ENVIRONMENTAL MONITORING REPORT

1. VULNERABLE SOIL AND STEEP AREA MONITORING

The vulnerable soil and steep areas in ARSB HS Petuang concession were monitored through:

i. Topography map

- Satellite image and digital topography map (**Figure 1 and Figure 2**) were used to check on the topography and land condition of the areas.
  - Refer steep area mapping and monitoring files for monitoring record.

- Forest manager checked the forest areas on the topography map and ensure the sensitive and steep areas of elevation 1,000 m above sea level (a.s.l.) are avoided for any forest road construction and harvesting activities.

ii. Field examination

- Forest manager and forest supervisor monitored the forest road construction and harvesting activities (Figure 3 and Figure 4).
  Observation and monitoring record
  - All of the forest operation activities were not conducted at the steep areas especially areas at elevations greater than 1,000 m a.s.l.
  - All the forest operation activities were conducted and compliance with the Garis Panduan Jalan Hutan 2010 (Pindaan 2013) and Guidelines for Reduced Impact Logging in Peninsular Malaysia (Revised 2018) from Forestry Department Peninsular Malaysia (FDPM).

- ARSB also cooperate with Terengganu State Forestry Department (TSFD) in conducting field examination and ground observations of the vulnerable soil and steep areas.

iii. Remote sensing applications

- ARSB cooperate with TSFD to monitor the condition of these areas using remote sensing application such as Forest Monitoring Using Remote Sensing.

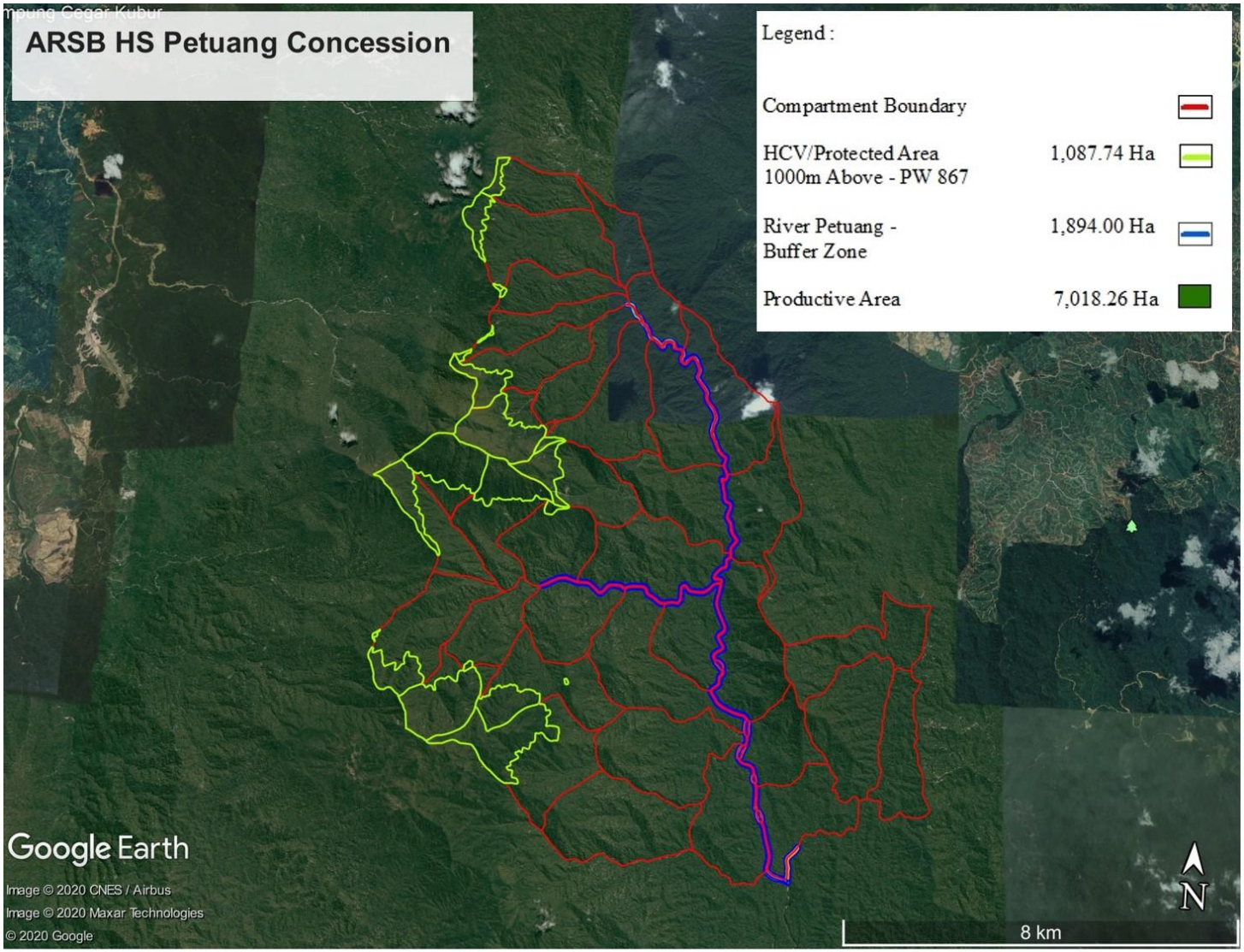

Figure 1. The satellite image of the 10,000 ha of ARSB HS Petuang concession. The protected area boundary (light green boundary) are mountainous area which is greater than 1,000 m above sea level (a.s.l) covering 1,087.74 ha.

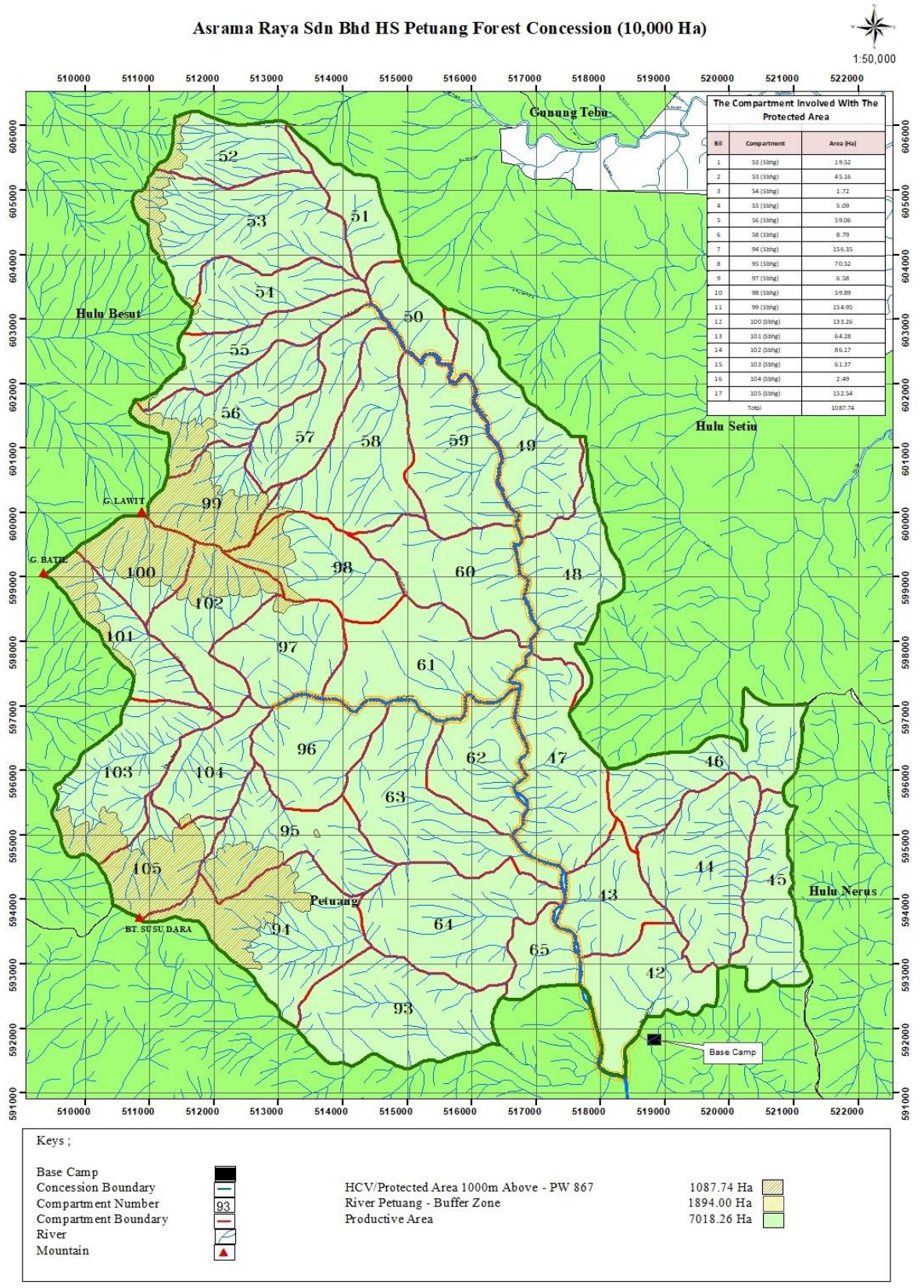

Figure 2. Map of ARSB HS Petuang concession (10,000 ha)

Document Control		
Title: Environmental Monitoring Report	**Issue:** V-02	**Date**: 29 July 2020

Figure 3. Forest manager and supervisor are monitoring the forest harvesting activities.

Figure 4. Forest supervisors are monitoring the harvested areas.

Document Control		
Title: Environmental Monitoring Report	**Issue:** V-02	**Date**: 29 July 2020

2. LOGGING CAMP AND LOGGING WORKSHOP MONITORING

- Forest manager and forest supervisor monitored the cleanness and conditions of the logging camp and logging workshop to ensure they are well maintained.

  Observation and monitoring record

  - The logging camp and logging workshop were clean and well maintained (Figure 5).
  - All the hazardous substances for forest harvesting operations were handled, stored and disposed based on the standard of procedure (SOP).
  - The conditions and usage of fuel tank and lubricant oil were recorded and under controlled condition.
  - All the wastes and scheduled wastes were taken out from ARSB HS Petuang concession / forest for disposing.

Figure 5. Logging camp of ARSB HS Petuang concession is clean and well maintained.

Document Control		
Title: Environmental Monitoring Report	**Issue:** V-02	**Date**: 29 July 2020

3. WATERCOURSE MONITORING

- Forest manager monitored the buffer zones of watercourse and identified watercourses which needed for protection.

  Observation and monitoring record

  - The trees located along the border of buffer zones are not harvested.
  - The trees located along the are painted with one (1) yellow ring at not more than 10-meter intervals.
- Forest manager and forest supervisor always monitor and ensure all the buffer zones of watercourse are established in accordance with the FDPM standard and Garis Panduan Jalan Hutan 2010 (Pindaan 2013).

- ARSB conducted regular monitoring of the water quality of the watercourses and river in ARSB HS Petuang concession.

  Observation and monitoring record

  - Most of the rivers in ARSB HS Petuang concession are clean and river shows greenish-blue colours (Figure 6).

Figure 6. River in ARSB HS Petuang concession shows greenish-blue colours.

- ARSB also collaborate with FDPM and Forest Research Institute Malaysia (FRIM) in conducting water quality analysis to monitor the quality and health status of the watercourse (Figure 7).

Observation and monitoring record

- Water quality analysis was conducted to determine the quality and health status of the watercourse. The water quality parameters such as pH, total suspended solids (TSS), dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD) and ammoniacal nitrogen (AN) were used to determine the water quality index. Turbidity was measured to determine the cloudiness of the water in the river. (Figure 7-11).

Figure 7. FRIM researchers are conducting the water quality analysis at the river of ARSB HS Petuang concession.

Figure 8. Aquatroll 600 Multiparameter Sonde is used to measures and monitor water quality.

Document Control		
Title: Environmental Monitoring Report	**Issue:** V-02	**Date**: 29 July 2020

Figure 9. (a) Turbidity and temperature probe (Analite NEP495P). (b) Set up of probe at Petuang river in compartment 63 Block A.

Figure 10. A multistage sampler is used to collect the TSS in water.

Figure 11. Probe and equipment used to measure the water level of the river.

Water Quality Monitoring Record

Based on Table 1, 2 and 3, the Sungai (Sg.) Petuang showed very high water quality index (WQI), ranged from 92 to 98. All these rivers were classified as Class I with status as clean river based on WQI.

Table 1. Sampling date and water quality parameters measured in the Sg. Petuang (November 2019).

Location	Date	BOD (mg/l)	COD (mg/l)	AN (mg/l)	TSS (mg/l)	pH	DO (%)	WQI	Class
Sg. Petuang 1	12/11/2019	0	11.00	0.01	3.25	6.11	93.30	95.90	I
Sg. Petuang 2	12/11/2019	0.24	5.00	0.03	0	6.53	89.81	96.80	I
Sg. Petuang 3	12/11/2019	0	9.00	0.18	12.50	6.13	101.27	92.80	I
Sg. Petuang 5	12/11/2019	0.12	5.00	0.09	2.00	6.12	92.93	96.00	I
Sg. Petuang 6	12/11/2019	0.48	7.00	0.19	4.50	7.84	89.42	92.70	I
Sg. Petuang 9	12/11/2019	0	3.00	0.11	5.00	6.80	90.79	96.00	I

Table 2. Sampling date and water quality parameters measured in the Sg. Petuang (March 2020).

Location	Date	BOD (mg/l)	COD (mg/l)	AN (mg/l)	TSS (mg/l)	pH	DO (%)	WQI	Class
Sg. Petuang 1	10/3/2020	0.35	8.00	0.11	8.50	5.75	93.22	93.50	I
	11/3/2020	0.10	5.00	0.15	9.75	5.66	93.69	93.40	I
Sg. Petuang 2	10/3/2020	0.50	14.00	0.02	16.00	6.36	95.73	93.90	I
	11/3/2020	0.35	13.00	0.13	3.50	6.25	95.85	93.50	I
Sg. Petuang 3	10/3/2020	0.20	10.00	0.06	14.00	6.22	96.13	94.40	I
	11/3/2020	0	5.00	0.01	3.25	6.31	96.34	97.50	I
Sg. Petuang 5	10/3/2020	0	1.00	0	3.75	6.51	97.83	98.60	I
	11/3/2020	0.10	3.00	0.01	5.75	6.32	97.32	97.60	I

Table 3. Sampling date and water quality parameters measured in the Sg. Petuang (June 2020).

Location	Date	BOD (mg/l)	COD (mg/l)	AN (mg/l)	TSS (mg/l)	pH	DO (%)	WQI	Class
Sg. Petuang 1	23/6/2020	0	18.00	0.09	0.25	5.99	95.20	93.20	I
Sg. Petuang 2	23/6/2020	0.60	11.00	0.24	0.50	6.71	96.10	92.80	I
Sg. Petuang 3	23/6/2020	0	0	0.24	10.00	6.49	69.70	94.50	I
Sg. Petuang 5	23/6/2020	0	0	0.22	1.50	6.90	98.00	95.20	I
Sg. Petuang 6									
Sg Petuang 9									

In March 2020, the turbidity values of Sg. Petuang in SP1, SP2, SP3, SP4, SP5 and SP6 are ranged from 5.48 to 22.80 NTU (Figure 12). In June 20202, the turbidity values of Sg. Petuang in SP1, SP2, SP3, SP4, SP5 and SP6 are ranged from 5 to 18.97 NTU (Figure 13). These turbidity values were within standard permissible limits of National Water Quality Standards for Malaysian rivers and classified as Class II. High turbidity was recorded in SP8 and SP9. SP8 recorded high turbidity of 109.13 NTU in March 2020, decreased to 69.47 NTU in June 2020. This is probably due to the temporary sediment wash off from the road construction in the compartment. For SP.9, natural landslide was occurred which caused high turbidity.

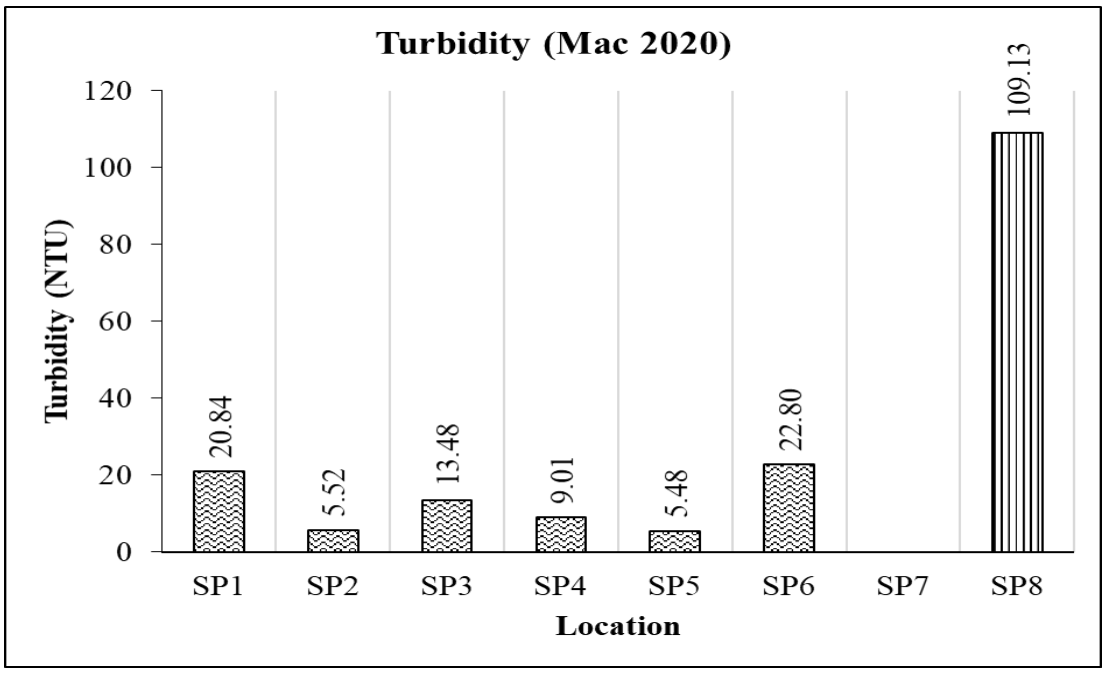

Figure 12. Turbidity measured in the Sg. Petuang in March 2020.

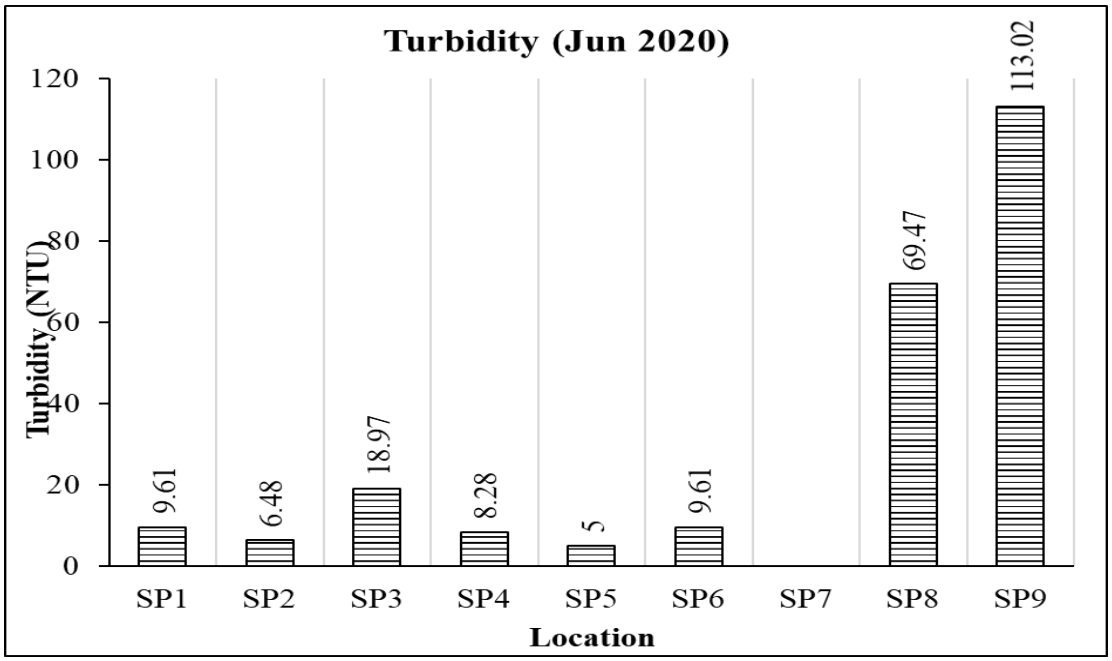

Figure 13. Turbidity measured in the Sg. Petuang in June 2020.

Document Control		
Title: Environmental Monitoring Report	**Issue:** V-02	**Date**: 29 July 2020

4. PLANT MONITORING

- Forest manager conducted the plants / trees monitoring and make sure all the protected tree species, rare and endangered tree species, mother trees are not harvested.

- ARSB collaborated with Universti Putra Malyasia (UPM) and expert team to conduct plant survey in ARSB HS Petuang concession (Figure 14).

Figure 14. UPM researchers and students are conducting plant survey in ARSB HS Petuang concession.

- Stripline sampling and **permanent sample plot (PSP)** were conducted and monitored in ARSB HS Petuang concession. The PSP was used to analyse frequency distribution of key dipterocarp species and tree growths.

Observation and monitoring record

- A total of four PSPs each with a size of 1.0 ha have been established in ARSB.
- Two PSP are set up in compartment 92, one PSP is set up in compartment 62 and 64 respectively (Figure 16).
- The PSP were monitored annually and remeasurement of tree growth will be conducted after 3 years.
- **Refer permanent sample plot (PSP) data for monitoring results.**

Table 4. List of plant found in ARSB HS Petuang concession from stripline sampling and PSP.

No.	Local Name of Plant	Scientific Name of Plant Species
1	Ara	*Ficus* spp.
2	Balau	*Shorea* spp.
3	Balau Laut Merah	*Shorea kunstleri*
4	Bayur	*Pterospermum diversifolium*
5	Berangan	*Castanopsis* spp.
6	Bintangor	*Calophyllum* spp.
7	Damar Hitam	*Shorea* spp.
8	Delek	*Anisophyllea griffithii*
9	Durian	*Durio* spp.
10	Geronggang	*Cratoxyllum* spp.
11	Gerutu	*Parashorea* spp.
12	Hampas Tebu	*Gironniera hirta*
13	Jangkang	*Xylopia* spp.
14	Jelutong	*Dyera costulata*
15	Kandis	*Garcinia* spp.
16	Karas	*Aquilaria malaccensis*
17	Kasai	*Pometia* spp.
18	Kayu Arang	*Diospyros* spp.
19	Kedondong	*Canarium/Santiria/Scutinanthe/Tiromma* spp.
20	Kekatong	*Cynometra* spp.
21	Kelat	*Eugenia* spp.
22	Keledang	*Artocarpus* spp.
23	Kembang Semangkok	*Scaphium* spp.
24	Kempas	*Koompassia malaccensis*
25	Keredas	*Pithecellobium bubalinum*
26	Keruing	*Dipterocarpus* spp.
27	Keruing Merah	*Dipterocarpus verrucosus*
28	Kulim	*Scorodocarpus borneensis*
29	Kungkur	*Pithecellobium splendens*
30	Leban	*Vitex* spp.
31	Ludai	*Sapium baccatum*
32	Machang	*Mangifera* spp.
33	Mahang	*Macaranga* spp.
34	Mata Keli	*Gynotroches axillaris*
35	Mata Ulat	*Kokoona*
36	Medang	*A*ctinodaphne/*Cinnamomum* spp.
37	Melunak	*Pentace* spp.
38	Membuluh	*Pellacalyx saccardianus Scort.*
39	Mempening	*Lithocarpus* spp.
40	Mempisang	*Annonaceae* spp.

41	Mengkulang	*Heritiera* spp.
42	Meransi	*Carallia brachiata*
43	Meranti Bukit	*Shorea platiclados*
44	Meranti Langgong	*Shorea lepidota*
45	Meranti Melantai	*Shorea macroptera*
46	Meranti Nemesu	*Shorea pauciflora*
47	Meranti Rambai Daun	*Shorea acuminata*
48	Meranti Sarang Punai	*Shorea parvifolia*
49	Meranti Sengkawang Merah	*Shorea singkawang*
50	Meranti Tembaga	*Shorea leprosula*
51	Merawan	*Hopea* spp.
52	Merbatu	*Atuna* spp.
53	Meribut	*Diospyros buxifolia*
54	Merpauh	*Swintonia* spp.
55	Minyak Berok	*Xanthophyllum* spp.
56	Nyatah ekor	*Payena lanceolata*
57	Nyatoh	*Ganua hirtiflora/Palaquium* spp.
58	Pelong	*Pentaspadon* spp.
59	Penaga	*Mesua ferrea*
60	Penarahan	Myristca sp.
61	Penarahan Arang	*Myristca cinnamomea*
62	Pepijat	*Prunus spp*
63	Perah	*Elateriospermum tapos*
64	Perupok	*Lophopetalum* spp.
65	Petai	*Parkia* spp.
66	Petaling	*Ochanostachys amentaceae*
67	Punah	*Tetramerista glabra*
68	Putat	*Barringtonia* spp.
69	Rambai Hutan	*Baccaurea kunstleri*
70	Rambutan Pacat	*Xerospermum* spp.
71	Ramin	*Gonystylus* spp.
72	Rengas	*Gluta/Melanorrhoea* Spp.
73	Resak	*Cotylelobium* spp. and *Vatica* spp.
74	Sebasah	*Aporusa symplocoides*
75	Sentul	*Sandoricum koetjapa*
76	Sepetir	*Sindora* spp.
77	Sesenduk	*Endospermum diadenum*
78	Simpoh	*Dillenia* spp.
79	Tampoi	*Baccaurea maingayi*
80	Terap	*Artocarpus* spp.
81	Terentang	*Campnosperma* spp.
82	Tinjau Belukar	*Randia scortechinii*
83	Tulang Daing	*Callerya atropurpurea*

Figure 15. PSP setup and tree inventory

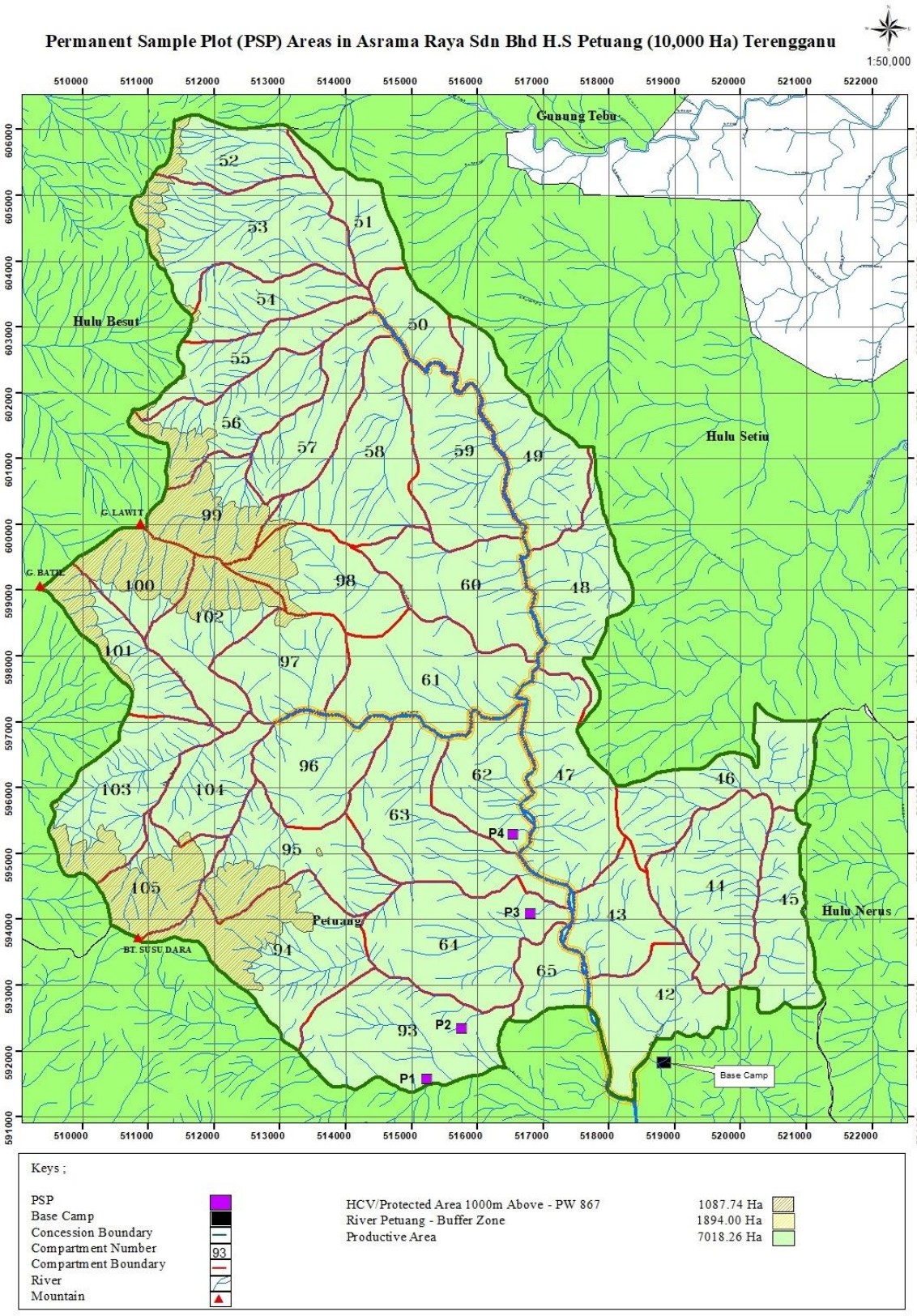

Figure 16. Map of PSP Location in ARSB HS Petuang concession.

Document Control		
Title: Environmental Monitoring Report	**Issue:** V-02	**Date**: 29 July 2020

5. WILDLIFE MONITORING

- ARSB regular monitor ARSB HS Petuang concession from encroachment, illegal activities and hunting.

- ARSB engaged with local community of Kg. Petuang and TSFD for helping in monitoring ARSB HS Petuang concession from encroachment and hunting.

- ARSB conducted periodic monitoring of wildlife.
  I. Monitored the occurrence of animals through camera trapping (Figure 17).
     - **Refer camera trapping data and results for monitoring results.**

  II. Monitored the occurrence of animals through opportunistic sightings.
     - **Refer opportunistic sightings data for monitoring results.**

Figure 17. Forest supervisor is collecting the data (memory card) from the camera trap.

Table 5. List of wildlife found in ARSB HS Petuang concession.

No.	Common name	Species name	IUCN conservation status
1	Malayan tapir	*Tapirus indicus*	Endangered
2	Sun bear	*Helarctosmalayanus*	Vulnerable
3	Southern pig-tailed macaque	*Macacanemestrina*	Vulnerable
4	Pale-thighed langur	*Presbytis siamensis*	Near Threatened
5	Banded civet	*Hemigalusderbyanus*	Near Threatened
6	Green broadbill	*Calyptomenaviridis*	Near Threatened
7	Banded Linsang	*Prionodon linsang*	Least Concern
8	Mouse-deer	*Tragulus*sp.	Least Concern
9	Barking deer /muntjac	*Muntiacusmuntjak*	Least Concern
10	Long-tailed macaque	*Macacafascicularis*	Least Concern
11	Plantain squirrel	*Callosciurusnotatus*	Least Concern
12	Pig	*Sus domesticus*	Least Concern
13	Wild boar	*Sus scrofa*	Least Concern
14	Blue-coloured bird	Unknown sp.	Least Concern
15	Black civet	Unknown sp.	Least Concern
16	Lizard	Unknown sp.	Least Concern
17	Bird	Unknown sp.	Least Concern
18	Rodent	Unknown sp.	Least Concern
19	Wild fowl	Unknown sp.	Least Concern

- Refer camera trapping data for more details information.
- The camera trapping only shows the occurrence of the wildlife, do not shows any frequent appearance of same species in the same location.
- The camera trapping did not record any wildlife habitat and pattern of wildlife distribution or diversity in ARSB HS Petuang concession.

- ARSB also collaborated with Malaysian National Society (MNS) Terengganu and expert teams to conduct wildlife survey (Figure 18 and 19).

Figure 18. A group of researchers and MNS expert teams come to ARSB HS Petuang for biodiversity site visit.

Figure 19. Researchers and MNS expert teams are observing and understanding the ARSB HS Petuang concession map before entering the forest area.