Assessment Summaries and Management Plans for Proposed New Development in Tivingau ILG of Lokono Village, New Ireland Province, Papua New Guinea

Lalautun one of the proposed new development area in Tivingau ILG

Contents

1. Overview and background

1.1 Description of location

The project area on Tivingau ILG land, is situated north-east of Lokono Village which is located 24km directly south of Kavieng on the north-western coast of New Ireland. The portions of land being evaluated for potential oil palm agriculture include Lalautun grassland situated about 2km north-east of the village, and the contiguous DPI station plus Kunaur 3 portion which are located about 7km also north-east of the village.

1.2 Topography and landform

The entire project area and its surroundings consist of raised coralline limestone. The top half of Lalautun grassland slants to the north and the bottom half tilts southerly in the direction of Lokono Village while the adjoined DPI/Kunaur 3 block has a northward gradient facing Tome Village. Water flow at Lalautun appears to be northbound from the upper segment and southward from the lower segment. At the DPI station/Kunaur 3 area, most of the water probably flows northward.

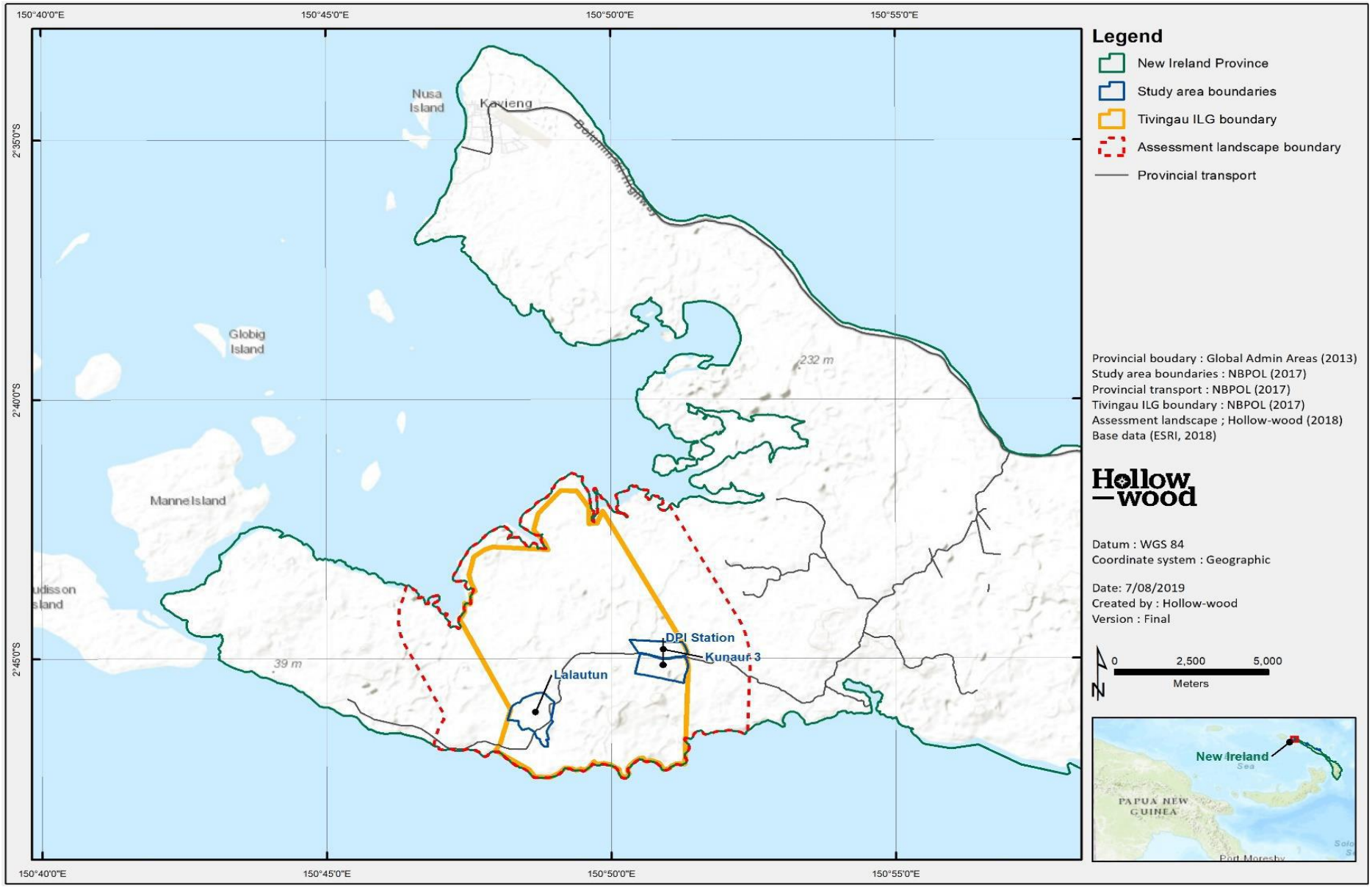
The vegetation on the proposed planting areas ranges from grassland at Lalautun through disturbed vegetation and old gardens on DPI station to old gardens, disturbed vegetation and advanced secondary vegetation on Kunaur 3.

1.3 Property description

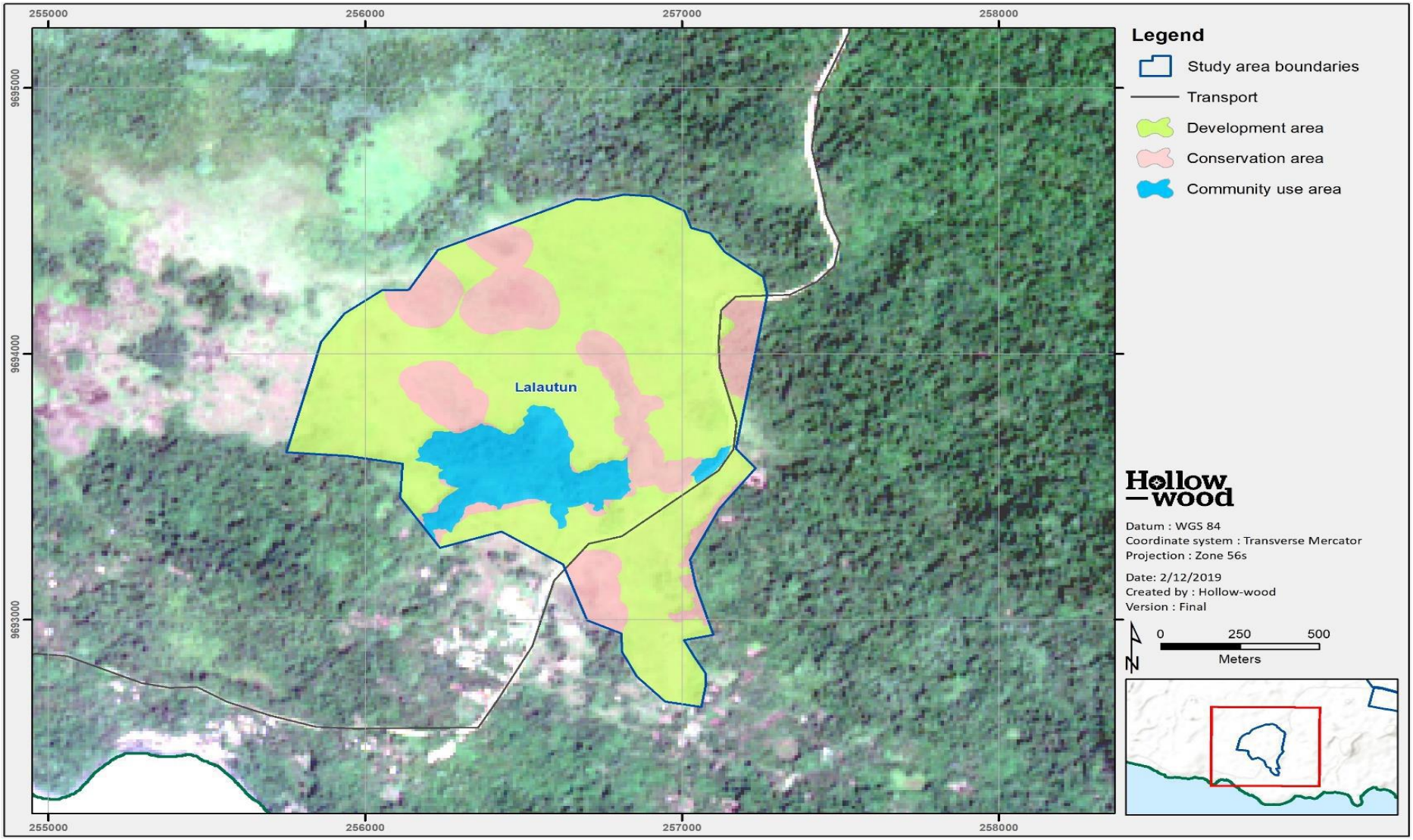
The assessment is on customary land and considers 3 separate land parcels, with a total area of 373.51 ha. This report details the findings of the integrated HCV-HCSA assessment. The study sites are located on New Ireland (also known as Nui Ailan or Latangai), NIP, Papua New Guinea, and consist of three separate study areas, totaling 373.51 ha. All three sites are owned by the Tivingau Incorporated Land Group (ILG).

Table 1: Indicates the property description of the 3 land parcels.

Site name	Land Tenure	Area (ha)	GPS Coordinates
Lalautun	Tivingau ILG	164.36	2° 46.149'S | 150° 48.591'E
Kunaur 3	Tivingau ILG	87.3	2° 44.821'S |150° 50.833'E
DPI station	Tivingau ILG	121.85	2° 45.196'S | 150° 50.887'E
	Total area	**373.51**	



Map 1: Location of the Tivingau ILG area of Interest in the broader landscape.



Map 1: The boundaries of the Lalautun area, of which 107.53 ha will be developed, 56.83 ha of conserve area & 17.44ha community use will be managed

Summary map for Lalautun that integrates all assessment findings, including HCV areas, HCSA forest and areas identified for community use by participatory mapping methods.

Map 2: The boundaries of the Kunau 3 area, of which 18.3 ha will be developed and 69.ha of conserve area plus DPI station area of which 73.8ha will be developed 48.06ha of conserve area will be managed.

Summary map for DPI Station and Kunaur 3 that integrates all assessment findings, including HCV areas, HCSA forest and areas identified for community use by participatory mapping methods.

In summary the following are the areas to be developed and managed under this proposed new development:

Table 2: Summary of study areas covered by this integrated HCV-HCSA assessment

Study area name	Land Tenure	Area (ha)	Description
DPI station	Customary	121.8	This site is under Tivingau ILG ownership, is of complex topography, with a mixed land use history. The underwent commercial logging in the 1980's and was further disturbed during the mid-1990's as part of a joint venture between the New Ireland Provincial Government and Agricultural Research and Advisory Sendirian Berhad (ARAB), Malaysia, with the aim of establishing a commercial rubber plantation in the area. This has resulted in highly disturbed vegetation, dominated by early pioneering species, such as *Rhus taitensis* and *Macaranga tanarius*. From field inspection, it is apparent that vegetation clearing had been confined to ridge-top areas that possess moderate slope. The site is heavily dissected by drainage lines, with a major, permanent creek (Kaut Creek) draining the site in north-east direction.
Kunaur 3	Customary	87.3	Kunaur 3 is a parcel that has been put forward for development by the Tivingau ILG. It has been commercially harvested in the past (1990's) and is currently regenerating. The site is of complex topography, with a series of deeply incised, northern draining, ephemeral streams traversing the site. Local steep slopes are present within drainage lines. There are two distinct types of vegetation present across the site, early pioneering and advanced secondary. The early pioneering vegetation is concentrated in the east of the study area, likely resulting from a disturbance in the recent past. The balance of the site is covered with quality, young regenerating low land rainforest.
Lalautun	Customary	164.4	This study area is predominantly an anthropogenic grassland, dominated by *Imperata cylindrica* and *Pennisetum polystachion*. The study area of very low relief, with the small hillock along the western boundary (Mt Vimuan) being 36m asl. A scattered woodland of *Pandanus tectorius* exists in the north of the study area, as do three permanent wetlands dominated by the sedge species *Lepironia articulata*. A small patch of remnant lowland rainforest exists along a drainage line in the centre of the study area, along with a small patch of sago swamp forest, dominated by *Metroxylon sagu*.
Total		373.5	

- HCVs1-6 is present and including permanent wetlands, community sago areas and a small patch of remnant lowland rainforest.

Table 3: In summary of area to be planted and HCV/HCS area to be conserved.

Site name	*Land Tenure*	*Area (ha)*	*Development area (ha)*	*Conservation area (ha)*
Lalautun	Tivingau ILG	164.36	107.53	56.83
Kunaur 3	Tivingau ILG	87.30	18.30	69.00
DPI station	Tivingau ILG	121.85	73.80	48.06
	Total area	**373.51**	**199.62**	**173.89**

The timeline for development is pending only for RSPO NPP approvals. Given the scale of the proposed new planting and the distance to existing operations NBPOL would like to complete the planting by November 2020.

Table 4: Timeline for development as per RSPO NPP approvals

Activity	***Date***
Boundary Survey	3rd – 5th August 2020
Spray-off of grass and site preparation	10th – 23rd August 2020
Road Lining and Traces	24th August – 6th September 2020
Planting commences	7th September 2020
Planting completed	30th November 2020

2. Assessment process and methods

2.1 Integrated HCV/HCS Assessment process and methods

2.1.1 Dates Integrated HCV/HCS assessments were conducted

Timelines associated with this integrated assessment

Phase	Description	Staff	Sept 2017	Feb 2018	Mar 2018	April 2018	May 2018	June 2018	July 2018	Aug 2018	Sept 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Dec 2019	Mar 2020
1. Scoping																	
	Document Review	MH															
	HCV/HCSA Team coordination	MH															
	Schedule for obtaining and analysing required spatial and other data to assist with field planning	MH															
	Review of preliminary analysis and preparation of detailed plan	MH															
	Agreement of methods for data collection and recording, threat assessment and data analysis by team experts	MH															
2. Data Collection and Field Work																	
	Data Collection and Field Work	MH,MF, MM, JL, NL															
	Stakeholder consultations	MH, NL															
	Regular communications to update progress of data collection	MH															
3. Analysis, Decision Making, Management and Draft reporting																	

	Analysis and HCV threshold	MH, MF															
	Decision making on HCVs	MH, MF															
	HCSA plot data analysis	MF															
	HCSA patch analysis decision tree	MF, MH															
	Development of HCV/HCSA management recommendations to address threats	MF, MH															
	Completing first draft	MF, MH															
4. Public Consultation, Peer Review and Final Report																	
	Preparation and Execution of Public Consultation	MH															
	Finalisation of HCV report based on feedback from public consultation and peer review	MF, MH															
	First resubmission of report	MF,MH															
	Second resubmission of report – minor changes only	MF,MH															12/3
	Public Summary	MF,MH															17/3
	Final review	MF,MH															31/3
	Approve date of HCVRN																31/3

2.1.2 Pre-assessment

Pre-assessment for this integrated HCV-HCSA assessment was undertaken by the lead assessor 24/09/2017 to the 29/09/2017. This pre-assessment exercise was a desktop investigation of all data provided to the lead assessor by NBPOL and through phone correspondence with NBPOL's then Sustainability Manager.

The four preconditions (due diligence) were deemed to be met as summarized:

- **Commitment to environmental and social safeguards:** NBPOL, through their parent company Sime Darby Plantation Berhad are RSPO certified and are HCSA members and have a number of publicly available documents which set out their commitment to environmental and social safeguards. These include Sime Darby's Code of Business Conduct and Group Policies and Authorities which articulate a commitment to respect fundamental human rights; their risk assessment framework, used when evaluating new investments, includes the identification of human rights risks; A Human Rights Charter; Slavery and Human Trafficking Statement; and their Responsible Agriculture Charter. NBPOL's the key documents are their Forest Policy, Human Rights Policy and Grievance Procedure for Stakeholder Issues.
- **Moratorium on any land clearing or land preparation until the ICLUP is completed:** NBPOL's commitment to such a moratorium is outlined in their Forest Policy which states that they are committed to the HCS approach, and therefore it is implied that they are willing and able to meet and adhere to such commitments.
- **Demonstrated legal right over or permission to explore the AOI:** The proposed development areas within the Tivingau ILG land boundary are customary lands, as such, the 'legal right' over these areas (i.e. a title) were not yet available at the time of pre-assessment. This full assessment report identifies areas appropriate for NBPOL to lease. NBPOL did gain permission from the Tivingau ILG land owners for assessors to enter their land and conduct the feasibility studies required by the RSPO New Planting Procedure (NPP).
- **FPIC process has been initiated:** Extensive FPIC had been undertaken by NBPOL. The process of formation and gazettal of the Tivingau ILG had been ongoing since 2011, official gazettal and registration of the Tivingau ILG in December 2016, and documentation of meetings (including minutes) provided evidence that the community is aware of the implications of oil palm development across their land. All documented evidence of NBPOL's FPIC activities at the time of pre-assessment was in order and collated in a single folder. An MOU was signed with the Tivingau Clan on 19/03/2014. Permission for the HCV/HCS and SEIA assessments to proceed was gained on the 11/01/2018.

The lead assessor was satisfied that NBPOL had met the required pre-conditions for an integrated HCV-HCSA assessment to continue. In particular, the lead assessor determined that the first FPIC gate (that FPIC had been initiated and that NBPOL had consent to conduct an assessment) had been satisfied.

2.1.3 Summary of scoping study activities

A scoping study is required before full assessment can occur and enables the lead assessor to understand the AOI in greater detail and determine planning and resource requirements for the full assessment. The scoping study for this assessment considered four separate land parcels, with a total area of 700.9 ha, as outlined in the table below.

Table 6: Summary of scoping study activities

Site name	Land tenure	Comments from scoping study	Area (ha)
Lalautun	Tivingau ILG	Mainly grasslands & *Pandanus tectorius* woodlands	**164.4**
Kunaur 3	Tivingau ILG	Mixture of advanced secondary forest, disturbed vegetation and old garden areas	**87.3**
Kunaur 4	Tivingau ILG	Advanced secondary forest	**327.4**
DPI Station	Tivingau ILG	Disturbed vegetation and old garden areas	**121.8**
Total			**700.9**

During the scoping study Hollow-wood determined that the 'Kunaur 4' study area was comprised of high quality advanced secondary forest, and the area was thus unable to be developed without breaching RSPO Principle and Criteria 7.2 and NBPOL's 'No deforestation' policy, and thus removed for further consideration.

The field component of the scoping study was conducted by the lead assessor between 24 – 29/09/2017, as outlined in Table 7.

Table 7: Timeline of the field component of the scoping study

Activity	Description	Timing
Information gathering	Background documents were gathered including spatial information of the proposed development sites, evidence of community engagement (FPIC) and all relevant documents (including policies, and standard operating procedures).	September 2017
Field visit(s)	The field component included land cover ground truthing, initial stakeholder identification and consultation, site visits and initial consultation with the relevant communities at both Lokono and Galong.	24/09/2017 to 29/09/2017
Visiting sample of communities	The communities at Lokono and Galong villages (i.e. Tivingau ILG area) were visited with initial discussions had with senior Tivingau ILG members regarding the FPIC process, the proposed development area and how NBPOL had initiated the development planning process. Permission was granted to access customary land at DPI Station, Lalautun and Kunaur 4 for initial field inspection. Permission was also given for the full assessment to be conducted, early in 2018.	27/09/2017
Ground truthing initial land cover map	The assessment team had previous experience in mapping land cover in the context of Papua New Guinea, but the initial inspection of land cover across the study areas revealed some land cover that required further understanding. This included the grasslands at Lalautun and the condition of the forested areas at DPI Station and Kunaur 3 and 4. GPS point were taken during this inspection and used to refine the mapping.	24/09/2017 – 29/09/2017

Stakeholder identification and initial consultations	Initial stakeholder consultations were had with a range of NGO and government officials working in the study area, including the local Catholic diocese, Live Learn, Wildlife Conservation Society and the New Ireland Provincial Lands Department.	26/09/2017

2.1.4 List of consultations

A summary of stakeholders consulted during the scoping study, including key outcomes of those interviews, are summarized in Table 8

Table 8: A summary of stakeholders consulted during the scoping study, including key outcomes of those interviews

Name	Title/role	Organisation/social group	Key concerns and recommendations
Rose Elias	Community Development Officer / small holder	Poliamba Ltd	Rose was supportive of the proposed developments because of their potential to benefit the local communities and provide a new road. No issue with commencing full assessment
Simon Konkas	Lands Manager	Catholic Dioceses of Kavieng	Simon confirmed the broad support for oil palm development across New Ireland because of the potential to generate community income and provide a new road. Also discussed the No issue with commencing full assessment
Thaiya Wokasup and Christian Gurumang	New Ireland Provincial Lands Department		Thaiya and Christian provided information that the Tivingau ILG land registration had changed from an SABL (Special Agricultural Business Lease) to VCLR (Voluntary Customary Land Registration). No issue with commencing full assessment
Patrick Topital	Program Manager	Live Learn, Kavieng Branch	Patrick supported NBPOL as an important part of the culture of New Ireland and provider of income and infrastructure. No issue with commencing full assessment
Annisah Sapul	Program Manager	Wildlife Conservation Society New Ireland	The Wildlife Conservation Society is supportive of NBPOL and identifies the new road as a key benefit of the proposed development. No issue with commencing full assessment
Lokono / Galong community			The community showed strong support for the proposed new development. No issue with commencing full assessment

2.1.5 Local people's lands and future livelihood security

The local environment Tivingau ILG members and Lokono villagers use the local environment as the main source of their basic needs. Out of the total Tivingau ILG land area of 5,205ha only 3.8% (199ha) is likely to be taken up by oil palm development.

The dependency on the local population on the local environment is not anticipated to be affected by the proposed oil palm development. The main reasons for this are: (i) the areas marked for oil palm planting are not directly used by the local people and (ii) they have more than adequate land to cater for these needs. In addition, the new planting areas do not contain grave sites or features with special cultural significance.

The only exceptions with respect to basic needs are limestone water holes and sago swamps located down-gradient from the Lalautun grassland. The limestone water holes are currently the only dry season sources of water for drinking, cooking and washing utensils. Sago is extracted from the sago swamps by the villagers as a reliable staple and ceremonial food. These uses must be protected during the establishment and operation of the mini estate. This is covered in Table 41.

2.1.6 Management and monitoring recommendations

The basis of the threat analysis is the IUCN Threats Classification Scheme (Salafsky & Margoluis, 1999; Salafsky et al., 2008), and utilises the CMP Direct Threats Classification spreadsheet Version 2. Using the CMP list, a high level evaluation was undertaken to identify threats that are known to be either currently present in the AOI, present in the wider landscape or have the potential to arise due to factors such as oil palm (or other development), population increase and climate change. The threats are divided into internal (NBPOL has control over the advent or management) and external (outside the company's span of control). The management and monitoring recommendations for threats to specific values and HCS forest are summarised in Table 41..

The focus of recommendations is on internal threats that are more likely to be realised, either because they are already present or they are a common feature resulting from oil palm development. Some recommendations are made regarding the management of external threats; however, these are typically generic as company influence outside its management area is limited. Whilst these recommendations are directly related to management of HCVs and HCS forest, they should not be viewed as a complete, detailed conservation area *management plan*. Conservation area management planning is a complex task and is based around the development of *objectives* that reflect the management goals and aspirations of both NBPOL and the Tivingau ILG members. It is advisable that the recommendations made here are used as an input into such a document, but the development of such a plan is outside the scope of this assessment. As recognised in the *Common Guidance for the Management and Monitoring of High Conservation Values* (Brown & Senior, 2014): 'It is the responsibility of the Organisation to take the findings and recommendations from the HCV assessment and incorporate these into a management plan aimed at maintaining and/or enhancing the HCVs. This includes allocation of sufficient resources to implement, monitor and, where necessary, adapt the plan during operations.'

Communities encompassed by the Tivingau ILG area (Lokono and Galong) are dependent on their local environment to meet much of their daily subsistence needs. A social baseline study is essential to understand the situation prior to development, with regular updates (every 5 to 10 years) to identify emerging trends/changes and enable pre-emptive action. Poor condition of the Kaut road representing a constraint to accessing markets in which to sell surplus garden produce. This situation may be remedied by the road upgrade that the establishment of a small Oil Palm estate will provide. Another key finding was that potable water security is a critical issue for communities at Lokono and Galong, with water availability during dry seasons being restricted to three major sources, one of which is located within the area proposed for development. Careful management of this critical resource is necessary, a fact that is compounded by both the topography and hydrology within the Lalautun study area currently being poorly understood.

2.1.6 Integrated HCV-HCSA Assessors and their credentials

Table 9 : Hollow-wood enterprise Pty Ltd intergrated HCV/HCS Team Composition

This integrated HCV-HCS assessment has been led by a registered HCSA practitioner and fully licensed HCV Lead Assessor License Number: ALS18002 MH under the HCVRN's new Assessor Licensing Scheme (ALS). The assessment team consisted of a range of independent experts and NBPOL staff, who acted as field assistants.

Name	Assessment role	experience	Relevant expertise	Relevant country or regional experience (including language proficiency
Michael Hansby	Lead assessor Vegetation Expert GIS expert	Hollow-wood Enterprises Pty Ltd	ALS provisionally licensed assessor Registered HCSA Practitioner BSci (ForSci) ANU Grad Dip. (BFire Mgt) Melb	PNG, Solomon Islands, Australia (Southern). English
Michelle Freeman	HCSA team Leader GIS expert	Hollow-wood Enterprises Pty Ltd	Registered HCSA Practitioner BSci/BFor (Hons) Melb, PhD Melb	PNG, Solomon Islands, Australia (Northern). English
Jeffery Lawrence	Flora expert	Independent	BSc (Forestry) Unitech	PNG. English / Tok PIdgin
Mellie Musonera	Fauna expert	Independent	MSc (Cons Biol) Uni Kent, BSc (Hons) (Biology) UPNG	PNG. English / Tok PIdgin
Narua Lovai	Narua Lovai	Consultant	Master of Engineering Science (Hydrochemistry), Uni Adelaide, BSc (Applied Chemistry) Unitech Diploma (Professional writing and Editing) Australian College, Certificate (Economics for community-based Project Management) Uni SP	PNG. English / Tok Pidgin
Rose Elias	Community engagement	Independent	Technical certificate in Basic Secretarial	PNG. English / Tok pidgin
Amalie Tibbits	Report writing -social	Hollow-wood Enterprises Pty Ltd	BSc (Geography) Melb, Grad Cert (Bfire Plan & Mgt) Melb	PNG, Australia (Southern). English

Besides the integrated HCV-HCSA assessment team, additional support was provided by Poliamba Ltd. senior managers.

Table 10: Field team of NBPOL staff, who assisted with the fieldwork component of the assessment

Name	NBPOL position	Qualifications
Theresa Endy	Lands Officer	Bachelor (Land Studies) *Unitech,* Diploma (Bus Mgt & Admin) *CIC – in progress* Certificate in Computing, Certificate in MapInfo
Naomi Pinga	Sustainability Officer	Bachelor (Commerce/IT) *Unitech ,* RSPO internal audit certificate
Timothy Matura	Palm Census and numbering officer	Grade 10
Alrick Kakpet	GPS operator	Grade 8
Missin	Assistant Sustainability Officer	Diploma (Tropical Agriculture) *Vudal Uni*
Ipiso Junior	Sustainability Manager	Bachelor (Tropical Agriculture) *Vudal Uni ,* Certificate IV (Bus Mgt) *Education Milne Bay* RSPO Lead Auditor Certificate

2.1.7 Full Assessment Methods used

Table 11: Full Assessment Methods used

Assessment type	Component	Team Requirements
HCSA	GIS & Remote Sensing	1 x analyst. Land cover classification,
	Field Assessment	• 1 x field inventory crew. • Field inventory team leader • Botanical specialist • Local field hands x 4
	Data analysis and report compilation	Assessment leader
HCV	Botanical survey	Largely covered by the HCSA field assessment team
	Faunal survey	Survey to focus on Mammals, Birds and Reptiles. Faunal assessment team needs to be able to work independently, in a team of two at the minimum. Given the differing Requirements of faunal assessment (early morning and late nights) it is a necessity that this team be independent of the botanical or social teams. Survey to focus on Mammals, Birds and Reptiles. Faunal assessment team needs to be able to work independently, in a team of two at the minimum. Given the differing requirements of faunal assessment (early morning and late nights) it is a necessity that this team be independent of the Botanical or social teams.
Social	HCV 5 and HCV 6	Assessor experienced in anthropological survey methodologies accompanied by a local (PNG national) interpreter. Ideally this team will have both male and female members, one of which fluent in Tok Pidgin.
	Social and Environmental Impact assessment	Assessor experienced in anthropological survey methodologies accompanied by a local (PNG national) interpreter. Ideally this team will have both male and female members, one of which fluent in Tok Pidgin

Methods included collection of both primary and secondary data. Secondary data was mostly collected prior to the survey and used to guide the field assessment (which involved the collection of primary data).

2.1.8 Secondary Data Collection

The secondary data was collected and analysed during the planning phase of the assessment, it included the following

Flora Desktop Study

Data from the IUCN website was augmented with existing information on the vegetation and flora of the study area and its conservation significance. The following data sources were used:

- The IUCN online database search was performed before the commencement of field work in October, 2016. A list of all flora species with an IUCN rating of vulnerable or greater (i.e. inclusive of endangered or critically endangered), was collated. The area of focus was the Papua New Guinea in general, with further investigation determining the relevance of each listed species to the New Ireland Province context;

- The CITES online database was performed before the commencement of field work October, 2016. The area of focus was the Papua New Guinea in general, with further investigation determining the relevance of each listed species to the Bismarck Archipelago and New Ireland Province;

- HCV toolkit for Papua New Guinea (PNG FSC, 2005) provides a range of species that a considered rare, threatened or endangered by IUCN or prohibited for trade under the CITES convention.

Fauna Desktop Assessment

A desktop review of current and relevant literature was conducted to collate data on mammal species which may have likely been encountered within the areas of interest**.**

Land cover mapping

The study area boundaries are derived from a combination of community participatory mapping for the study areas under customary land tenure, and GPS boundary surveys carried out by Poliamba staff for the delineation of areas. At the inception of this project, it was decided that the use of LIDAR was not feasible due to budget constraints, and that Option 3 (pp 5 in Rosoman *et al*, 2017b) would the most feasible approach for the purpose of this study. It was decided that two main sources of freely available satellite imagery were to be used for the project:

1) Sentinel 2 (freely available from European Space Agency (ESA));
2) High resolution Quick bird imagery downloaded using 'Terra Incognita' software.

Recent Sentinel 2 was used to gain an understanding of the vegetation present across the broader landscape and was the primary imagery dataset used for vegetation classification during the early stages of the project (i.e. preparing for the scoping study and fieldwork). The older Quick bird satellite imagery was used for refinement of the initial land cover classification.

Based on previous experience, it is the opinion of Hollow-wood that an integrated approach to land cover mapping provides the most accurate representation of the vegetation present across a study area. Supervised image classification was performed to derive an initial mapped extent of relevant land cover classes. Analysis of plot data and interrogation of higher resolution imagery is then used.

2.1.9 Primary Data Collection

The field survey focussed on:

- Vegetation
- Mammals
- Birds
- Amphibians and Reptiles

These were the main species groups known in the area. Bird species were observed to be traversing between the forested areas, the riparian zones, and probably to and from the coast. The study has identified high density of bats and flying foxes. An invasive amphibian, the cane toad was also identified whereas the white lipped green tree frog has a widespread range extending to mainland New Guinea.

Flora Field Survey

A Flora survey was carried out at Portion 8. Plots were established and 30m transects were plotted across opposite ends of a 50m transect line. Flora species within the plots were identified with a description of whether the vegetation is pioneer, secondary or primary. In this case there was almost no vegetation to describe. If one looks at the cover photo of the area, it is basically bare earth and a couple of introduced species (rain trees).

Fauna Field Survey

Faunal surveys were carried out between the 16-24th of March 2018 in eight areas of interest in the New Ireland Province, Papua New Guinea. These locations comprised of secondary forest, grassland, wetland and waterlogged areas, garden fallow areas and coconut plantations.

The surveys were conducted in varying habitats, with the locations to visit determined through satellite image analysis and topographic maps of each site. Birds were surveyed by walking through these areas using vegetation and topographic maps. Morning walks commenced at varying times from 5:30 to 6:00 AM. Mammal surveys occurred concurrently with the bird surveys as well as opportunistic sightings of reptiles. Frogs were easier to observe and locate at night during spot-lighting trips. These trips were also a good opportunity for surveys of mammals.

The surveys were conducted by teams to increase the effectiveness of the exercise. Employees attached with the Sustainability Department of Poliamba Ltd. supported the surveys. Members of the local communities, familiar with the sites were also involved in the surveys. Such an arrangement facilitated the opportunity to impart knowledge and skills pertaining to fauna as well as faunal survey and identification techniques

Amphibians and Reptiles Field Survey

Amphibian and reptile species are more likely to be encountered at night. Night trips were taken to survey for amphibians and reptiles and this occurred concurrently with spotlighting for mammals. The same survey routes were used to search for both reptiles and amphibians as well as for mammals. Amphibians or frogs were found by following their calls and searching for them in the understory as well as under bush. An audio recorder (ZOOM H1) was also used to record frogs calling. The search for reptiles was done using a spotlight (Coleman HCX – 450 Lumens) hand-held LED torches and headlamps.

The survey teams kept a close eye on the roads followed at night since snakes especially have a tendency on laying across the road at night. When a snake was spotted, photographs were taken

and the species identified and recorded. Members of the local community were also asked to recount any encounters they have had with reptiles or amphibian species in the past

2.1.10 Social section: methods and results

Social methods

To understand the local context of the areas of interest, a literature search (using Google Scholar and Google) was undertaken looking for information relevant to firstly the specific new plantings areas, then to the region, the Province and the country as a whole. All references cited are presented in the reference section (see Section 13), with key references regarding the socio-economic context being:

- *2011 National Census Report* – statistics on population (including growth rate)
- *Marine Resources of New Ireland Province* - utilization and potential for development of the province's marine resources
- *Agricultural Systems of Papua New Guinea Working Paper No. 17 New Ireland Province* - historical and capability data on food and cash crop production
- *Growing the major food plants of Papua New Guinea* – description, history, cultivation methods and problems of production of major food plants
- *2009-2010 Papua New Guinea Household Income and Expenditure Survey: Summary Tables* – statistics on education and employment in New Ireland rural areas

The tenure of the AOI was understood through interrogation of the documents relating to registration of the Tivingau ILG and title. The process to achieve registration is formalised under the PNG Lands Act 1996 and includes the establishment of an ILG committee, the identification and registration of all clan members in the ILG, surveying of boundaries, and meetings with, and agreement from neighbouring clans, on boundaries. Poliamba provided meeting minutes, meeting attendance records and correspondence between the company, customary landowners, community members and government stakeholders.
There was no baseline study on which to draw, however the SEIA (Lovai, 2018) conducted concurrently with the HCV/HCS integrated assessment provided valuable background information. The development of a social baseline study is a recommendation for Poliamba to commence in Section 6.
Four techniques were used to gather information to inform the HCV and HSC (including FPIC) assessments from communities and other stakeholders:

1) Participatory mapping with the Lokono community- including the identification of areas to be enclaved from community use, and areas identified as HCV 5 and HCV 6.
2) Independent verification of participatory mapping (community use areas and HCV 5 and 6) by lead assessor during full field assessment.
3) Semi-structured interviews – Lokono householder and key community representatives to inform HCV 5 and HCV 6
4) Focus groups with the Lokono community to inform HCV 5 and HCV 6.

The Lokono community was the focus of the social assessment, as the only village within the assessment area and the main residence of the Tivingau ILG membership. No communities or individuals declined to participate in the assessment or refused to grant FPIC for the assessment. Nine key community representatives attended the focus group and included representatives of the Tivingau ILG, local branch of the West Tigak Council of Women (WTCoW), Ward Development

Committee (WDC), Village Planning Community (VPC), Lokono Primary School and Lokono Aid Post. A summary of the meetings, including attendance, is provided in Table below.
12 Lokono community members were present at the community focus group (including participatory mapping). 10 members of the Tivingau ILG attended the ILG focus group meeting. 14 householder interviews with Lokono community members were completed.

Table 12 - Results of focus group held with local communities and meetings with Poliamba staff and other stakeholders to inform the SEIA and HCV/HCSA assessment.

Date	Expert/organisation/ social group	Type of interaction	Concerns and recommendations
07/02/2018	Provincial Lands Department Live and Learn	Face to face interview	Concerns regarding water contamination, increased population, and the willingness to work with the company for improved community services
09/02/2018	Lokono villagers	Community meeting	Details in SEIA report
09-10/02.2018	Lokono villagers	Group discussion	Participatory resource mapping
09/11/2019	Lokono villagers	Groupe discussion	Discussion regarding the identification of HCV 6 areas and a discussion regarding the protection requirements at the Talisarem 'ples masalai''
09-10/02.2018	Lokono villagers	Group discussion	Participatory resource mapping

The location of HCVs5 and 6 identified by the community are shown on Map 5.

Long discussions were had with community members during the full assessment regarding the importance of both wetland and riparian protection. These were aimed at increasing the community's awareness of the linkage between riparian protection and the continual presence of potable water during severe dry season events. The assessor found that the community was advocating for far more area to be put into production, with far fewer areas of riparian protection. After discussion, both during the assessment fieldwork and final consultation, agreement was reached on the value of riparian and wetland protection buffers.

2.2 Social Environmental Impact Assessment

2.2.1 Dates SEIA assessments were conducted

The SEIA stakeholder engagement was conducted from 5th – 11th February, 2018. An exchange of information and draft reports preceded the final report which was submitted 25th January 2019.

2.2.2 SEIA Assessors and FPIC experts and their credentials

Narua Lovai is a Freelance Environment Management and Technical Writing Consultant.

Mr Lovai has extensive experience as an environmental management consultant to the private industry and the PNG Government. His expertise and skills include strategic planning, organizational, personnel and financial management, outcomes-based project management, policy formulation and revision, natural resources legislation compilation and revision, baseline environmental data collection, waste management and cleaner technology, water pollution assessment and mitigation, hydrological data acquisition and analysis, integrated catchment management, biophysical environment impact assessment, socio-economic impact assessment, environmental compliance and audit monitoring, stakeholder engagement for community development, and professional writing and editing.

2.2.3 SEIA Methods

Secondary Data

The data collection, analysis and report writing was entirely carried out by Narua Lovai a social scientist with many years of experience carrying out assessments for the mining and oil palm industry both for government and the private sector. Preliminary preparation for this study was based on secondary data, and the consultant's accumulated knowledge and experience with social and environmental issues typically related to the development of oil palm in PNG. Literature searches were conducted to collate material relating to the biophysical and human environment of the location, latest RSPO information on new plantings and Poliamba Limited operations in the New Ireland Province.

Primary Data

Two separate sets of interview questions were developed and conducted by Narua Lovai one to collect information from householders in Lokono village, mainly focused on ascertaining HCV 5 community needs. The second was with key community members in Lokono village regarding the social infrastructure and services in the community. Semi-structured interviews were used because they allow the interviewer and interviewee to further discuss additional important points of interest that arise during the interview (Hancock, 2002).

- Householder interview: Formulated using criteria identified by Bourke, et al (1998) as crucial for agricultural land use mapping in PNG. The survey uses a rating system to determine the relative significance of farm land, crops (food and cash), method of cultivation, fallow period, cropping pattern as well as food harvested from the wild.
- Community interview: Used to determine the level of basic social infrastructure and services available to the community, the questions were based on other surveys conducted in the Guadalcanal Plains HCV assessment work undertaken by Jules Crawshaw (Daemeter, 2017).

Community members in Lokono village were invited to participate in the householder interview by the Village Planning Committee Chairman (VPCC). Participation was voluntary and no incentives were provided for people to participate. Of the 72 households reported to make up Lokono village, at least one member from 14 was interviewed (23.6%).

The VPCC invited ten key community representatives to participate in the community interview. Of these, nine were interviewed and included representatives of the Tivingau ILG, local branch of the West Tigak Council of Women (WTCoW), Ward Development Committee (WDC), Village Planning Community (VPC), Lokono Primary School and Lokono Aid Post.

All interviews were translated into Tok Pidgin, as was the preference of community members.

2.3 Soil Suitability Assessment

2. 3. 1 Dates Soil Suitability Assessments were conducted

A soil suitability assessment was carried out on the land on February 2019. Due to the size of the site and the proximity of existing Poliamba Ltd. operations with similar soil characteristics, field sampling and reporting was carried out by the Technical Services Division of Poliamba Ltd. lead by Dr. Banabas Murom.

2.3.2 Soil Suitability Assessment expert and credentials

- Banabas Murom has a PhD in Soils Science – 2007 (Massey University – New Zealand), Masters in Applied Science (Soils) – 1998 (Massey University – New Zealand);
- Bachelor of Science in Agriculture – 1990 (PNG University of Technology);
- Banabas Murom has worked for PNG OPRA for 27 years starting as an assistant agronomist. Last 9 years as Head of Agronomy.

Below are list of some of the publications and reports Banabas Murom was involved in:

Banabas, M. (2003a). Trial 305 Final Report - A factorial fertiliser trial (N, P, K, Mg) with oil palm on volcanic ash soils in Popondetta, Papua New Guinea, 1982 - 1997. p 55

Banabas, M. (2003b). Trial 306 Final Report - A fertiliser factorial trial (N, P, K, Mg) with oil palm on volcanic outwash plain soils in Popondetta, Papua New Guinea., p 58.

Banabas, M (2007) Study of nitrogen loss pathways in oil palm (*Elaeis guineensis* Jacq.) growing agro-ecosystems on volcanic ash soils in Papua New Guinea. PhD Thesis, Massey University, Palmerston North NZ. p 327

Banabas, M. (1998). A Comparative Study of the Phosphorus Characteristics of Oil Palm Volcanic Soils in Papua New Guinea and New Zealand Volcanic Soils. Unpublished Masters in Applied Science, Massey University, New Zealand. p.150

Banabas M, Turner MA, Scotter DR, Nelson PN (2008a) Losses of nitrogen fertiliser under oil palm in Papua New Guinea: 1. Water balance, and nitrogen in soil solution and runoff. *Australian Journal of Soil Research* 46, 332-339.

Banabas M, Scotter, DR, Turner MA (2008b) Losses of nitrogen fertiliser under oil palm in Papua New Guinea: 2. Nitrogen transformations and leaching, and a residence time model. *Australian Journal of Soil Research* 46, 340-347.

Nelson PN, **Banabas M**, Scotter DR, Webb MJ (2006) Using soil water depletion to measure spatial distribution of root activity in oil palm (*Elaeis guineensis* Jacq.) plantations. *Plant and Soil* **286**, 109-121.

Banabas, M. (1998). A Comparative Study of the Phosphorus Characteristics of Oil Palm Volcanic Soils in Papua New Guinea and New Zealand Volcanic Soils. Unpublished Masters in Applied Science, Massey University, New Zealand. p.150

Contributed to PNG OPRA Annual Reports 1998 – 2019

Goodrick I, Nelson PN, **Banabas M**, Wurster C, Bird MI. 2012. Soil carbon balance following conversion of grassland to oil palm. *Joint ASSSI and NZSSS Soil Science Conference 2012. Soil solutions for diverse landscapes*. 2-7 December 2012. Hobart, Australia. (poster)

Nelson PN, **Banabas M**, Goodrick I, Gabriel E. 2012. Soil fertility changes following conversion of grassland to oil palm. *Joint ASSSI and NZSSS Soil Science Conference 2012. Soil solutions for diverse landscapes*. 2-7 December 2012. Hobart, Australia. (poster)

Nelson P, **Banabas M**. 2013. Sustainability of soil and water management news. NBPOL Group Bulletin 30, 14-15.

Nelson PN, Rhebergen T, Berthelsen S, Webb MJ, **Banabas M**, Oberthür T, Donough CR, Rahmadsyah, Indrasuara K, and Lubis A. 2011. Soil acidification under oil palm: rates and effects on yield. *Better Crops* 95 (4), 22-25.

Nelson PN, Berthelsen S, Webb MJ and **Banabas M**. 2010. Acidification of volcanic ash soils under oil palm in Papua New Guinea: effects of fertiliser type and placement. In: Gilkes RJ, Prakongkep N, editors. *Proceedings of the 19th World Congress of Soil Science; Soil Solutions for a Changing World; ISBN 978-0-646-53783-2; Published on DVD; http://www.iuss.org; Division Symposium 3.2; Nutrient best management practices; 1-6 August 2010.* Brisbane, Australia: International Union of Soil Science. p 8-11.

Nelson PN, Webb MJ, Orrell I, van Rees H, **Banabas M**, Berthelsen S, Sheaves M, Bakani F,Pukam O, Hoare M, Griffiths W, King G, Carberry P, Pipai R, McNeill A, Meekers P, Lord S, Butler J, Pattison T, Armour J and Dewhurst C. 2010. *Environmental sustainability of oil palm cultivation in Papua New Guinea*. ACIAR Technical Report No. 75. The Australian Centre for International Agricultural Research, Canberra. 66 pp.

Nelson PN, Gabriel J, Filer C, **Banabas M**, Sayer J, Curry G, Koczberski G and Venter O (2013). Oil palm is not a major driver of deforestation in Papua New Guinea. *Conservation letters; A journal of the Society for Conservation Biology.* (Submitted for publication)

Nelson PN, Webb MJ, **Banabas M**, Nake S, Goodrick I, Gordon J, O'Grady D, Dubos B (2014) Methods to account for tree-scale variation in soil- and plant-related parameters in oil palm plantations. *Plant and Soil* **374**, 459-471.

Nelson PN, **Banabas M,** Goodrick I, Webb M, Huth NI, and O'Grady D. (2015) Soil sampling in oil palm plantations: a practical design that accounts for lateral variability at the tree scale. *Plant and Soil* **394**, 421-529.

Wakelin SA, Gerard E, Koten van C. **Banabas M**, O'Callaghan M, Nelson PN (2016) Soil Physicochemical properties impact more strongly on bacteria and fungi than conversion of grassland to oil palm.

2.3.3 Soil Suitability Assessment Methods

Secondary Data

The in-field data collection, mapping, analysis and report writing was carried out by the TSD team of Poliamba Ltd., under the oversight of Banabas Murom.

Primary Data

The proposed area was visited and inspected for soil types. The overall landform was inspected to concur with the literature description of the area. The soil was inspected physically by transects of soil cores using a hand auger.

Figure 3: Dr.Murom taking soil samples of the different soil types in Kunaur 3

Special soil samples from the wet depressed areas at Lalautun.

Soil samples were also collected from areas near to very wet areas at 0-20 cm and 20-40 cm depths. The results are presented in Appendix 2. The pH is high 5.2-5.3 with high levels of Total P, Total N and Total C. The soils also have a low C/N ratio of 11-15. Interestingly these samples have very high P retention (>90%). The soils just at the edge of the very wet pitpit swampy area showed no indication of peat soils. However these areas will be used as buffer around the wet pitpit swamp areas.

2.3.4 Soil suitability ratings

The suitability rating used here was revised by Paramananthan S who adapted the criteria derived from FAO Soils and Land Evaluations (1976). In the classification system, there are two orders, suitable and non-suitable and sub classes (Table 3). There are six limiting factors; climate, drainage, fertility, physical soil qualities, soil depth and topography. These factors are taken into considerations in the suitability

Table 1 Soil nutrient levels at top 40-50 cm depths

Sites	Sampling point	Depth (cm)	pH (water)	Total C	OM	Total N	C/N Ratio	Total P	P retentic	Exchangeable cations			CEC
										K	Ca	Mg	
DPI	Core	0-20	High	Very high	Very high	Low	Low	Very low	Low	Very low	Moderate	High	Moderate
DPI	Core	20-40	High	Moderate	Low	Low	Low	Very low	Low	Very low	Moderate	High	Moderate
	Sampling point	Depth (cm)	pH (water)	Total C	OM	Total N	C/N Ratio	Total P	P retentic	Exchangeable cations			CEC
										K	Ca	Mg	
Kunaur 3	Pit	0-30	Very high	Very high	Very high	Very high	Low	Low	Moderate	Very high	High	High	High
Kunaur 3	Pit	30-50	High	Moderate	Low	low	Low	Very low	Moderate	High	Moderate	High	High
Kunaur 3	Core	0-20	High	Very high	High	Very high	Low	Low	Moderate	Moderate	Moderate	High	High
Kunaur 3	Core	20-40	High	High	High	High	Low	Very low	Moderate	Low	Moderate	High	High
	Sampling point	Depth (cm)	pH (water)	Total C	OM	Total N	C/N Ratio	Total P	P retentic	Exchangeable cations			CEC
										K	Ca	Mg	
Lalautun	Pit	0-30	Moderate	Very high	High	Very high	Low	Very high	Low	Very low	Very low	HIgh	High
Lalautun	Pit	30-50	High	Moderate	Moderate	low	Low	Very high	Low	Very low	Very Low	Low	High
Lalautun	Core	0-20	High	Very high	High	Moderate	Low	Very high	Low	Very high	Low	Low	High
Lalautun	Core	20-40	High	Very high	High	Moderate	Low	Very high	Low	Very high	Low	High	High

Total C and OM

Total C and organic matter levels are high to very high in the top 20 to 30 cm soil depths than at lower depths (Table **1** and Appendix 2). The C/N ration is also low for all soils suggesting rapid mineralisation of OM in these soils. In the well drained soils, there are no indication of peat soils in the surveyed area.

Table 3 Land evaluation classification system

Order	Class	Definition
S (suitable)	S1 (highly suitable)	Land having no or only minor limitations to sustain cultivation of oil palm or any other crop for that matter
	S2 (moderately suitable)	Land having limitations that in aggregate are moderately severe for sustained oil palm cultivation.
		Productivity will be smaller and inputs will be more costly that S1
	S3 (marginally suitable)	Land having limmitations that in aggregate are moderatey severe for sustained oil palm cultivation.
		Productivity will be reduced and input costs so great that use of this land may not be marginally justified.
N (not suitable)	N (Not suitable)	Land qualities are not suitable for sustained oil palm cultivation.

A suitability summary of the climate, soil physical and main chemical properties is summarised in Table 4, Table 5 and Table 6 for DPI, Kunaur 3 and Lalautun respectively. The suitability rating is classed for the 3 major landforms; flat undulating terrain, steep hilly slope areas and wet swampy areas except for DPI which does not have swamp wet areas. The suitability classification is defined according to classification suitability for climate and soil physical and chemical properties

Table 4 Suitability ratings for oil palm production at DPI

Characteristics	Flat undulating	Suitability	Hills and slope	Suitability
Climate				
Annual rainfall (mm)	3,070	S1	3,070	S1
Dry season (months)	nil	S1	nil	S1
Mean annual max. temp. (°C)	29+	S1	29+	S1
Mean annual min. temp. (°C)	20+	S1	20+	S1
Mean annual temp. (° C)	25+	S1	25+	S1
Sunshine hours hrs/day	5.6	S1	5.6	S1
Topography				
Slope (%)	Flat	S1	>30%	NS
Soil wetness				
Drainage Class	Well drained	S1	Well drained	S1
Flooding	Not flooded	S1	Not flooded	S1
Soil physical conditions				
Texture	C-SiC	S3	C-SiC	S3
Structure	moderately developed	S1	moderately developed	S1
Depth (cm)	120	S1	120	S1
Depth to top of sulfuric horizon (cm)	N/A		No detailed survey	
Thickness of Peat (cm)	N/A		No detailed survey	
Chemical conditions				
CEC (me/100)	16-19	S1	16-19	S1
Base saturation in A horizon	56	S1	56	S1
Organic C in A horizon	2.6	S1	2.6	S1
Salinity 50 cm depth	N/A		N/A	
Micronutrients	N/A		N/A	

Table 5 Suitability ratings for oil palm production at Kunaur 3

Characteristics	Flat undulating	Suitability	Hills and slope	Suitability	Wet low lying areas	Suitability
Climate						
Annual rainfall (mm)	3,070	S1	3,070	S1	3,070	S1
Dry season (months)	nil	S1	nil	S1	nil	S1
Mean annual max. temp. (°C)	29+	S1	29+	S1	29+	S1
Mean annual min. temp. (°C)	20+	S1	20+	S1	20+	S1
Mean annual temp. (° C)	25+	S1	25+	S1	25+	S1
Sunshine hours hrs/day	5.6	S1	5.6	S1	5.6	S1
Topography						
Slope (%)	Flat	S1	>30%	NS	Flat	S1
Soil wetness						
Drainage Class	Well drained	S1	Well drained	S1	Poorly drained	NS
Flooding	Not flooded	S1	Not flooded	S1	Flooded	NS
Soil physical conditions						
Texture	C-SiC	S3	C-SiC	S3	Not determined	
Structure	moderately developed	S1	moderately developed	S1	underwater	
Depth (cm)	120	S1	120	S1	Underwater	
Depth to top of sulfuric horizon (cm)	N/A		No detailed survey		N/A	
Thickness of Peat (cm)	N/A		No detailed survey		N/A	
Chemical conditions						
CEC (me/100)	>25	S1	16-19	>25	Not determined	
Base saturation in A horizon	>50	S1	56	>50	underwater	
Organic C in A horizon	3.0	S1	2.6	3.0	Underwater	
Salinity 50 cm depth	N/A		N/A		N/A	
Micronutrients	N/A		N/A		N/A	

Table 6 Suitability ratings for oil palm production at Lalautun

Characteristics	Flat undulating	Suitability	Hills and slope	Suitability	Wet low lying areas	Suitability
Climate						
Annual rainfall (mm)	3,070	S1	3,070	S1	3,070	S1
Dry season (months)	nil	S1	nil	S1	nil	S1
Mean annual max. temp. (°C)	29+	S1	29+	S1	29+	S1
Mean annual min. temp. (°C)	20+	S1	20+	S1	20+	S1
Mean annual temp. (° C)	25+	S1	25+	S1	25+	S1
Sunshine hours hrs/day	5.6	S1	5.6	S1	5.6	S1
Topography						
Slope (%)	Flat	S1	<10	S2	Flat	S1
Soil wetness						
Drainage Class	Well drained	S1	Well drained	S1	Poorly drained	NS
Flooding	Not flooded	S1	Not flooded	S1	Flooded	NS
Soil physical conditions						
Texture	CL	S1	CL	S3	Not determined	
Structure	moderately developed	S1	moderately developed	S1	underwater	
Depth (cm)	120	S1	120	S1	Underwater	
Depth to top of sulfuric horizon (cm)	N/A		No detailed survey		N/A	
Thickness of Peat (cm)	N/A		No detailed survey		N/A	
Chemical conditions						
CEC (me/100)	15-20	S1	15-20	S1	Not determined	
Base saturation in A horizon	<20	S2	<20	S2	underwater	
Organic C in A horizon	4.0	S1	4.0	S1	Underwater	
Salinity 50 cm depth	N/A		N/A		N/A	
Micronutrients	N/A		N/A		N/A	

Executive Summary

- • Climate is highly suitable for oil palm production
- • The major limiting factors are steep slopes and poorly drained areas
- • There is surplus water throughout the year.
- • No peat in the well drained soils surveyed.
- • N and K fertilisers will be major nutrients required
- • Steep areas at DPI and Kunaur are to be avoided for planting.
- • The wet swampy areas at Kunaur and Lalautun to be avoided
- • Approximately 250 ha of the total of 373.1 ha is suitable for planting

2.4 High Carbon Stock Assessment

2.4.1 Dates High Carbon Stock Assessment was conducted

The High Carbon Stock field assessment was carried out on 17th March 2018.

2.4.2 High Carbon Stock Assessment expert and credentials

The High Carbon Stock Assessment was led by Michael Hansby and team (see above).

2.4.3 High Carbon Stock Assessment Methods

Secondary Data

The assessment used land cover data from the integrated HCV-HCS Assessment.

Primary Data

This approach led to a sample size of 76 plots needed to achieve the desired sample rate. Due to the relative ease of access across the study areas, it was decided that a stratified random sampling approach would be taken, with plots generated, by the 'create random point' function in ArcGIS, with a minimum distance of 100m being applied as a parameter within the tool.

2.5 Land Use Change Assessment

2.5.1 Dates Land Use Change assessments were conducted

The land use change assessment was carried out in August 2019. Maps of the boundaries supplied by Poliamba Ltd. to Hollow-wood, as part of a larger, integrated High Conservation Value (HCV) / High Carbon Stock (HCS) assessment that was undertaken in March, 2018.

2.5.2 Land Use Change Assessors and their credentials

Table 13: The Land Use Change Assessment was carried out by:

Name	Assessment role	experience	Relevant expertise	Relevant country or regional experience including language proficiency
Michael Hansby	Lead assessor Vegetation expert GIS expert	Hollow-wood Enterprises Pty Ltd	ALS provisionally licensed assessor Registered HCSA- License Number: ALS18002 MH Practitioner BSci (ForSci) ANU Grad Dip. (BFire Mgt) Melb	PNG, Solomon Islands, Australia (Southern). English
Amalie Tibbits	Report writing - social	Hollow-wood Enterprises Pty Ltd	*BSc (Geography) Melb, Grad Cert (Bfire Plan & Mgt) Melb*	PNG, Australia (Southern). English

2.5.3 Land Use Change Assessment Analysis

Land Use Change Analysis (LUCA) was conducted for the areas identified for oil palm development within the Tivingau Incorporated Land Group (ILG) customary lands, as part of the new planting procedure documentation required by RSPO certified Oil Palm producers.

The key steps:

- Literature review of previous studies and datasets to inform analysis, including acquisition of satellite imagery for the relevant time periods prescribed by RSPO (2015);

- The LUCA will ensure NBPOL is compliant with Criteria 7.12.1 of the RSPO Principles and Criteria (RSPO P&C), where 'new plantings since November 2005 have not replaced primary forest or any area required to maintain or enhance one or more High Conservation Values';
- LUCA across the study areas as supplied by Poliamba and consistent with the requirements set out in Section 3.3 of RaCP (2015), Annex 3 – LUCA Guidance document and Annex 4 – LUCA Reporting checklist;
- Results of LUCA presented in the reporting format prescribed by RSPO, Annex 3a – LUCA reporting template;
- Draft LUCA report, compliant with the RSPO Remediation and Compensation Procedures (RaCP);
- Final LUCA report, compliant with the RSPO Remediation and Compensation Procedures (RaCP).

2.6 Greenhouse Gas Analysis

2.6.1 Dates Greenhouse Gas Analysis was conducted

The greenhouse gas analysis was conducted in August 2019 based on the findings of the various assessment reports.

2.6.2 Greenhouse Gas Analyst credentials

Table 14: The greenhouse gas analysis was carried out by:

Name	Assessment role	experience	Relevant expertise	Relevant country or regional experience including language proficiency
Michael Hansby	Lead assessor Vegetation expert GIS expert	Hollow-wood Enterprises Pty Ltd	ALS provisionally licensed assessor Registered HCSA- License Number: ALS18002 MH Practitioner BSci (ForSci) ANU Grad Dip. (BFire Mgt) Melb	PNG, Solomon Islands, Australia (Southern). English
Amalie Tibbits	Report writing - social	Hollow-wood Enterprises Pty Ltd	*BSc (Geography) Melb, Grad Cert (Bfire Plan & Mgt) Melb*	PNG, Australia (Southern). English

2.6.3 Greenhouse Gas Analysis Methods

The RSPO GHG Assessment Procedure for New Plantings is meant to be used as guidance to identify and estimate the corresponding expected carbon stock fluxes (above and below ground) and GHG emissions associated with the resulting land cover change to oil palm, peat drainage (if appropriate) and emissions from mills and operations can be estimated and development plans adjusted to avoid areas with high carbon stocks and minimize net GHG emissions associated with new plantation development.

The GHG emissions were calculated using the RSPO GHG calculator provided for this purpose https://www.rspo.org/certification/GHG-assessment-procedure. The calculator was populated with previous years data for the mill to which the proposed crop will be delivered to. It was assumed that the entire development will take place within one year.

Five scenarios were tested to better understand the implications of development scenarios on the GHG budget of the site.

The following management plan is derived from the GHG report recommendations and is relevant to all areas identified in that reports. These recommendations will be incorporated into the Plantation Management whose coordination is responsibility of the Field Department.

Parameter to be monitored	*Proposed Enhancement / Mitigation Measures*	*Location*	*Measurement*	*Frequency*		*Estimated Time-frame for completion of task*
Mitigate net GHG emissions associated with oil palm cultivation	Implementation of the High Carbon Stock Approach prior to development. No conversion of HCSA vegetation with carbon stocks greater than that contained in Scrub	*All areas to be leased*	GIS Map	*Once*	*Sustainability Manager (SQMM)* *Senior Estate Manager (SEM)*	*Completed*
Enhancement of Carbon Stocks	All HCV/HCS areas to be leased to company to be managed as conservation areas allow for carbon sequestration.	*All areas to be leased*	GIS Map Field inspection	*Quarterly*	*SQMM* *SEM*	*August 2020 onwards*
	Awareness to be carried out on the importance of maintaining HCV/HCS areas identified. Fund raising, ie/ through HCSA, for funding into the conservation of these areas	*All areas to be leased*	GIS Map Field inspection	*Annual*	*SQMM* *SEM*	*August 2020 onwards*
	Monthly monitoring of all conservation areas within areas leased to NBPOL. Enforcement of incursions (ie/gardening) through consultation with communities, removal of crops and if that is not effective enforcement through stop payments of lease payments over conservation areas.	*All areas to be leased*	Field Inspections	*Annual*	*SQMM* *SEM*	*August 2020 onwards*

3. Summary of findings

3.1 SEIA Summary of findings

The SEIA utilized a risk ranking methodology to analyse the positive and negative impacts of all the aspects and activities and associated with the implementation of the project. The inputs to the risk ranking were obtained through an expert driven outreach process which captured the stakeholder perception of environmental risks. These were then analysed by the expert and reported in a matrix with the associated impacts to the phase of the project, the potential impacts and the medium to which the impacts are ascribed as summarized in the table below:

Table 15: Nature and level of risk of each potential impacts of the Project

Identified benefit/impact	Recommended action
The community may not have a clear understanding of how much money they can expect to receive from the plantation	• Provide an example of potential annual revenue to the ILG, based on an existing and comparable mini-estate
Concern from Lokono community (people not in the Tivingau ILG) regarding the impact of the development on water supply, sago production and the influx of people (workers) to the village	• Engage the wider Lokono community though ongoing public awareness activities
Opportunities for employment for members of the Tivingau ILG members and other Lokono community members	• Offer available positions to people in the local community
Workers coming from outside the local area may use customary land for gardens and forest resources	• Ensure all workers coming from outside are provided with adequate accommodation and utilities to ensure they do not use customary land (as per NBPOL housing improvement plan)
Potential for decrease or contamination of water supply, further increasing water shortages during the dry season	• Provide a buffer zone (as per HCV 4 standard requirements), • Water quality monitoring to ensure all relevant regulations are adhered to • Community engagement program regarding water quality, including provision of monitoring results on an ongoing basis • Provision of increased water storage capacity (additional tanks)
Inadequate sanitation within Lokono Village	• Poliamba to assist community applying for funding to improve sanitation for all households
Inadequate classrooms, teachers and resources at the primary and elementary schools at Lokono	• Assist community to apply for funding to improve education services
Inadequate supply of medical resources and access to health extension services in Kavieng	• Assist community to access funding to improve health services
Road works to support the plantation may improve education and health facilities by improving access from Kavieng	• Communicate to the community about when road works will be undertaken
Community expectations that Poliamba will provide funding for improving education and health facilities may not be met, which may lead to community resentment	• Ensure clear, open and honest communication to the Lokono community regarding what infrastructure and services the company will provide
Opportunities to increase household incomes due to improved road access to Kavieng	• Communicate to the community about when road works will be undertaken
Social issues that may arise due to the increased household incomes (through royalty payments and employment)	• Provide training on basic financial management
Social issues that may arise due to the influx of workers from outside the area	• Strict controls on immigration, ban on sale of land to outsiders, zero tolerance on squatting and prompt attendance to criminal cases and apprehension of offenders
Impacts on flora and fauna	• See HCV 1, 2 and 3
Impacts on sacred sites	• No sacred sites identified in the plantation areas
Potential noise pollution from development, particularly during construction phase	• Ensure all power generators are serviced regularly and have noise suppression features or attachments. • Ensure all items of machinery and equipment are serviced as Programmed, and where necessary, fitted with noise mufflers. • Prohibit night time work. • Provide hearing protection gear to workers where appropriate.

Potential decrease in air quality, particularly during the construction phase	• Ensure no burning of vegetation and other flammable waste. • Securely cover loose material. • Segregate solid waste and dispose of in properly constructed landfills. • Ensure empty fruit bunches are appropriately placed on the plantation so that foul odour and flies do not irritate residents in nearby villages. • Compact and dampen exposed dust generating surfaces. • Provide dust masks and safety eye glasses to workers engaged in dust generating activity. • Use water-spray trucks to suppress dust production on plantation roads whenever necessary. • Use low sulphur fuels in power generators. • Ensure all pieces of machinery and equipment are serviced as programmed.
Potential loss of soil quantity and quality during construction and over time within plantation areas	• Minimise unnecessary removal of vegetation. • Securely stockpile topsoil for subsequent re-vegetation work. • Immediately revegetate unused exposed surfaces. • Install and maintain silt traps, drainage sumps or other methods of silt reduction. • Ensure all items of machinery and equipment are serviced as programmed. • Clean up hydrocarbon and agrochemical spillages immediately and treat the contaminated soil in an appropriate waste management facility. • Ensure groundcover

3.1.1 Issues raised by stakeholders and assessors comments

All of the above issues were raised in consultation with the SEIA assessor and through his own expert analysis. In particular there was a concern with regards to achieving the full economical potential of the project.

3.1.2 List of legal documents, regulatory permits and property deeds related to the areas assessed

List of Reports

- Notification for Environmental Permits for the new plantings submitted to CEPA.
- Local stakeholders including ILG's have been informed and included in discussions.
- Land Title through Voluntary Customary Land Registration (VCLR) Title
- Land Lease agreement with Poliamba Limited.

3.1.3 List of Legal Documents

Table 16: List of Legal Documents consulted

No	Legal Document	Issuing Authority	Year
1	Environment Act	Conservation & Environment Protection Authority	2000
2	Environment (Prescribe Activities) Regulation	Conservation & Environment Protection Authority	2002
3	Land Registration Act	Lands Department	1981
4	Fauna (Protection & Control) Act	Conservation & Environment Protection Authority	2014
5	Papua New Guinea Logging Code of Practice	Forestry Authority	1996
6	Land (Amendment) Act	Lands Department	2018
7	Physical Planning Regulation	Lands Department	1990
8	Land Groups Incorporation (Amended) Act	Lands Department	2018
9	Land Regulations	Lands Department	1999

3.2 HCV assessment summary of findings

3.2.1 National / Regional Context

Papua New Guinea occupies the eastern half of the island of New Guinea, just north of Australia, and many outlying islands to the north and east, with a land area of about 462,243 sq. km. Lying at the boundary of the Australian and Pacific tectonic plates, Papua New Guinea is remarkably diverse in terms of species, landscapes and ecosystems. The forests on the main island of New Guinea (consisting of Papua New Guinea and West Papua) constitute the third largest expanse of tropical rainforest on the planet, after the Amazon and Congo forests. Rainforests cover 28.2 million hectares of Papua New Guinea and comprise 80% of the forest estate.

The total number of different plants and animals in Papua New Guinea is not accurately known but almost certainly exceeds 200,000 species and thus is far higher than the 26,318 reported by IUCN. The flora of Papua New Guinea is poorly known. Estimates for the number of vascular plant species for the entire island of New Guinea range from 11,000, to 13,858, to 16,203, based on species-area relationships and publishing trends, to 20,000-25000 species (including undescribed taxa) calculated on the assumption that orchid and fern species, which are relatively well known, comprise about a quarter of the overall flora.

Besides mining PNG's economy is dominated by subsistence agriculture, this is relied upon by approximately 75% of the population. Agriculture, timber and fish constitute products that are sold beyond a subsistence level. The main agricultural products are coffee, palm oil, cocoa, copra, tea, rubber and sugar. PNG is currently in a crisis of not being to attain sufficient US Dollars to pay its foreign debts. As such, palm oil is an earner of foreign exchange that PNG desperately needs.

3.2.2 Scope

Poliamba Limited is now in the process of securing a new planting site under consideration of a lease agreement area from the Tivingau ILG of Lokono village. The Tivingau ILG site has a total of 373.51 ha. Once planted this site will add approximately 3% to Poliamba Limited's current planted area.

3.2.3 Demographic and Socioeconomic Context

According to the 2011 National Census –Tikana LLG has the highest number of households and persons within the district but is still relatively low compared to other LLGS in New Ireland Province (PNG National Census, 2011).

Subsistence Agriculture

Besides mining PNG's economy is dominated by subsistence agriculture, this is relied upon by approximately 75% of the population. Agriculture, timber and fish constitute products that are sold beyond a subsistence level. The main agricultural products are coffee, palm oil, cocoa, copra, tea, rubber and sugar. The main carbohydrates consumed are cultivated in family food gardens using traditional shifting agriculture. They include taro, sweet potato, yams, banana and cassava. Whenever sufficient disposable income is available the villagers buy rice and flour to supplement garden carbohydrates. Sago is an important ceremonial and dry season food item. It is extracted from local sago swamps using traditional methods. Plate 2.0 shows a sago trunk prepared for starch extraction. Rice is becoming the preferred carbohydrate by young children and is a priority shopping item for parents.

The two main causes of the loss of natural forest habitat in Papua New Guinea are from industrial logging and expansion of subsistence agriculture which is driven by an increasing human population especially in rural PNG (Byan and Shearman 2015).

Presence and condition of protected areas in the landscape

There are no formally protected areas in the project area.

Key Biodiversity Areas in the Landscape

There are no key biodiversity areas in the landscape.

3.2.4 Landforms and hydrology

A landform refers to a 'recurring pattern of topography within the landscape' (Bryan and Shearman, 2008), with specific landforms often associated with specific vegetation associations and/or communities. The southern part of New Ireland is characterised by mountain ridges and V-shaped valleys underlain by igneous rocks, while the 36 central and northern parts are dominated by limestone with well-developed karst landforms (Bleeker, 1983). Along the north coast the island is fringed by a narrow strip of raised coral, while the south coast is fringed by a narrower, discontinuous strip of alluvium. The most distinctive landform that occurs across the northern part of New Ireland is limestone karst formations. Indeed, New Ireland contains the third most extensive area of karst landforms across Papua New Guinea (Loffler, 1974, 1977). Karst landforms are unique as rain and ground water percolation is the dominant form of landform development (Bryan and Shearman, 2008).

Hydrologically, New Ireland is depauperate of large rivers as the limestone karst land formations that dominate the landscape are porous and prone to excessive internal drainage, and thus exhibit a poorly developed system of surface drainage (Bryan and Shearman, 2008; Dekker, 2011). Small scale topographic variation is important, and the karst landscapes of NIP are characterised by numerous, small ephemeral drainage systems, that are not readily detectable form the datasets currently available, and Hollow-wood found that the current hydrological datasets available for NIP were highly erroneous. This being the case, Hollow-wood attempted to derive drainage structures from the 12.5m ALOS PALSAR elevation dataset (using ArcGIS 'spatial analyst'), which improved the quality of drainage line mapping (overall), but is still of insufficient resolution to identify drainage

structures at a local, operational scale. The result of this analysis can be seen on the landform maps provided below.

Figure 1: Topography and hydrology for the Tivingau ILG area

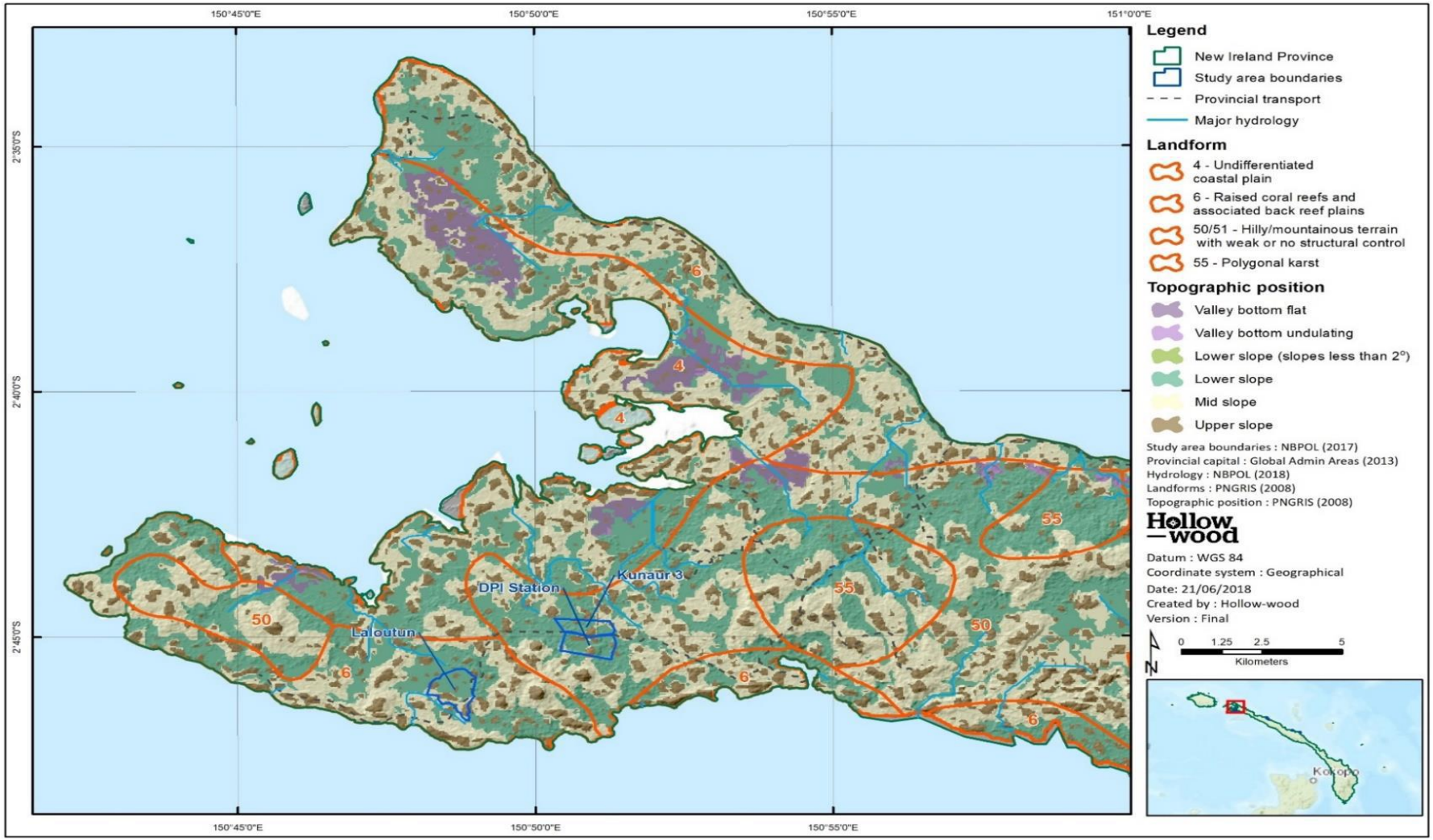


Figure 2; Landforms of Tivingau ILG landscape.

Table 17: Vegetation Classification

Site name	Land tenure	Vegetation	Area (ha)
Lalautun	Tivingau ILG	Mainly grasslands / *Pandanus tectorius* woodlands	164.36
Kunaur 3		Mixture of advanced secondary forest, disturbed vegetation and old garden areas	87.3
DPI		Disturbed vegetation and old garden areas	121.85
		Total area	**373.51**

HCV Outcomes and Justification

Table 18: HCV 1: Concentrations of biodiversity

Key Question	Finding
Does the assessment area or surrounding landscape contain either of the following categories of Protected Areas (PA)? • Legal Protected Areas, • Global conservation priority sites	Not Present

Justification

The HCV PNG National Interpretation guide is the authority on PAs in PNG however does not contain spatial data to enable accurate location of PAs. As such, within the current assessment, three major sources were interrogated and cross-referenced against the PNG National Interpretation to determine the location of PAs adjacent to study areas and across NIP as a whole:

1. The HCVF National Interpretation Toolkit for PNG (PNG FSC, 2005)
2. The 'Protected Planet' database (https://www.protectedplanet.net)
3. Any areas that are considered to be 'intact forest landscapes' (IFL) (Brown *et al.*, 2013)

There is a Locally Managed Marine Area 10 km off the central east coast and a classified "intact forest landscape" (Hans-Meyer Range) of 194,302 ha in the far south-east of New Ireland, but otherwise no formal PAs in the direct vicinity of the study areas (Map 12).

Key concept	Finding
Concentrations of biological diversity including: endemic species and rare, threatened or endangered species that are significant at global, regional or national levels.	PRESENT

Justification: HCV 1- grassland interpretation

As seen from above Table, grasslands account for 118.97 ha (31.8%) of the total study areas, with the vast majority being at Lalautun. The PNG NI provides no guidance regarding grassland HCV's, so in this case, the HCV CG will be used as the key guiding resource (CG, Annex 2, pp 58). No grassland HCV's were found during this assessment.

Table 19: Key concepts for identification of HCV 1 in grasslands

Key Terms - Interpretation for Grasslands	Indicator	Comment
RTE species	• Presence of RTE species (several RTE species, a substantial population of one RTE species, refugia). • Presence of recognised protected areas • Unprotected grasslands identified as IPAs or KBAs	-Grasslands across the study areas are classed as anthropogenic, and dominated by invasive species such as Mission grass (*Pennisetum purpureum*) and common and widespread native species such as Blady grass or 'Kunai' (*Imperata cylindrica*) and Kangaroo grass (*Themeda australis*) -As stated above, there are no protected areas near the study areas, nor are there any unprotected grasslands identified as KBA's.
Endemic species	• Presence of endemic (Eco region or country level) or highly range-limited species • Presence of recognised protected areas •Unprotected grasslands identified as IPAs or KBAs	There are a number of endemic birds present, although these are forest birds.
Concentrations - Critical temporal use (e.g. for migration)	• Mammal migration routes or flyways for birds & insects •Presence of recognised protected areas •Unprotected grasslands identified as IPAs or KBAs	• There are really no significant mammals in the area. • The World Database on Protected Areas does not include any areas nearby the assessment area.

RTE plant species

Examination of the data collected during HCSA plot work and observations made between plots indicates that three tree species listed under IUCN and one listed in the PNG HCV national interpretation were found to be present within forested areas across the AOI (Table 20). No species of flora listed under the CITES convention were found to be present across the study areas.

The presence of *Terminalia archipelagi* within 6 HCSA plots, totalling 25 individuals, indicates it is highly likely that many more individuals would be found in the area with increased survey effort. This being the case, under the precautionary principle, all forested areas within the DPI Station and Kunaur 3 study areas are considered to be HCV 1 (Map 1). No individual *T. archipelagi* were found at Lalautun.

The faunal taxa survey found that no species considered rare, threatened or endangered under IUCN, CITES or PNG national legislation were found across the study areas.

Figure 3: Mature Terminalia archipelagi found on road between Lalautun and DPI Station study areas (Photo M. Hansby).

Table 20: Rare, threatened or endangered plant species found during this assessment.

Species	Study area	HCSA plot numbers	IUCN Listing status
Terminalia archipelagi	DPI Station Kunaur 3	8, 10, 16 and, 19	Endangered
Intsia bijuga	Kunaur 3	15	Vulnerable

RTE faunal species

The faunal survey that was conducted during the full assessment generally found an impoverished fauna present across the study areas, with the detailed findings supplied in the faunal survey report

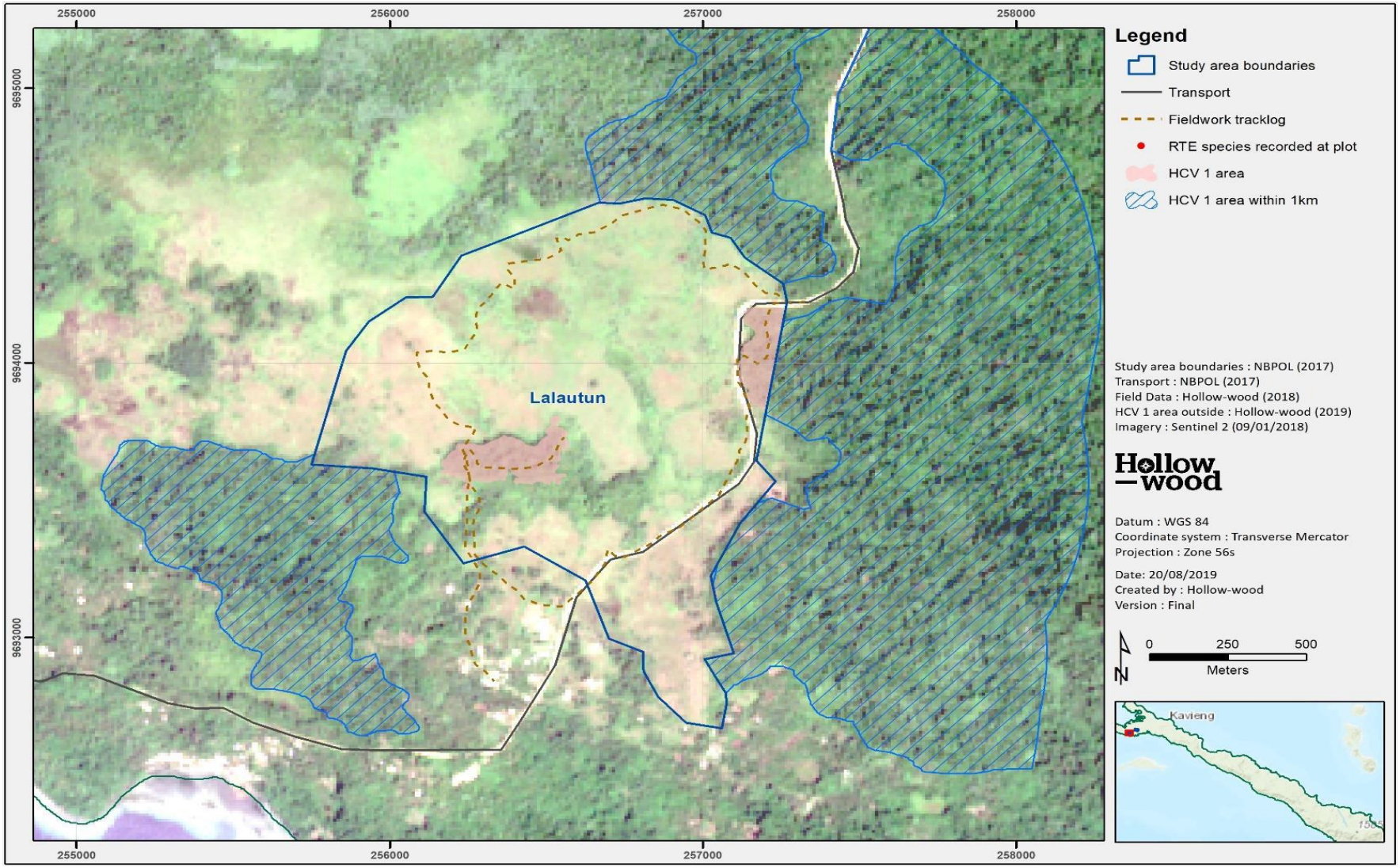
Table 21: Summary of faunal assessment findings

Taxa	Result
Birds	• 18 endemic species identified out of a total 36 species observed • Two species protected by the Government of Papua New Guinea • Four species classified under Appendix II of the CITES • One species classified under Appendix I of CITES • Kunaur 3 may be considered an HCV site
Mammals	• Three species of mammals were observed first hand while there was conclusive evidence of the existence of a forth terrestrial mammal species. • None of the mammals observed are listed as protected species in PNG. • None of the mammals thought to be found in the areas of interest is listed as protected by the Government of Papua New Guinea • Three endemic species were sighted
Reptiles and amphibians	• Seven species of frogs were sighted • None of the species of amphibians and reptiles are listed as protected fauna for PNG • The two species of snakes sighted are classified under Appendix II of CITES

The most outstanding species found during the assessment was the Nicobar Pigeon (*Caleonas nicobarica*), which while not protected by PNG legislation or listed as vulnerable or above under IUCN, is listed in Appendix I under the CITES convention. This species was sighted at the Lalautun study areas.

A single juvenile Nicobar Pigeon was observed at Lalautun feeding on seeds and flowers in the trees beside the road. This individual may not be a resident species within the boundaries of the Lalautun site itself. It would most likely be a resident of the adjacent secondary forest towards the south and south-east of Lalautun. No other Nicobar Pigeons were sighted at Lalautun during the survey period. Though, during early morning surveys at Lalautun, a single Nicobar Pigeon was heard calling within the secondary forest beyond the south-eastern borders of Lalautun. Considering these observations, Nicobar Pigeons may not be resident or roosting within the boundaries of Lalautun but may be only foraging on flowering trees on edges of the site. They may also be using Lalautun as a corridor to traverse between the secondary forest and the coast. It may be assumed that flocks of Nicobar Pigeons may also be venturing to nearby islands within the Tigak Island group during the day to feed and returning via the Lalautun site and further into secondary forested areas.

Map 4: HCV 1 area determined for the DPI Station and Kunaur 3 study areas...



Map 5: **HCV 1 area determined for Lalautun. No *T. archipelagi* was found within the Lalautun study area, but higher quality advanced secondary forest (mapped) adjacent to Lalautun is likely to possess individual *T. archipelagi*.**

*H*CV 2: Large landscapes

HCV 2	Findings
Large landscape-level ecosystems, ecosystem mosaics and Intact Forest Landscapes that are significant at global, regional or national levels.	PRESENT

A range of sources were interrogated in order to determine the presence or absence of this HCV, namely the HCVRN Common Guidance (CG) (HCVRN, 2014), the Papua New Guinea National Interpretation (PNG FSC, 2005), PNG national protected area (PA) dataset and the intact forest landscapes (IFL) dataset.

PNG FSC (2005) provides guidance for the identification of areas considered to be HCV 2, namely on pp 16 where the following is stated:

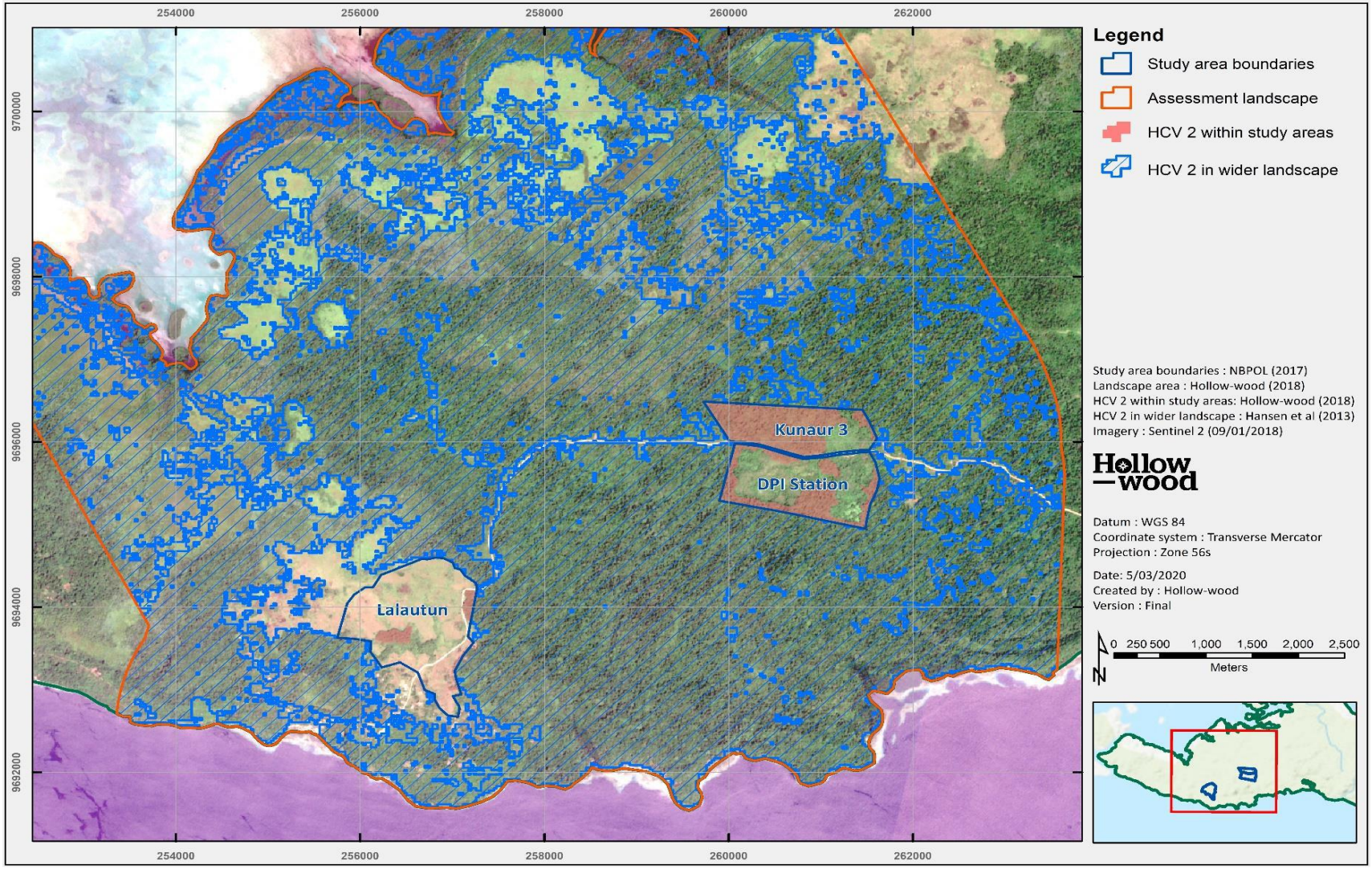
1. Determine the presence and size of forested areas surrounding protected areas (PA's)
2. Identify large continuous blocks of forest extending >500,000 ha on the mainland and >20% of total forest cover on satellite islands.
3. Identify small blocks of forest that may be important for connectivity between PA's and a large block of forest or between two blocks of forest
4. If possible determine the presence and persistence or abundance of a recognised umbrella species.

While no PA's exist adjacent to the study areas, New Ireland is largely forested, aside from arable land along the coastal fringe and the Lelet Plateau, therefore Point 2 is relevant to this assessment. An approximate total forest area value for New Ireland was calculated using the freely available, global dataset published by Hansen *et al.*, (2013), using the following method.

The Hansen *et al.*, (2013) dataset is made up of a range of components, such as forest cover (2000), cover loss (annual), cover loss (total) and cover gain (total). To calculate an approximate forest cover for New Ireland, the 'forest cover_2000' (i.e. forest cover in the year 2000) was clipped to the New Ireland boundary and 'cover loss' and Poliamba Plantation areas were clipped out from the dataset to approximate the current forest area of New Ireland.

The 'forest cover_2000' dataset is classed into a range from 0 – 100, representing canopy cover of the Landsat 7 pixel (Hansen *et al.*, 2013). Canopy cover, or '*the percentage of the sample site within the vertical projection of the periphery of the crowns with the crowns considered to be opaque*' (NCST, 2009), is a useful classification when used in conjunction with height of the dominant strata. This is a measure of vegetation structure, i.e. the height and canopy cover of the tallest strata. Forest stands with a mature canopy height > 30m and a canopy cover >80% are considered tall, 'closed forests' or 'rainforests' (Specht, 1970; AUSLIG, 1990; NCST, 2009). Based on this, the 'forest cover_2000' dataset was reclassified to show pixels with values >80% to represent forest areas.

This analysis shows that the area of continuous forest across New Ireland is 631,255.1 ha, accounting for 89.5% of the island area. This shows that the interior of New Ireland is almost continuously forested, indicating the presence of HCV 2. Map 3 shows the extent of forested area in relation to the study area boundaries, with Table 8 reporting the presence of HCV 2 by study area.



Map 6: HCV 2 areas identified in the Lalautun, DPI Station and Kunaur 3 study areas.

Table 22: HCV 2 by study area.

Study area	HCV 2 presence?	Area (ha)
DPI Station	YES	46.63
Kunaur 3	YES	69.00
Lalautun	YES	9.4
Total		**125.03**

HCV 3: Rare ecosystems

HCV 3	Findings
Rare, threatened, or endangered ecosystems, habitats or refugia.	**Present**

The HCV CG states that rare ecosystems, habitats or refugia are those that are either naturally restricted in geographic distribution or those that have undergone a >50% reduction in original distribution. In the context of New Guinea, PNG FSC (2005) prescribes that three main forms of land cover that should be considered HCV 3 areas, these are:

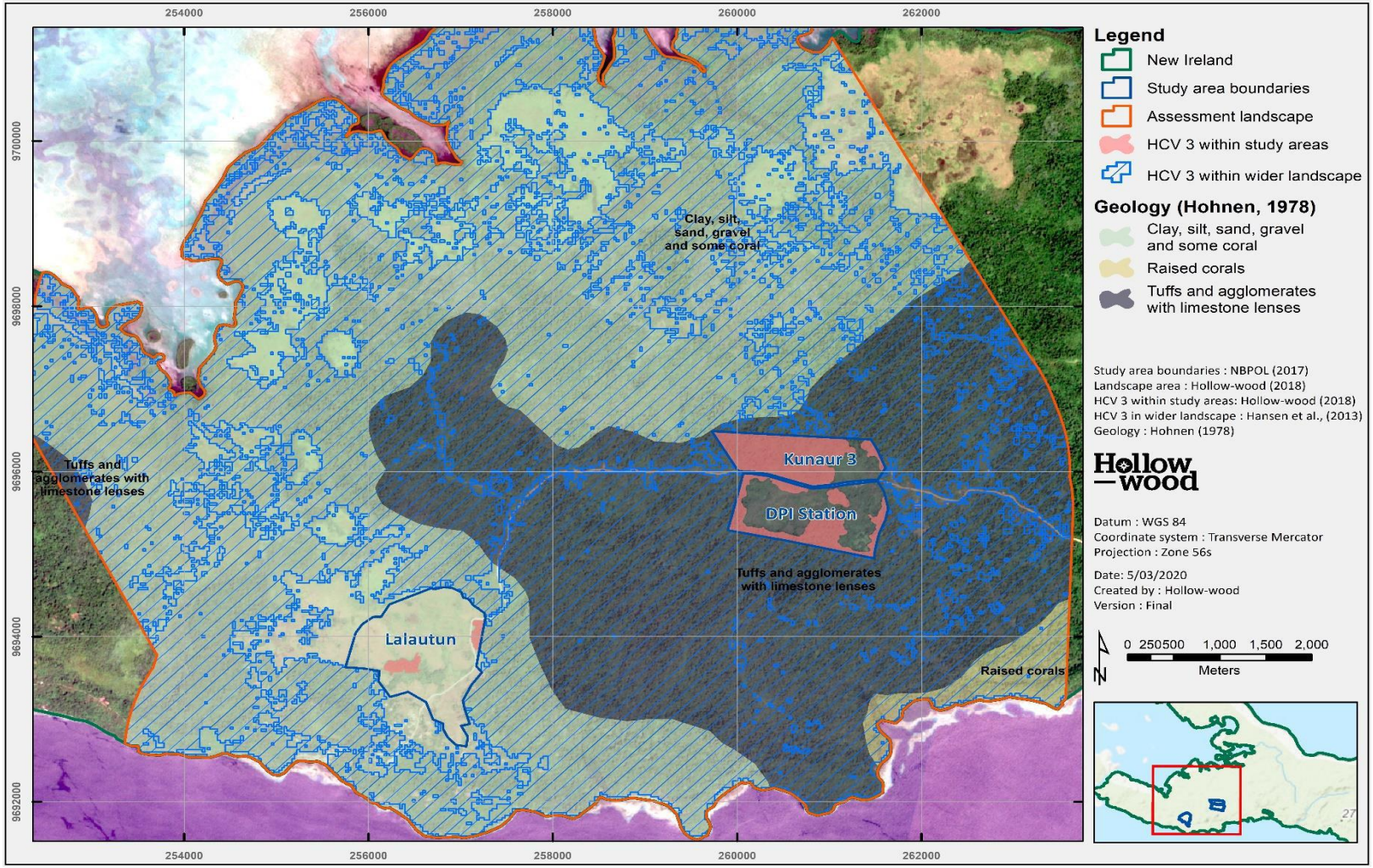
1. Identified threatened or endangered lowland forests on satellite islands, mangroves, swamp forests, *Araucaria* forests, *Eucalyptus deglupta* forests, *Terminalia brassii* forests, *Castanopsis* forests, *Nothofagus* forests, Savannahs and Monsoon forest;
2. Forests occurring on either limestone karst or ultrabasic soils;
3. Forests that do no regenerate sufficiently after logging events and where regeneration management and/or silvicultural measures cannot be applied;

Two major information sources were interrogated to determine the presence of HCV 3 across the study areas, namely the Papua New Guinea Resource Information System (PNGRIS) and Geology of New Ireland (Hohnen, 1978). PNGRIS was used to understand both parent material (underlaying geology) and landform, while the mapping supplied as an Appendix in Hohnen (1978) was digitised and used for comparative purposes.

These sources indicate that Limestone Karst is a common landform across the study areas, and thus the remnant, native lowland rainforest that occurs on karst landforms are to be considered HCV 3. This is consistent with Point 2 in the definition on pp 18 in PNG FSC (2005). Geology and landforms relative to the study areas have been mapped and supplied below in. Table below reports HCV 3 the presence of HCV 3 by study area and Map 4 shows the location of HCV 3 across study areas.

Table 23: HCV 3 by study area.

Study area	HCV 3 presence?	Area (ha)
DPI Station	YES	46.63
Kunaur 3	YES	69.00
Lalautun	YES	9.4
Total		**125.03**



Map 7. HCV 3 area (forest on Limestone Karst) across the DPI Station, Kunaur 3 and Lalautun study areas.

3.2.5 Peat soils

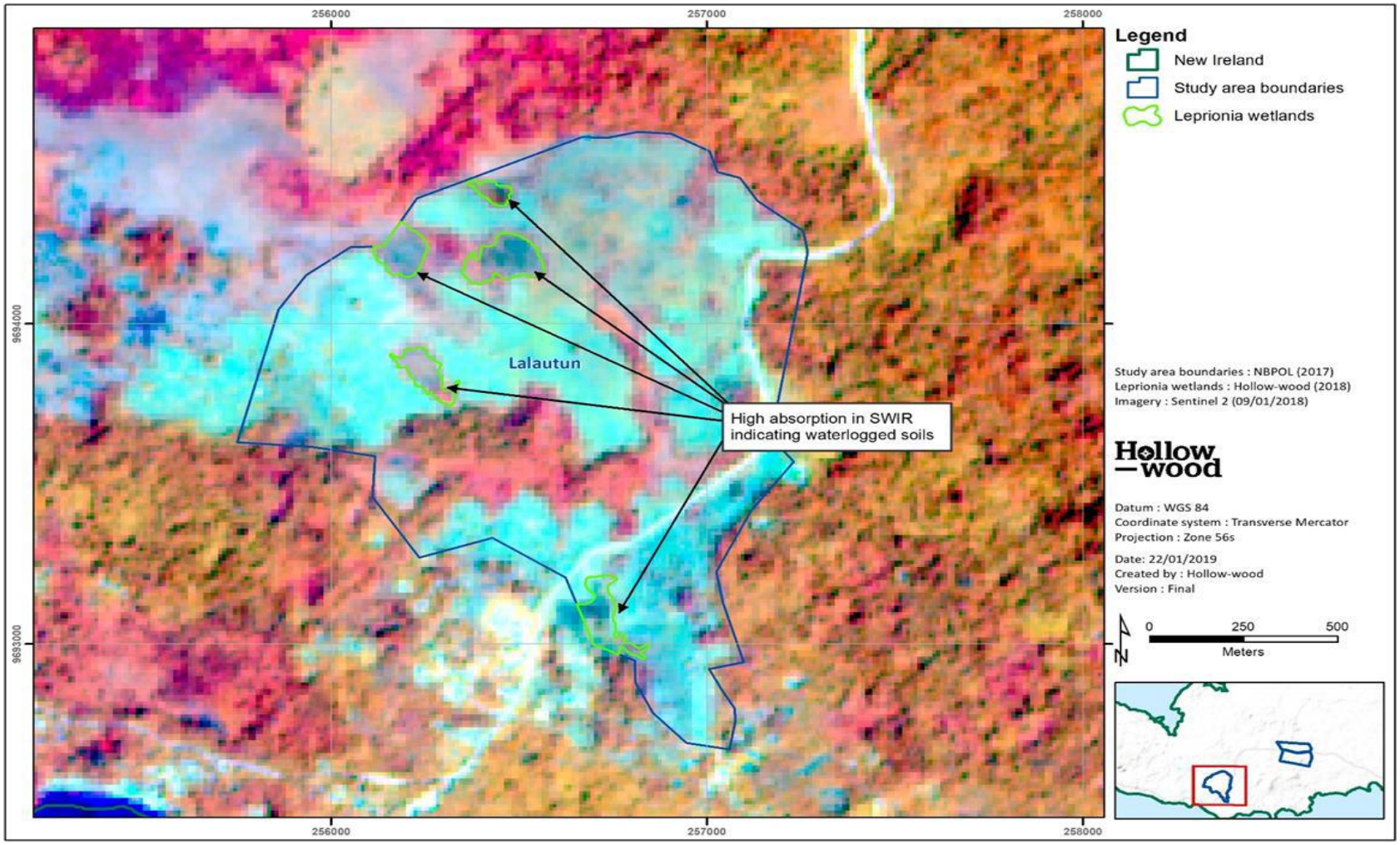
Extensive areas of tropical peat soils are not a common occurrence across Papua New Guinea, but they are known to occur in small areas, particularly in areas where anaerobic conditions are created by poor drainage in areas subject to near permanent water-logging.

While no formal peat study was conducted as part of this assessment, the presence of permanent wetlands dominated by Grey Sedge (*Lepironia articulata*) and Marsh Fern (*Thelypteris confluens*) in the north-western section of Lalautun are cause for concern and further investigation. An example can be seen in Figure 8. The combined area is 7.4 ha and studies, such as (Ikusima, 1978); indicate that Grey Sedge is reliable indicator of permanently waterlogged sites, and therefore a helpful aid in identifying areas where the potential for peat soil development exists.

A Sentinel 2 image composite, that included a short-wave infrared (SWIR) band, was also of use in indicating waterlogged areas, and thus areas with peat formation potential. This was accomplished by utilising the fact that the SWIR wavelength is increasingly absorbed by increasingly wet soil. Such wet areas are clearly identifiable in imagery utilising this wavelength. This can be seen in the areas with buffers as prescribed in Section 7.2.4 (HCV 4) can be seen in Map 5.

As a detailed peat study was not undertaken as part of this assessment, Hollow-wood recommends that soil analysis is undertaken in the areas identified on Map 5 to positively understand the Presence or absence of peat soils in the areas identified. Also refer soil suitability report in page 27.

Figure 4: *Leprionia/ Thelypteris* wetland in the north-west of Lalautun.



Map 8: Sentinel 2 image composite with short wave infrared (SWIR) indicating areas of water logging.

HCV 4 – Ecosystem services in critical situations

HCV 4	Findings
Basic ecosystem services in critical situations, including protection of water catchments and control of erosion of vulnerable soils and slopes.	Present

The presence of HCV 4 was determined by four main methods, 1) consultation with affected communities, 2) field observations during both the scoping study and full assessment, 3) analysis of relevant spatial data and 4) adherence to the HCVRN CG (HCVRN, 2014) and the PNG HCV National Interpretation (PNG NI) (PNG FSC, 2005).

The PNG NI identifies three separate categories of HCV 4, namely:
1. Forests critical to water catchments
2. Forests critical to erosion control
3. Forests providing barriers to destructive fire.

The HCVRN CG identifies a range of supporting and regulating ecosystem services that, if identified as critical, should be classed as HCV 4 and warrant protection. While the PNG NI is dated and primarily developed in the context of native forest harvesting, it is still in effect and is mostly consistent with the requirements of HCVRN CG, and therefore this section will address the requirements of the PNG NI.

3.2.6 Forests critical to water catchments

The PNG NI identifies 4 mains tasks to determine the presence of 'forests critical to water catchments', which are provided below in Table 24

.

Table 24: Key tasks from the PNG NI to determine the presence of areas critical for the protection of water catchments.

Key task	Comment	Present within or adjacent to study areas?
Determine the presence of significant wetlands such as those listed under the Ramsar Convention or those listed in the Directory of Asian Wetlands	Both databases were searched and it was found that no study areas were within or adjacent to any significant wetlands	Not Present
determine if the catchment provides critical water supply to urban areas	Guidance in the PNG NI states that (forests) 'that provide rural communities with a Class 2 stream according to the PNG Logging Code of Practice (PNGFA & DEC, 1996), including all water bodies and water courses', are designated as HCV 4. This being the case, forest areas and water courses that form the upper catchment of the Liangtalaulau Creek in the Lalautun study area are considered to be HCV 4	Not Present
Determine if the water supply provides critical water supply to rural communities	Guidance in the PNG NI states that (forests) 'that provide rural communities with a Class 2 stream according to the PNG Logging Code of Practice (PNGFA & DEC, 1996), including all water bodies and water courses', are designated as HCV 4. This being the case, forest areas and water courses that form the upper catchment of the Liangtalaulau Creek in the Lalautun study area are considered to be HCV 4	Present

Determine if the catchment lies within a gazetted water control district	Guidance is provided in Appendix 5 of the PNG NI to determine if the area lies within a gazetted 'Water Control District'. The closest gazetted Water Control District to the study areas is that declared for Kavieng Town, 19 km north of the closest study areas; those within the Tivingau ILG area, Lalautun, DPI Station and Kunaur 3. This assessment finds that no study areas are within gazetted Water Control Districts.	Not present

Section 4.4.2 of the RSPO Principles and Criteria National Interpretation for Papua New Guinea (RSPO, 2017), states: *'Protection of water courses and wetlands, including maintaining and restoring appropriate riparian and other buffer zones (refer to PNG Conservation and Environment Protection Authority (CEPA) requirements and other applicable guidelines) shall be demonstrated. For Smallholders, the status quo shall be maintained where it can be demonstrated that environmental damage is not being caused'.*

The requirements from CEPA (part of NBPOL's Agricultural Permit) utilise watercourse definitions from the PNG Logging Code of Practice (PNGFA & DEC, 1996) (Key Standards 1 and 2) and are provided in Appendix 5. The features listed in this table should be viewed only as draft as it does not incorporate unmapped streams that may require protection due to:

a) The low resolution of topographic data available to Hollow-wood for this assessment

b) The complex topography found at sites such as DPI Station and Kunaur 3.

Other riparian protection requirements

In the Lalautun study area, three permanent wetlands were identified in the north-west of the site, with the species composition providing an indicator of permanent waterlogging. Field survey found that these areas were dominated by Grey Sedge (*Lepironia articulata)* and Marsh Fern (*Thelypteris confluens*) (Figure 9). Published literature, such as Ikusima (1978), indicates that such communities are positive indicators of permanent water logging as they require free water for seeding establishment, and also indicate the high likelihood of peat soil formation beneath such wetland communities. Areas in question are mapped and provided below.

Table 25: Draft riparian protection requirements as per CEPA

Study area	Feature class (see Appendix 5)	Protection zone (m)	Comment
Lalautun	Liangtalaulau Creek – Class 2f	50m	Identified through community land use planning as critical water source for community use.
Lalautun	*Leprionia / Thelypteris* wetlands	50m	Field observation identified species composition and analysis of imagery utilising short-wave infrared (SWIR) bands confirmed water logging.
Lalautun	Sago swamp woodlands	20m	No specific guidance for this vegetation type, but discussion with NBPOL and the Tivingau community resulted in an agreement of 20m buffer being applied to these communities.
Lalautun	Ephemeral drainage line in the center, east of the site	10m	Ephemeral drainage line that does not technically require protection, but precautionary principle dictates that this drainage line may be contributing to dry season water persistence at Balpua water hole (see HCV 5). Protection to start 10m rom the edge of Pandanus community.
DPI Station	Kunaur Creek – Class 1d	10m	Multiple traverses across creek during field work reveals stream width to be approximately 2.5m

Figure 5: *Lepironia articulata* dominated wetlands in the north-west of Lalautun study area.

3.2.7 Forests providing critical barriers to destructive fire were identified according to the PNG HCV NI and utilising Modis Hotspot data.

The PNG HCV NI states that there are some forest communities that provide a natural barrier to the uncontrolled spread of fire, with these forests being important to mitigate potential loss of life or destruction of property.

The PNG HCV NI defines these forest types as:

1. Forests that are declared protected under the Forestry Act (1991)
2. Forests those are susceptible to fire, such as Savannahs or Monsoon forests
3. Forests that may provide a barrier to fire spread into plantation areas

The PNG HCV NI identifies that such forest types will mainly be found in the drier climates on the southern side of the mainland, where the pronounced dry season favours fire prone, tropical Savannah type vegetation. This vegetation type is absent from New Ireland.

Analysis to ensure that the threat of unmanaged fire is minimal within this landscape was performed using the complete MODIS hotspot (thermal anomalies) archive present for Papua New Guinea. This dataset dates back to November 2000 and contains some 36000 entries. For the entire period, 206 thermal anomalies were recorded across New Ireland, with some 30 being present within the area indicated on Map 9.

This analysis shows a very low frequency of fire events recorded by the MODIS sensor in relation to the study areas, with only 4 recorded at Lalautun, and no records present at either Kunaur 3 or DPI Station In the wider landscape (Map 9) it is apparent that most observations from the sensor occur within or close to grassland environments, and therefore are most likely of anthropogenic origin (i.e. hunting fires). Based on an understanding of the study areas and surrounding landscape, this assessment finds that fire is not a significant threat within the study areas or the surrounding landscape

Box 1: Fire

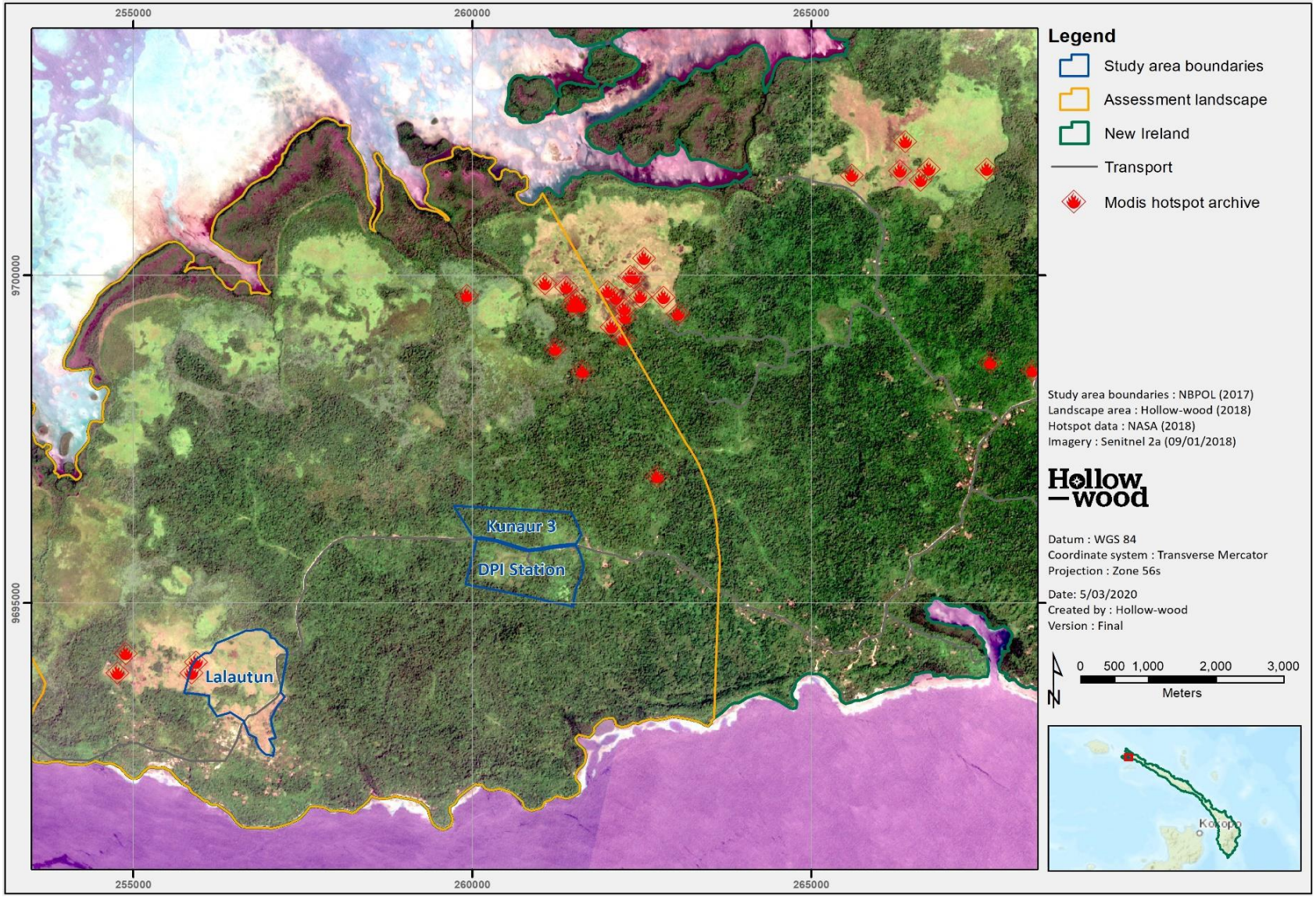
Hollow-wood's previous observation in tropical landscapes (such as mainland Papua New Guinea and the Solomon Islands) indicates that, outside of domestic usage (i.e. cooking), fire is generally utilised by communities in one of two ways;

1) As an aid in land clearing or
2) As a tool associated with hunting.

In these situations, fire is utilised quite differently, and thus the threat from each usage is different also.

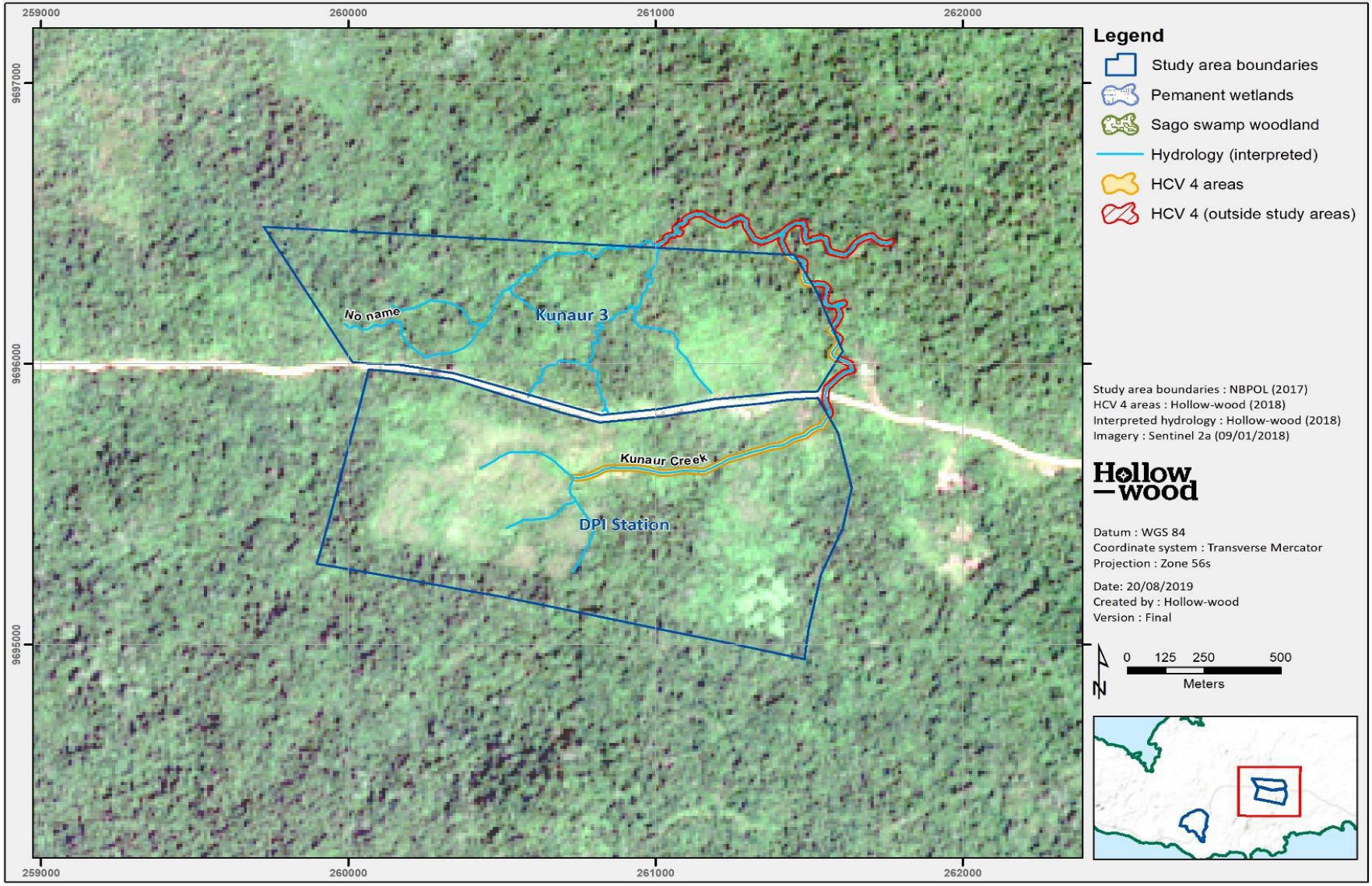
For example, when fire is used as a hunting tool it's usually characterised as a low intensity, wind-driven grassfire, where a running head fire is driven downwind into an area likely to hold game species (such as pigs, bandicoots or wallabies). The aim is to flush out game into the easy reach of waiting community members. The running edge of such fires can only be maintained while conditions are favourable (i.e. when relative humidity is at its lowest and the wind is constant) and usually self extinguish as they run into low fuel areas (e.g. previous fire scars) or the surface fuel moisture differential that is present under a rainforest canopy. Drought events, such as El Nino, may see such fires burn longer and with higher intensities due to lower relative humidity and fuel moisture. Under these conditions, running grassfires may penetrate further into rainforest stands, over time pushing back the rainforest and replacing it with fast growing pioneer species and eventually, grassland. Thus this fire regime may in fact be an agent of gradual deforestation.

The threat posed from the use of fire for subsistence gardening is slightly different due to how fire is used. During garden preparation, secondary forest canopy species are felled and the foliage is allowed to dry or 'cure'. Such areas are small, generally below one hectare. Once the vegetation is dry enough, the area is burnt using broadcast fire, resulting in a localised, but high intensity fire. The area is then planted out with desirable food crops, with the ashes providing in situ fertilisation. While many rainforest plant species are not adapted to fire, traditional fallow periods for shifting agriculture were often 20-30 years, long enough for the forest community to re-establish. Increasing populations are leading to decreased fallow periods, anecdotally as low as 5 – 7 years. The increase in frequency of high intensity fire associated with shifting cultivation may have a prounced affect on rainforest vegetation communities, a problem that may be exacerbated during El Nino events.



Map 9: MODIS hotspot thermal anomalies, derived from the complete Hotspot archive for the area.

Map 10: HCV 4 areas related to riparian protection identified for the Lalautun study area.



Map 11: HCV 4 areas related to riparian protection identified for the DPI Station and Kunaur 3 study areas.

HCV 5: – *Local people's basic needs*

Key question - HCV 5	Outcome
Does the assessment area or surrounding landscape contain sites and resources fundamental to the basic needs of local communities or indigenous peoples?	PRESENT

The Common Guidance (CG) describes several features within a community as indicators of its dependence on natural resources to satisfy basic needs. These features are discussed below. A wild food resource constitutes a significant part of the diet, either throughout the year or only during critical seasons.

- Hunting *and*/or fishing *are*/is an important source(*s*) of protein and income.
- There is little or no water and electricity infrastructure.
- There is presence of permanent or nomadic pastoralists.
- Farming of crops and livestock is done on a small or subsistence scale.
- Indigenous hunter-gatherers are present.
- Most houses are built from, and household tools made from, locally available traditional/natural materials.
- Access to health centres or hospitals is difficult.
- People have a low capacity to accumulate wealth (and so live "day to day").

The HCV 5 definition in the PNG HCV Toolkit is: "*If a community derives more than 50% of its needs for water, building materials, food, medicine, firewood, craft materials, cash NTFP's, and cultural materials from the forest, this (part of the) forest shall be HCV for this particular need".*

Table 13 provides a qualitative assessment of the relative importance of the each of the HCV 5 indicators to members of the Tivingau ILG and their fellow Lokono villagers.

Table 26: Indicators of the presence of HCV 5.

Indicator	Comment
Access to health centres and hospitals is difficult.	The availability of medicine and other treatment related material at Lokono Aid Post is unreliable due to inconsistent delivery of supplies from Kavieng. Poor road access and expensive sea transportation are contributing to this situation. In most cases of medical illness, the villagers will use traditional medicine. In serious cases, transportation in a banana boat to Kavieng for treatment at the Kavieng Provincial Hospital would need to be arranged.
Most houses and traditional tools are made from locally available / natural materials.	46% of the houses are made entirely out of bush material, 24% consist of some amount of bush material and 30% are made of modern material. One of the main components of the Lokono Ward Members Household Assistance Program is the provision of a set of 12 three metre corrugated roofing sheets for family houses which can capture water for storage in a 1,000 litres tank. The complete transition from full traditional material housing to modern material housing is unlikely to occur in the next 20 years.
There is little or no water and electricity infrastructure.	The villagers use rainwater tanks and limestone water holes as water sources for drinking, cooking and washing utensils. Each house was also allocated a solar power kit as a source of electricity under the Lokono Ward Members Household Assistance Program. The solar power kit contains a solar panel, one light bulb, a 6 volt battery with charger and power socket.
People have a low capacity to accumulate wealth.	The high cost and difficulty in transporting produce to markets appears to be the main hindrance to saving of money and improvement to living conditions.
Crop and livestock farming is done on a small or subsistence scale.	Subsistence farming is a major activity in the village and provides the bulk of the food needed by the people. The main cash crops are cocoa and copra. Some families raise pigs and chicken for household consumption or traditional ceremonial feasts.
Hunting and/or fishing are/is an important source(s) of protein and income.	Fishing and foraging for mud crabs are important income generating activities and sources of protein. Hunting is a source of protein as well but is not undertaken as frequently as fishing and foraging for mud crabs.
A wild food resource constitutes a significant part of the diet, either throughout the year or only during critical seasons.	Sago grows wild in swamps in the area and is processed into sago flour. Since sago flour can be extracted anytime and it outlasts the main root food crops, it is available all year round including severe dry seasons. Sago is also a compulsory food item for ceremonial feasts.

Food

The variety of food consumed by the villages is mainly dependent on the level of income generated and the capacity to tend subsistence gardens as well as fish and hunt. The amount of revenue earned is determined by the quantity of saleable items produced and the ability to deliver them to nearby markets especially in Kavieng. The nutritional and health status of the people reflect the type of food consumed. In many parts of New Ireland as well as the rest of PNG, the increased consumption of processed food is causing a rising incidence in lifestyle diseases such as diabetes and hypertension (WHO, 2011). Figure 10 shows samples of subsistence gardens in Lokono Village.

Figure 6: Typical subsistence food gardens in Lokono Village.

Carbohydrates

The main carbohydrates consumed are cultivated in family food gardens using traditional shifting agriculture. They include taro (*Colocasia esculanta* and *Arum chinense*), sweet potato (*Ipomoea batatas*), yams (*Dioscorea spp*), banana (*Musa spp*) and cassava (*Manihot esculenta*). Whenever sufficient disposable income is available the villagers buy rice and wheat flour to supplement garden carbohydrates. Sago is an important staple food in normal times and disaster situations as well as an essential ceremonial food item (see box 1). Rice is becoming the preferred carbohydrate by young children and therefore a priority shopping item for parents.

BOX 1 - SAGO

Sago palm (*Metroxylon sagu*) grows up to 10 to 25m and nearly a metre across the trunk. The trunk is filled with starch, which is harvested (see Figure 11) by shredding the pith into small pieces and washing the starch out (Ehara *et al*., 2018). After production the dried sago cake is stored in woven sago and pandanus leaf baskets in which the sago can last for up to six months.

Given its relatively low perishability and availability in critical times such as major flooding or dry seasons, sago has assumed a special cultural status as a compulsory food item in ceremonial feasts marking milestone events such as transition into adulthood, marriage, death and renewal of tribal ties

Figure 7: Sago trunk prepared for starch extraction

Fruit and vegetables

The most commonly consumed vegetables are cultivated in family subsistence food gardens. They include aibika (*Abelmoschus manihot*), aupa (*Amaranthus tricolor*), pumpkin (*Cucurbita maxima*), Chinese cabbage (*Brassia rapa chinensis*), snake beans (*Vigna unguiculata ssp. sesquipedalis*), tomato (*Solanum lycopersicum*), capsicum (*Capsicum annuum*) and ginger (*Zingiber officinale*). Edible ferns (*Diplazium esculentum*) sourced from the forest are widespread in the area.

Fruits make up a small proportion of the villagers' daily diet. The commonly consumed fruits including pawpaw (*Carica papaya*), pineapple (*Ananas comosus*), sweet banana (*Musa spp*), guava (*Psidium guajava*), mandarin (*Citrus reticulata*), mango (*Mangifera spp*), avocado (*Persea americana*), soursop (*Annona muricata*), rambutan (*Nephelium lappaceum*), okari (*Terminalia*

kaernbachii), taun *(Pometia pinnata)* and laulau (*Syzygium aqueum*) are cultivated. Laulau is also available in the forest together with taun, galip (*Canarium indicum*), breadfruit (*Artocarpus altilis*) and wild mango. Most abandoned garden sites still have fruit trees growing on them and many families cultivate these fruit plants within their residential areas.

Fish and seafood

Fishing and foraging for mud crabs (*Scylla serrata*) as well as an assortment of shells are common daily activities in the village. Most families consume fish, mud crabs or shells at least twice a week. A large proportion of the surplus catch or harvest is taken to markets in Kavieng. The main fish favoured by customers include snapper (*Lutjanus spp*), trevally (*Caranx spp*), coral trout (*Plectropomus spp*) as well as tuna (*Thunnus* spp and *Katsuwonus spp*).

Mud crabs too are always in high demand. Whenever there is sufficient cash in hand and no other protein is available, tinned fish can be bought from the small village trade stores. Figure 8 shows the main forms of transport used for fishing.

Figure 8: Common vessels used for fishing. Left image and powered, fiberglass 'banana boat', and right image a traditional, outrigger canoe made from Erima (*Octomeles sumatrama*).

Meat

In addition to fish, other types of animal protein consumed by the villagers include domesticated chicken and pigs as well as hunted wild pigs which are widespread in the nearby bushes and forests. Grey wallabies (*Dorcopsulus macleayi*) once common in the nearby grasslands and regularly hunted for their meat have moved to the north. Wild pigs are usually captured using traps, hunting dogs and spears.

Depending on cash availability families may be able to buy canned meat. In one week, families with disposable income are more likely to eat canned meat as well as meat from domesticated livestock in comparison to wild game meat. The setting up of a wild pig trap is portrayed in Figure 13.

Figure 9: Installation of a wild pig trap.

Water

Water availability in the area is determined by rainfall and the local geology. The predominantly limestone overlay of the area allows a significant proportion of the rainfall to infiltrate as groundwater and flow through the porous strata and sub-terrain channels. Long-term surface channelized flow is largely non-existent, and the sub-surface flow is indicated by interconnecting limestone water holes.

During the wet season the villagers obtain water for drinking, cooking and washing utensils from rainwater tanks while water for laundry and bathing is obtained from the mouth of Liangtalaulau Creek, which is a permanent water supply. The local topography indicates that a network of sub-surface channels join at various points to form Liangtalaulau Creek which emerges on the eastern Lokono Village beach-front about 100m from the high-water shoreline.

Under the Ward Members Assistance Program each household was supplied 12 x 3 meter corrugated iron sheets and a 1,000 litres polyethylene water tank. There are also two large (10,000 litre) community rainwater tanks in the village. In the peak dry season period when tank water is depleted, the villages fetch water for drinking, cooking and washing utensils from three limestone water holes - Losopot, Balpua and Kulaput. Losopot, Balpua and Kulaput waterholes are indicated on the HCV 5 map (Map 10) and latter two are shown in Figure 10.

Losopot waterhole is the main dry season water source for the community. It is located east of Lokono Village and south-east of Galong Hamlet as well as Lokono Primary School. It is also situated more than 2km from the south-eastern boundary of the proposed Lalautun oil palm planting area. Overflow from Losopot waterhole drains into Losopot Swamp which is one of the main sources of sago for the community.

Balpua waterhole is located north of Lokono Primary school as well as Galong Village and north-east of Lokono Village. It is also positioned about 1.2km from the eastern boundary of Lalautun oil palm planting area. Overflow from Balpua water hole runs through Balpua Swamp which drains into Kularisuk Creek, a tributary of Liangtalaulau Creek.

Kulaput waterhole is located north-east of Lokono Village and about 1km from the eastern boundary of the proposed planting area. This water source is mainly used by the villagers for drinking when they are moving around in the forest area. The villagers also use it as a water source for drinking, cooking and washing utensils during the dry season but not as frequently as Losopot and Balpua.

Losopot waterhole drains into Losopot Swamp which is one of the main sources of sago for the community.

Figure 10: Limestone waterholes that a crucial during the dry season. Left image = 'Kulaput' and the right image ''Losopot'

Housing

Forty-six percent (46%) of the houses are made solely of bush material, 24% consist of varying proportions of bush material and 30% are made of modern material. A sample of these house types is shown in Figure 11. The trees and other items required for the construction of bush material residences are widespread in the area. They include logs and poles for posts, bearers, wall and roof frames as well as bamboo and sago rachis for walls and sago leaves for the roof. The most commonly used tree species for construction of bush material housing are Kwila (*Intsia bijuga*), Taun and Malas (*Homalium foetidum*). Rattan (*Calamus longipinna*) and various bush vines are used as fasteners. Figure 16 shows the production of sago thatching.

Figure 11: Common housing construction materials in Lokono Village. Left image, 'bush' material construction, middle image, mixed 'bush' and 'modern' material construction and right image, 'modern' material construction

Figure 12: Construction of sago thatch roofing panels. Left image, *Pandanus spp* 'batons' being split for thatching supports, and right image, sewing sago thatching

Furniture, utensils and cooking

Most of the basic household furniture is made from local timber species especially Taun and Kwila which are hand-shaped or sawn using chain-saws and hand-saws. Dug-out canoes using Erima (*Octomeles sumatrana*) with Malas outriggers are still being made for fishing within near shore waters. These tree species are common in the local area. All tools are modern apart from bamboo (*Bambuseae spp*) spears, bows and arrows as well as digging sticks for planting taro and yams.

Fuel for cooking

The villagers use wood sourced from the nearby forest and old garden areas for cooking their meals. No other fuel source is available to the villagers. A large variety of trees which are common in the area are used as firewood, including dead fruit trees, Malas and various mangrove species. The wood is collected by adult members of each household. The amount of firewood consumed annually per household is estimated to be 12m3.

Electricity

The village does not have a reticulated electricity supply. Most families use kerosene lamps and solar light kits. The solar light kits, consisting of a solar panel, one light bulb, a 6 volt battery with a charger and a power socket, were supplied to each household under the Ward Members Household Assistance Program6. The villagers can charge mobile phones and listen to transistor radios via the kit's power socket.

Medicine

The villagers use a multitude of traditional medicinal plants for various ailments. These include pawpaw (leaves and seeds), guava leaves, lemon grass (*Cymbopogon citratus*), soursop leaves, periwinkle (*Catharanthus roseus*), lemon (*Citrus Limon*), ginger (*Zingiber officinale*) and crotons (*Codiaeum variegatum*). All these traditional medicinal plants are readily available in the village. Four of these medicinal plants are pictured in Figure 17. With the difficult access to the area, it is not unusual for modern medicines to be depleted at the Aid Post. In such situations, the villagers initially use traditional medicine and then seek treatment in Kavieng if necessary. Most of these medicinal plants are cultivated within family residential premises.

Fodder

Surplus garden foods, both raw and cooked, as well as left-overs from household meals are used to feed domestic livestock which are mainly pigs and chicken. No particular food item is taken from the proposed new planting areas to feed these livestock.

Income

The main sources of income for the villagers are from cash crops (copra and cocoa), fish and mud crabs. The major obstacle for the villagers is the difficult and expensive access to markets in Kavieng. The problem with access could also be hindering the ability for people to save money and improving living conditions, including housing, water supply and sanitation.

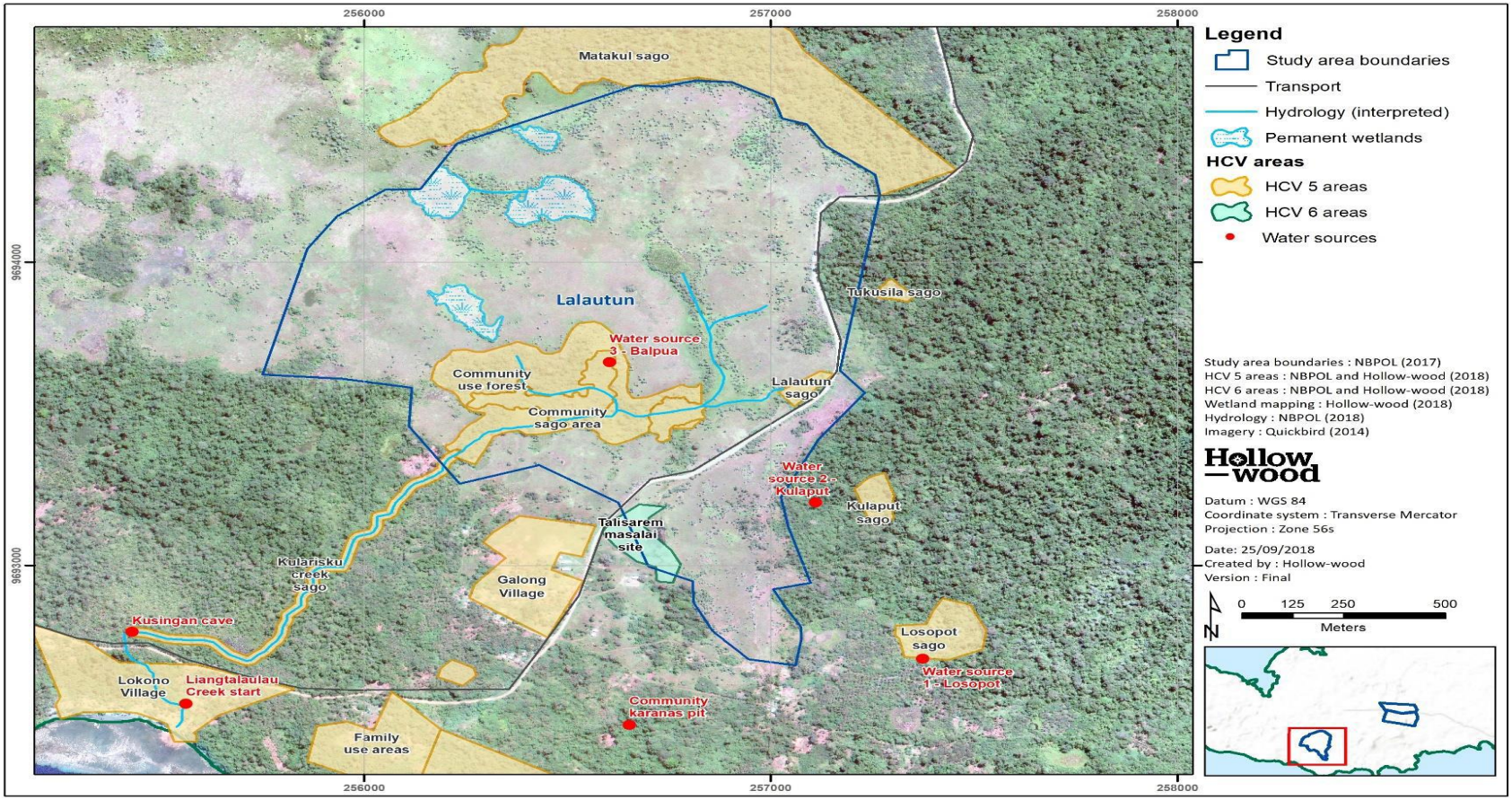
"Mandawas" for Diarrhoea

"Nanga" for Anaemia

"Pulgolgolo" for Asthma

Soursop for Diabetes

Figure 12: All these plants are readily available



Map 12: Areas considered to be HCV 5 and HCV 6 for the Lalautun study area

Household	Aisoli Junior	Ezekiel Menga	Daniel Sohut	Jackson Nagai	Steven Raves	Korah Watori	Sam Joshua	Tovaira Toniva	Philip Millam	James Nagai
Carbohydrates	95% grown and 5% bought (including rice and flour) 0]	90% grown and 10% bought (including rice and flour) [0]	90% grown and 10% bought (including rice and flour) 0]	80% grown and 20% bought (including rice and flour)[0]	90% grown and 10% bought (including rice and flour) 0]	90% grown and 10% bought (including rice and flour) 0]	90% grown and 10% bought (including rice and flour) 0]	95% grown and 5% bought (including rice and flour) [0]	95% grown and 5% bought (including rice and flour) 0]	90% grown and 10% bought (including rice and flour) 0]
Vegetables	95% grown and 5% gathered [0]	90% grown and 10% gathered [1]	90% grown and 10% gathered [1]	95% grown and 5% gathered [1]	95% grown and 5% gathered [0]	95% grown and 5% gathered [0]	90% grown and 10% gathered [1]	90% grown and 10% gathered [1]	90% grown and 10% gathered [1]	90% grown and 10% gathered [1]
Fruits	90% cultivated and 10% collected from the forest1]	90% cultivated and 10% collected from the forest [1]	85% cultivated and 15% collected from the forest 1]	80% and 20% collected from the forest [1]	85% cultivated and 15% collected from the forest 1]	85% cultivated and 15% collected from the forest 1]	85% cultivated and 15% collected from the forest 1]	90% cultivated and 10% collected from the forest [1]	90% cultivated and 10% collected from the forest 1]	90% cultivated and 10% collected from the forest 1]
Fish	90% extracted and 10% purchased [3]	90% extracted and 10% purchased [3]	90% extracted and 10% purchased [3]	90% extracted and 10% purchased [3]	90% extracted and 10% purchased [3]	90% extracted and 10% purchased [3]	90% extracted and 10% purchased [3]	90% extracted and 10% purchased [3]	90% extracted and 10% purchased [3]	90% extracted and 10% purchased [3]
Meat	20% hunted and 80% domestic plus purchased [1]	20% hunted and 80% domestic plus purchased [1]	20% hunted and 80% domestic plus purchased [1]	10% hunted and 90% domestic plus purchased [1]	20% hunted and 80% domestic plus purchased [1]	10% hunted and 90% domestic plus purchased [1]	20% hunted and 80% domestic plus purchased [1]	5% hunted and 95% domestic plus purchased [1]	20% hunted and 80% domestic plus purchased [1]	20% hunted and 80% domestic plus purchased [1]
Water	60% tank and 40% water hole [2]	60% tank and 40% water hole [2]	60% tank and 40% water hole [2]	60% tank and 40% water hole [2]	60% tank and 40% water hole [2]	60% tank and 40% water hole [2]	60% tank and 40% water hole [2]	60% tank and 40% water hole [2]	60% tank and 40% water hole [2]	60% tank and 40% water hole [2]
Timber and other building materials	100% bush, 0% purchased [4]	90 % bush, 10 % purchased [3]	100% bush, 0% purchased [4]	10% bush, 90 % purchased [3]	100% bush, 0% purchased [4]	90% bush, 10 % purchased [3]	80% bush, 20% bought [3]	10% bush, 90 % purchased [3]	100% bush, 0% purchased [4]	100% bush, 0% purchased [4]
Medicine	15% bush medicine and 85% modern medicine [1]	20% bush medicine and 80% medicine [1]	10% bush medicine and 90% modern medicine [1]	20% bush medicine and 80% modern medicine [1]	10% bush medicine and 90% modern medicine [1]	20% bush medicine and 80% modern medicine [1]	10% bush medicine and 90% modern medicine [1]	15% bush medicine and 85% modern medicine [1]	10% bush medicine and 90% modern medicine [1]	15% bush medicine and 85% modern medicine [1]
Fuel wood	100% gathered, 0% bought [4]	100% gathered, 0% bought [4]	100% gathered, 0% bought [4]	100% gathered, 0% bought [4]	100% gathered, 0% bought [4]	100% gathered, 0% bought [4]	100% gathered, 0% bought [4]	100% gathered, 0% bought [4]	100% gathered, 0% bought [4]	100% gathered, 0% bought [4
Fodder	100% garden/kitchen scraps plus meal leftovers [0]	100% garden/kitchen scraps plus meal leftovers [0]	100% garden/kitchen scraps plus meal leftovers [0]	100% garden/kitchen scraps plus meal leftovers [0]	100% garden/kitchen scraps plus meal leftovers [0]	100% garden/kitchen scraps plus meal leftovers [0]	100% garden/kitchen scraps plus meal leftovers [0]	100% garden/kitchen scraps plus meal leftovers [0]	100% garden/kitchen scraps plus meal leftovers [0]	100% garden/kitchen scraps plus meal leftovers [0]

Table 27: Summary of sources for information regarding basic needs

Notes on ranking:

0 - 9%	*If needs are not met by the forest or other ecosystems, these sources are considered unimportant with a **score of 0***
10 - 24%	*If needs are met from many sources, an individual source is considered of minor importance with a **score of 1**.*
25 - 49%	*If needs are met by several sources, each below 50%, the sources are regarded as important with a **score of 2.***
50 - 99%	*If most needs are met by a single source and few by others, the source is regarded as very important with a **score of 3***
100%	*If all needs are met by a single source, the source is regarded as extremely important with a **score of 4**.*

The ranking is used to assess the importance of a natural forest or eco-system in catering for a basic need of the local villagers. When the source for a basic need is neither a natural forest nor natural eco-system, a score of 0 is assigned. This means that the villagers do not rely on a natural forest or eco-system for this basic

HCV 6 – Cultural values

Key Questions	Outcome
Does the assessment area or surrounding landscape contain areas that are tied to cultural values critical to the traditional cultural identity of local communities, including areas of cultural, ecological, economic, religious or archaeological significance?	PRESENT

HCV 6 represents areas of cultural significance that have traditional importance to local or indigenous people. These may be religious or sacred sites, burial grounds or sites at which traditional ceremonies take place. National laws may require their identification and protection. The CG has identified the following values for consideration as HCV 6:

- Sites recognised as having high cultural value within national policy and legislation.
- Sites with official designation by national government and/or an international agency like UNESCO.
- Sites with recognized and important historical or cultural values, even if they remain unprotected by legislation.
- Religious or sacred sites, burial grounds or sites at which traditional ceremonies take place that have importance to local or indigenous people.
- Plant or animal resources with totemic values or used in traditional ceremonies.

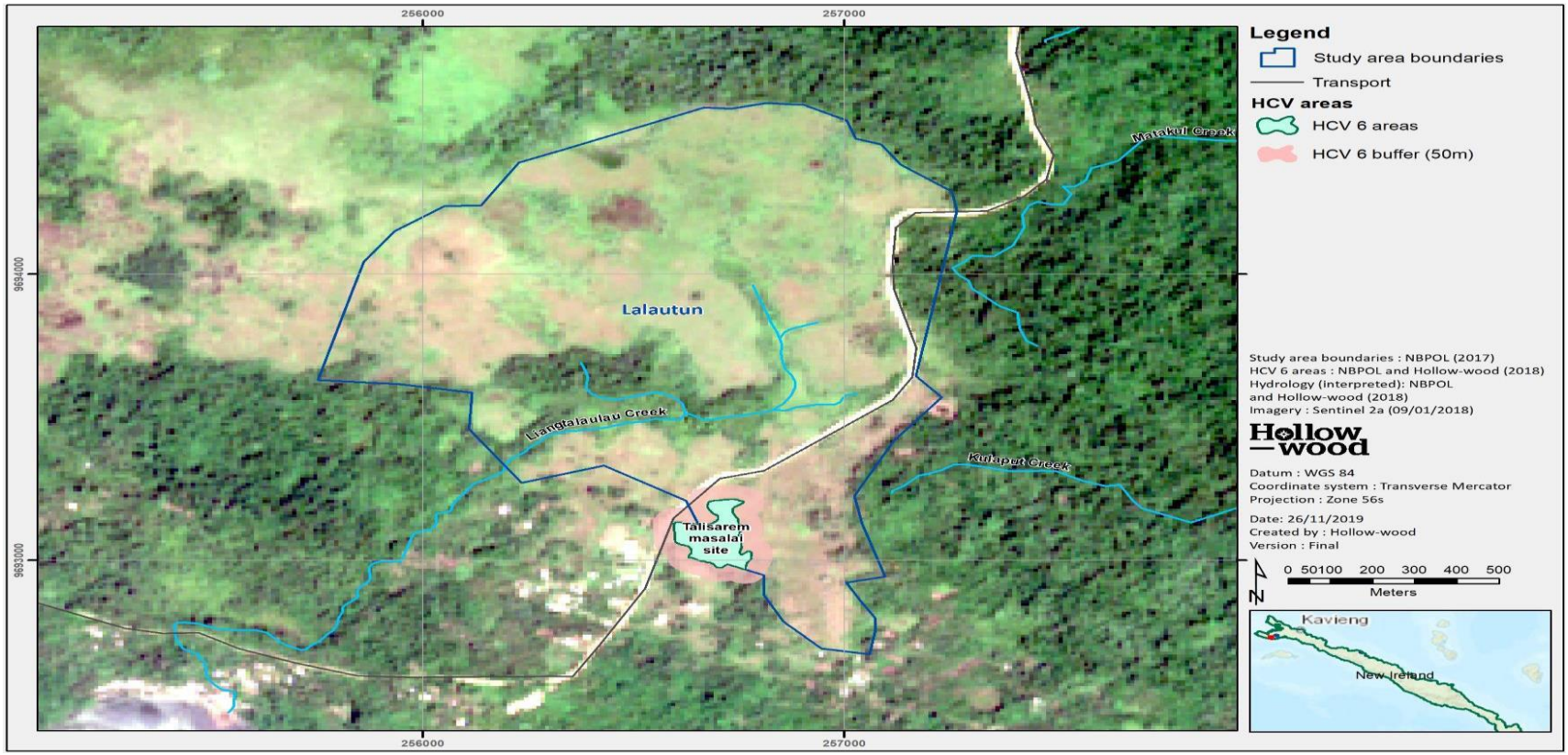
Cultural heritage refers to (i) tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values; (ii) unique natural features or tangible objects that embody cultural values, such as sacred groves, rocks, lakes, and waterfalls; and (iii) certain instances of intangible forms of culture that are proposed to be used for commercial purposes, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles.

During the field assessment, consultation with the Tivingau ILG members revealed one site considered to be HCV 6 (Table 15)

Table 15. HCV 6 areas identified during his assessment

Study area	Description	Protection requirements
Lalautun	Consultation during focus groups and subsequent field checking from Lead Assessor identified a Ghost Village or 'ples masalai', located south of the Kaut Road in the far south-west of the study area (Map 11). Community members expressed desire that the area not be disturbed during plantation establishment operations.	100m

In their usage of the land for other uses, the ILG members will ensure that each grave site and cultural site is allocated appropriate buffer reserves. An integrated version of both maps showing HCV 5 and 6 features on Tivingau ILG land is shown in Map 10.



Map 13: HCV 6 areas identified at the Lalautun study area.

The local environment Tivingau ILG members and Lokono villagers use the local environment as the main source of their basic needs. Out of the total Tivingau ILG land area of 5,205ha only 3.8% (199ha) is likely to be taken up by oil palm development.

The dependency on the local population on the local environment is not anticipated to be affected by the proposed oil palm development. The main reasons for this are: (i) the areas marked for oil palm planting are not directly used by the local people and (ii) they have more than adequate land to cater for these needs. In addition, the new planting areas do not contain grave sites or features with special cultural significance.

The only exceptions with respect to basic needs are limestone water holes and sago swamps located down-gradient from the Lalautun grassland. The limestone water holes are currently the only dry season sources of water for drinking, cooking and washing utensils. Sago is extracted from the sago swamps by the villagers as a reliable staple and ceremonial food. These uses must be protected during the establishment and operation of the mini estate.
Recommendations to monitor and manage any impacts from the development on lands and future livelihoods are made in Section 6.

3.2.8 Stakeholder Consultation

Initial stakeholder consultations were conducted on Tuesday 26th and Wednesday 27th of September 2017 by M. Hansby (Hollow-wood) and T. Endy (NBPOL). There were two main aims of these scoping study consultations:

1. To inform relevant community members, NGO's and Government representatives of NBPOL's intention to undertake the full integrated HCV/HCSA assessment;

2. To allow the lead assessor to understand of the extent of FPIC already undertaken by NBPOL and to determine whether further tasks were required to be undertaken by NBPOL prior to commencement of the full assessment.

A summary of stakeholders consulted during the scoping study, including key outcomes of those interviews, are summarised in Table 19. Evidence for these consultations can be found in Appendix 1 of the scoping assessment.

Additionally, environmental NGOs were sought for comment and input, however there are no environmental NGOs operating in this area. Only one was Wildlife conservation which was also interviewed.

Combined with the social surveys, people in the local villages were surveyed also. The results are presented in
Table17.

Table 28: List of initial stakeholder consultations undertaken during the scoping study

Name	Title/role	Organisation/social group	Date consulted	Key concerns and recommendations
Rose Elias	Community Development Officer / small	Women in Oil Palm	26/09/2017	Rose was supportive of the proposed developments because of their potential to benefit the local communities and provide

	holder			a new road. No issue with commencing full assessment
Simon Konkas	Lands Manager	Catholic Dioceses of Kavieng	26/09/2017	Simon confirmed the broad support for oil palm development across New Ireland because of the potential to generate community income and provide a new road. Also discussed the No issue with commencing full assessment
Thaiya Wokasup and Christine Gurumang	Customary and State Lands Officers	New Ireland Provincial Lands Department	26/09/2017	Thaana and Christian provided information that the Tivingau ILG land registration had changed from an SABL (Special Agricultural Business Lease) to VCLR (Voluntary Customary Land Registration). No issue with commencing full assessment
Patrick Topital	Project Coordinator	Live Learn, Kavieng Branch	26/09/2017	Patrick supported NBPOL as an important part of the culture of New Ireland and provider of income and infrastructure. No issue with commencing full assessment
Annisah Sapul	Program Manager	Wildlife Conservation Society New Ireland	26/09/2017	The Wildlife Conservation Society is supportive of NBPOL and identify the new road as a key benefit of the proposed development. No issue with commencing full assessment

Table 29: Stakeholder consultations held with local communities, Poliamba staff and other stakeholders to inform the SEIA and HCV/HCSA assessment

Date	Expert/organisation/ social group	Type of interaction	Concerns and recommendations	Evidence
07/02/2018	Provincial Lands Department Live and Learn	Face to face interview	Concerns regarding water contamination, increased population, and the willingness to work with the company for improved community services Summary in Table 17	Signed attendance record
09/02/2018	Lokono and Kaut villagers'	Community meeting	Details in SEIA report Summary in Table 17	Signed attendance record
09-10/02/2018	Lokono and Kaut villagers	Community meeting and interviews	HCV 5 and 6 assessment	Signed attendance record
09-10/02/2018	Lokono and Kaut villagers	Group discussion	Participatory resource mapping	Signed, marked up maps.

Table 30: Summary of FPIC activities for the Tivingau ILG area

Mandatory requirement	How the requirement has/has not been met	Evidence
The local peoples have chosen who will represent them in dealing with the operator.	It is assumed the Tivingau clan is represented by the ILG executive committee.	ILG Certificate No. 599
The local peoples agreed to SIA and HCV assessments being carried out on their lands.	Meeting on 11.01.2018	Minutes and signed attendance
The local peoples have meaningfully participated in SIA and HCV.	All Lokono village invited to participate in community use (HCV 5) interview (not sure how) - 14 people participated SEIA meetings were held with the ILG committee and key community stakeholders	Meeting attendance records and list of key points discussed
The HCV assessment has been completed, and recommends which areas need to be set-asides to maintain or enhance these	This report details the outcome of the HCV 4, 5 and 6 assessments and recommendations.	This report

values (including HCV 4, 5 and 6).		
A land tenure assessment has been completed.	Land Investigation undertaken by the Lands Department, New Ireland Government	Copy of Land Investigation Report by the Provincial Government
Participatory mapping of customary lands has been carried out, with the direct involvement of the communities concerned.	Participatory mapping was facilitated by Narua Lovai as part of HCV 5 and HCV 6 assessment. Final LUPs was taken to the community for approval on 10-12 September 2018	Photos of signed marked up maps Photos of participatory mapping exercise
Affected communities have agreed to the management plan, which should summarise the mitigation measures that will be implemented,	In progress	
Community representatives have agreed on the next steps in the FPIC process, including how negotiations to acquire lands' will be undertaken.	In progress	

3.2.9 Environmental section: methods and results

a) Environmental methods and results

Resources utilised during the **vegetation survey** desktop review are listed in Table below on **Major information sources used to perform desktop review.**

Resource	Comment
IUCN Red list	An area-based search using the IUCN online database was performed before the commencement of field work in October 2016. A list of all flora species with an IUCN rating of vulnerable or greater (i.e. inclusive of endangered or critically endangered), was collated. The area of focus was the Papua New Guinea in general, with further investigation determining the relevance of each listed species to the New Ireland Province context
CITES prohibited	An area-based search using the CITES online database was performed before the commencement of field work October 2016. The area of focus was the Papua New Guinea in general, with further investigation determining the relevance of each listed species to the Bismarck Archipelago and New Ireland Province.,
Nationally protected species	Little guidance is provided by the Papua New Guinea government as to the formal protection of particular plant species, but the HCV toolkit for Papua New Guinea (PNG FSC, 2005) provides a range of species that a considered rare, threatened or endangered by IUCN or prohibited for trade under the CITES convention.

The **animal survey** (mammal, bird, reptile and amphibians) was supported by a desktop review literature to collate data on extant animal species which may have been encountered within the areas of interest during the fieldwork.
The objectives of the field component of the environmental survey were to:

- • Ground truth the output of the initial image classification and to quantify the above-ground woody biomass (i.e. that within trees) found within each of the strata, across the study areas
- • Actively search for Rare, Threatened or Endangered (RTE) species or ecosystems listed under national or international acts or conventions within the study areas and adjacent landscape.

All field inventories for both the HCSA and HCV components of the assessment was performed in March 2018.

The sample design for the HCSA plots used a 1% sampling strategy, with data collection undertaken as per the methodology set out in Module 4, HCSA (2017). Plot data was analysed with 'R' statistical software package. Main outputs were summary statistics and the Scheffe post-hoc ANOVA. All biomass calculations were performed according to the method outlined in Chave *et al.*, (2014). All biomass values calculated using this method were converted to carbon content using a factor or 0.47 as per HCSA (2015) pp 66

Mammal species were mainly identified by talking with the Poliamba employees and the local villagers. Both groups were invaluable in providing information of extant mammals in their area; mainly based on their past experience. Day walks taken through the areas of interest were designed to maximize observations within various forest strata and/or grassland habitat. Two live-capture mammal traps were also set up at selected sites in an attempt to capture extant mammals there. The sites chosen to set up the mammal traps were based on the likelihood of successfully capturing mammals based on vegetation composition and also signs of activity by mammals.

In surveying birds, the point count method was employed where the observer walks along a designated path (in this case it was mostly existing tracks or roads through the study areas) and pause for five to ten minutes at regular intervals. At each interval, bird species are either recognised by their calls or if they are sighted (Bibby *et al.*, 1998). Opportunistic sightings and other interesting observations made of birds, were also recorded. An audio recorder (Zoom H1) was also used to capture bird calls. The audio records were analyzed post-survey to ascertain the presence of bird species at each location as well as identify other birds that may have been overlooked during the field surveys. A pair of binoculars (Olympus, 10 x 50 magnification) was used to visually identify birds while

a point-and-shoot camera (Sony Cybershot DSC-RX100) was used to photograph birds, whenever possible, including the habitats in which birds were observed.

A photographic guide of the birds of Melanesia {Dutson, 2011 #8} was used during informal interviews with members of the communities visited to verify the presence or absence of birds as well as collect local names of birds. During the survey, attempts were made to survey as many different habitat types as possible. Amphibian and reptile species were more likely to be encountered at night. Night trips were taken to survey for amphibians and reptiles concurrent with spotlighting for mammals. The same survey routes used to search for mammals were also used to search for amphibians and reptiles. Amphibians or frogs were found by following their calls and searching for them in the understory as well as under bush. An audio recorder (ZOOM H1) was also used to record frogs calling. Reptiles were searched for using spotlights and survey teams kept a close eye on the roads followed at night since snakes especially have a tendency on laying across the road at night. When a snake was spotted, photographs were taken, and the species identified and recorded. Local denizens were also asked to recount any encounters they have had with reptiles or amphibian species in the past during informal discussions.

B) Interviews with stakeholders and experts (see Table 31)
mainly occurred during the scoping phase. Information from an expert in tropical wetlands was sought following the fieldwork to confirm the permeance of the wetland areas identified during the fieldwork and the subsequent identification of potential peat swamps. Integrated into the social data collection were questions about the types of animals and plants used by communities, which contributed to the understanding of what species are present in the AOI.

Table 31: **Summary of interviews and discussions**

Organisation / group	***Name***	**Type of interaction**	**Concerns / recommendations**
Arthur Rylah Institute, Victoria Australia	Dr Freya Thomas Bryan Mole	Email correspondence	Dr Freya Thomas and Bryan Mole, wetland specialists (Botany) from the Arthur Rylah Institute in Victoria, Australia were contacted in order to aid in the positive identification of the wetland (*Leprionia articulata*) species found in the northern section of Lalautun. This identification was based on detailed photographs taken by the Lead Assessor of both infertile and fertile material on site during the field assessment. No voucher specimens were collected due to quarantine issues in bring such material back into Australia for analysis.
Wildlife Conservation Society	Annisah Sapul (Program manager)	Interview	The Wildlife Conservation Society are supportive of NBPOL and identify the new road as a key benefit of the proposed development. No issue with commencing full assessment
Live and Learn	Patrick Topital (Program manager)	Interview	Patrick supported NBPOL as an important part of the culture of New Ireland and provider of income and infrastructure. No issue with commencing full assessment
Lokono and Galong community members	Group discussion	Informal conversation	A range of informal discussions were had between the community members at Lalautun and Galong and Mellie Musonera (faunal assessment expert) regarding potential sightings of faunal species (IUCN redlist species and species protected by

3.3 Soil and Topography

From a study area point of view, geological mapping indicates that the study areas within the Tivingau ILG area (Lalautun, DPI Station and Kunaur 3) are all on limestone formations, either *Raised coral terraces* or the *Lelet limestones*).

Information regarding soils across the study areas was derived from the PNGRIS Handbook 3rd Edition (Bryan and Shearman, 2008). The soils dataset was clipped to the study area boundaries, revealing that four major soils types are present. This is shown below:

Table 32: Soil Classification of the proposed development in Tivingau ILG area

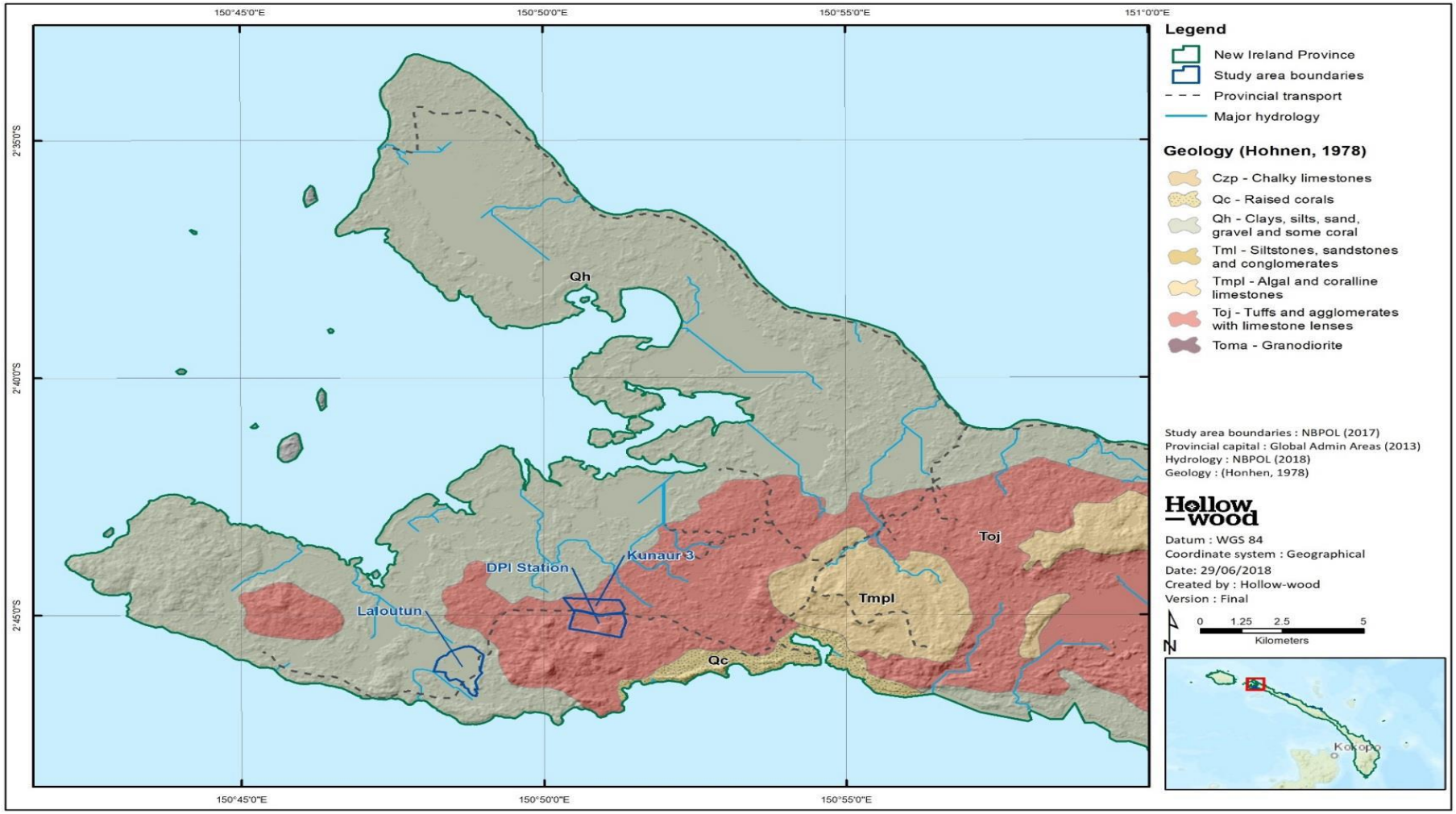
Order	Suborder	Great soil group	Brief description	Relevant study areas
Inceptions	Tropepts	Dystropepts	Strongly weathered red and brown clay soils, Acid red to brown soils, without strongly contrasting horizons	DPI station, Kunaur 3
Mollisols	Rendolls	n/a	Limestone soils, Rendzinas. Shallow soils derived from calcareous parent material in wet, humid regions	Lalautun
Alfisols	Udalfs	Tropudalfs	Moderately well drained soils of tropical, humid climates. Meadow soils, Gleyed plastic heavy clay soils and lateritics	Lalautun
Ulitsols	Udalts	Tropudalts	Moderately well drained, but humus poor soils of tropical, humid climates. Acid red to brown clay soils.	DPI station, Kunaur 3

Marginal or Fragile Soils

There were no marginal or fragile soils identified within the area to be converted to oil palm.

Identification of all areas of excessive gradients

There were no areas of excessive gradients identified within the area to be converted to oil palm.



Map 14: Soil map of Tivingau ILG area of Lokono village

3.4 Summary of Carbon Stock Assessment and GHG Emissions

3.4.1 Land cover stratification

The High Carbon Stock Assessment and Land Use Change Assessment conducted for the Tivingau ILG area concludes that the entire area is considered grassland. The area holds a standing Carbon stock of 0.84 t CO_2e/ha.

This is not seen to be an impediment to development of the site for oil palm which will result in a significant increase in standing carbon over the lifespan of the first oil palm planting. There are no peat soils within this area. A land cover analysis analysing tree cover at the year 2003 and tree cover loss and gain since then. It shows that the entire area has been static grassland, some logged in the late 1970s since then with minimal change in tree cover.

3.4.2 Map and description of all areas of significant carbon stocks including areas of peat soils

There were no areas of significant carbon stocks or peat soils identified in the proposed new planting area. This is further confirmed from the Soil Suitability Assessment report.

3.4.3 Identification of all likely significant sources of GHG emissions and sequestration related to the proposed development

A GHG Analysis was conducted for the proposed development at Tivingau ILG area by NBPOL. The study summarizes recommendations of the High Conservation Value and High Carbon Stock Assessments conducted there and provides guidance to company executive management to mitigate the GHG impact of this particular development.

The following scenarios were tested:

1) Full planting of the site with protection of 163.08ha of HCV;
2) Same site conditions with methane capture and electricity generation on mill (long term budget plan)

3.4.4 Results of the greenhouse gas emissions scenario modelling.

The land conversion scenarios were utilised as basic inputs into modelling the potential Green House Gas emissions resulting from the implementation of each scenario. The following tables summarize the results of modelling obtained by using the RSPO New Development Greenhouse Gas Calculator RSPO-PRO-T04-003 V2.0 ENG and utilising the above land cover classifications coupled with the carbon density values found during the High Carbon Stock study. Note that for each scenario a different amount of land is assumed to be put into conservation. Table 33 summarises net field emissions and sinks results of the 5 land conversion scenarios.

3.4.5 Measures taken to maintain and enhance carbon stocks within the new development areas

After consideration of the lands that have been made available by land owner consent and the removal of areas that are either High Conservation Value or High Carbon Stock, Scenario 5 has been chosen as the preferred development option. The greatest contributor to reduction of GHG emissions from the new

development is through avoided emissions that would have been derived from land use change through the application of the High Carbon Stock Approach and the protection of High Conservation Values.
By the application of the HCSA 'patch analysis decision tree', a range of land use types have been excluded from development. This includes any areas of high conservation value or natural vegetation classes with a carbon density higher than that of 'scrub', patches of 'young regenerating forests' with a core less than 10ha or outside of the 200-meter proximity of significant carbon. This has greatly reduced the potential emissions from land use change. Figures 4 – 6 illustrate the emissions of Scenario 5 as estimated by the GHG calculator.

Synthesis Reports:

The following table summarizes the net tCO2e/t of palm products of the proposed development (Scenario 5) as part of the existing operations of POL.

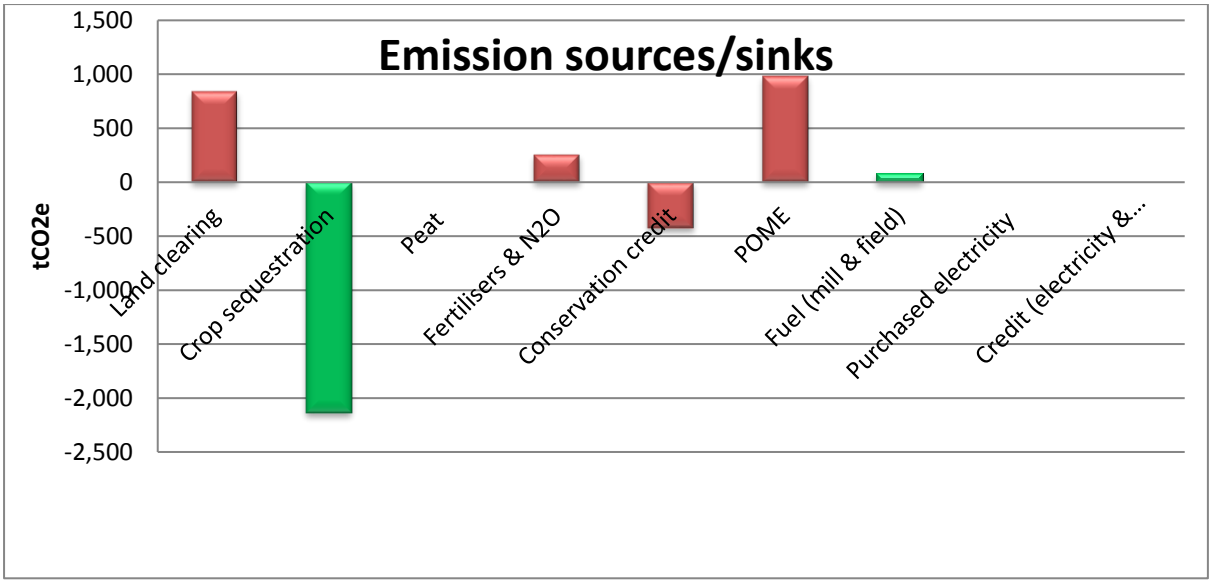
Summary of results

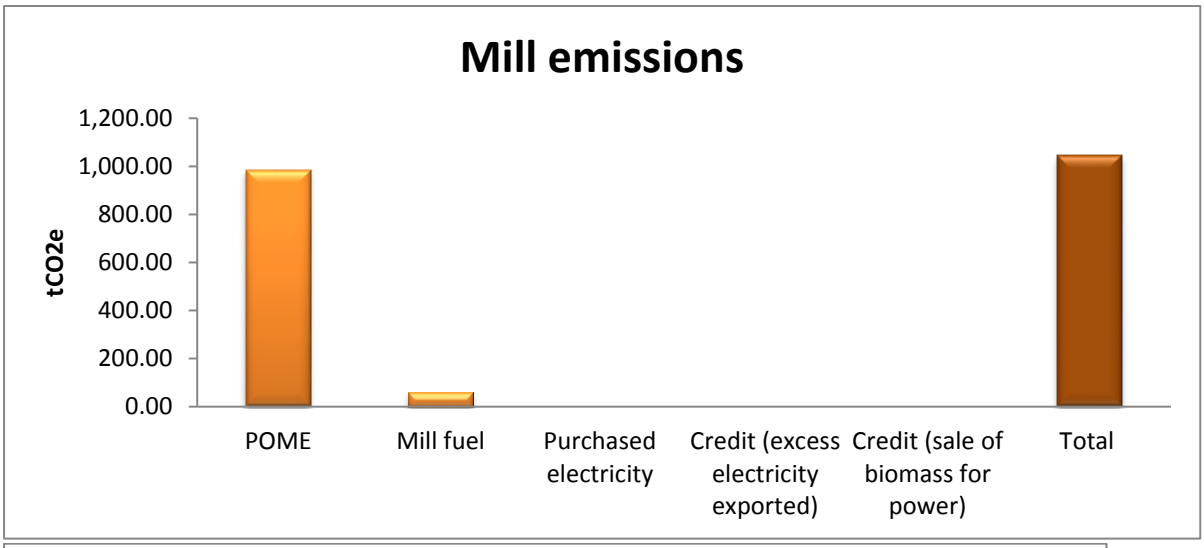
Field emissions & sinks (Assumes vigorous growth for oil palm - for use by large scale operations)

	t CO_2e	t CO_2e/ha	t CO_2e/t FFB
Land clearing	**839.85**	**3.68**	**0.17**
Crop sequestration	**-2,137.85**	**-9.36**	**-0.43**
Fertilisers	**129.64**	**0.57**	**0.03**
N2O	**126.12**	**0.55**	**0.03**
Field fuel	**27.93**	**0.12**	**0.01**
Peat	**0.00**	**0.00**	**0.00**
Conservation credit	**-422.80**	**-1.85**	**-0.08**
Total	**-1,437.11**	**-6.29**	**-0.29**

Mill emissions & credit	tCO_2e	t CO_2e/ha	tCO_2e/tFFB	
POME	**984.77**	**4.31**	**0.20**	87.18
Mill fuel	**59.25**	**0.26**	**0.01**	
Purchased electricity	**0.00**	**0.00**	**0.00**	
Credit (excess electricity exported)	**0.00**	**0.00**	**0.00**	
Credit (sale of biomass for power)	**0.00**	**0.00**	**0.00**	
Total	**1,044.02**	**4.57**	**0.21**	

Total emissions, tCO_2e (field and mill)	**-393**
Allocation:	
t CO_2e/t CPO	**-0.29**
t CO_2e/t PK	**-0.29**


Emission sources/sinks
tCO2e
1,500
1,000
500
0
-500
-1,000
-1,500
-2,000
-2,500
Land clearing
Crop sequestration
Peat
Fertilisers & N2O
Conservation credit
POME
Fuel (mill & field)
Purchased electricity
Credit (electricity &...


Mill emissions
tCO2e
1,200.00
1,000.00
800.00
600.00
400.00
200.00
0.00
POME
Mill fuel
Purchased electricity
Credit (excess electricity exported)
Credit (sale of biomass for power)
Total

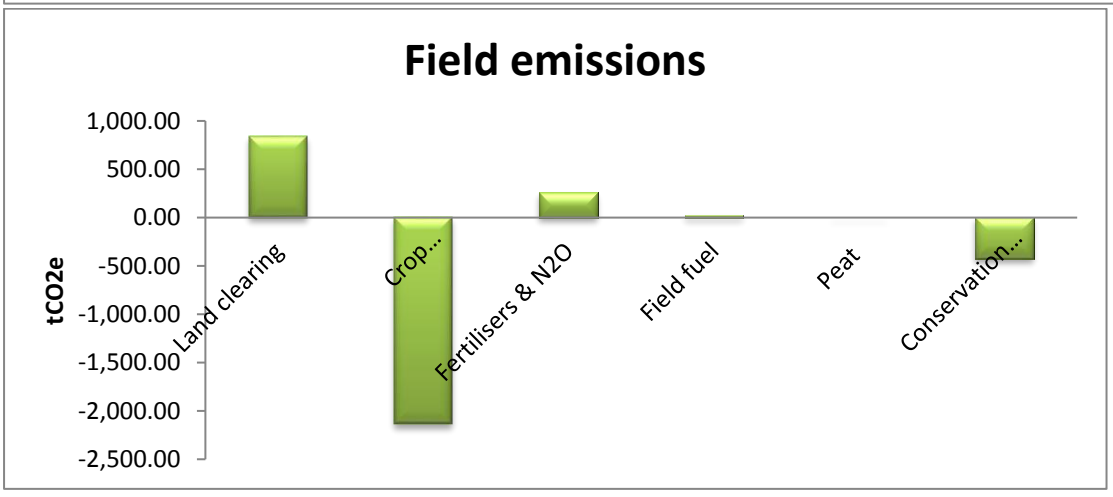

Field emissions
tCO2e
1,000.00
500.00
0.00
-500.00
-1,000.00
-1,500.00
-2,000.00
-2,500.00
Land clearing
Crop...
Fertilisers & N2O
Field fuel
Peat
Conservation...

Table 33: Description of development scenarios

Scenario 1

Previous land cover type	tC/ha	tCO_2e/ha
Undisturbed forest	268	982.67
Disturbed forest	128	469.33
Shrubland	46	168.67
Grassland	5	18.33
Tree crops	75	275.00
Annual/food crop	8.5	31.17
Oil Palm (Vigorous)	63.83	234.04
Oil Palm (Average)	59.29	217.38
Remnant forest	127.05	465.85
Secondary forest	91.79	336.56
Swamp woodland	94.01	344.70
Garden fallow / scrub	38.50	141.17
Grasslands	9.49	34.80
Pandanus woodland	9.49	34.80
Permanent wetland	51.15	187.55

Proposed development (mineral soil)

Land use type	**Total area (ha)**	**Planted Area (ha)**	**tCO_2e/ha**	**Total tCO_2e**	**tCO2e/yr (including land cleared for other use)**
Remnant forest	105.88	100.36	465.85	49325.09	1973.00
Secondary forest	26.72	25.32713	336.56	8993.01	359.72
Swamp woodland	5.46	5.17669	344.70	1882.57	75.30
Garden fallow / scrub	92.00	87.20215	141.17	12987.09	519.48
Grasslands	17.06	16.16966	34.80	593.60	23.74
Pandanus woodland	118.97	112.77	34.80	4139.70	165.59

Permanent wetland	7.43	7.04	187.55	1392.67	55.71
Total	373.51	354.04		79313.72	3172.55

Total planted area, ha: 354.04
Total emissions from LUC (incl other land use), tCO2e/yr: 3172.55

Scenario 2:

Previous land cover type	tC/ha	tCO_2e/ha
Undisturbed forest	268	982.67
Disturbed forest	128	469.33
Shrubland	46	168.67
Grassland	5	18.33
Tree crops	75	275.00
Annual/food crop	8.5	31.17
Oil Palm (Vigorous)	63.83	234.04
Oil Palm (Average)	59.29	217.38
Remnant forest	127.05	465.85
Secondary forest	91.79	336.56
Swamp woodland	94.01	344.70
Garden fallow / scrub	38.50	141.17
Pandanus woodland	9.49	34.80
Grassland	9.49	34.80
Permanent wetland	51.15	187.55

Proposed development (mineral soil)

Land use type	**Total area (ha)**	**Planted Area (ha)**	**tCO_2e/ha**	**Total tCO_2e**	**tCO2e/yr (including land cleared for other use)**
Remnant forest	5.29	5.01	465.85	2464.23	98.57
Secondary forest		0.00000	336.56	0.00	0.00

Swamp woodland		0.00000	344.70	0.00	0.00
Garden fallow / scrub	90.48	85.76128	141.17	12772.50	510.90
Pandanus woodland	11.90	11.28094	34.80	414.13	16.57
Grassland	101.99	96.67	34.80	3548.96	141.96
Permanent wetland	0.00	0.00	187.55	0.00	0.00
Total	209.66	198.73		19199.81	767.99

Total planted area, ha: 198.73
Total emissions from LUC (incl other land use), tCO2e/yr: 767.99

Scenario 3

Previous land cover type	**tC/ha**	**tCO_2e/ha**
Undisturbed forest	268	982.67
Disturbed forest	128	469.33
Shrubland	46	168.67
Grassland	5	18.33
Tree crops	75	275.00
Annual/food crop	8.5	31.17
Oil Palm (Vigorous)	63.83	234.04
Oil Palm (Average)	59.29	217.38
Remnant forest	127.05	465.85
Secondary forest	91.79	336.56
Swamp woodland	94.01	344.70
Garden fallow / scrub	38.50	141.17
Pandanus woodland	9.49	34.80
Grassland	9.49	34.80
Permanent wetland	51.15	187.55

Proposed development (mineral soil)

Land use type	Total area (ha)	Planted Area (ha)	tCO_2e/ha	Total tCO_2e	tCO2e/yr (including land cleared for other use)
Remnant forest		0.00	465.85	0.00	0.00
Secondary forest		0.00000	336.56	0.00	0.00
Swamp woodland	5.46	5.17669	344.70	1882.57	75.30
Garden fallow / scrub	92.00	87.20215	141.17	12987.09	519.48
Pandanus woodland	17.06	16.16966	34.80	593.60	23.74
Grassland	118.97	112.77	34.80	4139.70	165.59
Permanent wetland	7.43	7.04	187.55	1392.67	55.71
Total	240.91	228.35		20995.62	839.82

Total planted area, ha: 228.35
Total emissions from LUC (incl other land use), tCO2e/yr: 839.82

Scenario 4:

Previous land cover type	tC/ha	tCO_2e/ha
Undisturbed forest	268	982.67
Disturbed forest	128	469.33
Shrubland	46	168.67
Grassland	5	18.33
Tree crops	75	275.00
Annual/food crop	8.5	31.17
Oil Palm (Vigorous)	63.83	234.04
Oil Palm (Average)	59.29	217.38
Remnant forest	127.05	465.85
Secondary forest	91.79	336.56
Swamp woodland	94.01	344.70
Garden fallow / scrub	38.50	141.17
Pandanus woodland	9.49	34.80

Grassland	9.49	34.80
Permanent wetland	51.15	187.55

Proposed development (mineral soil)

Land use type	Total area (ha)	Planted Area (ha)	tCO_2e/ha	Total tCO_2e	tCO2e/yr (including land cleared for other use)
Remnant forest	95.43	90.46	465.85	44456.41	1778.26
Secondary forest	26.72	25.32713	336.56	8993.01	359.72
Swamp woodland	0.85	0.80704	344.70	293.49	11.74
Garden fallow / scrub	91.95	87.15691	141.17	12980.35	519.21
Pandanus woodland	16.67	15.80081	34.80	580.06	23.20
Grassland	117.10	111.00	34.80	4074.78	162.99
Permanent wetland	7.43	7.04	187.55	1392.67	55.71
Total	356.15	337.58		72770.77	2910.83

Total planted area, ha: 337.58
Total emissions from LUC (incl other land use), tCO2e/yr: 2910.83

Scenario 5:

Previous land cover type	tC/ha	tCO_2e/ha
Undisturbed forest	268	982.67
Disturbed forest	128	469.33
Shrubland	46	168.67
Grassland	5	18.33
Tree crops	75	275.00
Annual/food crop	8.5	31.17
Oil Palm (Vigorous)	63.83	234.04
Oil Palm (Average)	59.29	217.38
Remnant forest	127.05	465.85

Secondary forest	91.79	336.56
Swamp woodland	94.01	344.70
Garden fallow / scrub	38.50	141.17
Pandanus woodland	9.49	34.80
Grassland	9.49	34.80
Permanent wetland	51.15	187.55

Proposed development (mineral soil)

Land use type	Total area (ha)	Planted Area (ha)	tCO_2e/ha	Total tCO_2e	tCO2e/yr (including land cleared for other use)
Remnant forest	0.67	0.64	465.85	312.30	12.49
Secondary forest		0.00000	336.56	0.00	0.00
Swamp woodland		0.00000	344.70	0.00	0.00
Garden fallow / scrub	90.48	85.76086	141.17	12772.44	510.90
Pandanus woodland	11.74	11.13093	34.80	408.62	16.34
Grassland	101.50	96.21	34.80	3531.81	141.27
Permanent wetland	0.00	0.00	187.55	0.00	0.00
Total	204.39	193.73		17025.17	681.01

Total planted area, ha: 193.73
Total emissions from LUC (incl other land use), tCO2e/yr: 681.01

Table 17. Results of the greenhouse gas emissions scenario modelling, yellow box indicating preferred Development Scenario. Field emissions and sinks assume average growth for oil palm, for use by smallholders. Data derived from RSPO GHG Calculator (RSPO-PRO-T04-003 V2.0 ENG).

	Scenario 1			Scenario 2			Scenario 3			Scenario 4			Scenario 5		
Field emissions & sinks	tCO2e	t CO2e/ha	tCO2e/tFFB	t CO2e	t CO2e/ha	t CO2e/tFFB	t CO2e	t CO2e/ha	t CO2e/tFFB	t CO2e	t CO2e/ha	t CO2e/tFFB	t CO2e	t CO2e/ha	t CO2e/tFFB
Land clearing	3,172.55	8.96	0.41	767.99	3.86	0.18	839.82	3.68	0.17	2,910.83	8.62	0.39	681.01	3.52	0.16
Crop sequestration	-3,078.44	-8.70	-0.40	-1,727.99	-8.70	-0.40	-1,985.56	-8.70	-0.40	-2,935.34	-8.70	-0.40	-1,684.55	-8.70	-0.40
Fertilisers	200.98	0.57	0.03	112.82	0.57	0.03	129.63	0.57	0.03	191.64	0.57	0.03	109.98	0.57	0.03
N2O	195.53	0.55	0.03	109.75	0.55	0.03	126.11	0.55	0.03	186.44	0.55	0.03	106.99	0.55	0.03
Field fuel	43.30	0.12	0.01	24.31	0.12	0.01	27.93	0.12	0.01	41.29	0.12	0.01	23.69	0.12	0.01
Peat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Conservation credit	0.00	0.00	0.00	-409.63	-2.06	-0.09	-331.50	-1.45	-0.07	-43.40	-0.13	-0.01	-422.80	-2.18	-0.10
Total	533.92	1.51	0.07	-1,122.75	-5.65	-0.26	-1,193.56	-5.23	-0.24	351.46	1.04	0.05	-1,185.67	-6.12	-0.28
Mill emissions & credit	tCO2e	t CO2e/ha	tCO2e/tFFB	t CO2e	t CO2e/ha	t CO2e/tFFB	t CO2e	t CO2e/ha	t CO2e/tFFB	t CO2e	t CO2e/ha	t CO2e/tFFB	t CO2e	t CO2e/ha	t CO2e/tFFB
POME	1,526.76	4.31	0.20	857.00	4.31	0.20	984.74	4.31	0.20	1,455.79	4.31	0.20	835.45	4.31	0.20
Mill fuel	91.86	0.26	0.01	51.56	0.26	0.01	59.25	0.26	0.01	87.59	0.26	0.01	50.27	0.26	0.01
Purchased electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Credit (excess electricity exported)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Credit (sale of biomass for power)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	1,618.62	4.57	0.21	908.56	4.57	0.21	1,043.99	4.57	0.21	1,543.38	4.57	0.21	885.72	4.57	0.21
Total emissions, tCO2e (field and mill)	1,917			-347			-302			1,670			-429		
t CO2e/t CPO	0.92			-0.30			-0.22			0.84			-0.38		
t CO2e/t PK	0.92			-0.30			-0.22			0.84			-0.38		

3.4.6 Table presenting carbon stock estimated per ha (tC/ha) per land cover class

Field survey results (HCSA plot results)

Table 35 presents biomass and carbon values for the land cover classes defined during this assessment. The results presented are a mixture of both locally derived values (i.e. those derived from HCSA plot measurements) and values sourced from peer reviewed literature.

The values for 'remnant forest', 'secondary forest' and 'garden fallow / scrub' are derived from data collected during the HCSA field assessment. The values for 'swamp woodland' have been sourced from Fox et al., (2010), and the value for 'grasslands' has been sourced from CCDA, (2017). Due to the very low canopy cover of Pandanus tectorius present in the 'pandanus woodland' class (approx. 10-15%); the grassland biomass value has been used. All shoot/root ratios are taken from Mokany et al., (2006).

Although the small area of Lepironia articulata dominated 'permanent wetland' is totally excluded from development, an estimate of total biomass has been included. Above ground biomass is sourced from the value reported in Ikusima, (1978), where the sum of all living parts of L. articulata are reported as 4.58t/ha and the below ground carbon is taken from (Hiraishi et al., 2014).

3.4.7 Table summarising the total development area (ha) and carbon stock estimate per land cover class

The total areas assessed for High Carbon Stock (Table 36) reports the results of the 'patch analysis decision tree' as found in Module 5 (HCSA, 2017), and integrate the results of the High Conservation Value (HCV) assessment areas for community use, as identified using participatory mapping methods. As such, Table 36 reports across the gross study area.

As part of implementing the HCSA methodology, and as part of being a member of the Palm Oil Innovation Group, sufficient land is set aside for 'community use' so as to ensure that food security and future expansion of living areas are available. The 'community use' areas were mapped through participatory means and resulted in areas being set aside by the communities. These areas are considered 'enclaved' i.e./removed from the potential conversion areas and excluded from the identification of GHG emissions. The results of the HCSA exercise, including the community use areas to be 'enclaved' can be seen in the table.

Table 36: Carbon study land classifications and development options for gross area (ha).

Classification	Enclave (ha)	Conserve (ha)	Develop (ha)	Grand Total
Remnant forest on limestone karst	10.45	94.76	0.67	105.88
Secondary forest on limestone karst		26.72		26.72
Swamp woodlands	4.61	0.85		5.46
Garden fallow / scrub	0.05	1.47	90.48	92
Pandanus woodlands	0.18	5.12	11.76	17.06
Grassland / open land	1.37	20.88	96.71	118.96
Permanent wetlands		7.43		7.43
Total	**16.66**	**157.23**	**199.62**	**373.51**

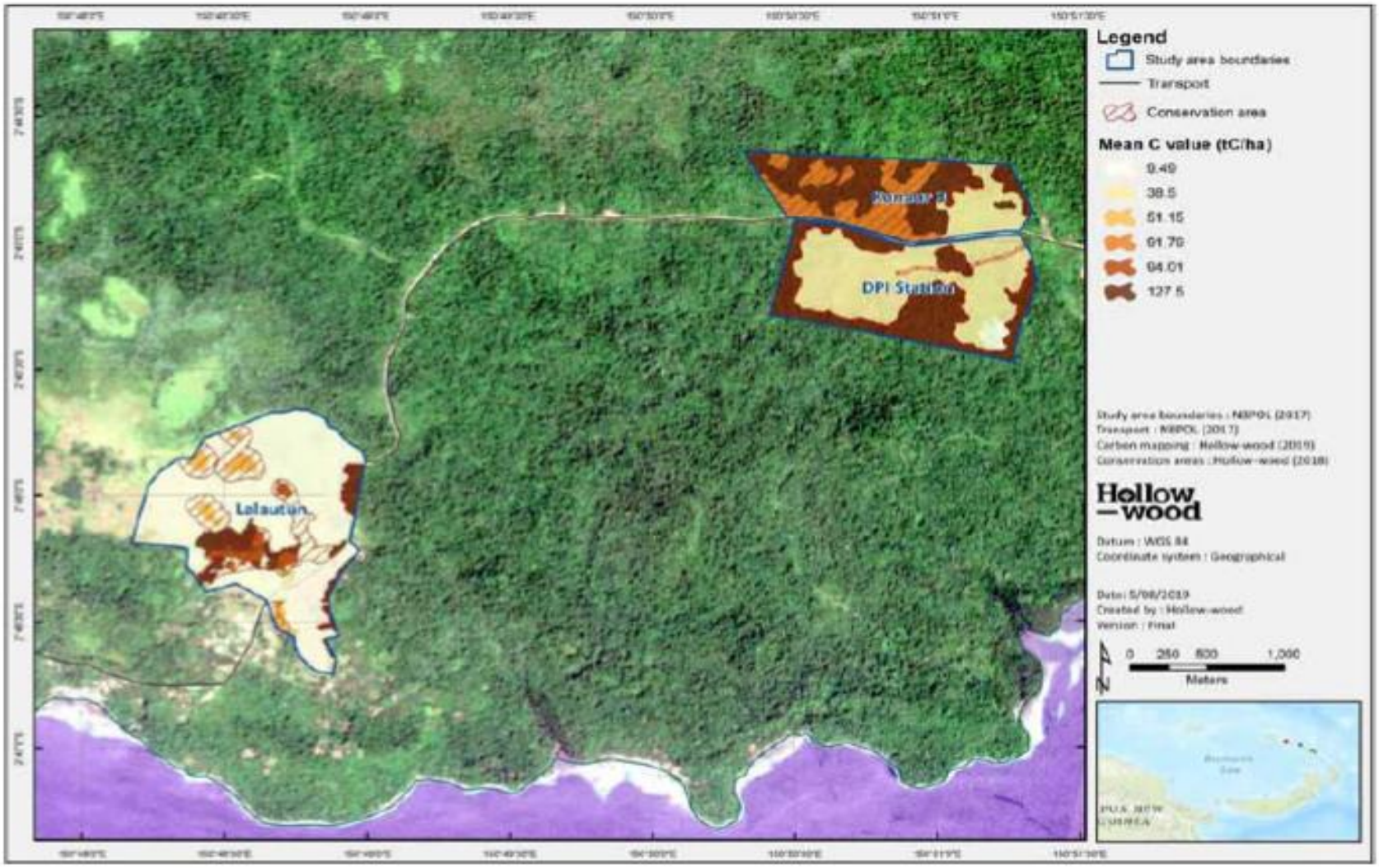
Table 37: Net area (ha) authorised for development

Classification	Conserve (ha)	Develop (ha)	Grand Total
Remnant forest on limestone karst	105.21	0.67	105.88
Secondary forest on limestone karst	26.72		26.72
Swamp woodlands	5.46		5.46
Garden fallow / scrub	1.52	90.48	92
Pandanus woodlands	5.3	11.76	17.06
Grassland / open land	22.25	96.71	118.96
Permanent wetlands	7.43		7.43
Total	**173.89**	**199.62**	**373.51**

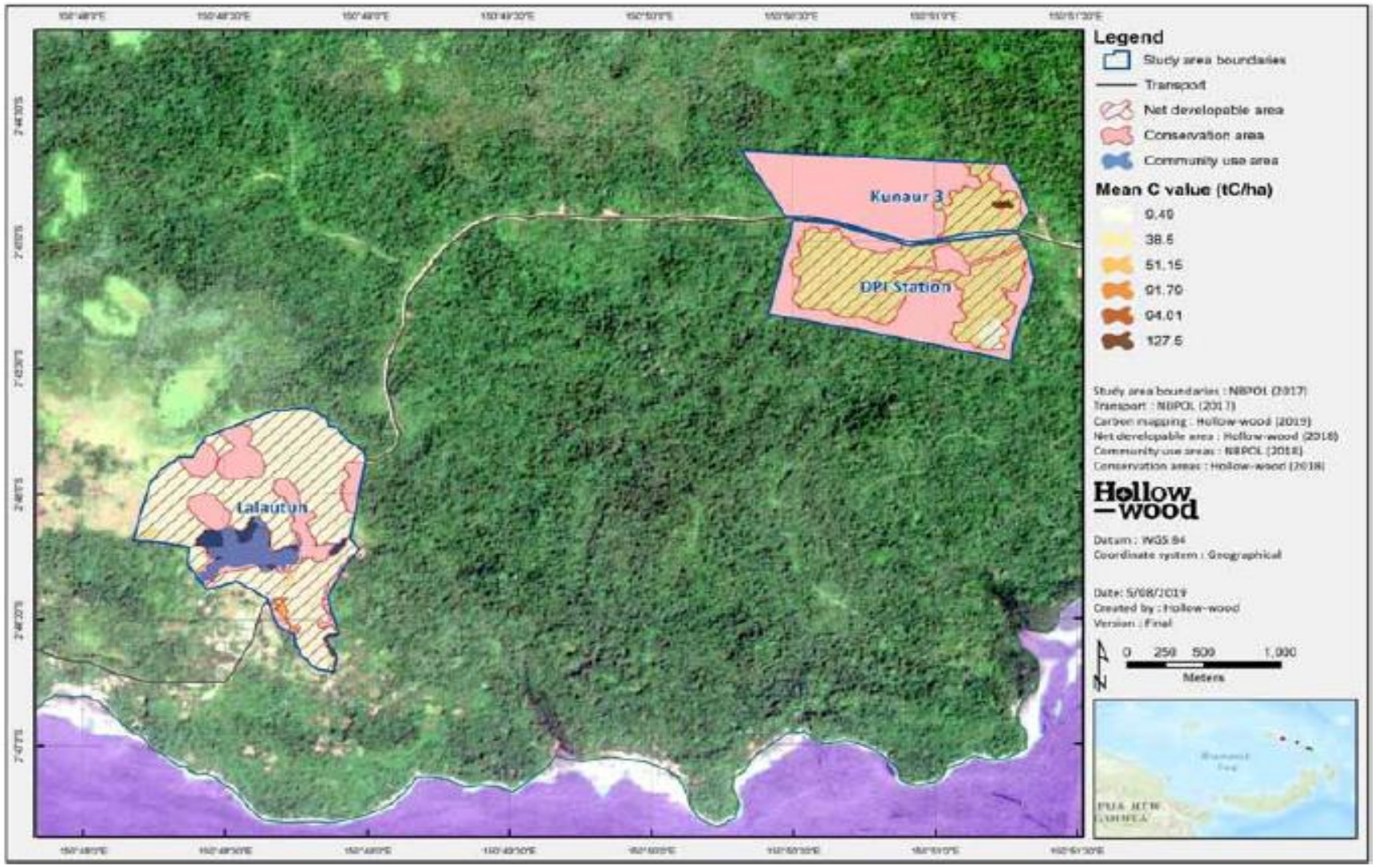
Table 44 below shows A summary table with carbon stock for every land cover assessed.

Table 44. Summary of statistical analysis of carbon stocks per vegetation class

Land cover class	Area (ha)	Plots (n)	Average Carbon stock (tC/ha)	Carbon stock standard error (tC/ha)	Confidence limits (90%) (tC/ha)		Total Carbon stocks (tC)
					Lower	Upper	
Potential HCS classes							
LDF	83.09	15	95.4	11.1	77.2	113.6	7,926.79
MDF	22.8	4	132.9	26.4	89.5	176.4	3,030.53
YRF	26.72	16	76.2	11.9	56.6	95.7	2,036.06
Non-HCS classes							
Scrub	91.36	24	32.8	5.8	23.3	42.3	2,996.6
Total							15,989.98



Map 15: Carbon stock estimates for the gross study



Map 16: Carbon stock estimates for the net area authorised for development.

3.5 Land Use Change Analysis

3.5.1 Methods

I. Relevant time of clearance period - *please tick*	
✗ November 1, 2005-November 31, 2007	✗ December 1, 2007-December 31, 2009
✗ January 1, 2010-May 9, 2014	✓ After May 9, 2014

II. Date of satellite image acquisition for each time of clearance period		
Period	**Date of acquisition**	**Cloud cover (over study area) (%)**
Before November 1, 2005 (baseline)	11/04/2003	0
November 1, 2005-November 31, 2007 (period 1)	21/05/2006	0
December 1, 2007-December 31, 2009 (period 2)	02/11/2008	0
January 1, 2010-May 9, 2014 (period 3)	09/11/2013	0
After HCV areas identified (period 4)	09/01/2018	0
HCV assessment to current (period 5)	28/12/2019	5
After becoming RSPO member (if relevant)	n/a	
After the management unit acquired (if relevant)	n/a	
Latest satellite image used for ground truthing	18/10/2014	0

Further notes regarding image acquisition

Sensor	Scene ID	Capture date	Resolution
Landsat 7 (ETM)	LE07_L1TP_094062_20030411_20170125_01_T1_ANG	11/04/2003	30m
Landsat 7 (ETM)	LE07_L1TP_094062_20060521_20170109_01_T1_ANG	21/05/2006	30m
Landsat 7 (ETM)	LE07_L1TP_094062_20081102_20161224_01_T1_ANG	02/11/2008	30m
Landsat 8 (OLI)	LC08_L1TP_094062_20131109_20170428_01_T1_ANG	09/11/2013	30m
Sentinel 2a	S2A_MSIL2A_20180109T002701_N0206_R016_T56MKB 20180109T015340	09/01/2018	20m (resampled to 30m)
Landsat 8 (OLI)	LC08_L1TP_094062_20191228_20200110_01_T1_ANG	28/12/2019	30m
Quick bird	Not provided	18/20/2014	0.5m

Baseline: The assessor considered in critical that a quality, cloud free image was used as a baseline for this assessment. Therefore, images that were not subject to the Landsat 7 (LS7), scan-line correction failure (May, 2003) were considered the best candidates for this analysis. This image was then able to be used as an input for scan line correction ('gap-filling') on the two other LS7 images (Period 1 and Period 2) used in this analysis.

Period 1: LS7 (scan line failure effected) image was gap-filled using ENVI 5.1, and used the baseline image as an input into the process. This resulted in an image with minimal cloud, corrected pixels and ready for analysis.

Period 2: This LS7 (scan line failure effected) image was gap-filled using ENVI 5.1. The baseline image was used as an input into the process, resulting in an image with no clouds, corrected pixels and ready for analysis.

Period 3: LS8 image was mostly cloud free, with the small areas of cloud not falling within the study areas.

Period 4: Sentinel 2a that was utilised for the integrated HCV/HCSA assessment. This image was cloud free, and was resampled to 30m, to allow direct cross tabulation with the Landsat products used for earlier periods.

Period 5. LS8 image was mostly cloud free, but small area of cloud exists over the eastern area in Lalautun. Clouded areas were masked during analysis, and re-classified as 'NoData'.

III. Satellite images used in the LUC Analysis	
Satellite name	**Satellite Resolution**
See above	See above

IV. List of data and document used in the LUC Analysis		
1. Land clearance progress map (monthly)	☐ Available/used	✘ Not applicable
2. Land clearance progress data (monthly)	☐ Available/used	✘ Not applicable
3. Planting year map	☐ Available/used	✘ Not applicable
4. Planting year data	☐ Available/used	✘ Not applicable
5. Land compensation progress map (if applicable)	☐ Available/used	✘ Not applicable
6. Land compensation progress data/document (if applicable)	☐ Available/used	✘ Not applicable
7. Soil map. ***Please attach the maps (in jpg/png/pdf format) AND submit the files (in shp/tab/dwg format).***	☐ Available/used	✘ Not available
8. Slope map. ***Please attach the maps (in jpg/png/pdf format) AND submit the files (in shp/tab/dwg format).***	✓ Available/used	☐ Not available
9. Watershed-hydrology map (rivers and streams, water bodies, springs, etc.). ***Please attach the maps (in jpg/png/pdf format) AND submit the files (in shp/tab/dwg format).***	✓ Available/used	☐ Not available
10. HCV assessment report. ***Please attach the maps (in jpg/png/pdf format) AND submit the files (in shp/tab/dwg format).***	✓ Available/used	☐ Not available
11. Others:	Social and Environmental Impact Assessment (SEIA); (Lovai, 2018)	

V. Image processing - *please tick*		
Radiometric correction	✓ Conducted	☐ Not conducted
Geometric correction	✓ Conducted	☐ Not conducted

VI. Image analysis - *please tick*		
✓ **Supervised classification**	☐ Unsupervised classification	☐ Object based visual interpretation

VII. Survey design	
Number of samples	250
Sampling method	Stratified Random Sampling. Two main data sources used for accuracy assessment. • 32 test points derived from data collected during HCSA (High Carbon Stock Approach) field assessment. These were all within the Study Area boundaries • 218 test points interpreted from the high resolution 'Quick bird' imagery, using both the information gained through field work and the assessor's knowledge as guidance.

Reference for sampling method	Congalton & Green, (2008); Jones & Vaughn, (2010); Lunetta & Lyon, (2004).

VIII. Field verification - *please describe the method and process used in the LUC analysis*

Validating the land cover data	Field verified (GPS'ed) ground truth and visually interpreted sample points from High Res imagery
Compiling information related to historical land use in the study area	Review of publicly available literature and reference to HCV and HCSA assessment reports
Identifying the loss of social HCVs	No loss of social HCV's. As this assessment is for a new planting (not RaCP), the combination of the SEIA carried out by N. Lovai (2018) and the integrated HCV/HCSA assessment conducted by Hollow-wood in 2018, both ensure that social HCVs or other areas of community importance have been identified and protected. See attached HCV assessment for further details.
Identifying the loss of areas where planting is prohibited by RSPO P&C or by country's specific legislation (e.g. riparian zones, steep slope, deep peat)	No loss of values on areas prohibited by RSPO P&C. This assessment is for a new planting, and the Integrated HCV/HCSA assessment conducted by Hollow-wood in 2018 identified a range of values that require protection.

IX. Image validation

Method used for LUCA accuracy assessment	Reference areas and test pixels created and 'Combine' function in ArcGIS (Spatial Analyst) was used to create dataset from which error matrix and descriptive statistics can be derived, namely Kappa coefficient.

X. Change detection analysis

Describe the method used and process conducted in this stage of LUC analysis

The 'Tabulate Area' tool was used perform a 'to and from' analysis that calculated area by land cover class on a pixel by pixel basis, or each of the four (4) required reporting periods.

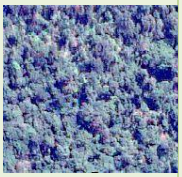
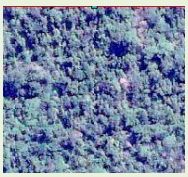
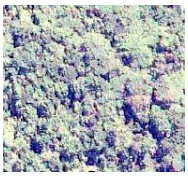
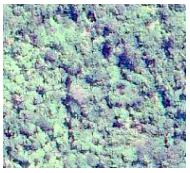
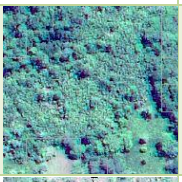
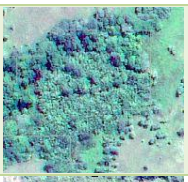
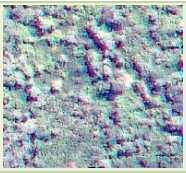
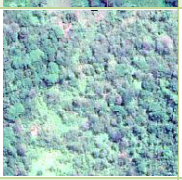
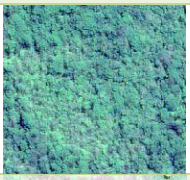
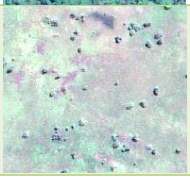
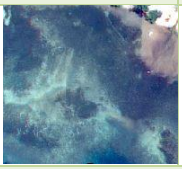
XI. Vegetation coefficient

Describe the method used and process conducted to determine and categorize the land cover class into vegetation coefficient

Land cover	Description	Coefficient
Remnant lowland rainforest on limestone karst	This community is one of the most commonly encountered across New Ireland, with these limestone karst communities characterised by alkaline soils and well-to excessively drained substrates. The poor water holding capacity of limestone karst ecosystems is a key cause of seasonal water stress. Mueller-Dombois and Fosberg (1998) states that the species composition of such ecosystems is generally similar to that found on other substrates, such as acid soils or alluvial plains and fans, and broadly follows that described by (Paijmans, 1976), although further investigation will likely reveal high levels of endemism on outlier islands such as New Britain and New Ireland . Dominant character species include *Pometia pinnata, Homalium foetidum* and *Alstonia scholaris*, and a high diversity of *Terminalia spp*. Typical sub-canopy tree genera includes *Garcinia, Myristica, Diospyros, Maniltoa and Microcos.* Black palms (*Caryota spp*), Fan palms (*Licuala spp*) and tree ferns (*Cyathea spp*) are	1

	common understorey components, as are pandanus species, both terrestrial (*Pandanus spp*) and climbing (*Freycinatia spp*.). One notable family that is absent on New Ireland is Araucariacea, with well-known species such as Kauri (*Agathis spp*), Hoop pine (*Araucaria cunninghamii*) and Klinki pine (*Araucaria hunstenii*) all absent from New Ireland.		
Secondary lowland rainforest on limestone karst	Much of the accessible forest areas across New Ireland consist of secondary forest communities, where broad-scale or repeated disturbance have removed mature, primary forest canopy species, resulting in a community largely dominated by early to mid-successional species. Both natural disturbance (in the form of landslips or wind-throw from severe storm events) and anthropogenic events, such as shifting cultivation or logging, are key drivers in the formation of secondary forests. In the context of New Ireland, canopy tree genera that are characteristic of secondary forests include; *Sterculia, Octomeles, Kleinhovia, Cananga*, *Terminalia, Vitex* and *Anthocephalus*.	0.7	
Anthropogenic grasslands and open lands	Most of the grasslands across PNG (including the Bismarcks) are considered to be of anthropogenic origin, maintained by a near annual, low intensity fire regime. The grassland communities found within the study areas can generally be classified as either the *Imperata cylindrica* (Kunai)/*Saccharum spontaneum* (Wild Sugarcane) dominated 'tall grasslands', or the *Themeda australis* (Kangaroo Grass)/*Capillipedium parvifolium* dominated 'short grasslands'. Open lands include impervious surfaces such as roads, bare soil, river gravels and beach sands.	0	
Swamp woodland / Sago woodland	*Metroxylon sagu*, is found in tropical lowland forest and freshwater swamps across Southeast Asia and New Guinea and is the primary source of sago. It tolerates a wide variety of soils and may reach 30 meters in height (including the leaves). Several other species of the genus *Metroxylon*, particularly *Metroxylon salomonense* and *Metroxylon amicarum*, are also used as sources of sago throughout Melanesia and Micronesia.	0.7	
Garden fallow / scrub	Areas in this category are ecosystems that have undergone intense and/or frequent disturbance events that are mainly of anthropomorphic origin. This also includes areas of vegetation that are under a system of shifting cultivation. This may include areas in fallow (i.e. resting) or areas in current use. This vegetation is typically low in diversity, is dominated by pioneering species and shows evidence of the repeated use of fire. In the AOI, common species common species observed were; *Piper aduncum, Trema orientalis, Macaranga tanarius, M. aleuritoides, Leea indica, Kleinhovia hospita, Hibiscus tiliaceus and variety of Ficus spp*	0	

3.5.2 Field verification

a) Documentation related to current and historical land cover class found in the study area (pictures and brief description of each land cover class).				
Land cover class	**Pic 1**	**Pic 2**	**Pic 3**	**Description**
Remnant forest				Remnant lowland rainforest on limestone karst. Such stands are close to primary in structure and species composition and exist in areas that were unsuitable for harvesting during the 1980's and 1990's due to locally steep slopes or poor drainage
Secondary forest				Secondary / disturbed lowland rainforest on limestone karst. This is the most extensive forest community across the AOI and is a result of native forest timber harvesting in the 1980's and 1990's.
Swamp woodland				In the Melanesian context, swamp woodlands are often dominated by 'Sago' *(Metroxylon sagu)*, but also may include other tree species that are tolerant of inundation.
Scrub				Highly degraded vegetation, often the result of shifting cultivation or other disturbances, such as the DPI cassava project in the 1990's.
Grasslands / open lands				Bare lands such as recently disturbed soil, recently burnt lands or exposed river gravel. Anthropogenic grasslands established for pasture, dominated by either *Imperata cylindrica* or *Themeda australis*
Open water		n/a	n/a	Open water: i.e. rivers or lakes

b) **Brief information on historical land use in the study area.**

New Ireland has had continuous human settlement going back 50,000 years or more (Gosden, 2010). European interaction with the region began in the early 1600s, with explorers from the Netherlands, Britain and France all making contact. In 1884 Century, German colonised New Ireland (calling in Nue Mecklenburg) as part of the German Protectorate of New Guinea (Jessep, 1977). Between 1914 and 1921 the island was under Australian military occupation, after which it was administered by Australia (Jessup, 1977). PNG become independent in September 1975.

Across most of the island, the German administration enacted a forced resettlement of inland populations, reducing inland agricultural use and increasing pressure on coastal areas (Hide *et al.*, 2002). Since the 1950s copra has been a major source of cash income, with cocoa planted later and generally on a smaller scale Hide *et al.*, 2002). There has also been logging in a number of areas since the mid-1970s (Hide *et al.*, 2002), with this practice continuing up to the present. Large timber rights purchases (TRP's) still being active across logging concessions in central New Ireland. Palm oil became a major plantation crop, both on an estate scale and, to a lesser extent, on smallholder plantations (Hide *et al.*, 2002).

Palm oil plantations were first introduced to New Ireland by the Commonwealth Development Corporation in 1987. It was then acquired by Cargill and Temasek Holdings and registered as CTP Holdings. The New Britain Palm Oil Limited (NBPOL) purchased CTP Holdings in 2010 and operates as Poliamba Estates. In 2009, the total area of oil palm plantations in New Ireland, including both plantations and smallholder blocks, was 8,302 hectares (Nelson P.

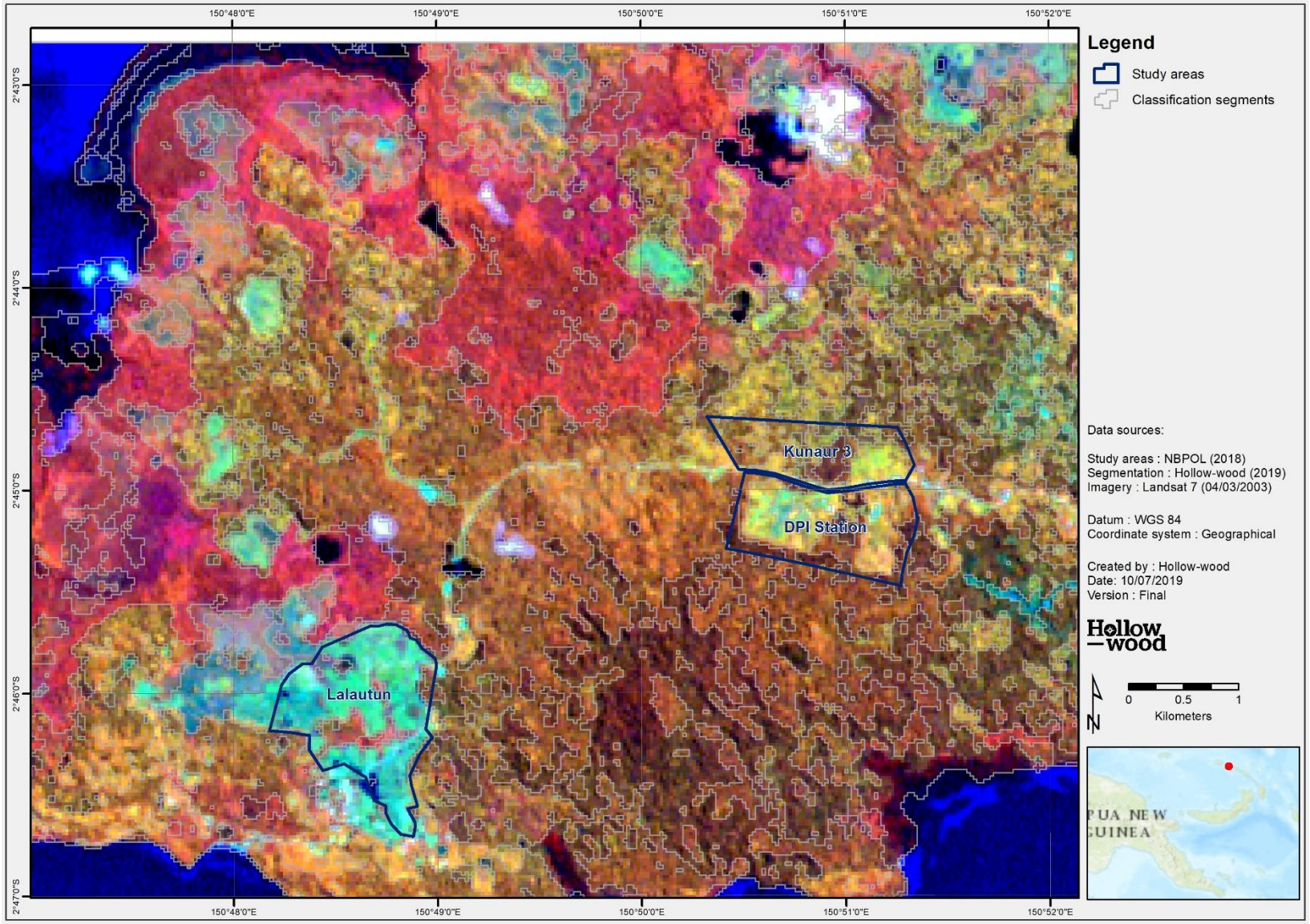
N. et al. 2010). This area would have increased since then considering expanded plantations, new smallholder blocks and re-planted areas.

The Kunaur 3, Lalautun and DPI Station plots are all within customary land boundary registered to the Tivingau ILG. The Tivingau ILG was registered in December 2016 (Certificate of Recognition of Incorporated Land Group – Tivingau Land Group Incorporated dated 20/12/2016). The ILG applied for registration of Customary land over the 2731ha, known as Portion 1270, Milinch Djaul, Fourmil Kavieng in the Kavieng District of New Ireland on 30/03/2017. Their claim was supported by a Land Investigation report, undisputed by neighbouring clans and recommended for registration by the Provincial Administrator, with the ILG being officially gazetted on the 20/12/2016.

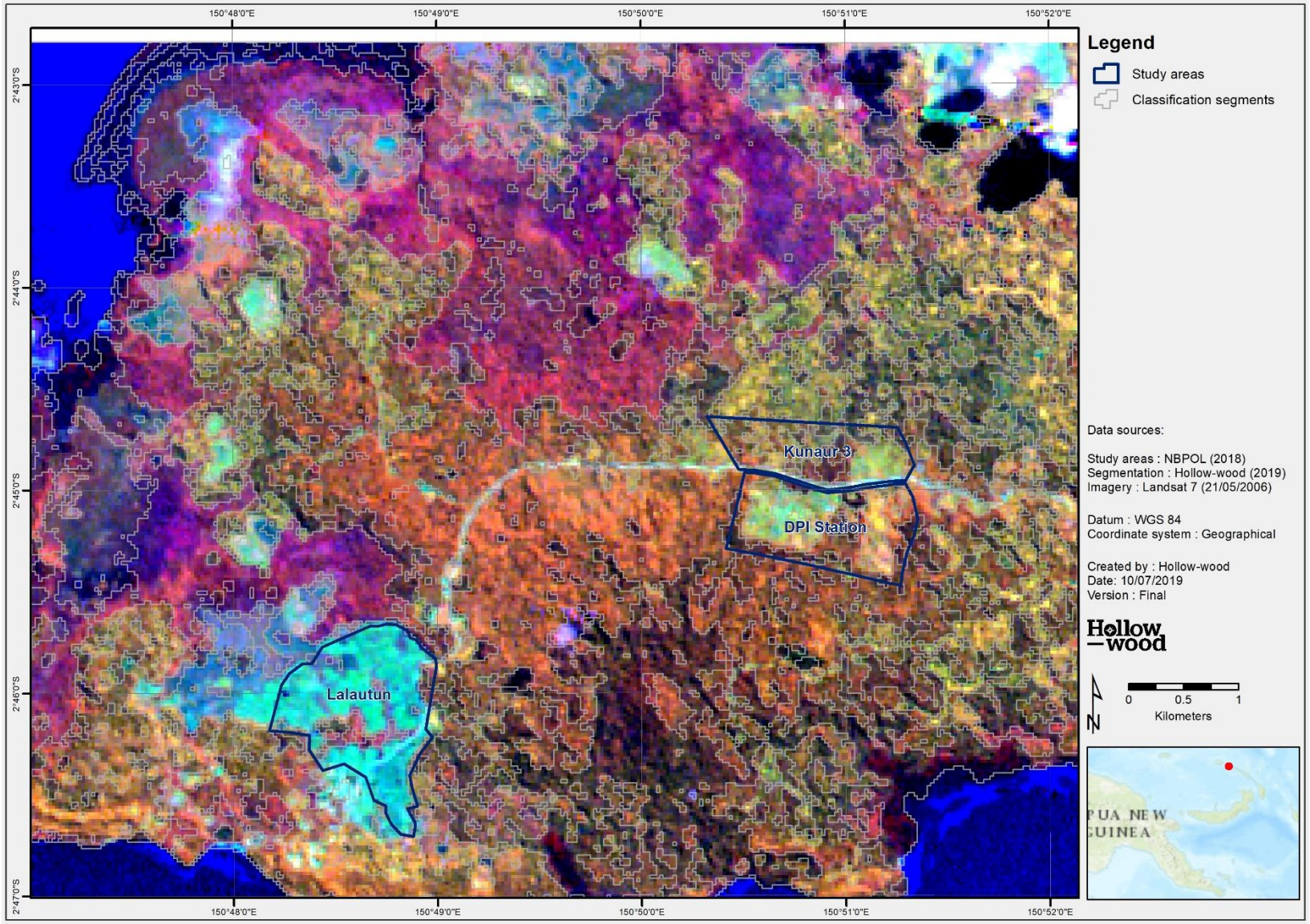
Two large scale agricultural ventures have been investigated in area around Lokono village, including within the current Tivingau ILG area:

- In September 1996 the New Ireland Provincial Government signed a Joint Venture Agreement with Agricultural Research and Advisory Sendririan Berhad (ARAB) Malaysia to establish a Nucleus Estate with surrounding smallholder or settler plantations for the production and supply of rubber and/ or other crops.

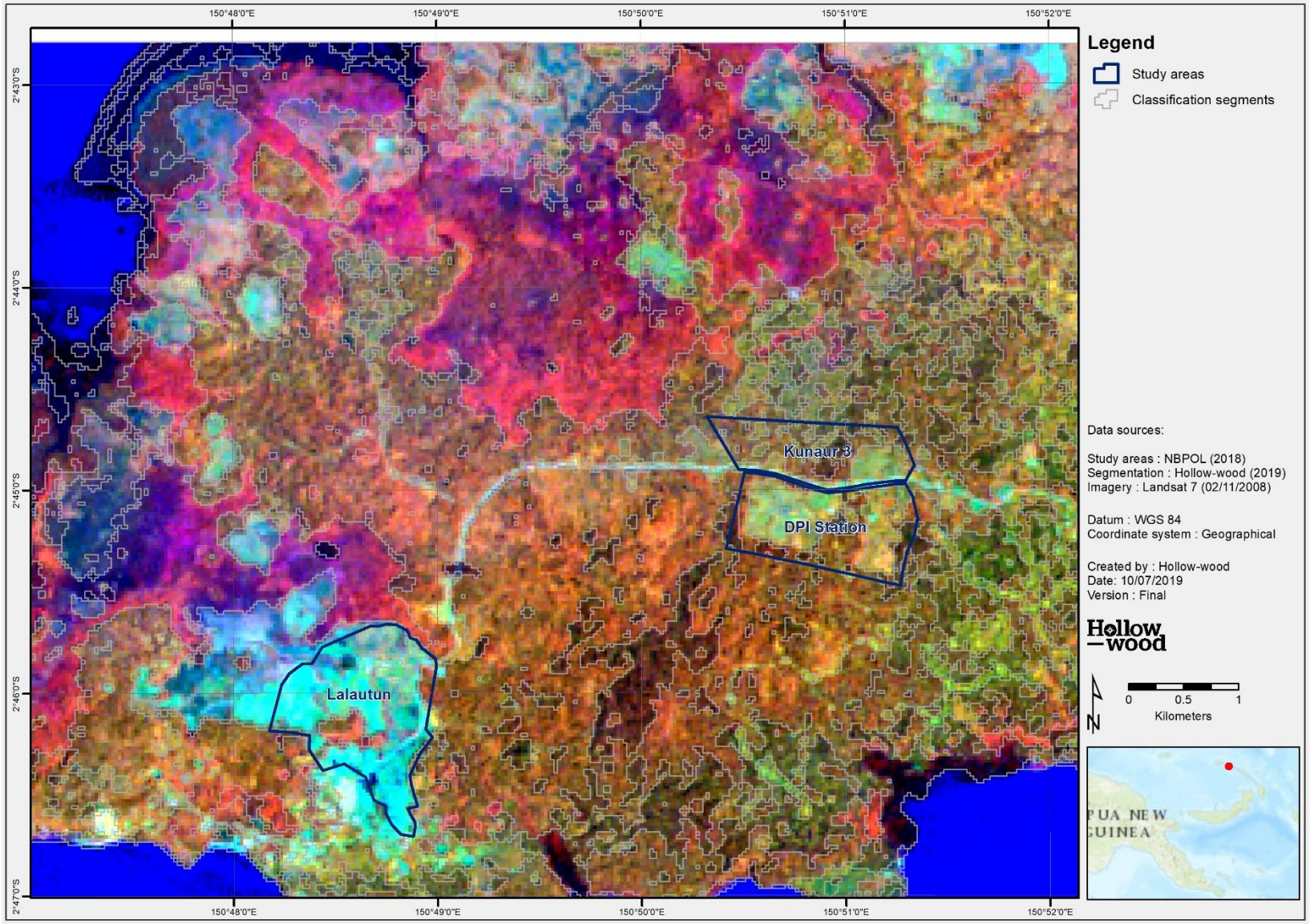
- In 2006 a Land Investigation Report for the New Ireland Cassava Project was published that strongly supports the development of land for growing cassava.



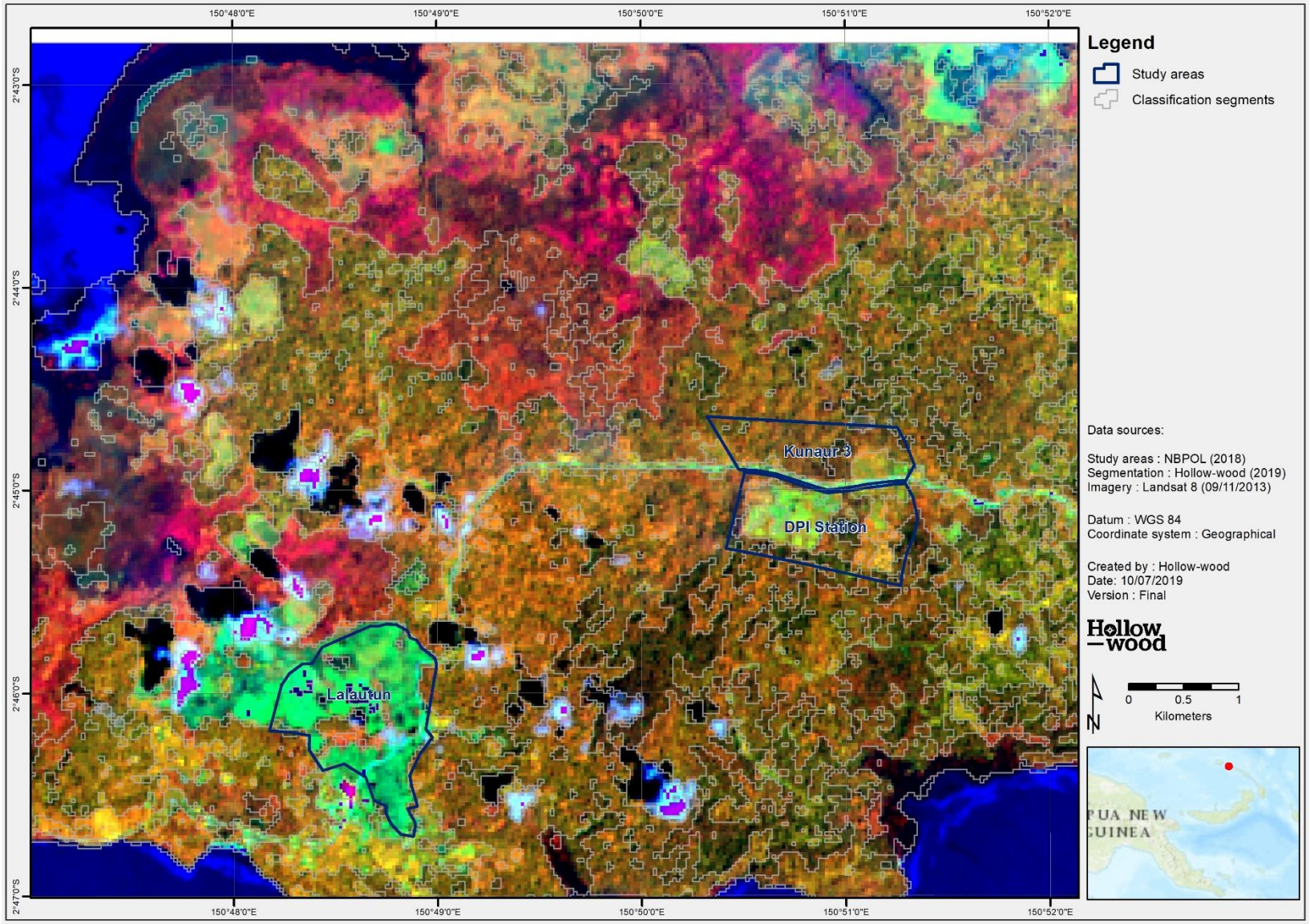
Map 17. Baseline imagery used for analysis. Landsat 7 (04/03/2003)



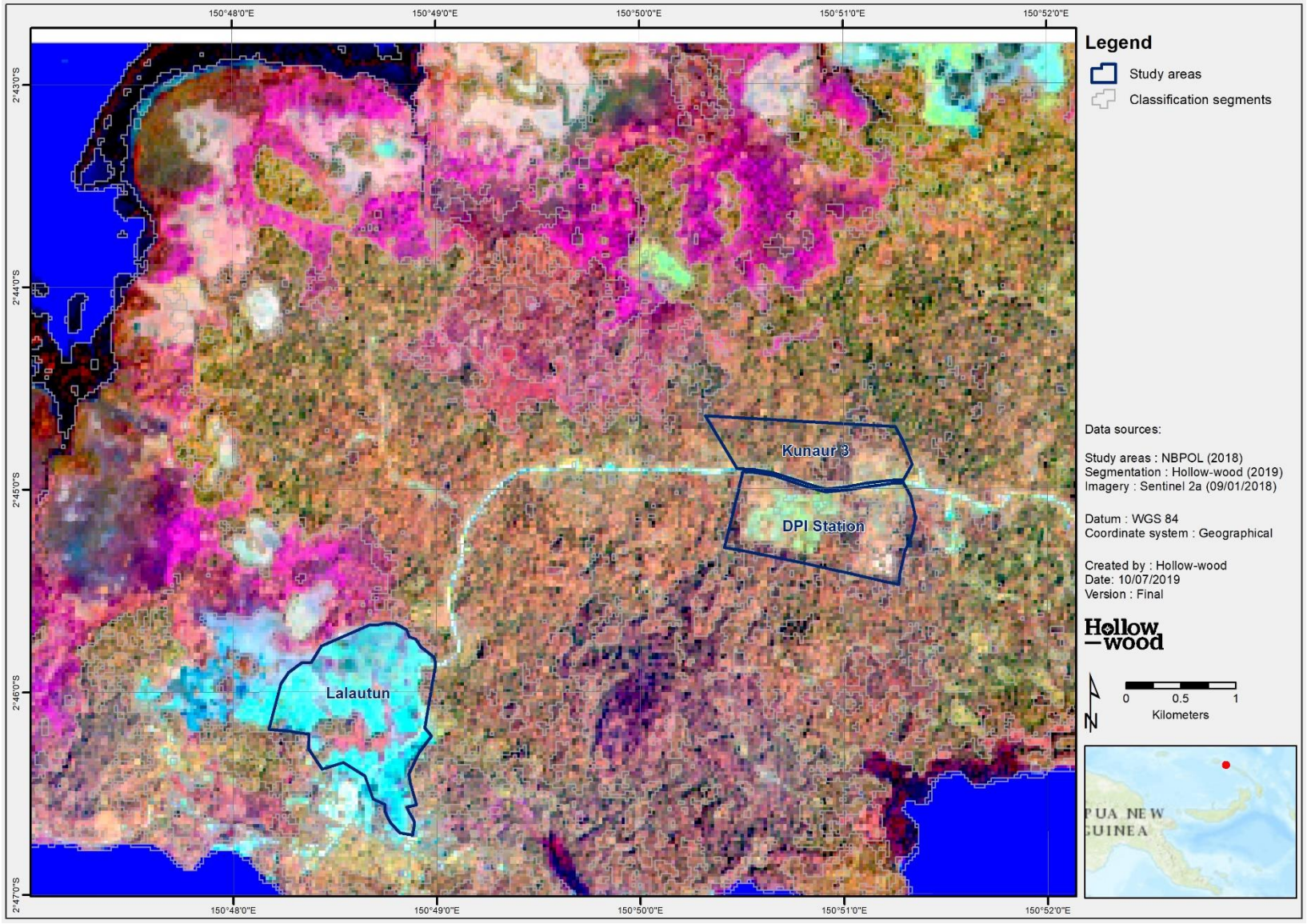
Map 18. Period 1 imagery used for analysis. Landsat 7 (21/05/2006)



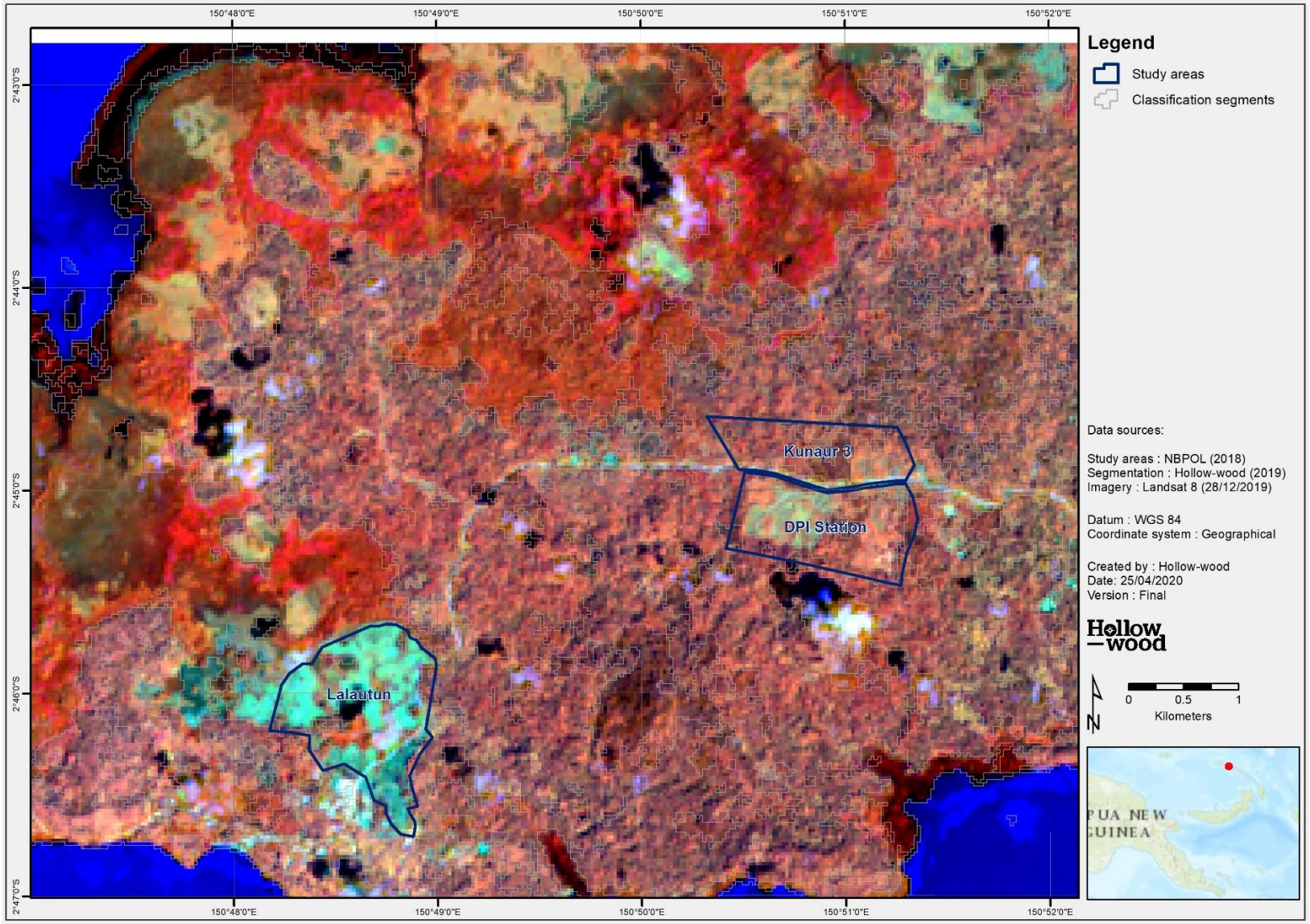
Map 19. Period 2 imagery used for analysis. Landsat 7 (02/11/2008)



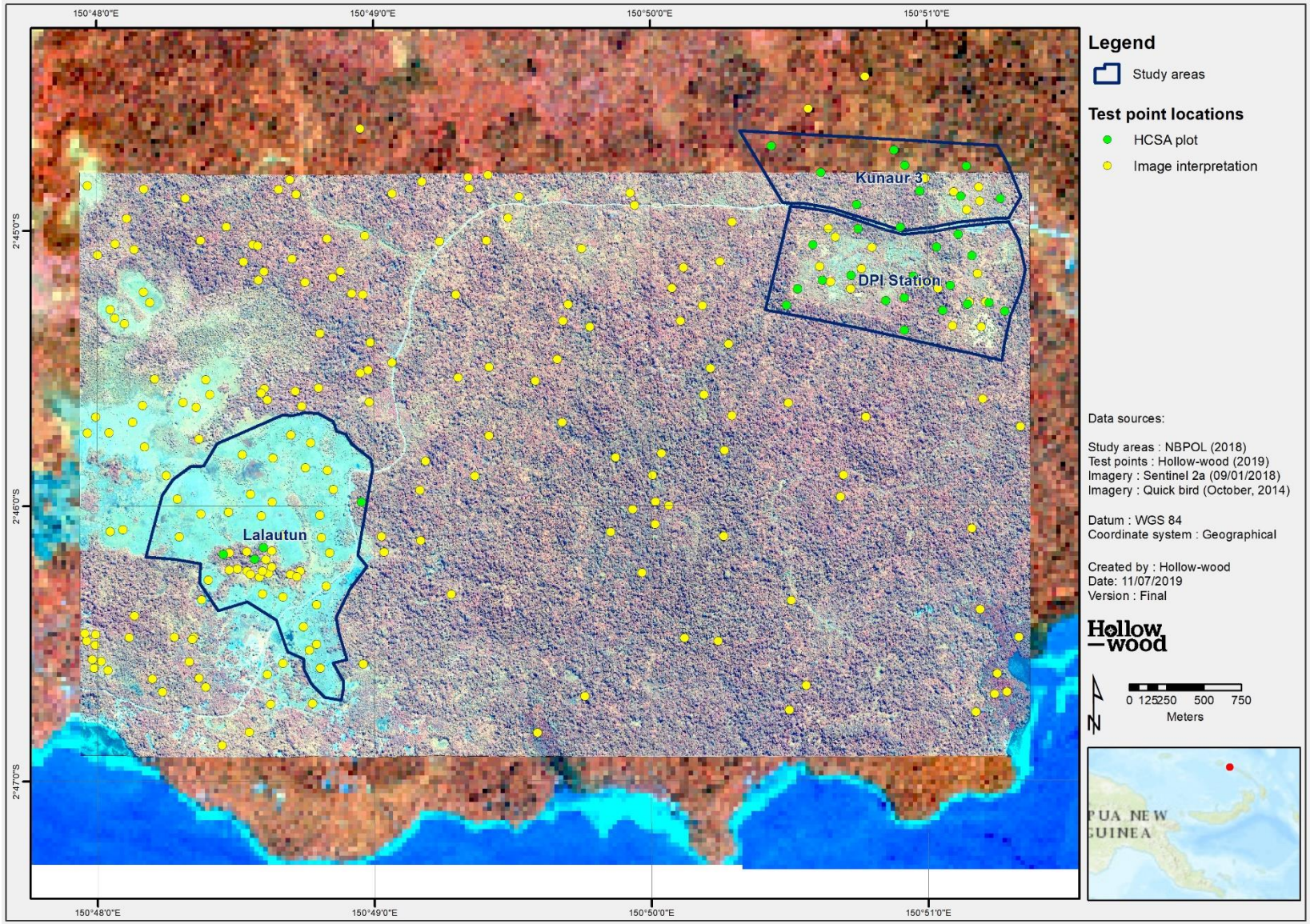
Map 20. Period 3 imagery used for analysis. Landsat 8 (09/11/2013)



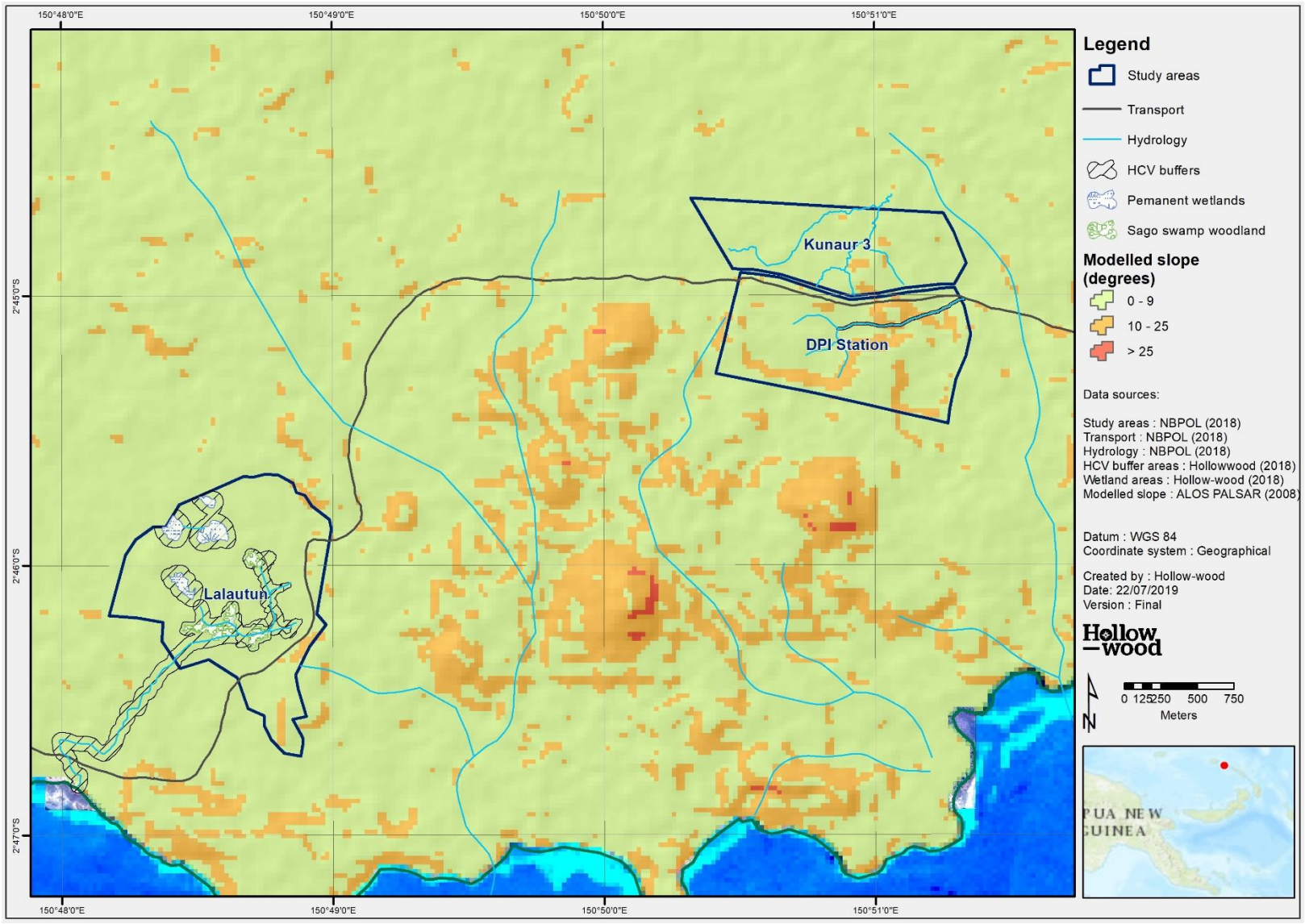
Map 21. Period 4 imagery used for analysis. Sentinel 2a (09/01/2018)



Map 22: Period 5 imagery used for analysis. Landsat 8 (28/12/2019).



Map 23. Image accuracy test sample locations.



Map 24: RSPO operational constraint

3.5.3. The loss of social HCVs and areas where planting is prohibited by RSPO P&C or by country's specific legislation

I. Brief information on the loss of social HCVs (if any). This includes estimated number of hectares and current condition of these areas.

This is a New Planting, therefore social HCV's have not been lost, but rather identified for protection by participatory means and reported in the SIA and integrated HCV/HCSA assessment for the new development (Lovai, 2018 and Hollow-wood, 2018) respectively.

II. Map of social HCV areas lost (if any)

Not applicable

III. Brief information on the loss of areas where planting is prohibited by RSPO P&C or by country's specific legislation (e.g. riparian zones, steep slope, deep peat) (if any). This includes estimated number of hectares and current condition of these areas.

HCV identification

A range of HCVs were identified during the recently conducted integrated HCV/HCSA assessment. These include areas of HCV 1, HCV 2, HCV3 HCV 4 and some small areas of HCV 5 and HCV 6. The values can broadly be seen on Map 8, and detailed on HCV map summaries on Maps 9 and 10.

- **HCV 1** values include areas of remnant forest and secondary forest where the IUCN Red-listed species '*Terminalia archipelagi*' was found
- **HCV 2** includes all areas of forest that are connected the larger landscape
- **HCV 3** includes all areas of forest that are occurring on 'limestone karst' parent material
- **HCV 4** areas include the south flowing drainage lines within the Lalautun study area (Liangtalaulau Creek), the permanent wetlands found in the north west of Lalautun, the patch of *Metroxylon sagu* (Sago) dominated swamp woodland found within the center of Lalautun and the north flowing drainage line (DPI creek) found in the DPI Station study area.
- **HCV 5** areas include all potable drinking water sources and Sago patches identified through participatory means
- **HCV 6** includes the two patches of sago already identified and the sacred site 'Talisarem masalai' area on the south western boundary of Lalautun.

The total, merged sum of all HCV areas across all study areas is 163.08 ha

Identification of area prohibited for Oil Palm production

A range of documents were used in order to understand the where industrial oil palm establishment is not appropriate, including the following;

- The Papua New Guinea High Conservation Value National Interpretation (PNG FSC, 2005)
- The Common Guidance for the identification of High Conservation Values (Brown *et al.*, 2013)
- The RSPO Principles and Criteria ; Papua New Guinea National Interpretation (RSPO, 2017)

Guidance for slope limitations were sourced from page 36 of RSPO (2017), and are as follows;
'*Excessive gradients which shall be avoided are those that are 25 degrees or greater. Soil conservation measures (e.g. terracing, platforms, cover crop etc.) should be applied for terrain with gradients between 9 and 25 degrees. Soil suitability should be determined using crop and environmental Suitability criteria. Those identified as marginal and/or problematic should be avoided if the soil cannot be improved through agro-management input*'.

In addition to the guidance found within these documents, NBPOL have environmental protection requirements set out in the *agricultural permit* that is issued by the Conservation and Environmental Protection Authority (CEPA). This is provided in the Table below.

Classification	Definition	Measure from	Buffer Width (new development)	Buffer Width (Replant of existing palms, or crop conversion)
Permanent Watercourse 1A	50m or greater bed width	Top of bank	100m	50m
Permanent Watercourse 1B	10-50m bed width	Top of bank	50m	50m
Permanent Watercourse 1C	5-10m bed width	Top of bank	20m	20m
Permanent Watercourse 1D	1-5 bed width	Top of bank	10m	10m
Swamps	including swamps that have surface water present for at least 6 months of the year	Water edge during wet season.	50m	50m
Ox-bow lakes	Cut-off river meanders that have surface water present for at least 6 months of the year	Top of bank	50m	50m
Sea	Includes estuaries and mangroves	From spring high tide mark	100m	50m
Watercourse	That is an essential source of drinking water for the community.	Top of bank	50m	50m
Protected Areas	WMA, Conservation Areas, National Parks	From boundary	100m	100m
Cultural Sites	As defined in SEIA	Edge of site as delineated in SEIA	100m guideline (greater or lesser as directed by community)	100m

IV. Map depicting the loss of areas where oil palm establishment is prohibited by RSPO P&C

See Map 8

3.5.4 Summary of the LUC accuracy assessment result

The accuracy assessments presented in this section are conducted as per the methods outlined in Lunetta and Lyon (2004), Congalton and Green (2008) and Lillesand *et al*., (2015).

The accuracy assessment result for the Tivingau AOI is provided below. The error matrix presented in Figure 1 shows a good result, with an overall accuracy of 91.9% and a k-statistic (Cohens kappa value) 0.90. Figure 1 is an assessment of the accuracy of the training samples developed for the land cover classification, with the high result being an indication of training polygon homogeneity, and therefore the spectral separability of each of the classes developed. The results of this test are arguably the most important when performing landscape scale classification, as a high result provides confidence in the results, and suggests that the classes that were defined were appropriate.

Figure 2 is an accuracy assessment of the classified image itself, with a sample of test pixels being compared against model output (i.e. the classified image). The ground truth result from HCSA plot locations are used in conjunction with manually interpreted test points (derived from the high resolution 'Quickbird' image, not the classified output)

to create a spread of test points, which are then converted to pixels and snapped to the grid of the classified output. The 'combine' function in spatial analyst was used for both test pixels and reference polygons, with the error matrix reported above derived from creating a pivot table of the results. This approach enables the rate of both commission (over-classification) and omission (under-classification) to be known.

Most classes performed well, with a small amount of both omission and commission error present between the 'secondary forest' and 'swamp woodland' classes. This phenomenon is not unexpected as community change may occur gradually along a moisture gradient, rather than as a sharp, defined line.

3.5.5. Corporate and non-corporate clearance divided into vegetation coefficient from specific period of time - *in hectares*

Summary process for determining corporate and non-corporate clearance

No land clearing has commenced

3.5.6 . Raw lands cover data (contingency matrix)

A. Period November 2005-November 2007 - *in hectares*

		Land cover 2006						
		Remnant forest	**Secondary forest**	**Swamp woodland**	**Garden fallow / scrub**	**Grassland / open land**	**Open water**	**Total**
Landcover 2003	**Remnant forest**	34.38	10.08	0.09	1.53	1.80	0.00	**47.88**
	Secondary forest	9.45	58.14	1.08	8.64	0.63	0.00	**77.94**
	Swamp woodland	0.54	0.09	1.08	0.00	0.00	0.00	**1.71**
	Garden fallow / scrub	1.44	7.65	0.09	84.42	5.13	0.00	**98.73**
	Grassland / open land	0.36	0.18	0.00	5.76	140.58	0.00	**146.88**
	Open water	0.00	0.00	0.00	0.00	0.27	0.00	**0.27**
	Total	**46.17**	**76.14**	**2.34**	**100.35**	**148.41**	**0.00**	**373.41**

B. Period December 2007-December 2009 - *in hectares*

		Land cover 2008					
		Remnant forest	**Secondary forest**	**Swamp woodland**	**Garden fallow / scrub**	**Grassland / open land**	**Total**
Land cover 2006	**Remnant forest**	23.94	19.26	0.18	1.44	1.35	**46.17**
	Secondary forest	7.11	58.14	0	9.81	1.08	**76.14**
	Swamp woodland	0.18	1.53	0.09	0	0.54	**2.34**
	Garden fallow / scrub	1.62	12.69	0	79.74	6.3	**100.35**
	Grassland / open land	0	0.54	0	20.07	127.8	**148.41**
	Total	**32.85**	**92.16**	**0.27**	**111.06**	**137.07**	**373.41**

C. **Period January 2010-April 2014** - *in hectares*

		Land cover 2013					
		Remnant forest	**Secondary forest**	**Swamp woodland**	**Garden fallow / scrub**	**Grassland / open land**	**Total**
Land cover 2008	**Remnant forest**	15.66	15.21	0.99	0.99	0	**32.85**
	Secondary forest	9.36	73.98	2.52	4.41	1.89	**92.16**
	Swamp woodland	0	0.09	0.18	0	0	**0.27**
	Garden fallow / scrub	1.26	27.18	0	53.55	29.07	**111.06**
	Grassland / open land	1.53	1.98	2.25	7.56	123.75	**137.07**
	Total	**27.81**	**118.44**	**5.94**	**66.51**	**154.71**	**373.41**

D. **Period May 2014-HCV assessment** - *in hectares (if the HCV assessment conducted and the report issued after May 2014)*

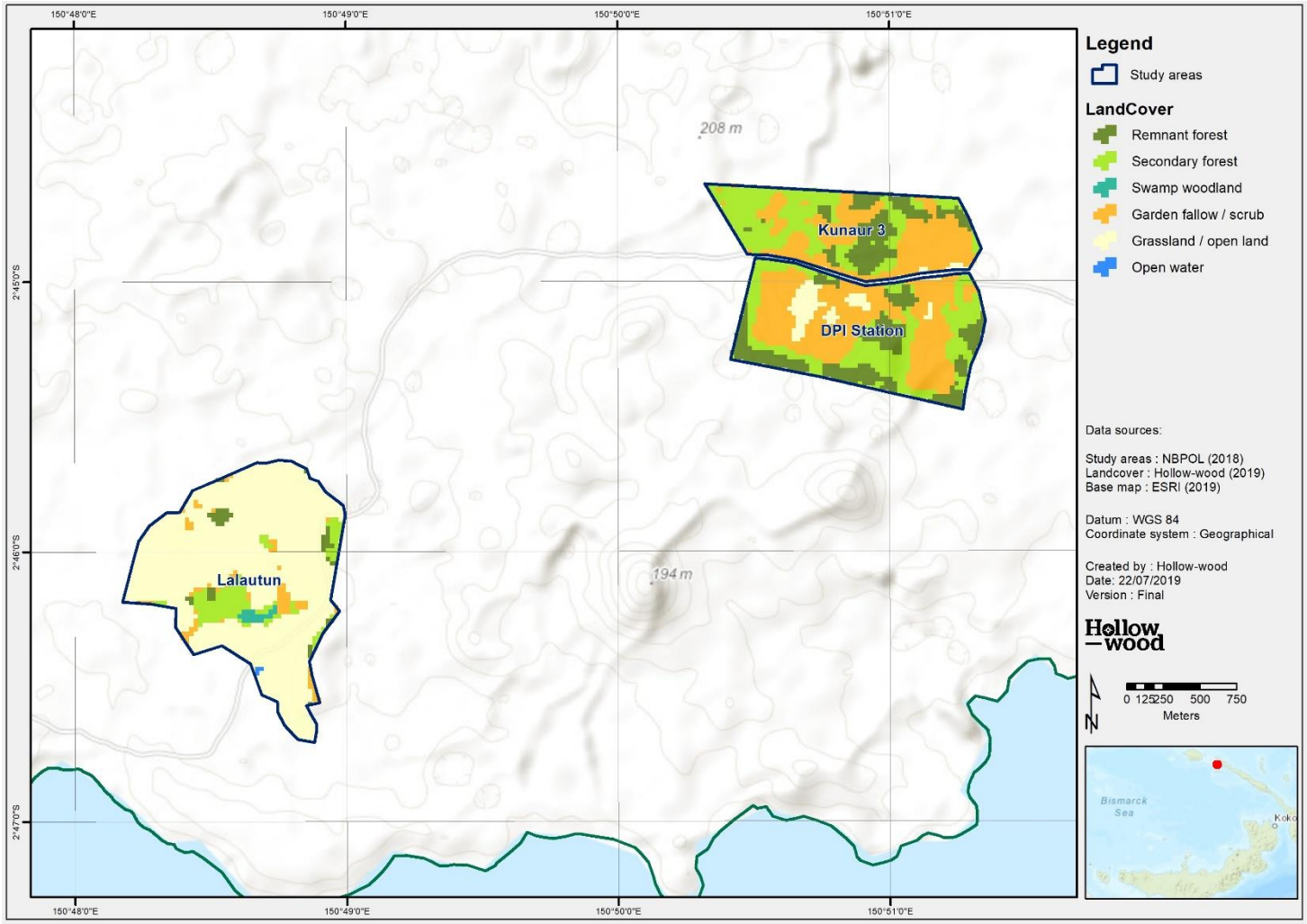
		Land cover 2018					
		Remnant forest	**Secondary forest**	**Swamp woodland**	**Garden fallow / scrub**	**Grassland / open land**	**Total**
Land cover 2013	**Remnant forest**	14.04	9.99	0	1.62	2.16	**27.81**
	Secondary forest	22.05	72	3.15	16.11	5.13	**118.44**
	Swamp woodland	1.35	0.09	2.34	0	2.16	**5.94**
	Garden fallow / scrub	2.25	5.04	0.99	49.23	9	**66.51**
	Grassland / open land	0.45	4.68	2.52	13.68	133.38	**154.71**
	Total	**40.14**	**91.8**	**9.0**	**80.64**	**151.83**	**373.41**

E. **Period HCV assessment (Feb 2018) to Current (28/12/2019)**

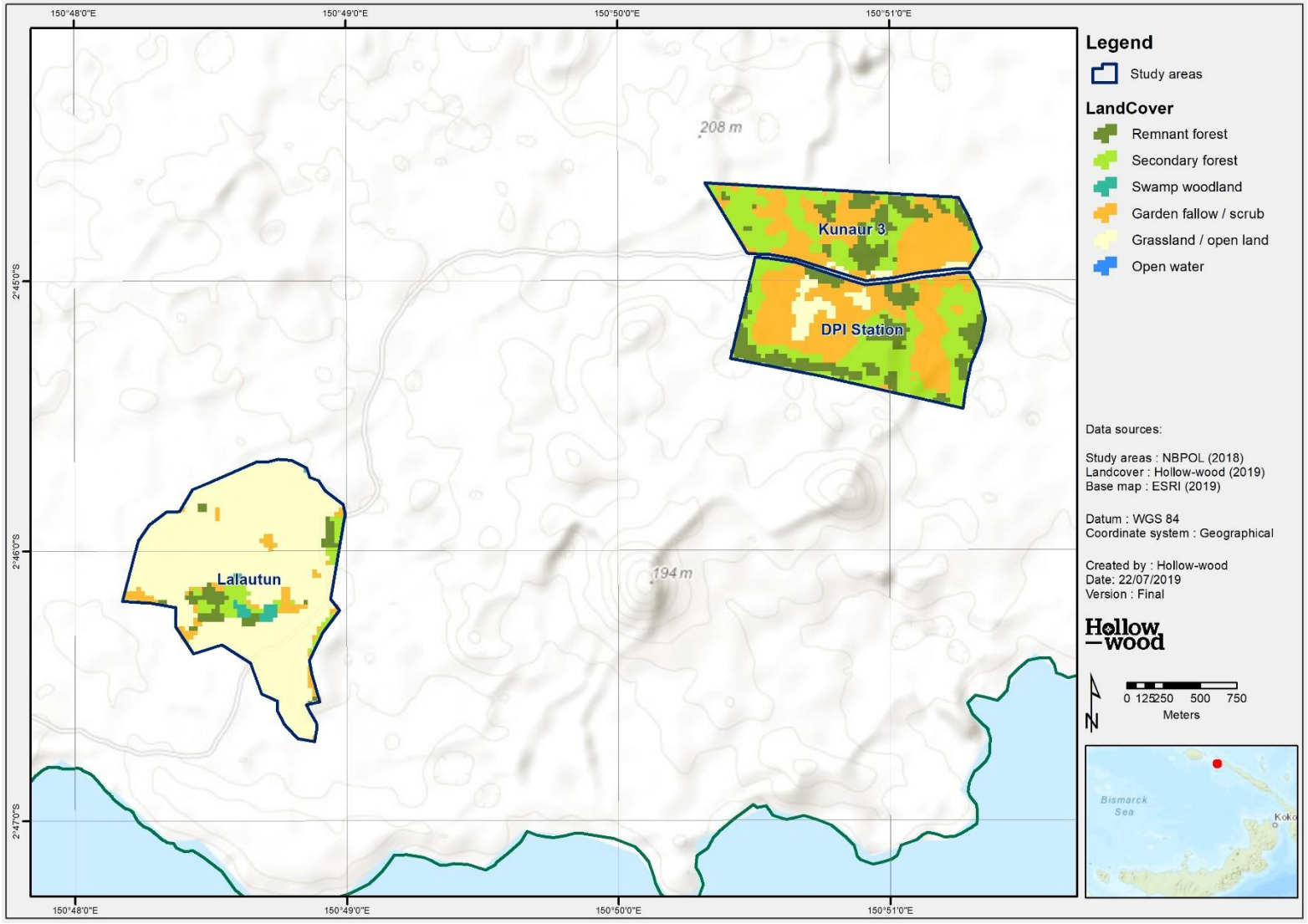
		Land cover 2019						
		Remnant forest	**Secondary forest**	**Swamp woodland**	**Garden fallow / scrub**	**Grassland / open land**	**NoData**	**Total**
Landcover 2018	**Remnant forest**	23.58	10.62	1.53	3.78	0.27	0.36	**40.14**
	Secondary forest	14.94	61.92	1.98	12.6	0.36	0	**91.8**
	Swamp woodland	0.63	0.09	5.49	0	0.99	1.8	**9**
	Garden fallow / scrub	1.35	12.87	3.96	52.83	9.63	0	**80.64**
	Grassland / open land	2.34	2.7	16.83	2.7	118.08	9.18	**151.83**
	Total	**42.84**	**88.2**	**29.79**	**71.91**	**129.33**	**11.34**	**373.41**

3.5.7. Raw and processed lands cover maps

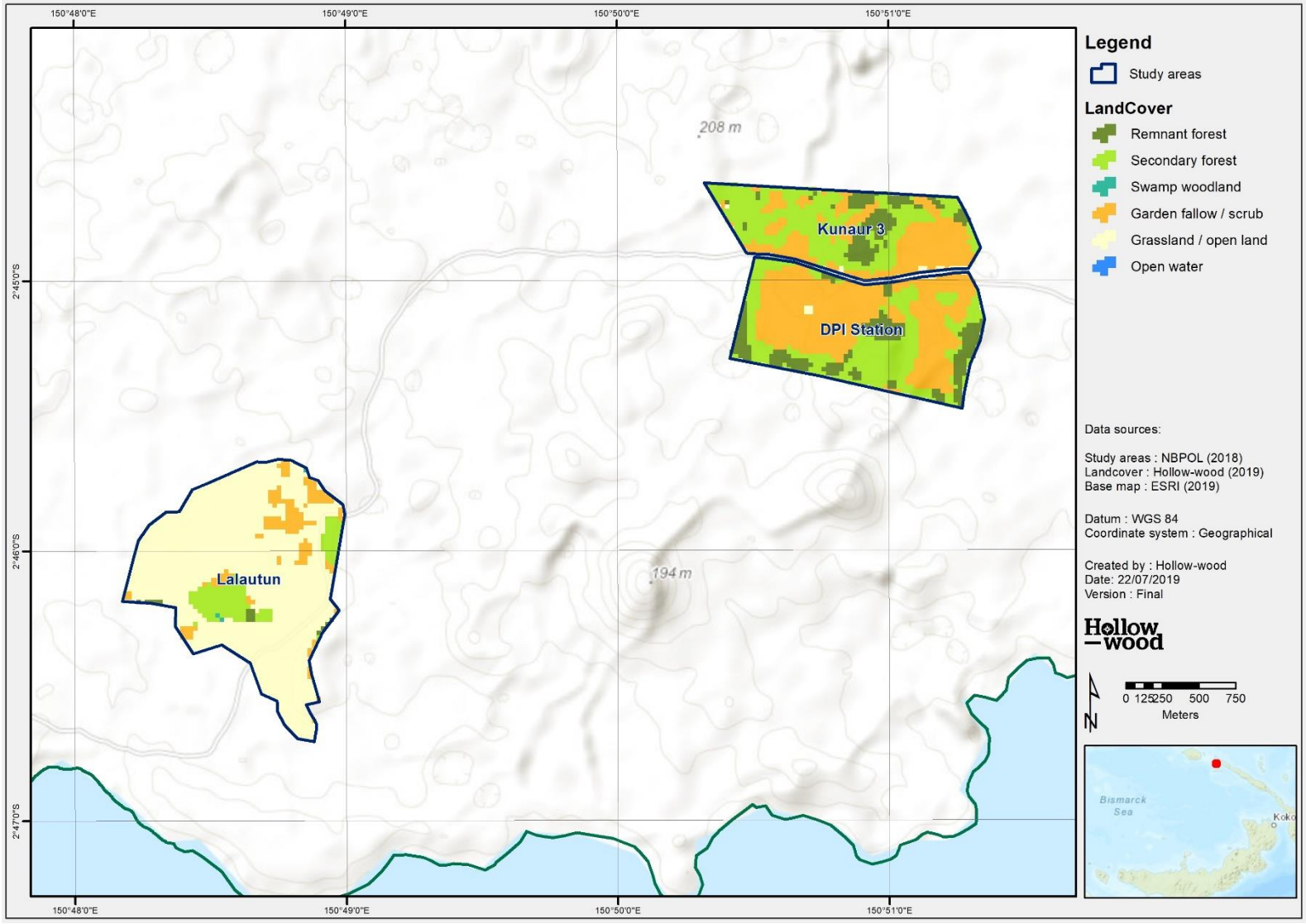
i. **Raw land cover maps** *(prior division into the according vegetation coefficients for each of clearance period and additional cut-off periods)*



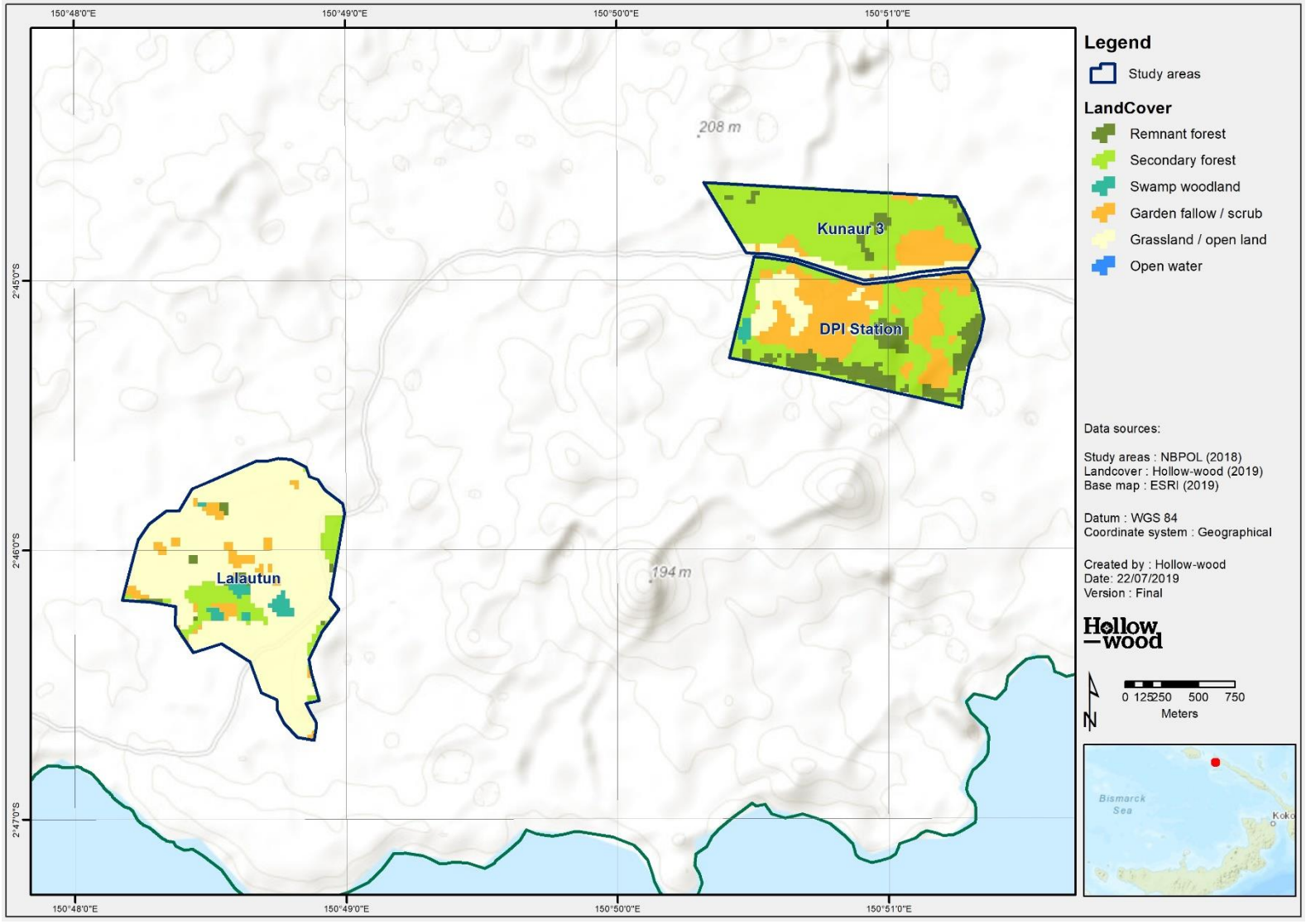
Map 25. Land cover Nov 1, 2005 to Nov 30, 2007



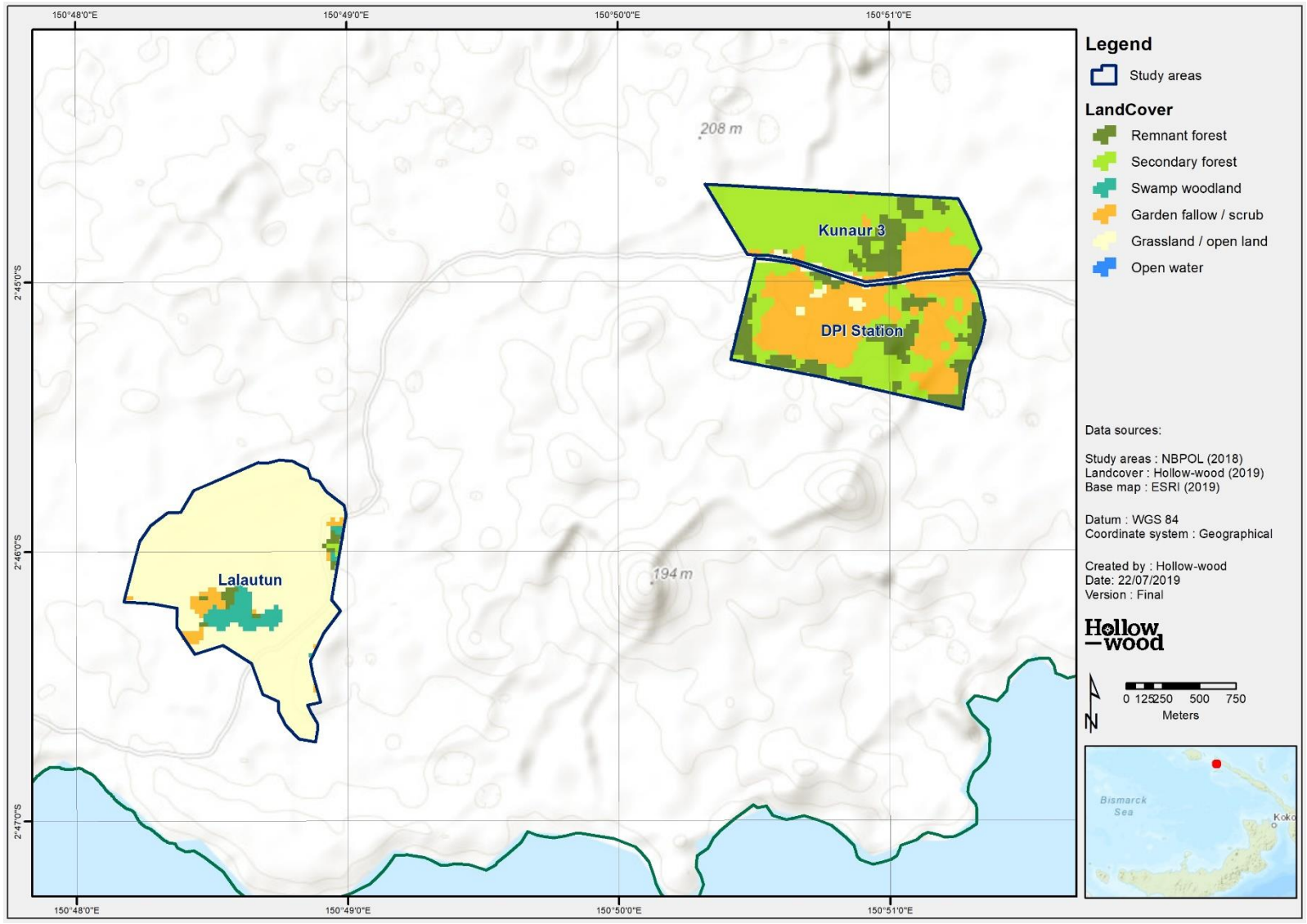
Map 26. Land cover Dec 1, 2007 to Dec 31, 2009



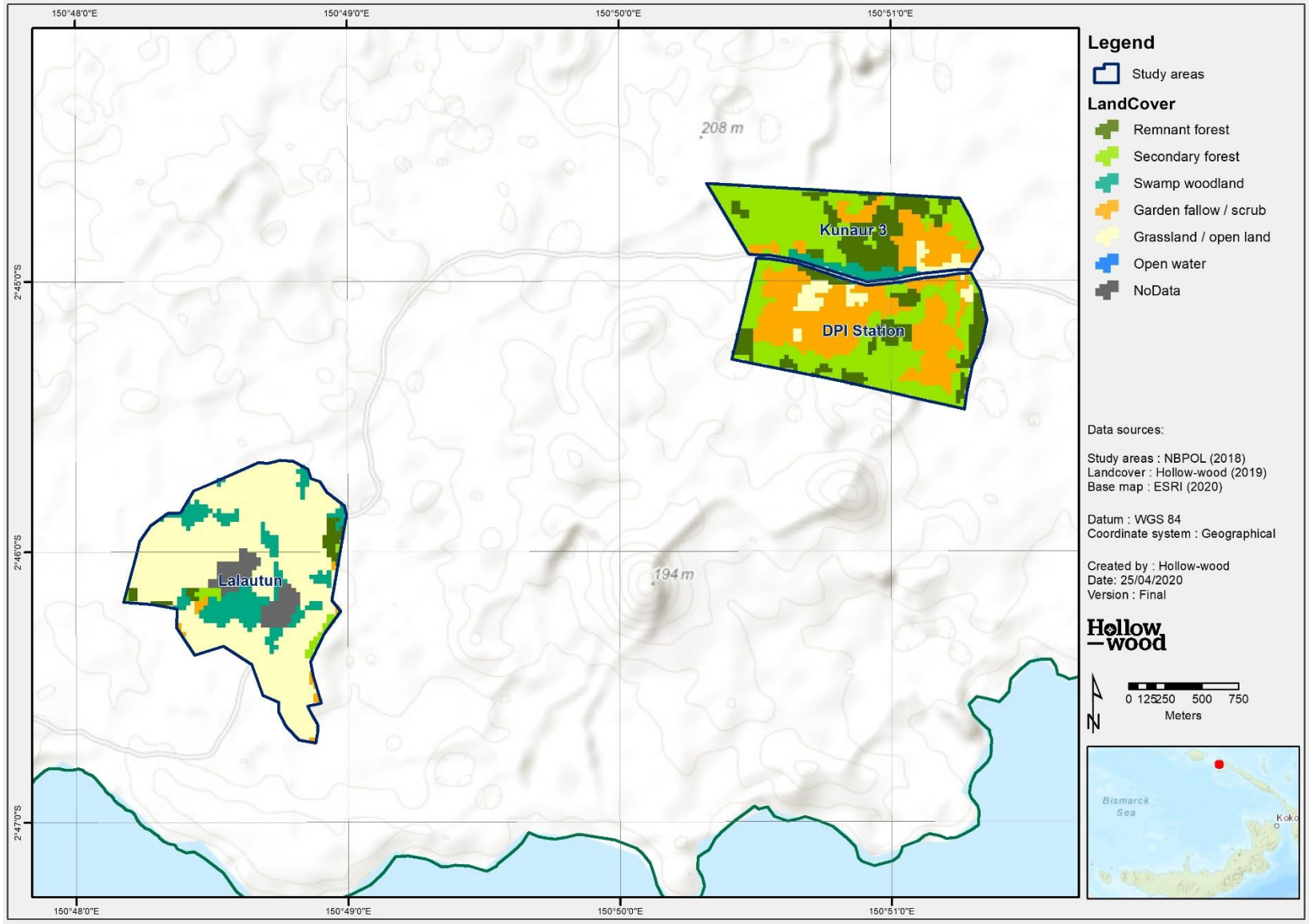
Map 27. Land cover Jan 1, 2010 to April, 2011



Map 28. Land cover April 2011 to May 9, 2014

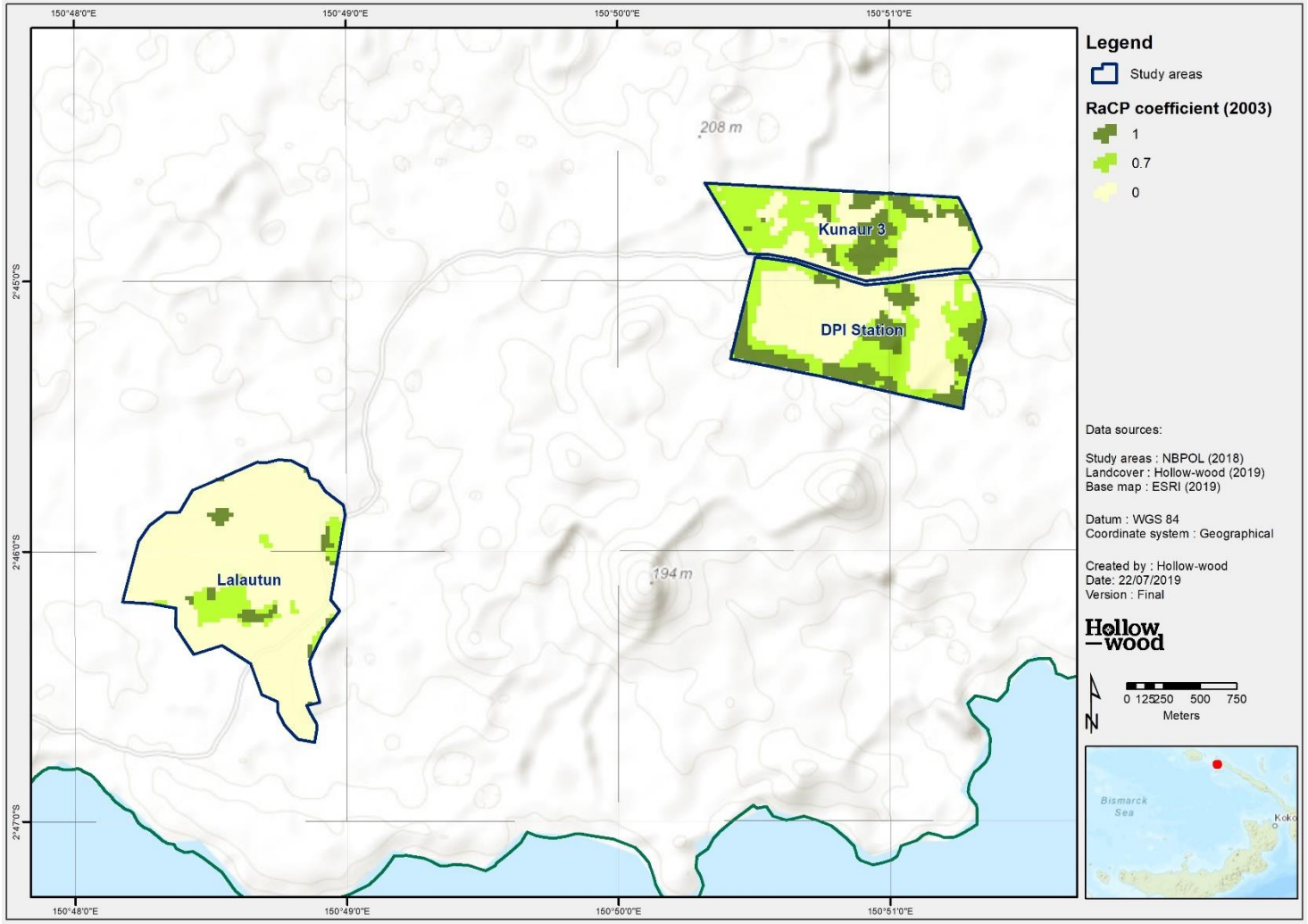


Map 29. Land cover after 9 May 2014 to 09 January 2018.

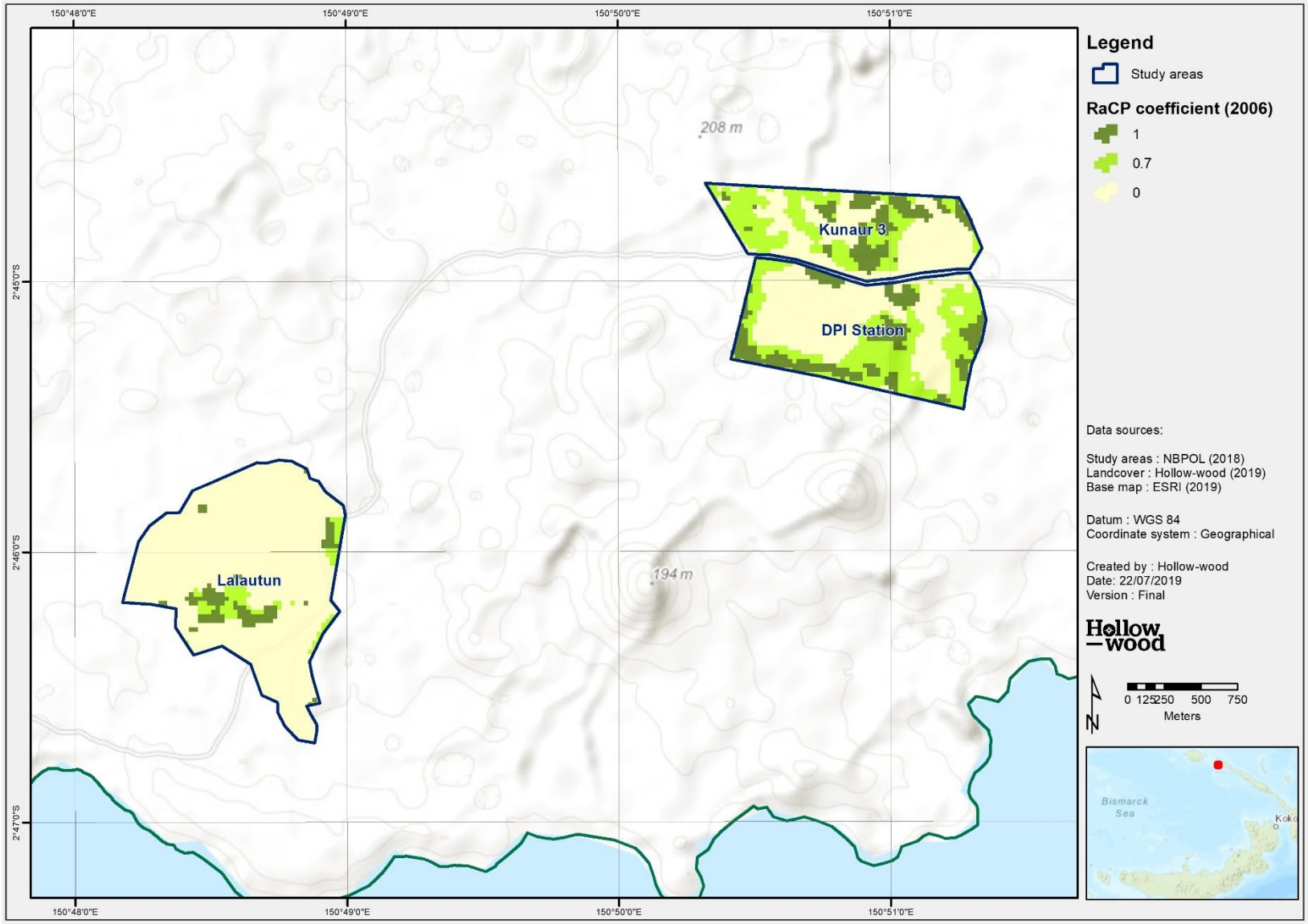


Map 30: Land cover 09 January 2018 to 28 December 2019

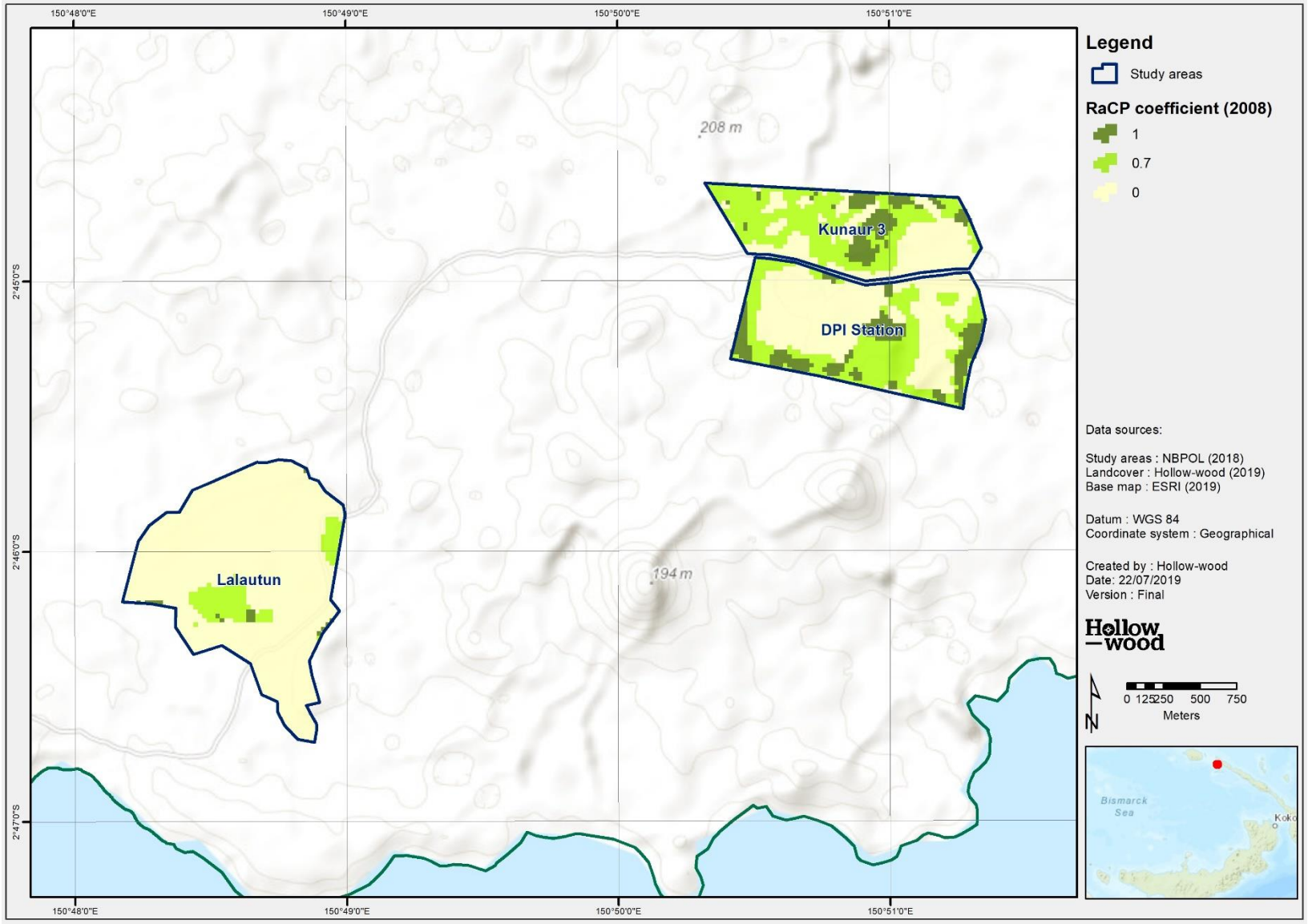
ii. **Processed land cover maps** *(after division into the according vegetation coefficients (1.0, 0.7, 0.4, 0) for each of clearance period and additional cut-off periods)*



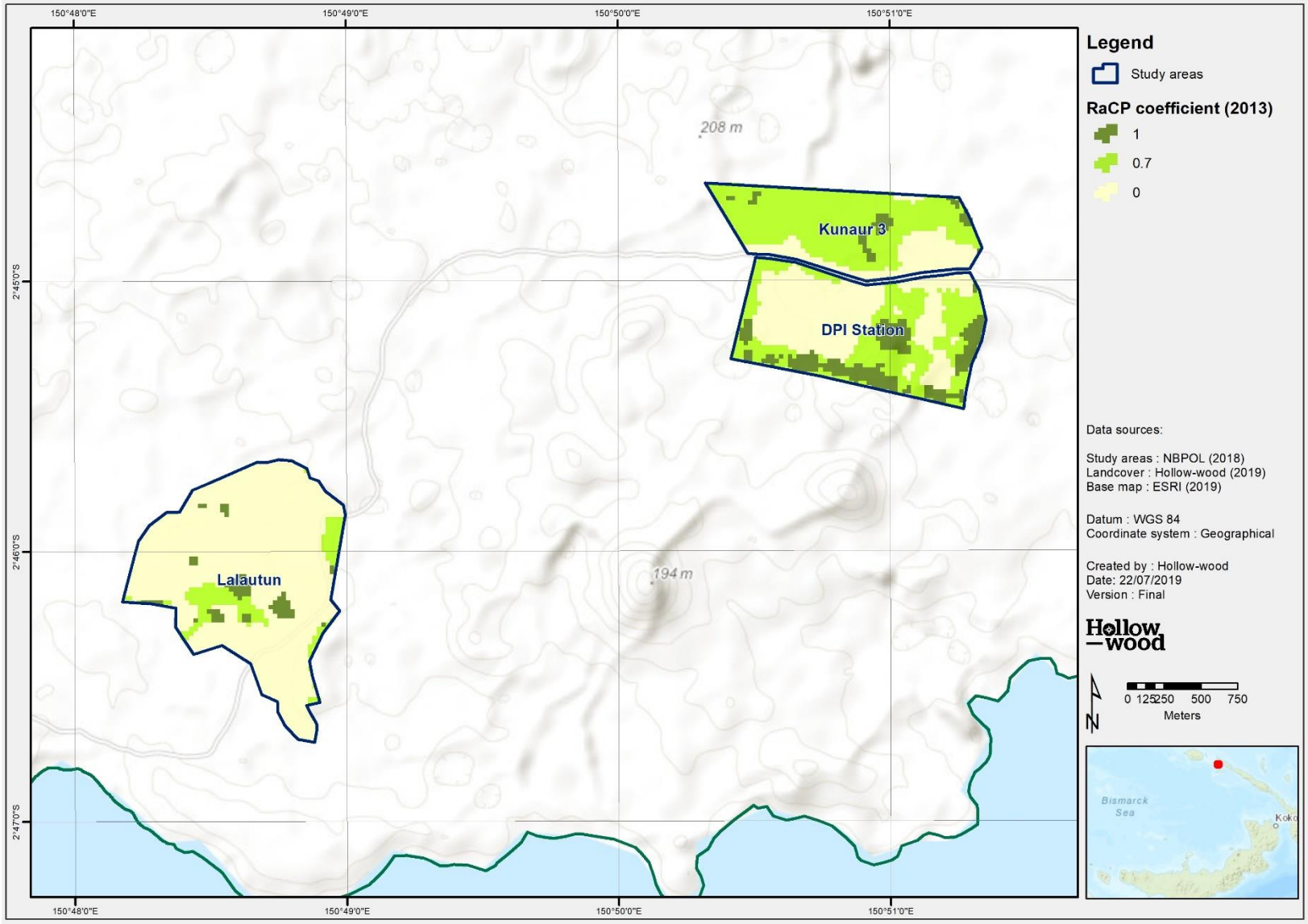
Map 31: Vegetation coefficients before Nov 1 2005 (2003).



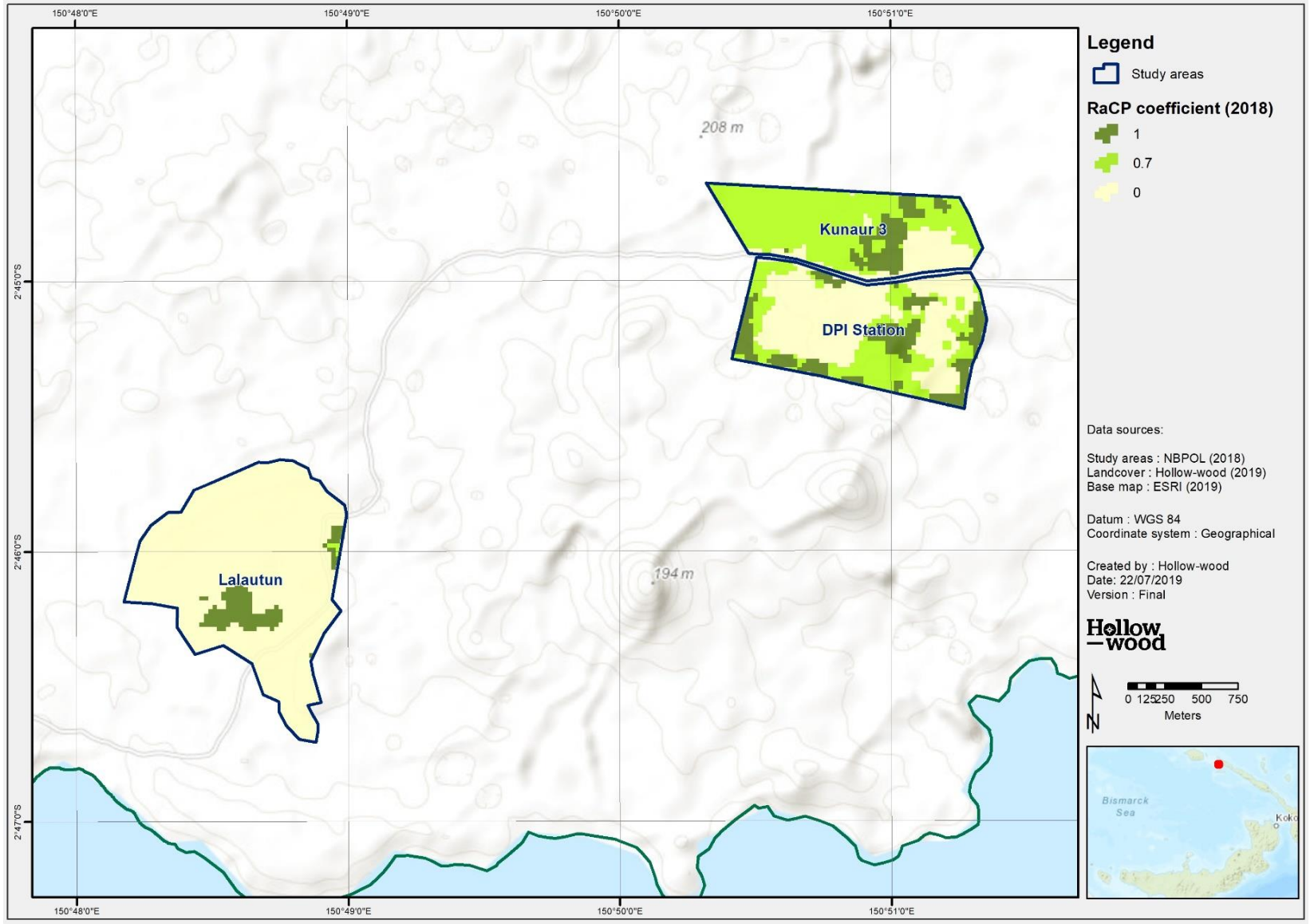
Map 32: Vegetation coefficients Nov 1, 2005 to Nov 30, 2007



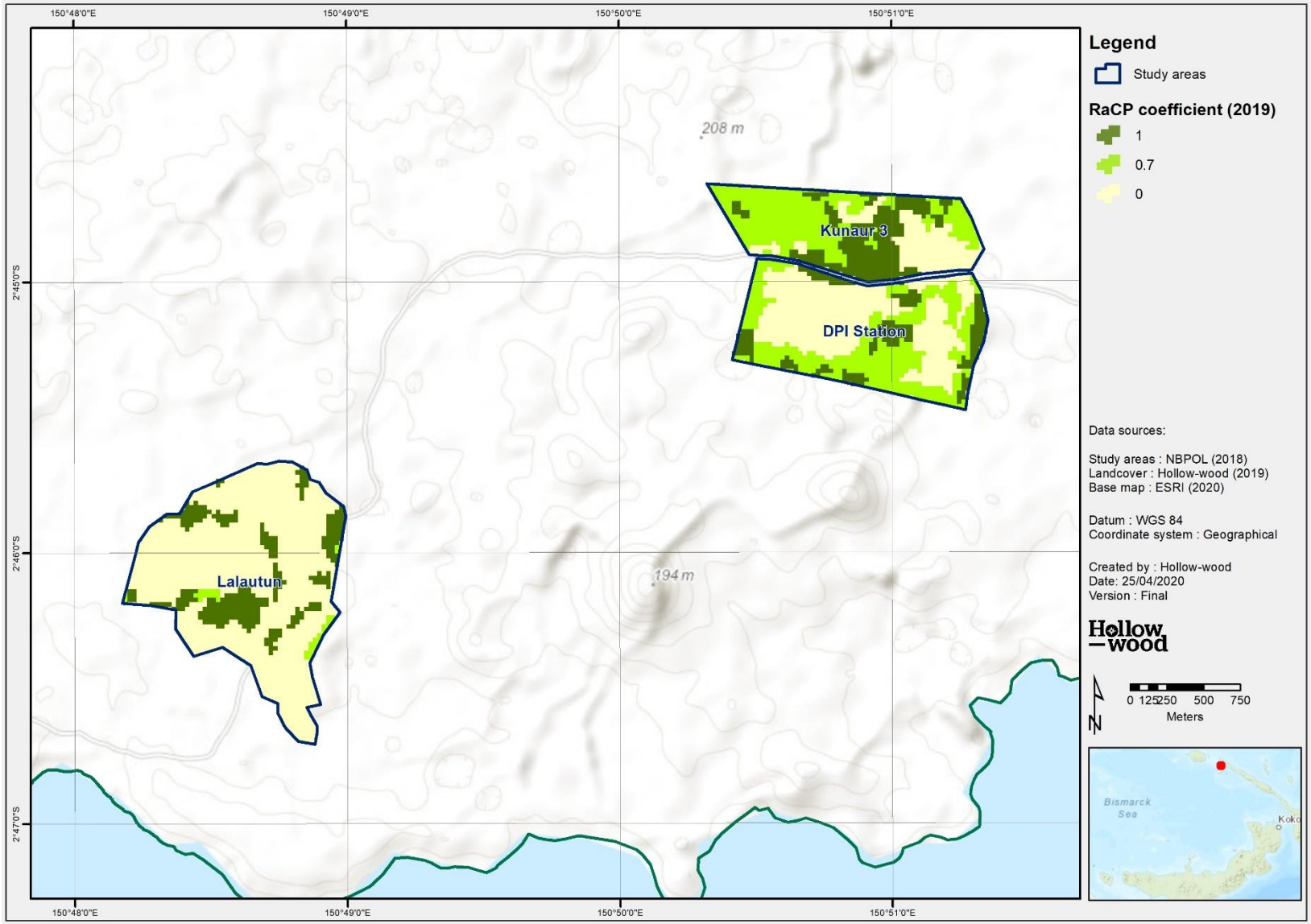
Map 33 Vegetation coefficients Dec 1, 2007 to Dec 31, 2009



Map 34: Vegetation coefficients Jan 1, 2010 to May 2014



Map 35: Vegetation coefficients after May 9, 2014 to January 9 2018.



Map 36 Vegetation coefficients January 9 2018 to December 28 2019

As there has been no clearing for oil palm establishment to date, there is no environmental remediation required.

3.5.8 Environmental remediation - *the loss of areas where oil palm establishment is prohibited*

Period of land clearance	Riparian buffer	Steep slope	Peat	….	Total
After May 9, 2014	0	0	0	0	0
Jan 1, 2010 to May 9, 2014	0	0	0	0	0
Dec 1, 2007 to Dec 31, 2009	0	0	0	0	0
Nov 1, 2005 to Nov 30, 2007	0	0	0	0	0
Total (sum of row)	0	0	0	0	0

As there has been no clearing for oil palm establishment to date, and this assessment is for a NPP submission, rather than a Remediation and Compensation case, this section is not required.

3.5.9. LUCA result before multiplying with vegetation coefficient

Land cover class	Vegetation Coefficient	Nov 1, 2005 to Nov 30, 2007	Dec 1, 2007 to Dec 31, 2009	Jan 1, 2010 to May 9, 2014	After May 9, 2014
One or more land cover classes which fulfill the criterion of vegetation coefficient 1.0	1.0	0	0	0	0
One or more land cover classes which fulfill the criterion of vegetation coefficient 0.7	0.7	0	0	0	0
One or more land cover classes which fulfill the criterion of vegetation coefficient 0.4	0.4	0	0	0	0
One or more land cover classes which fulfill the criterion of vegetation coefficient 0.0	0	0	0	0	0
Total (sum of rows)		0	0	0	0

As there has been no clearing for oil palm establishment to date, and this assessment is for a NPP submission, rather than a Remediation and Compensation case, there is no final compensation liability.

3.5.10 Final compensation liability *(see Remediation and Compensation Procedures November 2015, page 15, Table 3 determining conservation liability)*		
Period of land clearance	**Land controlled by a non-member at time of clearance**	**Land controlled by an RSPO member at the time of clearance. This includes land acquired from other RSPO members**
After May 9, 2014	0	0
January 1, 2010 to May 9, 2014	0	0
December 1, 2007 to December 31, 2009	0	0
November 1, 2005 to November 30, 2007	0	0
Total (sum of rows and columns)	0	

PLEASE NOTE: Table 3.7.7 reports a 16.83 ha increase in the occurrence of the 'swamp woodland' class across the Lalautun study area. This has largely occurred at the expense of the 'Grassland / openland' class. This should not be interpreted as 'new swamp forest growth', but as the image was captured during the wet season of 2019 / 20, this increase should be interpreted as seasonally waterlogged areas within the Lalautun grasslands.

3.6 FPIC process

The SEIA concludes that Poliamba Limited has complied with FPIC since its initial response to the expressions of interest lodged by the landowners. The SEIA recommends that this engagement is maintained and verify that the landowners fully understand the terms and conditions of the sub-lease agreement before endorsing it. It is concluded that the Tivingau ILG of Lokono is allocating the Lalautun, Kunaur 3 & DPI to POL for estate development for mostly positive impacts including revenue generation.

The SEIA provides documentary evidence that Poliamba Limited shows it has an adequate process of Free and Prior Informed Consent in place and local people are fully part of the process. Poliamba Ltd part of the New Britain Palm Oil Group adheres to the principles and process set forth in the Lands and Mini Estate Guidelines: Land Acquisition (MG21). These guidelines set forth the principles of NBPOL's land acquisition modus operandi, it establishes the professional relationship with a landowner group who wish to mobilise their under-utilised arable land for the planting of estate oil palm and to facilitate this by the signing of a formal Sub-lease Agreement between the landowning family and NBPOL.

4. Summary of Management Plans

4.1 Team responsible for developing management plans

The NBPOL Group and Poliamba Limited Sustainability and Plantation Department are responsible to implement the mitigation and management recommendations summarized in this report.

In addition, the management plans were discussed with the PNG Conservation and Environmental Protection Authority, as well as Save PNG, a local NGO. Local Government officials were also consulted with regards to the assessments and management plans. Correspondence with these stakeholders is contained within the HCV Assessment.

Table 39; Internal responsibility for management plans

Name & Position	Responsibility
Theresa Endy - Sustainability & Quality Management (SQM) Manager	Ensure communication of management recommendation to all relevant Managers.
	Facilitate compliance to management recommendation through provision of training and technical support.
	Monitor and report implementation of management recommendations through regular inspections.
Mathew Bua - Senior Estate Manager	Ensure all management recommendations as communicated by SQM Manager and this report are implemented.
Roland Soupa General Manager	Ensure all resources as necessary are provided to Plantation staff to implement the management recommendations.
Ian Orrell Group SQM Manager	Ensure annual monitoring reports are reviewed and compliant to the management plans within this report.
	Implement remote sensing monitoring utilizing a platform as recommended, i.e./Open Foris, Collect Earth.

4.2 Elements to be included in management plans

Integrated HCV-HCS and the SEIA Management Plan

The recommendations for maintaining and enhancing the HCV-HCS encountered are based on the co-management model.
The monitoring and management actions laid out in the Environment table below are aimed at mitigating negative and the environmental and socio-economic impacts and maximising positive outcomes.
Integrated HCV-HCS management & mitigation plan of the threats identified.
The successful implementation of these actions requires the support and close oversight of Poliamba management.

All of these management recommendations are summarized in the below table:

Table 40 ; Social & Environment management mitigation plan

No	Aspect/Activity	Potential Impact/s	Relevant RSPO Principles and Criteria Indicators	Mitigation measure/s	Performance indicator/s	Monitoring period/ frequency Monitoring period/ frequency	Time Frame	Persons responsible for mitigation and monitoring
1	Familiarisation of Tivingau ILG members with terms and conditions of the development agreement including its likely revenue scope before they sign it.	Tivingau ILG members sign development agreement with unrealistic expectations and subsequently become dejected and resentful.	1.1.1, 4.4.1, 4.5.1, 4.7.1	Ensure Tivingau ILG members understand the terms and conditions of the development agreement including its likely revenue scope before they sign it.	Terms and conditions of the development agreement including its likely revenue scope understood by Tivingau ILG members before they signed it.	Before start of site Preparation.	June 2020	Sustainability Manager (SM)
2	Project awareness meeting in Lokono village before commencement of development work.	Villagers may claim ignorance of any negative impacts and collectively disrupt the establishment and operation of the mini-estate.	1.1 1	Hold project awareness meeting in Lokono Village.	Project awareness meeting held in Lokono Village.	Before start of site preparation.	June 2020	Sustainability Manager (SM)
3	Pre-development water quality analysis of surface and groundwater within and at the periphery of the project area.	The absence of baseline water quality data will not help Poliamba deal effectively with subsequent water contamination allegations.	2.1.1, 7.8.2 , 7.12.4 & 3.4.1	Carry out at least a one -off pre-development water quality monitoring.	Pre-development water quality monitoring carried out.	Before start of site preparation.	July 2020	Sustainability Manager (SM)
4	Detailed survey of entire lease area and demarcation of buffer zones, oil palm plots, access roads, drainage, as well as workers accommodation.	Buffer zones not appropriately demarcated.	2.1.3, 7.5.1, 7.6.1, 7.7.2, 7.8.1 & 7.12.1	Ensure buffer zones are appropriately demarcated.	Buffer zones are appropriately demarcated.	Before site preparation, then monthly through to start of operation phase and quarterly thereafter	August 2020	Lands Officer Estate Senior Manager (SEM) SM
		Oil palm plots, access	2.1.3,	Ensure plantation	Plantation infrastructure	Before site	September	Lands Officer

		roads, drainage, as well as workers accommodation, not sited to minimize environmental degradation.	7.5.1, 7.6.1, 7.8.1, 3.4.1, 7.12.1 & 7.3.2	infrastructure is positioned so that environmental impacts are minimised.	is positioned so that environmental impact is minimal.	preparation and then weekly through to start of routine operation.	2020	Estate Senior Manager
5	Direct employment and contractual engagement for site preparation, construction of roads and drainage, oil palm planting as well as installation of workers accommodation.	Priority for employment and contractual work not given to nearby villagers.	2.1.2, 3.6.1, 6.7.3, 3.7.1, 5.1.5, 6.2.2, 5.2.1, 4.3..1 & 3.4.2	Give equal opportunity for employment and contractual work to nearby villagers who are willing to work as required by the company	Priority for employment and contractual work given to nearby villagers.	Prior to start of site preparation .	October 2020	Senior Estate Managers Sustainability Manager
		Employees not advised of their terms and conditions of employment, not adequately trained and not provided with appropriate PPE.		Advise all employees of their terms and conditions of employment, train them and provide appropriate PPE	All employees advised of their terms and conditions of employment, trained and provided with appropriate PPE.	Prior to start of site preparation .	October 2020	Senior Estate Managers Sustainability Manager
6	Reforestation where necessary of buffer zones	Some buffer zones not reforested where necessary	2.1.1, 7.5.3, 7.12.4, 7.3.2 & 7.4.1	Ensure buffer areas are reforested where necessary	Buffer zones not reforested as required	Before site preparation, then weekly through to start of routine operation phase and quarterly thereafter	September 2020	Senior Estate Managers Sustainability Manager
		Clear and legible signage in Tok Pidgin not erected alongside buffer zones.	2.1.1, 7.5.3, 7.6.3, 7.7.2, 7.8.1 & 7.12.6	Install sufficient, clear and legible signage in Tok Pidgin on restrictions within the buffer zones.	Sufficient, clear and legible signage in Tok Pidgin on restrictions within the buffer zones and conservation reserves installed.	Before site preparation, weekly through to start of operation phase and then six monthly thereafter	September 2020	Senior Estate Managers Sustainability Manager

		Enhancement of local flora in the buffer zones.	2.1.1, 7.5.3, 7.6.1, 7.7.1, 7.8.2 & 7.12.6	Enhance variety of local plant species in each buffer zone.	Inventory of local plant species in each buffer zone is enhanced.	Before site preparation, weekly through to start of routine operation and then quarterly thereafter	June 2020	Senior Estate Managers Sustainability Manager
		Reduced soil erosion and siltation of nearby surface water bodies	2.1.1, 7.5.2, 7.6.3, 7.7.4, 7.8.2 & 7.12.5	Monitor soil erosion and siltation reduction capacity of buffer zones.	Soil erosion and siltation management capacity of buffer zones are monitored for continuous improvement.	Before site Preparation and then six monthly thereafter.	June 2020	Senior Estate Managers Sustainability Manager
7	Removal of vegetation as demarcated in preparation of oil palm plots as well as construction of access roads and drainage, workers accommodation, and plantation Infrastructure.	Significant variation in local hydrology.	2.1.1, 7.5.1, 7.6.1, 7.7.2, 7.8.2, 3.4.1, 7.3.2, 5.1.4 & 7.12.3	Contour landscape to local natural drainage.	Minimum net deviation from local natural drainage.	Weekly	October 2020	Senior Estate Managers Sustainability Manager
		Increased soil erosion and siltation of surface water		Restrict vegetation clearance to pre-designated areas.	Minimum unwarranted vegetation removed.			
				Where appropriate, use the removed vegetation as flow impediment structures and silt traps.	Removed vegetation effectively used to impede flow and retain silt.			
				Where required stock pile topsoil on a zero to very low gradient site for subsequent re-use.	Topsoil strategically stored for later re-use.		September 2020	
		Elevated noise level in nearby communities.	2.1.1, 3.4.1, 7.10.1, 5.1.4	Ensure noise generating machinery and equipment are in good working condition prior to being brought onsite	Noise generating machinery and equipment are in good working condition prior to being brought on site			
				Ensure regular maintenance of all noise	Regular maintenance of all noise generating		October 2020	

				generating machinery and equipment.	machinery and equipment.			
				Carry out pre-start machinery and equipment check before every shift work.	Pre-start machinery and equipment check carried out before every shift work.			
		Contamination of soil and water by accidental hydrocarbon spillage.	2.1.1, 7.5.3, 7.6.3, 7.7.2, 3.4.1, 7.10.1 & 5.1.4	Confine vegetation clearance to pre-designated areas.	Minimum unwarranted vegetation removed.		September 2020	
				Ensure regular maintenance of machinery and equipment.	Regular maintenance of all noise generating machinery and equipment.		October 2020	
				Carry out pre-start machinery and equipment before every shift work.	Pre-start machinery and equipment check carried out before every shift work.			
		Generation of excess dust from exposed soil surfaces and vehicular movement especially during dry periods	2.1.1, 3.6.1, 6.7.3, 3.4.1, 7.10.1, 5.1.4 & 7.5	Confine vegetation clearance to pre-designated areas.	Minimum unwarranted Vegetation removed.		As required	
				Apply water spraying to suppress excessive dust formation	Dust suppression via water spraying applied at an effective frequency.			
8	Management of the various waste -streams generated during site preparation and crop establishment.	Aesthetic nuisance and habitat destruction. Emission of offensive smoke and odour. Breeding of disease transmission vectors such as rats and flies. Contamination of nearby water bodies.	2.1.1, 5.1.4, 6.2.2, 7.11.2, 3.4.1, 7.3.3, 7.12.2, 3.3.1, 7.8.1, 3.6.1, 6.7.3 & 3.7.1	Segregate waste types and dispose in designated landfill site.	Ensure appropriate management and disposal of wastes.	Weekly	September 2020	Senior Estate Managers Sustainability Manager
				Reduce amount of waste produced and reuse or recycle items where possible			October 2020	
				Avoid burning of vegetative waste and use it as mulch or for erosion control.				
				Provide adequate water supply and sanitation facilities for all workers.			September 2020	
9	Planting of ground cover on oil palm plots.	Reduced soil erosion and siltation of surface	2.1.1, 7.6.3, 7.7.4, 3.4.1,	Ensure groundcover planted to improve soil	Groundcover planted to improve soil fertility and	Weekly	December 2020	Senior Estate Managers

		water .	6.2.4, 7.12.7 & 5.1.4	fertility and control erosion.	control erosion.			Sustainability Manager
10	Planting of oil palm seedlings.	Planting on non -designated sites.	2.1.2, 7.6.3, 7.7.1, 7.8.2, 7.1.1, 7.2.1, 3.4.1, 6.2.5, 7.12.3, 7.5.3	Ensure seedlings are planted where they should be	Seedlings planted as Demarcated.	Monthly	August 2020	Senior Estate Managers Sustainability Manager
11	Application of soil remediation substances and fertilizers.	Improper handling of soil remediation substances and fertilizers resulting in personal injury to workers and contamination of local surface and ground water	3.3.1, 7.5.3, 7.8.2, 3.6.1, 6.7.3, 3.7.1, 3.4.1 & 6.2.4	Ensure proper application of soil remediation substances and fertilizers.	Application of soil remediation substances and fertilizers by trained persons using the correct procedure.	Monthly	August 2020	Senior Estate Managers Sustainability Manager
				Carry out periodic water quality monitoring.	Surface and ground water quality monitoring carried out as scheduled.	Quarterly		
12	Control of weeds .	Improper application of herbicides resulting in bodily harm to prayers and contamination of local surface and groundwater.	2.1.2, 3.3.1, 7.8.2, 7.1.1, 7.2.1, 3.6.1, 6.7.3, 3.7.1, 3.4.1 & 6.2.4	Ensure proper application of herbicides.	Application of herbicides by trained persons using the correct PPE and procedure.	Monthly	September 2020	Senior Estate Managers Sustainability Manager
				Carry out periodic surface and ground water quality monitoring	Surface and ground water quality monitoring carried out as scheduled	Quarterly	August 2020	
13	Control of pests .	Improper application of pesticides resulting in bodily harm to sprayers and contamination of surface and ground water.	2.1.1, 3.3.1, 7.8.2, 7.1.1, 7.2.1, 3.6.1, 6.7.3, 3.7.1, 3.4.1 & 6.2.4,	Ensure proper application of pesticides.	Application of pesticides by trained persons using the correct PPE and procedure.	Monthly	December 2020	Senior Estate Managers Sustainability Manager
				Carry out periodic surface and ground water quality monitoring.	Surface and ground water quality monitoring carried out as scheduled.	Quarterly	August 2020	
14	Harvesting of FFB .	Delayed collection of FFB resulting in build -up of free fatty acids (FFA) and loss in value of the crop. If delay is prolonged the crop will not be milled and will have to be disposed properly.	3.3.1, 7.8.2, 3.7.1, 3.4.1, 6.2.4, 7.3.3, 7.11.2, 7.12.2	Ensure timely collection of FFB.	Timely collection of FFB.	Daily	August 2022	Senior Estate Managers Sustainability Manager
				If necessary, correctly dispose the ruined fruit.	Correct disposal of ruined fruit.			

15	Maintenance of buffer zones during routine operation.	Neglected buffer zones not effectively performing their intended functions	2.1.1, 7.6.3, 7.7.4, 7.8.2, 3.7.1, 3.4.1, 6.2.4, 7.12.4 & 7.8.2	Maintain local species variety in the buffer zones.	Diverse local species in the buffer zones.	Monthly	August 2020	Senior Estate Managers Sustainability Manager
				Ensure buffer zone signage intact and legible and restrictions are not breached.	Buffer zone signage intact and legible and restrictions enforced.			
16	Maintenance of roads and drainage during routine operation.	Increased erosion and siltation of local water bodies.	2.1.1, 7.6.3, 7.7.4, 7.8.2, 3.4.1, 6.2.4, 7.12.4, .3.2, & 7.5.1	Ensure timely maintenance of access roads and site drainage.	Access roads and drainage in good condition.	Monthly	September 2020	Senior Estate Managers Sustainability Manager
		Dust generation adversely affecting health and wellbeing of workers and local residents.	2.1.1, 3.6.1, 6.7.3, 3.4.1, 6.2.4, 7.10.2	Carry out dust suppression during the dry season using water spray trucks.	Dust suppression with water spray carried out during the dry season.		As required	
17	Management of various waste streams generated during routine operation.	Aesthetic nuisance and habitat destruction. Emission of offensive smoke and odour. Breeding of disease transmission vectors such as rats and flies. Contamination of nearby water bodies.	2.1.1, 3.3.1, 7.8.2, 3.6.1, 6.7.3, 3.7.1, 3.4.1, 6.2.4, 7.3.2, 7.11.1, 7.12.4, & 6.2.4	Install and maintain appropriate waste management equipment and facilities.	Appropriate waste management equipment and facilities installed and maintained.	Monthly	September 2020	Senior Estate Managers Sustainability Manager
				Segregate waste types and dispose in designated sites.	Waste types, segregated and disposed in designated sites.			
				Reduce amount of waste produced and reuse or recycle items where possible	Amount of waste reduced and where feasible items reused or recycled			
				Use organic waste as mulch or for composting.	Organic waste used as mulch or for composting.			
				Provide adequate water supply and sanitation facilities for all workers	Adequate water supply and sanitation facilities provided for all workers		October 2020	
18	Employment during routine operation	Priority for employment and business contracts not given to nearby villagers.	2.1.1, 3.6.1, 6.7.3, 3.7.1, 6.2.4, & 3.4.1	Give priority for employment and business contracts to nearby villagers.	Priority for employment and business contracts given to nearby villagers.	Six monthly	October 2020	Senior Estate Managers Sustainability Manager
		Employees are not advised of their terms and conditions of		Educate employees about the terms and conditions of employment, train	Employees advised of their terms and conditions of			

		employment, not properly trained and not supplied with appropriate PPE.		them and provide them appropriate PPE.	employment, trained and provided appropriate PPE.			
19	Adaptive management and continual improvement to the operation.	Appropriate remedial actions and changes are not implemented so that the operation, its various stakeholders, the environment and the local economy are negatively affected,	2.1.1, 3.4.1, 6.2.4 & 3.2.1	Promptly carry out remedial work as well as make changes that will improve pperformance and maximise positive outcomes.	Remedial actions and improved practices documented in the Continuous Improvement Plan and implemented.	Continuous	September 2020	General Manager Senior Estate Managers Sustainability Manager
20	Contribution where possible to local community infrastructural, socio-economic and integrated sustainable development.	Obvious lack of support to local infrastructural, socio-economic and integrated sustainable development.	5.2.1 & 4.3.1	Maintain close liaison with local government officials and communities and where possible assist in sustainable development projects.	Close liaison maintained with local government officials and communities and assistance in sustainable development projects provided where possible.	Continuous	September 2020	General Manager Senior Estate Managers Sustainability Manager

Table 41: Summary of Key findings for HCV – HCS Management and monitoring recommendations

Values	Threat classification1	Internal	External
		Monitoring and management	**Monitoring and management**
All HCVs and HCS forest	1.1 Housing & Urban Areas	• Development of the ICLUP to place company housing outside HCV areas. • Social baseline study (and regular scheduled updates) to identify potential future issues. • Routine monitoring of the site (including set asides) and reporting of squatters to the company for management via formal processes.	Ongoing engagement with the community about HCVs and promotion of their protection.
	2.1 Annual & Perennial Non-Timber Crops	• Establish appropriate buffers around identified HCVs (as per HCV assessment). • Social baseline study (and regular scheduled updates) to identify potential future issues. • SOPs and appropriate equipment to ensure plantations stay within correct boundaries. • Monitoring of buffers and conservation areas for gardens, policies and procedures to manage incursions. • Paying a lease on the conservation areas. Stop paying lease if evidence of subsequent clearing is observed. • Having a conservation area manager that socialises the purpose of conservation and gets conservation area projects running. • Agreement on forest boundaries with relevant communities and demarcation of all	Ongoing engagement with the community about HCVs and promotion of their protection.

		HCV areas, including boundaries adjacent to future palms and within existing forest. • Agreement on use of forest areas by tribe / clans (e.g. no clearing for agriculture, limited firewood extraction, but no tree felling allowed) • Communication and awareness on the importance of maintaining HCVs. • Quarterly surveys of all HCVs to check for incursions. • Surveys include mapping of any further clearing and restoration activities within HCVMA. This should include Landsat image interpretation as well as in-field GPS recording of boundaries. • Use of Monitoring Results to adapt management recommendations in the future. Use of information signage that delineates HCV areas and details allowed usage	
All HCVs and HCS forest	2.2 Wood & Pulp Plantations	N/A	Influence on development out of the study area is limited. Encourage communities to only work with companies that adhere to sustainability principles, promoted through highlighting the benefits/improved outcomes of this project.
	7.1 Fire & Fire Suppression	Policies, SOPs, staff training and resources to minimise the likelihood of accidental fire ignition and spread.	Discourage the use of fire that may have detrimental outcomes.
HCS forest areas	5.3 Logging & Wood Harvesting	• Ban on collection of trees and woody vegetation from within conservation areas. • Engagement with workers and local communities to ensure awareness, including penalties. • Surveys that establish benchmark. • Monitoring programs to identify any harvesting ASAP. • Rehabilitation programs to increase populations. • Establishment of firewood plantations and promotion of fuel reduction technologies (e.g. Ecostoves).	• Community engagement to encourage sustainable harvesting practices. • Discouragement to harvest particular species (protected and endangered). • Encourage establishment of community firewood plantations and promotion of fuel reduction technologies (e.g. Ecostoves).
	7.4 Removing / Reducing Human Maintenance	Use forest integrity assessment to establish benchmark scores and monitor change over time.	• N/A
	8.1 Invasive Non-Native / Alien Plants & Animals	• Collection of loose fruit to minimise spread. • SOPs to minimize spread of weeds across the landscape associated with trucks, plant and other machinery. • Regular monitoring to identify the presence of weed species • Policies regarding the containment of introduced plants and animals.	• N/A
	8.2 Problematic Native Plants & Animals	• Monitoring species distribution and abundance within conservation areas.	• N/A
	8.3 Introduced Genetic Material	• Use of local provenance seed stock.	• N/A
HCV 1	5.1 Hunting & Collecting Terrestrial Animals	Banning of hunting within plantation lease area (including conservation areas). • Adequate land available to works and the promotion of sustainable gardening practices for workers. • Community engagement to make people aware of restrictions, including penalties.	Community engagement to encourage sustainable hunting practices. • Discouragement to hunt particular species (protected and endangered).

		• Social baseline study (and regular scheduled updates) to identify potential future issues. • Surveys establish benchmark and population dynamics overtime. • Revegetation to create animal habitat.	• Adequate land available to workers and the promotion of sustainable gardening practices
	5.2 Gathering Terrestrial Plants	• Ban on plant collection within set asides. • Engagement with workers and local communities to ensure awareness, including penalties. • Social baseline study (and regular scheduled updates) to identify potential future issues. • Adequate land available to workers and the promotion of sustainable gardening practices. • Surveys that establish benchmark and population dynamics overtime. • Rehabilitation programs to increase populations.	• Community engagement to encourage sustainable harvesting practices. • Adequate land available to workers and the promotion of sustainable gardening practices • Discouragement to harvest particular species (protected and endangered).
HCV 1	5.3 Logging & Wood Harvesting	• Ban on collection of trees and woody vegetation from within conservation areas. • Engagement with workers and local communities to ensure awareness, including penalties. • Social baseline study (and regular scheduled updates) to identify potential future issues. • Surveys that establish benchmark. • Monitoring programs to identify any harvesting ASAP. • Rehabilitation programs to increase populations. • Establishment of firewood plantations and promotion of fuel reduction technologies (e.g. Ecostoves).	• Community engagement to encourage sustainable harvesting practices. • Discouragement to harvest particular species (protected and endangered). • Encourage establishment of community firewood plantations and promotion of fuel reduction technologies (e.g. Ecostoves).
	5.3 Logging & Wood Harvesting specific threat to RTE species *Terminalia archipelagi* and *Intsia bijuga*	• Specific ban on harvesting of these species. • Planting additional trees. • Making an inventory of this species and ensuring they remain. • Use of information signage that delineates HCV areas and details allowed usage.	• Community engagement to encourage sustainable harvesting practices. • Discouragement to harvest these particular species.
	7.4 Removing / Reducing Human Maintenance	• Use forest integrity assessment to establish benchmark scores and monitor change over time.	N/A
	8.1 Invasive Non-Native / Alien Plants & Animals	• Collection of loose fruit to minimise spread. • SOPs to minimize spread of weeds across the landscape associated with trucks, plant and other machinery. • Regular monitoring to identify the presence of weed species • Policies regarding the containment of introduced plants and animals.	N/A
HCV 1	8.2 Problematic Native Plants & Animals	• Monitoring species distribution and abundance within conservation areas.	N/A
	8.3 Introduced Genetic Material	• Use of local provenance seed stock.	N/A
	9.5 Air-Borne Pollutants	• Road surface materials and that reduce dust.	N/A

		• Drainage management to reduce pollution into waterways during rain events. • Wetting of roads during dry season. • Speed limits on internal roads, particularly during dry season.	
HCV 2	5.3 Logging & Wood Harvesting	• Ban on collection of trees and woody vegetation from within conservation areas. • Engagement with workers and local communities to ensure awareness, including penalties. • Surveys that establish benchmark. • Monitoring programs to identify any harvesting ASAP. • Rehabilitation programs to increase populations. • Establishment of firewood plantations and promotion of fuel reduction technologies (e.g. Ecostoves).	• Community engagement to encourage sustainable harvesting practices. • Discouragement to harvest particular species (protected and endangered). • Encourage establishment of community firewood plantations and promotion of fuel reduction technologies (e.g. Ecostoves).
	7.4 Removing / Reducing Human Maintenance	• Use forest integrity assessment to establish benchmark scores and monitor change over time.	N/A
	8.1 Invasive Non-Native / Alien Plants & Animals	• Collection of loose fruit to minimise spread. • SOPs to minimize spread of weeds across the landscape associated with trucks, plant and other machinery. • Regular monitoring to identify the presence of weed species • Policies regarding the containment of introduced plants and animals.	N/A
	8.2 Problematic Native Plants & Animals	• Monitoring species distribution and abundance within conservation areas.	N/A
	8.3 Introduced Genetic Material	• Use of local provenance seed stock.	N/A
HCV 3	5.3 Logging & Wood Harvesting	• Ban on collection of trees and woody vegetation from within conservation areas. • Engagement with workers and local communities to ensure awareness, including penalties. • Surveys that establish benchmark. • Monitoring programs to identify any harvesting ASAP. • Rehabilitation programs to increase populations. • Establishment of firewood plantations and promotion of fuel reduction technologies (e.g. Ecostoves).	• Community engagement to encourage sustainable harvesting practices. • Discouragement to harvest particular species (protected and endangered). • Encourage establishment of community firewood plantations and promotion of fuel reduction technologies (e.g. Ecostoves).
	7.4 Removing / Reducing Human Maintenance	• Use forest integrity assessment to establish benchmark scores and monitor change over time.	
	8.1 Invasive Non-Native / Alien Plants & Animals	• Collection of loose fruit to minimise spread. • SOPs to minimize spread of weeds across the landscape associated with trucks, plant and other machinery. • Regular monitoring to identify the presence of weed species • Policies regarding the containment of introduced plants and animals.	N/A
	8.2 Problematic Native Plants & Animals	• Monitoring species distribution and abundance within conservation areas.	N/A
	8.3 Introduced Genetic	• Use of local provenance seed stock.	N/A

	Material		
HCV 4	4.1 Roads & Railroads	• Road planning to ensure identified HCVs, conservation areas are protected externally. • Policies and SOPs to minimise impact of surrounding areas during road construction. • Construction standards such that anticipated use and weather conditions will not cause longer term damage (e.g. runoff and road materials being washed away).	• Policies and procedures to minimise impact of surrounding areas during road construction. • Construction standards such that anticipated use and weather conditions will not cause longer term damage (e.g. runoff and road materials being washed away).
	5.3 Logging & Wood Harvesting	• Ban on collection of trees and woody vegetation from within conservation areas. • Engagement with workers and local communities to ensure awareness, including penalties. • Surveys that establish benchmark. • Monitoring programs to identify any harvesting ASAP. • Rehabilitation programs to increase populations. • Establishment of firewood plantations and promotion of fuel reduction technologies (e.g. Ecostoves).	• Community engagement to encourage sustainable harvesting practices. • Discouragement to harvest particular species (protected and endangered). • Encourage establishment of community firewood plantations and promotion of fuel reduction technologies (e.g. Ecostoves).
	7.2 Dams & Water Management / Use	• SOPs to ensure plantation establishment and water use consider downstream water impacts. • Detailed survey to understand hydrological system at Lalautun. • Monitoring of water flows.	• Working with communities to protect/improve water supply and environmental flows.
	9.3 Agricultural & Forestry Effluents	• Policies and SOPs to reduce likelihood of erosion and ensure correct application of fertilizers and herbicides to minimise run-off. • Allocate at least 20m buffer protection for the sago swamps and limestone waterholes and enhance vegetation density with local species. • Install sediment and silt control structures at strategic locations. • Repair or upgrade sediment and silt control structures as required. • Monitor buffer zone integrity regularly. • Monitor water quality every three months (quarterly intervals). • Check sediment and silt control structures regularly	N/A
HCV 5	4.1 Roads & Railroads	• Road planning to ensure identified HCVs, conservation areas are protected externally. • Policies and SOPs to minimise impact of surrounding areas during road construction. • Construction standards such that anticipated use and weather conditions will not cause longer term damage (e.g. runoff and road materials being washed away).	• Policies and procedures to minimise impact of surrounding areas during road construction. • Construction standards such that anticipated use and weather conditions will not cause longer term damage (e.g. runoff and road materials being washed away).
	5.1 Hunting & Collecting Terrestrial Animals	• Banning of hunting within plantation lease area (including conservation areas). • Adequate land available to works and the promotion of sustainable gardening practices for workers. • Social baseline study (and regular scheduled updates) to identify potential future issues. • Community engagement to make people aware of restrictions, including penalties. • Surveys establish benchmark and population dynamics overtime.	• Community engagement to encourage sustainable hunting practices. • Discouragement to hunt particular species (protected and endangered). • Adequate land available to workers and the promotion of sustainable gardening practices

		• Revegetation to create animal habitat.	
	5.2 Gathering Terrestrial Plants	• Ban on plant collection within set asides. • Engagement with workers and local communities to ensure awareness, including penalties. • Adequate land available to workers and the promotion of sustainable gardening practices. • Social baseline study (and regular scheduled updates) to identify potential future issues. • Surveys that establish benchmark and population dynamics overtime. • Rehabilitation programs to increase populations.	• Community engagement to encourage sustainable harvesting practices. • Adequate land available to workers and the promotion of sustainable gardening practices • Discouragement to harvest particular species (protected and endangered).
	5.3 Logging & Wood Harvesting	• Ban on collection of trees and woody vegetation from within conservation areas. • Engagement with workers and local communities to ensure awareness, including penalties. • Social baseline study (and regular scheduled updates) to identify potential future issues. • Surveys that establish benchmark. • Monitoring programs to identify any harvesting ASAP. • Rehabilitation programs to increase populations. • Establishment of firewood plantations and promotion of fuel reduction technologies (e.g. Ecostoves).	• Community engagement to encourage sustainable harvesting practices. • Discouragement to harvest particular species (protected and endangered). • Encourage establishment of community firewood plantations and promotion of fuel reduction technologies (e.g. Ecostoves).
	5.4 Fishing & Harvesting Aquatic Resources	N/A	• Engagement to encourage sustainable use.
	7.2 Dams & Water Management / Use	• SOPs to ensure plantation establishment and water use consider downstream water impacts. • Detailed survey to understand hydrological system at Lalautun. • Monitoring of water flows.	• Working with communities to protect/improve water supply and environmental flows.
	9.1 Household Sewage & Urban Wastewater	• Capture and treatment of all wastewater. • Design and implement water monitoring to identify potential contamination. • Social baseline study (and regular scheduled updates) to identify potential future issues.	• Promotion of good hygiene practices. • Assistance to communities to access financial assistance for improved water and waste water management.
	9.3 Agricultural & Forestry Effluents	• Policies and SOPs to reduce likelihood of erosion and ensure correct application of fertilizers and herbicides to minimise run-off. • Regular water monitoring to ensure pollutant levels downstream are within acceptable parameters.	N/A
	9.4 Garbage & Solid Waste	• Onsite waste management to contain solid waste, such as an onsite landfill. • Policies and procedures to minimise solid waste, especially plastics. • Engagement programs with staff and families on waste reduction and appropriate management supported by company programs such as composting.	• Community engagement regarding waste minimisation and management. Assistance in establishing communal waste facilities (such as a landfill). • Social baseline study (and regular scheduled updates) to identify potential future issues.

	9.5 Air-Borne Pollutants	• Road surface materials and that reduce dust. • Drainage management to reduce pollution into waterways during rain events. • Wetting of roads during dry season. • Speed limits on internal roads, particularly during dry season.	N/A
Peat (if present)		• Confirm the presence or absence of peat in swamp areas. • Ensure peat is within conservation areas with an appropriate buffer. • Monitor buffers for incursions	• Community engagement to encourage the protection and conservation of peat areas outside the company's management.

Carbon and GHG Management Plans

Based on the carbon emission sources identified in the GHG Calculator (Figure 23), the following management recommendations are made.

Table 42: Management and Monitoring for GHG

Source (Emissions)	Details	Mitigation Measures	Monitoring Actions
Land Clearing	Potential additional emissions through over clearing of boundaries	Site marked out in advance of vegetation clearance activities to ensure no clearance of vegetation outside of lease area	Site Inspections by Sustainability Team to review site mark-out prior to land clearing activities
Fertilisers and N_2O	Risk of sublimation of nitrogen based fertilisers into atmosphere as N_2O	Fertilisers to be applied while soils are wet to ensure that nitrogen moves down into soil and does not dry out on the surface	Amount of fertiliser, and timing of application must be as per the fertiliser schedule (records kept in OMP agronomy database)
Fuel usage	Use of diesel in plantation and milling activities releases greenhouses gases from fossil fuel	As a direct cost input, use of vehicles and diesel is strictly controlled	Regular reporting in monthly reports, as well as RSPO GHG Calculator
Carbon Sequestration	Planting trees and maintaining forest cover will increase carbon sequestration from the atmosphere into long term stores	POL will work with the landowner to select appropriate trees for planting in the riparian buffer.	NBPOL will be implementing Collect Earth monitoring for buffers and HCV areas

Parameter to be monitored	Proposed enhancement/ Mitigation measures	Location	Measurement	Frequency	Responsibility	Estimated time
Mitigate net GHG emissions associated with oil palm cultivation	Implementation of the High Carbon Stock Approach prior to development. No conversion of HCSA vegetation with carbon stocks greater than that contained in Scrub	*All areas to be leased*	GIS Map	Once	*Sustainability Manager* *Field Manager*	Completed
Enhancement of Carbon Stocks	All HCV/HCS areas to be leased to company to be managed as conservation areas allow for carbon sequestration.	*All areas to be leased*	GIS Map Field inspection	Quarterly	*Sustainability Manager* *Field Manager*	January 2021 and onwards
	Awareness to be carried out on the importance of maintaining HCV/HCS areas identified. Fund raising, i.e/ through HCSA, for funding into the conservation of these areas			Annual		
	Monthly monitoring of all conservation areas within areas leased to NBPOL. Enforcement of incursions (i.e/gardening) through consultation with communities, removal of crops and if that is not effective enforcement through stop payments of lease payments over conservation areas.		Field Inspections			

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5.1 List of references used in the assessments

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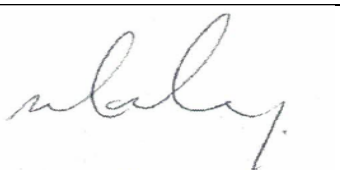
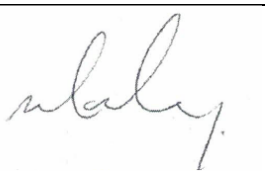
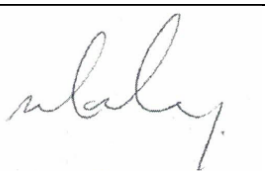
6. Internal responsibility

6.1 Formal signing off (with date) by assessors and grower.

The following assessors formally accept our interpretation of their findings and management recommendation as summarised in this report:

Assessment	Name of Lead Assessor	Signature
High Conservation Value Assessment	Michael Hansby	
Social Environmental Impact Assessment	Narua Lovai	
Soil Suitability Assessment	Banabas Murom	
Land Use Change Analysis	Michael Hansby	
Carbon Stock Assessment	Michael Hansby	
Green House Gas Analysis	Michael Hansby	

6.2 Statement of acceptance of responsibility for assessments and Formal signing off (with date) of management plan.

This document is the public summary of the integrated SEIA, HCV & HCS management for new developments of Tivingau ILG of Lokono at Poliamba Limited and has been approved by the management.

Roland Soupa General Manager

Signature:  Date: 9th April 2020

Theresa Endy: Sustainability and Quality Management Manager

Signature:  Date: 9th April 2020

6.3 Organisational information and contact persons.

Contact persons:

For RSPO Matters:
Laszlo Mathe: Principal Sustainability Officer, New Britain Palm Oil Group.
E-mail: laszlo.mathe@nbpol.com

Theresa Endy: Sustainability & Quality Management Manager, Poliamba Limited, New Britain Palm Oil Group.
Email: Theresa.endy@nbpol.com

For Legal and Financial Matters:
Roland Soupa, General Manager, Poliamba Limited, New Britain Palm Oil Group.
Email: Roland.soupa@nbpol.com

6.4 Personnel involved in planning and implementation.

Theresa Endy - Sustainability & Quality Management Manager

Roland Soupa - General Manager