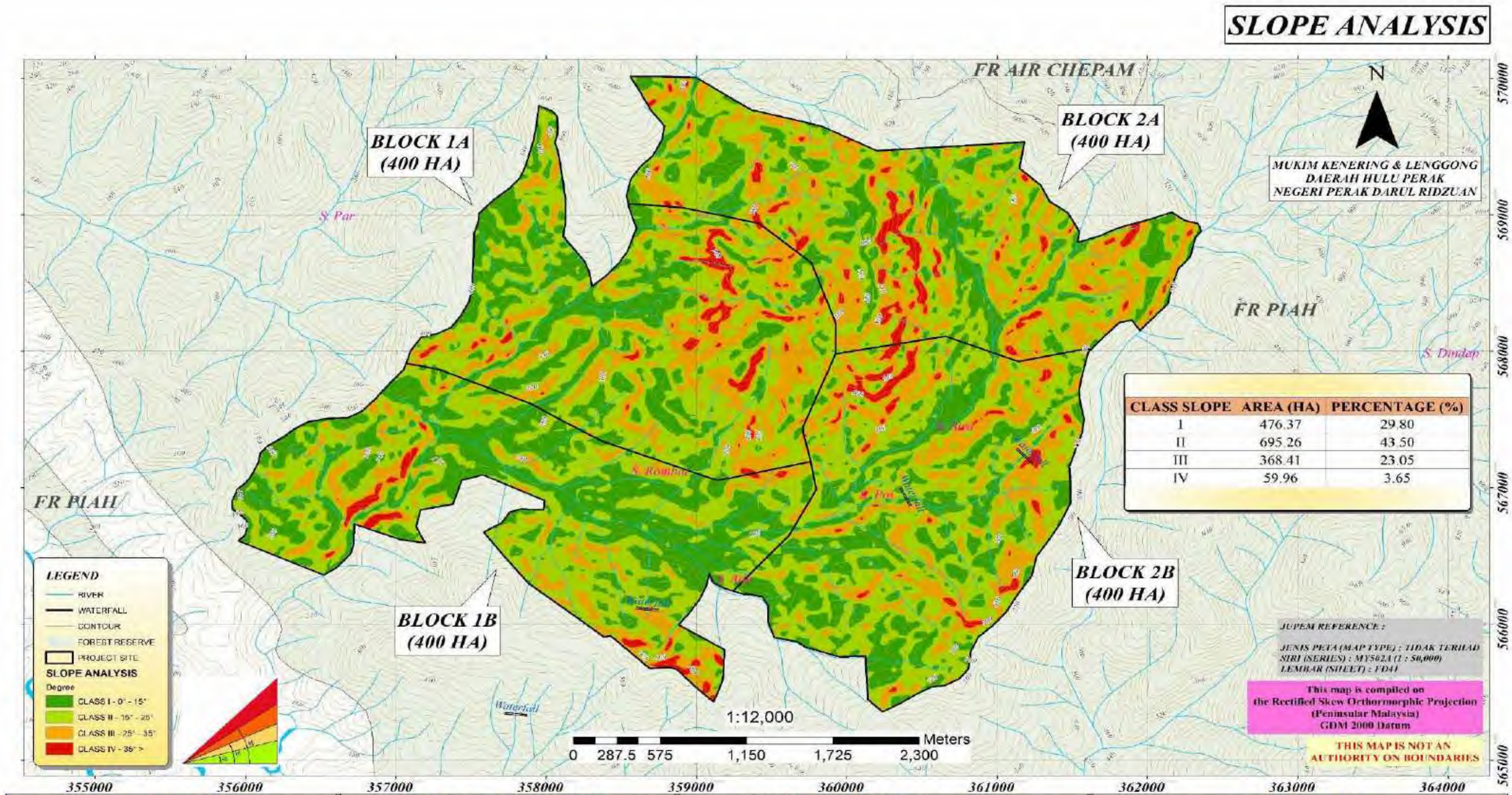

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Figure 6.3 : Slope Analysis Map

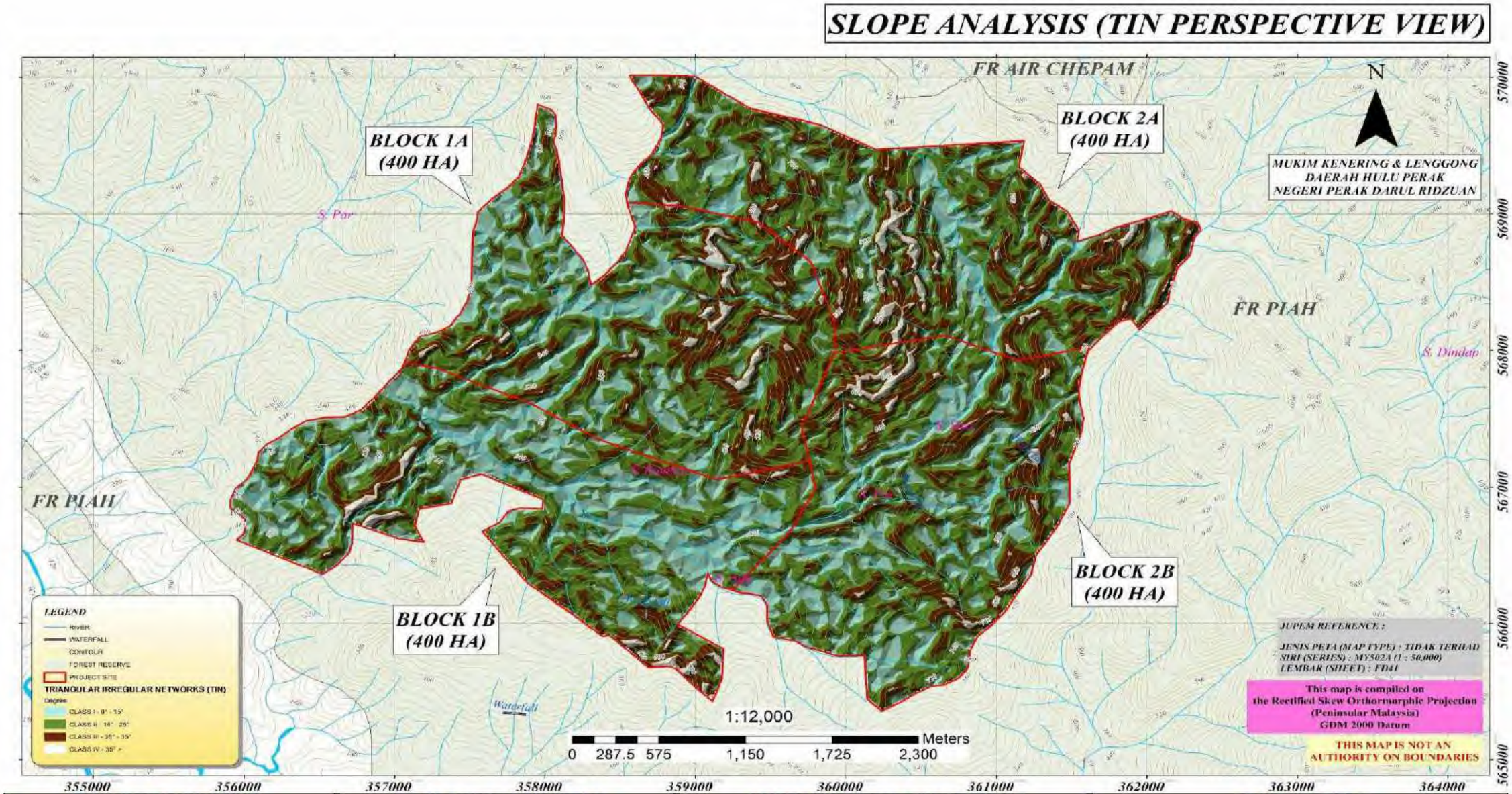

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Figure 6.4 : Slope Analysis Map (Tin Perspective View)

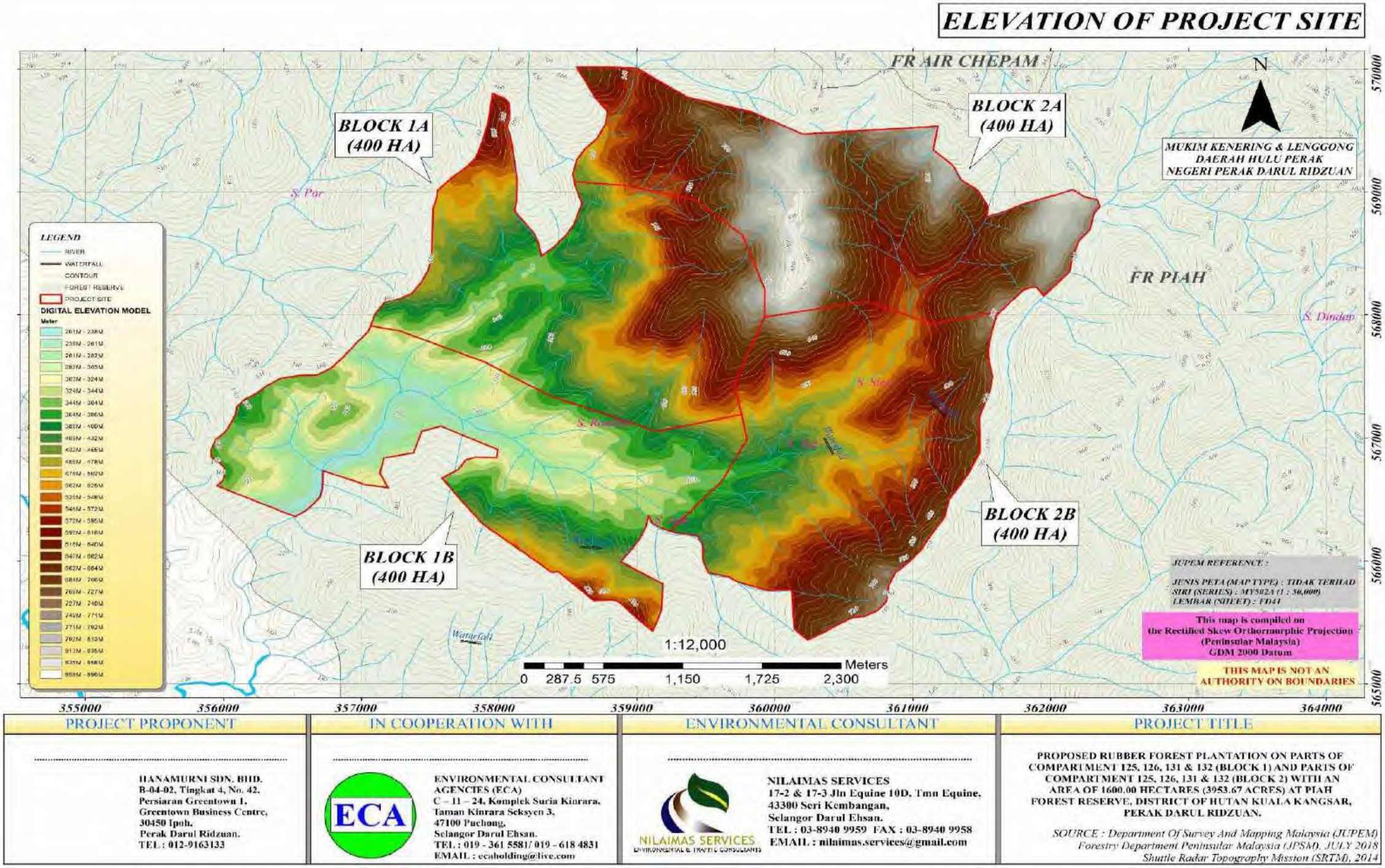

Figure 6.5 : Elevation of Project Site Map

6.4 GEOLOGY AND SOIL

Information about the geological set up in the Project site was obtained from the Geological Map of Peninsular Malaysia, 1985, published by the Malaysian Geological Survey Department. In general, the site is underlain by metamorphic rock and the age of this formation is Palaeozoic, in Silurian-Ordovician era, as shown in **Figure 6.6.**

Lower Palaeozoic rocks are confined to the western part of the peninsula, and Upper Palaeozoic rocks are found in all three belts in the tripartite peninsular divisions, the most complete sequence of Palaeozoic sedimentary rocks, ranging in age from Upper Cambrian to Upper Permian, is exposed in the North-western Domain of the Western Belt, in Langkawi, Kedah and Perlis.

These formations further south in the Western Belt are the Silurian to Permian Kinta Limestone, Terolak Formation and Kati formation in Perak, and the Lower Palaeozoic Dinding and Hawthornden Schists and Kuala Lumpur Limestone and Carboniferous to Permian Kenny Hill Formation in Selangor. Rocks of the Bentong Group, consisting of Pilah Schist and its correlatives and the Karak Formation, form an unbroken belt along the eastern foothills of the Main Range.

Schist, phyllite, slate, limestone and minor intercalations of sandstone and volcanic are present, but the majority at the site is schist. Schist is a coarse-grained metamorphic rock which consists of layers of different minerals and can be split into thin irregular plates. It is also classified as a medium-grade metamorphic rock. Schist has medium to large, flat, sheet-like grains in a preferred orientation (nearby grains are roughly parallel). It is defined by having more than 50% platy and elongated minerals (such as micas or talc), often finely interleaved with quartz and feldspar.

For this project, Geological Terrain Mapping is not necessary since there is no permanent structure will be build. (*See **Appendix 6-A**).*

GEOLOGICAL MAP

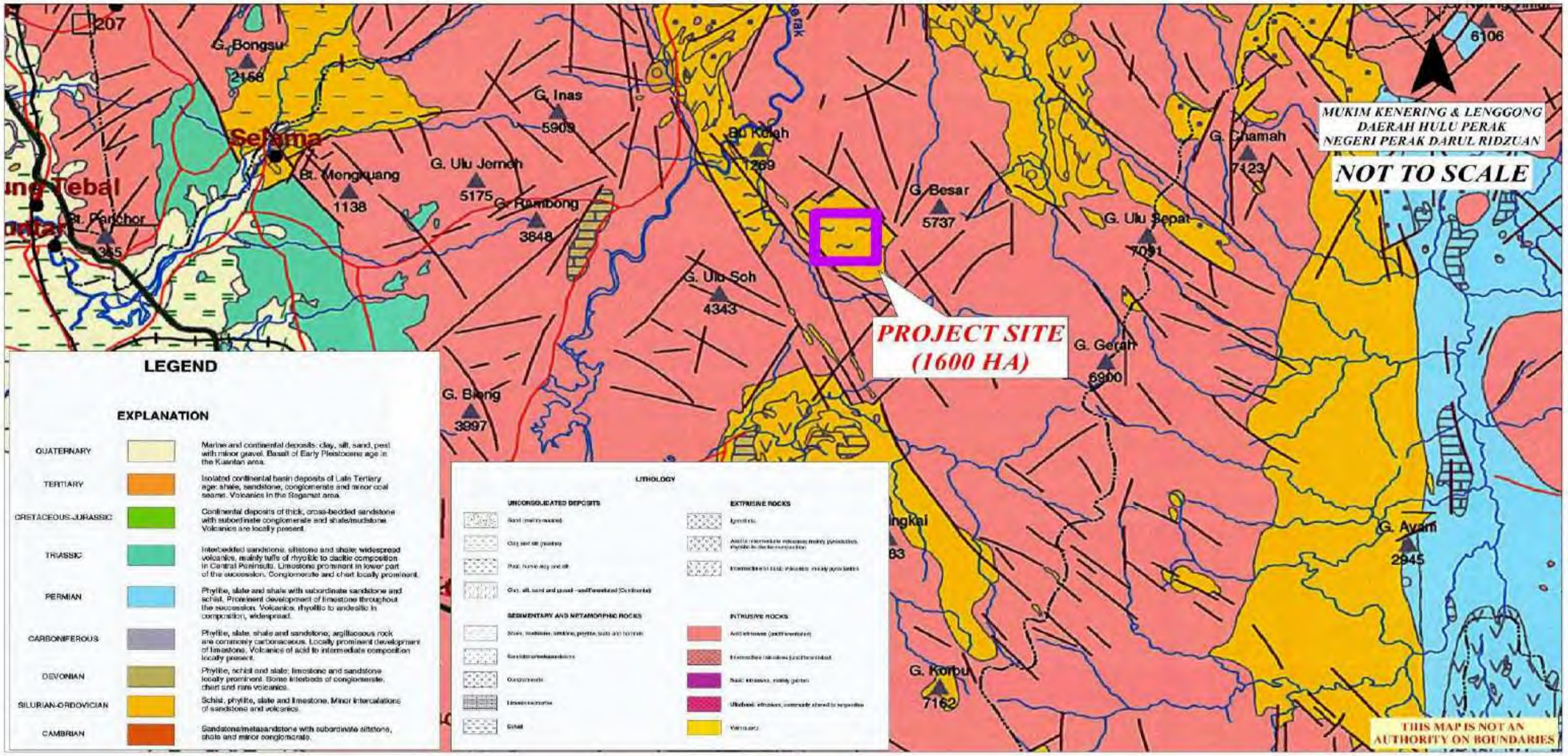

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Figure 6.6 : Geological Map

6.5 CLIMATE

The Project area experiences an equatorial type of climate, which is characterised by warm and humid weather all the year round. As with the rest of the country, it is under the influence of the Asian Monsoon system. There are two distinct monsoon seasons, the Northeast Monsoon (from November to March) and the Southwest Monsoon (from May to September) between which are the inter-monsoon or transition months.

6.5.1 Source of Data

No meteorological observations are available at the Project site. However, the **Malaysian Meteorological Service (MMS)** maintains a principal meteorological station in **Lubok Merbau, Perak (Table 6.3)**. For the purpose of this study, meteorological observations taken at the stations can be considered as representative of the Project site. The meteorological observations taken at the MMS meteorological station include surface winds, rainfall, and relative humidity. The climate of the area is of the equatorial type, which is characterised by relatively high and uniform temperatures throughout the year, high rainfall, high humidity and light winds. The meteorological of areas under this climate regime is influence very much by local factors such as the topography of the area, land cover and water bodies. The data meteorology obtained from **Jabatan Meteorologi Malaysia** are attached in **Appendix 6-B.**

Table 6.3 : Station Meteorology

No.	Station	Coordinate	Data
1	Lubok Merbau	Latitude: 4° 47’ 40” Longitude: 100° 53’ 50”	Rainfall Rain days Temperature Humidity Wind Speed and Windrose

Source: Malaysian Meteorological Department

The following is summary of the meteorological conditions based on Lubok Merbau Station:

- Annual mean rainfall amount was between 1515.0 mm – 2382.7 mm. The maximum monthly rainfalls was recorded in March 2011.
- Monthly mean temperature ranges from 25.6°C to 29.7°C.
- Mean monthly relative humidity ranges from 70.8% to 85.3%.
- The high wind speeds ranged between 5.5 to 7.9 m/s, which comes from the southwest (SW) direction (about 0.3%), while lower wind speeds ranged between 0.3 to 1.5 m/s (about 18.1%) blows from the north direction.

6.5.2 Mean Relative Humidity

The station for Relative Humidity is located at **Lubok Merbau, Perak** with elevation 77.50 m. The trend for annual mean maximum relative humidity for 2008 until 2018 is shown in **Table 6.4** and illustrated in **Figure 6.7.** Based on the result, it showed the annual 24 hours mean relative humidity for the year of 2008 until 2018 (August) data. The results for the year of 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015 and 2016 are 81.5%, 82.8%, 84.0%, 83.0%, 83.4%, 80.5%, 77.8%, 79.1%, 79.4% and defected result for the year of 2017. Between the periods of 10 years, the lowest 24 hours mean relative humidity recorded is 67.0% in Feb 2014 whilst the highest is 88.2% in November 2017. The monthly variations coincide with the dry and wet seasons. It is expected that the project site would experience a similar range of humidity.

6.5.3 Rainfall and Rain days

The monthly rainfall amount recorded at Lubok Merbau, Perak presented as the annual rainfall for the year of 2008 until 2018 is shown in **Table 6.6** and illustrated in **Figure 6.8**. The highest annual mean rainfall reading is in 2008, which is 2382.7 mm, while the lowest is in 2013 with 1515.0 mm. The highest rainfall recorded is 426.2 mm, which was recorded in March 2011, while 13.2 mm recorded in

February 2014 is the lowest annual mean rainfall reading recorded compared to the other months.

Based on the number of rain days records in **Table 6.7** and illustrated in **Figure 6.9**, the highest annual rain days is in 2008 (210) and lowest is in 2014 and 2016 (173). The highest rain day's number was recorded in November 2010 and January 2018 with 27 days. The lowest rain day is only 1 day, recorded in February 2014.

6.5.4 Temperature

The monthly temperature recorded at Lubok Merbau Station for year 2008 to year 2018 is as shown in **Table 6.4** and illustrated in **Figure 6.9.** Temperature and relative humidity are both related. When the temperature is high, therefore, the relative humidity will goes down vice versa. From the records, the highest temperature occurs in March 2016 (29.7°C) with relative humidity 70.8% while the lowest recorded in December 2010 (25.6°C) with relative humidity 85.3%.

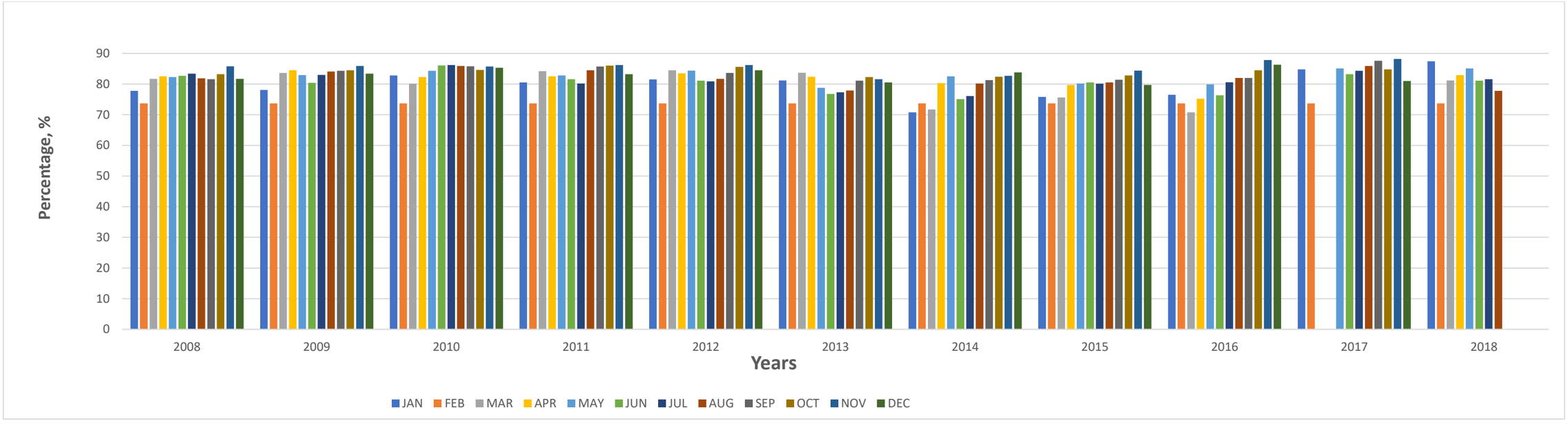
6.5.5 Wind Rose Profiles

Wind rose profiles recorded at Lubok Merbau Station located at latitude 4° 47' 40" N, and longitude 100° 53' 50" E with elevation 77.50 m. The averaged over the period 2008 to 2018, are tabulated in **Table 6.5** and portrayed as annual in **Figure 6.10**. Based on the wind profile, it is noted that calm wind occurs frequently on an annual basis. The maximum wind speed occurs in the range of 5.5 – 7.9 m/s in the south-west directions. The wind is calm at <0.3 m/s for 20.6% of the year.

Table 6.4 : 24 Hours Mean Relative Humidity at Lubok Merbau Station

Year	Months Percentage (%)												Annual Percentage (%)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2008	77.8	73.7	81.7	82.5	82.3	82.7	83.4	81.9	81.6	83.2	85.8	81.7	81.5
2009	78.1	78.6	83.6	84.5	82.9	80.4	83.0	84.1	84.3	84.5	85.9	83.4	82.8
2010	82.8	78.7	80.1	82.3	84.3	86.1	86.2	85.9	85.8	84.6	85.7	85.3	84.0
2011	80.5	78.7	84.2	82.5	82.8	81.6	80.2	84.5	85.7	86.0	86.2	83.2	83.0
2012	81.5	82.6	84.5	83.5	84.4	81.1	80.9	81.7	83.6	85.6	86.2	84.5	83.4
2013	81.2	82.6	83.7	82.4	78.8	76.8	77.3	77.9	81.1	82.3	81.6	80.5	80.5
2014	70.8	67.0	71.7	80.3	82.5	75.1	76.1	80.2	81.3	82.4	82.7	83.8	77.8
2015	75.8	69.0	75.6	79.7	80.2	80.5	80.1	80.5	81.4	82.8	84.4	79.7	79.1
2016	76.5	70.5	70.8	75.2	79.9	76.3	80.6	82.0	82.0	84.5	87.8	86.3	79.4
2017	84.8	Def.	Def.	Def.	85.1	83.2	84.3	85.9	87.6	84.8	88.2	81.0	Def.
2018	87.4	76.4	81.2	82.9	85.1	81.1	81.6	77.8					

Note: Def. means Defect (Source: Department of Meteorology Malaysia, 2018



***0% = Def. Value**

(Source: Department of Meteorology Malaysia, 2018)

Figure 6.7 : 24 Hour Mean Relative Humidity

Table 6.5 : Monthly Rainfall Amount (mm)

Year	Monthly Rainfall Amount (mm)												Annual (mm)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2008	168.0	101.2	335.9	174.8	88.6	220.6	230.6	235.8	159.2	375.0	112.2	180.8	2382.7
2009	90.2	47.6	267.8	226.0	122.6	103.2	63.8	218.8	214.2	268.8	311.6	175.8	2110.4
2010	194.6	45.4	176.8	172.4	131.0	246.2	189.6	112.8	149.4	198.2	380.4	142.8	2139.6
2011	43.6	222.2	426.2	141.4	86.6	46.6	114.4	237.0	183.6	278.4	238.8	163.6	2182.4
2012	149.0	190.4	178.1	63.2	199.4	52.0	114.2	101.6	141.4	159.4	212.0	281.2	1841.9
2013	194.2	127.2	86.4	172.6	49.0	44.8	75.4	95.2	159.4	252.0	185.4	73.4	1515.0
2014	75.6	13.2	117.4	66.2	146.0	43.8	41.0	149.2	230.6	362.2	181.4	270.0	1696.6
2015	245.2	157.4	68.5	211.3	121.4	315.4	148.8	78.2	333.2	205.2	344.0	129.0	2357.6
2016	105.0	37.0	97.6	87.6	279.0	102.2	126.0	169.4	176.2	146.0	313.8	213.8	1853.6
2017	300.8	52.4	178.9	362.7	81.2	177.8	50.6	138.8	196.2	99.8	246.8	69.4	1955.4
2018	248.0	151.0	109.6	189.4	266.6	68.6	106.0	79.6					

Note: Def. means Defect (Source: Department of Meteorology Malaysia, 2018

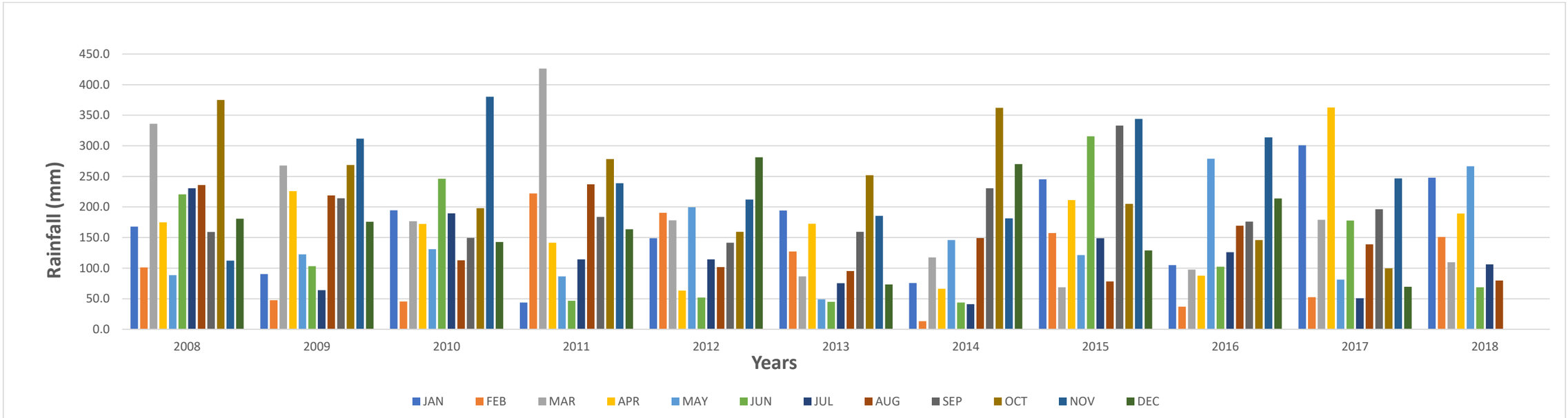
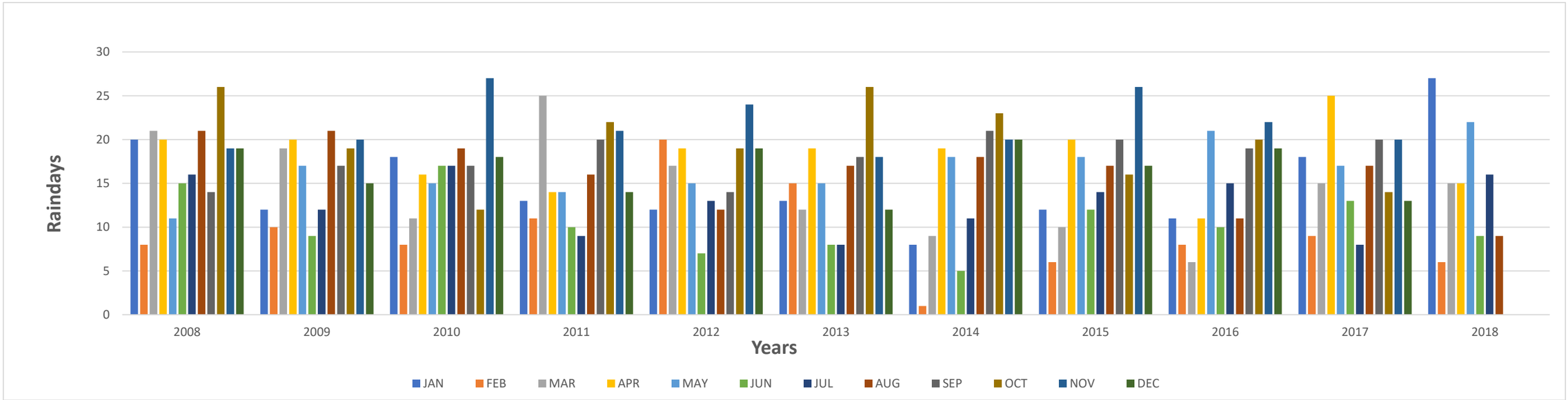


Figure 6.8 : Monthly Rainfall Amount (2008-2018)

Table 6.6 : Number of Raindays

Year	Months												Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2008	20	8	21	20	11	15	16	21	14	26	19	19	210
2009	12	10	19	20	17	9	12	21	17	19	20	15	191
2010	18	8	11	16	15	17	17	19	17	12	27	18	195
2011	13	11	25	14	14	10	9	16	20	22	21	14	189
2012	12	20	17	19	15	7	13	12	14	19	24	19	191
2013	13	15	12	19	15	8	8	17	18	26	18	12	181
2014	8	1	9	19	18	5	11	18	21	23	20	20	173
2015	12	6	10	20	18	12	14	17	20	16	26	17	188
2016	11	8	6	11	21	10	15	11	19	20	22	19	173
2017	18	9	15	25	17	13	8	17	20	14	20	13	189
2018	27	6	15	15	22	9	16	9					

Note: Def. means Defect (Source: Department of Meteorology Malaysia, 2018



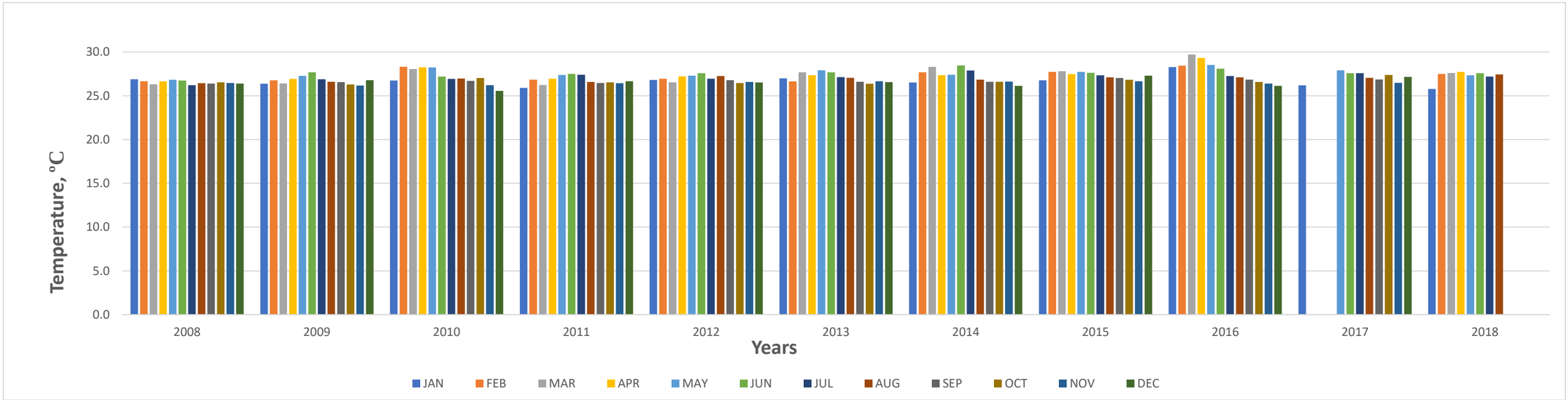
(Source: Department of Meteorology Malaysia, 2018)

Figure 6.9 : Number of Raindays (2008–2018)

Table 6.7 : Mean 24 Hours Temperature (ºC)

Year	Months (ºC)												Annual (ºC)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2008	26.9	26.7	26.3	26.6	26.8	26.7	26.2	26.4	26.4	26.5	26.4	26.4	26.5
2009	26.4	26.8	26.4	26.9	27.3	27.7	26.9	26.6	26.6	26.3	26.2	26.8	26.7
2010	26.7	28.3	28.0	28.3	28.2	27.2	26.9	27.0	26.7	27.0	26.2	25.6	27.2
2011	25.9	26.8	26.2	26.9	27.4	27.5	27.4	26.6	26.4	26.5	26.4	26.6	26.7
2012	26.8	26.9	26.5	27.2	27.3	27.6	26.9	27.3	26.8	26.5	26.6	26.5	26.9
2013	27.0	26.6	27.7	27.3	27.9	27.7	27.1	27.0	26.6	26.4	26.7	26.6	27.0
2014	26.5	27.7	28.3	27.4	27.4	28.5	27.9	26.8	26.6	26.6	26.6	26.1	27.2
2015	26.8	27.7	27.8	27.5	27.7	27.6	27.3	27.1	27.0	26.8	26.7	27.3	27.3
2016	28.3	28.4	29.7	29.3	28.5	28.1	27.2	27.1	26.8	26.6	26.4	26.1	27.7
2017	26.2	Def.	Def.	Def.	27.9	27.6	27.6	27.0	26.9	27.4	26.5	27.1	Def.
2018	25.8	27.5	27.6	27.7	27.3	27.6	27.2	27.4					

Note: Def. means Defect (Source: Department of Meteorology Malaysia, 2018



(Source: Department of Meteorology Malaysia, 2018)

Figure 6.10 : Mean 24 Hours Temperature (2008-2018)

Table 6.8 : Percentage frequencies of occurrence for concurrent wind direction (degrees) and speed (m/s) within specified ranges [%]

Wind speed range								
Direction	**0.3-1.5**	**1.6-3.3**	**3.4-5.4**	**5.5-7.9**	**8.0-10.7**	**>10.7**	**Total**	**Mean Speed**
Calm							**20.6**	
Variable	0	0	0	0	0	0	**0**	
N	18.1	4.3	0.8	0.1	0	0	**23.2**	1.2
NE	8.3	6.4	0.5	0	0	0	**15.3**	1.6
E	2.5	0.7	0	0	0	0	**3.2**	1.1
SE	1.9	1.9	0.7	0.1	0	0	**4.6**	2.1
S	3.8	3.9	1	0.1	0	0	**8.8**	2
SW	1.6	4.6	3.4	0.3	0	0	**9.9**	2.9
W	2.5	2.6	1.3	0.1	0	0	**6.5**	2.2
NW	5.3	0.5	0.1	0	0	0	**5.9**	0.9

(Source: Department of Meteorology Malaysia, 2018)

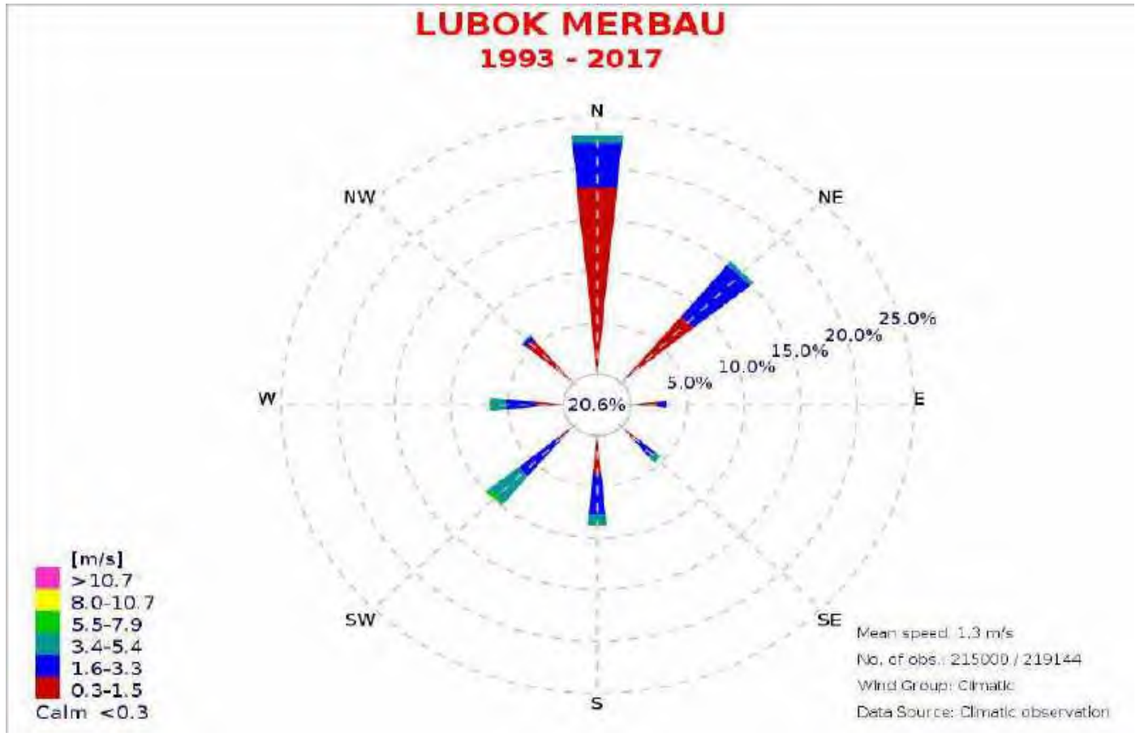


Figure 6.11 : Annual Wind Rose Profile

6.6 WATER INTAKE

Sg. Piah is one of the rivers in Perak State that supply water to the community. There are three water intake point along the streams converging into Sg. Piah. These three points are the so called Air Tandak Sg. Buaya (N 5° 6' 13.71", E 101° 12' 36.36"), Air Tandak Sg. Piau (N 5° 5' 11.75", E 101° 13' 2.83") and Air Tandak Sg. Tengtor (N 5° 4' 47.3", E 101° 15' 38.7") (*see* **Figure 6.13**). The distance of the water intake point from the boundary of the project site is approximately ±1.3 km from Air Tandak Sg. Buaya, ±2.6 km from Air Tandak Sg. Piau and ±4.4 km from Air Tandak Sg. Tengtor. It is anticipate that, the water quality at the intake will not be affected by this project since they are located on the upstream of the project area as shown in the flow pattern of river map (**Figure 6.15)**.

Next, from both water intake, the water will flow into the Water Treatment Plant (WTP) **(Figure 6.14)** through approximately ±20 cm in diameter of circular pipe. From WTP, which located at N 5° 5' 31.70", E 101° 11' 33.60", the water will be distribute to seven different settlements in Pos Poi. The details of WTP is as tabulated in **Table 6.9**.

The water from Air Tandak Sg. Tengtor, will go into the Village Pump station (N 5° 4' 55.2", E 101° 15' 56.8") and the treated water will be distributed to the nearest settlements in Pos Piah.

Source : Site Study, August 2018

Figure 6.12 : Drone View of Water Treatment Plant

Table 6.9 : Water Treatment Plant

No.	Name of Water Treatment Plant	Supply
1.	Loji Rawatan Air Kg. Terham Baru	Kg. Terham Baru
2.	Loji Rawatan Air Kg. Kabu & Kg. Terham Lama	Kg. Kabu & Kg. Terham Lama
3.	Loji Rawatan Air Kg. Lalang & Kg. Sanum	Kg. Lalang & Kg. Sanum
4.	Loji Rawatan Air Kg. Chat	Kg. Chat, Kg Jelwel & Kg. Gerol

Source : Site Study, August 2018.

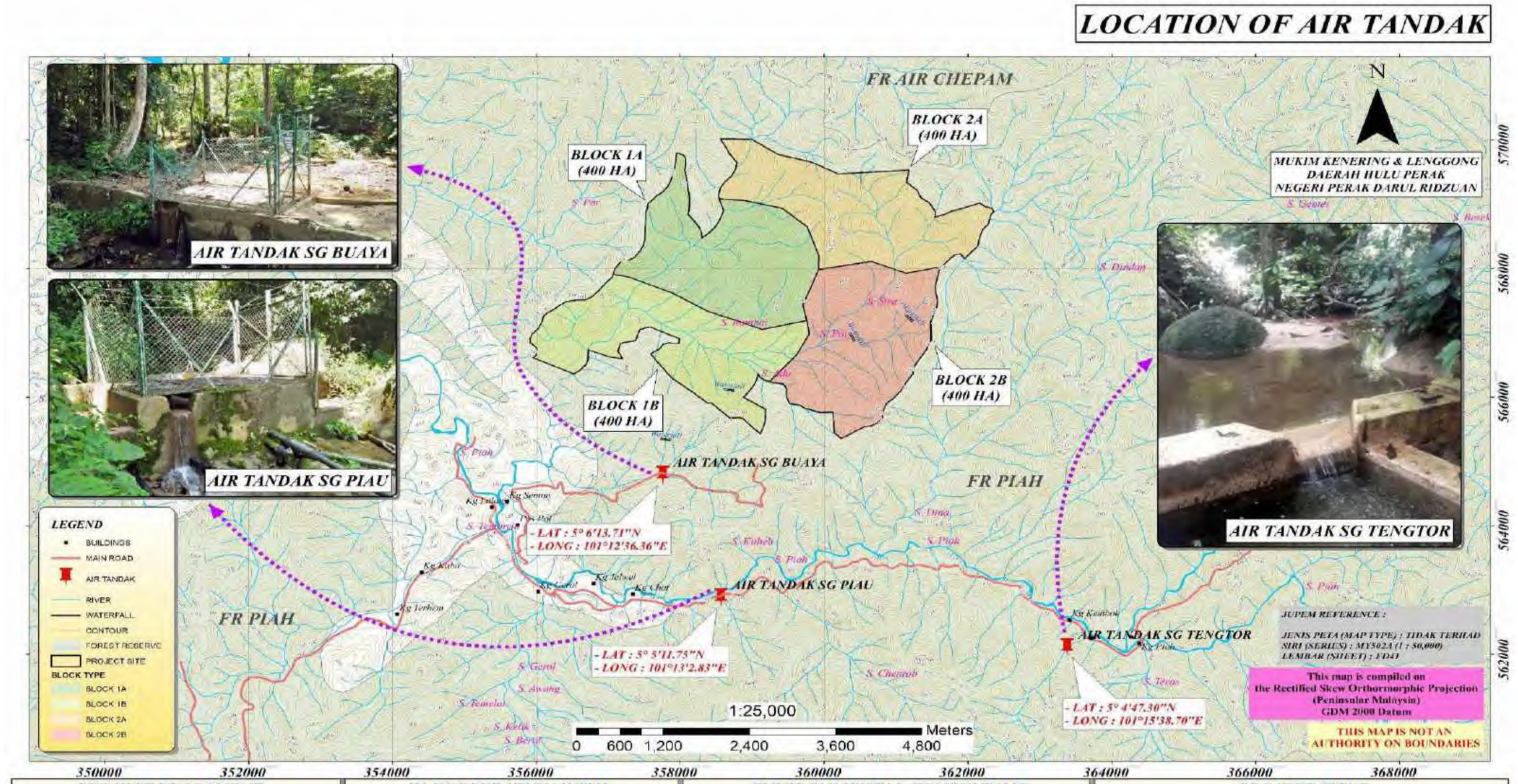


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Figure 6.13 : Location of Air Tandak

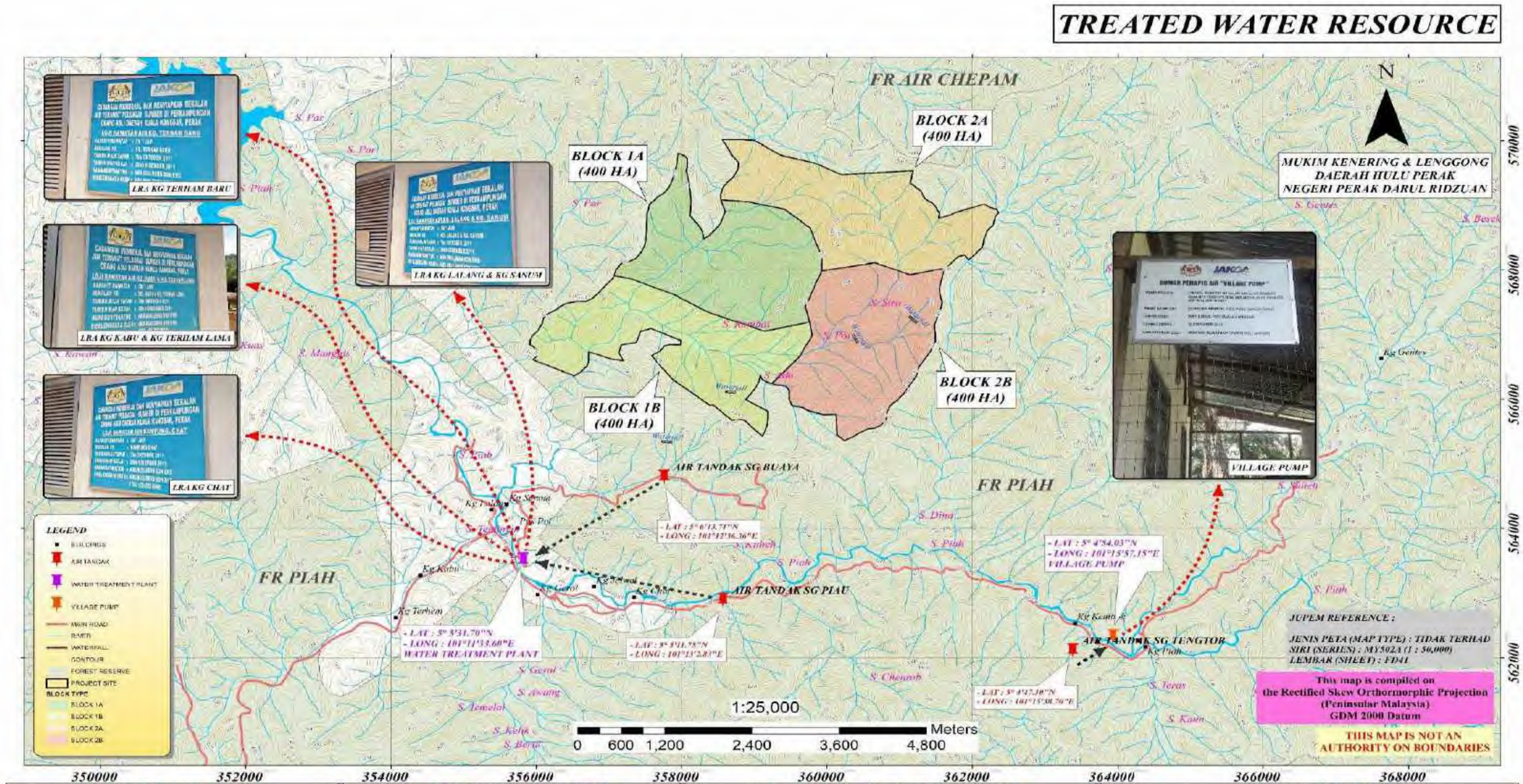

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Figure 6.14 : Location of Treated Water Resources

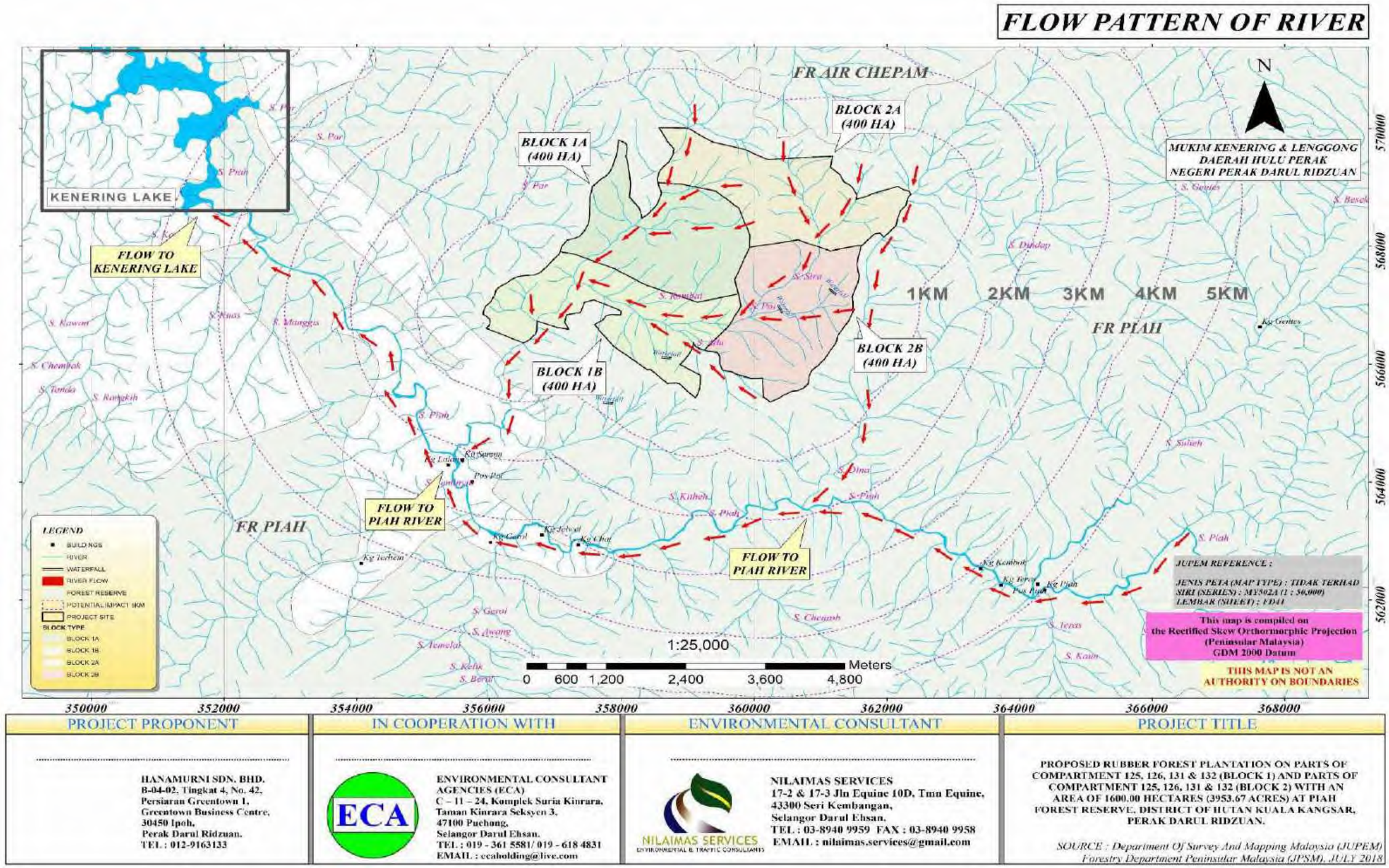

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Figure 6.15 : Flow Pattern of River

6.7 WATER QUALITY

6.7.1 Water Quality Standard

Water quality (WQ) is characterised by the values of some appropriate parameters of variables at those points where the water is to be used for specific purpose. In this respect, the Department of Environment (DOE) has established a set of criteria by which water bodies are classified into five categories based on the prevailing quality of their water in relation to the various downstream needs. As the DOE WQ Interim Standards is specifically tailored for local environment valuations and interpretation of water quality data gathered during this study will be based primarily on this standard. **Table 6.10** summarised the Department Interim National Water Quality Standards (INWQS).

- **Class I** represents water bodies of excellent quality. Standards are set for the conservation of natural environment in its undisturbed state. Water bodies such as those in the national park areas, fountain-heads, and in high land and undisturbed areas come under this category where strictly no discharge of any kind is permitted. Water bodies in this category meet the most stringent requirements for human health and aquatic life protection.

- **Class II** represents water bodies of good quality. Most exiting raw water supply sources come under category. In practice, no body contact activity is allowed in this water for the prevention of probable human pathogens. There is a need to introduce another class for water bodies not used for water supply but of similar quality which may be referred to as Class IIB. The determination of Class IIB standards is based on criteria for recreational use and protection of sensitive aquatic species.

- **Class III** is defined with the primary objective of protecting common and moderately tolerant aquatic species of economic value. Water under classification may be used for water supply with extensive/advanced treatment. This class of water is also defined to suit livestock drinking needs.

- **Class IV** defines water quality required for major agricultural irrigation activities which may not cover minor applications to sensitive crops.

- **Class V** represents other waters which do not meet any of the above uses.

Table 6.10 : The Department of Environment Interim National Water Quality Standards

Parameters	Unit	Class					
		I	IIA	IIB	III	IV	V
pH	-	6.5-8.5	6-9	6-9	5-9	5-9	-
Temperature	℃	normal	-	normal	-	-	-
DO	mg/l	7	5-7	5-7	3-5	<3	<1
Turbidity	NTU	5	50	50	-	-	-
COD	mg/l	10	25	25	50	100	>100
BOD	mg/l	1	3	3	6	12	>12
Suspended Solid	mg/l	25	50	50	150	300	>300
Hg	mg/l	natural	0.001	0.001	0.004	0.002	>0.002
Cd	mg/l	natural	0.01	0.01	0.01	0.01	>0.01
As	mg/l	natural	0.05	0.05	0.4	0.1	>0.1
Pb	mg/l	natural	0.05	0.5	0.02	5	>5
Cu	mg/l	natural	1	1	-	0.2	>0.2
Mn	mg/l	natural	0.1	0.1	0.1	0.2	>0.2
Ni	mg/l	natural	0.05	0.05	0.9	0.2	>0.2
Zn	mg/l	natural	5	5	0.4*	2	>2
Fe	mg/l	natural	0.3	0.3	1	1-5	>5
Ammonical-N	mg/l	0.1	0.3	0.3	0.9	2.7	>2.7
Oil & Grease	mg/l	natural	Nil	nil	-	-	-
Sulphate	mg/l	natural	250	250	-	-	-
Cr (IV)	mg/l	natural	0.05	0.05	1.4	0.1	>0.1
Cyanide (CN)	mg/l	natural	0.02	0.02	0.06	-	-
Cr (III)	mg/l	natural	-	-	2.5	-	-
Tin (Sn)	mg/l	natural	-	-	0.004	-	-
Boron (B)	mg/l	natural	1	1	(3.4)	0.8	>0.8
Al	mg/l	natural	-	-	(0.06)	0.5	>0.5
Ba	mg/l	natural	1	1	-	-	-
Se	mg/l	natural	0.01	0.01	0.25	0.02	>0.02

Ag	mg/l	natural	0.05	0.05	0.0002	-	-
Colour	Pt-Co	15	150	150	-	-	-
Phenol	µg/l	natural	10	10	-	-	-
Cl_2	mg/l	natural	-	-	(0.02)	-	-
Faecal Coliform	CFU/100ml	10	100	400	5000	5000	-

Table 6.11 : Water Classes and Uses

Classification	WQI	Water Use
Class I	> 92.7	Conservation of natural environment Water supply – practically no treatment necessary. Fishery I – very sensitive aquatic species
Class II	76.5 – 92.7	Water supply II – conventional treatment required Fishery II – sensitive aquatic species Recreational use with body contact.
Class III	51.9 – 76.5	Water supply III – extensive treatment required Fishery III – common of economic value and tolerant species; livestock drinking.
Class IV	31.0 – 51.9	Irrigation
Class V	< 31.0	None of the above

6.7.2 Existing Water Quality Status

The water quality status of principal watercourses, which receive surface run-offs from the Project site, which is the main concern here. Its quality has been assessed based on information garnered from water quality monitoring exercises carried out during the course of this EIA study and other relevant desk studies.

6.7.3 Sampling Location

The in-situ measurement and grab water samplings were taken on 17th to 19th August 2018 at 16 different locations surrounding project site. There are 3 additional points which so called as Air Tandak,

located at the upstream of sampling point (**Figure 6.13)**. **Figure 6.16** shows the locations of the sampling points. The details description coordinates of water quality sampling tabulated in **Table 6.12.**

Table 6.12 : Location of Water Sampling

Sampling Station	Description Location of Water Sampling	Coordinates	Sampling Visual
W1	Representing water quality level at tributary upstream of Sg. Poi	N 5° 9' 3.7476", E 101° 13' 15.834"	
W2	Representing water quality level at tributary upstream of Sg. Sira	N 5° 6' 48.9852", E 101° 11' 41.2728"	
W3	Representing water quality level at tributary midstream Sg. Sira	N 5° 7' 57.972", E 101° 12' 37.4256"	

W4	Representing water quality level at tributary downstream of Sg. Sira	N 5° 8' 27.8808", E 101° 13' 11.7372"	
W5	Representing water quality level at tributary of Sg. Poi	N 5° 8' 31.92", E 101° 12' 47.844"	
W6	Representing water quality level at tributary of Sg. Adu	N 5° 6' 25.4628", E 101° 11' 47.2956"	
W7	Representing water quality level at tributary of Sg. Rombai	N 5° 8' 15.828", E 101° 9' 42.4656"	

W8	Representing water quality level at tributary of Sg. Rombai	N 5° 5' 37.788", E 101° 14' 7.4004"	
W9	Representing water quality level at tributary downstream of Sg. Poi	N 5° 8' 39.2784", E 101° 14' 6.8352"	
W10	Representing water quality level at tributary downstream of Sg. Poi	N 5° 8' 18.0276", E 101° 14' 34.872"	
W11	Representing water quality level at tributary midstream of Sg. Poi	N 5° 7' 48.2736", E 101° 14' 16.6668"	

W12	Representing water quality level at tributary upstream of Sg. Poi	N 5° 7' 18.7572", E 101° 13' 45.0264"	
W13	Representing water quality level at tributary upstream of Sg. Poi	N 5° 6' 52.182", E 101° 13' 32.2392"	
W14	Representing water quality level at upstream of Sg. Poi	N 5° 7' 21.63", E 101° 12' 51.3972"	
W15	Representing water quality level at upstream of Sg. Piah	N 5° 7' 43.7196", E 101° 14' 43.584"	

W16	Representing water quality level at upstream of Sg. Piah	N 5° 7' 37.524", E 101° 12' 20.3292"	
AT 1	Representing water quality level at Air Tandak Sg. Piah	N 5° 5' 11.7492", E 101° 13' 2.8272"	
AT 2	Representing water quality level at Air Tandak Sg. Buaya	N 5° 6' 13.7052", E 101° 12' 36.3636"	
AT 3	Representing water quality level at Air Tandak Sg. Tengtor	N 5° 4' 47.3", E 101° 15' 38.7"	

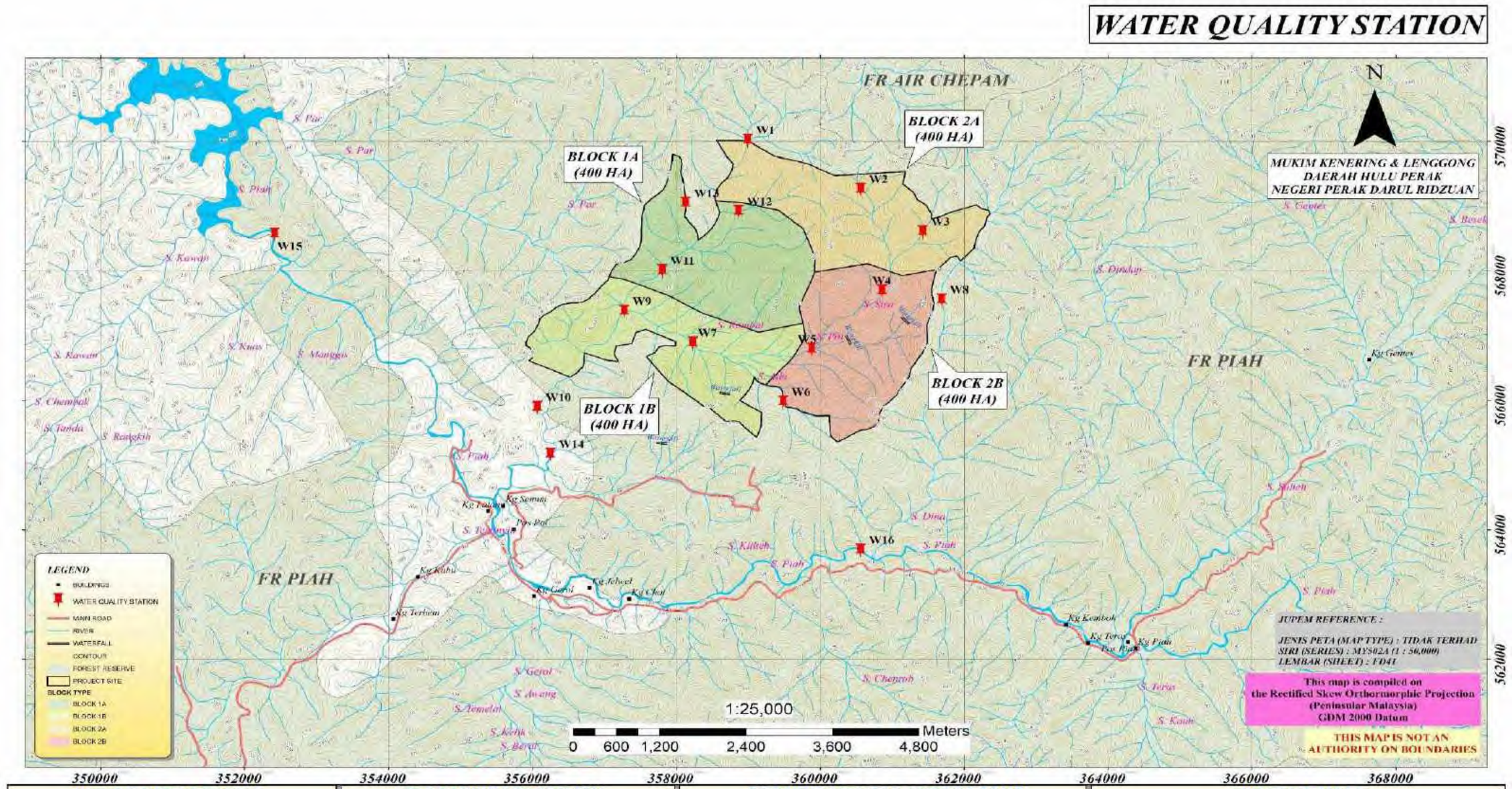

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Figure 6.16 : Water Quality Stations

6.7.4 Data Analyses and Results

Water sampling, in-situ measurements and laboratory analyses were carried out on 17th to 19th August 2018 at 16 different locations surrounding project site and another 3 sampling points for Air Tandak. Non-conservatives, non preservable parameters were analysed in-situ during the sampling exercises. Samples for non-conservative but preservable parameters and other conservative preservable parameters were acidified to pH 2 prior to analyses at the laboratory.

The water quality parameters measured were the physical parameter of pH, Turbidity, Temperature, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solid (TSS), Oil & Grease and the content of ammonical nitrogen. The physical parameter would give a rapid indication of the state of water quality. The BOD parameter would induce degree of pollution by organisms. The level of nutrients would primarily indicate pollution by sewage, industrial and agricultural activities.

Water quality data obtained from this exercise are summarised in **Table 6.13-6.15**. Certificates of the water quality analysis are enclosed in **Appendix 6-C**. The mean parameters for every water quality monitoring station at proposed project were calculated. The concentrations of each parameter also were computed and compared with the NWQS for Malaysia River.

Water Quality index (WQI) is a method to relate a group of variables water quality parameters to a common scale and combining them into a single number according to a chosen method or model. This method simplifies the water quality parameters to be used in representing the level and the trend of water quality. For this purpose, the WQI was calculated using the following equation:

WQI = 0.22 * SIDO + 0.19 * SIBOD + 0.16 * SICOD + 0.15 * SIAN + 0.16 * SISS + 0.12 * SIpH

Where, * indicates multiplication and SI, sub – index for the represented parameter.

Table 6.13 : Result of Water Quality Sampling

Parameter	W1	W2	W3	W4	W5	W6	W7	W8	DOE Class IIB (NWQS)
pH	6.94	7.03	6.52	6.50	6.82	6.94	6.81	6.69	6 - 9
Temperature ^{o}C	28.9	29.1	29.1	29.1	29.0	28.9	28.8	28.9	-
DO, mg/L	6.27	6.26	6.24	6.25	6.28	6.26	6.23	6.26	5 - 7
COD, mg/L	10	10	13	10	10	10	13	10	25
BOD_5, mg/L	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	5
TSS, mg/L	8	8	8	8	17	8	8	8	50
Turbidity, NTU	10.3	9.8	10.1	9.4	20.3	10.8	9.6	9.8	50
NH_3-N, mg/L	ND(<0.01)	0.22	0.02	ND(<0.01)	ND(<0.01)	ND(<0.01)	0.01	ND(<0.01)	0.3
O&G, mg/L	ND(<1)	ND(<1)	ND(<1)	ND(<1)	ND(<1)	ND(<1)	ND(<1)	ND(<1)	ND
E.coli, CFU/100mL	1.15×10^2	4.0 × 10	3.5 × 10	6.5 × 10	8.0 × 10	1.5 × 10	4.5×10	5.5×10	4×10^2
Water Quality Index (WQI)	93.32	91.12	93.32	94.28	93.78	94.55	93.59	94.42	-
Class	I	II	I	I	I	I	I	I	-
Status	Clean	Clean	Clean	Clean	Clean	Clean	Clean	Clean	-

Table 6.14 : Result of Water Quality Sampling *(cont.)*

Parameter	W9	W10	W11	W12	W13	W14	W15	W16	DOE Class IIB (NWQS)
pH	6.72	7.03	6.92	6.88	7.00	6.72	7.00	6.73	6 - 9
Temperature ^{o}C	29.0	29.1	29.1	29.6	28.8	29.0	28.9	29.2	-
DO, mg/L	6.27	6.27	6.24	6.24	6.28	6.27	6.29	6.24	5 - 7
COD, mg/L	13	13	13	13	10	13	10	10	25
BOD_5, mg/L	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	5
TSS, mg/L	26	26	9	10	8	8	11	8	50
Turbidity, NTU	23.6	23.6	12.4	12.4	9.5	11.2	13.2	10.1	50
NH_3-N, mg/L	ND(<0.01)	ND(<0.01)	ND(<0.01)	0.06	ND(<0.01)	0.11	ND(<0.01)	0.13	0.3
O&G, mg/L	ND(<1)	ND(<1)	ND(<1)	ND(<1)	ND(<1)	ND(<1)	ND(<1)	ND(<1)	ND
E.coli, CFU/100mL	2.4 × 10	4.5 × 10	1.8 × 10^2	5.5 × 10	1.2 × 10^2	ND(<10)	4.5 × 10	8.5 × 10	4×10^2
Water Quality Index (WQI)	92.29	92.31	93.82	93.85	94.60	92.12	94.38	91.49	-
Class	II	II	I	I	I	II	I	II	-
Status	Clean	Clean	Clean	Clean	Clean	Clean	Clean	Clean	-

Table 6.15 : Result of Water Quality Sampling *(cont.)*

Parameter	AT1	AT2	AT3	DOE Class IIB (NWQS)
pH	6.72	6.72	8.07	6 - 9
Temperature ^{o}C	29.0	28.9	26.5	-
DO, mg/L	6.28	6.31	6.45	5 - 7
COD, mg/L	13	10	10	25
BOD_5, mg/L	ND(<5)	ND(<5)	ND(<5)	5
TSS, mg/L	8	8	13	50
Turbidity, NTU	10.3	11.1	12.1	50
NH_3-N, mg/L	0.12	0.15	0.26	0.3
O&G, mg/L	ND(<1)	ND(<1)	ND(<1)	ND
E.coli, CFU/100mL	3.5 × 10	ND (<10)	4.5 x 10	4×10^2
Water Quality Index (WQI)	91.99	92.21	89.96	-
Class	**II**	**II**	**II**	-
Status	Clean	Clean	Slightly Polluted	-

(Source: ChemVi Laboratory,2018)

SIDO, SIBOD, SICOD, SIAN, SISS and SIpH are the sub-indices of dissolved oxygen, biological oxygen demand, chemical oxygen demand, ammoniacal nitrogen and pH values, respectively. The value of each sub – indices is derived from the specific equation given by DOE (1993). The WQI values ranged from 0 to 100 with 100 represent the best water quality and 0 as the worst.

The River Water Quality Classification listed in **Table 6.13-6.15** is used to compose the existing data at all monitoring stations to determine the class classification for the rivers. Based on the calculations, sampling stations falls under WQI class I and II that indicated in the water quality index range as clean water (81-100). Sampling station at W13 has the highest WQI value, which is 94.60. Meanwhile, the sampling station at W2 has the lowest WQI value which is 91.12.

Brief account on selected water quality parameters are presented in the following paragraphs:

i. Temperature

Normal (thermal unpolluted) and favourable for dissolved oxygen. The obtained temperature readings range from 28.8℃ to 29.6℃.

ii. pH

No significant and adverse pH levels were observed from the samples collected. The analyses show that all samples have pH value ranging from 6.50 to 7.03.

iii. Dissolved Oxygen (DO)

The Dissolved Oxygen (DO) levels analysed gave readings between 6.23 mg/L to 6.31 mg/L which fall within Class IIB of the NWQS. Standard limit for DO level ranged from 5 mg/L to 7 mg/L. If high levels of DO appear, it indicates low organic loading which reflected

unpolluted watercourses. Thus, DO is a vital component for living organism in any water body system.

iv. Biological Oxygen Demand (BOD)

Results of all samples analysed for BOD5 are Not Detected (ND) <5 mg/L. BOD is normally used as an indicator for organic loading of natural waterbody. The level of BOD indicates the level of the presence of decomposing organic matter which is also reflected in the DO level.

v. Chemical Oxygen Demand (COD)

The COD levels of all water samples are between 10 mg/L to 13 mg/L which ranging from the Class IIB, NWQS for all sampling. The concentration of COD measures the presence of non – biodegradable matter in water body. It may act as indicator of chemical pollution in any waterbody.

vi. Total Suspended Solid (TSS)

Samples from all stations register levels of TSS are mostly below 50 mg/L which are ranging from 8 mg/L to 26 mg/L. TSS in water is indicative of the presence of inorganic and organic particles and immiscible liquids. These materials are common constituents of surface water due to water erosion and may include silt, clay, plant fibres and biological solids.

vii. Ammoniacal Nitrogen (NH_3-N)

Samples taken at the few stations shows the results of the Ammoniacal Nitrogen values are Not Detected (ND) <0.01 which, that is not in ranging (50 mg/L) from the Class IIB, NWQS. But the station

of W2, W3, W7, W12, W14, W16, AT1 and AT2, the Ammoniacal Nitrogen values are between 0.01 mg/L to 0.22 mg/L respectively, which falls below Class IIB, NWQS. The presence of excessive concentration of Ammoniacal Nitrogen and phosphorus is generally caused by the human activities in the vicinity of the Project site, which shall lead to eutrophication which then reduce DO. Eutrophication shall impede the regeneration of the benthic organisms and the quality of the water ecosystem.

viii. Turbidity

The lowest turbidity result is 9.4 NTU at the station of W4 and the highest result is 23.6 NTU at the station of W9 and W10. Based on the DOE Class IIB (NWQS), the standard for the turbidity value should be 50 mg/L or below.

ix. Oil and Grease (O&G)

Oil and Grease (O&G) in water can cause surface films and shoreline deposits leading to environmental degradation, and can induce human health risks when discharged in surface or ground waters. But, the O&G result for this test are ND (<1), where ND stands for Not Detected. Based on the DOE Class IIB (NWQS), the result supposed to be (ND) Not Detected.

6.7.5 Metals

There few metals detected in the water quality samples which are lead, iron, aluminium, copper, nickel, zinc and barium. All parameter detected comply with NWQS Class IIB. **Table 6.16** shows the summary of heavy metal analysis in water quality.

Table 6.16 : Analysis of Heavy Metal in Water Quality

Parameter	STATIONS																	NWQS Class IIB
	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8	WQ9	WQ10	WQ11	WQ12	WQ13	WQ14	WQ15	WQ16	WQ17	WQ18	
Hg	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	0.001
Cr	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	0.01
CN	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	0.02
Pb	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	0.003	ND(<0.002)	ND(<0.002)	0.05
Cr (III)	ND(<0.001)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	ND(<0.02)	-
Cu	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	0.89	ND(<0.001)	0.02
Ni	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	0.01	ND(<0.001)	ND(<0.001)	0.05
Sn	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	-
Zn	ND(<0.001)	ND(<0.001)	0.002	0.001	0.004	0.002	0.002	0.01	0.001	0.001	ND(<0.001)	0.001	ND(<0.001)	0.01	0.01	0.01	ND(<0.001)	ND(<0.001)	5
B	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	ND(<0.002)	1
Fe	0.04	0.02	0.06	0.04	0.18	0.07	0.29	0.04	0.62	0.62	0.05	0.18	0.05	0.23	0.4	0.28	0.09	0.17	1
Al	0.06	0.04	0.08	0.15	0.23	0.05	0.22	0.15	0.11	0.11	0.04	0.04	0.03	0.08	0.12	0.89	1.21	0.01	-
Ba	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	ND(<0.002)	0.05	1
Se	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	ND(<0.001)	0.01

6.7.6 Water Quality Modelling

The development of agricultural in the high to moderately high-elevated area could have devastating environmental effects, for instant towards the water quality of the nearby water bodies. Hence, a water quality modelling is useful to help in predict the scenario that might happen shall a development of the area is needed. QUAL2K is a river water quality model which is typically used to assess the environmental impact of multiple pollution discharges along rivers, including both point and non-point sources.

The model, which was developed by United State Environmental Protection Agency (USEPA), uses 1-D modelling principle, of which the river is assumed to be fully mixed in the vertical and lateral directions. The model, whereby the pollutants inputs and predicted water quality parameters cannot evolve over time, also assumes steady state. For the hydraulic-wise assumption, the cross sectional of the river channel is assumed to be a trapezoid cross-section, unless specific in-situ data is available for use. A wide range of chemical and biological pollutants within a river can be modelled; however, the centre of the result discussion will be mainly on the proposed site's activities possible impacts.

Physical-chemical processes simulated by the model include water quality kinetics, chemical equilibrium, advection, dispersion, settling and interactions with the atmosphere and riverbed. The model assumes the input flow would be from the river flow and pollution inflow, while output flow would be from river flow and abstraction.

6.7.6.1Model Scenarios

Multiple scenarios can be simulated within the model, however only four scenarios have been simulated for the water quality impact prediction at the proposed site. Specific focus on the potential pollutants are being considered in different treatment/pollutant removal scenario. The proposed site seems spatially engulfed by the existing forestland use hence some water quality deterioration at the

site shall be expected as the result of incoming pollutant runoff into the river along the stretch.

The proposed area is located within a forested area; hence, the model assumed there is no pollutant source at the upstream-most section, and along the study, reaches except for the point sources and non-point sources location pre-determined in this model setting. Class-I water quality condition is pre-set for the initial water quality at the headwater flow, considering a normal season (with occasional rainfall events) flow rate (Q=0.01 m^3/s). The point sources for the proposed study are presented in schematic diagram as in **Figure 6.17**, **Figure 6.18** and **Table 6.17**, whereby insignificant contribution of non-point sources from groundwater diffusion is assumed, hence, neglected in the model.

The objective of this study is to determine the carrying capacity of Sungai Piah (and its tributaries to absorb contaminants, in this context, the sediment. This QUAL2K was used in this river water quality modelling study to compare the existing and future impact to the river water quality during a forest plantation establishment and operation phases. The main source of pollution in agricultural activities will come mainly from surface soil erosion especially during rain event; hence, increase of sediment load into the river system can be expected.

Water quality impacts were modelled based on 4 different pollutant-treatment scenarios as mentioned below:

i. No treatment (Worst case scenario)
ii. 75% efficiency in SS treatment (practical case scenario)
iii. 90% efficiency in SS treatment (best case scenario)
iv. Existing scenario (Calibration)

(see modelling scenario **Table 6.17**)

6.7.6.2Potential Point Source (PS) For the Proposed Site Area

For worst case scenario, an assumption used was the existing BMPs applied at the project site are not fully efficient in retaining and

trapping SS from entering the river. In this scenario, the point sources will discharge a Class V TSS concentration (TSS mixing>300mg/l). (See **Appendix 6-K** for mass balance calculation during 100% BMPs failure (worst-case scenario)).

Approximation of Runoff Volume

An extensive overland flow gauging and analysis would have been preferable to quantify the actual overland flow-rate during precipitation to enable point source (PS) pollution quantification. However due to the limited time and resources, the overland flow and runoff volume had to be estimated from literary sources taking into consideration a margin of safety. The primary method engaged was the Rational Method, which relates peak runoff to rainfall intensity through a proportionality factor (Sturm, 2001). The Rational Formula is one of the most frequently used urban hydrology methods in Malaysia.

The formula is (Sturm, 2001):

where:

Qy = y year ARI peak flow (m^3/s)
C = dimensionless runoff coefficient
yIt = y year ARI average rainfall intensity, mm/hr
A = drainage area, ha

Table 6.17 : Modelling Scenario

Scenario 1 (No Treatment)	
It is assumed for the worst case scenario, wastewater are not treated and discharge directly into river	
TSS (mg/L)	1000
Scenario 2 (75% Treatment Efficiency of SS)	
It is assumed for the practical case scenario, wastewater are partially treated (for SS) prior to discharge into river.	
TSS (mg/L)	250
Scenario 3 (90% Treatment Efficiency)	

It is assumed the best mitigation measures are applied at the proposed site, whereby very minimal sediment being introduced into the river	
TSS (mg/L)	100
Scenario 4 (Existing Condition)	
Average value of SS according to data collected onsite.	
TSS (mg/L)	10

Potential Point Source (PS) For the Proposed Site Area

Table 6.18 : Potential point source (PS) of the proposed study area

Point Source ID	Potential Source	Remark
PS1	Runoff from the project	Assumption that the existing BMPs applied at the project region of the proposed site are not fully efficient in retaining and trapping SS from entering the river
PS2	Runoff from the project	Assumption that the existing BMPs applied at the project region of the proposed site are not fully efficient in trapping and retaining SS from entering the river.

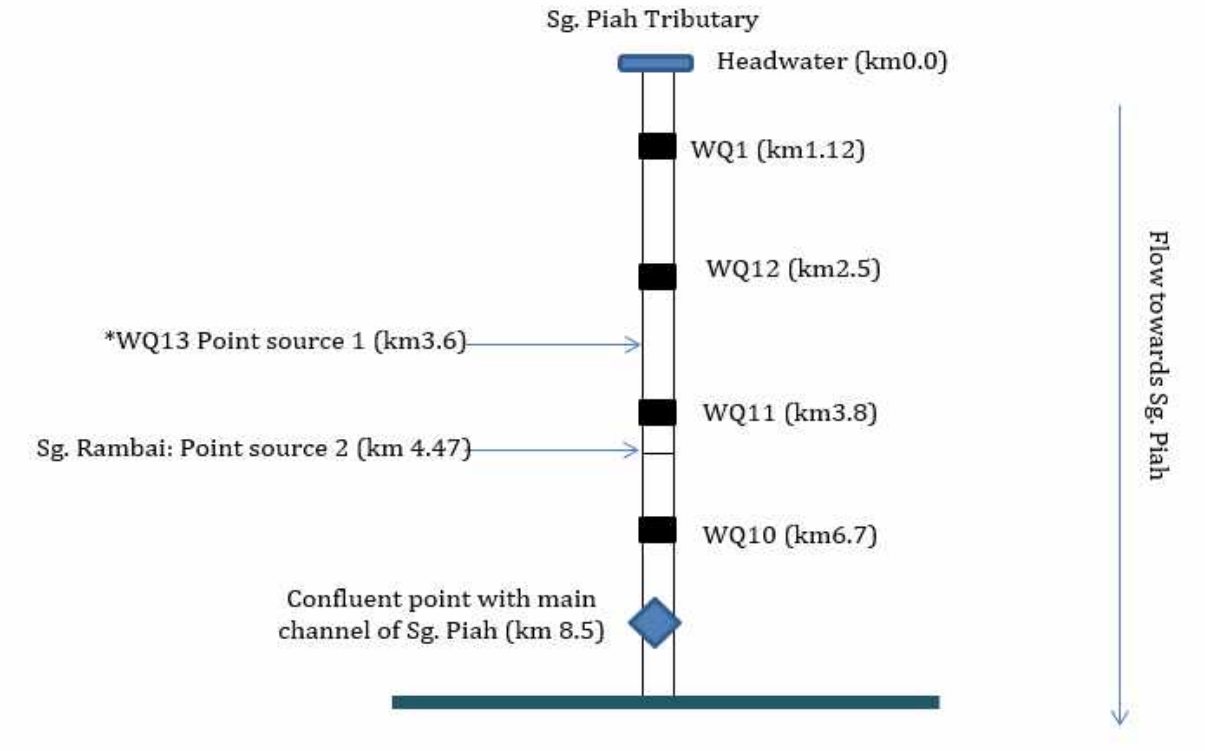


Figure 6.17 : Sg. Piah

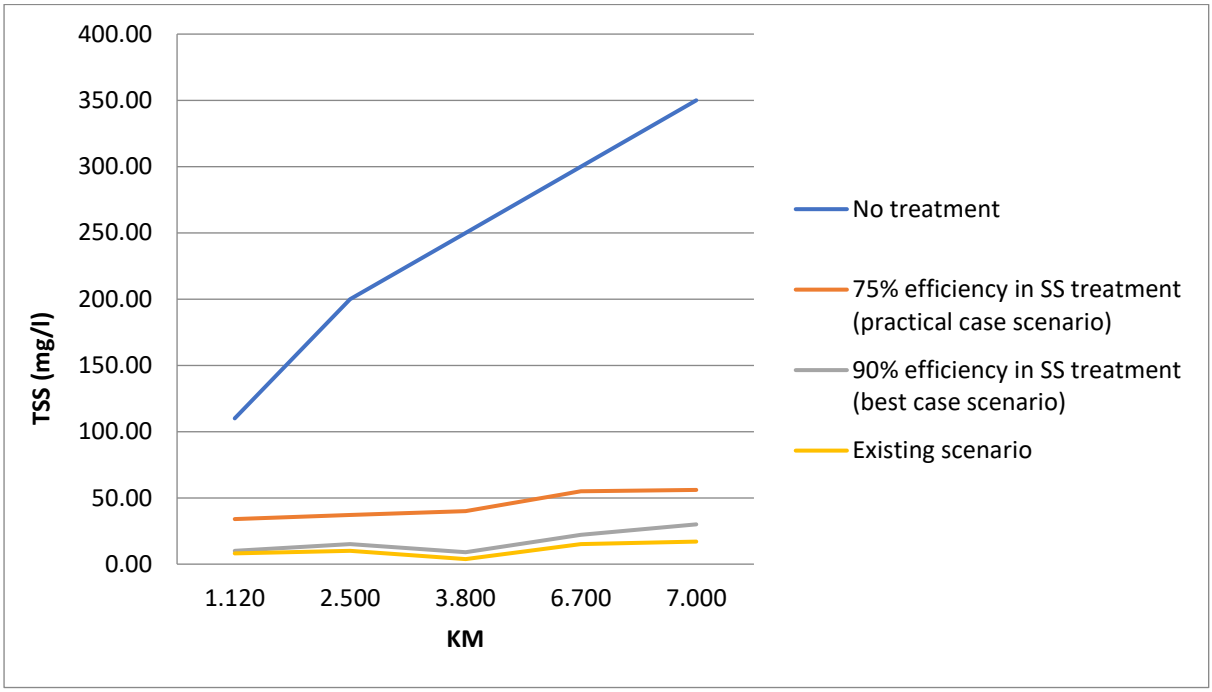


Figure 6.18 : Spatial Distribution of the Pollutant

Figure 6.18 summaries the predicted TSS profile of Sg. Piah from upstream to downstream base on worst scenario condition. In this scenario, the predicted TSS loading were input due to a complete failure of proposed BMPs. From the figure, the Class I category of 1 mg/l of TSS from headwater was present reflecting the current undeveloped and fully-forest coverage of the uppermost stream of Sg. Piah tributaries.

As the water flows towards the km 3.6, the TSS level rocketed from 350 mg/l as several tributaries contribute towards the TSS loading into the river. As a summary, the contribution of sediment discharge input from the Sg Piah catchment that drain from the project area has dramatic cumulative impacts of total suspended solid accumulation at the downstream region. In the worst case scenario, a Class-IV can be expected, whereby complete failure of effective BMPs such as 30-meter river buffer zone, sediment trap, sediment basin, temporary earth drain, check dam, slope protection, slope drain and diversion channel. This scenario should be avoided at all cost as it impacted the receiving river in terms of TSS pollutant load.

For 95% efficiency, **Figure 6.18** summaries the predicted TSS profile of Sg. Piah from upstream to downstream base on compliance to Class II for TSS discharge/runoff (not more than 50mg/l) according to National Water Quality Standards (NWQS) at 0.80 m^3/s average discharge under normal flow conditions. In this scenario, the 95% efficiency of the proposed BMPs or a 95% of TSS total removal by the proposed BMPs must be obtained to achieve this scenario.

From the figure, the Class I category of 1 mg/l of TSS from headwater was present reflecting the current undeveloped and fully-forest coverage of the uppermost stream of Sg. Piah tributaries. By adopting this scenario, the level of TSS discharge into the receiving river at the boundary of proposed project site is 24mg/l (NWQS Class I for TSS parameter).The improvised value of TSS discharged from the proposed project area is lower compared to previous scenario. As for this scenario, the contribution of sediment discharge input from the Sg Piah catchment that drain from the project area has dramatic cumulative impacts of total suspended solid accumulation at the downstream region.

However, with the 95% efficiency of all BMPs leads to a successful compliance with 50mg/l permissible TSS discharge from the project site, and the impact somehow, can tremendously been improved and Class-I can be expected to be discharged out.

Figure 6.18 also summaries the predicted TSS profile of Sg. Piah from upstream to downstream base on 75% efficiency of BMPs under normal flow conditions. From the figure, the Class I category of 10 mg/l of TSS from headwater was present reflecting the current undeveloped and fully-forest coverage of the uppermost stream of Sg. Piah tributaries. In this scenario it has been expected that the discharge coming out from the proposed project area be within Class III based on NWQS with the TSS loading at the boundary of the proposed project site is 55mg/l. With incompliance of TSS value of Class II, hence the 95% of BMPs effectiveness must be made as a priority to maintain the existing TSS Class II.

6.7.6.3Result summary

Table 6.19 : Summary (Sg Piah)

Scenario/Treatment	SS Input (mg/l)	Input after treatment	Range of SS quality after treatment
No treatment	1000	1000	350
70% efficiency	1000	250	52-55
95% efficiency	1000	100	24
Natural condition	10	10	15

6.7.6.4Conclusion for Water Quality Modelling

A study to predict the impact of proposed project to the water quality of Sg. Piah and some other river lies in sub-catchment located at the southwest of the proposed project site were conducted using QUAL2K modelling during earlier stage of forest plantation establishment and operation activities. A proper BMPs such as basin trap, silt fencing as well as vegetation strips is expected to be applied at the proposed site to minimise the cumulative erosion impact from the activities around the area. High concentration of TSS in the river may shallow the river and affecting the activities at the downstream part of the river physical, biological and chemical disturbance towards the aquatic ecosystem shall be expected from the high concentration of TSS in a river water.

Several key points can be conclude from the modelling exercise:

i. Based on modelling result, the 95% efficiency is sufficient to comply the Class II of TSS discharge requirement from the proposed project site.

ii. Any significant deterioration in water quality should immediately reported to the DOE and other relevant authorities for further action.

iii. As natural filter to surface runoff. Any exposed and bared area shall be immediately being covered.

6.8 HYDROLOGY

The process of land use changes has increased the frequency of flash flood in an area that is not normally associated with flash flood. The process of land use changes is normally associated with the reduction of natural flood detention storage (lakes and water bodies) and increasing the percentage of impervious area. The changes in topography and land use could result in the tremendous increase in surface runoff. The flooding problem may aggravate due to increase of directly connected impervious area. This phenomenon could result in extensive flooding where property damage and loss of lives is imminent. The study requires general hydrologic data such as rainfall, stream flow and evaporation data. It also depends on the catchment and channel characteristics. However, each study might require different spatial and temporal data resolution.

The land clearing and earthwork of the proposed development area for the construction of the residential, commercial and industrial area may expose the large tract of bare soil to erosion. The increase in sedimentation rate at the nearby river may not only reduce river conveyance capacities, but also may destroy the habitat for aquatic lives. The reduction in conveyance capacities may result in the occurrences of flash flood.

6.8.1 Study Objectives

The objectives of the study are:

i. To determine flooded area at various locations within the study area before the development of the area.
ii. To determine flooded area at various locations within the study area after the area was developed.
iii. To determine flooded area at various locations within the study area during the development of the area.

6.8.2 Scope of Works (Flooding Impact)

The scope of work for the study will be as follows:

i. Collate and review available data and information on flooding and drainage problems encountered in the Study Area and collect additional data when necessary.
ii. Define the existing drainage system in the Study area and identify its inadequacies, constraint and potentials of the existing drainage system.
iii. Identify and evaluate the cause of future flooding and drainage problems encountered in the Study Area due to the proposed development.
iv. Carry out hydrological and hydraulic analyses using appropriate methods and procedures.
v. Propose feasible structural and related non-structural works for immediate implementation to alleviate the flooding problems in the Study Area and enhance its drainage systems.

6.8.3 Methodology

Methodology of Study (Rainfall-Runoff)

HEC-HMS model will be used in this study to analyse the hydrologic and hydraulic behaviour of present catchment characteristics, and to simulate the impact of future development to the flooding problem. It is always a good practice the model be calibrated first prior to its simulation of future scenarios. The calibrated model could be used to predict the impact of future development to the flow hydrograph at the outlet. Proposed flood mitigation alternatives will be simulated and evaluated to determine the most suitable alternative.

Hydrologic Modelling

The purpose of hydrologic modelling is to estimate flow hydrograph from tributary catchment for various ARI's. The estimated flow hydrograph serve as an input to the hydraulic modelling of the study

area. The hydrologic model in HEC-HMS is available ad can be downloaded from the US Army Corps website. There are plenty of options available in this module for calculating catchment losses, transformation of excess rainfall and base flow estimation. The options for estimating hydrologic losses include Initial Constant Loss Method, Horton, Philips and Green & Ampt Method. The options for rainfall excess transformation include kinematic wave U – H methods and Non-Linear Reservoir method. The synthetic U-H and quasi U-H method that are available includes Snyder, Clark Time Area, SCS and Santa Barbara U-H. These empirical, conceptual or mathematical models have coefficients or parameters that need to be verified or quantified. Most of these parameters/coefficients are not measurable at site.

It is always good that the hydrologic and hydraulic model parameters be calibrated first prior to applying it for simulation of future scenarios. The purpose of calibration and validation of model parameters is to ensure the accuracy and reliability of flow estimation for the existing and future condition of the study area. If there is no gauged stream flow station in the study area, other prediction methods has to be employed in order to ensure the reliability of the simulated result. The method includes using calibrated parameters from nearby gauged catchment. The calibrated parameters will be extrapolated to the ungauged catchment in the study area, which is in the same river basin of the gaged catchment. The results obtained will be compared with other empirical methods such as HP 4, 5 and 11. The calibrated model parameters will be used to simulate for future land use flow hydrograph.

For the purpose of modelling, the catchment was divided into several sub-catchments. These sub-catchments are represented as nodes in HEC-HMS. The selections of nodes are based on the consideration of certain aspects of the catchment characteristics and locations where determination of flow is required. Each sub-catchment is given a name and provided with a link number for connectivity among the nodes.

Hydraulic Modelling

The objective of the hydraulic modelling is to perform hydraulic routing of flood flow in the drainage system, which uses the upstream inflow hydrograph generated from Runoff Mode. The hydraulic flow routing model in XP-SWMM is called EXTRAN. It is available under Hydraulic Mode. The simulated water surface profile and discharge will determine which area is prone to flooding under various scenarios (existing & future). The modelling scenarios will include existing and future conditions of the study area plus with existing and future flood mitigation facilities. The scenarios considered in this study are as follows:

i. Existing condition
ii. Future condition with existing channel capacity
iii. Future condition with upgraded facilities (increase the existing channel capacity and construction of detention ponds)

EXTRAN can model water surface profiles along the channels and flood plain in the drainage system. EXTRAN model uses fully dynamic flood routing technique based on the St. Venant equation. The model is based on gradually varied one- dimensional flow. The channel cross sections would be obtained from field measurement (cross-section survey), if the survey data is available as many studies have been conducted previously within Sg. Piah catchment. The provided river cross sections along the main channel and its tributaries will be used as data input in the model hydraulic simulation. This information will help determine water surface profile spatially (along the channel) and temporally (along the simulation period).

6.8.4 Scope of Study

The study covers the impact of the proposed plantation area to the downstream area of the proposed project. The location of the proposed plantation area is shown in **Figure 6.19.** The proposed rubber forest plantation area will somehow generate an increase in the volume of surface runoff towards the receiving water bodies.

There are also contributions of stream flow from the upstream area of the plantation area. The discharge from the plantation area will be drained towards the nearest river. The surface runoff from the site will also be drained toward the same river, before discharging toward nearby rivers. There are also many natural lakes within the project area. The recent case of flooding in the downstream area of Sg. Perak should provide a good lesson on the importance of preserving the natural catchment area within the river basin. It is important to study the impact of the proposed land use changes to the flow in the downstream area as this project might affect the livelihood of the people who live in the downstream area, and the aquatic life. Hydrologic models will be used to simulate the impact of the development to the downstream area.

6.8.5 Study Area

The project is “Proposed Rubber Plantation Development on Parts of Compartment 123, 125, 131 and 132 With an Area of 1600 Hectares (3953 Acres) in Piah Forest Reserve, Mukim Sungai Siput, District of Kuala Kangsar, Perak Darul Ridzuan” **(Figure 6.19).** The total project area of the proposed plantation area is about 1289 hectares. The proposed development area lies within Sg. Perak River Basin. Most of the project area drains toward Sg. Piah catchment area before draining toward Sg. Perak. The total project area that drains toward their respective catchment area is listed in **Table 6.20**. The proposed development area drains toward a small river within the site and merge with another river before discharging toward Sg. Piah and finally toward Sg. Perak **(Figure 6.20).** Sg. Perak River Basin is one of the biggest river basin within the state of Perak. The outlet of Sg. Perak River Basin faces the Straits of Melaka on the western side. The tidal influence for Sg. Perak could travel up a few kilometres upstream of the estuary, but it would not reach the proposed development site, as the project area is located at the most upstream area of the river basin.

The plantation area is divided into four blocks and contains 2 catchments. **Figure 6.23** shows the phases and catchment within the

plantation area, while **Table 6.20** lists the area for each catchment and phase. Based on the location **(Figure 6.22),** it is found that the proposed plantation area is not affected by any major floods event since it is located at the upstream area of Sg. Perak and at the middle reaches of Sg. Piah. The surrounding area has many secondary forest with natural depression storages that serves as flood storage. The proposed development area is not affected during the flood, basically due to the surrounding area has plenty of flood storages. However, rapid land use changes within the catchment area has most of these natural hydrological processes and interception storages being removed for plantation.

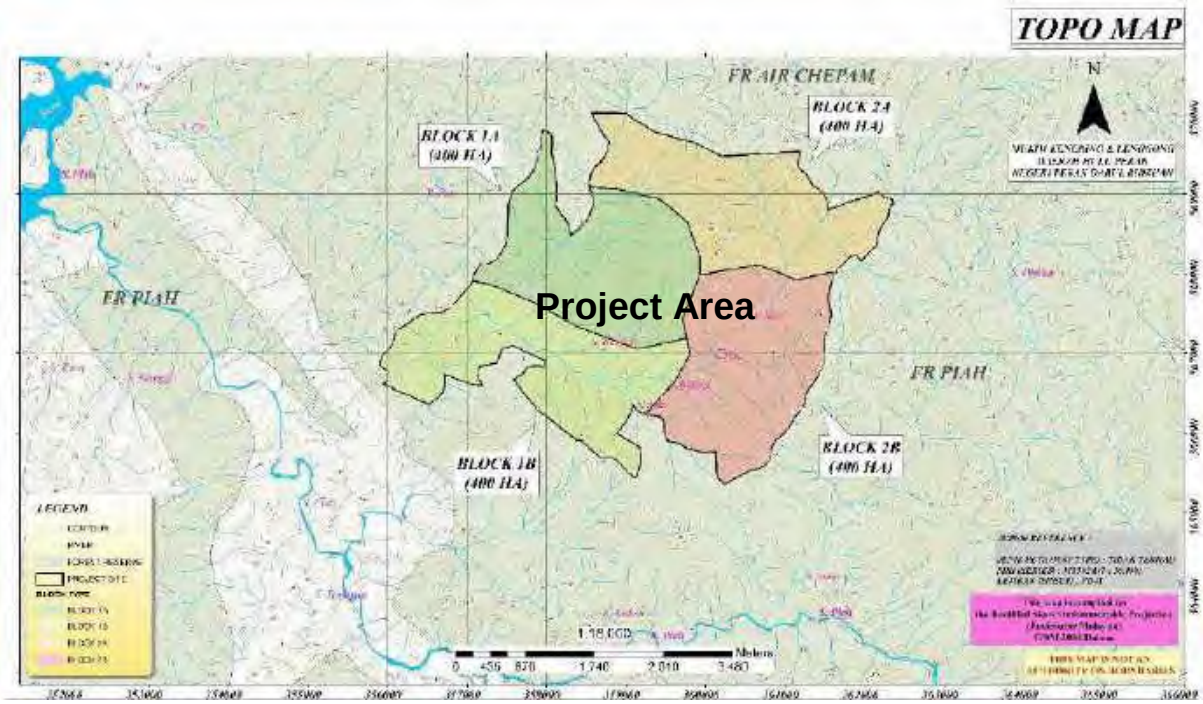


Figure 6.19 : Location of Study Area within Sg Catchment

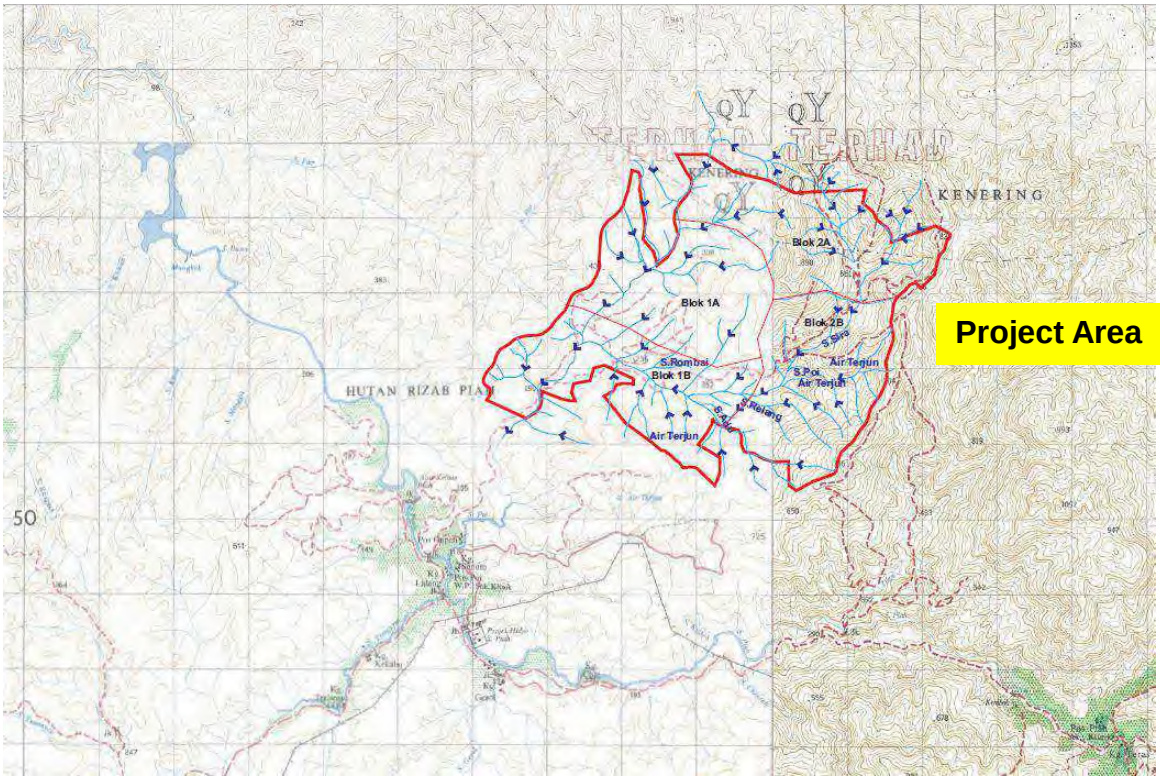


Figure 6.20 : Drainage System Downstream of Study Area

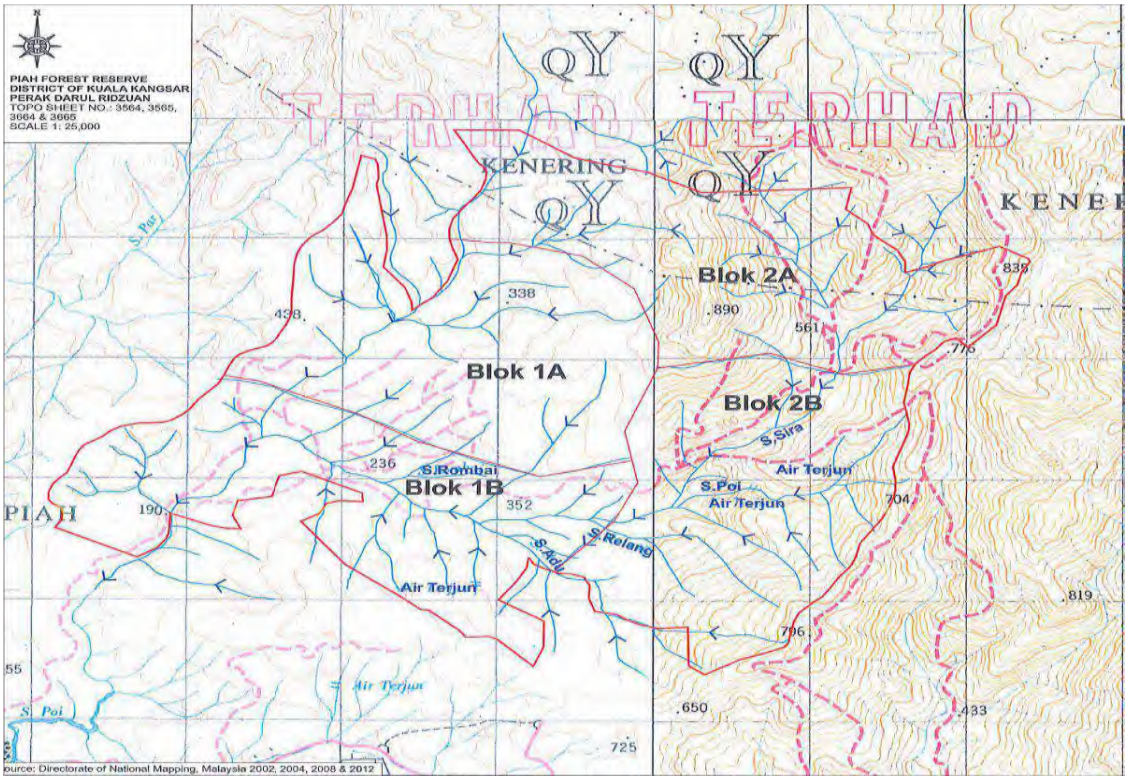


Figure 6.21 : Drainage and Water Bodies within the Study Area

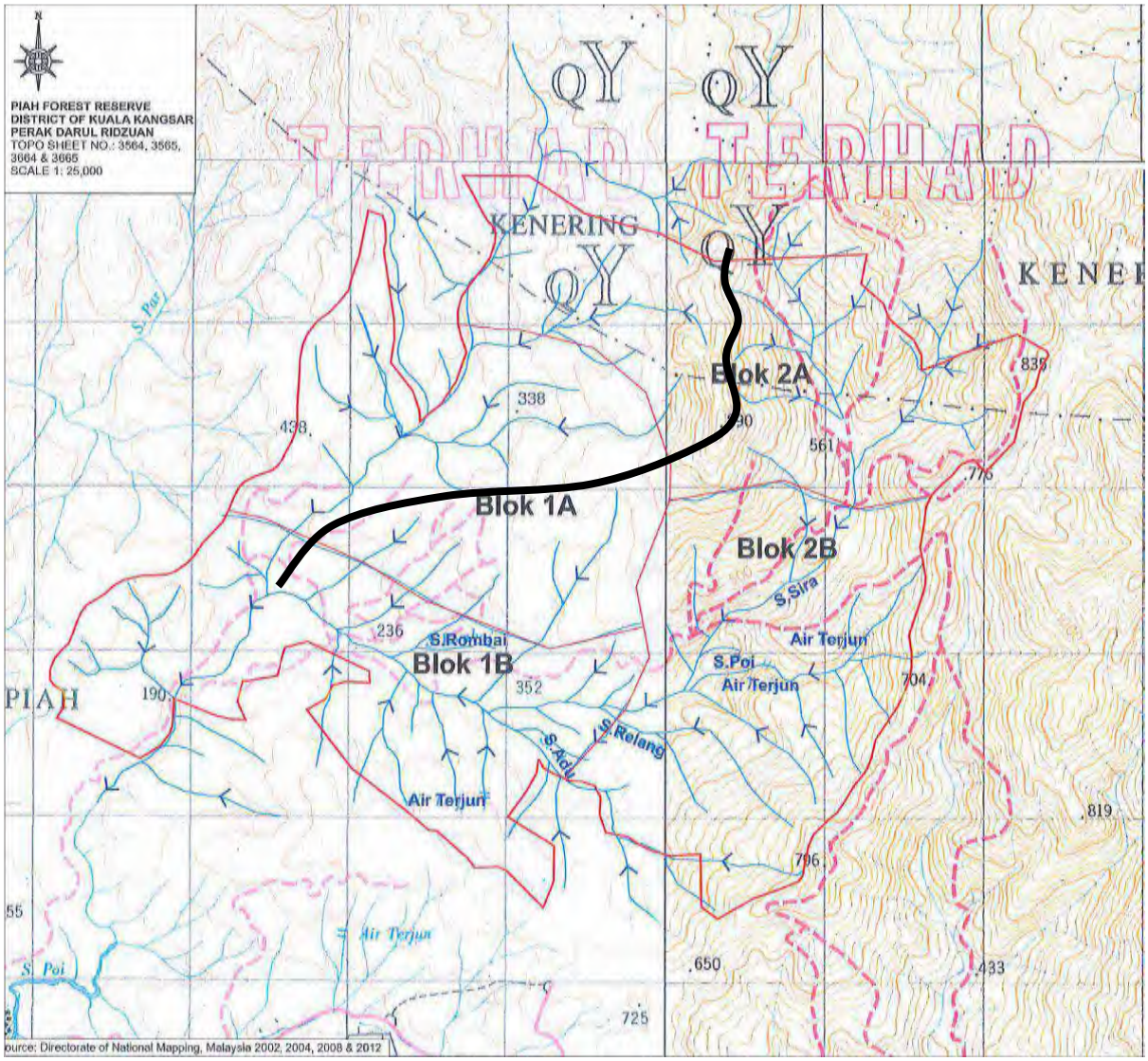


Figure 6.22 : Catchment of the Project Area

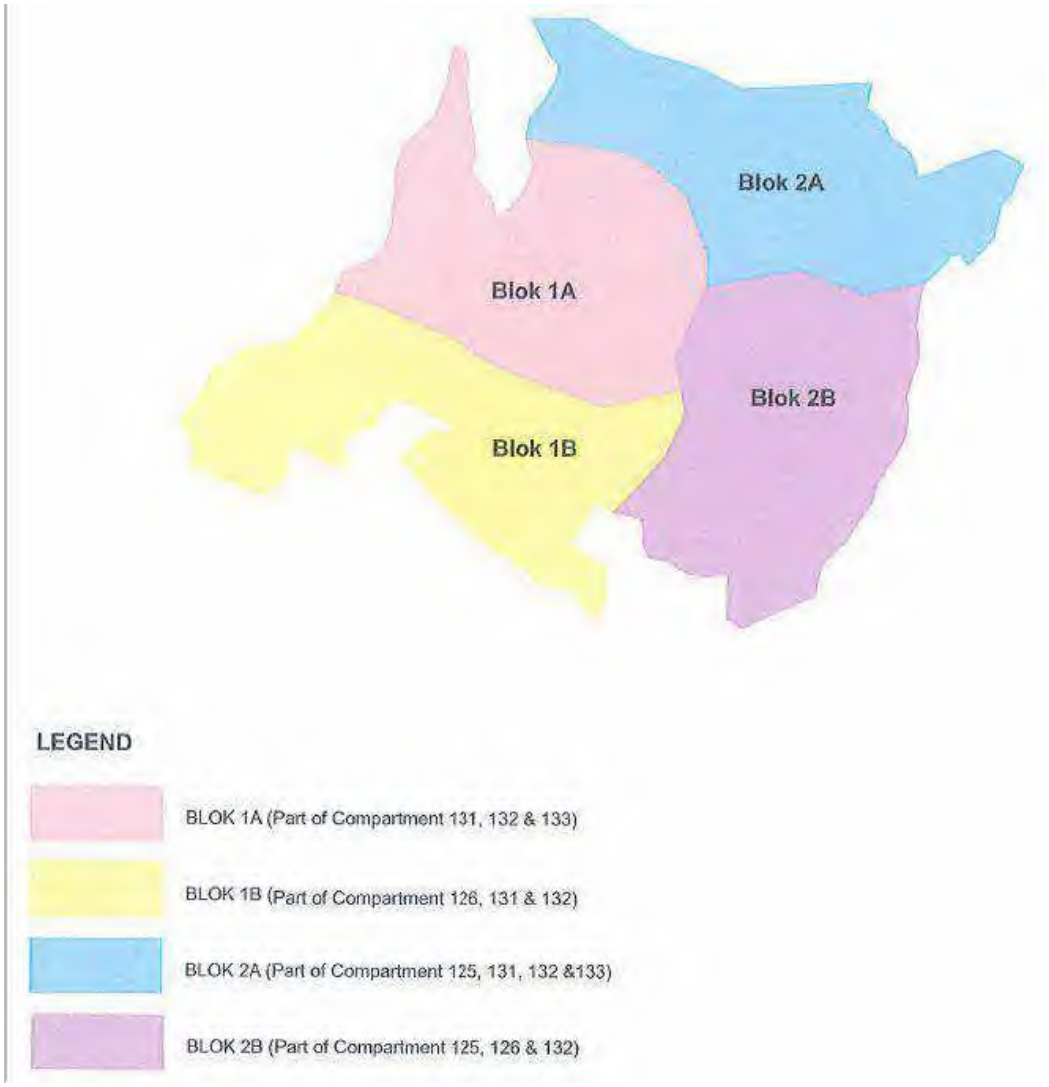
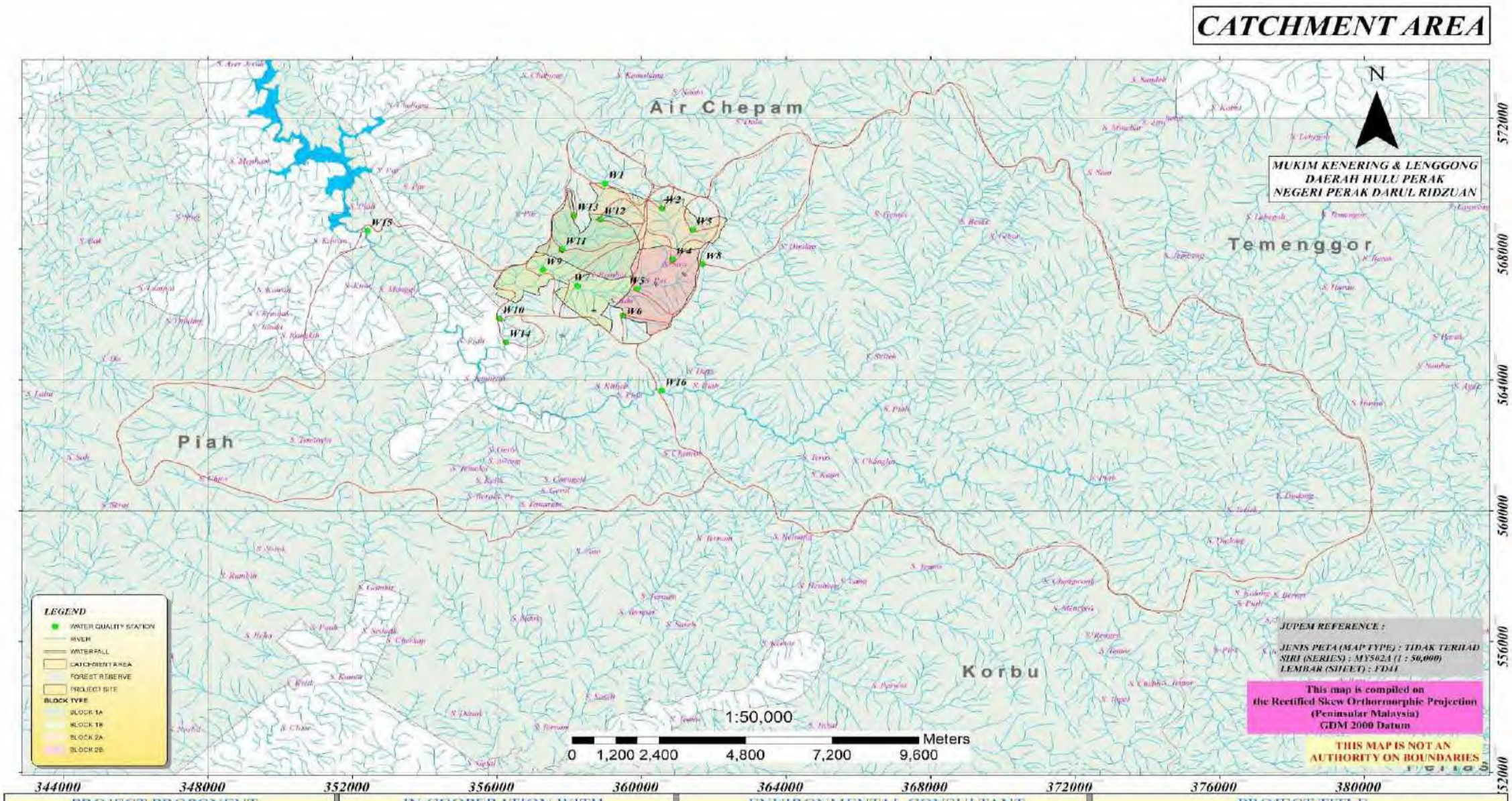


Figure 6.23 : Phases and Catchment within the Project Area



PROJECT PROPONENT	IN COOPERATION WITH	ENVIRONMENTAL CONSULTANT	PROJECT TITLE
HANAMURNI SDN. BHD. B-04-02, Tingkat 4, No. 42, Persiaran Greentown 1, Greentown Business Centre, 30450 Ipoh, Perak Darul Ridzuan. TEL : 012-9163133	ENVIRONMENTAL CONSULTANT AGENCIES (ECA) C – 11 – 24, Komplek Suria Kinrara, Taman Kinrara Seksyen 3, 47100 Puchong, Selangor Darul Ehsan. TEL : 019 - 361 5581/ 019 - 618 4831 EMAIL : ecaholding@live.com	NILAIMAS SERVICES 17-2 & 17-3 Jln Equine 10D, Tmn Equine, 43300 Seri Kembangan, Selangor Darul Ehsan. TEL : 03-8940 9959 FAX : 03-8940 9958 EMAIL : nilaimas.services@gmail.com	PROPOSED RUBBER FOREST PLANTATION ON PARTS OF COMPARTMENT 125, 126, 131 & 132 (BLOCK 1) AND PARTS OF COMPARTMENT 125, 126, 131 & 132 (BLOCK 2) WITH AN AREA OF 1600.00 HECTARES (3953.67 ACRES) AT PIAH FOREST RESERVE, DISTRICT OF HUTAN KUALA KANGSAR, PERAK DARUL RIDZUAN. SOURCE : Department Of Survey And Mapping Malaysia (JUPEM) Forestry Department Peninsular Malaysia (JPSM), JULY 2018

Figure 6.24 : Overall Catchment Area

Table 6.20 : Project Area within Respective Catchment

Catchment	Catchment Area (m^2)
W1	2,819,539.42
W2	291,557.07
W3	794,814.58
W4	2,927,065.14
W5	6,140,639.16
W6	735,091.61
W7	11,380,399.25
W8	8,244,069.60
W9	19,692,739.53
W10	21,702,251.40
W11	6,969,576.13
W12	681,900.80
W13	150,893.01
W14	22,585,548.81
W15	282,766,099.10
W16	185,945,551.00

6.8.6 Existing Landuse

Currently the land use on site is dominated by secondary forest (about 85% of the site) with patches of shrubs (secondary growth). There are also many natural lakes occupying the low land of the project area. **Figure 6.25** illustrates the existing land use and the water bodies (blue color) on the proposed plantation boundary. The land use surrounding the site is basically agriculture in nature with few patches of belukar or secondary growth.

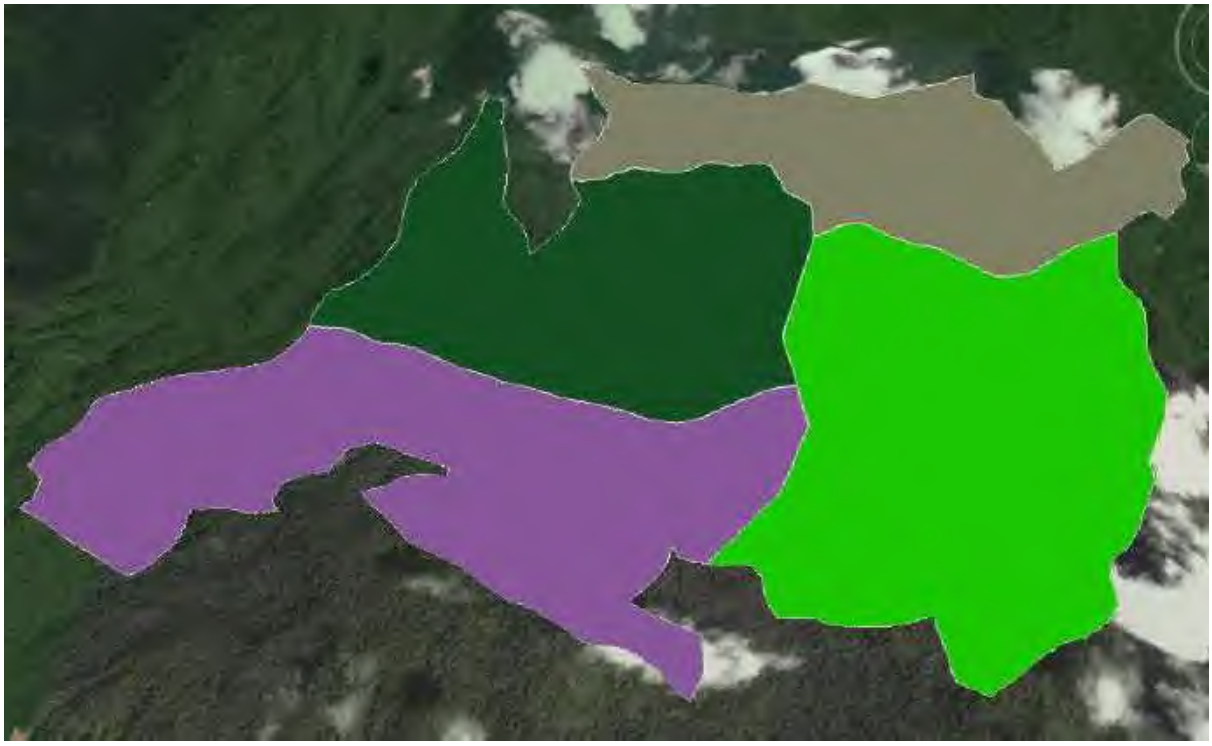


Figure 6.25 : Existing Land Use from Google Map

6.8.7 Proposed Landuse and Drainage System

The project proponent has proposed the area (secondary forest) to be converted into rubber forest plantation. The proposed drainage system within the development area is to drain all surface runoff from the site towards Sg. Piah catchment. There are a few river tributaries that flow within the project site that discharges toward Sg. Piah. All the contributed river were flows to Sg. Piah at southwest and northwest of the project site. The additional surface runoff from Sg. Piah catchment should be regulated before being discharged in to Sg. Perak.

6.8.8 Rainfall Stations Network

Figure 6.26 shows the location of the rainfall stations and the boundary of project site in Google Map, while **Figure 6.27** shows the selected rainfall stations from many stations that are located near the project area. There are about 20 rainfall stations all together. All 20

rainfall stations have rainfall data that is more than 20 years. **Table 6.21** shows the list of rainfall stations within the study area that was established by JPS. Some of these rainfall stations are still operational, while a few stations have been closed or shifted to other locations. The rain gage at the rainfall stations are either manual or automatic gage with logger. The same table provides all the necessary information about the rainfall stations including it's locations. Only rainfall with long period of data will be used in this study to derive the rainfall isohyets.

Table 6.21 shows the lists of rainfall stations that were used to derive the annual average rainfall (AAR) and monthly Average Rainfall (MAR). However, there are still a number of rainfall stations that were listed on the JPS list but the data are not available.

Table 6.21 : Lists of Rainfall Stations Used to Derive Mean Annual Rainfall (Perak)

Station Number	Station Name
4811075	RANC. BELIA PERLOP at SG. SIPUT
3615003	PEKAN TANJUNG MALIM
4010001	JPS. TELOK INTAN
4012143	LDG. BIKAM
4207048	PEJABAT JPS SITIAWAN
4209093	JPS. TELOK SENA
4311001	PEJABAT DEARAH KAMPAR
4409091	RUMAH PAM KUBANG HAJI
4411001	KOLAM TAKONGAN at AIR GOPENG
4511111	POLITEKNIK UNGKU OMAR
4611001	LDG. KUDA KEB. U/KINTA
4708084	IBU BEKALAN TALANG at KUALA KANGSAR
4807016	BKT. LARUT at TAIPING
4908018	PUSAT KESIHATAN KECIL at BATU KURAU
5005003	JLN. MATANG BULOH at BAGAN SERAI
5207001	KOLAM AIR JKR. at SELAMA
5210069	STN. PEMEREKSAAN at LAWIN
5411066	KUALA KENDERONG
5610063	KG. LALANG
5710061	DISPENSARI KROH

Figure 6.26 : Location of Rainfall Stations Within and Surrounding Project Area

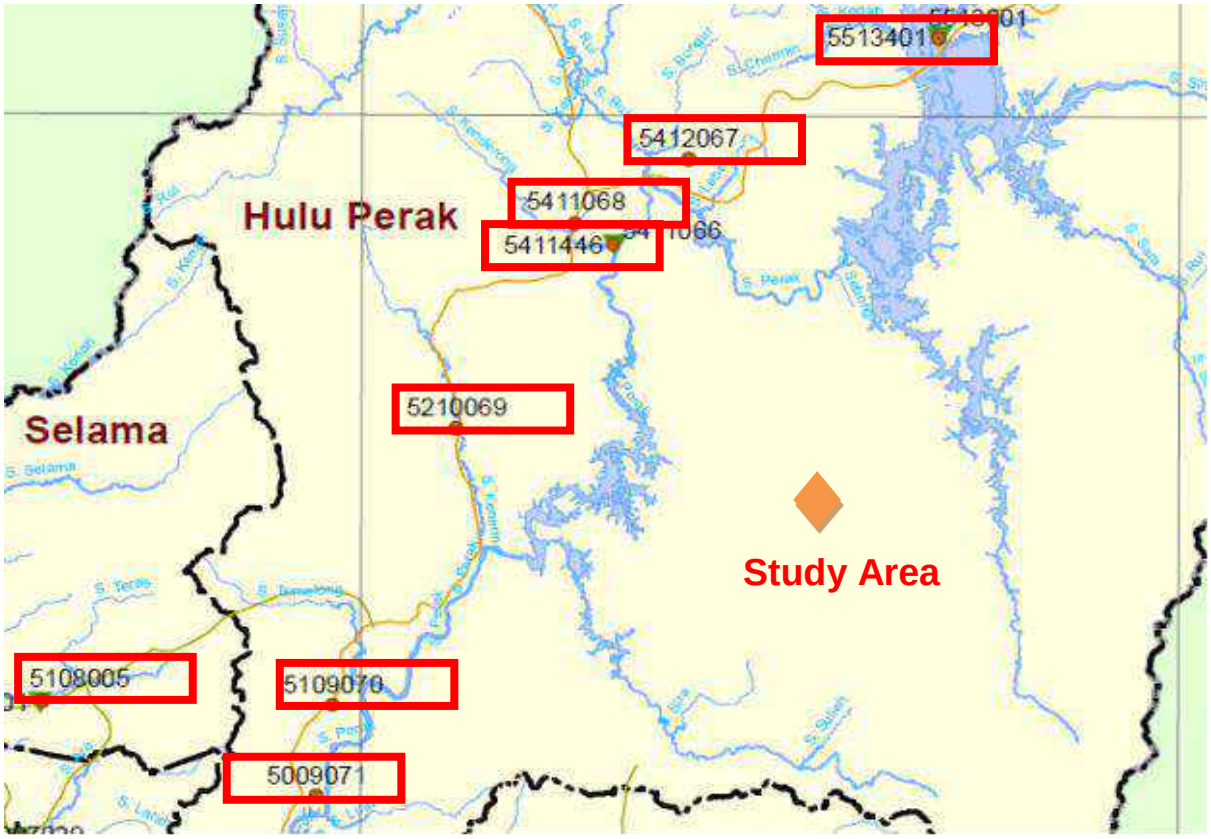


Figure 6.27 : Selected Rainfall Stations Within and Near Study Area

6.8.9 Rainfall Result and Analysis

The annual average rainfall (AAR) and monthly average rainfall (MAR) were derived from the available rainfall data from each rainfall station. The result from the nearest station (5210069) will be adopted for the project site. The AAR for the study area is shown in **Table 6.22**, while **Table 6.23** shows the AAR for all rainfall stations. The same table shows that the range of the AAR is between 1566 mm and 2971 mm. The result also shows that the rainfall is quite localized and shows large variation spatially. The STN. PEMEREKSAAN at LAWIN (5210069) station which is the closest station to the project site receives about 1566 mm while the neighbouring station (KUALA KENDERONG) receives about 1897 mm. The monthly average rainfall (MAR) was derived based on the average monthly rainfall during one year and based on average monthly rainfall for a specific month (January to December). **Table 6.24** shows the MAR based on STN. PEMEREKSAAN at LAWIN (5210069). The result shows that the month of October to January receives more rainfall than the other months, while February is the driest month.

Table 6.22 : Annual Rainfall for Various Stations

Station Number	Station Name	Period	Years	AAR
4811075	RANC. BELIA PERLOP at SG. SIPUT	1979-2012	33	1720.6
3615003	PEKAN TANJUNG MALIM	1973-2013	40	2369
4010001	JPS. TELOK INTAN	1971-2013	42	1947.9
4012143	LDG. BIKAM	1971-2013	42	2259.6
4207048	PEJABAT JPS SITIAWAN	1971-2012	41	1486.2
4209093	JPS. TELOK SENA	1975-2012	37	1981.1
4311001	PEJABAT DEARAH KAMPAR	1974-2013	39	2970.7
4409091	RUMAH PAM KUBANG HAJI	1971-2013	42	2259.6
4411001	KOLAM TAKONGAN at AIR GOPENG	1970-2014	44	1782.1

4511111	POLITEKNIK UNGKU OMAR	1972-2013	41	1966.5
4611001	LDG. KUDA KEB. U/KINTA	1975-2013	38	2040.5
4708084	IBU BEKALAN TALANG at KUALA KANGSAR	1970-2012	42	1601.4
4807016	BKT. LARUT at TAIPING	1970-2013	43	3698.7
4908018	PUSAT KESIHATAN KECIL at BATU KURAU	1970-2013	43	2869.7
5005003	JLN. MATANG BULOH at BAGAN SERAI	1970-2012	42	1867.6
5207001	KOLAM AIR JKR. At SELAMA	1975-2013	38	2628.4
5210069	STN. PEMEREKSAAN at LAWIN	1970-2012	42	1566.2
5411066	KUALA KENDERONG	1973-2013	40	1896.6
5610063	KG. LALANG	1972-2012	40	1831.2
5710061	DISPENSARI KROH	1970-2012	42	1893.5

Table 6.23 : Annual Average Rainfall for Various Stations

Year	4811075	3615003	4010001	4012143	4207048	4209093	4311001	4409091	4411001	4511111	4611001	4708084	4807016	4908018	5005003	5207001	5210069	5411066	5610063	5710061
1970		2369	-	-	0.0	1169.9		-	1290.0	1266.6	-	1046.8	2408.8	2035.5	1441.5	1226.6	1357.1	-	-	1429.2
1971		1702.5	1808.3	1842.8	1114.9	-		1099.1	1590.6	1094.8	1276.0	1638.9	2862.4	2975.8	1558.2	1997.5	1422.1	1894.2	1321.9	-
1972		1141.1	1533.7	2715.2	-	-		1803.9	1477.1	1094.8	-	-	1976.4	2965.1	2030.1	2159.0	1856.8	1043.1	1900.0	1696.1
1973		1283	-1448.2	2538.7	1599.4	-		1669.7	2209.7	1307.6	-	-	-	3918.7	2057.3	1457.0	1240.0	1071.1	-	1941.0
1974		-	-	1599.2	1300.8	-	1141.1	1088.7	-	2250.5	-	1405.0	-	2003.7	1044.9	1366.1	1102.8	-	2157.6	1402.1
1975		1210	1448.2	2032.2	1086.1	1069.6	2169.0	-	2175.1	1842.0	1464.5	1544.2	-	3126.5	2228.5	3421.2	-	1397.0	1951.0	-
1976		2257	1388.0	2650.0	1628.7	1915.2	2560.0	1090.9	-	1306.5	2252.9	1588.5	-	3058.0	1351.5	2849.3	-	1200.0	1527.0	-
1977		2249.1	1699.5	-	1620.0	1891.5	3245.5	1542	-	1306.5	1918.6	1491.5	-	3062.5	1667.0	2556.1	1206.5	1051.2	1016.0	-
1978		2528.8	1331.8	1052.2	1620.0	1625.5	1816.7	1001.5	-	1306.5	2469.9	-	1061.0	2594.0	1798.5	2743.7	1265.0	1070.0	1673.0	-
1979	1053.0	2790.7	1645.7	2175.1	1391.6	2375.2	3059.1	1711.5	-	1904.5	1666.5	1342.9	2665.0	2931.3	2108.5	3061.5	1772.0	1189.1	1521.1	1047.4
1980	1965.9	2060	2001.7	2820.7	1649.8	1956.7	3404.2	1842.6	-	2017.5	2267.0	1525.9	4563.3	3794.9	2632.3	2543.5	1863.9	1746.5	1519.3	1613.8
1981	1586.9	3107	2023.5	2093.3	1454.3	1995.2	2808.5	1541.5	-	2006.0	2125.5	1405.5	1030.2	3298.9	1676.5	2610.0	1403.6	1186.0	1640.0	1658.9
1982	1847.5	2322	4607.5	1737.3	1618.2	1934.8	3483.3	1940	-	2759.0	1786.0	1618.0	4820.0	3514.3	1906.4	3165.5	1680.2	1297.0	1265.0	1298.7
1983	1646.0	2456	1585.0	2737.0	1352.5	1594.5	3155.2	1455.5	-	2298.5	2239.5	1319.0	4063.0	3101.2	1696.7	3127.0	1736.3	3433.0	1707.0	1975.5
1984	1849.8	2693.5	2564.0	3369.0	1936.5	2508.0	3059.5	1973	-	1489.0	2017.5	1346.0	4502.0	3085.0	2390.5	2623.0	1398.5	3740.0	3244.0	1864.0
1985	2075.0	2954.5	2024.5	2739.0	1590.5	2295.0	2774.5	1798.5	-	2404.5	2050.0	1437.0	4437.0	3067.0	1786.5	3279.5	1534.0	3056.0	2311.7	2208.5
1986	1405.5	2591	1745.5	3294.5	1485.5	2067.0	1854.5	-	-	2726.0	-	1112.5	4221.5	2792.0	1732.5	3027.5	1128.5	2767.0	3305.0	1902.0
1987	1882.0	2010.4	2507.5	3056.5	1484.7	1965.0	3420.5	1834.5	-	2203.3	1844.7	1585.0	4217.0	3091.5	2117.0	2117.5	1537.0	3042.0	1642.5	1912.0
1988	1990.0	2276	2788.0	3269.0	1610.5	2301.5	3193.0	1567.5	-	1443.7	1828.0	1908.7	4332.0	3353.5	1665.7	3054.0	-	2010.0	2164.6	2305.0
1989	1521.0	1820	2290.5	2759.0	1586.0	2251.5	3091.4	1493.5	-	2004.0	2184.0	1475.5	3623.5	2796.0	1921.5	2648.5	1029.6	1532.5	1828.0	1500.3
1990	1584.5	2857.5	2245.5	2397.0	1413.3	1227.0	2214.6	1698.5	-	1484.0	1499.2	1654.0	3632.9	3653.0	1950.0	2711.0	1177.0	1501.0	2269.0	1922.5
1991	1443.0	2577	2322.5	2363.5	1039.0	2018.2	2998.5	1727	-	2837.5	2646.3	1543.5	3632.9	3408.5	2457.5	3533.5	1166.7	2220.5	1871.0	1862.0
1992	1567.5	3347.5	1923.5	2116.5	1581.5	2019.5	2244.0	1375	-	1679.5	2897.7	1215.5	3056.5	2432.5	1622.0	2815.0	1359.0	2436.0	1640.0	1894.1
1993	1176.7	2439.5	2232.5	1172.7	2057.0	2355.5	3100.0	2169	-	2481.5	1691.0	2212.0	4715.0	3402.0	2289.0	3261.0	2153.5	1915.5	1874.0	1883.5
1994	1801.0	2552	1669.0	2072.0	1341.0	2151.0	2713.0	1811	1599.5	2051.0	1732.2	1491.4	3298.5	2907.5	1843.5	3557.7	1631.5	2656.5	2230.0	1992.0
1995	2077.0	2102.4	1819.0	1043.8	1854.7	1557.0	3728.5	2062.9	-	1279.5	2829.0	2103.0	4186.0	3315.0	-	2801.7	1716.5	1887.0	1909.5	1914.5
1996	1979.0	2251.5	-	2173.7	1477.7	2036.5	3379.0	-	-	1724.3	3003.8	1899.6	4146.0	3480.0	-	2744.8	2319.5	2595.5	1920.0	2848.5

1997	2005.0	2810.4	2402.0	2331.6	1178.0	2144.0	3591.0	1555.5	-	2681.1	3003.8	1572.5	2972.0	2996.0	1609.2	2829.9	1549.0	2435.3	1891.5	2366.0
1998	1398.8	2547.5	1739.3	1457.1	1220.4	1888.6	3118.1	1799	-	2194.7	2199.3	1855.3	3497.0	3431.0	2537.3	2934.7	1679.8	2184.9	2375.9	2006.5
1999	2149.1	2421.8	1739.3	2639.4	1846.5	1924.5	3877.1	2349	-	2578.6	2332.0	1516.3	5244.0	3207.0	1885.5	1536.0	2332.8	2016.6	1775.8	2799.0
2000	2227.2	2875.7	2311.4	3077.8	1446.3	2336.1	3790.7	2349	-	2131.0	2231.5	1791.0	5238.0	2383.0	1786.5	-	2095.0	1756.4	1723.6	-
2001	1635.7	3049.1	1611.6	2521.7	1402.0	1646.8	2770.7	1689	-	1867.0	1623.5	1628.6	4245.1	1466.5	1637.9	-	1799.5	1009.4	1582.0	-
2002	1723.0	2237	2076.9	3098.3	1586.0	1721.8	3716.7	1721.5	-	2022.4	1457.5	1702.2	3726.5	3024.0	1512.9	1777.0	1234.3	1192.9	1377.6	1743.0
2003	1595.6	3516	2827.3	2584.0	1896.3	2034.1	3656.0	1702.9	-	1432.0	-	1669.1	3583.7	1565.7	-	-	1439.5	1241.5	-	1974.1
2004	1956.8	1868.5	1033.8	2600.0	1529.8	2458.7	3595.7	1943.1	-	1714.0	1164.0	1948.7	3872.7	3812.2	1889.7	2571	1497.3	-	1641.0	1954.7
2005	1461.0	3431.5	1636.0	1329.5	1714.5	-	3186.0	1400.5	-	1005.0	1687.0	1087.5	-	1392.1	-	3149	1289.0	1578.0	1172.5	1634.0
2006	1302.5	2245.5	2617.5	1564.0	-	1724.5	3001.0	1286	-	4027.0	1866.5	-	-	1089.5	-	3304.5	-	-	1936.0	-
2007	1991.7	2465.4	1594.0	1435.0	-	-	2027.5	-	-	2580.5	1963.5	1624.0	-	-	1534.5	3182.1	1451.5	2131	1209.5	2257.5
2008	1736	1283	2392.5	1006.0	-	1706.5	3933.0	1915.5	1589.0	2889.5	2805.3	2293.4	-	-	-	1347.3	1987.0	2031	2037.5	1359.4
2009	1407.9		2334.5	2402	1789.5	2124	3327	1778.5	2326	2421.5	1045.7	2050.6	4830.5	1517.6	2130.5		1971.5	1878.7	1898	2375.6
2010	1934.5		2200.5	1226.5	1173.5	2179.5	3112	1917	2779	2500		1781	3793	2915	1690.5		1879.5	1794.8	2124.8	2016.5
2011	-	-	2575.5	2569.5	2262.9	2679.9	2978.6	2120.5	2265.7	1074.3		1921.4	4884.8	2969.3	2218.5		1765.5	-	2017.9	2253.3
2012			2689.9	2669.5	1682.6	2451.4	2941.4	1820.5	2648.3			1765.1	4968.9	3286.6	1784.3		1743.4		-	2246
2013			1120.2	-	-	-	1590	1248.5	1298			-	1523.3	1216.3	-		-			-
Average	1718.003	2386.853	1967.29	2251.995	1503.141	1981.114	2970.653	1689.572	1937.333	1968.755	2031.453	1618.374	3709.44	2843.707	1870.024	2641.394	1583.903	1896.978	1850.559	1915.92

Table 6.24 : MAR for STN. PEMEREKSAAN at LAWIN (5210069)

YEAR	MONTHLY RAINFALL (mm/month)											
	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DIS
1970	?	?	?	?	?	2.8	121.8	126.1	331.4	358.3	253.9	162.7
1971	35.8	99.3	103.2	58.7	165.2	104.4	31.6	115.6	194.1	178.5	94.3	241.4
1972	0.1	219.7	49.7	238.1	90.7	86	6.2	103.7	221.2	361.8	458	21.6
1973	51.3	22	18.2	110.9	184.2	143	39.9	71.1	161.8	114.5	159.9	163.3
1974	3.8	62.2	72.6	34.1	71.8	202.7	181.9	64.2	107.5	121.6	179.5	0.8
1975	178	53.7	80.3	38.9	67.1	46.7	62	45.6	4.3	121.5	?	3.7
1976	1.8	0	9.6	?	13.1	123.3	38	94	177	282.5	208	50
1977	91	33	36.5	58	178	25	65	100	114.5	297.2	129.8	78.5
1978	44	44.5	172	180.5	114	40	91	64	109	214	164	28
1979	11	91	88.5	225	43.5	151.5	147.5	126.5	194.5	289.5	403.5	0
1980	9.7	44.2	113.7	144	378	48.7	58.5	276.5	98.1	320.9	255.1	116.5
1981	12	72	149.5	147.8	385.3	61.5	9	55.5	247.5	76.5	162.5	24.5
1982	2.5	10.5	38.5	218	310.5	31.5	99.5	61	126.5	311.5	356.7	113.5
1983	3.3	153.5	108	154.5	272.5	127.5	72	113	359	154	60.5	158.5
1984	141	66.5	123	92.5	103	89	186	36.5	91.5	206	184	79.5
1985	23.5	96.5	201	44	147	12.5	148	73	135.7	257.3	353.5	42
1986	9	41.5	135	185	106	100	57	10.5	119	230	65.5	70
1987	3	0	92.5	82	257.5	127	83.5	184.5	143.5	271	139.5	153
1988	9	27	111.5	97	38	56	68.5	29.5	92.5	105.5	119.5	238.5
1989	87.5	66.5	41	165	65.5	150.5	78.6	30.5	172	172	0.5	?
1990	3.5	26.5	42	93	222	52.5	136	64.5	126.5	243.5	141	26
1991	0	?	100	200	362.5	33	?	51.7	97	175.5	68.3	78.7
1992	14	97.5	113.5	236.5	115	70	102	102.5	140	159.5	132.5	76
1993	66.5	49.5	96.5	185.5	463.5	109.5	113	130.5	185.5	272	288.5	193
1994	4	131.5	155	226.5	178.5	94.5	21.5	213.5	103	233	177.5	93
1995	60.5	79.5	97.5	234.5	77.5	64.5	129	344	113.5	274.5	181	60.5
1996	126.5	54.5	119.4	316.1	145.5	229.5	234.5	120.5	84.5	328	180.9	379.6

1997	25	64.5	65	160.5	56	112	174.5	121.5	249.5	239	230.5	51
1998	59.5	33.5	83	68	120.5	57.5	230.5	152	103	207.2	386.8	178.3
1999	135.7	71.5	173.9	191.7	187.7	71.9	109.3	185.7	421	403.2	205.8	175.4
2000	76.9	129.4	184.1	260.5	145.5	95.5	53	163.5	309.7	260.8	311.7	104.4
2001	219.1	20.4	118.5	277.4	152	161.8	95.6	44.6	129.5	297	168.6	115
2002	7.1	88.2	18.5	168.5	45.6	168.3	51.1	118	127.5	187.5	140	114
2003	23.3	14.2	84.6	224.9	179	196.5	70.5	53	72.5	254	197	70
2004	77.3	63.7	193.5	65.5	246	61.3	76.1	74	186.5	159.8	207.6	86
2005	1	64.5	112.5	164.5	79	95	72	159	66	164	157.5	154
2006	81	123.5	0.5	137	0.5	83.5	95.5	116.5	61.5	11.5	151.5	118.5
2007	5.5	95.5	88	218	198.5	196.5	0	?	?	311.5	108	230
2008	149	109.5	138.5	92.5	75.5	125.5	64.5	195.5	229.4	314.6	328.5	164
2009	68	23	280	207.5	162	7.4	184.1	275.2	228.5	155.8	328.5	51.5
2010	39	119	89.5	129.5	107.5	106	185	380.5	221.5	86	359.5	56.5
2011	100	61	219.5	189.5	125.5	87.5	30.5	179.5	219	239.5	220	94
2012	117	142.5	268.5	180.5	52	77.8	48.7	132.5	107	198	188	230.9
2013	33.6	126.8	75.7	147.5	89	50.1	?	?	?	?	?	?
Avg	51	71	108	158	153	94	93	123	161	224	205	111

6.8.10 Water Balance at Project Site

Water balance equation is used to obtain the total volume of rain water that infiltrate into soil as recharge to groundwater. The sandy soil within the area provides recharge area to the saturated zone. The water balance equation is as follows:-

$\Delta S/\Delta T = P - R - G - ET$

$\Delta S/\Delta T$ - Storage
P - Precipitation
R - Runoff
G - Groundwater
ET - Evapotranspiration

Therefore, $G = P - \Delta S/\Delta T - R - ET$

• Precipitation data

The precipitation data was obtained from Station RANC. BELIA PERLOP at SG. SIPUT (4811075) since it is the closest station to the project site. The monthly and annual average rainfall for this station are shown in **Table 6.25 and 6.26** respectively. The annual average is lower than the national average by 1000mm. The monthly average shows that February is the driest month. The rest of the months provide plenty of rainfall for groundwater recharge and storm water.

Table 6.25 : Monthly Rainfall Data Obtained from Station PEMEREKSAAN at LAWIN (5210069)

Year	Monthly Rainfall (Mm/Month)											
	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DIS
1970	?	?	?	?	?	2.8	121.8	126.1	331.4	358.3	253.9	162.7
1971	35.8	99.3	103.2	58.7	165.2	104.4	31.6	115.6	194.1	178.5	94.3	241.4
1972	0.1	219.7	49.7	238.1	90.7	86	6.2	103.7	221.2	361.8	458	21.6
1973	51.3	22	18.2	110.9	184.2	143	39.9	71.1	161.8	114.5	159.9	163.3
1974	3.8	62.2	72.6	34.1	71.8	202.7	181.9	64.2	107.5	121.6	179.5	0.8
1975	178	53.7	80.3	38.9	67.1	46.7	62	45.6	4.3	121.5	?	3.7
1976	1.8	0	9.6	?	13.1	123.3	38	94	177	282.5	208	50
1977	91	33	36.5	58	178	25	65	100	114.5	297.2	129.8	78.5
1978	44	44.5	172	180.5	114	40	91	64	109	214	164	28
1979	11	91	88.5	225	43.5	151.5	147.5	126.5	194.5	289.5	403.5	0
1980	9.7	44.2	113.7	144	378	48.7	58.5	276.5	98.1	320.9	255.1	116.5
1981	12	72	149.5	147.8	385.3	61.5	9	55.5	247.5	76.5	162.5	24.5
1982	2.5	10.5	38.5	218	310.5	31.5	99.5	61	126.5	311.5	356.7	113.5
1983	3.3	153.5	108	154.5	272.5	127.5	72	113	359	154	60.5	158.5
1984	141	66.5	123	92.5	103	89	186	36.5	91.5	206	184	79.5
1985	23.5	96.5	201	44	147	12.5	148	73	135.7	257.3	353.5	42
1986	9	41.5	135	185	106	100	57	10.5	119	230	65.5	70

1987	3	0	92.5	82	257.5	127	83.5	184.5	143.5	271	139.5	153
1988	9	27	111.5	97	38	56	68.5	29.5	92.5	105.5	119.5	238.5
1989	87.5	66.5	41	165	65.5	150.5	78.6	30.5	172	172	0.5	?
1990	3.5	26.5	42	93	222	52.5	136	64.5	126.5	243.5	141	26
1991	0	?	100	200	362.5	33	?	51.7	97	175.5	68.3	78.7
1992	14	97.5	113.5	236.5	115	70	102	102.5	140	159.5	132.5	76
1993	66.5	49.5	96.5	185.5	463.5	109.5	113	130.5	185.5	272	288.5	193
1994	4	131.5	155	226.5	178.5	94.5	21.5	213.5	103	233	177.5	93
1995	60.5	79.5	97.5	234.5	77.5	64.5	129	344	113.5	274.5	181	60.5
1996	126.5	54.5	119.4	316.1	145.5	229.5	234.5	120.5	84.5	328	180.9	379.6
1997	25	64.5	65	160.5	56	112	174.5	121.5	249.5	239	230.5	51
1998	59.5	33.5	83	68	120.5	57.5	230.5	152	103	207.2	386.8	178.3
1999	135.7	71.5	173.9	191.7	187.7	71.9	109.3	185.7	421	403.2	205.8	175.4
2000	76.9	129.4	184.1	260.5	145.5	95.5	53	163.5	309.7	260.8	311.7	104.4
2001	219.1	20.4	118.5	277.4	152	161.8	95.6	44.6	129.5	297	168.6	115
2002	7.1	88.2	18.5	168.5	45.6	168.3	51.1	118	127.5	187.5	140	114
2003	23.3	14.2	84.6	224.9	179	196.5	70.5	53	72.5	254	197	70
2004	77.3	63.7	193.5	65.5	246	61.3	76.1	74	186.5	159.8	207.6	86
2005	1	64.5	112.5	164.5	79	95	72	159	66	164	157.5	154
2006	81	123.5	0.5	137	0.5	83.5	95.5	116.5	61.5	11.5	151.5	118.5
2007	5.5	95.5	88	218	198.5	196.5	0	?	?	311.5	108	230
2008	149	109.5	138.5	92.5	75.5	125.5	64.5	195.5	229.4	314.6	328.5	164
2009	68	23	280	207.5	162	7.4	184.1	275.2	228.5	155.8	328.5	51.5
2010	39	119	89.5	129.5	107.5	106	185	380.5	221.5	86	359.5	56.5
2011	100	61	219.5	189.5	125.5	87.5	30.5	179.5	219	239.5	220	94
2012	117	142.5	268.5	180.5	52	77.8	48.7	132.5	107	198	188	230.9
2013	33.6	126.8	75.7	147.5	89	50.1	?	?	?	?	?	?
Avg	51	71	108	158	153	94	93	123	161	224	205	111

Table 6.26 : Annual Rainfall Data Obtained from Station PEMEREKSAAN at LAWIN (5210069)

ANNUAL RAINFALL	
5210069	
1970	1357.1
1971	1422.1
1972	1856.8
1973	1240.0
1974	1102.8
1975	-
1976	-
1977	1206.5
1978	1265.0
1979	1772.0
1980	1863.9
1981	1403.6
1982	1680.2
1983	1736.3
1984	1398.5
1985	1534.0
1986	1128.5
1987	1537.0
1988	-
1989	1029.6
1990	1177.0
1991	1166.7
1992	1359.0
1993	2153.5
1994	1631.5
1995	1716.5
1996	2319.5
1997	1549.0
1998	1679.8
1999	2332.8
2000	2095.0
2001	1799.5
2002	1234.3
2003	1439.5
2004	1497.3
2005	1289.0
2006	-

2007	1451.5
2008	1987.0
2009	1971.5
2010	1879.5
2011	1765.5
2012	1743.4
2013	-
AVG =	**1566.2**

- Surface Runoff (R)
  Runoff (R) is estimated to be about 40% of the total precipitation, therefore the R value is shown in **Table 6.27**.

Table 6.27 : Estimated Runoff (mm/month)

Month	Runoff (mm)
JAN	21
FEB	29
MAR	43
APR	63
MAY	61
JUN	38
JULY	37
AUG	49
SEPT	65
OCT	89
NOV	82
DIS	44

- Evaporation (E)
  Evaporation (E) for project site is obtained from the nearest evaporation station measured in Bagan Serai. This station is suitable for the study since this station is located near coastal area. The evaporation rate for the project site is based on the value obtained from other evaporation station (Bagan Serai). The recorded evaporation rate is from 1993 to 2014 (**Table 6.28**). The average evaporation rate ranges from 2.8 mm/day to 4.6 mm/day. The month of December records the lowest evaporation rate while month of April records the highest evaporation rate.

Table 6.28 : Evaporation Rate Measured in Bagan Serai

Year	Month											
	Jan	Feb	March	April	May	June	July	August	Sept	October	Nov	Dec
1993	2.7	3.9	4.4	3.9	4.1	4.4	3.8	4.4	4.2	3.7	3.1	2.4
1994	3.3	3.4	3.1	3.6	4.0	3.9	4.0	3.5	3.4	3.6	1.8	3.3
1995	3.2	2.8	3.9	4.0	4.1	3.8	3.6	3.5	3.8	3.6	3.0	2.5
1996	3.0	3.0	4.4	4.5	4.0	3.5	3.9	4.2	3.9	3.3	3.3	2.4
1997	4.0	3.6	4.4	3.7	4.5	4.4	3.9	4.1	3.4	3.4	3.2	2.8
1998	3.4	4.8	4.6	5.6	4.6	4.0	4.1	3.9	4.3	4.1	3.2	2.9
1999	2.6	4.2	4.3	3.8	4.0	3.8	4.2	4.2	4.0	3.1	3.0	2.7
2000	3.2	3.4	3.9	4.2	4.2	4.0	3.8	4.3	3.7	4.0	2.9	2.9
2001	3.3	3.8	3.6	3.9	4.1	4.0	4.6	4.3	4.3	3.7	2.5	2.9
2002	3.2	4.5	5.3	4.7	4.1	3.9	4.6	4.5	4.2	4.6	3.8	3.7
2003	3.6	4.1	4.8	4.8	4.5	5.1	4.2	4.6	4.6	4.3	3.7	3.2
2004	3.6	4.0	4.0	5.2	4.7	4.5	4.3	4.9	4.4	4.0	3.7	3.4
2005	3.4	5.2	4.9	4.9	4.4	4.1	4.3	4.3	4.5	3.0	3.3	2.1
2006	3.2	3.1	3.8	3.5	3.4	3.7	4.1	4.4	4.6	3.5	3.2	3.2
2007	2.2	3.5	3.6	3.7	3.8	3.8	3.7	4.2	4.0	4.0	3.1	3.6
2008	2.6	3.8	3.3	4.3	3.4	4.0	3.3	4.2	4.3	3.7	3.4	2.5
2009	3.2	4.0	3.9	4.1	4.3	4.2	3.9	4.2	4.2	5.0	2.8	2.7
2010	3.4	4.4	4.6	5.0	4.2	4.5	4.2	4.1	3.9	3.5	3.5	3.0
2011	3.1	3.7	3.1	3.8	4.1	3.7	3.5	4.0	4.4	4.2	3.0	2.9
2012	2.9	4.1	4.0	3.8	4.1	4.1	4.0	4.6	4.3	3.5	3.5	2.9
2013	2.7	3.1	4.1	3.9	4.2	4.2	4.3	4.0	4.6	4.2	3.4	2.7
Mean	3.1	3.8	4.1	4.2	4.1	4.1	4.0	4.2	4.1	3.8	3.2	2.9
Mm/month	97	107	127	127	128	122	125	130	124	118	95	89

- $\Delta S/\Delta T$ is assumed to be zero

The monthly recharge to groundwater (G) values is calculated using the water balance equation as shown in **Table 6.29**. The trend of the groundwater recharge is shown in **Figure 6.28**. The driest month in February provides little or no recharge to the groundwater. The project proponent should provide storage for storing surface runoff during wet season and use it during dry season. The continuous recharge throughout the year should provide enough groundwater to be used during the dry season.

Table 6.29 : Monthly Groundwater Recharge (mm/month)

Month	Gwater (mm)
JAN	0
FEB	0
MAR	0
APR	0
MAY	0
JUN	0
JULY	0
AUG	0
SEPT	0
OCT	40
NOV	47
DIS	0

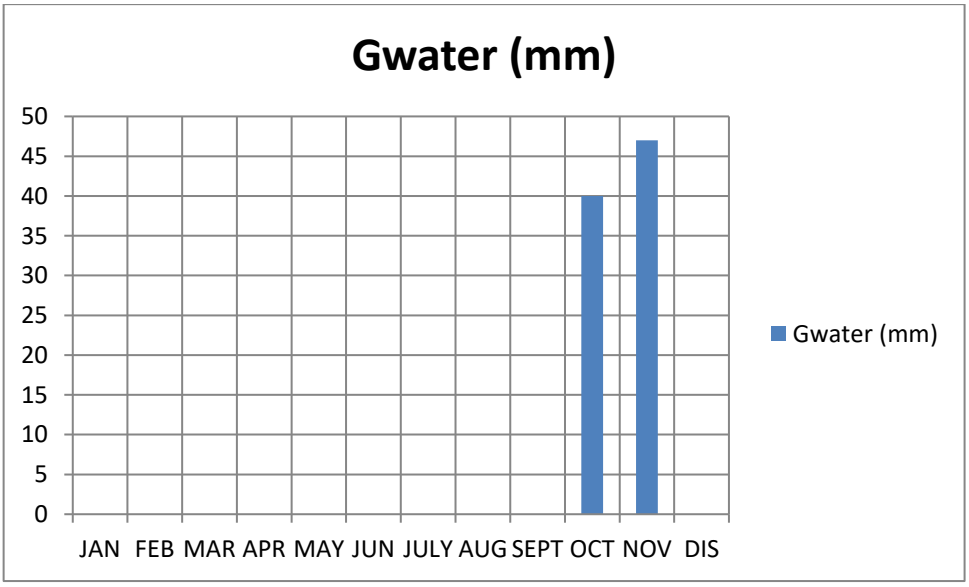


Figure 6.28 : Trend of Groundwater Recharge

6.8.11 Catchments Area Characteristics

The proposed plantation area lies within five catchment area. **Figure 6.29** shows the location of the project site in relation to the Sg. Piah tributary catchments. The project site is located relatively at the middle stretch of the Sg. Piah catchment, and at the upstream of Sg. Perak river basin. The catchment area for the plantation area is listed in Table. The proposed project site drains into a small stream that traverses the site before joining a much bigger river. The river then joins with a few other major tributaries before flowing towards the estuary.

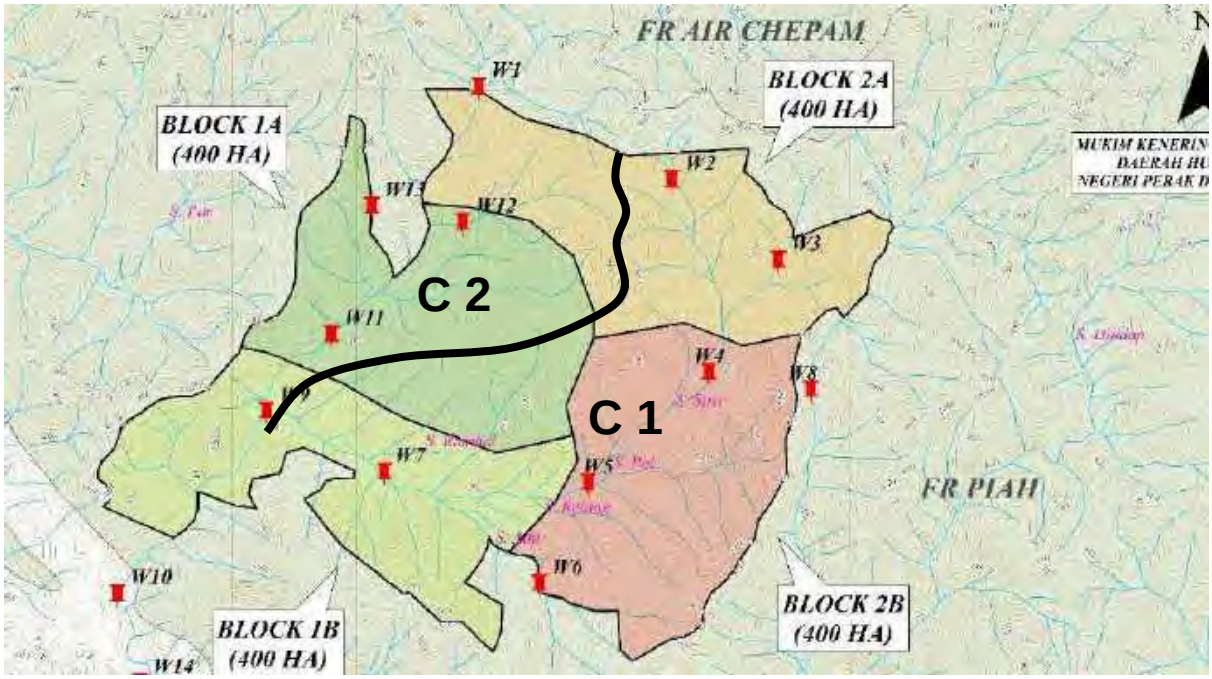


Figure 6.29 : Location of Project area within Sg. Piah Catchment.

Within the project site itself, there are small streams or channels flowing through the project site. However, in the upstream area of Sg. Perak, the main river flows through the project development area. However, the proposed drainage system is designed that the surface runoff from the project development area would only discharge toward Sg. Perak. The runoff from the project site were designed in such a way that it would discharge toward Sg. Piah catchment. The

plantation area can be subdivided into 2 catchments. **Table 6.30** lists the catchment area.

The changing of land use from forested area to plantation areas causes an increase of peak flow and volume in surface runoff water. The green areas that have been providing canopy storage for interception of rainfall have been chopped down, and this causes the increase of surface runoff that will be drained to the drainage system.

Table 6.30 : Catchmet Area

Catchment	Area (HA)
1	1000
2	600

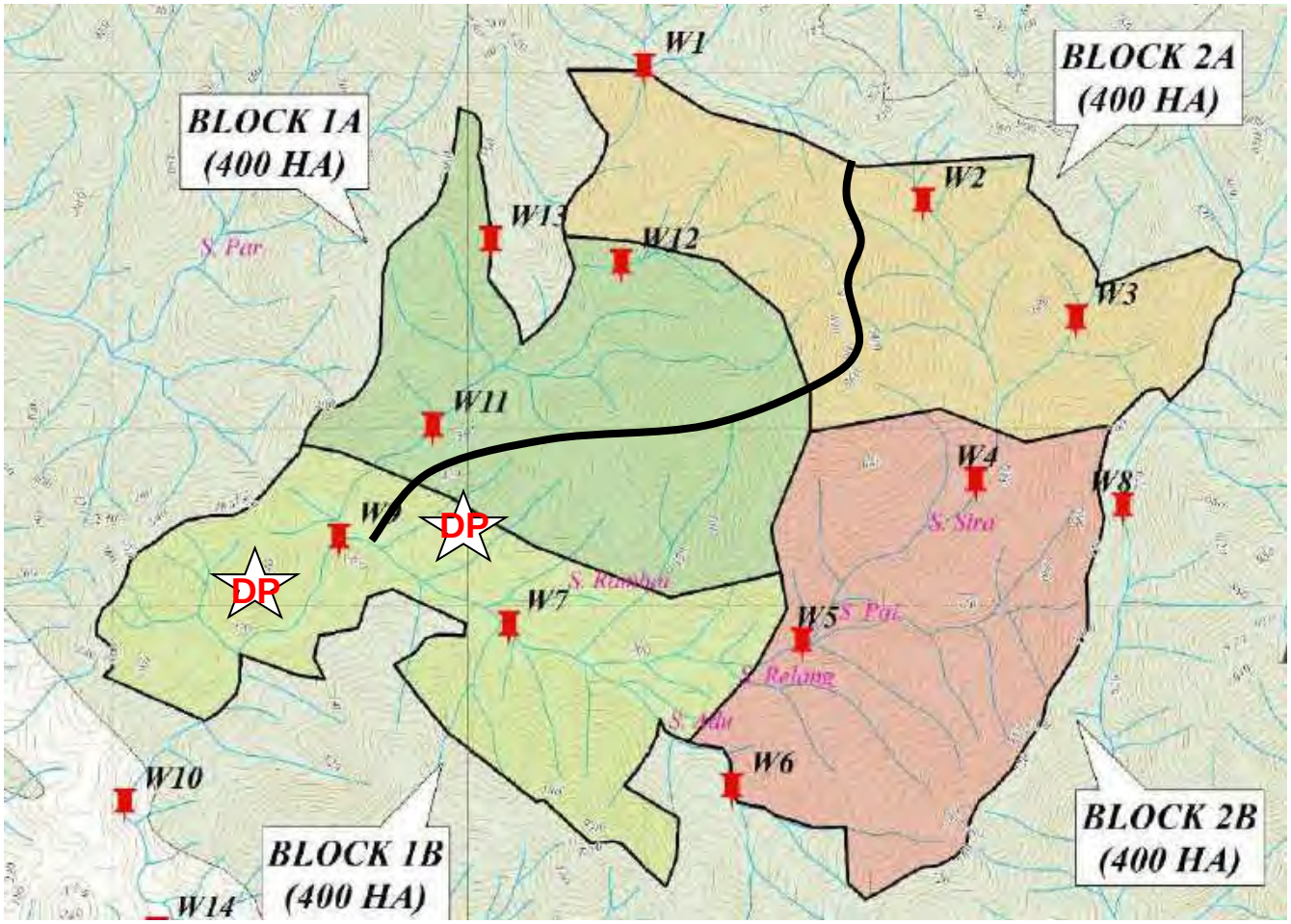


Figure 6.30 : Proposed Layout of Flood Detention Pond (Sg. Piah Catchment)

6.8.12 Hydrologic Modelling

Hydrologic modelling of the pre and post-development flows for the catchment area was carried out using HEC-HMS model. The development area is located within two sub-catchments (**Figure 6.29**). The representation of the sub-catchments for the project development area in HEC-HMS is shown in **Figure 6.31**. Catchment represents the catchment area that drains naturally toward the outlet based on the topography. The discharge from the project area that lies within Sg. Piah catchment would be diverted to Sg. Perak. The design storm selected for this study depends on the time of concentration of the study area (t_c). The t_c (t_o + t_d) was estimated by using the overland flow time formulae and drain flow time formulae. The estimated t_c at the outlet of the sub-catchment is listed in **Table 6.31.**

Travel Path	Travel Time	Remark
Overland Flow	$t_o = \frac{107 n^* L^{1/3}}{S^{1/5}}$	t_o = Overland sheet flow travel time (minutes) L = Overland sheet flow path length (m) *for Steep Slope (>10%), L ≤ 50 m* *for Moderate Slope (<5%), L ≤ 100 m* *for Mild Slope (<1%), L ≤ 200 m* n^* = Horton's roughness value for the surface (Table 2.2) S = Slope of overland surface (%)
Drain Flow	$t_d = \frac{n.L}{60R^{2/3}S^{1/2}}$	n = Manning's roughness coefficient (Table 2.3) R = Hydraulic radius (m) S = Friction slope (m/m) L = Length of reach (m) t_d = Travel time in the drain (minutes)

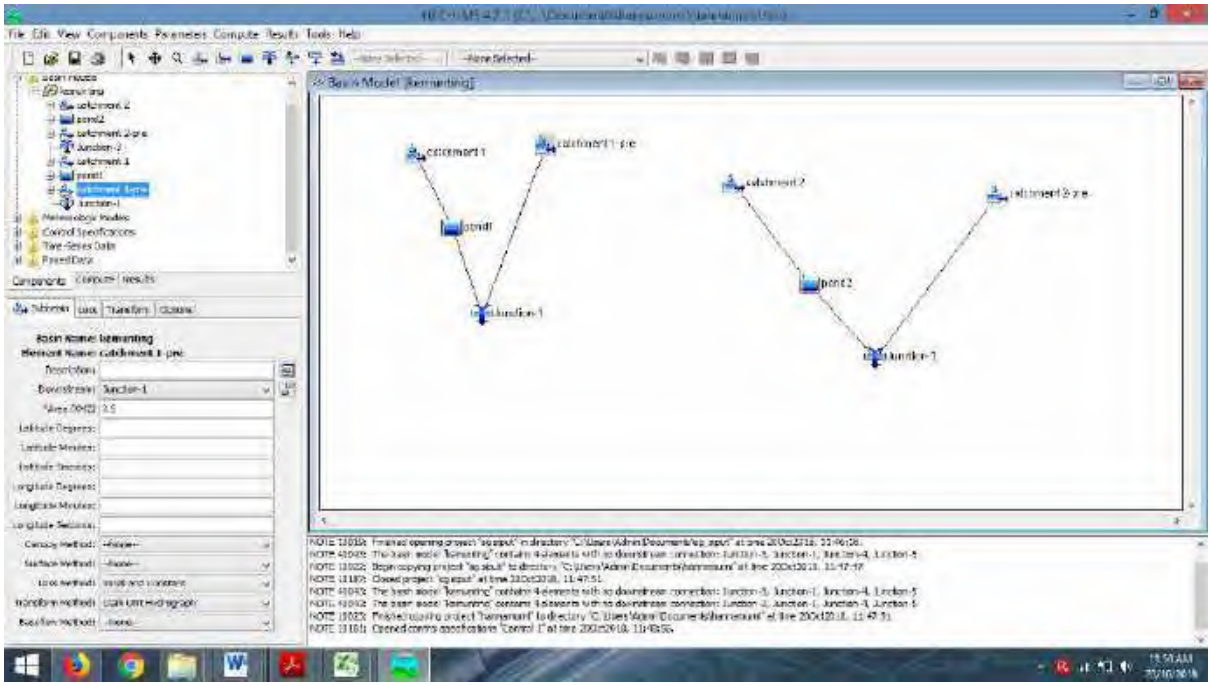


Figure 6.31 : Representations of the Project Area Sub-Catchments

Table 6.31 : Estimated t_c values (Pre-Development)

Catchment	Area (HA)	Tc (Hr)
1	1000	3
2	600	2.2

The time of concentration (t_c) ranges from 120 to 180 minutes for pre-development condition. The flow from catchment C1 will flow toward C2, and discharges to Sg. Piah. Therefore, the adopted storm duration for this study is based on the longest time of concentration which is about 3 hour.

The derived Tc serves as the storm duration for the design storm. The design storm intensity for the area can be derived from the IDF curve. The IDF equation used to derive the rainfall intensity is shown in equation 2. There are a number of IDF curves within the state of Perak (**Table 6.32**). The closest IDF curve available for this study area is Station PEMEREKSAAN at LAWIN. Station PEMEREKSAAN at LAWIN station is located within the river basin of Sg. Perak. Therefore, the station is selected based on the station that is located

within the same river basin. In this study, the IDF derived for the Station PEMEREKSAAN at LAWIN (**Figure 6.32**) will be used for the simulation of surface runoff as the station is located within the same river basin as the project development site. The temporal pattern used for this study is based on the Perak temporal pattern. The design storm hyetograph of 5, **50** years and **100** years ARI will be used in this study. **Table 6.34 and Table 6.35** listed the rainfall intensity used in this study for various ARI's.

$$i = \frac{\lambda T^{\kappa}}{(d+\theta)^{\eta}}$$

where,

i = Average rainfall intensity (mm/hr);

T = Average recurrence interval - ARI ($0.5 \leq T \leq 12$ month and $2 \leq T \leq 100$ year);

d = Storm duration (hours), $0.0833 \leq d \leq 72$; and

λ, κ, θ and η = Fitting constants dependent on the rain gauge location

Figure 6.32 : Study Area and the Selected Design Storm Station

Table 6.32 : IDF Curves for Various Stations within Perak.

State	No.	Station ID	Station Name	Constants			
				λ	κ	θ	η
Perak	1	5005003	JPS Teluk Intan	65.1854	0.3681	0.2552	0.8458
	2	4010001	JPS Setiawan	56.2695	0.3434	0.2058	0.8465
	3	4207048	Pejabat Daerah Kampar	79.2706	0.1829	0.3048	0.8532
	4	4311001	Rumah Pam Kubang Haji	47.8316	0.3527	0.1038	0.8018
	5	4409091	Politeknik Ungku Umar	62.9315	0.3439	0.1703	0.8229
	6	4511111	Bukit Larut Taiping	83.3964	0.3189	0.1767	0.8166
	7	4807016	Rancangan Belia Perlop	57.4914	0.3199	0.2027	0.8696
	8	4811075	Jln. Mtg. Buloh Bgn Serai	63.2357	0.3176	0.3330	0.8462
	9	5207001	Kolam Air JKR Selama	67.0499	0.3164	0.2255	0.8080
	10	5210069	Stesen Pem. Hutan Lawin	53.7310	0.3372	0.2237	0.8347
	11	5411066	Kuala Kenderong	68.5357	0.4196	0.1558	0.8378
	12	5710061	Dispensari Keroh	59.2197	0.3265	0.1621	0.8522

Table 6.33 : Region 2: Perak, Kedah, Pulau Pinang, and Perlis

No. of Block	Storm Duration								
	15-min	30-min	60-min	180-min	6-hr	12-hr	24-hr	48-hr	72-hr
1	0.215	0.158	0.068	0.06	0.045	0.04	0.022	0.027	0.016
2	0.395	0.161	0.074	0.085	0.07	0.06	0.024	0.028	0.023
3	0.39	0.21	0.077	0.086	0.078	0.066	0.029	0.029	0.027
4		0.173	0.087	0.087	0.099	0.092	0.031	0.033	0.033
5		0.158	0.099	0.1	0.113	0.114	0.032	0.037	0.036
6		0.141	0.106	0.1	0.129	0.166	0.035	0.04	0.043
7			0.104	0.1	0.121	0.199	0.039	0.046	0.047
8			0.098	0.088	0.099	0.113	0.042	0.048	0.049
9			0.078	0.087	0.081	0.081	0.05	0.049	0.049
10			0.075	0.085	0.076	0.066	0.054	0.054	0.051
11			0.072	0.063	0.047	0.046	0.065	0.058	0.067
12			0.064	0.059	0.041	0.036	0.093	0.065	0.079
13							0.083	0.06	0.068
14							0.057	0.055	0.057
15							0.052	0.053	0.05
16							0.047	0.048	0.049

17							0.04	0.046	0.048
18							0.039	0.044	0.043
19							0.033	0.038	0.038
20							0.031	0.034	0.035
21							0.029	0.03	0.03
22							0.028	0.029	0.024
23							0.024	0.028	0.022
24							0.02	0.019	0.016

Table 6.34 : Rainfall Intensity (mm/hr) for various duration (minutes)

ARI (yrs)	30	60	90	120	180	360
2	78.27	50.29	37.70	30.44	22.29	12.83
5	91.38	58.71	44.02	35.54	26.02	14.98
10	102.74	66.01	49.49	39.96	29.25	16.85
20	115.50	74.21	55.64	44.92	32.89	18.94
50	134.85	86.64	64.96	52.45	38.40	22.11
100	151.61	97.41	73.03	58.96	43.17	24.86

Table 6.35 : Rainfall depth (mm) for various duration (minutes)

ARI (yrs)	30	60	90	120	180	360
2	39.13	50.29	56.55	60.88	66.86	77.01
5	45.69	58.71	66.03	71.08	78.06	89.91
10	51.37	66.01	74.23	79.91	87.76	101.08
20	57.75	74.21	83.46	89.84	98.67	113.64
50	67.42	86.64	97.43	104.89	115.20	132.68
100	75.80	97.41	109.54	117.93	129.51	149.17

The temporal pattern used for this study is based on the temporal pattern for Perak state. The design storm hyetograph of 20, 50 years and 100 years ARI's for 3 hour storm duration is also shown in **Table 6.36.**

Table 6.36 : Temporal Pattern for 3 hour Storm

3 hour		
20 Year	**50 year**	**100 Year**
4.5	6.9	5.8
6.3	9.8	8.3
6.4	9.9	8.4
6.5	10.0	8.5
7.4	11.5	9.7
7.4	11.5	9.7
7.4	11.5	9.7
6.5	10.1	8.6
6.5	10.0	8.5
6.3	9.8	8.3
4.7	7.3	6.1
4.4	6.8	5.7

The hydrologic losses for the area will be based on initial and continuing loss method. The initial loss is assumed to be 10 mm and the continuing loss is assumed to be 15 mm/hr. It is also assumed that the pre-development land cover consists of 10% impervious area, and the post-plantation consists of 45% impervious area. The transformation of effective rainfall to the outlet area will be based on Clark time-area method. The two parameters used for the development of this synthetic unit hydrograph are T_C and R. These two parameters can be obtained from observed hydrograph. In the absence of the observed hydrograph, the parameters can be estimated from regression equations derived areas with gauged data.

The regression equation used in this study is derived from a study in small rural watersheds in Illinois, USA (Straub, Melching and Kocher, 2000). The regression equations are as listed below.

$T_c = 1.54\ L^{0.875}\ S^{-0.181}$ .....Equation 2.

$R = 16.4\ L^{0.342}\ S^{-0.790}$ .....Equation 3.

The T_C and R for the pre and post-development within the sub-catchments are listed in **Table 6.37**. L is the stream length measured along the main channel from the outlet to the watershed divide-in mile.

R is the main channel slope determined from elevation at points that represent 10 and 85 percent of the distance along the channel from the outlet to the watershed divide in ft/mile.

The T_C and R for the study area within the sub-catchments are listed in **Table 6.37**.

Table 6.37 : Tc and R for the Study Area

		Pre		Post	
Catchment	Area (HA)	Tc (Hr)	R (Hr)	Tc (Hr)	R (Hr)
1	1000	3.0	4.5	2.5	3.75
2	600	2.2	3.36	2.0	3

The base flow for the area is assumed to be constant at 0.1 m^3/sec. Based on these input data, the result obtained from the simulation is shown in **Table 6.28**. Comparison of estimated flow with other method such as Rational Method is also shown in the table. The flow hydrograph generated at the outlet for pre and post-development based on various storm duration and average recurrence interval is listed in **Table 6.39.**

Table 6.38 : Comparison of estimated flow (Pre-Development) using Clark Time-Area Method with Rational Method (50 Year ARI)

	Area (km^2)	Q (HMS) m^3/s	Q (Rational) m^3/s
Catchment 1-pre	10	27.7	40
Catchment 2-pre	6	21.9	25

The new drainage manual (MASMA2) specifically mentioned that the post-development flow at the outlet must be equal to or less than the pre-development level. The result clearly shows that the 50 year ARI post-development peak flow for Catchment 1 (48 m^3/s) exceeds the pre-development peak flow (28 m^3/s) by about 20 m^3/sec. The pre and post development peak flow for all the catchment is shown in **Table 6.38.** The proposed detention ponds intend to bring down the post-development flow to the pre-development level. The sediment basins that were used to trap sediment during clearing works will be converted into flood detention pond once the area has been replanted. The number of proposed flood detention ponds that will be located within the proposed development area is 2 (**Figure 6.30**). The ponds should provide temporary storage for the excess runoff during storm event. The total combine surface area for the proposed flood detention pond will be based on the sediment basin area, which is about 18 hectares. The total volume of flood storage provided for a 3 meter depth of flood detention pond is about 540000 cubic meter. Ample space should be provided at the proposed community pond for future expansion of the pond whenever it is necessary in the event of the development of the upstream area in the future. Detention pond normally consists of storage area, inlet to the pond and outlet out of the pond. The proposed pond in the study area is a dry pond. A typical dry pond is as shown in **Figure 6.33.**

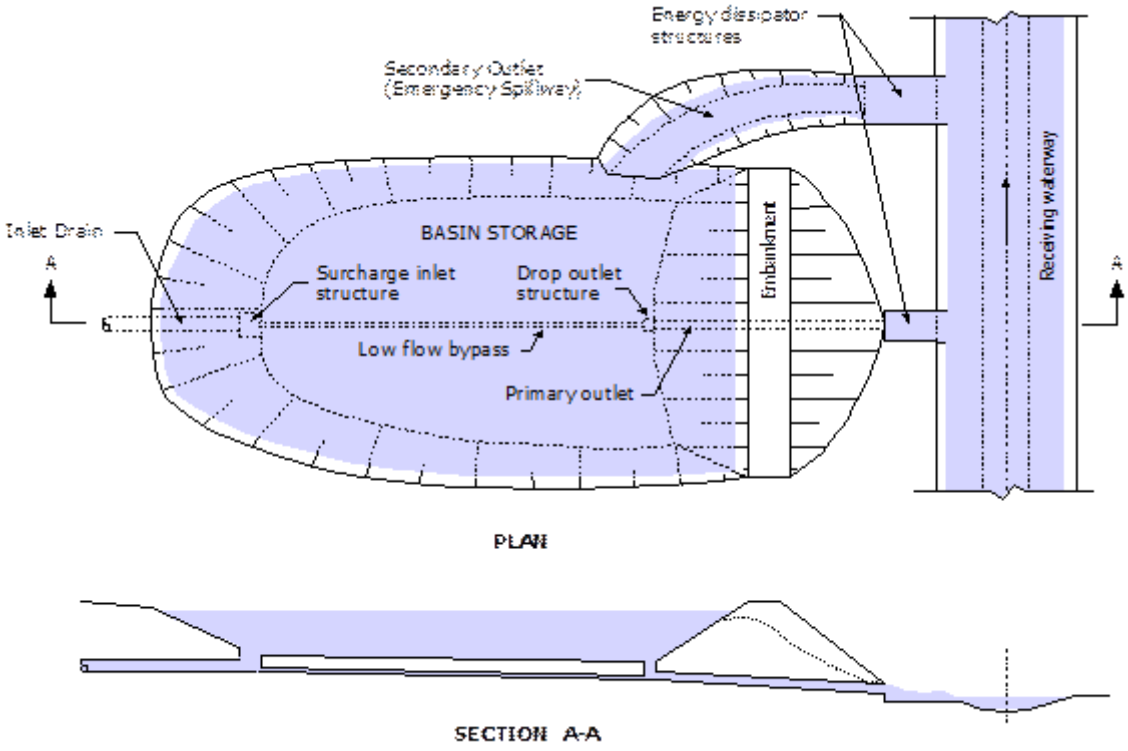


Figure 6.33 : Typical Design of a Dry Pond

The design storm should accommodate storm of 50 year ARI, while its spillway should be able to cater for 100 year storm. Therefore, enough storage volume within the ponds should be provided in order to control flood of 50 year ARI. The required storage volume can be estimated by using the linear regression formula developed by USDOT (Eqn 4). The preliminary required storage volume for these ponds is listed in **Table 6.39**.

$$V_s = \frac{1}{2} t_i (Q_i - Q_o)$$ .....Equation 4.

Where,

V_s = estimated storage volume (m^3/s)

Q_i = inflow hydrograph peak flow rate (m^3/s)

Q_o = allowable peak outflow rate (m^3/s)

t_i = time base of the inflow hydrograph (minutes)

Table 6.39 : Preliminary Estimation of storage volume Based on 50 Year ARI

Catchment	Area (HA)	Qpre	Qpost	Required Pond
		(m^3/s)	(m^3/s)	Storage Volume (m^3)
1	1000	27.7	47.6	**322740**
2	600	21.9	35.1	**212220**

The estimated storage volume required for the three detention ponds is about 540000 cubic meter. Assuming that the shape of the pond is rectangular and the depth of the pond not exceeding 3.0 meter, the proposed surface area of the pond is also shown in the **Table 6.40.**

Based on this required storage volume, the outlet for the pond is designed in order to develop the Storage Indication Curve. The outlets need to be design appropriately so that the discharge would meet the storm water control objective (less than pre-development discharge). The proposed outlet from the ponds should either consist of a culvert or an orifice to regulate the storm water flow up to 50 year ARI (major storm). The outlet should also consist of abroad crested weir to cater for rare storm of 50 year. The trial size of the outlets (culvert and broad crested weir) and pond size were used initially in order to determine the appropriate size. Using these trial data, the flow routing for the community pond is modelled using HEC-HMS. However, the size of the community pond will be based on the proposed size of the sediment basins. The adopted detention ponds storage volume is similar to the total storage volume of the total sediment basins volume. The results of the routed flow through the catchments and detention ponds are shown in **Table 6.41**. The result also clearly shows that the post-development with pond outflow is less than the pre-development flow.

Table 6.40 : Adopted Storage Volume

Catchment	Catch Area (ha)	Pond Width (m)	Pond Length (m)	Pond Depth (m)	Pond Vol (m^3)
1	1000	250	450	3	330000
2	600	200	350	3	210000

Table 6.41 : Pre and Post-Development Flows with and without Ponds (50 Year ARI)

Catchment	Q_{pre} m^3/s	Q_{post} m^3/s	Q_{post} + pond m^3/s	Reduction (%)
1	27.7	47.6	27	43
2	21.9	35.1	19	37

The objective of constructing a detention pond is to meet the condition where the post-development peak outflow at the outlet is less than or equal to the pre-development condition. The result shows that this objective can be achieved through the proposed design of the community pond. This will help authorities control flooding downstream of the project area. The efficiency of the detention pond in peak flow reduction is shown in **Table 6.41.**

The percentage of peak flow reduction ranges from about 37 to 43 percent. The detention ponds should also be designed to be able to withstand rarer flood (100 year ARI). The designed flood detention pond should be capable of draining the 100 year ARI peak flow from the ponds with its emergency spillway. The result of 100 year ARI discharge from the detention ponds is shown in **Table 6.42**. The outflow from the detention ponds is slightly more than the predevelopment level. It is important that the spillway is capable to drain the 100 year flood flow in order to prevent it from overtopping

the detention pond. The maximum water level is slightly below the crest level but higher than the free board level (2.5 m).

Table 6.42 : 50 Year Discharge from Detention Pond

Catchment	Q_{pre} m^3/s	Q_{post} m^3/s	Q_{post} + pond m^3/s	Water Level (m)
1	27.7	47.6	27	2.7
2	21.9	35.1	19	2.6

6.9 AMBIENT AIR QUALITY

An ambient air quality sampling was carried out at the project site to identify significant sources of the existing environment. The sampling was done on 17th to 20th August 2018 by using Portable Air Volume Sampler to collect air sample within 24 hours period. The sampling location is shows in **Figure 6.34** and the summary of result is tabulated in **Table 6.43**.

6.9.1 Ambient Air Quality Analysis

The concentration of PM_{10} is expected to be contributed by local and regional sources. PM_{10} in ambient air usually contributes by mechanically generated sources, including soil dust and related aerosols, other than sources from combustion, industries and motor vehicles.

The results show that the air parameter is within the acceptable level of the New **Malaysia Air Quality Standard** (MAAQS) 2013 which is below 150µg/m³. Concentrated PM_{10} at point A1 is 111 µg/m^3, A2 is 42 µg/m^3, A3 is 56 µg/m^3, A4 is 28 µg/m^3 and point A5 is 56 µg/m^3. The certificates of analysis for the ambient air quality are attached in **Appendix 6-D.**

Table 6.43 : Ambient Air Quality Results for All Sampling Stations

Station	A1	Sampling Picture
Location	Project Boundary	
Description	Surrounded by forest area	
Sampling Date	17th to 18th August 2018	
Coordinate	N 5° 7' 4.66", E 101° 11' 50.84"	
Test Parameter	PM_{10}	
Result	111 µg/m^3	
MAAQS	150 µg/m^3	

Station	A2	Sampling Picture
Location	Pos Gapeh	
Description	Near residential area	
Sampling Date	17th to 18th August 2018	
Coordinate	N 5° 6' 16.57", E 101° 11' 25.01"	
Test Parameter	PM_{10}	
Result	42 µg/m^3	
MAAQS	150 µg/m^3	

Station	A3	Sampling Picture
Location	Kg. Lalang	
Description	Near residential area	
Sampling Date	18th to 19th August 2018	
Coordinate	N 5° 6' 0.30", E 101° 11' 18.19"	
Test Parameter	PM_{10}	
Result	56 µg/m^3	
MAAQS	150 µg/m^3	

Station	A4	Sampling Picture
Location	Kg. Kekabu	
Description	Near residential area	
Sampling Date	18th to 19th August 2018	
Coordinate	N 5° 5' 26.27", E 101° 10' 48.46"	
Test Parameter	PM_{10}	
Result	28 µg/m^3	
MAAQS	150 µg/m^3	

Station	A5	Sampling Picture
Location	Kg. Chat	
Description	Near residential area	
Sampling Date	19th to 20th August 2018	
Coordinate	N 5° 5' 18.28", E 101° 12' 18.13"	
Test Parameter	PM_{10}	
Result	56 µg/m^3	
MAAQS	150 µg/m^3	

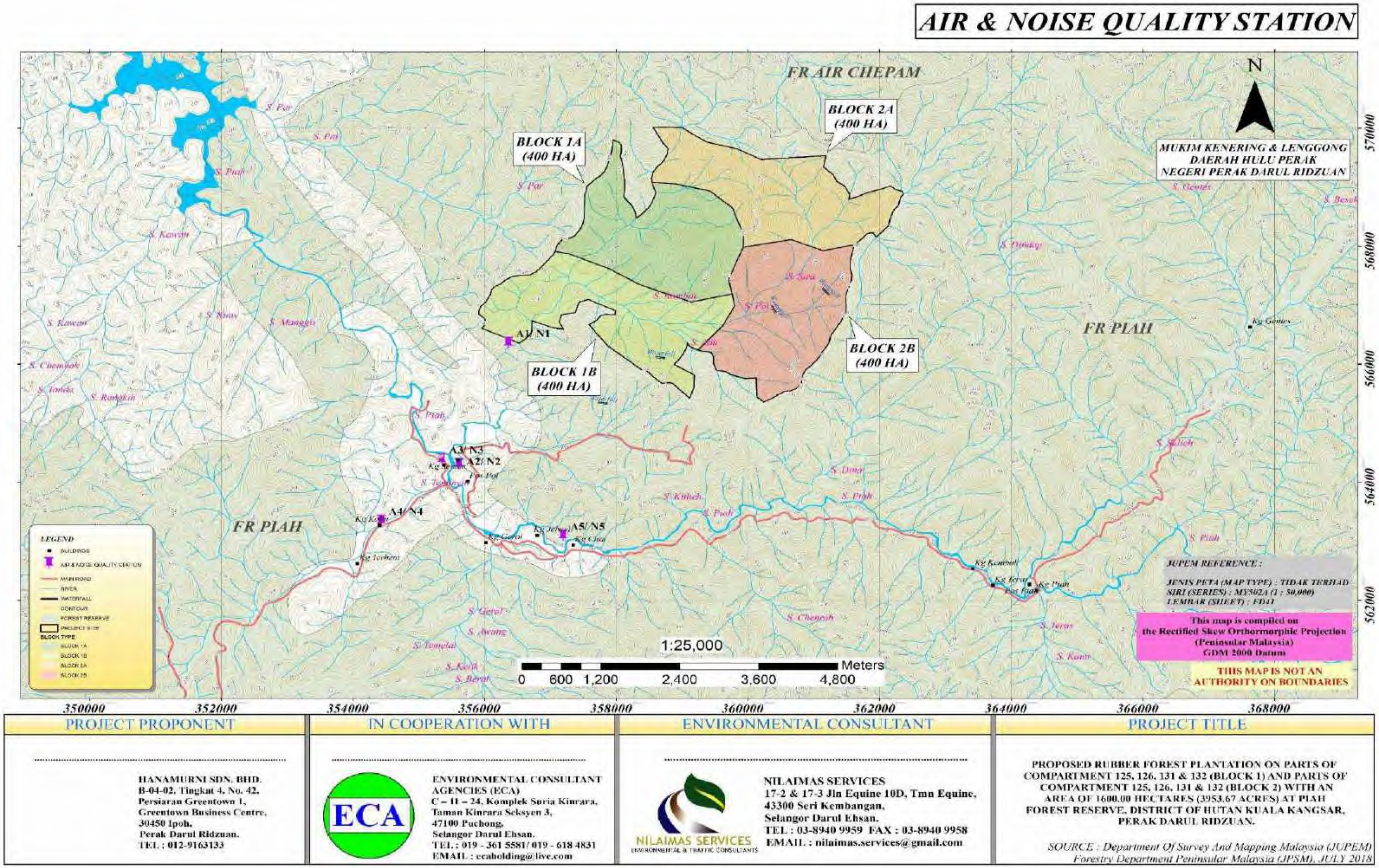


Figure 6.34 : Air & Noise Quality Stations

6.10 NOISE

Noise level monitoring was carried out in the project site to delineate the existing noise levels and also to obtain baseline data for the EIA report. Noise level monitoring was carried out on 17th to 20th August 2018. Five ambient noise level stations were selected and their results are summarised in **Table 6.44.**

The results will be compared with Schedule 1: Maximum Permissible Sound Level (L_{Aeq}) by Receiving Land Use for Planning and New Development for Suburban Residential (Medium Density) Areas, Public Spaces, Parks, Recreational Areas of The Planning Guidelines for Environmental Noise Limits and Noise, 2007.

The project site is surrounded by agricultural and forested; therefore the sources of noise were mainly from human activities, vehicles movements and animals. The results of the noise study show that the baseline L_{Aeq} ranged between 52.8 dBA to 53.8 dBA for day time while for night time, the LAeq ranged between 43.1 dBA to 44.7 dBA. Therefore, the results for all sampling stations (N1, N2, N3, N4 and N5) during daytime and nighttime comply with Schedule 1 in the Planning Guidelines for Environmental Noise Limits and Control, 2007. The certificate of analysis is attached in **Appendix 6-E**.

Table 6.44 : Ambient Noise Levels for All Sampling Stations

Station	**N1**		**Sampling Picture**
Location	Project Boundary		
Description	Surrounded by forest area		
Sampling Date	17th to 18th August 2018		
Coordinate	N 5° 7' 4.66", E 101° 11' 50.84"		
Test Parameter	Day Time (dBA)	Night Time (dBA)	
Result L_{Aeq}	52.8	43.1	

Guideline Limit	Day Time (dBA)	Night Time (dBA)	
Schedule 1 L_{Aeq}	55	45	

Station	**N2**		**Sampling Picture**
Location	Pos Gapeh		
Description	Near residential area		
Sampling Date	17th to 18th August 2018		
Coordinate	N 5° 6' 16.57", E 101° 11' 25.01"		
Test Parameter	Day Time (dBA)	Night Time (dBA)	
Result L_{Aeq}	53.1	43.7	
Guideline Limit	Day Time (dBA)	Night Time (dBA)	
Schedule 1 L_{Aeq}	55	45	

Station	**N3**		**Sampling Picture**
Location	Kg. Lalang		
Description	Near residential area		
Sampling Date	18th to 19th August 2018		
Coordinate	N 5° 6' 0.30", E 101° 11' 18.19"		
Test Parameter	Day Time (dBA)	Night Time (dBA)	
Result L_{Aeq}	53.0	43.5	
Guideline Limit	Day Time (dBA)	Night Time (dBA)	
Schedule 1 L_{Aeq}	55	45	

Station	**N4**		**Sampling Picture**
Location	Kg. Kekabu		
Description	Near residential area		
Sampling Date	18th to 19th August 2018		
Coordinate	N 5° 5' 26.27", E 101° 10' 48.46"		
Test Parameter	Day Time (dBA)	Night Time (dBA)	
Result L_{Aeq}	52.8	43.6	
Guideline Limit	Day Time (dBA)	Night Time (dBA)	
Schedule 1 L_{Aeq}	55	45	

Station	**N5**		**Sampling Picture**
Location	Kg. Chat		
Description	Near residential area		
Sampling Date	19th to 20th August 2018		
Coordinate	N 5° 5' 18.28", E 101° 12' 18.13"		
Test Parameter	Day Time (dBA)	Night Time (dBA)	
Result L_{Aeq}	53.8	44.7	
Guideline Limit	Day Time (dBA)	Night Time (dBA)	
Schedule 1 L_{Aeq}	55	45	

6.11 ECOLOGY

6.11.1 Flora

6.11.1.1 Introduction

The vegetation covers within the Project area are divided into 2 main types:

i. Lowland forest remnant;
ii. Open cleared land for rubber plantations with regenerating forest succession.

The Project area is located within the Piah Forest Reserve and nearby Air Chepam Forest Reserve (based on JPSM 2016) and were logged-over at different logging cycles. The northern part of the Project area can be considered as a part of lowland forest with past logging history and nearly restored by natural forest succession with the mixture of medium-sized pole and mature native tree species. The southern part of the Project area is experiencing first phase of forest succession with the growth of pioneer and late-seral tree species with the invasion of weed species. Overall, the Project area can be considered as a disturbed lowland forest remnant with the evidence of massive anthropogenic disturbances (logging activities, monoculture plantations) and experiencing edge effect at nearly 50% of the total land of the Project area.

The flora survey was conducted for 4 consecutive days; 16th, 17th, 20th and 21st August 2018. The survey outcomes were in terms of inventory list of recorded flora, conservation status and the estimation of the biomass from the plant covers. The survey was conducted by using two methods:

i. Ground Observation

The flora survey was conducted by randomly exploring the Project area and listing all existing plants. Observed plants were recorded, identified and photographed.

ii. Plot Enumeration

Two 10 m x 10 m plots (Plot 1 and Plot 2) were established and subdivided into 4 sub-plots at every 10 m interval. Each sub-plot has a dimension of 5 m length x 5 m width. Each plot covered an area of 0.01 ha (10 m x 10 m). The location and details of Plot 1 and Plot 2 are showed in **Table 6.45** and **Figure 6.35.**

Table 6.45 : Location and details of Plot

Plot	Coordinate (Plot Center)	Habitat Description
1	5° 8'17.19" N 101°14'56.52" E	Plot established at the forest remnant nearby the logging track within previous logged-over forest
2	5° 7'53.56" N 101°12'26.49" E	Plot established on the flat ground of the undulating terrain of the regenerating lowland forest remnant

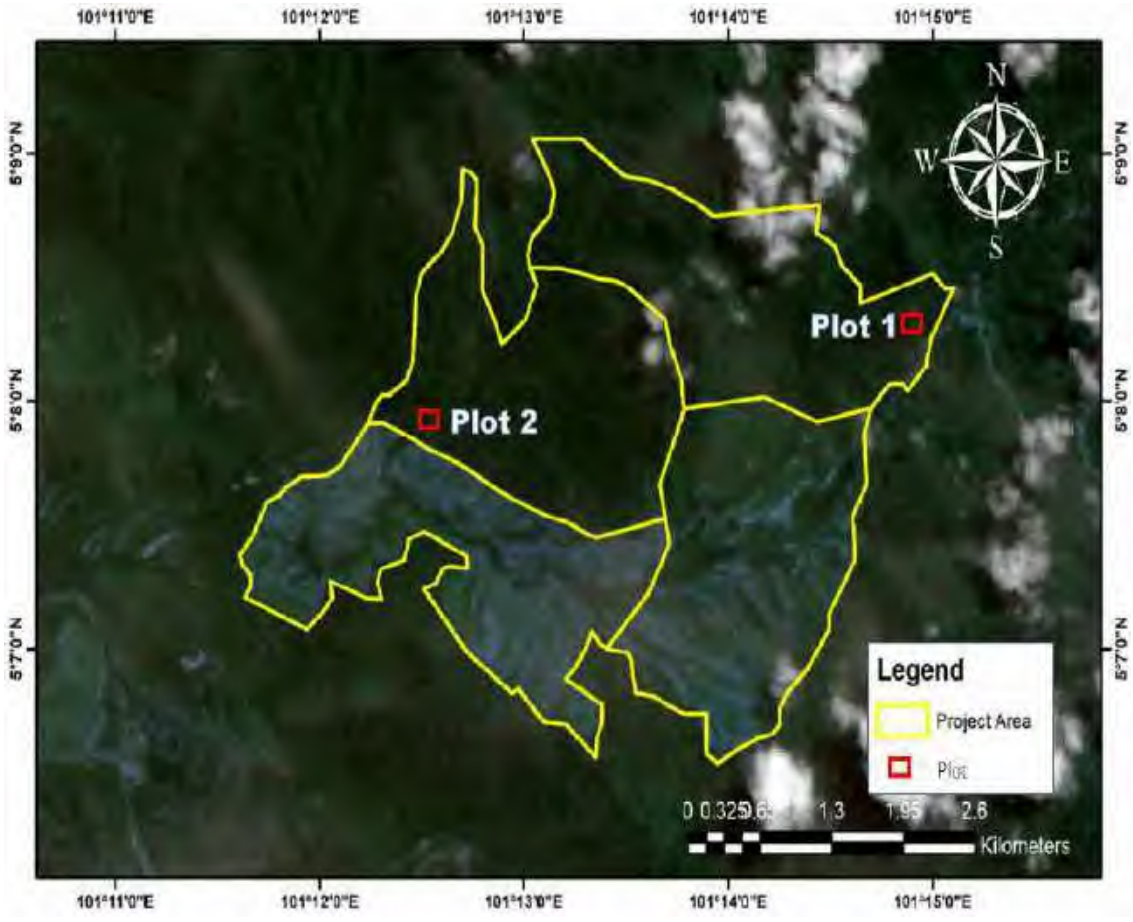


Figure 6.35 : Satellite Image of the Project Area and Location of Plot 1 and Plot 2

The plot lines were measured by using 30 m measuring tape, marker pole, inclinometer and Leica Disto D8 Laser Rangefinder. Coordinates for the plot center was recorded by using Garmin GPSMAP 64S. Bearing for each plot markers were determined by using prismatic compass during plot establishment.

At every sub-plot, all trees ≥ 5 cm DBH (diameter at breast height) were enumerated, measured and identified. DBH of recorded trees were measured by using 2 m Lufkin Executive Thinline Diameter Tape or 5 m DBH Tape at 1.3 m above ground level. Nikon Forestry Laser Rangefinder was used to measure tree height with high accuracy readings (**Figure 6.36).**

Figure 6.36 : a) 10 m grid line was established by choosing the best pathway within forested land to make the 10 m x 10 m plot. Marker poles were used to mark the starting and ending points of the grid line. b) Recorded tree was temporarily tagged with plastic ribbon and measured with DBH tape at 1.3m from the ground.

Figure 6.37 : a) Leica Disto D8 Laser Rangefinder was used to measure horizontal terrain distance b) Nikon Forestry was used to measure tree height c) Equipment for plot establishment and inventory

6.11.1.2 Vegetation Types

The proposed Project area is located within Piah Forest Reserve with the total estimated area of 3955 acres (1601 ha). The Project area comprises of an undulating hilly terrain with contours ranging from about 218 m to 886 m above mean sea level. Thus, the Project area should be considered within the lowland mixed forest formation and a part of lower montane forest formation with high floristic composition of lowland and hill dipterocarp forests.

Almost 50% of the total land area of the Project area can be considered as remnant of lowland forest land with high floristic composition and the other parts were totally disturbed due to previous total land clearing with less native trees. The total Project area lies under Piah Forest Reserve (based on JPSM, 2016) and were logged-over at 4 different logging cycles, thus caused significant disturbances at different levels to the natural forest formation (**Figure 6.38** and **Figure 6.39**).

Almost 50% of the Project area on the south were open cleared and converted into rubber plantations with less plantation management

practice. Several plantation areas were left unmanaged and caused the expansion of alien and weed species. The boundary between forested and plantation areas were not clearly delineated, thus promoting the invasion of secondary succession towards the forested area. The significant different in tree canopy height between these 2 land types has caused fallen trees and canopy gap formation to the forested land due to wind throw effect.

Some areas were experiencing forest succession at old logging tracks and forest fringe. Overall, the Project area can be considered as having both natural and disturbed forest formation with most of the disturbed lands were under rapid secondary succession. Several forested areas on the north can be categorized as mixture lowland forest remnants with regenerating secondary forest succession at different stages due to past and current anthropogenic activities. The Project area is located within the remaining Piah Forest Reserve but the surrounding is rapidly open cleared and converted into different land use.

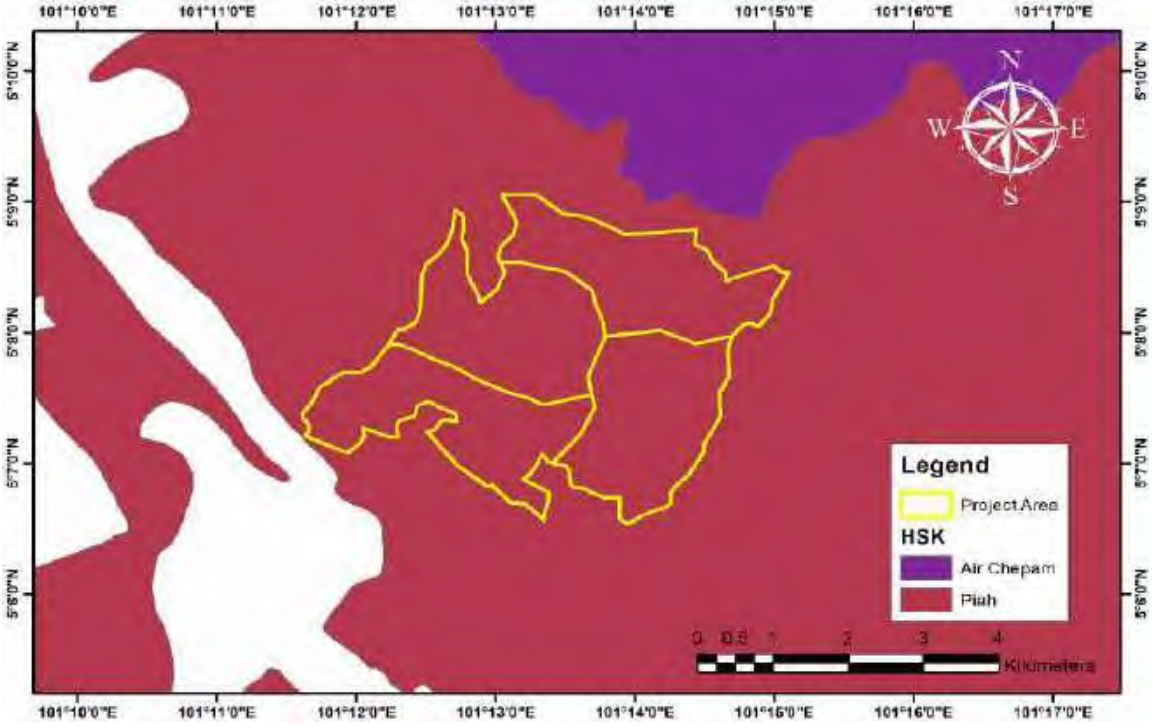


Figure 6.38 : Location of the Project Area Based On Permanent Forest Reserve (HSK). Note That the Project Area Is Located within the Piah Forest Reserve as Delineated by JPSM database (2016)

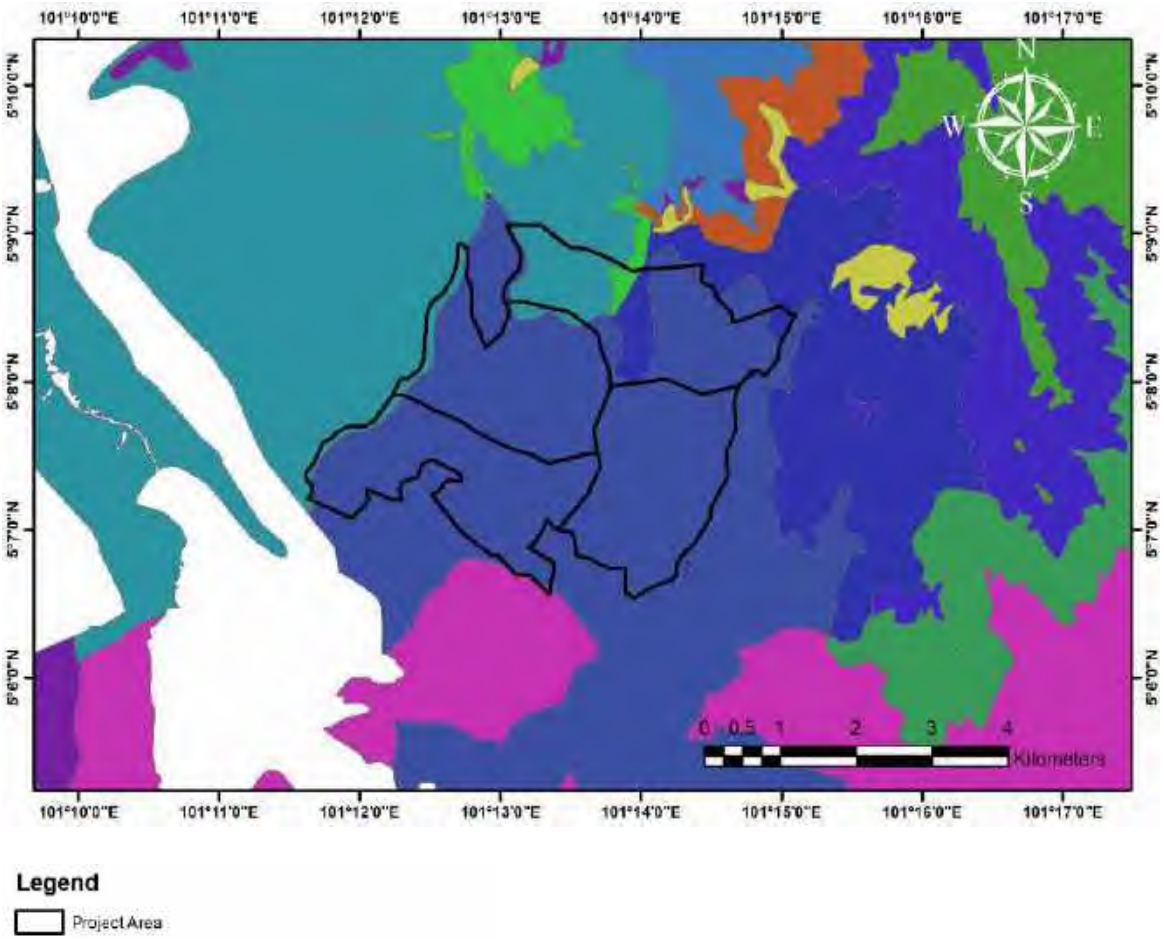


Figure 6.39 : Zonation of the Project Area Based on Logging Cycle. Note that the Project Area consists of Logged-over Forests at Different Cycles within the Piah Forest Reserve (JPSM, 2016)

Normalized Differentiate Vegetation Index (NDVI) of the Project area was generated by analyzing Landsat-8 satellite image (Source: USGS Database) dated on 7th June 2018 (**Figure 6.40**).

The NDVI value was ranging from -1 (the least or no vegetation) to 1 (the most vegetated) based on the light absorbed and reflected by green plants. The densest vegetation area was delineated by dark

green color and can be clearly seen at the middle of the Project area near to eastern boundary. Several dark green color patches also can be found in scattered at the northern part of the Project area especially at the area within 11 - 20 years of logging cycle.

The process of forest restoration at the respected area is nearly complete at certain blocks, thus making the area detected as having dense green tree crowns in patches. The scattered yellow patches represented by regenerating forests. Red patches indicate totally no vegetation area (open cleared land). There was an aggregation of red patches at the south of the Project area due to open cleared land for rubber plantations. White patches representing cloud images. Five different microhabitats were categorized based on different vegetation form and abiotic parameters (**Figure 6.41 – 6.44**).

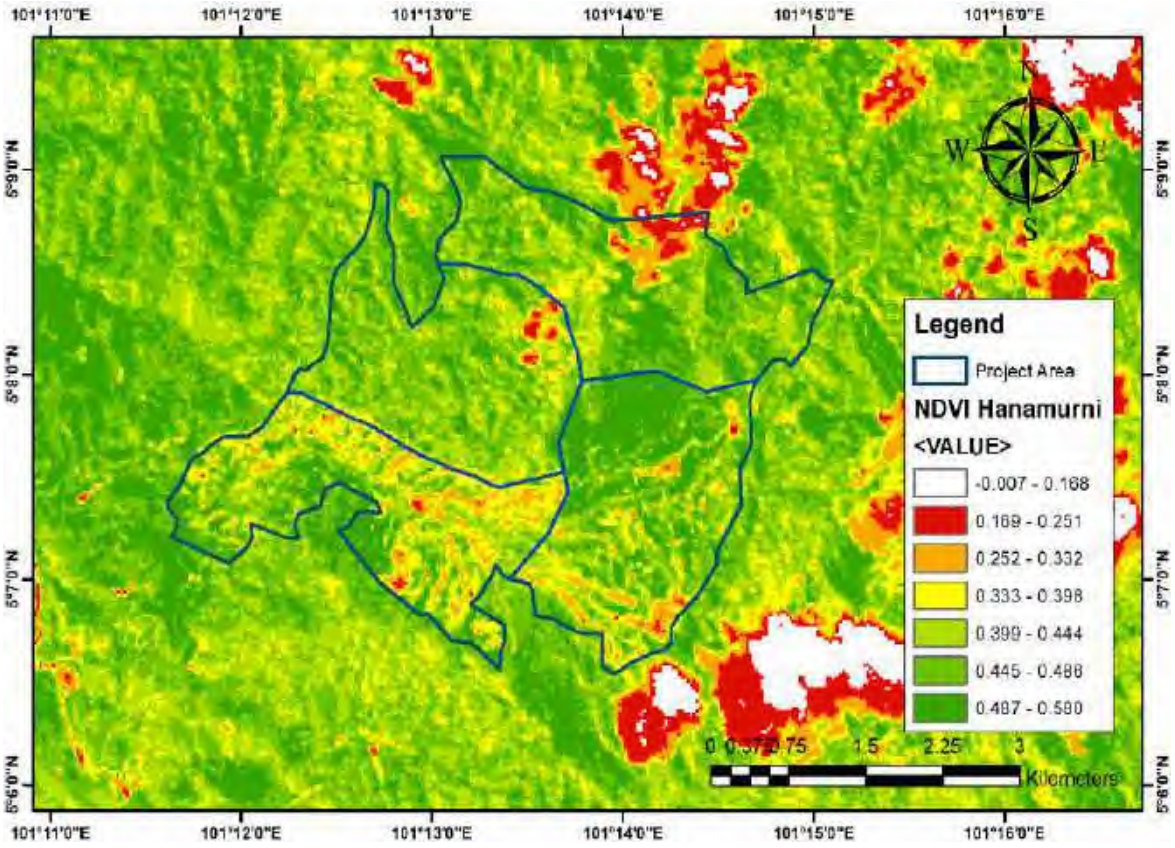


Figure 6.40 : Normalized Differentiate Vegetation Index (NDVI) of the Project Area Generated From Landsat 8 Satellite Image Dated on 7th June 2018. Note that Darker Green Represents High Vegetation Area

Most of the vegetation at the Project area were represented by typical lowland and hill dipterocarps canopy and sub-canopy trees such as Meranti group (*Shorea spp*.), Keruing group (*Dipterocarpus spp*.), Kapok (*Ceiba pentandra*), Sesenduk (*Endospermum diadenum*), Kedondong (*Dacryodes spp., Santiria spp*.), Jelutong (*Dyera costulata*), Kelat (*Syzygium spp*.) and Kempas (*Koompassia malaccensis*).

The disturbed area consists of several large open areas with direct sunlight onto the forest floor, thus caused regeneration of pioneer and invasive plants (*Macaranga spp., Melastoma malabatrichum,* and several weed species) to take place. Several mature late-seral and light demanding tree species were observed as dominating the transition zone between crop and forested lands of the Project area such as *Pometia pinnata, Vitex spp*. and *Azadirachta excelsa*.

Several natural slow-flowing streams were occupied by stream vegetation and several palm species. Other streams were disturbed by earthworks thus altered the natural formation of stream/ streambank and occupied by weeds and secondary vegetation. Crop plantations represented by rubber trees (*Hevea brasiliensis)* and wild bananas (*Musa spp*.).

Mixed lowland forest:

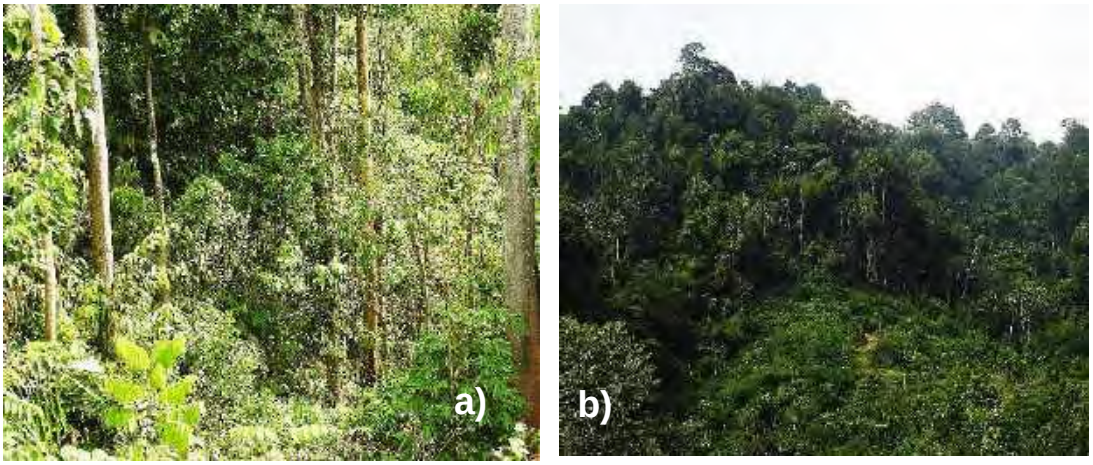


Figure 6.41 :a) Mixed Lowland Forest Remnant With Medium To Large Pole Trees.b) Boundary between Mixed Lowland Forest And Previously Open Cleared Land With Significant Tree Height Difference.

Secondary Vegetation:

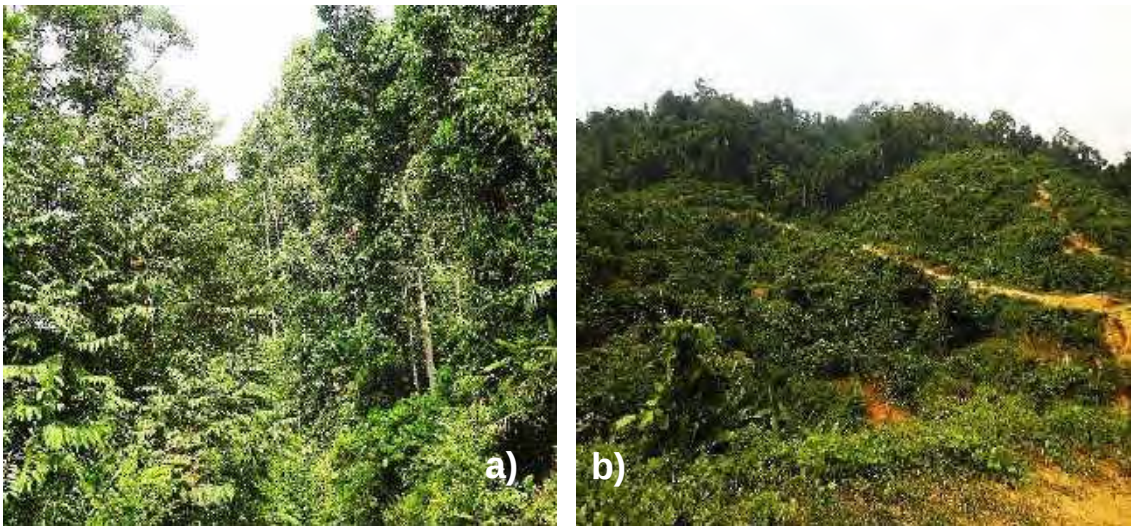


Figure 6.42 : a) Nearly Mature Secondary Forest at the Forest Edge of the Project Area b) Shrubs and Weeds Dominating the Vast Area of Once Open Cleared Land with Several Secondary Tree Species.

Other Vegetation :

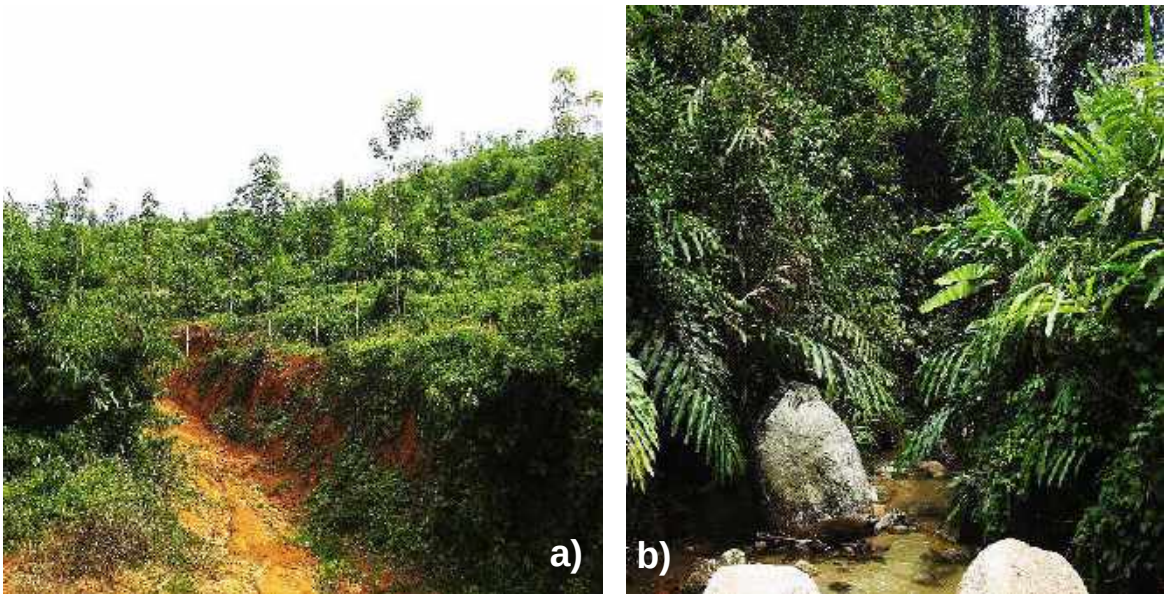


Figure 6.43 : a) Open Cleared Terraced Hill for Rubber Plantation b) Slow-Flowing Stream with Rocky Substrate and Stream Vegetation.

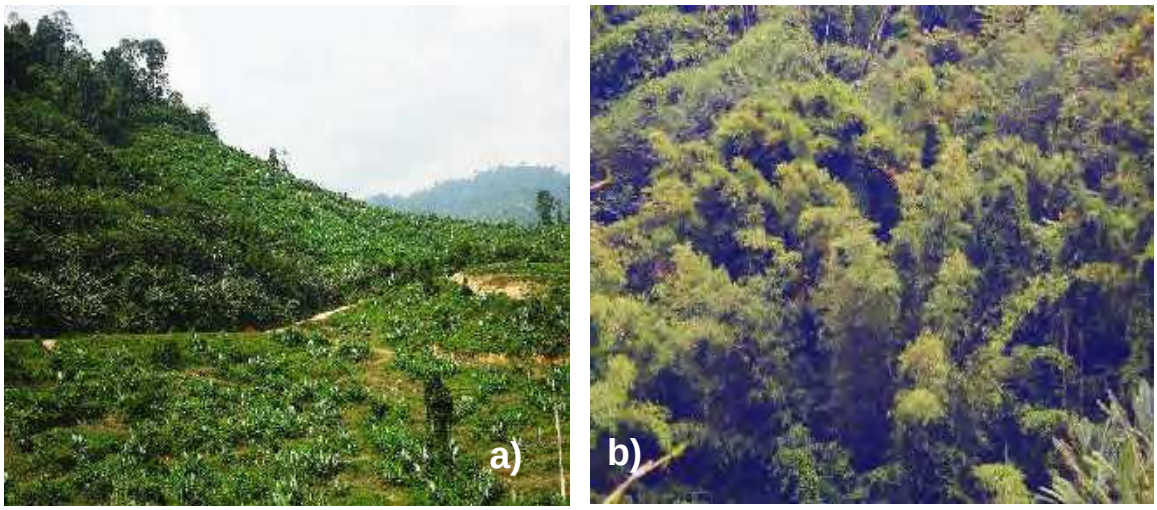


Figure 6.44 : a) Open Cleared Land With Regenerating Shrubs And Weeds. Note The Invasion Of Wild Bananas (Musa Spp.) On The Abandoned Hill Terrace. b) Bamboo Forest Dominating Previous Open Cleared Land

6.11.1.3 Floristic Composition

From the flora survey conducted, a total of 194 species within 149 genus and 67 families of plants were recorded from both ground observation and plot enumeration methods. The plot enumeration recorded less species than ground observation records due to the location within the forest restoring area, small sampling size (0.02 ha) and did not cover some of the abiotic aggregated plant species.

Based on the detailed list, a total of 22 tree individuals ≥ 5 cm DBH were recorded at Plot 1. Floristic composition of tree communities at Plot 1 comprised of 10 families, 15 genus and 16 species.

Overall, Euphorbiaceae was the most speciose family for Plot 1, represented by the sum of 5 species. Floristic composition of tree communities at Plot 2 comprised of 9 families, 13 genus and 16 species. Overall, Dipterocarpaceae was the most speciose family represented by the sum of 6 species.

Euphorbiaceae was the most speciose family recorded during ground observation, represented by the sum of 21 species and followed by Dipterocarpaceae (15 species). Five most speciose tree families at the Project area are showed in **Table 6.46**.

Table 6.46 : Five Most Speciose Tree Families at the Project Area

Family	Genus	Species
Euphorbiaceae	14	21
Dipterocarpaceae	4	15
Leguminosae	12	14
Anacardiaceae	6	7
Melastomataceae	6	7
Overall: 194 species; 149 genera; 67 families		

At different DBH classes, the 5.0-9.9 cm DBH class recorded the highest tree density for Plot 1 (10 individuals) and Plot 2 (8 individuals) The maximum DBH measurement recorded in the Plot 1 was 21.7 cm DBH and Plot 2 (31.2 cm DBH). However, there were several trees with DBH measurement more than 40 cm DBH in the Project area but observed outside the designated Plot 1 and Plot 2 (For instance, at least 15 big trees with > 50 cm DBH were observed at the hill slope area (estimated as the same size of Plot 1) but inaccessible due to extreme terrain). The number of tree > 40 cm DBH were less due to the past logging history at the Project area. The finding indicates that Project area was a mixture of forest remnant with mature secondary vegetation and continuously experiencing latter forest succession with high density of medium-sized growing trees. Selected photographs of plants observed within the Project area are shown in **Figure 6.45** – **6.48**.

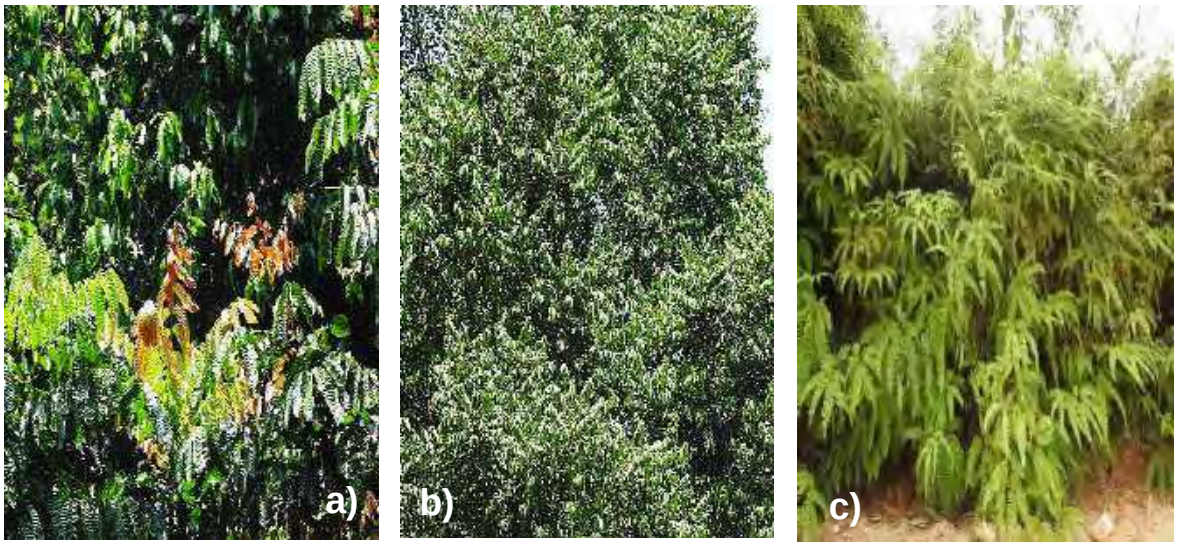


Figure 6.45 : a) Kasai Daun Besar, *Pometia Pinnata* (Sapindaceae) b) Sentang, *Azadirachta Excels* (Meliaceae) c) Resam, *Dicranopteris Linearis* (Gleicheniaceae)

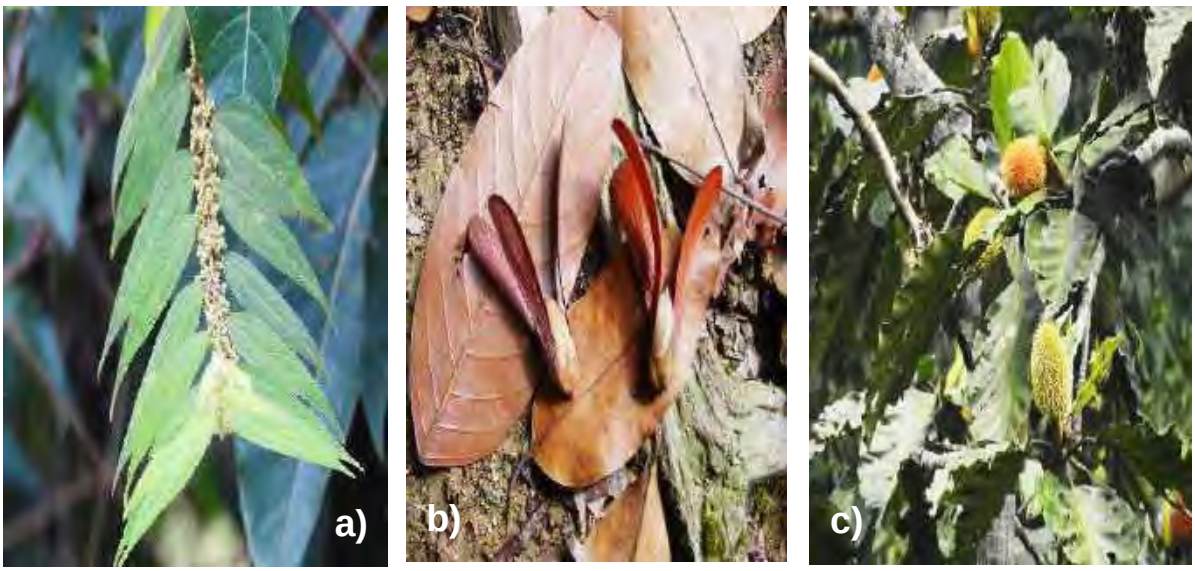


Figure 6.46 : a) Seraya, *Shorea Curtisii* (Dipterocarpaceae) b) Terap Nasi, *Artocarpus Elasticus* (Moraceae) c) Menarong, *Trema Tomentosa* (Ulmaceae)

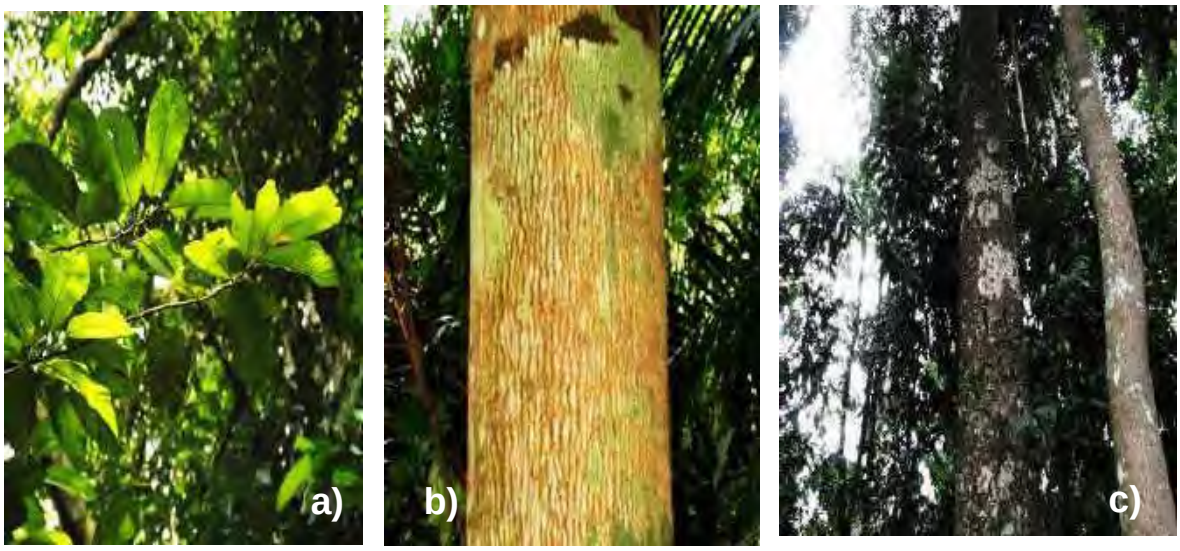


Figure 6.47 : a) Keruing Gombang Merah, *Dipterocarpus Kunstleri* (Dipterocarpaceae) b) Mempening, *Lithocarpus Lucidus* (Fagaceae) c) Kempas, *Koompassia Malaccensis* (Leguminosae)

Figure 6.48 : a) Sesenduk, *Endospermum Diadenum* (Euphorbiaceae) b) Tepus Tanah, *Zingiber Spectabile* (Zingiberaceae) c) Bunga Pompun, *Anaxagorea Javanica* (Annonaceae)

6.11.1.4 Conservation Need

All the existing plant species at the Project area are mostly common lowland and hill dipterocarp tree species in Peninsular Malaysia. There is no specific legislation on protection of plant species in Peninsular Malaysia. However, there are several species, which have conservation or biodiversity importance upon cross-referenced to the International Union for Conservation of Nature (IUCN) Red List.

The Red Data Book (RDB) lists by IUCN is the most widely used classification for evaluating the status for classifying species at high risk of global extinction. The general aim of the system is to provide an explicit, objective framework for the classification of the broadest range of species according to their extinction risk. The nine categories are as below:

Extinct (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed 'Extinct' when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), and throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form

Extinct in the Wild (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed 'Extinct in the Wild' when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

Critically Endangered (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for 'Critically Endangered', and it is therefore considered to be facing an extremely high risk of extinction in the wild.

Endangered (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for 'Endangered', and it is therefore considered to be facing a very high risk of extinction in the wild.

Vulnerable (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for 'Vulnerable', and it is therefore considered to be facing a high risk of extinction in the wild.

Near Threatened (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for 'Critically Endangered', 'Endangered' or 'Vulnerable' now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Least Concern (LC)

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for 'Critically Endangered', 'Endangered', 'Vulnerable' or 'Near Threatened'. Widespread and abundant taxa are included in this category.

Data Deficient (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. 'Data Deficient' is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases, great care should be exercise in choosing between 'Data Deficient' and a threatened status. If the

range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Not Evaluated (NE)

A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

Based on the complete plant survey, there were 3 plant species categorized by IUCN Red List as described in Malaysia Plant Red List as listed in **Table 6.47**. They were categorized as Near Threatened and described as threated by restricted habitat and logging activities. The rest of recorded species were not evaluated by IUCN Red List and Malaysian Plant Red List. All of the recorded flora was categorized as common lowland plant species with the mixture of secondary and succession species due to past logging activities and anthropogenic disturbances. There is no endemic species recorded at the Project area.

Flora database was accessed through Malaysian Biological Diversity Clearing House Mechanism (CHM) website to gather status of Malaysia Plant Red List for each recorded species. Secondary conservation status for recorded plants were gathered from C Chua, L.S.L, et al. (2010), Kiew, R. et al. (1998), La Frankie, J.V. (2010), Ng, F.S.P. & Low, C.M. (1982), Ng, F.S.P. et al. (1990), Parris, B.S. et al. (2010), Symington, C.F. (1943), Turner, I.M. (1995) and Wyatt-Smith, J. (1999).

Table 6.47 : List of Plant with Significant Biodiversity and Conservation Importance

Species	Common Name	Malaysia Plant Red List
Dipterocarpus kunstleri	Keruing Gombang Merah	NT
Shorea ovalis	Meranti Kepong	NT
Platycerium coronarium	Paku Tanduk Rusa	NT

*Note: VU = Vulnerable, NT = Near Threatened

6.11.2 Fauna

6.11.2.1 Introduction

Malaysia being one of the mega-diversity countries in the world is exceptionally rich in biodiversity especially in fauna. The country has anything from the second largest living land animal species i.e. the Asian elephant exceeding 3000 kg, the largest wild cattle species in the world i.e. the Malayan gaur exceeding 900 kg to the longest snake species in the world i.e. Reticulated python reaching 10 metres. Not only rich with these records breaking giant species, Malaysia is also blessed with far more diverse smaller species which are no less fascinating and amazing. Though may not as rich as some other larger countries such as Brazil in term of total number of species, the country is still very rich in term of species numbers per unit of area. Being a part of Borneo, which is well known for its biodiversity and natural resources, Peninsular Malaysia with its own biodiversity wealth is equally diverse. Unlike in African savannah where hundreds of fauna can be seen wandering in the open, many of the fauna in Malaysia are seldom seen for the reasons being the thick habitats especially forests they occupy and the nature of the fauna themselves which are shy and wary.

Perak state, in which the proposed project is located, is blessed with myriad of habitats harbouring tremendous number of biodiversity especially fauna. The state has all sort of habitats from the deep-sea bed to the summit of the second highest mountain in Peninsular Malaysia i.e. Mt. Korbu which stands at 2183 metres. Among the habitats present between these two ends are mangroves, swamps, lowland forests and hill forests. The state has the first protected area namely Chior Wildlife Reserve which was gazetted in 1909. Unfortunately, this wildlife reserve had been revoked in recent years and the area is now made into an oil palm plantation. Perak also has the largest state park in Peninsular Malaysia namely Royal Belum State Park covering about 117,500 hectares. Regardless, forests reserves are the largest habitats available for biodiversity to thrive in. About half of the state land area is comprised of habitats within forest reserves. Unfortunately, even the so called “permanent forest reserves” are no longer being reserved, let alone made permanent,

since conversions into plantations are taking place on large scales nowadays.

The proposed project is part of Piah Forest Reserve and based on record, was made gazette during the British colonisation back in 1915 with last known total area of about 75,103 hectares. It's part of the largest and longest forest complex and range known as the Main Range or locally as Banjaran Titiwangsa. Despite being relatively large in size, not much of extensive documentation on biodiversity is known to been carried out in this forest reserve. Data from this survey on terrestrial vertebrate fauna perhaps would provide the best and latest information before much of the biodiversity resources at the proposed project site are gone.

6.11.2.2 Methodology and Conditions of the Study Site

Survey for fauna was carried out for five days and five nights on from 1st to 5th October 2018 on terrestrial vertebrates namely mammals, birds, reptiles and amphibians. Methods of observation include direct sighting, vocalization, markings including foot marks, faeces etc. Two knowledgeable villagers were hired from an aboriginal village located to the southwest of the proposed project border known as Kampung Lalang shown in **Figure 6.49**.

Two Digital SLR cameras, mounted with wide angle, macro, general or tele-photo lenses covering 16 – 960 mm focal length were used for photography as well as a pair of binoculars. No fauna was disturbed or harmed in the process including their habitats except having to inspect a few specimens to check thoroughly for identifications. Tracks and trails were observed opportunistically to document the fauna species in addition to along streams with a combined length of more than 10 kilometres.

The proposed project is divided into four plots known as petak 1A, 1B, 2A and 2B. Both petak 1B and 2B located in the south had been clear felled recently. Petak 1B had been terraced and planted with rubber trees. Petak 1A and 2A are still well forested although they had also been logged about two to three decades ago, based on

information from the hired aborigines from the nearby village of Kampung Lalang. There is now recent and decent resolution aerial view for the proposed project from Google Earth or ESRI. The most recent available image is dated 31 December 2016 but it's a low resolution one. Nevertheless, it shows well that petak 1B had been clear felled. Prior to that, the whole project area was forested. **Figure 6.50** shows the proposed project and vicinity on Google Terrain map showing plot petak 1B and 2B which had been clear felled.

Meanwhile, **Figure 6.51** shows a low-resolution Google Earth's aerial view dated 31 December 2016 showing plot petak 1B had been clear felled. Based on elevation of the proposed project, which ranges from about 180 to 840 metres above sea level (ASL) the forest in the past can be categorised as lowland dipterocarp forest (up to 300 m ASL), hill dipterocarp forest (300 m to 750 m ASL) and upper dipterocarp forest (750 m – 1200 m ASL) including in petak 1B and 2B which had been clear felled recently. From these three forest types, the most dominant at the site is the hill dipterocarp forest based on percentage of altitude coverage. Lowland dipterocarp and upper dipterocarp forests are known to harbour the highest level of biodiversity especially mega fauna such as Asian Elephant, Malayan Tiger and Malayan Tapir.

Figure 6.52 shows typical view of plot petak 1B which had been terraced and planted with rubber trees (red circles) and **Figure 6.53** is a typical view of plot petak 1A and 2A which are still well forested. Seen here is the view along Sungai (River) Laluk (this name is not present in JUPEM's topo map but widely used by the local aborigines) in petak 1A.

Figure 6.49 : The Fauna Survey Team Which Includes Two Aborigines (Leftmost & Rightmost) From A Nearby Village Known As Kampung Lalang In Petak 2A of The Proposed Project.

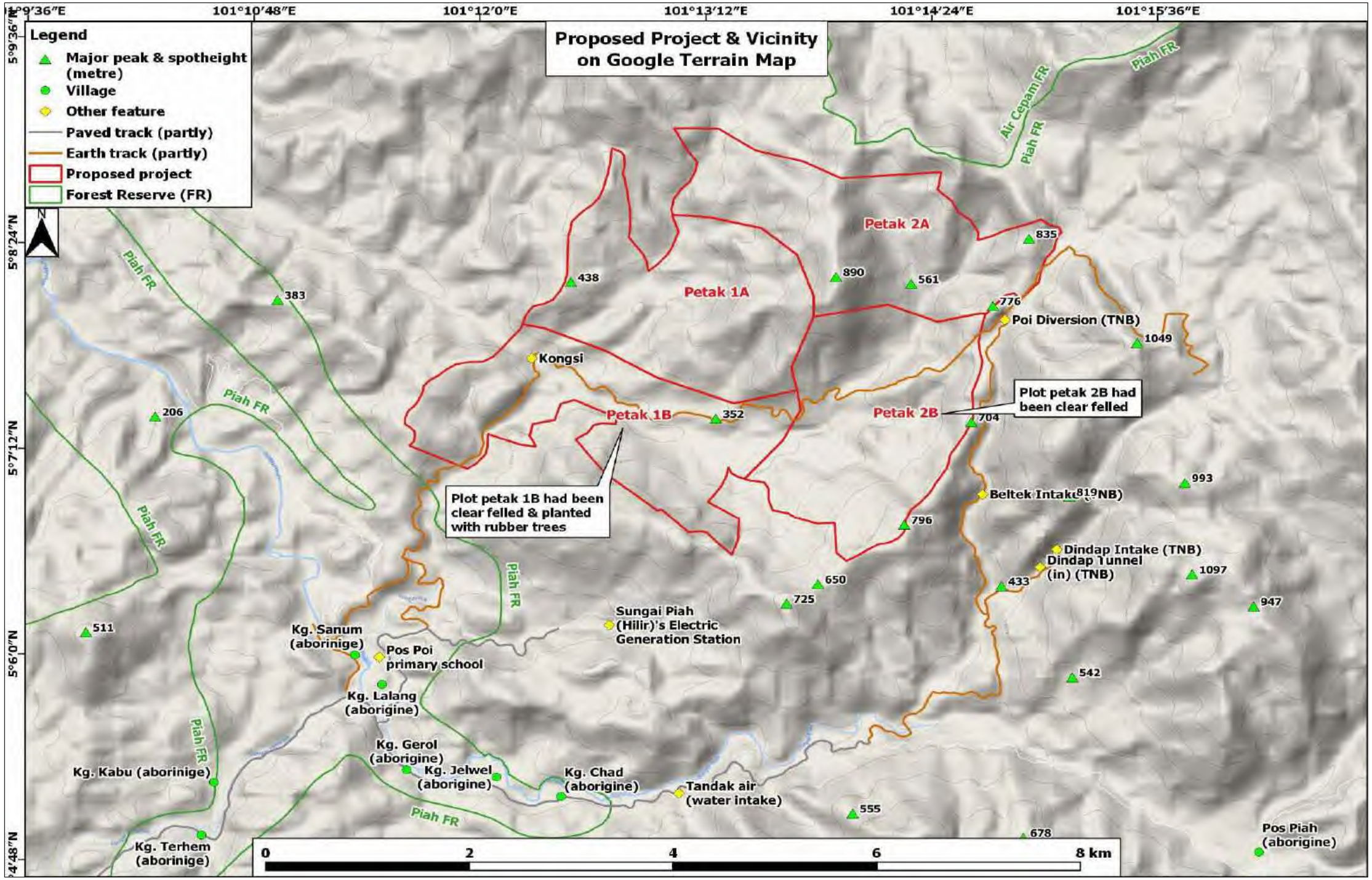


Figure 6.50 : Proposed project & vicinity on Google Terrain map showing plot petak 1B and 2B which had been clear felled

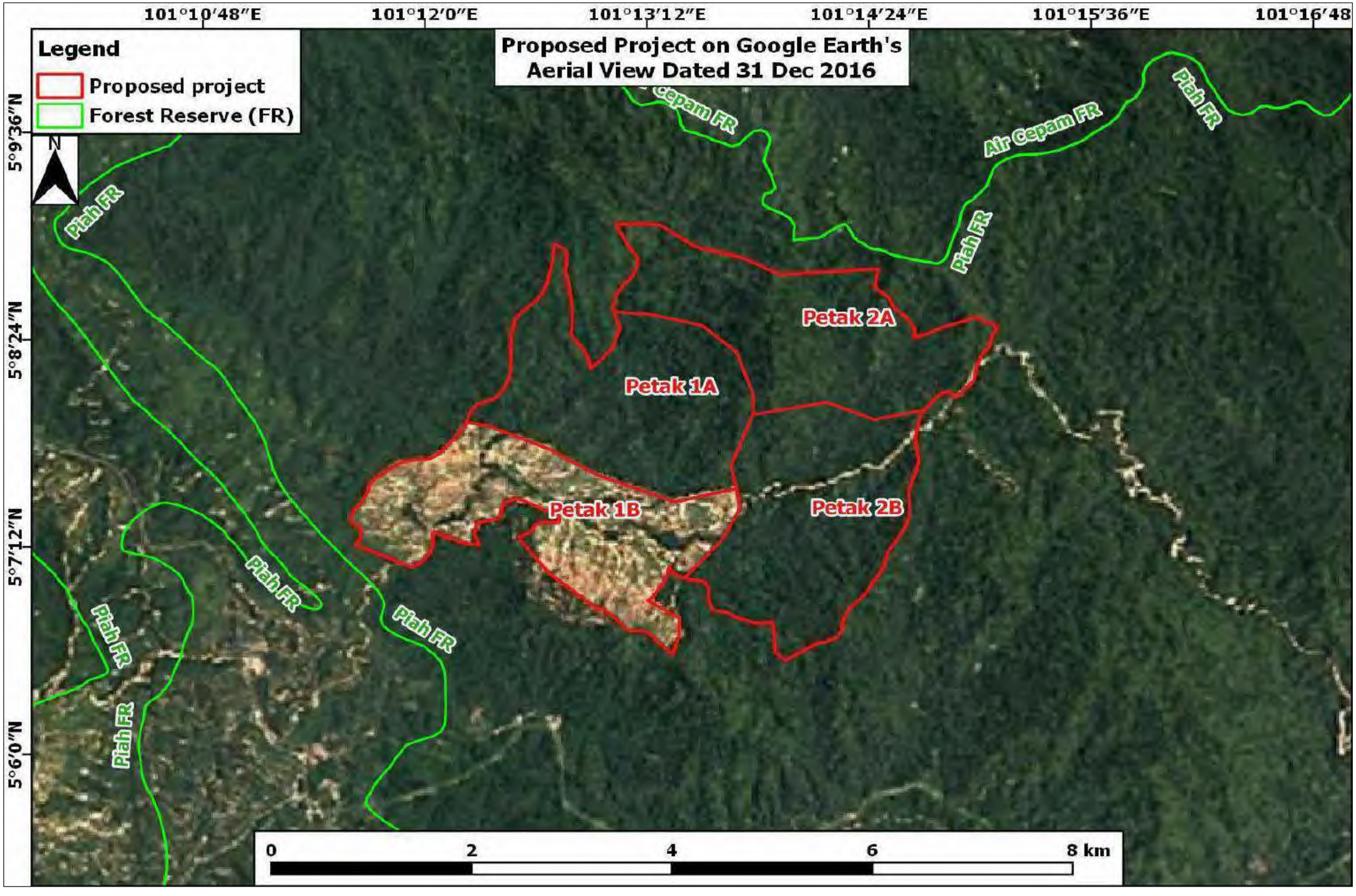


Figure 6.51 : Google Earth's Aerial View Dated 31 December 2016.

Figure 6.52 : A Typical View of Plot Petak 1B Which Had Been Terraced and Planted With Rubber Trees (Red Circles).

Figure 6.53 : A Typical View of Plot Petak 1A and 2A Which Are Still Well Forested.

6.11.2.3 Legal Protection and Conservation Statuses for Fauna

In Peninsular Malaysia, the law governing wildlife is the Wildlife Conservation Act (WCA) 2010, Act 716 (amendment 2012). Under the act, there are two levels of legal protection namely totally protected and protected. Totally protected under WCA 2010 (amendment 2012) provides that the species cannot be captured, taken or kept unless by special permit by the Ministry of Natural Resources and Environment. Meanwhile species with protected status may be captured, taken or kept with license granted from Department of Wildlife and National Parks (DWNP). The Wildlife Conservation Act (WCA) 2010 replaced the 38-year old Wildlife Protection Act (WPA) 1972. The new act covers more species including those that were not listed in the previous act and imposes stricter penalties involving wildlife crime.

In term of conservation status, the Red List by the International Union for Conservation of Nature (IUCN) is the most widely used for fauna and flora. It classifies species under nine categories namely extinct, extinct in the wild, critically endangered, endangered, vulnerable, near threatened, least concern, data deficient and not evaluated. **Figure 6.54** is a diagram showing the hierarchy of the categories whereas **Table 6.48** provides details for each of them.

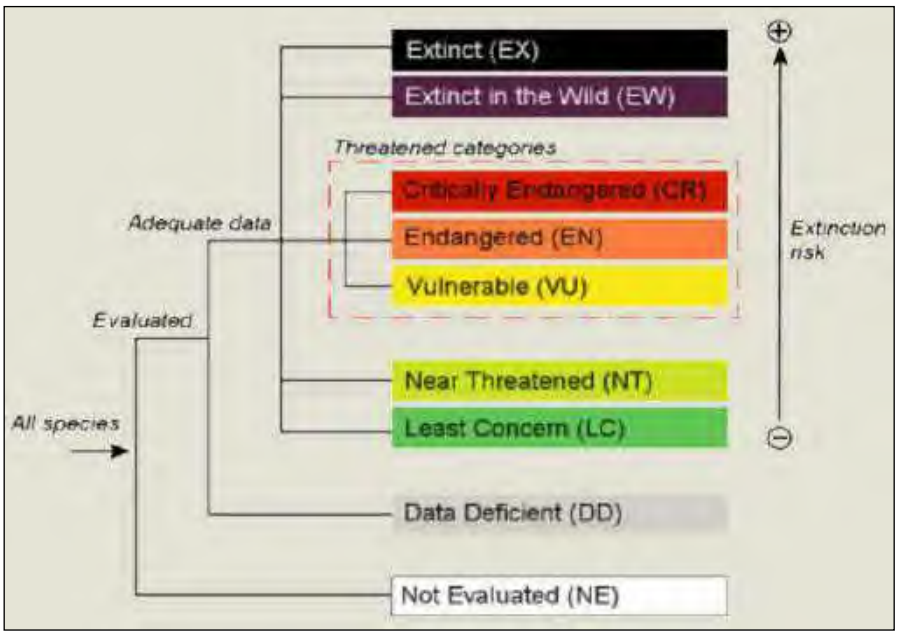


Figure 6.54 : Hierarchy of IUCN's Red List categories.

Table 6.48 : Details for Each Categories of Classification Under IUCN's Red List.

Category	Details
Extinct (EX)	When there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the wild (EW)	When it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically endangered (CR)	When the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	When the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	When the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
Near threatened (NT)	When it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least concern (LC)	When it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data deficient (DD)	When there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or

	distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.
Not evaluated (NE)	When it has not yet been evaluated against the criteria.

6.11.2.4 Findings and Discussion

Mammals

Unlike birds, mammals were relatively more difficult to detect for their secretive nature and many of them being active at night. Besides, only certain species make call to be detected from a distance such as primates. Bats and rodents are the most diverse yet the most challenging for surveillance. Many of the well-known and appreciated mega fauna such as Tiger, Asian Elephant and Malayan Tapir come from the mammal group but mammals are still comprised by fewer number of species compared to birds and herpetofauna (reptiles and amphibians). Nevertheless, many mammals face far greater threats compared to birds and herpetofauna for their ecological diversity and complexity nature such as the need of vast home range for the bigger ones. For example, a male tiger in India is recorded to have a home range of at least 5,000 hectares though any reliable data is for tigers in Malaysia is still lacking. The smallest of the only eight living bear species in the world, Sun bear was recorded to have an average home range of 1,480 hectares based on a study in Borneo.

Table 6.49 shows the lists of mammal species recorded and expected to be present at the proposed project site and surroundings. The expected species including for birds, reptiles and amphibians below are included for the following reasons:

i. Based on information from the aborigines hired from nearby village and habitat observation at the site;
ii. Some of these species are very low in number, rare, shy, elusive or occur only seasonally that much longer time is needed up to weeks or even months;
iii. For some species, special methods are required such as camera trapping, cage trapping, and mist netting. These methods require much longer time and costlier as well. Cage trapping and mist netting may also cause injury and death to the animals trapped.

A few species were only able to be detected through their markings and faeces such as the Sun Bear where encountering them directly would be very rare. A total 17 mammalian species were recorded with another 42 expected. Among the big mammals (more than five kg in body weight) recorded here include Asian Elephant, Malayan Tiger, Sun Bear, and Barking Deer. From the recorded species, seven species are totally protected, mainly the big mammals while six are protected and the remaining four are not listed under WCA 2010. One of the recorded mammals is classified as critically endangered under IUCN's Red List namely the Malayan Tiger. Critically endangered is the most critical level under IUCN Red List before a species is extinct. Three species are endangered namely Asian Elephant, Siamang and White-handed Gibbon. One species is vulnerable, three near threatened and nine least concern.

Table 6.49 : List of Mammals Recorded and Expected at The Proposed Project Site and Surroundings.

No.	Species	English Name	Malay Name	WCA 2010[1] (Amendment 2012)	IUCN[2] Red List	Detection method
A. Recorded Species						
Cercopithecidae (monkeys)						
1	*Presbytis siamensis*	White-thighed Langur	Lotong Chenekah	Protected (*P.melalophos*)	Near threatened	Call

2	*Trachypithecus obscurus*	Spectacled Leaf Monkey	Lotong Chengkong	Protected	Near threatened	Sighting, call
Cervidae (deers)						
3	*Muntiacus muntjak*	Barking Deer	Kijang	Protected	Least concern	Sighting
Elephantidae (elephants)						
4	*Elephas maximus*	Asian Elephant	Gajah	Totally protected	Endangered	Footmark, faeces, vocal, rubbing on tree, movement and feeding sound
Felidae (cats)						
5	*Panthera tigris jacksoni*	Malayan Tiger	Harimau Belang	Totally protected	Critically endangered	Footmark
Hylobatidae (gibbons, Siamang)						
6	*Hylobates lar*	White-handed Gibbon	Ungka Tangan Putih	Totally protected	Endangered	Call
Hylobatidae (gibbons, Siamang)						
7	*Symphalangus syndactylus*	Siamang	Siamang	Totally protected	Endangered	Call
Lorisidae (lorises)						
8	*Nycticebus coucang*	Sunda Slow Loris	Kongkang	Totally protected	Vulnerable	Sighting
Muridae (rats and mice)						
9	*Chiropodomys gliroides*	Indomalayan Pencil-tailed Tree-mouse	Tikus Buluh	–	Least concern	Sighting

Mustelidae (martens, weasels, badgers & otters)						
10	*Martes flavigula*	Yellow-throated Marten	Mengkira	Totally protected	Least concern	Sighting by the flora survey team
Pteropodidae (fruit bats)						
11	Either *Macroglossus sobrinus* or *M. minimus*	Either Greater or Lesser Long-tongued Nectar Bat	Either Cecadu Madu Bukit or Bakau	–	Least concern	Sighting
Sciuridae (squirrels)						
12	*Callosciurus notatus*	Plantain Squirrel	Tupai Pinang	–	Least concern	Sighting, call
13	Either *Sundasciurus lowii* or *S. tenuis*	Either Low's or Slender Squirrel	Either Tupai Ekor Pendek or Cerleh	–	Least concern	Sighting, call
Suidae (pigs)						
14	*Sus scrofa*	Wild Boar	Babi Hutan	Protected	Least concern	Footmark, faeces, lair
Tupaiidae (treeshrews)						
15	*Tupaia glis*	Common Treeshrew	Tupai Muncung Besar	Protected	Least concern	Sighting, call
Ursidae (bears)						
16	*Helarctos malayanus*	Sun Bear, Honey Bear	Beruang Matahari/ Madu	Totally protected	Near threatened	Scratch
Viverridae (civets)						
17	*Paradoxurus hermaphroditus*	Common Palm Civet	Musang Pulut	Protected	Least concern	Sighting

B. Other Expected Species						
Bovidae (cattle, buffalo, sheep & serows)						
1	*Capricornis sumatrensis*	Sumatran Serow	Kambing Gurun	Totally protected	Vulnerable	Foot mark
Cercopithecidae (monkeys)						
2	*Macaca fascicularis*	Long-tailed Macaque	Kera	Protected	Least concern	–
3	*Macaca nemestrina*	Southern Pig-tailed Macaque	Berok	Protected	Vulnerable	–
Cynocephalidae (colugos)						
4	*Galeopterus variegatus*	Colugo/ Flying Lemur	Kubung	Totally protected	Least concern	–
Emballonuridae (sheath-tailed & tomb bats)						
5	*Saccolaimus saccolaimus*	Pouched Tomb Bat		–	Least concern	–
6	*Taphozous melanopogon*	Black-bearded Tomb Bat	Kelawar Dagu Hitam	–	Least concern	–
Erinaceidae (gymnures)						
7	*Echinosorex gymnurus*	Moonrat	Tikus Ambang Bulan	–	Least concern	–
Felidae (cats)						
8	*Felis benghalensis*	Leopard Cat	Kucing Batu	Totally protected	Least concern	–
Hipposideridae (roundleaf bats)						
9	*Hipposideros armiger*	Great Roundleaf Bat	Kelawar Ladam Bulat Besar	–	Least concern	–
10	*Hipposideros larvatus*	Intermediate Roundleaf Bat	Kelawar Ladam Bulat Besar	–	Least concern	–

Hystricidae (porcupines)						
11	*Atherurus macrourus*	Brush-tailed Porcupine	Landak Batu	Protected	Least concern	–
12	*Hystrix brachyura*	Malayan Porcupine	Landak Raya	Protected	Least concern	–
Manidae (pangolins)						
13	*Manis javanica*	Sunda Pangolin	Tenggiling	Totally protected	Endangered	–
Muridae (rats and mice)						
14	*Leopoldamys sabanus*	Long-tailed Giant Rat	Tikus Mondok Ekor Panjang	–	Least concern	–
15	*Maxomys whiteheadi*	Whitehead's Maxomys		–	Least concern	–
16	*Mus musculus*	Asian House Mouse		–	Least concern	–
17	*Rattus rattus*	House Rat	Tikus Rumah	–	Least concern	–
18	*Rattus tiomanicus*	Malaysian Wood Rat		–	Least concern	–
19	*Sundamys muelleri*	Mueller's Rat	Tikus Lembah	–	Least concern	–
Mustelidae (martens, weasels, badgers & otters)						
20	*Aonyx cinerea*	Oriental Small-clawed Otter	Memerang Kecil	Totally protected	Least concern	–
Pteropodidae (fruit bats)						
21	*Balionycteris maculata*	Spotted-winged Fruit Bat	Cecadu Sayap Berbintik	–	Least concern	–
22	*Cynopterus brachyotis*	Short-nosed Fruit Bat	Cecadu Pisang	–	Least concern	–

23	*Cynopterus horsfieldi*	Horsfield's Fruit Bat		–	Least concern	–
Rhinolophidae (horseshoe bats)						
24	*Rhinolophus affinis*	Intermediate Horseshoe Bat	Kelawar Ladam Hutan	–	Least concern	–
25	*Rhinolophus pusillus*	Least Horseshoe Bat	Kelawar Ladam Terkecil	–	Least concern	–
Sciuridae (squirrels)						
26	*Callosciurus caniceps*	Grey-bellied Squirrel	Tupai Perut Kelabu	–	Least concern	–
27	*Ratufa affinis*	Cream-coloured Giant Squirrel	Tupai Kerawak Putih Kuning	Totally protected	Near threatened	–
28	*Ratufa bicolor*	Black Giant Squirrel	Tupai Kerawak Hitam	Totally protected	Near threatened	–
Soricidae (shrews)						
29	*Crocidura fuliginosa*	South-east Asian Shrew	Cencurut Hutan	–	Least concern	–
30	*Suncus murinus*	House Shrew	Cencurut Rumah	–	Least concern	–
Tapiridae (tapirs)						
31	*Tapirus indicus*	Malayan Tapir	Tapir	Totally protected	Endangered	–
Traguilidae (mousedeers)						
32	*Tragulus javanicus*	Lesser Mousedeer	Pelanduk	Protected	Data deficient	–
33	*Tragulus napu*	Greater Mousedeer	Napuh	Protected	Least concern	–
Vespertilionidae (common bats)						

34	*Kerivoula hardwickii*	Hardwicke's Woolly Bat	Kelawar Hutan	–	Least concern	–
35	*Miniopterus magnater*	Large Bent-winged Bat		–	Least concern	–
36	*Murina cyclotis*	Round-eared Tube-nosed Bat	Kelawar Hidung Laras	–	Least concern	–
37	*Myotis muricola*	Asian Whiskered Myotis		–	Least concern	–
38	*Pipistrellus javanicus*	Javan Pipistrelle	Kelawar Hidung Pendek Jawa	–	Least concern	–
39	*Pipistrellus tenuis*	Least Pipistrelle	Kelawar Hidung Pendek	–	Least concern	–
40	*Scotophilus kuhlii*	Lesser Asian House Bat	Kelawar Rumah	–	Least concern	–
41	*Tylonycteris pachypus*	Lesser Bamboo Bat	Kelawar Buluh Kecil	–	Least concern	–
Viverridae (civets)						
42	*Arctogalidia trivigrata*	Small-toothed Palm Civet	Musang Akar	Totally protected	Least concern	–

Source : [1]WCA 2010: Wildlife Conservation Act 2010 (Amendment 2012).
[2]IUCN: International Union for Conservation of Nature.

Asian Elephants require a very large area as their home range and feeding ground. Despite the abundance of plants available in the forests, only a small percentage serves as food for them and therefore they need to travel tens of kilometres every day to find consumable plants and minerals. In addition, more than half of the plants that they feed do not digest in their stomach although an adult Asian Elephant feed almost 200 kg of food every day. Elephants that raid crops are usually caused by one or two male(s) that leave his/ their herd headed by an old female. Crop raiding usually occurs during fruiting season or when the elephants are disoriented by the loss of or disturbance to their habitat. The Barking Deer got its name

from its loud barking-like calls especially when it feels threaten. Only the male has antlers and it meets female mostly during breeding season.

Unlike many mammals which are active at night, squirrels and shrews are active during the day. Common Palm Civet is mostly active at night and feeds on both plant and animal material. Its ability to dwell on the ground, burrow and climb trees makes it a highly adaptable including within human habitation. Its smelling ability is excellent that it can find its food in darkness of the night. One of the most majestic creatures in the animal kingdom, the Malayan Tiger is both admired and feared by mankind. It appears as symbol and logo in countries it is present especially in Malaysia. With estimated of less than 400 tigers in Peninsular Malaysia, efforts to increase its numbers to 1000 by the year 2020 had failed. It's mainly because its natural forested habitat is ever dwindling and fragmented especially forest reserves in addition to poaching.

Out of the many calls that can be heard in the forest, the Siamang's is the loudest that can be heard even a few kilometers away. It is strictly arboreal and very shy to human presence making it rarely seen though its calls are frequent and loud. The Sun Bear is the smallest of the only eight bear species in the world. It is active periodically during day and night, on the ground and trees. It builds nests of small branches in tall trees for sleeping and its diet includes honey, termites, small animals and fruits.

Sunda Slow Loris is indeed a slow species but could be surprisingly fast when felt threatened. It is strictly arboreal and very clumsy on the ground, making it very vulnerable during forest clearings. It is active at night where its searches for its food especially insects. The White-handed Gibbon is an endangered primate which was observed through its vocalization from a distance. It's strictly arboreal and very difficult to be sighted directly since due to its shyness. Like other primates, it needs contiguous forests to survive well since it may not be able to travel between two or more fragmented forests.

Birds

Birds were the most observed species both in term of number and diversity. The main reason for this was that most species were active during the day and many make calls and songs that their presence can be detected even without seeing them. Only a small percentage of birds are active at night namely owl, frogmouth and nightjar and their presence too could be detected through their calls. On the other hand, most mammals, reptiles and amphibians were not only active at night but also very secretive that their presence is more difficult to detect. The avifauna (bird) compositions at the proposed project site and its vicinity were mixed of both natural habitats and disturbed habitats. The compositions included some of relatively common birds such as the Grey-headed Canary Flycatcher and Crested Serpent-eagle and threatened such as the Chestnut-naped Forktail. Birds in Peninsular Malaysia receive the best legal protection where most species are totally protected under the WCA 2010 (amended 2012).

Table 6.50 below lists the bird species recorded and expected to be present at the proposed project site and surroundings with 61 recorded whereas another 39 expected. The majority of the recorded birds are totally protected with 50 species under the Wildlife Conservation Act whereas five are protected and the remaining six are not listed. Most of the recorded birds are classified as least concern with 52 species under the Red List by the International Union for Conservation of Nature (IUCN). Nine species are classified as near threatened such as Great Argus, Chestnut-naped Forktail, Crested Jay and Dark-throated Oriole. There seems to be difference between the statuses where the WCA 2010 gives maximum protection whereas the IUCN's Red List provides less concern. It is because WCA 2010 is legal protection specifically for Peninsular Malaysia whereas IUCN's Red List is a non-legal conservation status on a global scale. However, the IUCN's Red List status is assessed and updated by IUCN from time to time.

Table 6.50 : List of Birds Recorded and Expected at the Proposed Project Site and Surroundings.

No.	Species	English Name	Malay Name	WCA 2010[1] (Amendment 2012)	IUCN Red List[2]	Detection method
A. Recorded Species						
Alcedinidae: Halyconidae (larger kingfishers)						
1	*Halcyon smyrnensis*	White-throated Kingfisher	Pekaka Belukar	Totally protected	Least concern	Sighting, call
Apodidae: Apodinae (typical swifts)						
2	*Apus affinis*	House Swift	Layang-layang Rumah	Totally protected	Least concern	Sighting
Apodidae: Hemiprocninae (treeswifts)						
3	*Hemiprocne comata*	Whiskered Treeswift	Layang-layang Jambul Kecil	Totally protected	Least concern	Sighting, call
Bucerotidae (hornbills)						
4	*Buceros rhinoceros*	Rhinoceros Hornbill	Enggang Badak	Totally protected	Near threatened	–
Chloropseidae (leafbirds)						
5	*Chloropsis cochinchinensis*	Blue-winged Leafbird	Daun Sayap Biru	Totally protected	Least concern	Sighting
Cisticolidae (cisticolas, tailorbirds, prinias & allies)						
6	*Orthotomus atrogularis*	Dark-necked Tailorbird	Perenjak Belukar	Totally protected	Least concern	Sighting, call
7	*Orthotomus sutorius*	Common Tailorbird	Perenjak Pisang	Totally protected	Least concern	Call
8	*Prinia flaviventris*	Yellow-bellied Prinia	Perenjak Padi	Totally protected	Least concern	Sighting, call

9	*Prinia rufescens*	Rufescent Prinia	Perenjak Sampah	Totally protected	Least concern	Sighting
Columbidae: Columbinae (typical pigeons & doves)						
10	*Chalcophaps indica*	Emerald Dove	Punai Tanah	Protected	Least concern	Sighting, call
11	*Geopelia striata*	Peaceful Dove	Merbok Aman	–	Least concern	Sighting, call
12	*Spilopelia (Streptopelia) chinensis*	Spotted Dove	Merbok Balam	–	Least concern	Sighting, call
Cuculidae: Centropodinae (coucals)						
13	*Centropus sinensis*	Greater Coucal	But-but Carik Anak	Totally protected	Least concern	Sighting, call
Cuculidae: Cuculinae (Old World cuckoos)						
14	*Cacomantis sonneratii*	Banded Bay Cuckoo	Sewah Takuweh	Totally protected	Least concern	Sighting, call
15	*Chrysococcyx xanthorhynchus*	Violet Cuckoo	Sewah Rembah	Totally protected	Least concern	Call
Cuculidae: Phaenicophaeinae (malkohas & allies)						
16	*Rhinortha* (*Phaenicophaeus) chlorophaeus*	Raffles's Malkoha	Cenok Kerak	Totally protected	Least concern	Call
Coraciidae (rollers)						
17	*Eurystomus orientalis*	Dollarbird	Tiong Batu/ Belacan	Totally protected	Least concern	Sighting, call
Corvidae (crows, nutcrackers, magpies, jays, treepies & allies)						
18	*Corvus macrorynchos*	Southern Jungle Crow	Gagak Paruh Besar	–	Least concern	Sighting, call

19	*Platylophus galericulatus*	Crested Jay	Gagak Jerit	Totally protected	Near threatened	Call
Dicruridae (drongos)						
20	*Dicrurus paradiseus*	Greater Racket-tailed Drongo	Cecawi Anting-anting	Totally protected	Least concern	Sighting, call
Estrildidae: Lonchurinae (Java sparrow, munias, parrotfinches & allies)						
21	*Lonchura punctulata*	Scaly-breasted Munia	Pipit Pinang	Protected	Least concern	Sighting, call
22	*Lonchura striata*	White-rumped Munia	Pipit Tuli	Protected	Least concern	Sighting, call
Calyptomeninae (Asian green broadbills)						
23	*Calyptomena viridis*	Green Broadbill	Takau Selawit	Totally protected	Near threatened	Call
Eurylaimidae: Eurylaiminae (typical broadbills)						
24	*Corydon sumatranus*	Dusky Broadbill	Takau Rimba Hujan	Totally protected	Least concern	Sighting, call
25	*Eurylaimus javanicus*	Banded Broadbill	Takau Rimba	Totally protected	Least concern	Call
26	*Eurylaimus ochromalus*	Black-and-yellow Broadbill	Takau Hitam Kuning	Totally protected	Near threatened	Sighting, call
Falconidae: Accipitrinae (hawks, eagles and allies)						
27	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	Lang Siput	Totally protected	Least concern	Sighting, call
28	*Pernis ptilorhynchus*	Oriental Honey-buzzard	Lang Lebah	Totally protected	Least concern	Sighting, call
29	*Spirlornis cheela*	Crested Serpent-eagle	Lang Berjambul	Totally protected	Least concern	Sighting, call
Hirundinidae: Hirundininae (martins, swallows & allies)						

30	*Hirundo rustica*	Barn Swallow	Sualo Api	Totally protected	Least concern	Sighting, call
31	*Hirundo tahitica*	Pacific Swallow	Sualo Batu	Totally protected	Least concern	Sighting, call
Laniidae (shrikes)						
32	*Lanius cristatus*	Brown Shrike	Tirjup Tanah	Totally protected	Least concern	Sighting, call
Meropidae (bee-eaters)						
33	*Merops philipinus*	Blue-tailed Bee-eater	Berek-berek Carik Dada	Totally protected	Least concern	Sighting, call
34	*Nyctyornis amictus*	Red-bearded Bee-eater	Berek-berek Janggut Merah	Totally protected	Least concern	Sighting, call
Motacillidae (wagtails & pipits)						
35	*Anthus rufulus*	Paddyfield Pipit	Pipit Padi	Totally protected	Least concern	Sighting
36	*Motacilla flava*	Yellow Wagtail	Pipit Kuning	Totally protected	Least concern	Sighting, call
Muscicapidae: Muscicapinae (Old World flycatchers & allies)						
37	*Copsychus malabaricus*	White-rumped Shama	Murai Batu	Protected	Least concern	Sighting, call
38	*Copsychus saularis*	Oriental Magpie-robin	Murai Kampung	–	Least concern	Sighting, call
39	*Eumyias thalassina*	Verditer Flycatcher	Sambar Ranting	Totally protected	Least concern	Sighting
40	*Muscicapa dauurica*	Asian Brown Flycatcher	Sambar Asia	Totally protected	Least concern	Sighting
Muscicapidae: Saxicolinae (shortwings, robins, redstarts, rock-trushes, chats, forktails, whistling-trushes & allies)						
41	*Enicurus ruficapillus*	Chestnut-naped Forktail	Murai Cegar	Totally protected	Near threatened	Sighting, call

Nectariniidae (sunbirds & spiderhunters)						
42	*Aethopyga temminckii*	Temminck's Sunbird	Kelicap Merah	Totally protected	Least concern	Sighting
43	*Arachnothera longirostra*	Little Spiderhunter	Kelicap Jantung	Totally protected	Least concern	Sighting, call
Oriolidae (orioles & allies)						
44	*Oriolus xanthonotus*	Dark-throated Oriole	Dendang Senja	Totally protected	Near threatened	Sighting, call
Phasianidae: Phasianinae (pheasants & junglefowls)						
45	*Argusianus argus*	Great Argus	Kuang Raya	Totally protected	Near threatened	Call, dancing ground
Picidae: Picinae (typical woodpeckers)						
46	*Blythipicus rubiginosus*	Maroon Woodpecker	Belatok Punggor	Totally protected	Least concern	Call
Pycnonotidae (bulbuls)						
47	*Pycnonotus atriceps*	Black-headed Bulbul	Merbah Siam	Totally protected	Least concern	Sighting, call
48	*Pycnonotus brunneus*	Red-eyed Bulbul	Merbah Mata Merah	Totally protected	Least concern	Sighting
49	*Pycnonotus goiavier*	Yellow-vented Bulbul	Merbah Kapur	–	Least concern	Sighting, call
50	*Pycnonotus plumosus*	Olive-winged Bulbul	Merbah Belukar	Totally protected	Least concern	Sighting, call
51	*Pycnonotus simplex*	Cream-vented Bulbul	Merbah Mata Putih	Totally protected	Least concern	Sighting
Ramphastidae: Megalaiminae (Asian barbets						
52	*Calorhamphus fuliginosus*	Brown Barbet	Takor Dahan	Totally protected	Least concern	Call

53	*Megalaima australis*	Blue-eared Barbet	Takor Akar	Totally protected	Least concern	Call
54	*Megalaima chrysopogon*	Gold-whiskered Barbet	Takor Jambang Emas	Totally protected	Least concern	Call
55	*Megalaima mystacophanos*	Red-throated Barbet	Takor Raya	Totally protected	Near threatened	Sighting, call
Stenostiridae (Canary Flycatchers & allies)						
56	*Culicicapa ceylonensis*	Grey-headed Canary Flycatcher	Sambar Pacat	Totally protected	Least concern	Sighting, call
Strigidae (typical owls)						
57	*Otus lettia*	Sunda Scops-owl	Hantu Reban (*Otus bakkamoena*)	Totally protected (*Otus bakkamoena*)	Least concern	Call
Sturnidae: Sturninae (mynas, starlings & allies)						
58	*Acridotheres tristis*	Common Myna	Tiong Gembala Kerbau	–	Least concern	Sighting, call
59	*Gracula religiosa*	Common Hill-myna	Tiong Mas	Protected	Least concern	Call
Timaliidae (babblers)						
60	*Macronous gularis*	Pin-striped Tit-babbler	Rimba Berjalur	Totally protected	Least concern	Call
61	*Stachyris maculata*	Chestnut-rumped Babbler	Rimba Rembah Besar	Totally protected	Near threatened	Sighting
B. Other Expected Species						
Aegithinidae (ioras)						
1	*Aegithina tiphia*	Common Iora	Kunyit Kacat	Totally protected	Least concern	–

Alcedinidae: Alcidininae (smaller kingfishers)						
2	*Alcedo atthis*	Common Kingfisher	Pekaka Cit-cit Kecil	Totally protected	Least concern	–
3	*Alcedo euryzona*	Blue-banded Kingfisher	Pekaka Bukit	Totally protected	Near threatened	–
Apodidae: Apodinae (typical swifts)						
4	*Collocalia esculenta*	Glossy Swiftlet	Layang-layang Perut Putih	Totally protected	Least concern	–
5	*Cypsiurus balasiensis*	Asian Palm Swift	Layang-layang Asia	Totally protected	Least concern	–
Bucerotidae (hornbills)						
6	*Anthracoceros albirostris*	Oriental Pied Hornbill	Enggang Belulang	Totally protected	Least concern	–
Caprimulgidae: Caprimulginae (typical nightjars)						
7	*Caprimulgus affinis*	Savanna Nightjar	Tukang Savana	Totally protected	Least concern	–
8	*Caprimulgus macrurus*	Large-tailed Nightjar	Tukang Kubur, Pungguk	Totally protected	Least concern	–
Corvidae (crows, nutcrackers, magpies, jays, treepies & allies)						
9	*Platysmurus leucopterus*	Black Magpie	Gagak Kambing	Totally protected	Near threatened	–
Cuculidae: Centropodinae (coucals)						
10	*Centropus bengalensis*	Lesser Coucal	But-but Kecil	Totally protected	Least concern	–
Cuculidae: Cuculinae (Old World cuckoos)						
11	*Cacomantis merulinus*	Plaintive Cuckoo	Sewah Mati Anak	Totally protected	Least concern	–
12	*Cacormantis sepulcralis*	Rusty-breasted Cuckoo	Sewah Gila	Totally protected	Least concern	–

13	*Eudynamys scolopaceus*	Asian Koel	Sewah Tahu	Totally protected	Least concern	–
Cuculidae: Phaenicophaeinae (malkohas & allies)						
14	*Phaenicophaeus sumatranus*	Chestnut-bellied Malkoha	Cenok Kecil	Totally protected	Near threatened	–
Dicaeidae (flowerpeckers)						
15	*Dicaeum trigonostigma*	Orange-bellied Flowerpecker	Sepah Puteri Bukit	Totally protected	Least concern	–
Dicruridae (drongos)						
16	*Dicrurus aeneus*	Bronzed Drongo	Cecawi Keladi	Totally protected	Least concern	–
Eurylaimidae: Eurylaiminae (typical broadbills)						
17	*Cymbirhynchus macrorhynchos*	Black-and-red Broadbill	Takau Rakit	Totally protected	Least concern	–
Falconidae: Accipitrinae (hawks, eagles and allies)						
18	*Elanus caeruleus*	Black-shouldered Kite	Lang Bahu Hitam	Totally protected	Least concern	–
19	*Nisaetus (Spizaetus) limnaeetus (cirrhatus)*	Changeable Hawk-eagle	Lang Hindek	Totally protected	Least concern	–
Incertae sedis (Latin for "of uncertain placement") (woodshrikes, flycatcher-shrikes & philentomas)						
20	*Philentoma pyrhopterum*	Rufous-winged Philentoma	Sambar Paya	Totally protected	Least concern	–
Irenidae (fairy-bluebirds)						
21	*Irena puella*	Asian Fairy-bluebird	Dendang Gajah	Totally protected	Least concern	–
Meropidae (bee-eaters)						

22	*Merops viridis*	Blue-throated Bee-eater	Berek-berek Tadah Hujan	Totally protected	Least concern	–
Monarchidae (monarchs, paradise-flycatchers & allies)						
23	*Terpsiphone paradisi*	Asian Paradise-Flycatcher	Sambar Ekor Panjang	Totally protected	Least concern	–
Motacillidae (wagtails & pipits)						
24	*Dendronanthus indicus*	Forest Wagtail	Pipit Rimba	Totally protected	Least concern	–
Nectariniidae (sunbirds & spiderhunters)						
25	*Nectarinia jugularis*	Olive-backed Sunbird	Kelicap Bukit	Totally protected	Least concern	–
Oriolidae (orioles & allies)						
26	*Oriolus chinensis*	Black-naped Oriole	Dendang Selayang	Totally protected	Least concern	–
Phasianidae: Phasianinae (pheasants & junglefowls)						
27	*Gallus gallus*	Red Junglefowl	Ayam Hutan	Protected	Least concern	–
Phylloscopidae (*Seicerus* & *Phylloscopus* warblers)						
28	*Phylloscopus borealis*	Arctic Warbler	Cekup Artik	Totally protected	Least concern	–
Picidae: Picinae (typical woodpeckers)						
29	*Dinopium javanense*	Common Flameback	Belatok Pinang Muda	Totally protected	Least concern	–
Podargidae: Batrachostominae (Asian frogmouths)						
30	*Batrachostomus javensis*	Javan Frogmouth	Segan Jawa	Totally protected	Least concern	–
Pycnonotidae (bulbuls)						
31	*Pycnonotus cyaniventris*	Grey-bellied Bulbul	Merbah Kelabu	Totally protected	Near threatened	–

32	*Pycnonotus flaviventris* (*melanicterus*)	Black-crested Bulbul	Merbah Jambul Hitam	Totally protected	Least concern	–
Rallidae (rails, crakes, gallinules & coots)						
33	*Amaurornis phoenicurus*	White-breasted Waterhen	Ruak Ruak	Protected	Least concern	–
Rhipiduridae (fantails)						
34	*Rhipidura javanica*	Pied Fantail	Sambar Murai Gila	Totally protected	Least concern	–
Strigidae (typical owls)						
35	*Ketupa ketupu*	Buffy Fish Owl	Hantu Kuning	Totally protected	Least concern	–
Sturnidae: Sturninae (mynas, starlings & allies)						
36	*Aplonis panayensis*	Asian Glossy Starling	Perling Mata Merah	–	Least concern	–
Timaliidae (babblers)						
37	*Macronous ptilosus*	Fluffy-backed Tit-babbler	Rimba Pong-pong	Totally protected	Near threatened	–
Turnicidae (buttonquails)						
38	*Turnix suscitator*	Barred Buttonquail	Puyuh Tanah	Totally protected	Least concern	–
Tytonidae: Tytoninae (Barn- and grass-owls)						
39	*Tyto alba*	Common Barn-owl	Jampok Kubur	Totally protected	Least concern	–

Source : [1]WCA 2010: Wildlife Conservation Act 2010 (amendment 2012).
[2]IUCN: International Union for Conservation of Nature.

Every species of birds listed above has its own unique features and niches (ecological functions). Features of only selected species are included here since description for every species would be too lengthy in this report. Birds are active during the day with the exception for owls, nightjar and frogmouths. All nocturnal birds have

enlarged eyes for better vision in the dark. Birds of prey or raptors are among the largest birds with hooked and down-curved bills and strong and clawed feet. Like other barbets, Blue-eared Barbet is a colourful bird which nests in tree holes. Barbets got their name from the bristles which fringe their heavy bills and the Blue-eared barbet is the smallest.

The Chestnut-naped Forktail is an endangered species strictly confined along rivers, streams and waterfalls. It is a shy species but adaptable to partially disturbed habitats. Common Hill-myna is a well-known species in Malaysia as pet for its ability to pronounce several words and mimic certain sounds such as car alarm. Crested Jay belongs to same family as crows but primarily present in forested habitat and listed as near threaten. Same as Crow, it is almost black in colour except white spot on the sides of its neck and long black crest.

The Crested Serpent-eagle is the most common bird of prey usually flying high in the sky in the afternoon looking for prey such as snakes, small mammals and lizards. Dark-throated Oriole male has black streaks on its belly while female and juvenile also have on breast and throat. Dark throat is obvious only in adult male. The bird’s nest is cradle-like, built in between forked tree branch. Emerald Dove is among the very few species with protected status which means it could be hunted with license granted from DWNP. Often heard than seen, Gold-whiskered Barbet spends most of the day singing and foraging for food in the forest canopy. It is one of the largest barbets out of several species in Malaysia.

Great Argus is a member of pheasant family. Pheasants belong to a group of big birds confined to the ground with eight species present in Malaysia. It is about the size of a peacock reaching almost two metres in length including the long tail in males. The male being more attractive than the female as in many bird species makes dancing ground during mating season. A bird with very striking green colour, Green Broadbill is a shy species but can often be detected through its distinct call. Its beak is very weak and almost hidden by the crest above it and unlike many other birds, both sexes are almost similar.

A small bird but with loud and frequent calls, Grey-headed Canary Flycatcher is an insect feeding bird. It often joins other birds in mixed-species foraging flocks where birds of different species join each other and move together while foraging. A noisy bird which is often heard than seen, the Pin-striped-tit babbler previously was known only as Striped-tit babbler. Now it is divided into two species, the other being Bold-striped-tit babbler. Red-throated Barbet is a colourful bird species often staying high up in the forest canopy. This near threatened species nest in tree holes and the female usually lays 2 to 4 eggs, which are incubated for 13 to 15 days. White-rumped Shama is a species recognizable through its duet calls in the forests and therefore a highly sought species as song bird.

Reptiles and Amphibians

Reptiles which evolved from amphibians were decedents to mammals and birds that they had been living much earlier than the latter from prehistoric times. Amphibians are still heavily dependent of moist and watery habitat whereas reptiles had evolved to survive in much drier environment thanks to their development of scales. Both groups are largely carnivorous and lay eggs with the exception that certain reptiles give birth to live young.

Like mammals, many reptiles especially snakes were very shy and nocturnal in habit that detecting them was very challenging given that none of them make any calls. Many herpetofauna too are small in size and blend well with their surrounding that they could be missed even when they are nearby. Fortunately, many amphibians and certain lizards make calls that they are less difficult to detect. Reptiles and amphibians are the least studied and document vertebrates though their diversity is greater than mammals by about three times and birds by about one and half times, globally.

Table 6.51 below lists the reptiles and amphibians recorded and expected to be present at the proposed project site and surroundings. A total of 34 herpetofauna species were recorded while another 46 were expected. It's a pity when none of the recorded herpetofauna is totally protected while 12 are protected and as many as 22 others are

not listed. Majority of the recorded herpetofauna are classified as least concern with 26 species while seven species are not evaluated. Only one species is considered of higher concern which is categorised as near threatened. The lack for protection both legally and in term of conservation value is mainly due to lack of understanding and appreciation towards herpetofauna.

In Peninsular Malaysia many of the protected species were only given such status since 2010 when WCA 2010 was gazetted and amended in 2012. The poor understanding also leads to insufficient protection where most of the birds which are categorized as least concern by IUCN but totally protected under the WCA 2010 whereas chelonians (turtles and tortoises) which are categorized as endangered and vulnerable, are given only protected status rather than totally protected.

Table 6.51 : List of Reptiles and Amphibians Recorded and Expected at the Proposed Project Site and Surroundings.

No.	Species	English Name	Malay Name	WCA 2010[1] (Amendment 2012)	IUCN Red List[2]	Detection method
A. Recorded Species						
Agamidae (agamid lizards)						
1	*Bronchocela cristatella*	Green Crested Lizard		–	Not evaluated	Sighting
2	*Calotes emma*	Forest Crested Lizard		Protected	Not evaluated	Sighting
3	*Calotes versicolor*	Garden Lizard	Sesumpah Kuning	Protected	Not evaluated	Sighting
4	*Gonocephalus grandis*	Great Anglehead Lizard	Cicak Kepala Segi Besar	Protected	Not evaluated	Sighting
Bufonidae (toads)						

5	*Duttaphrynus melanostictus*	Common Sunda Toad		–	Least concern	Sighting
6	*Ingerophrynus parvus*	Dwarf Stream Toad		–	Least concern	Sighting, call
7	*Phrynoidis aspera*	River Toad		–	Least concern	Sighting, call
Dicroglossidae (true frogs)						
8	*Limnonectes blythii*	Blyth's River Frog	Katak Demam	Protected	Near threatened	Sighting
9	*Limnonectes (Taylorana) hascheanus*	Hill Forest Frog		–	Least concern	Sighting, call
10	*Limnonectes kuhlii*	Kuhl's Stream Frog		–	Least concern	Sighting
11	*Limnonectes laticeps*	Corrugated Frog		–	Least concern	Sighting, call
12	*Limnonectes plicatellus*	Rhinoceros Frog	–	–	Least concern	Call
Gekkonidae (geckos)						
13	*Gekko monarchus*	Spotted House Gecko		–	Not evaluated	Sighting
14	*Gekko smithi*	Forest Gecko		Protected	Least concern	Sighting, call
15	*Hemidactylus frenatus*	Common House Gecko		–	Least concern	Sighting, call
Megophryidae (litter frogs)						
16	*Leptobrachium hendricksoni*	Spotted Litter Frog		–	Least concern	Sighting, call
17	*Megophrys nasuta*	Malayan Horned Frog	Katak Bertanduk Borneo	Protected	Least concern	Sighting, call

Microhylidae (narrow-mouthed frogs)						
18	*Microhyla butleri*	Butler's Rice Frog		–	Least concern	Sighting, call
19	*Microhyla heymonsi*	Dark-sided Chorus Frog		–	Least concern	Sighting, call
Ranidae (true frogs)						
20	*Abavorana* (*Hylarana*) *luctuosa*	Mahogany Frog	–	–	Least concern	Sighting
21	*Amolops larutensis*	Larut Torrent Frog		Protected	Least concern	Sighting
22	*Fejervarya limnocharis*	Grass Frog		–	Least concern	Sighting, call
23	*Humerana miopus*	Diagonal-lined Frog		–	Least concern	Sighting
24	*Hylarana erythraea*	Green Paddy Frog	Katak Sawah Hijau	Protected	Least concern	Sighting
25	*Hylarana glandulosa*	Rough-sided Frog		–	Least concern	Sighting, call
26	*Hylarana labialis*	White-lipped Frog	Katak Anak Sungai Kesat	Protected (*H. raniceps*)	Not evaluated	Sighting
27	*Hylarana nicobariensis*	Cricket Frog		–	Least concern	Call
28	*Odorrana hosii*	Hose's Rock Frog	Katak Batu Beracun	Protected	Least concern	Sighting
Rhacophoridae (Afro-Asian tree frogs)						
29	*Polypedates leucomystax*	Four-lined Tree Frog		–	Least concern	Sighting, call

30	*Raorchestes* (*Philautus*) *parvulus*	Dwarf Bush Frog		–	Least concern	Call
31	*Rhacophorus nigropalmatus*	Wallace's Flying Frog	Katak Terbang Wallace	Protected	Least concern	Sighting
32	*Rhacophorus tunkui*	Tunku's Flying Frog	–	–	Least concern	Sighting, call
Scincidae (skinks)						
33	*Eutropis multifasciata*	Common Sun Skink		–	Not evaluated	Sighting
Varanidae (monitor lizards)						
34	*Varanus salvator*	Water Monitor	Biawak Air	Protected	Least concern	Sighting
B. Other Expected Species						
Agamidae (agamid lizards)						
1	*Aphaniotus fusca*	Earless Lizard	Sesumpah Tanpa Telinga	Protected	Not evaluated	–
2	*Draco formosus*	Dusky Gliding Lizard		–	Not evaluated	–
3	*Draco melanopogon*	Black-bearded Gliding Lizard		Protected	Not evaluated	–
4	*Draco quinquefasciatus*	Five-banded Gliding Lizard	Cicak Terbang Lima Jalur	Protected	Not evaluated	–
5	*Draco sumatranus*	Common Gliding Lizard	Cicak Kobin	Protected	Not evaluated	–
6	*Gonocephalus bellii*	Bell's Anglehead Lizard		Protected	Not evaluated	–
Bufonidae (toads)						

7	*Leptophryne borbonica*	Hour-glass Slender Toad		–	Least concern	–
8	*Pedostibes hosii*	Yellow-spotted Tree Toad		–	Least concern	–
Colubridae (rear fanged snakes)						
9	*Ahaetulla prasina*	Oriental Whip Snake	Ular Pucuk	Protected	Least concern	–
10	*Boiga cynodon*	Dog-toothed Cat Snake	Ular Kucing Taring	Protected	Not evaluated	–
11	*Boiga dendrophila*	Mangrove Snake	Ular Bakau	Protected	Not evaluated	–
12	*Coelognathus radiatus*	Radiated Rat Snake	Ular Rusuk Kerbau	Protected (*Coelognathus radiata*)	Not evaluated	–
13	*Dendrelaphis pictus*	Painted Bronzeback		–	Not evaluated	–
14	*Pseudorabdion longiceps*	Dwarf Reed Snake		–	Not evaluated	–
15	*Ptyas fusca*	White-Bellied Rat Snake		Protected	Not evaluated	–
16	*Ptyas korros*	Indo-Chinese Ratsnake		Protected	Not evaluated	–
17	*Xenochrophis trianguligerus*	Triangle Keelback		Protected	Least concern	–
Dicroglossidae (true frogs)						
18	*Limnonectes malesianus*	Peat Swamp Frog	Katak Paya Tanah Gambut	Protected	Near threatened	–
Elapidae (cobras, kraits, coral snakes & sea snakes)						
19	*Naja kaouthia*	Monocellate Cobra	Ular Senduk	Protected	Least concern	–

20	*Ophiophagus hannah*	King Cobra	Tedung Selar	Protected	Vulnerable	–
Gekkonidae (geckos)						
21	*Cyrtodactylus consobrinus*	Peter's Bent-toed Gecko		Protected	Not evaluated	–
22	*Cyrtodactylus quadrivirgatus*	Marbled Bent-toed Gecko	Cicak Jari Bengkok	Protected	Not evaluated	–
23	*Gehyra mutilata*	Four-clawed Gecko		–	Not evaluated	–
24	*Ptychozoon lionotum*	Burmese Parachute Gecko		–	Least concern	–
Geoemydidae (Asian hard-shelled turtles)						
25	*Cyclemys dentata*	Asian Leaf Turtle		Protected	Near threatened	–
26	*Heosemys spinosa*	Spiny Hill Turtle	Kura-Kura Duri Bukit	Protected	Endangered	–
Ichthyophidae (caecilians)						
27	*Ichthyophis* sp.	Caecilian		–	–	–
Megophryidae (litter frogs)						
28	*Leptolalax heteropus*	Variable Litter Frog		–	Least concern	–
Microhylidae (narrow-mouthed frogs)						
29	*Kaloula baleata*	Brown Bullfrog		–	Least concern	–
30	*Microhyla fissipes*	Ornate Narrow-mouthed Frog		–	Least concern	–
31	*Microhyla mantheyi*	Manthey's Narrow-mouthed Frog		–	Least concern	–

Pythonidae (pythons)						
32	*Python reticulatus*	Reticulated Python	Ular Sawa Batik	Protected	Not evaluated	–
Ranidae (true frogs)						
33	*Hylarana picturata*	Spotted Stream Frog	Katak Sungai Berbintik	Protected	Least concern	–
Rhacophoridae (Afro-Asian tree frogs)						
34	*Kurixalus (Rhacophorus) appendiculatus*	Frilled Tree Frog		–	Least concern	–
35	*Polypedates discantus*	Malayan Slender Tree Frog		–	Not evaluated	–
36	*Polypedates macrotis*	Dark-eared Tree Frog		–	Least concern	–
37	*Rhacophorus norhayatii* (*reinwardtii*)	Norhayati's Flying Frog		Protected (*Rhacophorus* (*reinwardtii*)	Least concern	–
Scincidae (skinks)						
38	*Dasia olivacea*	Olive Tree Skink		–	Least concern	–
39	*Eutropis rugifera*	Rough-scaled Skink		–	Not evaluated	–
40	*Lygosoma bowringii*	Bowring's Supple Skink		–	Not evaluated	–
41	*Sphenomorphus sungaicolus*	Malaysian Riparian Skink		–	Not evaluated	–
Testudinidae (tortoises)						
42	*Manouria emys*	Asian Brown Tortoise	Baning Perang	Protected	Endangered	–

Trionychidae (softshell turtles)						
43	*Amyda cartilaginea*	Southeast Asian Softshell Turtle	Labi-labi Biasa	Protected	Vulnerable	–
Varanidae (monitor lizards)						
44	*Varanus nebulosus*	Clouded Monitor	Biawak Puru	Totally protected	Least concern	–
Viperidae (vipers & pit vipers)						
45	*Parias (Trimeresurus) hageni*	Hagen's Pit Viper	Ular Kapak Hijau	Protected	Least concern	–
Xenopeltidae (sunbeam snakes)						
46	*Xenopeltis unicolor*	Sunbeam Snake	Ular Pelangi	Protected	Least concern	–

Source : [1]WCA 2010: Wildlife Conservation Act 2010 (amendment 2012).
[2]IUCN: International Union for Conservation of Nature.
**Note: the many blanks under the Malay name column indicate that there are no widely used names.*

A distinguishing feature of the Diagonal-lined Frog is the three-oblique scar-like diagonal lines on its back. Its call is like a rapidly repeated dog bark. Dwarf Bush Frogs can be heard making calls at night in the forests but would be very difficult to find even if they are located quite close. Bush Frogs (also called Shrub Frogs) lack a larval stage and develop directly from a gelatinous egg into the adult form. In the absence of a tadpole stage they are able to breed in areas where there is no free-standing water. Dwarf Stream Toad is active on forest floor at night in lowland forest and most common after rainfall when males congregate in large numbers to call along riverbanks of small stream to rivers. The Forest Crested Lizard is one the colourful lizard with a pair of thorn-like small spines above its eyes. During mating season, the males will turn darker to attract females.

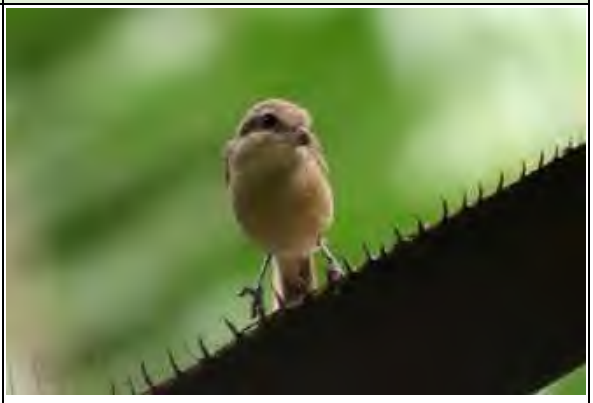
Forest Gecko is a large gecko capable of growing up to 30 cm long. It is often heard but extremely difficult to see as it is very shy and hides instantly. It has spots on the upper parts of its body with green

eyes. Green Crested Lizard is a handsome lizard striking green colour which can grow up to 58 cm. Under stress, it could darken its color to brown or dark grey. Besides forests, it is sometimes found in parks and gardens. It's a tree canopy dwelling species becoming less agile on the ground. It is a favourite prey for the Oriental Whip Snake. The Hose's Rock Frog is the only frog in Peninsular Malaysia to be poisonous but the poison is only effective for smaller animals and no significant effect to human. Mahogany Frog is quite colourful on a homogenous background but virtually dissolves when sitting in its preferred microhabitat, i.e. leaf litter. Mahogany refers to its colouration on the upper side of its body and it breeds in rain pools.

Despite its name, the Malayan Horned Frog does not possess any horn but elongated and pointed eyelids. Its snout too is elongated and pointed making it appear a dangerous frog. However, this frog is very gentle and camouflages well among litter on the forest floor. Males of Rhinoceros Frog have pointing backward protrusion on its head, giving its name. Contrary to many frogs which have white belly, this species has yellow. Although being small, it has relatively large head. It's reported as having no vocal sac, hence no call is made. Spotted Litter Frog inhabits lowland forests and also slightly disturbed areas. It is usually found on the ground, on forest trails and old logging tracks. One of interesting characteristics of this amphibian is having eyes with the top half being bright orange.

The beautiful and colourful Wallace's Flying Frog was named for the biologist, Alfred R. Wallace, who collected the first specimen to be formally identified. Its eyes and eardrums are large, its limbs are very long, and its fingers and toes are webbed right to the tips. Together with a fringe of skin stretching between the limbs, this frog can parachute to the forest floor from high in the trees where it is normally found. The White-lipped Frog is a common frog frequently encountered on vegetation by forest streams and swamps. It is mostly green in colour with brown being present on certain individuals but all has white lips. A distinguishing feature of the Diagonal-lined frog is the three-oblique scar-like diagonal lines on its back. The call is like a rapidly repeated dog bark.

Table 6.52 : Photos of Selected Fauna Recorded at Site and Its Vicinity.

	
Asian Brown Flycatcher	Asian Elephant's Footmark
	
Black-Winged Flycatcher-Shrike (Adult Male)	Brown Shrike (Adult)
	
Chestnut-Rumped Babbler	Common Tailorbirds

	
Crested Serpent-Eagle (Juvenile)	Dark-Throated Oriole (Adult Male)
	
Diagonal-Lined Frog	Ferruginous Flycatcher (Adult)
	
Forest Gecko	Greater or Lesser Long-Tongued Nectar Bat

	
Greater Racket-Tailed Drongo (Juvenile)	Green Crested Lizard
	
Hill Forest Frog	Indomalayan Pencil-Tailed Tree-Mouse
	
Low's or Slender Squirrel	Malayan Tiger's Footmark

	
Red-Throated Barbet (Male)	Rhinoceros Frog (Male)
	
Rough-Sided Frog	Rufescent Prinia
	
Scaly-Breasted Munia (Adult)	Siamang

	
Sun Bear's Scratch	Sunda Slow Loris
	
Tunku's Flying Frog	Verditer Flycatcher
	
Wallace's Flying Frog	Water Monitor

	
Whiskered Treeswift (Male)	White-Bellied Sea-Eagles (Adult)
	
White-Handed Gibbon	White-Throated Kingfisher

6.11.2.5 A Short Note on Fauna Other than Terrestrial Vertebrates

This survey did not cover terrestrial vertebrate fauna for the following reason:

i. Their diversity is tremendous that many experts and so much time (could be weeks) and equipment would be needed which means more money is required for the work:
ii. Many species are yet to be properly described and existing publications are still lacking.
iii. Hardly any of them are covered under the Wildlife Conservation Act 2010 for Peninsular Malaysia or the Red List by IUCN.

The survey also did not cover aquatic fauna. However, it must be noted that they are far more diverse than any other living organism on the planet despite mostly being small and tiny in size. For example,

there are more than 300,000 described species of beetles alone worldwide, which is more diverse than all plant species combined. In Malaysia alone, it is estimated that there are more than 150,000 invertebrate species. Although often not appreciated, they play important roles in the ecosystem such as pollination of flowers not only in the forest and wilderness but also in plantations and orchards.

The proposed project is highly anticipated to home to thousands of invertebrate species. One of the interesting invertebrates encountered at the proposed project was Malaysian Jungle Nymph (Heteropteryx dilatata), a type of stick insect which is active at night. The species holds the record for the largest egg laid by an insect at about 13 mm in length. Females bright green in colour, could reach 25 centimetres long as shown in **Figure 6.55**, are one of the world's heaviest insects while the males are about 10 centimetres long with brown colouration. Females have small wings which don't enable them to fly in addition to spines all over the whole insect. The eggs are said take from 12 to 14 months to hatch.

Malaysia is one of the few countries this magnificent creature occurs naturally. Most Malaysians may not know about this insect but it's quite famous internationally as a pet for insect lovers. Due to its slow reproduction and slow-moving nature, this species is one of those that could be easily wiped out by rampant deforestation. **Figure 6.56** and **6.57** show another two interesting invertebrates encountered at the proposed project site namely a caterpillar of Archduke butterfly (Lexias pardalis) and a pill millipede.

Figure 6.55 : This Female Malaysian Jungle Nymph, Found at The Site, Is One of The World's Heaviest Insects Reaching 25 cm Long and Holds The Record for The Largest Egg Laid By An Insect.

Figure 6.56 : This Comb-Like Caterpillar, Found at The Site, Would Develop into A Beautiful Archduke Butterfly. Despite Looking Dangerous/ Deadly, The Spines Are Said Not to Be Poisonous.

Figure 6.57 : True to Its Name, This Pill Millipede Which Would Roll into A Spherical Shape Like A Pill as Seen Here, Was Another Interesting Invertebrate Encountered at The Proposed Project Site.

6.12 TRAFFIC

6.12.1 Introduction

This report presents the findings and recommendations of the TIA study.

Objectives

The study has been carried out in fulfilment of the following objectives:

- To evaluate the existing traffic flow on the surrounding road network;
- To assess the impact of the proposed development onto the existing traffic flow in the vicinity of the project site; and
- To recommend appropriate measures to improve the efficiency and capacity of the road network to cope with future traffic.

Scope of Works

The scope of works shall cover, inter alia, the following:

- Carrying out traffic counts to determine the current traffic volumes of the surrounding road network;
- Projecting future traffic generated by the proposed development and its neighbouring developments;
- Assessing the traffic impact of the trips generated by the proposed development and its neighbours onto the existing and future road network; and
- Recommending a suitable traffic circulation system.

6.12.2 The Proposed Site

The proposed site is shown in **Figure 6.58 and 6.59**. It is on a plot land to the northeast hand side of route A19 from the proposed site.

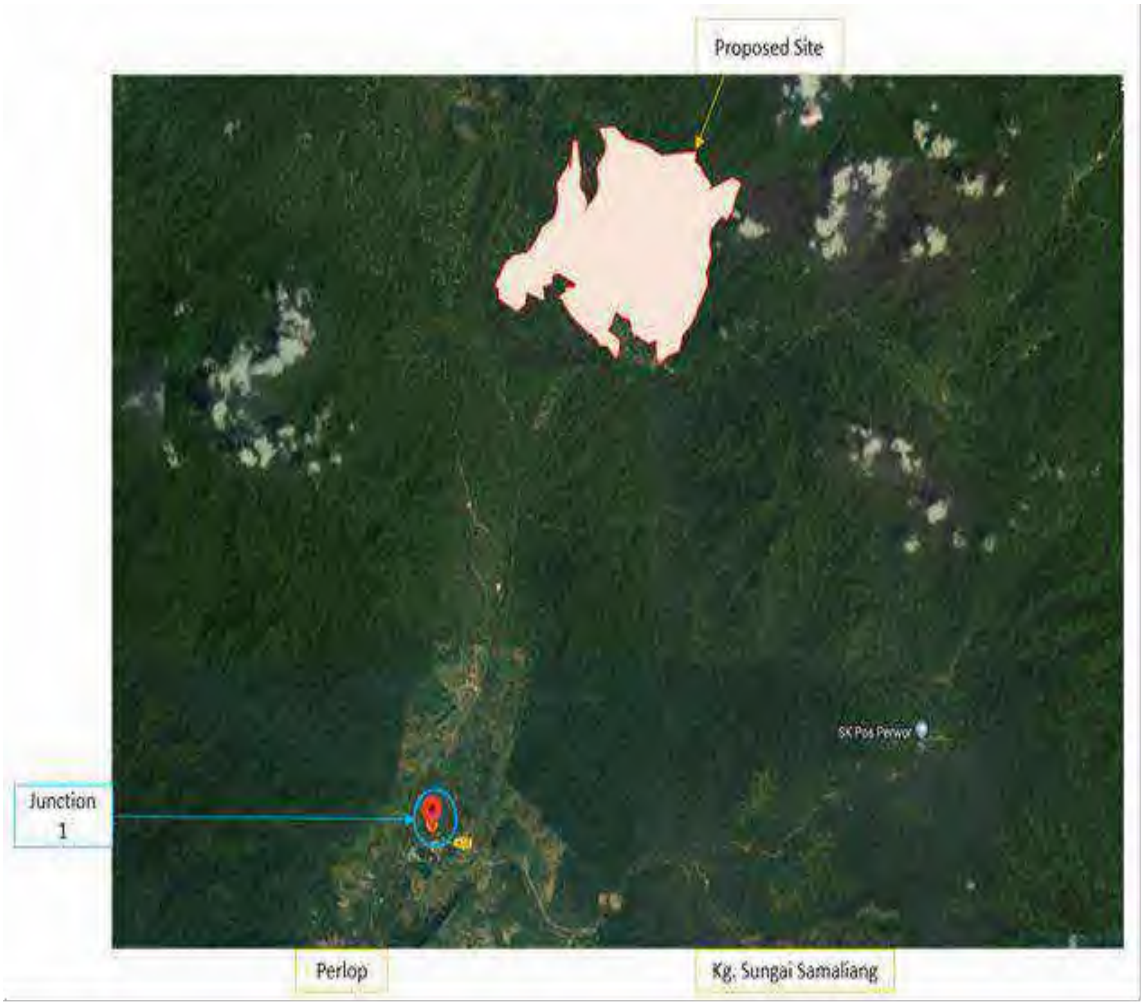


Figure 6.58 : Site Location Map

Figure 6.59 : Unsignalised 4-Legged Junction

The Proposed Development

The proposed project is located on parts of compartment 126, 131 and 132 (Block 1) and parts of Compartments 125, 126, 131 and 132 (Block 2) with an area of 1,600.00 Hectares (3,953.67 Acres) at Piah Forest Reserve, District of Hutan Kuala Kangsar, Perak Darul Ridzuan.

Pos Gapeh and Sekolah Kebangsaan Pos Piah are lies about 2km southwest and 2.8km southern from the proposed site, respectively. Kampung Lalang is situated approximately 2.5 km southeast from the proposed site. Meanwhile, Kampung Chat and kampong kekabu are located about 3 km southwest and 3.75 km southwest from the proposed project site. Lading Tasik Kenering is located about 5km northwest from the proposed site. Sekolah Kebangsaan Pos Poi (Sungai Siput Utara) is located abot 8.8 km southeast from the proposed site. Lenggong is located about 25 km western from the proposed project site. Sungai Siput and Taiping are situated

approximately 35 km southern and 56 km southwest from the proposed project site, respectively.

The proposed project site can be access via existing main road, Jalan Lenggong-Gerik. The unpaved access road run for approximately 25km before reaching the project site.

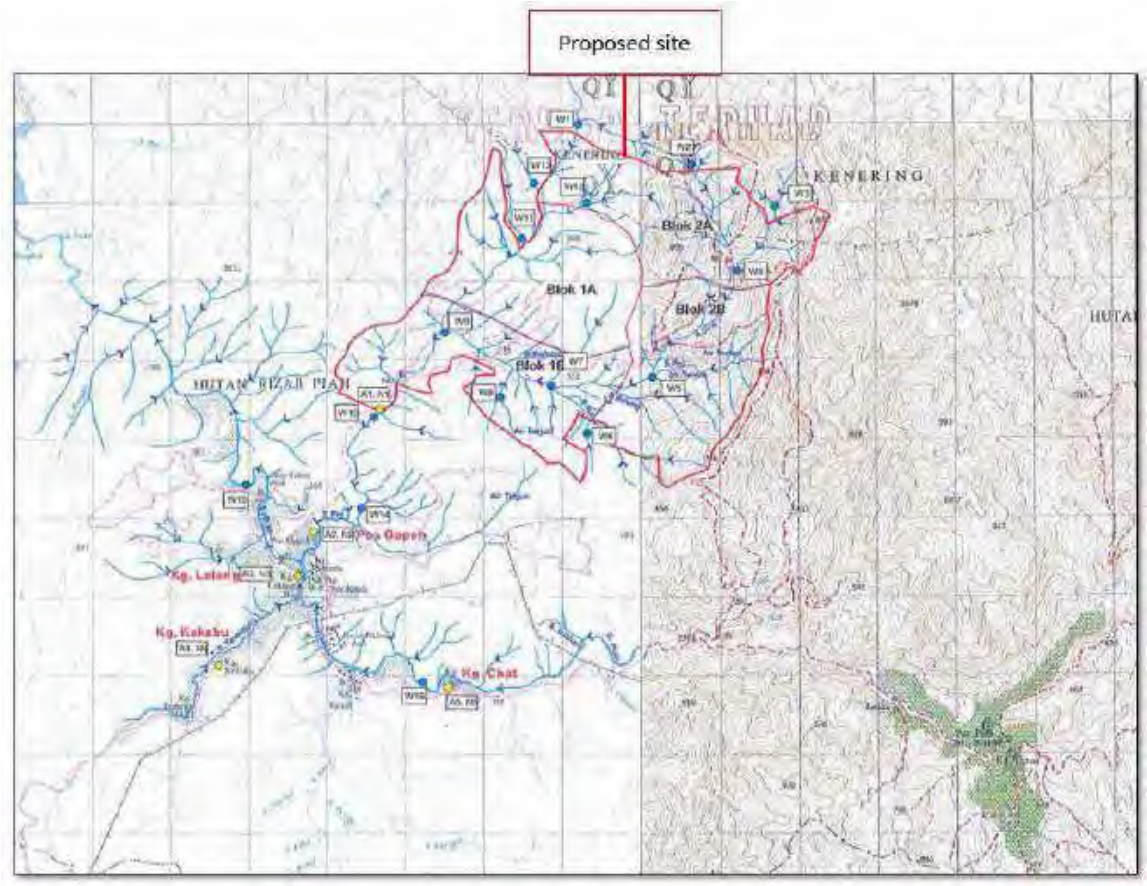


Figure 6.60 : Proposed Development Layout Plan and Access Road with Route A1

Intended access is through ingress and egress junction with route A1 which will eventually be linked to AR501-Ipoh-Kuala Kangsar - Changkat Jering (Kg. Kuala Dal)

6.12.3 Existing Situation

To determine the existing traffic situation in the vicinity of the proposed development, the following tasks were carried out:

- An examination of the trip origins and destinations of the study area;
- An inventory of the surrounding road and highway network;
- Traffic counts at strategic locations within the study area;
- An assessment of the road adequacy in terms of traffic volumes, carrying capacity and level of service (LoS).

Existing Road Network

A1 is recently constructed as a dual 2-lane carriageway of JKR R3 standard. R3 provides low geometric standard and serves mainly local traffic. There is partial and no access control. Thus, the site is having very good accessibility from all directions.

Current Peak Hour Traffic

Current peak hour traffic volumes on the roads within the study area were determined from classified manual traffic counts. These counts were conducted on a weekday in October 2018 for the morning and evening peak hour periods, i.e. 7.00 am to 10.00 am and 4.00 pm to 7.00 pm respectively.

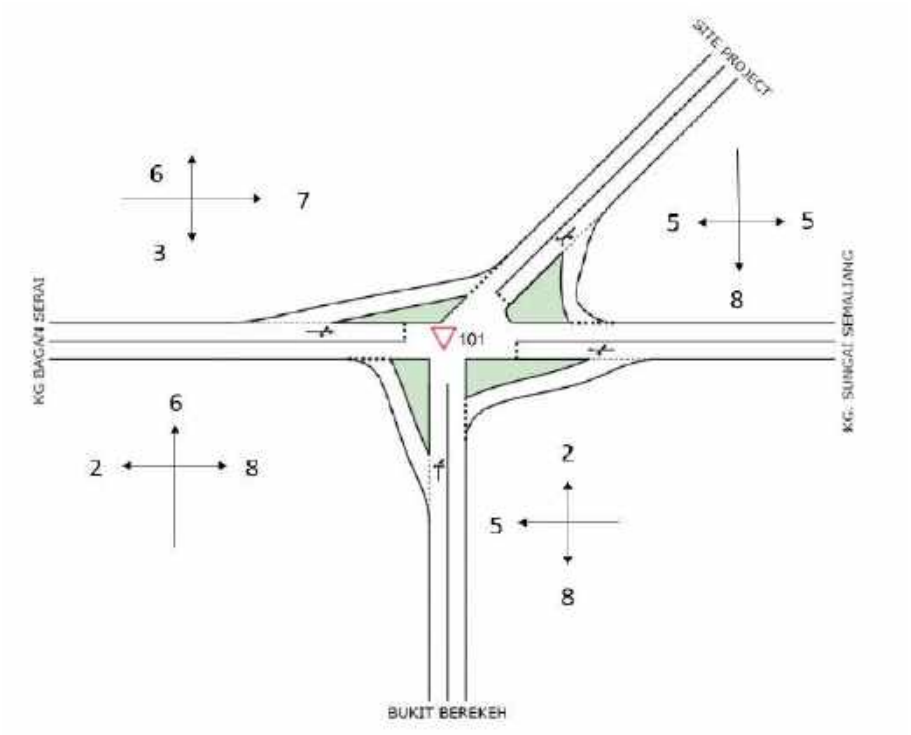
Classified traffic movements were conducted at 1 strategically at selected stations in the study area. The 1 strategic locations are:

- Station 1 – Junction of route A1 (unsignalised 4 legged-junction)

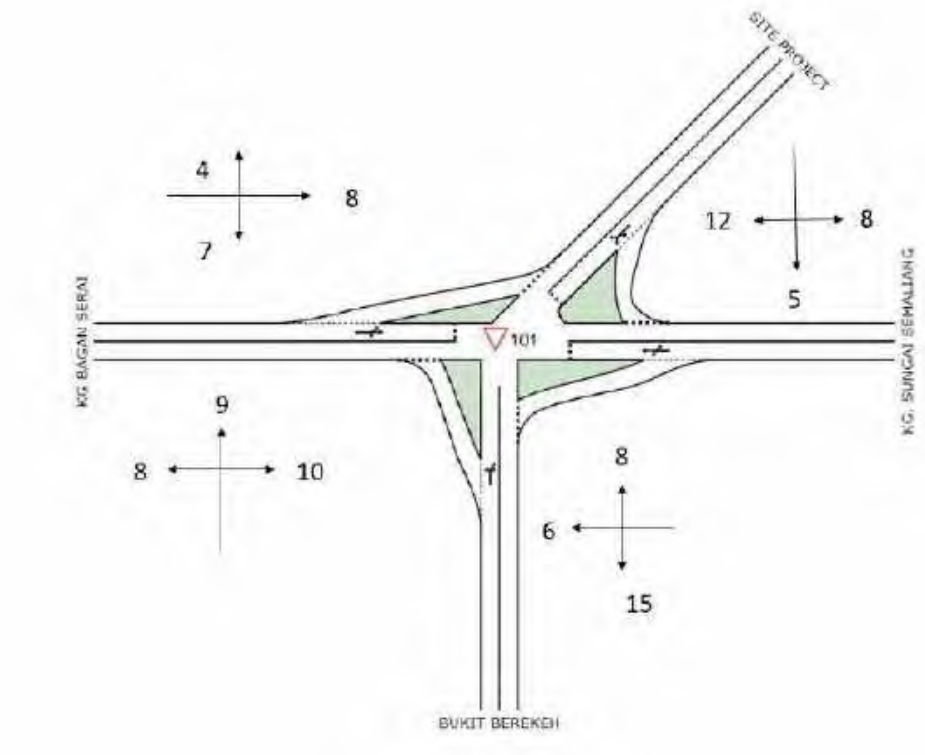
From the traffic survey, the following conclusion was made of the peak hours:

- AM peak hour – 7:30 am to 8:30 am
- PM peak hour – 5:15 pm to 6:15 pm

Figure 6.27 shows the existing morning and evening peak hour traffic volumes at the two traffic survey stations while **Table 6.55** below show the traffic composition analysis. It could be observed that the morning peak traffic volume is heavier by 5% as compared to the evening peak hour traffic volume. It was a relieve that all inspected roads are operating below the design road capacity during the peak hours.



(a) AM Peak Hour



(b) PM Peak Hour

Figure 6.61 : Peak Hour Traffic Volume 2018 At the Survey Stations

Figure 6.62 : Peak Hour Traffic Composition

Peak Hour	Passenger Vehicle	Medium Lorry	Heavy Lorry	Bus	Motorcycle	Total
AM	52.3%	4.1%	2.0%	0.3%	41.3%	100%
PM	57.1%	2.9%	2.6%	0.2%	37.2%	100%

It could be observed that cars, which include 4-wheel drives and vans, constitute the highest percentage of the total traffic composition of some 57.1% followed by motorcycles, 41.3 % and heavy vehicles of lorries and buses 2.6%.

6.12.4 Evaluation of Existing Road Networks

The Surrounding Road Network

To determine the adequacy of the existing roads in the vicinity of the project site, an evaluation was made by comparing the current traffic volume and the carrying capacity of the road sections. The procedure used in estimating the capacities of the various roads are based on the Highway Capacity Manual by the Transportation Research Board, USA. Using procedure, the peak hour traffic volume for each road section was determined. This value was then divided with the capacity of the respective road section to obtain the volume/capacity (v/c) ratio and its corresponding Level of Service (LoS).

Table 6.53 shows the relationship between LoS, v/c ratio and the corresponding traffic situation. Simply, LoS A indicates the highest level of driving comfort while LoS F indicates traffic congestion. A v/c ratio of over 0.82 or LoS E indicates that the road will be reaching its capacity and congestion and delay would result if no immediate action is taken.

Table 6.53 : Relationship between LoS, V/C Ratio and Traffic Condition

Level of Service	V/C ratio	Traffic Condition
A	<0.26	Free flow with low volumes, densities and high speeds. Drivers can maintain their desired speeds with little or no delay.
B	0.26 -0.42	Stable flow. Operating speeds beginning to be restricted somewhat by traffic conditions. Some slight delay.
C	0.43 -0.61	Stable flow. Operating speeds and maneuverability are more closely controlled by higher volumes. Acceptable delay.
D	0.62 -0.81	Approaching unstable flow. Tolerable operating speeds which are considerably affected by operating conditions. Tolerable delay.
E	0.82 -1.00	Unstable flow. Yet lower operating speeds and perhaps stoppages of momentary duration. Volumes are at or near capacity congestion and intolerable delay.
F	>1.00	Forced flow. Speeds and volume can drop to zero. Stoppages can occur for long periods. Queues of vehicles backing up from a restriction downstream.

Source: Highway Capacity Manual, TRB, 2000

Junction Capacity Analysis

Junction or intersection saturation degree is more critical than link capacity. Although link capacity can be conducted for the surrounding road network, the intersection capacity will dictate for provision of the infrastructural facilities that will mitigate the traffic impact from the development.

Junction capacity and level of service (LoS) for un-signalised and signalised junctions is determined by the estimation of control delay or measured control delay for each movement in accordance to Malaysia Highway Capacity Manual (MHCM). For un-signalised junction however, LoS is not defined for the junction as a whole, thus individual lane performance will serve as the measurement of the LoS.

Junction capacity analysis will be carried out in the following sequences:

i. Analysis of junction capacity and LoS by un-signalised junction procedures as per the following table and figure.

Table 6.54 : LoS Criteria for Un-Signalised Junctions

LoS	Average controlled delay (sec/veh)
A	0 – 10
B	> 10 – 15
C	> 15 – 25
D	> 25 – 35
E	> 35 – 50
F	> 50

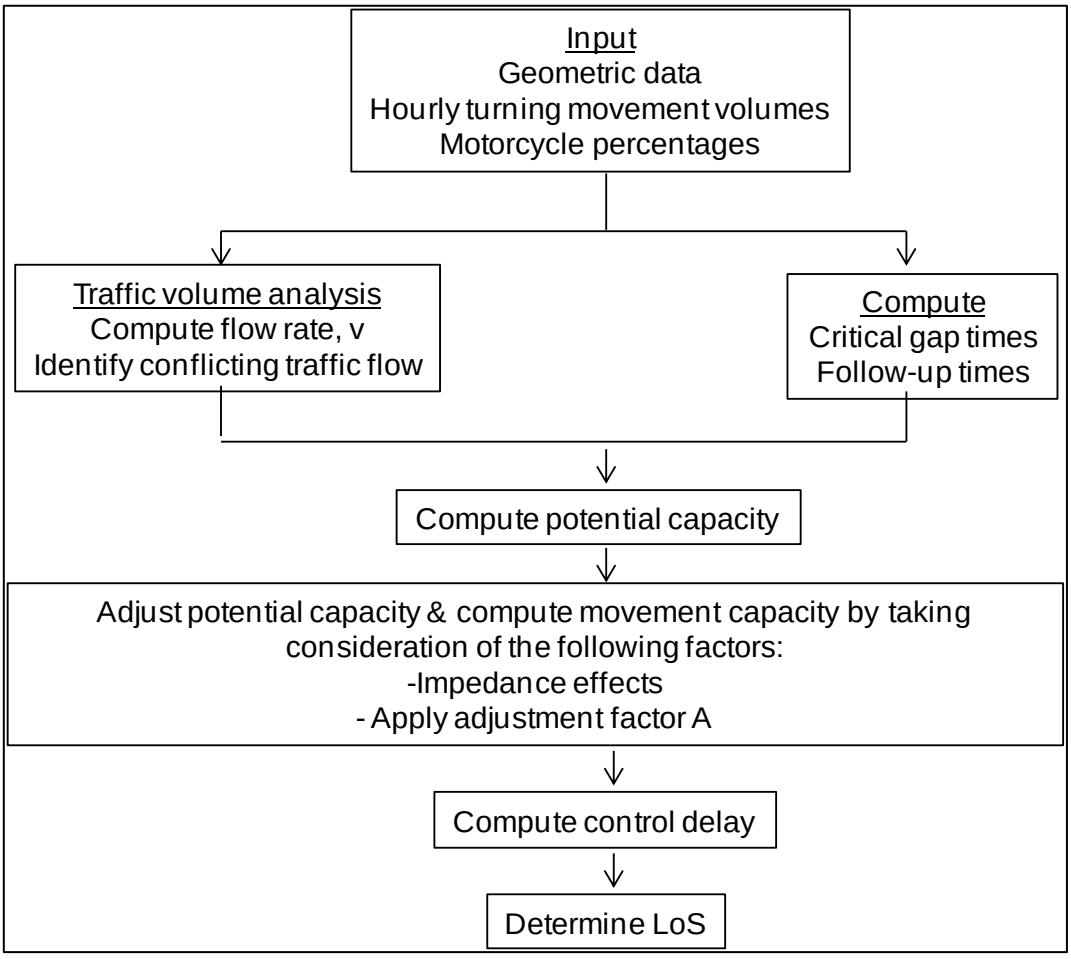


Figure 6.63 : Operational Analysis Procedures for Un-Signalised Junctions

ii. If the LoS is not satisfactory, i.e. F, a signalised junction capacity assuming a 1-lane exclusive for each turning movement is considered for the junction.

iii. If the junction saturation degree (JSD) exceeds 0.90, additional lane will be added to the critical movements one after another. Once the JSD less than 0.90 are obtained, the traffic signal cycle length and junction LoS will be determined.

iv. If the LoS is still not satisfactory, i.e. LoS F, this condition warrant for the construction of a grade separated junction in form of flyover for the major flow (partially free flows) or an interchange, i.e. free flows from/to all directions.

Junction capacity and level of service (LoS) for signalised junction is determined by the estimation of control delay or measured control delay for the whole junction as in **Table 6.55.**

Table 6.55 : LoS Criteria for Signalised Junctions

LoS	Average controlled delay (sec/veh)
A	0 – 10
B	> 10 – 20
C	> 20 – 35
D	> 35 – 55
E	> 55 – 80
F	> 80

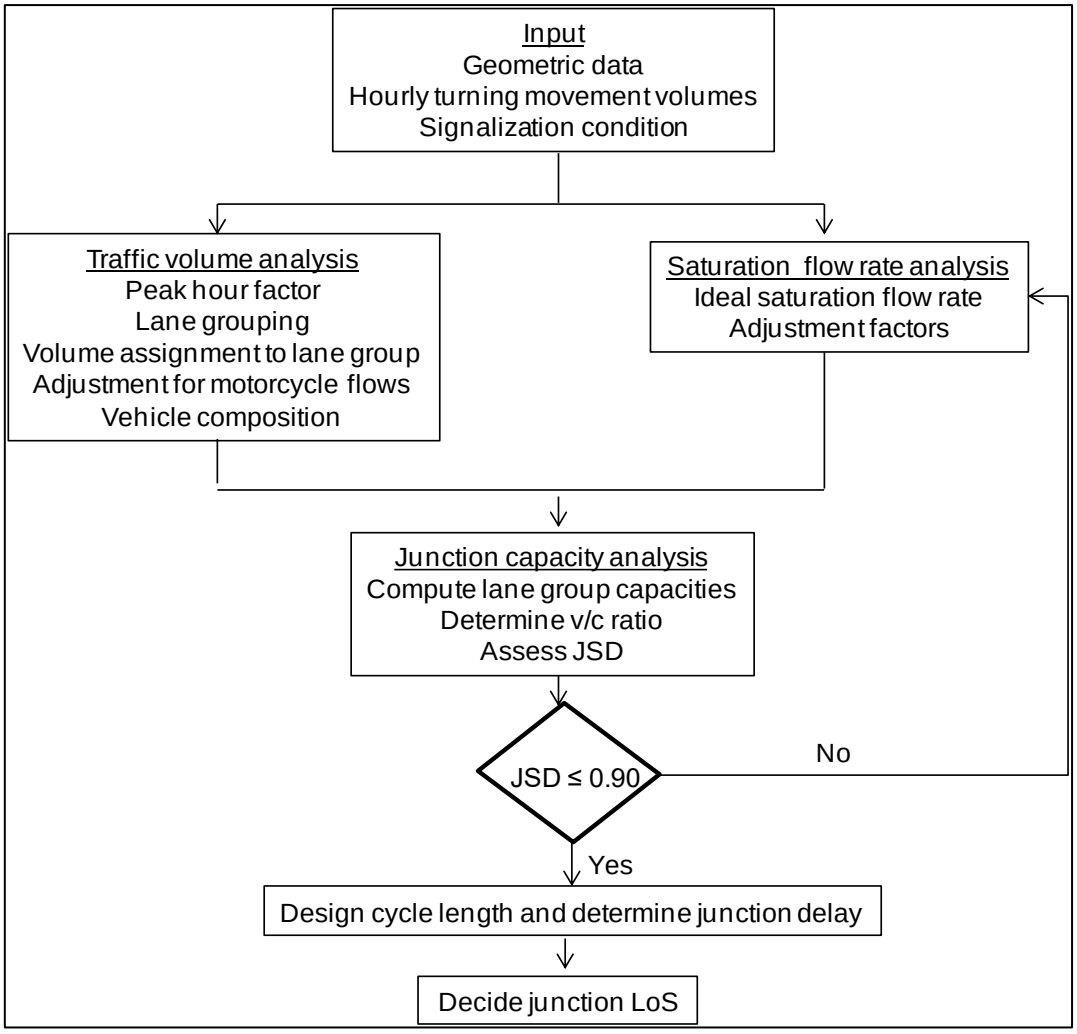


Figure 6.64 : Analysis Procedures for Signalised Junctions

Results of the capacity analysis

Results of the analysis are presented in **Figure 6.65**. As can be seen not all existing roads and junctions are performing at satisfactory level of service (LoS) during the morning peak hour and evening peak hour.

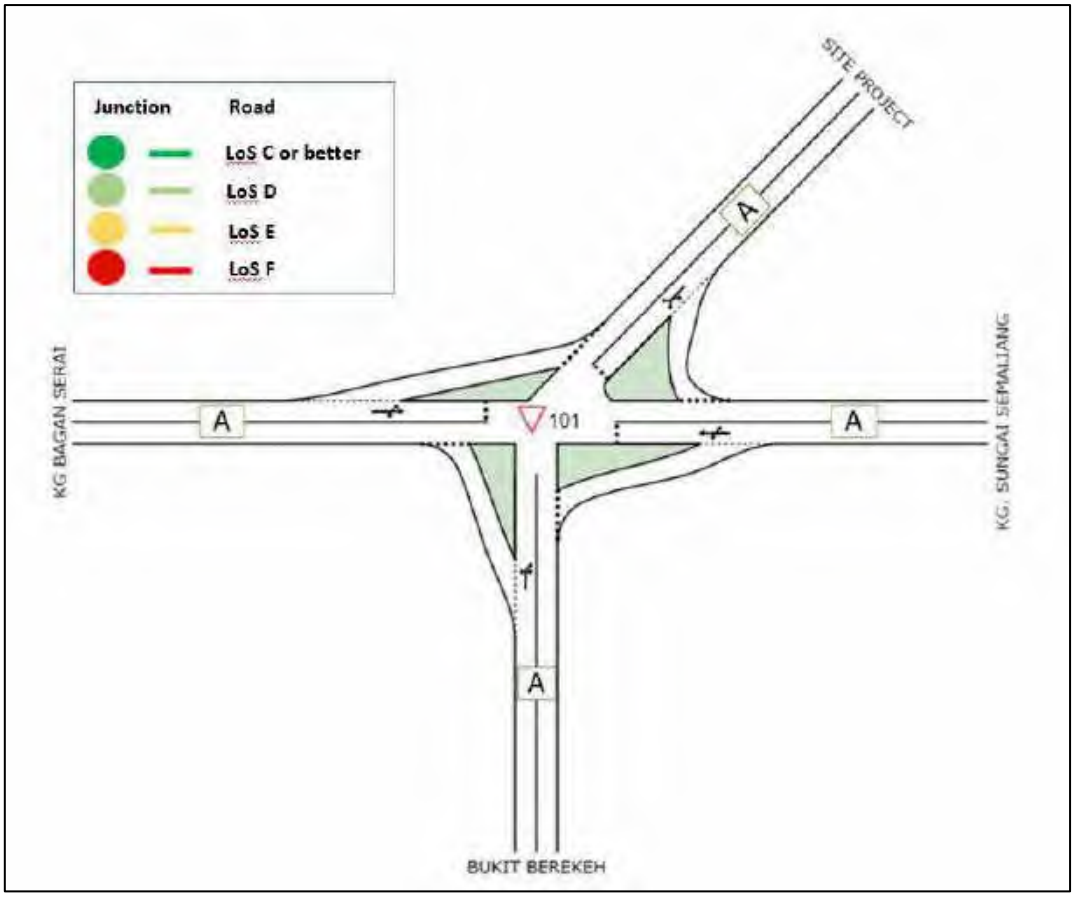


Figure 6.65 : Results of Junction Capacity Analysis 2018

6.12.5 Traffic Impact of Proposed Development

The proposed development, when completed, would inevitably result in additional trips generated onto the surrounding road network. To assess the traffic impact of the proposed development, it is necessary to:

- Project the normal traffic growth of the surrounding road network;
- Evaluate the trips generated by the proposed development and its neighbours;
- Carry out a distribution and assignment of generated trips onto the surrounding road network; and
- Evaluate the traffic impact of the trips generated by the proposed development and its neighbours onto the surrounding road network.

Normal Traffic Growth

Table 6.56 shows the annual growth rate (AGR) obtained from the historical data of year 2005 to 2015 of traffic count stations within Kuala Kangsar.

Table 6.56 : Annual Traffic Growth Rates at Relevant HPU Stations in Kuala Kangsar

Station No.	Route No	Location	AGR
AR501	1	Ipoh-Kuala Kangsar	2.2
AR502	1	Ipoh-Kuala Kangsar-Changkat Jering(Kg.Kuala Dal)	0.4
AR503	A76	Ipoh-Kuala Kangsar-Lenggong (Lunuk Merbau)	2.4
AR504	A76	Ipoh-Kuala Kangsar-Grik (Kg. Chuar Hulu)	0.5
AR505	A11	Ipoh-Kampong Tamuan-Kati (Kg. Lubuk Chapin)	2.5
AR506	A3	Ipoh-Kuala Kangsar-Kenas RPA 4, Jerlun	3.5
AR507	A164	Simpang Sayong-Jambatan Sultan Abdul Jalil	5.1
AR508	A164	Simpang Sayong-Tg.Belanja	3.0
Average for Kuala Kangsar			2.5
Average for Perak			2.4

Source: Road Traffic Volume, Malaysia, 2015, Highway Planning Unit (HPU), Malaysia

The historical data indicates that the annual traffic growth rate in the study area is averaged at 3%. We reckon that as the study area will have has a descending growth in the future, so a moderate AGR of less than 3% by year 2028 should be applicable.

6.12.6 Peak Hour Trips Generated By Proposed Development

The proposed development mainly comprises residential, commercial, industrial and institutional units. For the purpose of peak hour trip generation, although we will be focusing on AM peak hour traffic, however we will also conduct the PM peak hour traffic as a control measures.

Since there is no sample of vehicle trip generation for substation based on Trip Generation Manual 2010 by HPU, Malaysia, the peak hour traffic attracted (in) and produced (out) by the proposed development are modelled based on existing TNB substation facility as shown in **Table 6.57**.

Table 6.57 : Peak Hour Trip Generation

Land Use (Ha)	Peak Hour	Generation Rate (vph)	Traffic (vph)		Traffic Composition (%)				
			In	Out	Car	Motor	Lorry	Truck	Bus
1,600	AM	103	78	25	63.58	31.99	4.05	0.32	0.66
	PM	102	77	25	64.00	21.50	1.50	12.30	0.70

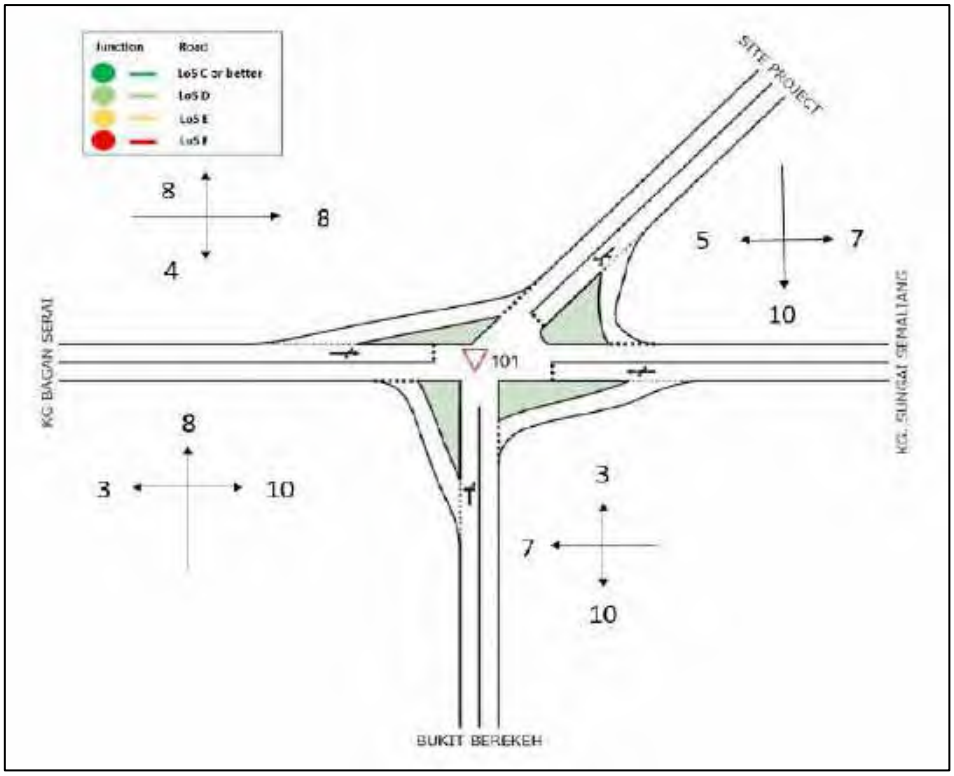
*Note: vph: vehicle per hour

The AM peak hour traffic is 0.98 % higher than the PM peak hour and this is consistent with the current traffic pattern.

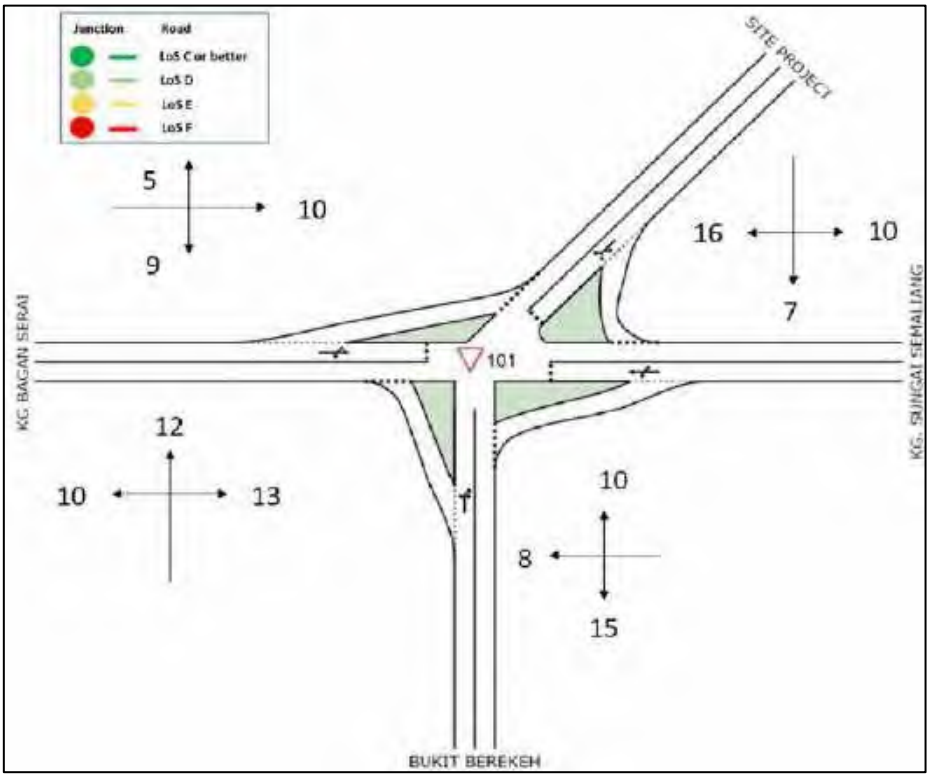
6.12.7 Trip Distribution and Assignment

One of the objectives of this study is to recommend appropriate measures to improve the efficiency and capacity of the road network surrounding the proposed development to cope with future traffic.

Based on the existing traffic analysis, generated traffic is distributed according to the current traffic pattern and using these assumptions, the total generated peak hour trips were distributed and assigned to the access points and the surrounding road network as per **Figure 6.66**.



(a) AM peak hour



(b) PM peak hour

Figure 6.66 : Traffic at the Strategic Stations In 2028

6.12.8 Traffic Impact of the Proposed Development

We shall assume that the proposed development shall be completed and occupied by year 2020 and we shall then analyse the scenario 10 years from 2018. Hence, combining traffic from the prevailing year 2018 and the trip generation and distribution model in the preceding sections, a traffic projection exercise 2028 were carried out. The traffic impact of the proposed development shall be evaluated for the surrounding road network. These will be discussed in detail in the following two sections.

Applying the same procedure as of the analysis for links and junctions as of the existing year 2018, results of the analysis for future year 2028 are presented as in **Figure 6.67**

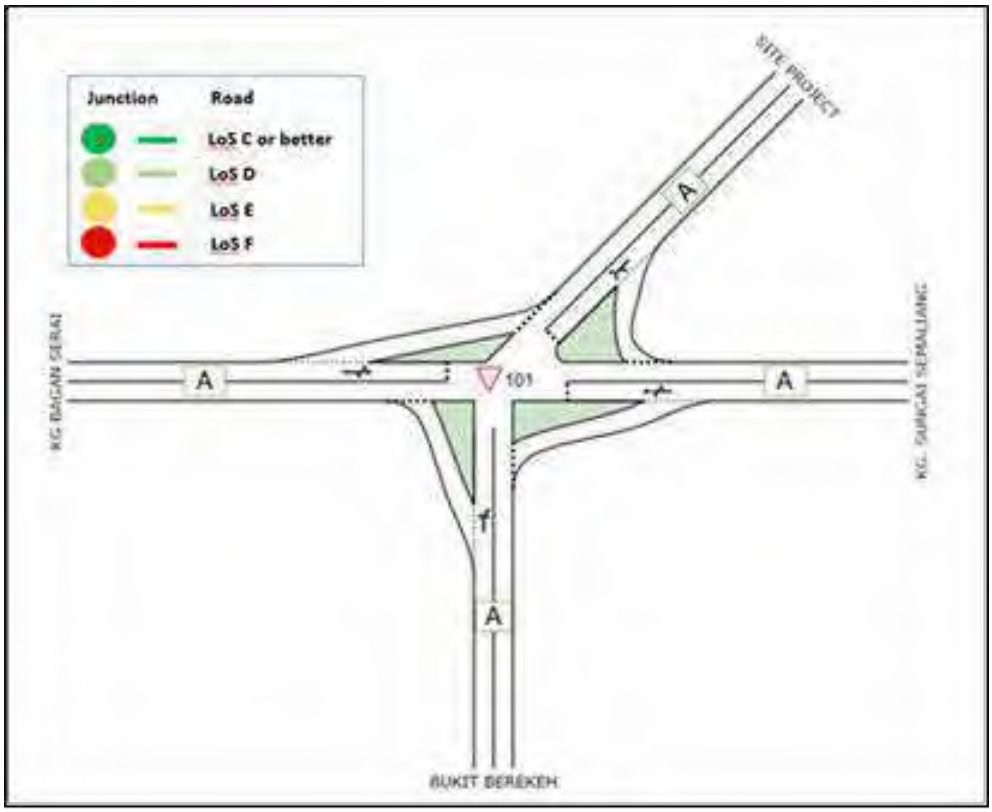


Figure 6.67 : Road and Junctions LoS 2028

Based on the results that had been presented, the following observations can be made:

- With proposed development generated traffic, roads and junctions can accommodate the future traffic demand

satisfactorily with prevailing traffic congestion reducing to acceptable level due to higher modal split to public transportation in the future.

- Impact from the proposed development will be able to be conservatively absorbed by the proposed site accessibility plan.

6.12.9 Traffic Circulation

Internal Traffic Circulation

All other internal roads should be provided according to the development standards. These roads are expected to be managed and maintain by the developers.

Parking Requirements

Adequate parking for cars and motorcycles in accordance to the development standards based on proposed development

6.12.10 Recommendations/Conclusion

The recommendations/conclusion is broadly grouped into three (3) categories:

- Road Accessibility to the Proposed Development.
- Impact of the generated traffic to road network.
- Public Transportation Provision for the Proposed Development.

Road Accessibility to The Proposed Development

From/To Kg Bagan Serai and From/To Kg Sungai Semaliang serve as the backbone of accessibility for the proposed development. The Level of Services (LoS) along these road is LoS A (2018) because the width of the road are suitable with the capacity of road access.

Impact of Generated Traffic

Very low and will not cause significant change to the performance of the existing road network. For any development, efficient ingress and egress points are imperative to enable smooth, safe and efficient traffic flow.

Public Transportation Provision for the Proposed Development

There is no pedestrian crossway along the junction and T-junction for the proposed development. Finally, we hereby certify that the traffic study for the proposed development had been duly undertaken according to the prevailing standards and best practices

The details SIDRA analysis are attached in **Appendix 6-F**.

6.13 TNB INTAKE

The Sungai Piah Hydroelectric Project is located in the State of Perak in the north – western part of the Malaysian Peninsular. It will develop the hydroelectric potential of the Sungai Piah, between its upper reaches and the Kenering reservoir, the Kenering Hydroelectric Development being one of the three Developments on the upper regions of the Sungai Perak. (*See* ***Appendix 6I***).

The Project consists of two (2) hydroelectric power generating station generally as described in the final Feasibility Study Report dated March 1984 and the Addendum Report entitled Review of the Project Evaluation dated August 27, 1984.

The Project consists of an Upper Scheme (15 MW) and a Lower Scheme (55 MW) operating in cascade. Both are run–of–river schemes with no storage available for regulation of stream flows.

The Sungai Piah Hydroelectric Scheme comprises the following:

A. Upper Piah Power Station

1. An Upper Piah surface power station (36m x 25.8m) housing two units of twin-jet horizontal axis Pelton turbines and synchronous with a capacity of 14.6MW.
2. A 132kV switchyard and related facilities.

3. A Temor Diversion Tunnel approximately 740m long.
4. A Piah and Piah Kecil Intake and Diversion Tunnel.
5. A Low Pressure Tunnel measuring approximately 2.4m x 2.4m x 5.5km long.
6. A High Pressure Dropshaft (233.52m) with a High Pressure Tunnel approximately 1.8km long.
7. An Access Tunnel to High Pressure Drop Shaft.

B. Lower Piah Power Station

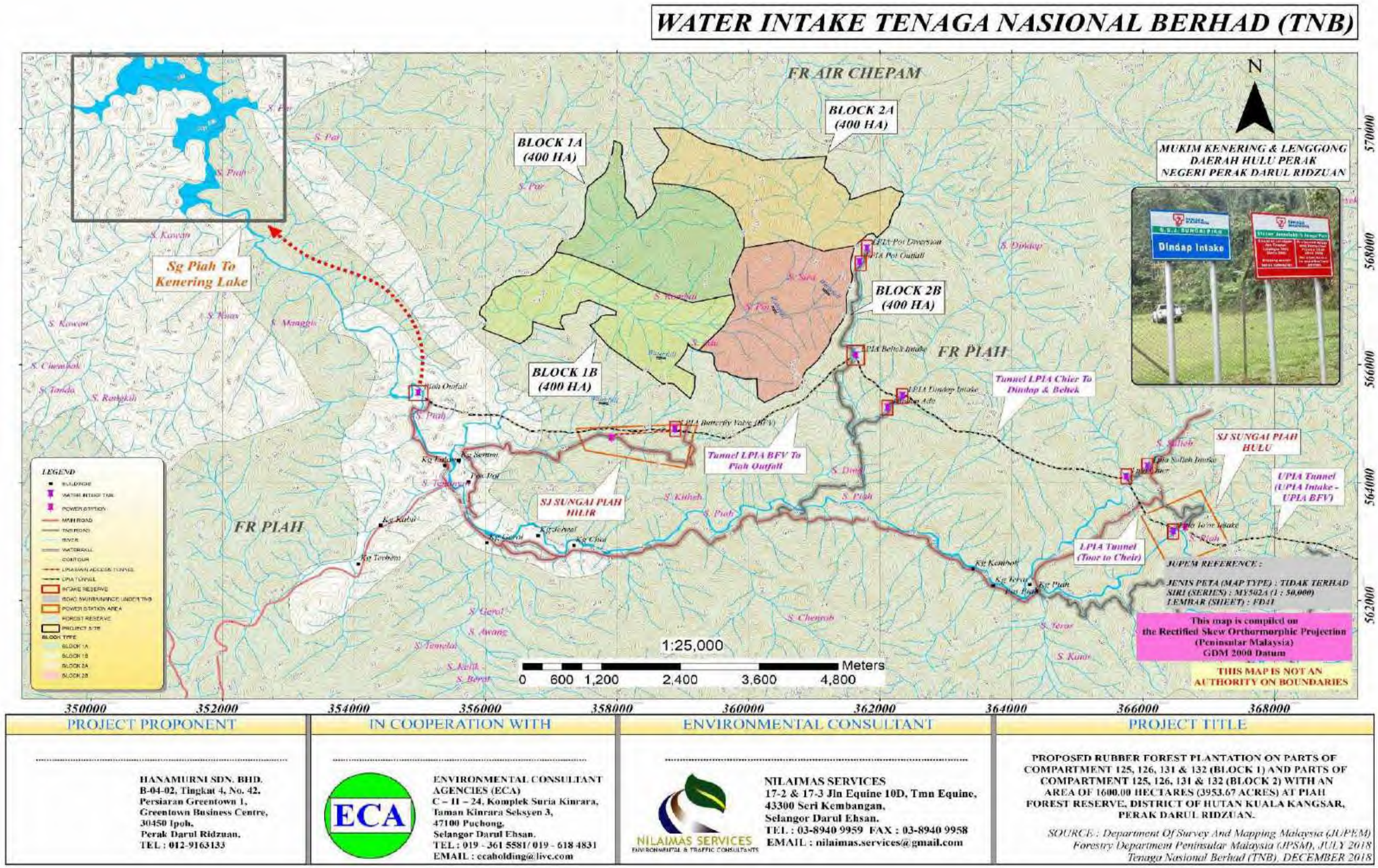
1. An Underground Lower Piah power station (70m x 15m) consisting two units of 4 jet vertical axis Pelton turbines and synchronous generators with a capacity of 55.4MW.
2. A Main Access Tunnel approximately 1km long.
3. A Tailrace Tunnel approximately 4km long.
4. A Diversion Tunnel consisting of intakes from side streams (Toor, Chier, Poi, Beltek, Dindap and Sulleh).
5. A substation consisting of a control building, 132kV switchyard and related facilities.
6. A Low Pressure Tunnel measuring approximately 3.42m x 3.42m x 8.5km long.
7. A High Pressure Dropshaft (400m) and High Pressure Tunnel approximately 108km long.
8. An Access Tunnel to High Pressure Drop Shaft.

The upper Scheme provides for the diversion of the upper reaches of Sungai Piah and Sungai Piah Kechil at E1.800m through a tunnel system to a conventional surface power station and a tailrace discharging into Sungai Toor at E1.534m.

The Lower Scheme involves a second diversion of Sungai Piah immediately downstream of its confluence with the Sungai Toor. The flows are carried by a tunnel system to an underground power station and then discharged into Sungai Piah at E1.120m, by a free surface flow tailrace tunnel.

Within the 5km zone of impact radius, there are several TNB Intake Stations. From the map **(Figure 6.68),** it shows that none of the intake stations and the diversion channel intercept with the Project site. The

outflow originating from the project site will ultimately end up in Kenering Dam. There is possibility that this Project might affect the quality of water if mitigations are not carried out properly. The water from the site might carry floating debris and Total Suspended Solid. TSS will cause sedimentation in the reservoir, which could result in reducing the productive water, increasing the level of water that might cause overflow. Cumulatively if the problem persistent, these pollutants might pose a threat to TNB operation.



PROJECT PROPONENT	IN COOPERATION WITH	ENVIRONMENTAL CONSULTANT	PROJECT TITLE
HANAMURNI SDN. BHD. B-04-02, Tingkat 4, No. 42, Persiaran Greentown 1, Greentown Business Centre, 30450 Ipoh, Perak Darul Ridzuan. TEL : 012-9163133	ENVIRONMENTAL CONSULTANT AGENCIES (ECA) C – 11 – 24, Komplek Suria Kinrara, Taman Kinrara Seksyen 3, 47100 Puchong, Selangor Darul Ehsan. TEL : 019 - 361 5581/ 019 - 618 4831 EMAIL : ecaholding@live.com	NILAIMAS SERVICES 17-2 & 17-3 Jln Equine 10D, Tmn Equine, 43300 Seri Kembangan, Selangor Darul Ehsan. TEL : 03-8940 9959 FAX : 03-8940 9958 EMAIL : nilaimas.services@gmail.com	PROPOSED RUBBER FOREST PLANTATION ON PARTS OF COMPARTMENT 125, 126, 131 & 132 (BLOCK 1) AND PARTS OF COMPARTMENT 125, 126, 131 & 132 (BLOCK 2) WITH AN AREA OF 1600.00 HECTARES (3953.67 ACRES) AT PIAH FOREST RESERVE, DISTRICT OF HUTAN KUALA KANGSAR, PERAK DARUL RIDZUAN. *SOURCE : Department Of Survey And Mapping Malaysia (JUPEM)* *Forestry Department Peninsular Malaysia (JPSM), JULY 2018* *Tenaga Nasional Berhad (TNB), DECEMBER 2018*

Figure 6.68 : Water Intake TNB

6.14 SOCIO-ECONOMY

The socio-economic assessment of the human environment is one of important aspects of an EIA of any project. In compliance with the objectives of this EIA, the baseline socio-economic profile of the project area and its surrounding is assembled. The awareness, perception and opinion of the communities whose lives would be affected were noted.

6.14.1 Introduction

Social Impact Assessment (SIA) is described as a systematic analysis of social, economic and cultural impacts of a proposed development project and programs onto individuals and communities where they live. It is undeniable that when a project is constructed, the resulting impacts will eventually affect, directly or indirectly on the surrounding environment and hence, the inhabitants living therein, whether positive or negative. SIA intends to assess impacts that focus specifically on the social considerations, which relates on the bio-physical (environmental) issues. According to Rabel Burdge (The Concepts, Process and Methods of Social Impact Assessment, 2004), SIA is the process of assessing or estimating, in advance, the social consequences that are likely to follow from specific project development, particularly in the context of legislation.

The main objectives of SIA study are:

i. To assess the probable impact of the project, with particular attention to demographic, socio-cultural issues and land use including the recent history of change in land use.
ii. To provide recommendations to any negative socio-economic effects of the project and maximizing contribution, with particular attention to land use, and to ensure incorporation of local perception in the project.

6.14.2 Background of the Study Area

Population Profile

The total population of Perak in 2010 as mention before was **2,352,743 people**. The ethnic composition of Perak consists of Malay, Chinese, Indian and others. **Table 6.58** shows the total population by ethnic group in Perak. Malay ethnic has the highest total population with 52.6% while the lowest is others (0.3%).

Table 6.58 : Population According to Ethnic Group in Perak, 2010.

Total population by ethnic group in Perak				
Malaysian Citizens	Bumiputera	Malay	1,238,357	52.6%
		Other Bumiputera	63,809	2.7%
	Chinese		693,397	29.5%
	Indian		281,688	12.0%
	Others		6,039	0.3%
Non-Malaysian Citizens			69,453	3.0%
Total			**2,352,743**	**100.0%**

Source: Department of Statistic Malaysia, 2010

Hulu Perak has a total population of 91,218 people only (3.9%) as of 2010. **Table 6.59** shows the total population by ethnic in Hulu Perak. Malay ethnic is the majority of Hulu Perak's population with 72.3%, and followed by other Bumiputera ethnic (12.6%).

Table 6.59 : Population According to Ethnic Group in Hulu Perak District, 2010.

Total population by ethnic group in Hulu Perak District				
Malaysian Citizens	Bumiputera	Malay	65,925	72.3%
		Other Bumiputera	11,461	12.6%
	Chinese		8,628	9.5%
	Indian		1,658	1.8%
	Others		1,395	1.5%
Non-Malaysian Citizens			2,151	2.4%
Total			**91,218**	**100.0**

Source: Department of Statistic Malaysia, 2010

There are two main Pos near the Project Site area which are Pos Poi and Pos Piah. The number of population in each settlements are as shown in **Table 6.60. (***See* ***Appendix 6-H).***

Table 6.60 : Number of Population in Pos Poi and Pos Piah

Pos	Village/Settlement	Population
Poi	Terhem	119
	Kabu	92
	Sanum	45
	Lalang	236
	Gerol	125
	Jelwel	163
	Chat	177
Total Pos Poi		**957**
Piah	Teras	232
	Kembok	169
	Piah	218
	Gentes	170
Total Pos Piah		**789**
Total (Pos Poi + Pos Piah)		**1, 746**

Source : JAKOA Negeri Perak dan Kedah, 2018

Zone of Influence

To evaluate a project's potential social risks and impacts, the area of influence should be first determined. It is defined as an area which likely to be affected by the project, including all of its ancillary aspects, such as power transmission corridors, pipelines, residential clusters, village settlements, existing access roads, disposal areas, and construction sites, as well as unplanned development induced by the project (e.g.: small agricultural activity along the access roads, fishing by the recreational areas and food stalls). Areas involved in the influence of this study includes 5km from the study area (refer **Figure 6.2 and 6.70**).

Nevertheless, the zone of influence is subjected to the area's homogenous characteristics and social activities that may associated with the proposed project even when the radius is underlined

beforehand. This is due to the possible development impacts in a much farther areas because of certain contributing factors.

Matau near Project Site

Air Tandak JAKOA

Balai Pengawal Polis Bantuan

TNB Station

Orang Asli Settlement Area

Figure 6.69 : Photos of Study Area within 5km radius from Project Site

6.14.3 Socio-Economic Background of the Study Area

The sample of the target populations was selected using a two-stage procedure. In stage one, prior to the actual fieldwork, a preliminary and on-site observation was made to determine the locality of the survey site, its physical components and the people perceived to be impacted by the implementation of the proposed project. In stage two, the individual adult respondents were then identified and interviewed. To ensure that the data collected are reliable and representative of the population being studied, strict ground supervision was carried out. During the on-site observations, the consultant conducted the surveys on 15th until 17th August 2018 for SIA study. The photos during the interviewed session are shown in **Figure**.**6.71**.

Source: Field Study, August 2018.

Figure 6.70 : Photos of Interview Sessions

The data were recorded using specially designed questionnaire, which can be referred in **Appendix 6-G**. The interviews were based on random sampling technique. The area covered in choosing respondents are more broad and inclusive of total 5 kilometre radius. The total number of respondents were taken within three days of SIA study are 152 respondents. The respondents are those who are staying within the 3 kilometre radius. The obtained data were analysed using SPSS software where the results were quantitatively tabulated and summarised for report writing purposes. **Table 6.61** below are the number of questionnaire distributed according to the distance in radius from the proposed project site in acquiring the feedbacks.

Table 6.61 : Sampling Locations

Location in Radius	Frequency	Percentage (%)
Kampung Sanum	2	1.3
Kampung Lalang	24	15.8
Kampung Gerol	36	23.7
Kampung Chat	22	14.5
Kampung Kabu	8	5.3
Kampung Terhem	20	13.2
Kampung Kembok	6	3.9
Kampung Teras	8	5.3
Kampung Gentes	6	3.9
Kampung Jelwel	14	9.2
Kampung Piah	6	3.9
Total	**152**	**100.0**

Socio-Demographic Profiles

The study area is located near the Orang Asli settlement areas. Therefore, in this study, most of the respondents that have been interviewed are the Orang Asli who have been staying in the study area for a period of time. The total respondents are 152 people, which 51.3% are women and 48.7% are men. The number of respondents according to the ethnicity is tabulated in **Table 6.62** The least race among the respondents is the other race, which the respondent is a Christian.

Table 6.62 : Races of Respondents

Race	Respondents	
	Frequency	Percentage (%)
Malay	6	3.9
Chinese	-	-
Indian	-	-
Orang Asli	144	94.7
Other	2	1.3
Total	**152**	**100.0**

Source: Field Study, August 2018

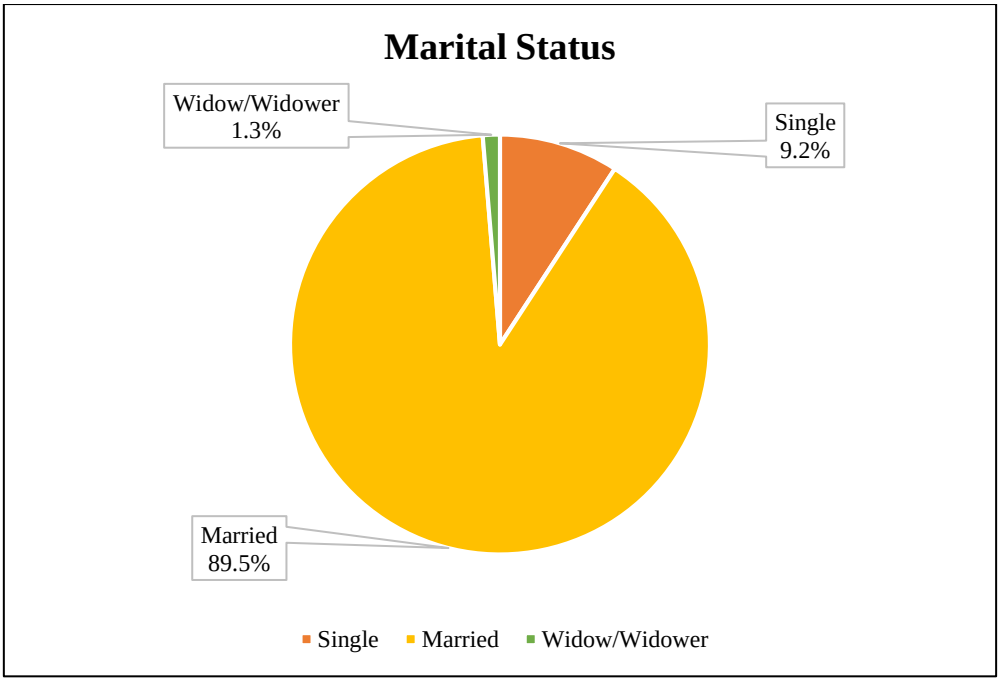
From **Table 6.63**, majority of the respondents are from 21-30 years group age with 35.5% while the least respondents are from below 20 years age group with 10.5% respondents only.

Table 6.63 : Age Group of Respondents

Race	Respondents	
	Frequency	Percentage (%)
< 20 years	16	10.5
21-30 years	54	35.5
31-40 years	20	13.2
41-50 years	22	14.5
51-60 years	22	14.5
> 61 years	18	11.8
Total	**152**	**100.0**

Source: Field Study, August 2018

From 152 respondents, 89.5% from them are already married as can be seen in **Figure 6.72**. 9.2% of the respondents are still single while the rest 1.3% are widow and widower. This may result in higher birth rate and growing population in the future.



Source: Field Study, August 2018

Figure 6.71 : Marital Status of Respondents

Educational Profiles

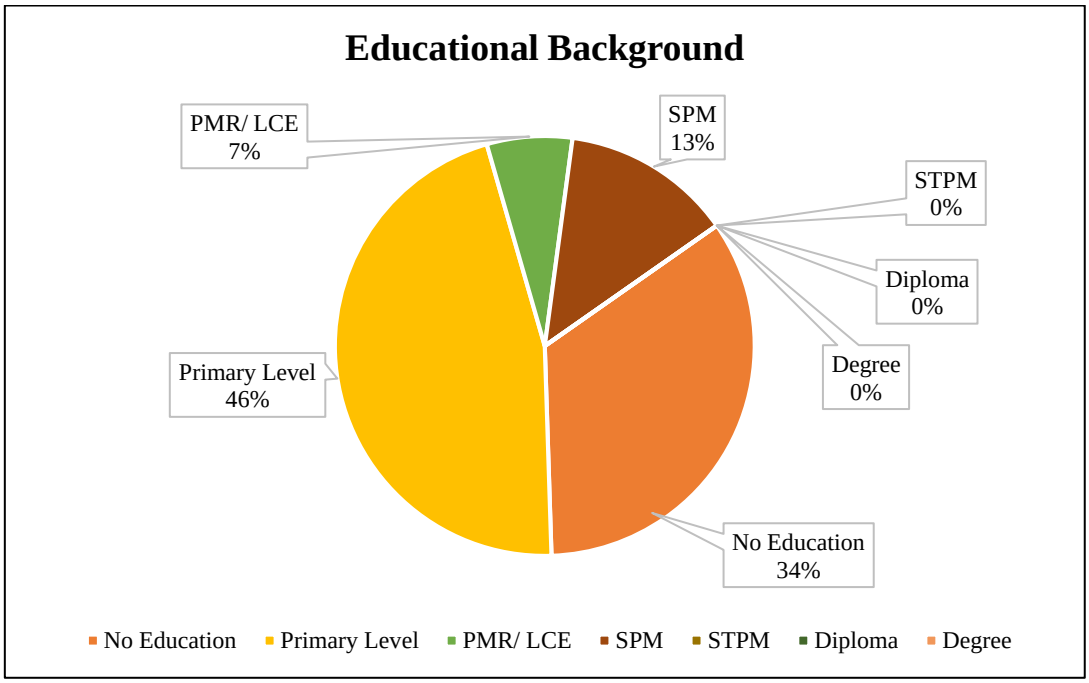
Education is critical to social and economic development and has a profound impact on population development. From **Figure 6.73**, the highest educational attainments for the respondents were in SPM level with 13.2%. Majority of the respondents (46.0%) are just having their education in primary level only. None of the respondents are STPM holder and above. As expected, respondents with no educational level rank second (34.2%), as the study area takes place in rural areas. From the cross tabulation in **Table 6.64**, all respondents which aging 61 years old and above do not have any educational background.

Table 6.64 : Cross Tabulation of Educational Level and Respondents' Age

Educational Level	Occupation Type						
	<20 years	< 21-30 years	< 31-40 years	< 41-50 years	< 51-60 years	> 61 years	Total
No Education	2	10	6	10	6	18	**52**
Primary	6	34	14	2	14	0	**70**
PMR/LCE	2	6	0	0	2	0	**10**

SPM	6	4	0	10	0	0	**20**
STPM	0	0	0	0	0	0	**0**
Diploma	0	0	0	0	0	0	**0**
Degree	0	0	0	0	0	0	**0**
Total	**16**	**54**	**20**	**22**	**22**	**18**	**152**

Source: Field Study, August 2018



Source: Field Study, August 2018

Figure 6.72 : Educational Level of Respondents

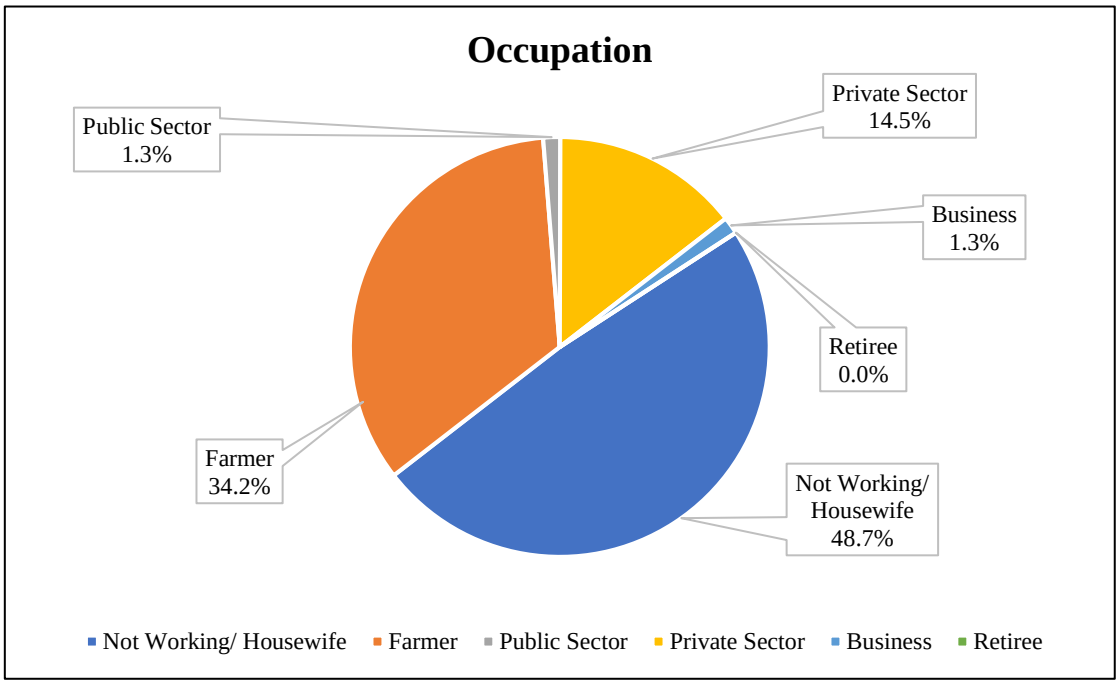
Occupation Status

From the SIA study conducted, 48.7% of the respondents are not working (refer **Figure 6.74**). Farmer follows with 34.2% and Private Sector (14.5%) completed the top three ranking. By referring to the cross tabulation of educational level and occupation type in **Table 6.65**, 24 out of 37 not working respondents do have education background. This shows that in Orang Asli's life style, the wives are normally not working and housewives even they have educational background.

Table 6.65 : Cross Tabulation of Educational Level and Occupation Type of Respondents

Educational Level	Occupation Type						
	Not Working	Farmer	Public Sector	Private Sector	Business	Retiree	Total
No Education	26	20	0	6	0	0	**52**
Primary	30	28	2	8	2	0	**70**
PMR/LCE	8	0	0	2	0	0	**10**
SPM	10	4	0	6	0	0	**20**
STPM	0	0	0	0	0	0	0
Diploma	0	0	0	0	0	0	0
Degree	0	0	0	0	0	0	0
Total	**74**	**52**	**2**	**22**	**2**	**0**	**152**

Source: Field Study, August 2018



Source: Field Study, August 2018

Figure 6.73 : Respondents' Occupation Type

Family Income

The range of income levels earned by the households ranging from below RM500 per month to more than RM6,000 per month which is shown in **Table 6.66**. Majority of the respondents (47.4%) are earning

below RM500 as their monthly household income. Only 28.9% of the respondents have salary ranging from RM1,000 and above.

Table 6.66 : Monthly Household Income of Respondents

Monthly Income	Respondents	
	Frequency	Percentage (%)
< RM500	72	47.4
RM501 – RM1,000	36	23.7
RM1,001 – RM1,500	14	9.2
RM1,501 – RM2,000	24	15.8
RM2,001 – RM3,000	6	3.9
RM3,001 – RM4,000	0	0.0
RM4,001 – RM5,000	0	0.0
RM5,001 – RM6,000	0	0.0
> RM6,000	0	0.0
Total	**152**	**100.0**

Source: Field Study, August 2018

The income distribution data corresponded to the respondents' occupation type (refer **Table 6.67**). As can be seen in cross tabulation of monthly individual income and occupation type of respondents, most of the respondents with income below RM500 are the Not working/housewife respondents apart from farmer and respondents doing their own business.

Table 6.67 : Cross Tabulation of Educational Level and Occupation Type of Respondents

Monthly Income	Occupation Type						
	Not Working	Farmer	Public Sector	Private Sector	Business	Retiree	Total
< RM500	72	30	0	0	2	0	**104**
RM501 – RM1,000	2	14	0	0	0	0	**16**
RM1,001 – RM1,500	0	6	2	10	0	0	**18**
RM1,501 – RM2,000	0	2	0	12	0	0	**14**
RM2,001 – RM3,000	0	0	0	0	0	0	**0**

RM3,001 – RM4,000	0	0	0	0	0	0	**0**
RM4,001 – RM5,000	0	0	0	0	0	0	**0**
RM5,001 – RM6,000	0	0	0	0	0	0	**0**
> RM6,000	0	0	0	0	0	0	**0**
Total	**74**	**52**	**2**	**22**	**2**	**0**	**152**

Source: Field Study, August 2018

Property Ownership

In this study, most of the respondents (98.7%) are living in their own residence in traditional housing area as can be seen in **Table 6.68**. As for the land status, majority of the respondents self-own the land they lived in (97.4%).

Table 6.68 : Property and Land Ownership

Monthly Income	Respondents	
	Frequency	Percentage (%)
House Ownership		
Own the Residence in Planned Housing Area	0	0.0
Own the Residence in Traditional Housing Area	150	98.7
Renting	2	1.3
Quarters	0	0.0
Total	**152**	**100.0**
Land Ownership		
Own the Land	148	97.4
Renting	2	1.3
Others	2	1.3
Total	**152**	**100.0**

Source: Field Study, August 2018

Duration of Residence

To determine the level of precision of the information obtained, in particular with regard to the representativeness of the opinions and perceptions of those who will be directly or indirectly affected by the

construction of the proposed project, the respondents were asked to state their status as resident regarding on the length of stay at the present address. This was the expectation that those residents who have been living a long period of time in the area would be able to provide better opinions/views of the potential impact of the proposed project on the local society well. The duration of the residence can be referred in **Table 6.69**.

Table 6.69 : Duration of Residence

Duration of Residence	Respondents	
	Frequency	Percentage (%)
0 - 5 years	24	15.8
6 - 11 years	22	14.5
12 - 17 years	14	9.2
18 - 24 years	18	11.8
More than 24 years	74	48.7
Total	**152**	**100.0**

Source: Field Study, August 2018

Based on the survey, majority of the respondents (48.7%) have been living in the study area for more than 24 years. It is as an indication that the residents in this group are originally the prime shapers of the area. They are the most familiar and dominantly associated people with the region. Therefore, their involvement in giving perception and input towards the proposed development are greatly encouraged, qualitatively.

6.14.4 Affected Community

Referring to the group of population that are impacted from the proposed project development. Within the 5km radius of the study area, these are the affected community involved and are taken into consideration in the assessment:

a) Host Community

i. Locals and Villagers

ii. Employees, laborers, and shop man
iii. Civil Servants
iv. Students
v. Chalets and Homestay Entrepreneurs
vi. Fishermen
vii. Cultural activists

b) Surrounding Community

i. Tourists
ii. Seasonal Purpose Visitors

The proposed site is located in District of Kuala Kangsar. The project site is covered with secondary vegetation. The project is surrounded rubber plantation and forest. There are other plantation developments on surrounding area, therefore, the proposed project is seen to be compatible and congruent with the existing land use. The existing environment within 5 kilometer radius consists of palm oil plantation and orang asli settlements areas.

6.14.5 Facilities and Amenities

Table 6.24 shows the infrastructures available within the study area. The study area was provided with amenities and community facilities such as electric supply, water supply and road system. All the houses in the study area received electrical supply from Tenaga Nasional Berhad (TNB) and road system provided by government while there is no drainage system and garbage transportation services provided as the villagers use traditional method. For water supply, the villagers get clean water from ‘air tandak’. The locations of river water intake are at Air Tandak Sg. Buaya, Air Tandak Sg. Piau and Air Tandak Sg. Tengtor **Figure 6.75**. The details regarding Air Tandak can be refer in **Sub Chapter 6.6.**

Air Tandak Sungai Buaya

Air Tandak Sungai Piau

Air Tandak Sg. Tengtor

Figure 6.74 : Air Tandak for Orang Asli Settlements

Table 6.70 : Public Amenities at the Study Area

Infrastructures	Availability	Remarks
Electric Supply	Yes	Provided by Tenaga Nasional Berhad
Water Supply	Yes	Source from Air Tandak Sg. Buaya, Air Tandak Sg. Piau and Air Tandak Sg. Tengtor
Garbage Transportation Services	No	Villagers using traditional way to disposed their garbage
Telephone	No	No telecommunication coverage
Road system	Yes	-
Drainage system	No	Only existing natural drainage system available

Source: Field data August 2018.

Being located at the rural area, the study area is lack of essential amenities. The nearest school are SK Pos Poi, SK Pos Piah and SMK Bawong (**Figure 6.75**). SK Pos Piah has a total number of 166 students with 90 boys and 76 girls. SK Pos Poi has a total number of 166 students with 91 boys and 75 girls. The nearest clinic and mosque located 8 km to the southern of village area. The proposed area took a 1 hour and 30 minutes' drive to Pekan Sungai Siput's commercial area that hosts various services which comprises banks, car wash, Shell petrol station and numerous stores and shops including 7-Eleven and fast food restaurants.

PROJECT PROPONENT	IN COOPERATION WITH	ENVIRONMENTAL CONSULTANT	PROJECT TITLE
HANAMURNI SDN. BHD. B-04-02, Tingkat 4, No. 42, Persiaran Greentown 1, Greentown Business Centre, 30450 Ipoh, Perak Darul Ridzuan. TEL : 012-9163133	ENVIRONMENTAL CONSULTANT AGENCIES (ECA) C – 11 – 24, Komplek Suria Kinrara, Taman Kinrara Seksyen 3, 47100 Puchong, Selangor Darul Ehsan. TEL : 019 - 361 5581/ 019 - 618 4831 EMAIL : ecaholding@live.com	NILAIMAS SERVICES 17-2 & 17-3 Jln Equine 10D, Tmn Equine, 43300 Seri Kembangan, Selangor Darul Ehsan. TEL : 03-8940 9959 FAX : 03-8940 9958 EMAIL : nilaimas.services@gmail.com	PROPOSED RUBBER FOREST PLANTATION ON PARTS OF COMPARTMENT 125, 126, 131 & 132 (BLOCK 1) AND PARTS OF COMPARTMENT 125, 126, 131 & 132 (BLOCK 2) WITH AN AREA OF 1600.00 HECTARES (3953.67 ACRES) AT PIAH FOREST RESERVE, DISTRICT OF HUTAN KUALA KANGSAR, PERAK DARUL RIDZUAN. SOURCE : Department Of Survey And Mapping Malaysia (JUPEM) Forestry Department Peninsular Malaysia (JPSM), JULY 2018

Figure 6.75 : Facilities and Amenities

6.14.6 Current Social Issue

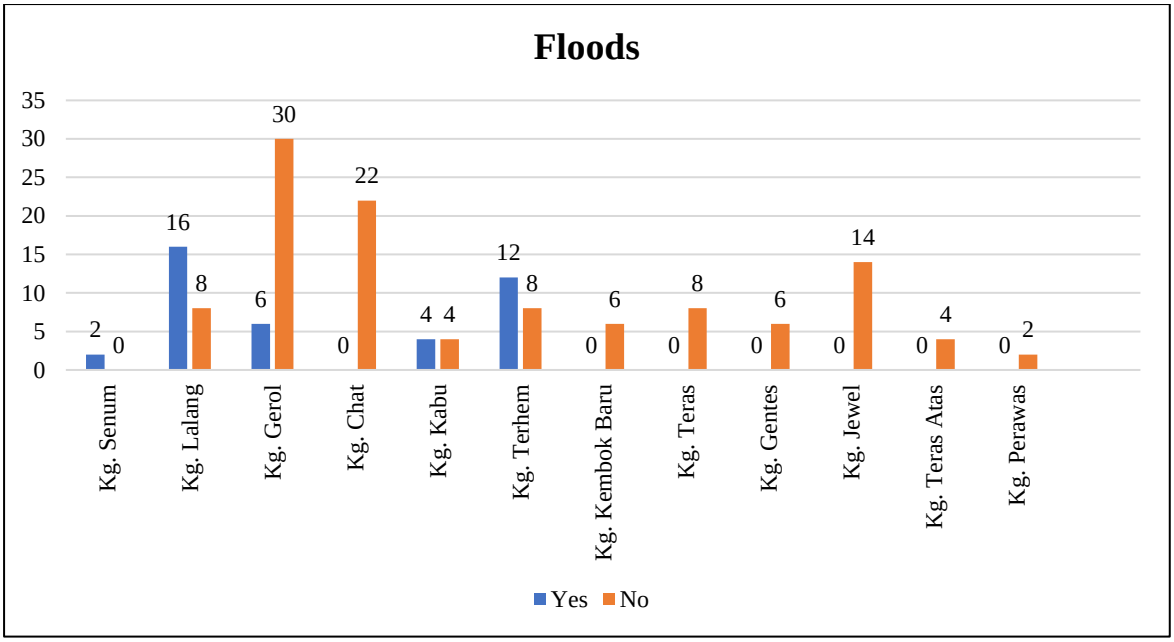
The respondents also been asked about the current social issue that been faced by the respondents through years. From the listed social issue (refer **Table 6.71**), most of the respondent are agreed (71.1%) on the dust problem in their settlement areas. From the observation during the site visit, the dust problem can be seen caused by the high number of heavy vehicle passing through the villagers to the project site.

Table 6.71 : Current Social Issues

No.	Social Issue	Yes	No
1.	Dust	71.1%	28.9%
2.	Water Quality Problem	36.8%	63.2%
3.	Health Problem	18.4%	81.6%
4.	Traffic Congestion	7.9%	92.1%
5.	Crop Damage	14.5%	85.5%
6.	Livestock Animal Affected	5.3%	94.7%
7.	Road Damage	34.2%	65.8%
8.	Flood	26.3%	73.7%
9.	Wild Animal Attack	6.6%	93.4%

Source: Field Study, August 2018

There are about 26.3% of the respondents are agreeing with the flood problem. As can be referred in **Figure 6.76**, 28 out of 40 respondents are from Kampung Terhem and Kampung Lalang as both of the villages are located at the lowland area.

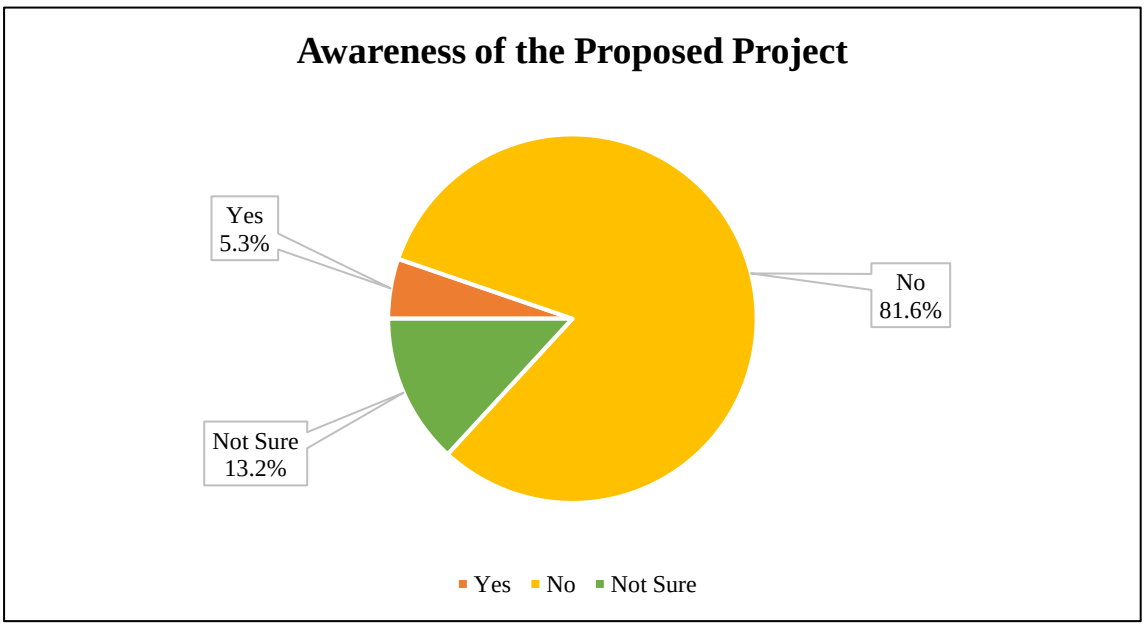


Source: Field Study, August 2018

Figure 6.76 : Floods Issues

6.14.7 Awareness and Perception

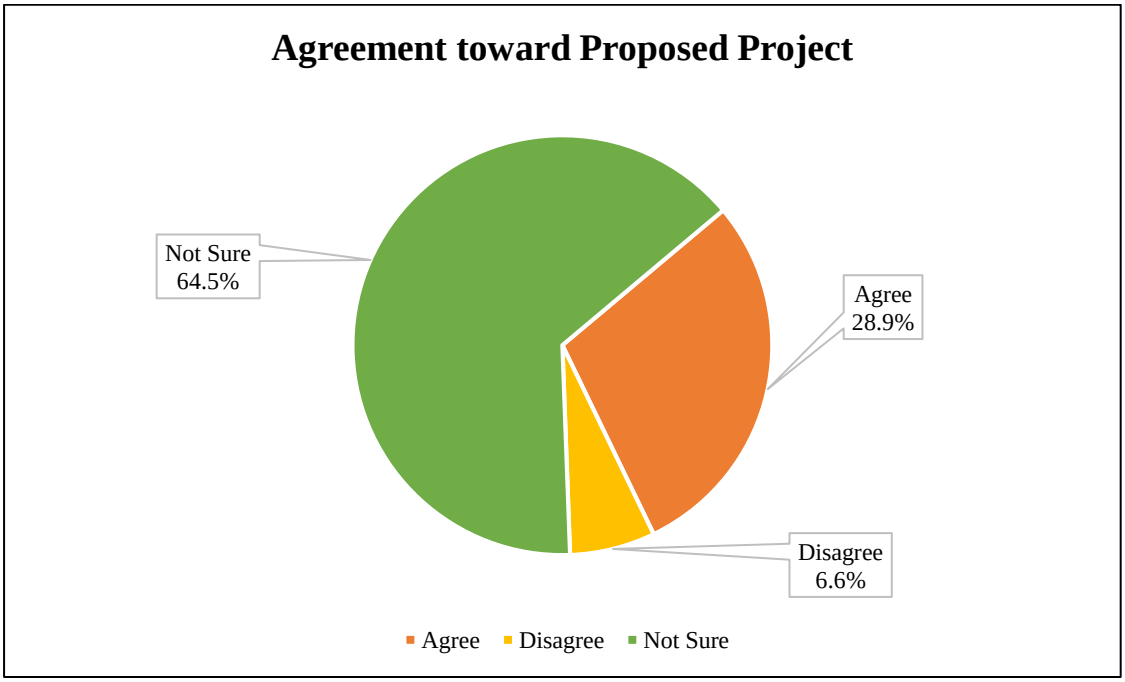
From the survey, only 5.3% of the respondents are totally aware of this proposed rubber forest plantation while majority of the respondents (81.6%) have never heard regarding it (refer **Figure 6.77**).



Source: Field Study, August 2018

Figure 6.77 : Awareness of the Proposed Project

As for the result, majority of the respondents did not oppose the proposed project. 28.9% of respondents agreed to the proposed project and 64.5% of them are not sure. Only 6.6% of respondents did not agree (refer **Figure 6.78**). The respondents are less convinced towards the approval of proposed project as they are referring to their Tok Batin to respond on it.



Source: Field Study, August 2018

Figure 6.78 : Agreement toward Proposed Project

Level of Concern in Project Impact

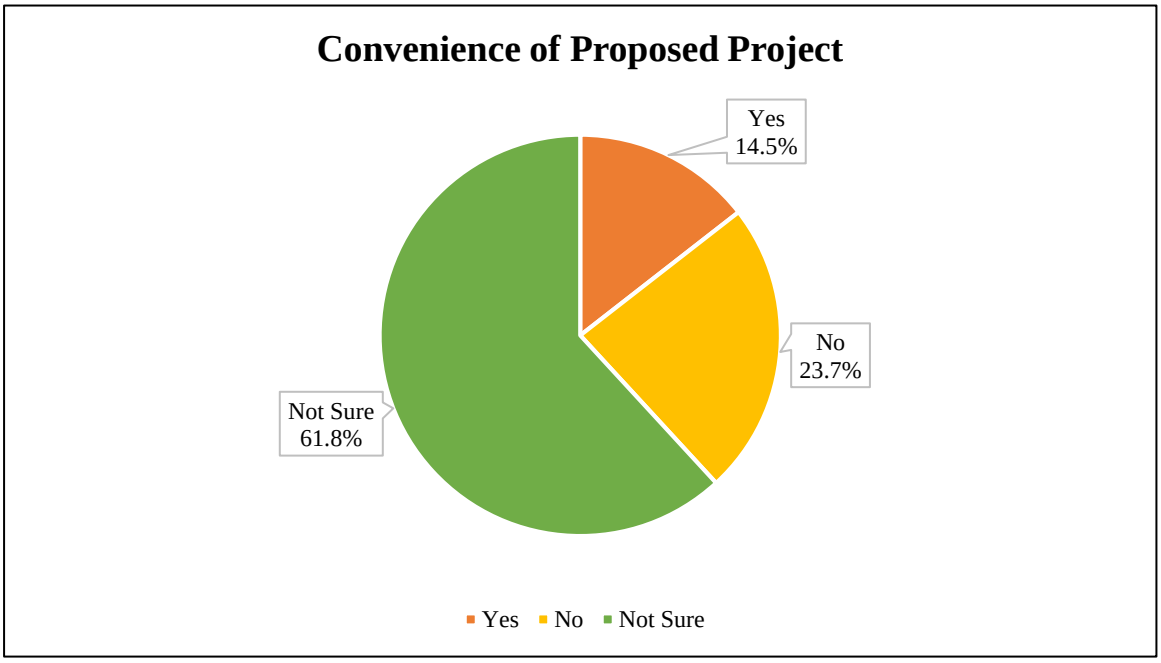
The respondents have been asked regarding their opinion on the convenience of the proposed project. By referring to the **Figure 6.79**, only 14.5% (22 respondents) of the respondents feel that the proposed project will bring harm to them and their settlement areas.

The proposed project may bring harm to them in context of health, water, noise, and air pollution, traffic congestion and flood. The 14.5% respondents are agreed on the context as shown in **Table 6.73**. The proposed project is expected to cause water/ river pollution and air pollution in the future. Mitigation measures are required in reducing the pollution caused by the proposed project.

Table 6.72 : Negative Impacts from the Proposed Project

No.	Negative Impacts	Yes	No
1.	Health	14	8
2.	Water/ River Pollution	20	2
3.	Noise Pollution	12	10
4.	Air Pollution	18	4
5.	Traffic Congestion	0	22
6.	Topography	0	22
7.	Flood	4	18
8.	Farming/Agriculture/Eco Tourism	0	22

Source: Field Study, August 2018



Source: Field Study, August 2018

Figure 6.79 : Convenience of the Proposed Project

As for the positive impacts of the proposed project, majority of the respondents agreed on the positive impacts that have been listed in **Table 6.73**. The respondents agreed that the proposed rubber forest plantation will help the local people in increasing the job opportunities, increasing local people economic, increasing the socio economic and increasing the infrastructure in Orang Asli settlements areas. In addition, the distance of the proposed project from the nearest settlement areas are about 2 kilometers, which may not affect them directly.

Table 6.73 : Positive Impacts from the Proposed Project

No.	Negative Impacts	Yes	No	Not Sure
1.	Increase job opportunities	77.6%	2.6%	19.7%
2.	Increase the local people economic	51.3%	18.4%	30.3%
3.	Increase the socio economic	47.4%	17.1%	35.5%
4.	Increase infrastructure	48.7%	15.8%	35.5%

Source: Field Study, August 2018

6.14.8 Public Involvement and Consultation

A public dialogue for the proposed project were held during the study period. The objectives of the public dialogue was to brief and introduce the proposed development of rubber forest plantation project to the communities, as well as to further understand the community concern and outlook of the development

There were two public involvement and consultation meetings or focal group discussion (FGD) carried out in the study area, which are Pre-FGD and FGD. Pre-FGD focuses on giving the information to the head of communities, Tok Batin or NGO's before the actual FGD takes place. This is to ensure that the information given to the communities were deliver correctly since some of the orang asli's communities having language barriers. Besides, Pre-FGD and FGD were design to ensure that there is no conflicts by the NGO's (JARINGAN).

Details of the public involvement and consultation carried out are as in **Appendix 6J**. Table of summary for the Pre-FGD and FGD as shown in **Table 6.74**.

Table 6.74 : Public Dialogues for Proposed Development

Item	Venue	Participants	Remarks
Pre-FGD 23th January 2019	Kg. Chat (Pos Poi) & Balai Adat Kg. Teras	JAKOA representatives, Nilaimas Services (EIA Consultant)	• Briefing from Tok Batin at Pos Poi and Pos Piah

	(Pos Piah), Sungai Siput.		
FGD 25th January 2019	Balai Adat Kampung Teras, Sungai Siput	Government Agencies:- -Perak State Forestry Department • Health Department Perak • Department of Agriculture Perak • Department of Wildlife and National Parks Perak • JAKOA • Department of Mineral and Geoscience Perak • Land Office Perak • Police headquarters Sg. Siput • TNB Bhd, SSJ Sg. Perak • Department of Irrigation and Drainage Perak Community representative: A total of 122 people from Pos Piah and Pos Poi recorded attending the session, led by Tok Batin from:- • Kg. Sanum • Kg. Terhem • Kg. Kembok • Kg. Chat • Kg. Teras • Kg. Kabu • Kg. Lalang • Kg. Jelwel	• Presentation of project development and EIA study from consultant • Q&A and open discussion session within agencies, consultants and communities

Table 6.75 is the summary the concern and issues arising from both community representatives and agencies gathered from the discussion session.

Table 6.75 : Issue raised in Public Dialogue

No	Comment By	Question/Comment/Concern
1	Tok Batin Pos Poi Sudin Bin Busu	1. Ensure the river is not polluted. 2. Ensure the soil is not eroded or damaged. 3. Ensure the natural resources such as rattan, herbal traditions and forest products are preserved. 4. Ensure there are no air pollution will occur. 5. Ensure the noise from the daily operation will not disturb the local people. 6. Ensure the waste material properly manage. 7. Ensure the main road and route to the project site is well maintained and heavy vehicles used apply the correct standard and follow the permissible weight. 8. Ensure that 80% of the workers are from Orang Asli and the salaries are according to the academic and skills (not biased to the race differences). 9. Ensure the community wellbeing of Pos Poi and Pos Piah's residents is given attention from time to time according to the needs of the Orang Asli community. 10. Make sure that every employee is paid for SOCSO and EPF immediately for the future benefits of the employee. 11. Ensure the safety of the residents on the main road and route to the project site. 12. Medical bills and hospital treatment are incurred by the company for common good. 13. Suggest state government to gazette the land rights to Orang Asli Pos Piah and Pos Poi under **Act 134 ABORIGINAL PEOPLES,1954** after the lease period reaches maturity/end. This is because the land location that is close

No	Comment By	Question/Comment/Concern
		to the Pos Piah settlements is seen to have economic potential for the community. Provision for the process should be allocated. 14. Federal government of Perak and project proponent to employ to at least 200 and more people from Pos Poi and Pos Piah community to work in the proposed project. If this request is implemented, project proponent succeed in helping one of the government targets, which to lift the poverty issues among Orang Asli's community.
2	Awish Village Representative	1. Ensure the foreign workers are not disturbing the *Orang Asli* community, especially the women. 2. Propose to the project proponent to take *Orang Asli* as *anak angkat* to teach them more in entrepreneurship education in order to produce entrepreneurs from *Orang Asli's* community and not just merely workers.
3	Najib Anak Alang Village Representative Kampung Gentes	1. As JARINGAN representative, disagreed but hope for detailed discussion between Project Proponent and *Tok Batin* before further project activity.
4	En. Moshair Mohd TNB SSJ. Sg. Perak Representative	1. Project proponent and consultant to arrange meeting with TNB to explain and discuss the project before project commence, due to close proximity of the TNB infrastructure (Stesen Janaelektrik Sg. Piah) and the project site.

As conclusion, majority of representatives have no objection to development as long as project proponent take into consideration their concern and proposal. The only person who is seen to object the development is En. Najib, representative from Kg. Gentes. Even though Kg. Gentes is part of Pos Piah, it is outside the zone of influence (5km). The reason of the objection is due to lack of understanding on the project matter and concern for Orang Asli land rights.

Subjects and proposals on the development operation issues have been noted by the consultants and to be included in the study where applicable.

Photos during Pre-FGD at Kg. Chat, Pos Poi. (23rd January 2019)

Photos during Pre-FGD at Kg. Teras, Pos Piah. (23rd January 2019)

Photos during FGD at Kg. Teras (25th January 2019)

Figure 6.80 : Photos during the Public Dialogue

6.14.9 SOCIAL IMPACTS MANAGEMENT PLAN (SIMP)

6.14.9.1 INTRODUCTION

Social Impact Management Plan (SIMP) is a tool and guidance for the project proponent and other stakeholders to understand the process of identifying, assessing and mitigate the social impacts on the affected community from the development of the proposed upgrading interconnection project. The plans provide guidelines for the project proponent and related agencies to implement the SIMP in the best manner according to the needs of the proposed project. The SIMP matrix covers the impacts and its mitigation measures based on the stages of the proposed project developments (pre-plantation, plantation, operation and maintenance).

6.14.9.2 INVESTIGATION STAGE

Activities during the pre-construction stage is comprised of project planning and land acquisition. Both activities bring no social impacts toward local people.

6.14.9.3 CONSTRUCTION STAGE

Most of the impacts on the local residents are caused during the construction activities such as access and haul road construction, site clearing, biomass disposal and construction of basic facilities and amenities. These activities have caused air, water and noise pollution and may have affected the daily life routine of the local people. In the SIMP matrix as can be referred in **Table 6.76**, the cause of the impacts has been identified, the mitigation and measured are determined and the respective agencies responsible to expedite or involved in the monitoring and controlling bodies are spell out in the management plan.

Table 6.76: SIMP Matrix during Construction Stage

No	Social Impact	Significance	Desired Outcome	Mitigation	KPI	Monitoring Frequency	Agency Involved
1	Traffic Impacts						
	• Movement of construction vehicles poses a safety risk to existing public road users. • The transport vehicles can be a source of transient noise and air pollution through dust and smoke.	Medium Impact: Short term impacts on local traffics at major roads transacted by the proposed project.	Temporary accessibility to local road users.	• Placing manned traffic controller on site • Appropriate signage for road user safety. • Water browsers to reduce dust dispersion.	At least 30% of the affected people achieve the target.	• Weekly	• JKR • PBT • DOE • JPS
2	Air, Noise and Water Quality						
	• Air pollution • Noise disturbance; and • Water pollution	Medium Impact and very high significant: Short term impacts on local environment	Better environmental status to community as good as before construction activities.	• Water browsers to reduce dust dispersion. • Noise control through noise barrier, exhaust noise control on vehicles, use low noise	At least 30% of the affected people achieve the target.	• Weekly • Air quality standard • Noise standards • Water quality of water bodies	• PBT • DOE • JPS

No	Social Impact	Significance	Desired Outcome	Mitigation	KPI	Monitoring Frequency	Agency Involved
				emission piling method. • Noise control devices and monitoring. • Soil erosion control near rivers and drains.		• Flood control programs	
3	Residents' Safety						
	• Attract more immigrants' employment • Social conflict between local and foreign workers	Medium Impact and very high significant: Short term impacts on local environment	Better environmental status to community as good as before construction activities.	• Supervise relationship between foreign workers and local worker and local community • Ensure foreign worker embrace code of conduct	At least 70% of the affected people achieve the target.	• Weekly	• DOSH • MOHR

4	Community Economic Wellbeing						
	• Provide job opportunities	Low impact and very high significant.	Better economic status to community	• To give job opportunities to the nearby residents	At least 70% achieve the target.	• Yearly	• MOHR

6.14.9.4 OPERATIONAL STAGE

The operational phase gives impact on the local communities caused by the operation activity by the rubber forest plantation such as earthworks and landscaping, transport and usage of haulage, waste generation and road construction and maintenance activities. **Table 6.77** shows the SIMP Matrix during the operational phase.

Table 6.77 : SIMP Matrix during Operational Stage

No	Social Impact	Significance	Desired Outcome	Mitigation	KPI	Monitoring Frequency	Agency Involved
1	Community Economic Wellbeing						
	• Provide job opportunities	Low impact and very high significant.	Better economic status to community	• To give job opportunities to the nearby residents	At least 70% achieve the target	• Yearly	• MOHR

6.14.9.5 SIMP SCHEDULE

The proposed development of PROPOSED RUBBER FOREST PLANTATION ON PARTS OF COMPARTMENT 126, 131 & 132 (BLOCK 1) AND PARTS OF COMPARTMENT 125, 126, 131 & 132 (BLOCK 2) WITH AN AREA OF 1,600.00 HECTARES (3,953.67 ACRES) AT PIAH FOREST RESERVE, DISTRICT OF HUTAN KUALA KANGSAR, PERAK DARUL RIDZUAN has planned its construction around July 2019 by stage. As soon as all of the necessary approvals (including the EMP Report) are obtained, the proponent plans shall start the project immediately.