PAPUA LNG PROJECT

UPSTREAM ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2: ENVIRONMENTAL AND SOCIAL BASELINE STUDIES

Part 6: Upstream Terrestrial Biodiversity Baseline Report
Annex 1d: Upstream Forestry Baseline Study Report

TOTAL E&P PNG LIMITED

December 2019
(Report No. 01215B_1-9_v5)

Upstream Forestry Baseline Study Report

Papua LNG Project

Total E&P PNG Limited

August 2017

01215B_25-1-9_v5

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Document History and Status

Company:	Booyong Forest Science Pty Ltd
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Title:	Upstream Forestry Baseline Study Report, Papua LNG Project
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Client:	ERIAS Group Pty Ltd for Total E&P PNG Limited
Client Contact:	Andrew Pym
Date of Issue:	August 2017
Version	V5
Project Number	ER1502
Report Reference Number:	01215B_25-1-9_v5
Delivery Format:	MS Word and PDF
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EXECUTIVE SUMMARY

Total E&P PNG Limited (TEP PNG) and their Joint Ventures are proposing to develop the Papua LNG Project (the Project) to commercialize the natural gas resource present in the Elk-Antelope gas field in Gulf Province, Papua New Guinea (PNG). As part of the Project environmental, social and health impact assessment (ESHIA), a Forestry study has been commissioned. This report presents the results of the technical study on Forestry conducted as part of the environmental and social impact assessment (ESIA).

Forestry was assessed over the upstream terrestrial biodiversity study area that covers approximately 7,290 km^2 of the Gulf Province lowlands (to c. 600 m above sea level (AMSL)).

The assessment involved a review of forestry sector reports and peer reviewed scientific literature, analysis of spatial datasets, aerial survey, interviews with key forestry and associated sector organisations in Papua New Guinea (PNG), and interviews with village communities to determine small-scale forestry activities, including harvesting of the high value non-timber forest products Eaglewood and Massoy.

The only large-scale industrial land use across the study area is commercial forestry. There are seven logging concessions within or adjacent to the study area of which only Vailala Block 3 and East Kikori are active, Iowa River, Pie Era and Eia River have expired and Vailala is still current, but appears to have been logged out. The main active logging concession is Vailala Block 3 Forest Management Area (FMA), which extends from the south bank of the Purari River to the coast and operates over 196,353 ha, all of which is in the study area. The other active concession is the East Kikori Timber Rights Purchase (TRP) area of which only 10,900 ha overlaps the study area. To the west of the Purari River is the Baimuru Block 3 FMA, which is still to be developed by Turama Forest Industries. This concession covers 321,876 ha of which 293,600 ha overlap the study area. These concessions operate in the main commercial forest types across the study area, which comprise hill forest (293,723 ha) and alluvial forest (101,699 ha). The areas of the commercial forest do not account for inoperable areas, which includes slopes greater than 30 degrees, however these have been mapped as part of this study.

The production forest is of relatively low quality for PNG because of the low merchantable volumes available for harvesting. The average merchantable volume is only 18m^3/ha, which is the equal lowest in PNG. The main commercial species available are *Terminalia* spp. and *Pometia pinnata* which are likely to account for approximately 10% of the available merchantable volume based on historical inventory data. These species are Group 1 species, which comprises the best quality timbers.

In addition to large-scale forestry the study area provides extensive forest resources that are suitable for small-scale logging using portable sawmills. However, small-scale forestry is almost absent from the study area based on an assessment of village based forestry activities, other than at Paevera where a portable sawmill is based.

Other high value but small-scale forestry products are also available from the study area. These include Eaglewood, which is harvested across PNG for its aromatic resin and Massoy bark. Massoy bark is harvested from trees from the species *Cryptocarya massoia* which is likely to occur in the hill forests of the study areas. However, there is no known commercial harvesting of these products, which appears to reflect a lack of knowledge about the markets, identification and location of the species and harvesting technique.

Although commercial forestry, designated by specific FMAs is the only licenced forestry land use across the study area, one Special Agricultural and Business Lease (SABL), the Purari SABL was gazetted in January 2011 over a total land area of 656,034 ha of which approximately three quarters overlaps the study area. A SABL is a lease-leaseback mechanism designed for conversion of forest to agricultural land use, the boundaries of which are usually proposed by the commercial entity interested in the land and registered with the Department of Lands. However, the SABL mechanism is widely regarded as providing access to production forest rather than a mechanism for appropriate conversion of land to agricultural use. However, the Purari SABL has not been developed yet and the reason for its establishment is subject to wide speculation that is not reportable here.

Future interactions of the Project (shipping and vehicle movements) with commercial forestry activities are likely to occur along major transport routes. Mostly, interactions will be confined to the Purari River, which is used to barge logs from the Evara Logging Camp downstream and the major logging haul road from South of the Purari River to Evara Logging Camp.

GLOSSARY AND ABBREVIATIONS

AAC	Annual Allowable Cut
AMSL	above mean sea level
Blk	block
CSIRO	Commonwealth Scientific and Industrial Research Organisation
COI	Commission of Inquiry
DBH	Diameter at breast height
DEM	Digital elevation model
EIS	Environmental Impact Statement
ESBS	Environmental and Social Baseline Study
FIMS	Forest Inventory Mapping System
FMA	Forest Management Area
ITTO	International Tropical Timber Organization
ha	hectare
km	kilometer
LLG	Local level government
NFP	National Forest Plan
NFS	National Forest Service
NTFP	Non-Timber Forest Product
PNGFA	Papua New Guinea Forest Authority
PNGRIS	Papua New Guinea Resource Information System
PRL	Petroleum Retention Licence
SABL	Special Agricultural and Business Leases
SFM	Sustainable Forest Management
TA	Timber Authority
TRP	Timber Rights Purchase Area

1 INTRODUCTION

1.1 PROJECT OVERVIEW

The following Project description is focused on the upstream components of the Papua LNG Project and aims at providing minimal but appropriate context for the baseline reports.

Joint venture partners are currently planning the development of the Elk-Antelope gas field, which is located within Petroleum Retention License 15 (PRL-15) in the Gulf Province, Papua New Guinea. Total E&P PNG Limited (TEP PNG), a wholly owned subsidiary of TOTAL S.A (TOTAL) has the largest interest in the Elk-Antelope gas field and is the operator of the Papua LNG Project (the Project) on behalf of the other joint venture partners.

The Elk-Antelope gas field is a significant gas discovery in Papua New Guinea consisting of a gas reservoir with several trillion cubic feet of gas reserves located approximately 120 km inland from the township of Kerema, and 340 km northwest of Port Moresby.

The Project will comprise upstream production well development and associated infrastructure at the gas field within PRL-15, construction of an upstream central processing facility (CPF) and delivery of gas and condensate via onshore and offshore export pipelines to a LNG Plant site at Caution Bay, Central Province, 20 km northwest of Port Moresby. The design life for the Project will be 25 years.

The Project area comprises the physical footprint of the various Project components and associated infrastructure as detailed below.

- Production, processing and related facilities (within PRL-15):
  - Wellpads and the associated gathering system (including flowlines and trunkline).
  - CPF.
  - Logistics base and river offloading facilities, accommodation camps, airstrip, roads and bridges.
  - Quarries, communications infrastructure.
  - Initial section of the onshore export pipeline.
- Onshore pipeline (outside PRL-15):
  - Remainder of the onshore export pipeline to landfall on the Gulf coast including valve stations.
  - Temporary laydown areas and camps.
  - Quarries, communications infrastructure.
- Transport (river) corridors:
  - River transport routes — the Purari, Urika-Ivo and Wame-Varoi rivers.
- Offshore pipeline:
  - Offshore section of the export pipeline to a LNG Plant site, Caution Bay.

As part of the Project environmental, social and health impact assessment (ESHIA), a terrestrial biodiversity study has been commissioned to provide a baseline characterization of terrestrial biodiversity and conservation values present in the vicinity of the upstream Project area. This report presents the results of the technical study on forestry conducted as part of the upstream terrestrial biodiversity study.

1.2 UPSTREAM TERRESTRIAL BIODIVERSITY STUDY AREA AND ECOLOGICAL ZONES

The upstream terrestrial biodiversity study area (hereafter 'study area') covers approximately 7,290 km^2 of the Gulf Province lowlands (to c. 600 m above sea level (asl)). The study area is divided into five ecological zones, each of which is expected to support a distinct assemblage of terrestrial biota.

The study area encompasses the upstream Project area of influence (upstream PAOI), the area within which the Project may potentially and measurably impact biodiversity. The terrestrial biodiversity field surveys were focused at representative sites within the upstream PAOI, hereafter referred to in this report as survey sites. Further description of the PAOI is provided in the main Upstream ESBS report

and is no longer referred to in this report.[1] The study area and its associated vegetation and land use are shown in Figure 1-1.

1.3 TECHNICAL STUDY OBJECTIVES

The objectives of the forestry baseline technical study report are to:

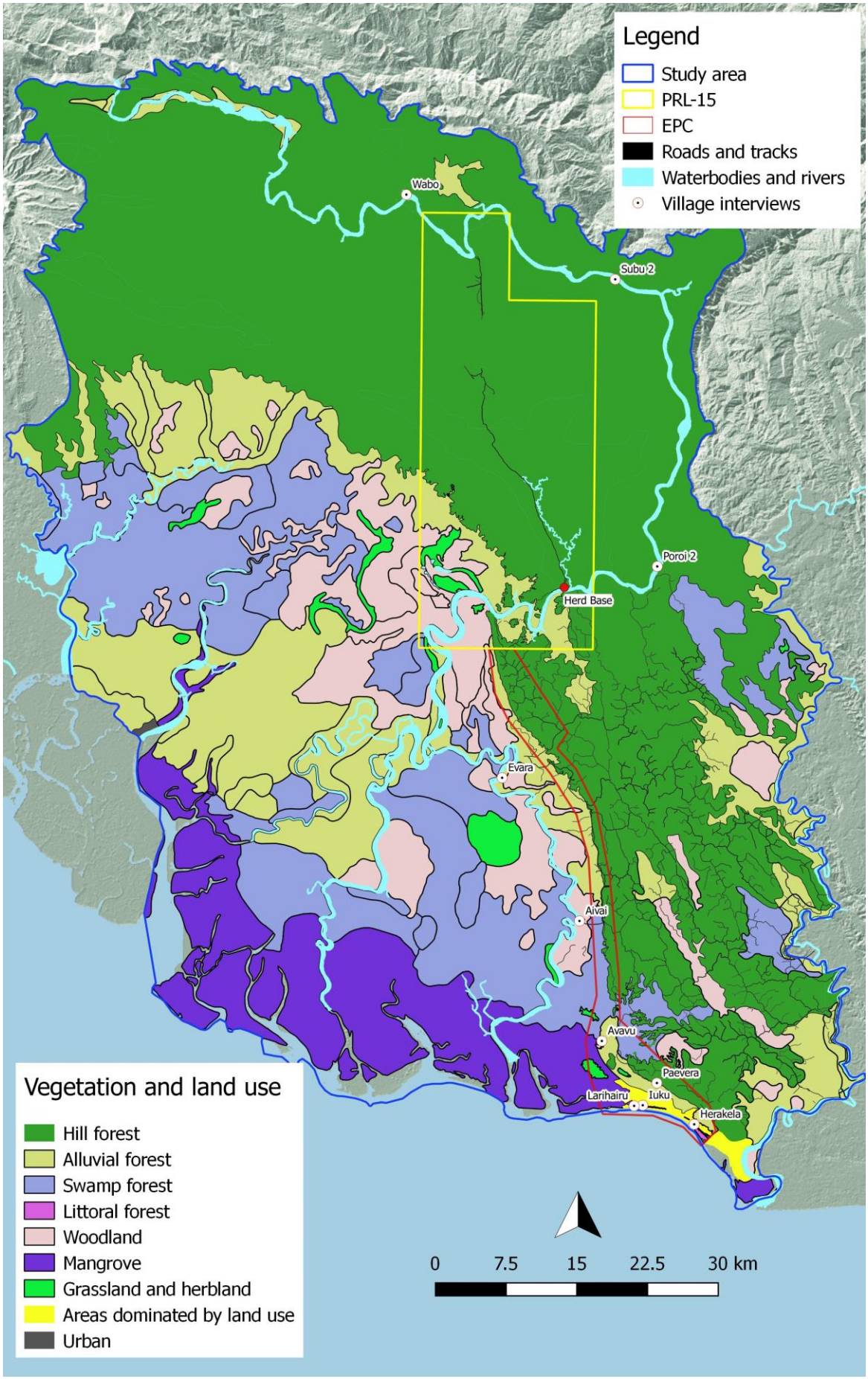
- Identify key forestry resources of the study area.
- Assess the interaction of forestry activities with the project.
- Identify areas at high risk of forestry development as a consequence of the project.

1.4 STUDY AREA AND DEFINITIONS

The study area is defined as the aerial extent of forest resources that could potentially be directly or indirectly impacted within the biodiversity study area because of the construction, operation and decommissioning of this Project and encompasses approximately 7,290 km^2. The study area and forest (vegetation) is shown in Figure 1-1.

[1] The boundary of the PAOI is shown in figures for context only.

Figure 1-1 Study area and vegetation



2 METHOD

The study methods focused on data collection and analysis to characterise forestry sector activities within the study area. The methods included a review of forestry sector reports and peer reviewed scientific literature, targeted aerial survey of the study area, analysis of spatial datasets, interviews with key forestry sector and associated organisations and interviews with selected village communities within the study area.

2.1 DATASETS AND INTERVIEWS

The following spatial datasets were used:

- Forest Inventory Mapping System (FIMS).
- Papua New Guinea Resource Information System (PNGRIS).
- Papua New Guinea Forest Authority forestry concessions.
- Special Purpose Agricultural Business Leases (SABLs).
- Revised Forest Inventory Mapping System (FIMS) vegetation mapping for the Project (Rogers, 2017).
- Global Forest Change (GFC, 2016).

Spatial data from these datasets is used throughout the report in the various mapping figures.

Organisations interviewed are listed in Table 2-1. Information from the interviews is presented throughout the report to support the findings of other datasets, where applicable. Where the information provided is potentially sensitive, reference has not been made to the source.

Table 2-1 List of Organisations

Organisation	Position	Date interviewed
Frontier Holdings	Evara logging camp manager	11/02/2016
Frontier Holdings	Shipment and marketing manager	11/02/2016
Société Générale de Surveillance (SGS)	General Manger	21/09/2016
PNG Forest Authority	Forest Acquisitions Manger	20/09/2016
PNG Forest Industries Association	Executive Officer	21/09/2016
Frontier Holdings	General Manger Operations, Rimbunan Hijau (PNG) Group (responsible for Frontier Holdings)	21/09/2016
PNG Forest Authority	Officer – Non-timber forest products	21/09/2016
PNG Forest Authority	Officer - Marketing	21/09/2016
PNG Forest Authority	Forestry Officer	10/10/2016
Provincial Forest Authority	Provincial Forestry Officer	16/08/2016

* Interview conducted by Mike Finlayson as part of the social baseline assessment

Discussions about forestry activities in the study area were incorporated into the ecosystem services interviews for selected village communities. Three forestry related themes were discussed, but questions about each theme were phrased differently depending on the village meeting participants to stimulate an informal discussion, as opposed to generating a standardised response to a standardised question. The three main forestry related themes that were discussed were:

- The presence of small scale community based logging utilising portable sawmills.
- The presence of large scale industrial logging.
- The presence of commercial activities in relation to the high value non-timber forest products, Eaglewood and Massoy.

The villages interviewed were; Wabo, Ura, Poroi 2, Subu 2, Evara, Aivai, Avavu, Herakela, Iuku, Larihairu and Paevera. The information collected from the informal discussions has been used

throughout the report to support findings from other sources of information where relevant. The location of the village interviews is provided in Figure 1-1.

2.2 AERIAL SURVEY

Aerial survey was undertaken on July 2nd, 2017 to obtain an overview of commercial forestry and associated infrastructure, to verify the location of current operations, and to confirm the commercial forest types where logging has occurred.

2.3 VEGETATION TERMINOLOGY

Vegetation types are referred to in the text using a set of Forest Inventory Mapping System (FIMS) - equivalent terms developed specifically for the Upstream Terrestrial Biodiversity Baseline Report (Appendix A). These closely follow the formal FIMS descriptors, which are based on the founding vegetation descriptions (Hammermaster and Saunders, 1995, Paijmans, 1976), but are less cumbersome.

Where a specific vegetation type is referred to in the text it is capitalized and followed in brackets by its FIMS code. In this way reference is made to vegetation mapping units present in surveyed areas, for example 'Hill forest (Hm)' and 'Open alluvial forest/Swamp forest (Po/Fsw)'.

Where more general reference is made to broader vegetation types that include multiple possible variants within the study area (and more widely in PNG) it appears without capitals or a FIMS code, for example 'hill forest' and 'alluvial forest'. These generic types closely follow the various basal FIMS vegetation types, which in these examples are coded 'H' and 'P' respectively.

A full list of FIMS vegetation types present within the study area, and equivalent terms used in the upstream terrestrial biodiversity study, is presented in the Upstream Terrestrial Biodiversity Baseline Report.

2.4 LIMITATIONS

The findings presented in this report are based on a combination of publicly available data and comment obtained from key persons and organisations. Independent confirmation of the reliability, accuracy or completeness, mathematical accuracy and reasonableness of the above information has not been sought. Thus, it should not be construed that a due diligence type audit of forestry activities in the study area has been carried out.

Where there is insufficient data or interviewee comment, the following assumptions have been made in preparing this report:

- SABLs in most cases are effectively a logging concession that circumvents the forest management area process unless otherwise stated.
- Forest quality (e.g., merchantable log volumes) is assumed to be sufficient for a large-scale commercial logging operation where free of physical and regulatory constraints.
- Areas at high risk for forestry development includes all forest free of physical constraints unless data is available that contradicts this.

3 FORESTS AND FORESTRY IN PAPUA NEW GUINEA

3.1 FOREST COVER

Papua New Guinea has a total land area of 46,410,390 ha which includes extensive lowland and montane forest types. The area of forest is reported at around 33 million ha or 71% (Shearman *et al.*, 2008). This figure is based on detailed analysis of land cover maps derived from satellite imagery in 2002. Therefore, it does not reflect the current extent of forests. Since 2002 ongoing forest loss has occurred from a range of activities, including conversion to oil palm cultivation, large-scale logging, mining and hydrocarbon development projects, and extensive expansion of subsistence agricultural activities. Combined, these activities contribute to an annual deforestation[2] and degradation[3] rate of 1.71% (Shearman *et al.*, 2008).

Across Papua New Guinea the forest cover and forest quality has and is constantly being impacted by a range of competing land uses. Subsistence agriculture is the dominant cause of deforestation, particularly in the New Guinea Highlands, but substantial forest degradation occurs in the lowlands due to commercial forestry. In 2002 Gulf Province had a primary forest cover of 4 million ha with a further cover of 0.5 million ha of degraded forest. The combined forest cover is the largest of any of the Papua New Guinea provinces and represents approximately 15% of the total forest cover across Papua New Guinea.

The remaining potential production forests accessible to logging primarily occur in the lowlands of the mainland (c. 18.5 million ha) and the islands (2.5 million ha), and in particular in Western Province, with a relatively small area of production forest occurring in the montane (highlands) zone (0.5 million ha) (Shearman *et al.*, 2008).

3.2 NATIONAL FOREST PLAN

Logging of Papua New Guinea's forests is guided by the draft National Forest Plan (NFP) of 2013 which is invoked under the *Forestry Act 1991*. The NFP outlines how the forests of Papua New Guinea are to be managed and for what purpose, and identifies areas of production forest and reserve/conservation forest for each province. The draft NFP forest classification is provided in Table 3-1.

This classification focuses on the timber production value of forests and not FIMS vegetation type (that is, the forest definitions are based on logging potential and not forest type. Each forest type has logging potential) but also considers community use, eco-forestry, non-timber forest products and conservation. However, since there has been no recent National Forest Inventory as stipulated in the National Forest Policy (1991), the accuracy of the data in the NFP is uncertain.

Table 3-1 Forest classification

Forest Classification	Area (ha)	Description
Production forest	14.60 million	Identified as timber production areas in the long term. Of the total area of production forest an estimated 5.5 million ha is available for development under concessions while 9.1 million ha is considered as future production forest.
Reserve forest and protection forests	12.44 million	While decisions have yet to be made on their functions, a large proportion would be for protection although only 1.796 million ha have been either officially gazetted as conservation areas and or being proposed. Other forested areas are classified as protection forest by virtue of their location, topographic constraints, and ecological, cultural or environmental considerations, e.g. water catchment protection.
Afforestation and salvage forest	9.22 million	Grassland areas and forests cleared for other uses.
Others	10.10 million	Areas taken up by other land-use including urban settlements, agriculture etc.
Total	**46.36 million**	

[2] Deforestation refers to the loss of forest and replacement with another land type (e.g. agricultural use and grasslands).

[3] Forest degradation refers to the conversion of primary (unmodified forest) to secondary (modified) forest, typically through logging or shifting cultivation practices.

3.3 TIMBER PRODUCTION

Timber harvesting for round log exports in the *Production Forests* is the primary focus of the Papua New Guinea Forest Authority. The natural forests are biologically diverse and heterogeneous comprising more than 2,000 tree species (Kula, 1994), of which about 200 have economic value (PNGFA, 1996c). Of these 200 commercial species, seventeen species have the highest market value (Group 1 species), and are consequently targeted for logging and export. Some of the seventeen species are common throughout PNG and include *Pometia pinnata*, *Canarium indicum*, *Homalium foetidum*, *Terminalia* and *Calophyllum*, all of which occur within the study area. Market access determines the choice of species to be harvested. The only limiting factor is the size of the tree which must be of minimum diameter 50 cm DBH (diameter at breast height) to be legally harvested. Timber production operational practices are guided by various controls outlined in the Papua New Guinea Logging Code of Practice (PNGFA, 1996b), however breaches of the code are common (ITTO, 2007, PWC, 2006), and concerns have been raised about unsustainable levels of harvest that could expose the country to timber shortages in the future (ITTO, 2012).

There are about 77 forest concessions (FMAs[4]) currently listed as 'in production', operating over an area of 8.3 million ha across the country of which 1.5 million ha (46%) is in Gulf Province. In addition, for Gulf Province a further 500,000 ha (14%) have been logged under the earlier TRP[5] system. The currently active concessions range from approximately 100,000 ha to 530,000 ha for large-scale operations. Active concessions that overlap the study area are entirely operated by foreign companies. Large-scale commercial forestry is dominated by Malaysian-owned or controlled companies. In 2006, five companies together controlled over 80% of the market across Papua New Guinea (PWC, 2006), and this situation is unlikely to have changed. Logging concessions in Gulf Province are listed in Table 3-2 and are mapped in Figure 3-1.

Additional logging is undertaken by small-scale portable sawmill operations which produce sawn timber for community needs (e.g., house building) and local building markets. The small-scale operations are usually operated by communities and landowner companies and produce very small volumes of sawn timber, but collectively are estimated to account for 10% of all log harvesting in Papua New Guinea (Lawson, 2014a). The only small-scale portable sawmill activity known to occur in the study area is at Paevera (within the export pipeline corridor) where a Lucas Mill was being used to produce sawn timber for community use. No other small-scale logging was reported elsewhere in the study area. However, it is likely that some communities' use chainsaws for slabbing small volumes of timber for community use and local sales.

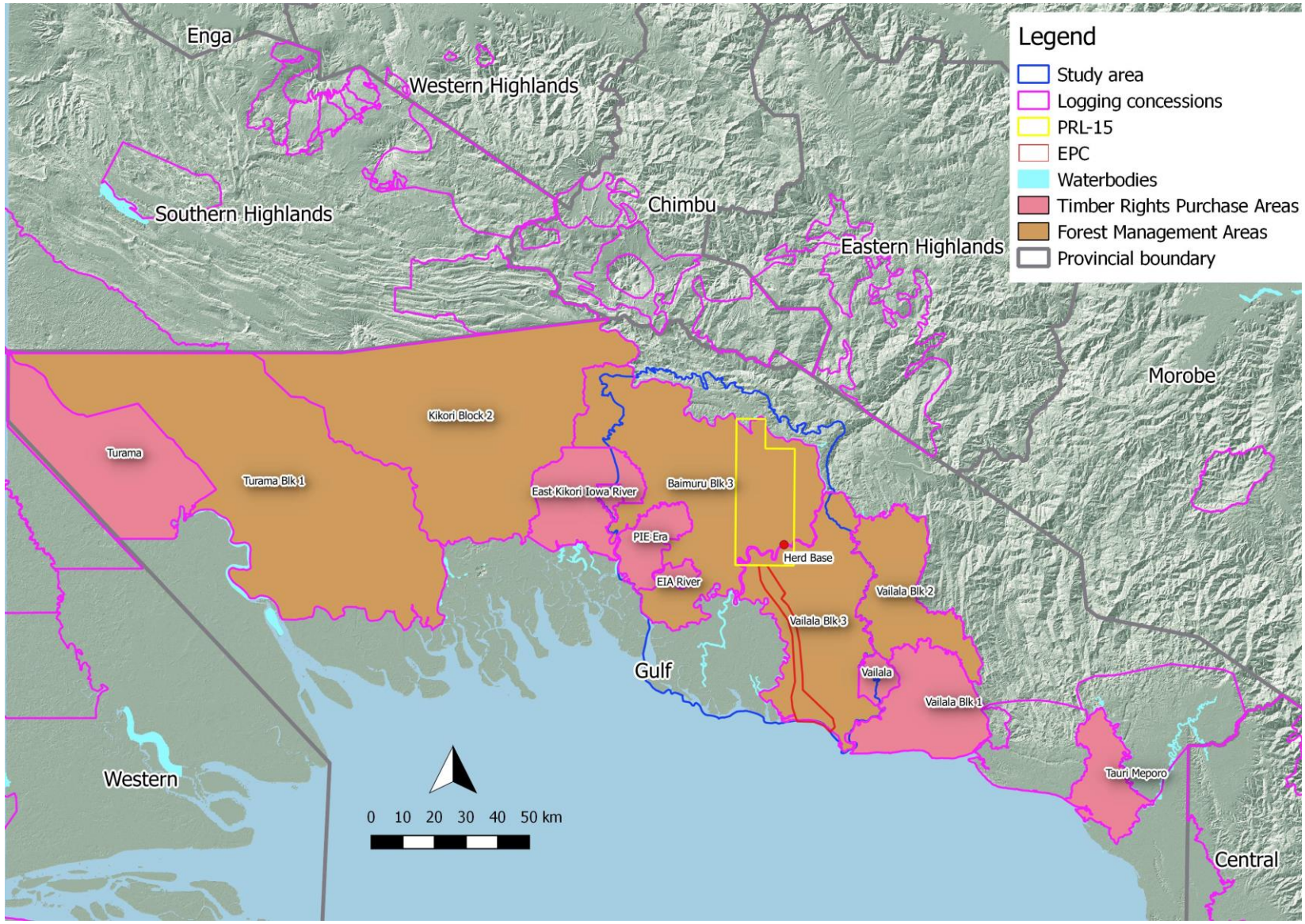
Table 3-2 Logging concessions and their status in Gulf Province

Name	Concession type	Area (ha)	Expiry	Status	Study Area*
Turama Block 1	FMA	530,913	28/05/2045	Concession	-
Kikori Block 2	FMA	443,269	28/05/2045	Concession	-
Baimuru Block 3	FMA	321,876	28/05/2045	Concession	•
Vailala Block 2	FMA	102,473	17/12/2045	Concession	-
Vailala Block 3	FMA	196,353	17/12/2045	Concession	•
	Subtotal	**1,594,884**			
Eia River	TRP	8,063	05/04/1995	Concession	•
Pie Era	TRP	37,443	27/11/2004	Concession	•
Iowa River	TRP	5,747	26/03/2005	Concession	•
Vailala	TRP	14,543	30/06/2025	Concession	•
Turama	TRP	185,190	03/03/2028	Concession	-
Vailala Block 1	TRP	104,437	10/04/2029	Concession	-
East Kikori	TRP	83,362	11/09/2030	Concession	•
Tauri Meporo	TRP	54,590	11/09/2030	Concession	-
	Subtotal	**493,375**			
Kakoro	Proposed	128,590		Not active	-
Meporo (Malalaua)	Proposed	79,268		Not active	-
*• = Yes, - = No	***Subtotal***	**207,858**			
Grand Total		**2,296,117**			

[4] An FMA is a logging concession that has been acquired by the state and is subsequently tendered for by private companies based on a 34 step process that includes consent of the customary landowners to implement logging.

[5] A TRP is an area of customary land over which the State has acquired the rights of felling, cutting, removing and disposing of timber under Section 8 of the *Forestry Act. (Logging companies tendered for TRPs once the State has acquired the rights.).* The TRP system has been replaced by the FMA system.

Figure 3-1 Logging Concessions in Gulf Province



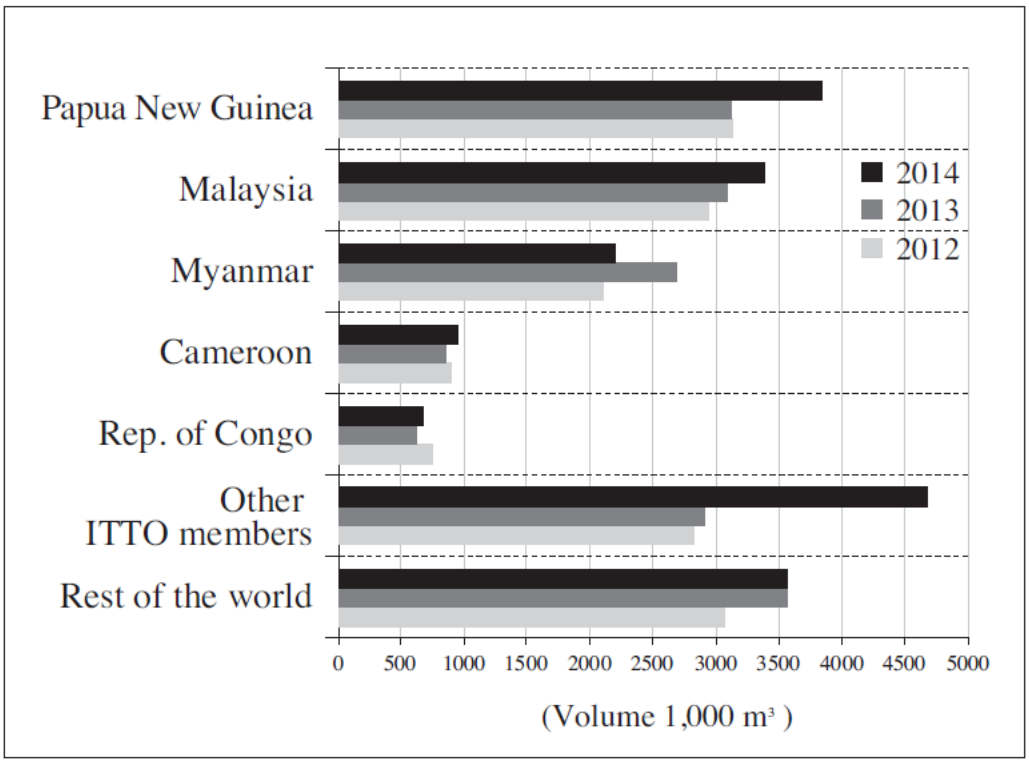
3.4 MARKETS

A significant proportion of the global trade in tropical primary wood products (logs, sawn wood, veneer and plywood) is conducted within the Asia Pacific region[6]. Tropical saw and veneer log exports from Asia Pacific producers represent about three-quarters of global exports, with the major log trade flows being from Papua New Guinea, Malaysia, Myanmar, Cameroon and the Republic of Congo (Figure 3-2) to China and India. In 2013 Papua New Guinea became the world's largest exporter of tropical logs (Plate 3-1) exporting 3.8 million m^3, which is an increase of 22% from 2013. China has remained the dominant market importer, accounting for 56% of the share of total International Tropical Timber Organisation (ITTO) tropical log imports in 2013. The volumes imported in 2014 surged by 26% to 11.8 million m^3 (ITTO, 2014).

In contrast to Malaysia, which has a range of export markets, Papua New Guinea's tropical log exports are overwhelmingly channelled to China, which accounts for 90% of Papua New Guinea's exports (Figure 3-3), and in combination with exports from the Solomon Islands makes up 51% of all the logs imported into China. However, the sustainability of this log supply is questionable at the current levels. In particular the rate of harvesting in the Solomon Islands has far exceeded the sustainable capacity of its forests, and most projections indicate that these forests will be exhausted in a decade (ITTO, 2012), placing Papua New Guinea's forests under more pressure. For Papua New Guinea increases in production are partly attributed to the logging of SABLs.

In contrast to exports of logs, Papua New Guinea's export trade in sawn wood products is relatively small at only 5,146 m^3 in 2014, with the dominant producer, Rimbunan Hijau, exporting approximately 36,000 m^3/year, most of which is imported by Australia and to a lesser extent New Zealand (RH, 2016).

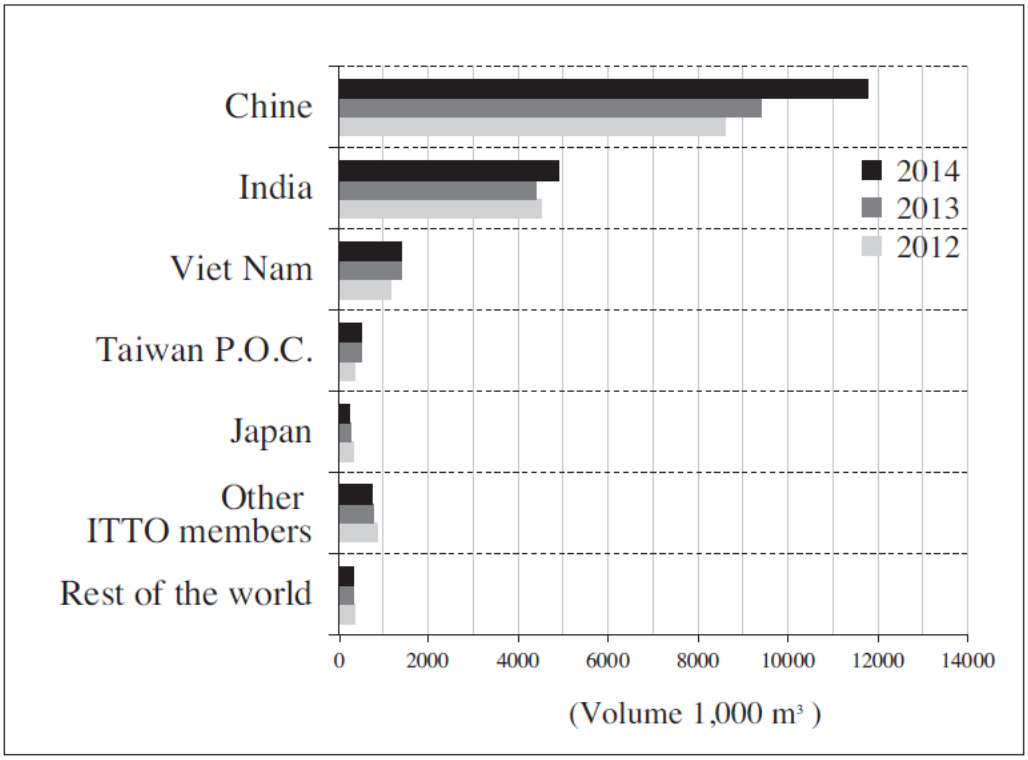
Figure 3-2 Major tropical log exporters from 2012 to 2014



(Source: ITTO 2014)

[6] Information on the global trade in timber is produced by the ITTO every two years. The 2013/2014 data is the current version until the 2015/2016 data is made available.

Figure 3-3 Major tropical log importers from 2012 to 2014



(Source ITTO 2014)

Plate 3-1 Barcoded log ready for export to China at Evara logging camp

3.4.1 Log exports from the study area

Log export volumes could only be obtained for the combined exports from the FMAs Vailala Block 2 and Vailala Block 3, of which only Vailala Block 3 is in the study area. Between January 1995 and September 2016 log exports from these FMAs totalled 1,545,794.57 m^3 (Pers. Com. Bruce Telfer, SGS Forestry) which is an annual export rate of 71,345 m^3, of which 46,879 m^3/year is estimated to be exported from Vailala Block 3[7]. The main species exported were *Terminalia*, *Homalium foetidum*, *Octomeles sumatrana*, *Endospermum medullosum*, *Anisoptera thurifera*, *Mastixiodendron pachyclado*, *Canarium oleosum*, *Buchanania*, *Pterygota horsfieldii*, *Canarium indicum*, *Dracontomelon dao*, *Aglaia cucullate* and *Pometia pinnata*. These species made up 73% of the total export volume.

4 FOREST LEGISLATION AND REGULATION

Legislation and regulations for the governance and management of forests that are applicable to the study area are described in the following sections.

4.1 FORESTRY ACT 1991, FOREST GOVERNANCE AND LAW ENFORCEMENT

Forestry is regulated by the Papua New Guinea Forest Authority (PNGFA), which was established under Section S.5 of the *Forestry Act 1991*. Mandated by this Act, and operating through the National Forest Board, the National Forest Service and the Provincial Forest Management Committees, the PNGFA is empowered to manage the nation's forest resources through implementing the overall objectives of the National Forest Plan. The national goals and directive principles as set out in the constitution provide the basis for forest policy, the formulation of which is guided by the fourth goal of the constitution. The fourth goal of the constitution forms the cornerstone for forestry policies, which is to ensure that the forest resources of the country are used and replenished for the collective benefit of all Papua New Guineans now and for future generations, i.e., sustainably managed forests.

The primary functions of the PNGFA are to identify areas of suitable production forests that can be harvested on a sustainable basis based on the annual allowable cut (AAC)[8], and subsequently to negotiate Forest Management Agreements (FMAs) for the production forest areas with resource owners (i.e. the customary landowners) and select developers (logging companies). Individual FMA's cannot be logged until a logging company has successfully tendered for the FMA under a competitive process. This involves a 34 step process, including consultation with the customary landowners who must sign the FMA prior to the commencement of logging.

The *Forestry Act 1991* (as amended in 1996/2000/2005/2007/2010) includes several important parts, which relate to:

- (90A) large-scale conversion of forest to agriculture or other land use.
- (90B) applications for agriculture or other land use.
- (90C) large-scale conversion of forest to road.
- (90D) applications for conversion of forest to road.
- (90E) cancellation etc. of authorities.

Other important regulations and acts include the Forestry Regulations 1998 and the *Environment Act 2000*, which is also applicable to large-scale agricultural projects. The Forestry Regulations 1998 provides details on regulations applicable to how forestry proposals are to be submitted, rules governing the issuing and cancelling of commercial forestry permits, rules governing the operating procedures of the Forestry Board and the Provincial Forest Management Committee, and declaration of classes and species of reserved trees.

The *Environment Act 2000* provides for and gives effect to the National Goals and Directive Principles relating to the environment, and in particular:

- Provides for protection of the environment (i.e. forests) in accordance with the Fourth National Goal and Directive Principle (Natural Resources and Environment) of the Constitution.

[7] Annual exports from Vailala Block 3 were estimated based on the proportion of the total area of the combined FMAs that forms the Vailala Block 3 FMA.

[8] The AAC is the amount of timber that can be harvested on a sustainable basis (in accordance with the policy of sustained yield) within a defined planning area, i.e. an FMA.

- Regulates the environmental impacts of development activities to promote sustainable development of the environment and the economic, social and physical well-being of people by safeguarding the life-supporting capacity of air, water, soil and ecosystems for present and future generations and avoiding, remedying and mitigating any adverse effects of activities on the environment.
- Provides for the protection of the environment from environmental harm.
- Provides for the management of national water resources and the responsibility for their management.

Taken in isolation, the laws governing the Papua New Guinea forestry sector are regarded as thorough, with the principal relevant legislation including (a) the *Environment Act 2000*, (b) the *Forestry Act 1991*, and (c) the Forestry Regulations 1998. However, the forestry sector is subject to extensive and ongoing litigation across multiple concessions. Landowners frequently challenge the legality of timber licensing on grounds of sustainability and due process. This includes issuances of permits and related extensions in the absence of a finalized National Forest Plan, and a certified forest resource inventory; and in alleged contravention of established procedures for (amongst others) securing the consent of landowners and Provincial Forest Management Committees (PFMCs). Claims have also been brought for trespass (and related nuisance) on grounds that permits do not provide a valid basis for logging (ODI, 2007). The alleged failure of the Papua New Guinea Government to fulfill its responsibilities has become a more frequent complaint than logging company concession compliance with environmental and social commitments, and is possibly a more pressing issue, particularly with the current land grab of potential production forests under SABLs.

Overall, in the past the imperative to promote logging has influenced the National Forest Board to take decisions without regard to the procedures required by the *Forestry Act 1991*. This has been an ongoing complaint since the Barnett report[9] and is persistently raised, e.g., (APAG, 1990, Avosa and Rungol, 2011, PWC, 2006). A typical example of this includes the extension of large-scale logging concession permits without any consultation with landowners (PWC, 2006). This situation has been exacerbated by the issuing of SABLs by the Department of Lands and the associated environmental permits by the Conservation and Environment Protection Authority (formerly Department of Environment and Conservation) (See Section 5).

4.2 TIMBER PERMITS

Logging for timber production from small and large scale logging operations is regulated by the PNGFA through the National Forest Service (NFS). Large-scale logging is required to operate under an FMA. Forest Management Agreements were brought in to replace the earlier Timber Rights Purchase system (TRPs) in the early 1990s. An FMA usually covers a few hundred thousand hectares of forest, where the resource owners representative Incorporated Landholder Group (ILG) have signed an agreement with the Papua New Guinean Government, which lasts for 40 years. Logging companies bid for FMAs by competitive tender.

For small-scale logging and road line clearances where the logs are to be sold or exported a Timber Authority (TA) permit is required. Where timber is harvested solely for community needs, e.g., house building and local infrastructure a TA is not required.

For small-scale logging a TA-01 allows 5,000 m^3 of logs to be harvested annually. For road line clearances, a TA-02 is required if the timber is to be sold locally or exported. Where the timber is not sold, left to decay or utilised for community needs no TA is required. For harvesting of produce other than timber a TA-04 is required.

[9] The Barnett report presents the findings of the 1987 Commission of Inquiry into corrupt practices in Papua New Guinea's logging industry. The focus was on corruption in the private sector and in government departments.

5 SPECIAL AGRICULTURE AND BUSINESS LEASES

A SABL is a mechanism by which land can be leased for conversion of forest to agriculture for a period of up to 99 years. This mechanism is promoted for conversion of forested land to oil palm plantations. Between the beginning of July 2003 and the end of January 2011 almost 5 million hectares of customary land (11% of Papua New Guinea's total land area) has passed into the hands of national and foreign corporate entities through the SABL legal mechanism 'lease-leaseback scheme'.

The SABL land lease mechanism is widely viewed as an opportunity for logging companies to gain access to land for timber harvesting where there is no FMA, as opposed to clearing for the development of a legitimate oil palm plantation or other agricultural activity. This is supported by the fact that most of the areas in excess of 10,000 hectares that have been leased back to private companies appear to contain areas of forest which are defined by the PNGFA as 'Potential Areas for Forestry Development' (Goldman, 2014). These are areas of primary forest where officers of the National Forest Service (the bureaucratic arm of the PNGFA) have identified a commercial timber resource, which has yet to be logged, but where the Papua New Guinean Government has not yet acquired the timber harvesting rights through an FMA with the customary landowners. In most of these cases, the process of resource acquisition has stalled because the size of the resource does not meet the minimum requirements for what is defined as a 'sustainable forest management' (or selective logging) project under the terms of the National Forest Policy and the National Forestry Development Guidelines.

Consequently, SABLs are often regarded as cover for illegal logging activities falling under the ruse of "so called agricultural development projects". In practice the agricultural project rarely happens but the forest resource is harvested and exported without meeting the following requirements (FIA, 2010):

- Statutory requirements nor payment of forest charges as specified under the *Forestry Act 1991*.
- Environmental conditions for large-scale harvesting or agricultural activities as prescribed under the *Forestry Act 1991* and the *Environment Act 2000* of Papua New Guinea.
- Infrastructure development for customary landowners.

The effectiveness in the use of SABLs to access forest resources is evident in the export statistics for logs from selective harvesting and forest conversion. There has been a rapid increase in log exports from forests converted under SABLs since 2007 (Figure 5-1) when less than 5% of log exports originated from converted forests. In 2012, exports from converted forests rose to 25% of total log exports. Much of the exports from converted forests are considered illegal (Lawson, 2014b), however this is not proven. These exports are sanctioned by the National Forestry Board, which must approve a log export licence for any merchantable timber harvested from land to be cleared. Without a log export licence from the PNGFA cleared forest must be burned or left to decay.
Future exports from SABLs may be limited since many SABLs are likely to be cancelled based on the Commission of Inquiry (COI) that commenced in July 2011. The COI reviewed each SABL including legality, lease boundary and landholder agreement issues, and concluded that the customary landowners were not adequately consulted or represented, due process was not followed by the Papua New Guinean Government in tendering and it was recommended that many of the SABLs be revoked (COI, 2016).

Figure 5-1 Log exports from selective logging and conversion, 2005 - 2012

(Source: Lawson, 2014)

6 LOGGING CONCESSIONS AND PRODUCTION FORESTS IN THE STUDY AREA

Production forests in the study area are those areas of forest that occur within an existing concession that comprise commercial species with merchantable volumes. These factors are discussed in the following sections.

6.1 FOREST MANAGEMENT AREAS

There are seven logging concessions within or adjacent to the study area (Table 6-1, Figure 6-1), of which only two appear to be active (Vailala Block 3 and East Kikori), three have expired (Iowa River, PIE Era and EIA River) and one is current (Vailala), but appears to have been logged out. The main active logging concession is Vailala Block 3, which extends from the south bank of the Purari River to the coast. This concession is held by Frontier Holdings, which is a subsidiary of the large Malaysian logging company Rimbunan Hijau. Much of the concession has been logged with current harvesting occurring in hill forest approximately 15 km to the southwest of Herd Base. The other active concession is the East Kikori TRP of which only 10,900 ha overlaps the study area. Spatial data from the Global Forest Change website (GFC, 2016) indicates extensive logging tracks in the overlapping East Kikori TRP for the years 2000 to 2014 (Figure 6-2). The same data source also indicates logging in the adjacent expired TRP, Iowa River. The Iowa River TRP expired in 2005 but this concession is the base for a large active logging camp that is used to export logs via barge (Plate 6-1). This logging camp is possibly being used as the base for the East Kikori TRP which expires in 2030.

Table 6-1 Logging concessions in or overlapping the study area

Concession Name	Concession type	Gross area* (ha)	Overlap with study area	Status
Vailala	TRP	14,543	5,253	Current but logged out
Vailala Block 3	FMA	196,353	196,353	Current
Baimuru Block 3	FMA	321,876	293,600	Current but no logging yet
East Kikori	TRP	83,362	10,900	Current
Iowa River	TRP	5,747	4,835	Expired
Pie Era	TRP	37,443	37,443	Expired
Eia River	TRP	8,063	8,063	Expired
Total		**667,387**	**556,447**	

* Gross area includes operable and inoperable areas. Inoperable areas include steep slopes, swamps, gardens and settlements and can account for up to 50% of the area in some instances.

Plate 6-1 Logging barges at the Iowa River TRP

Figure 6-1 Production forests in the study area

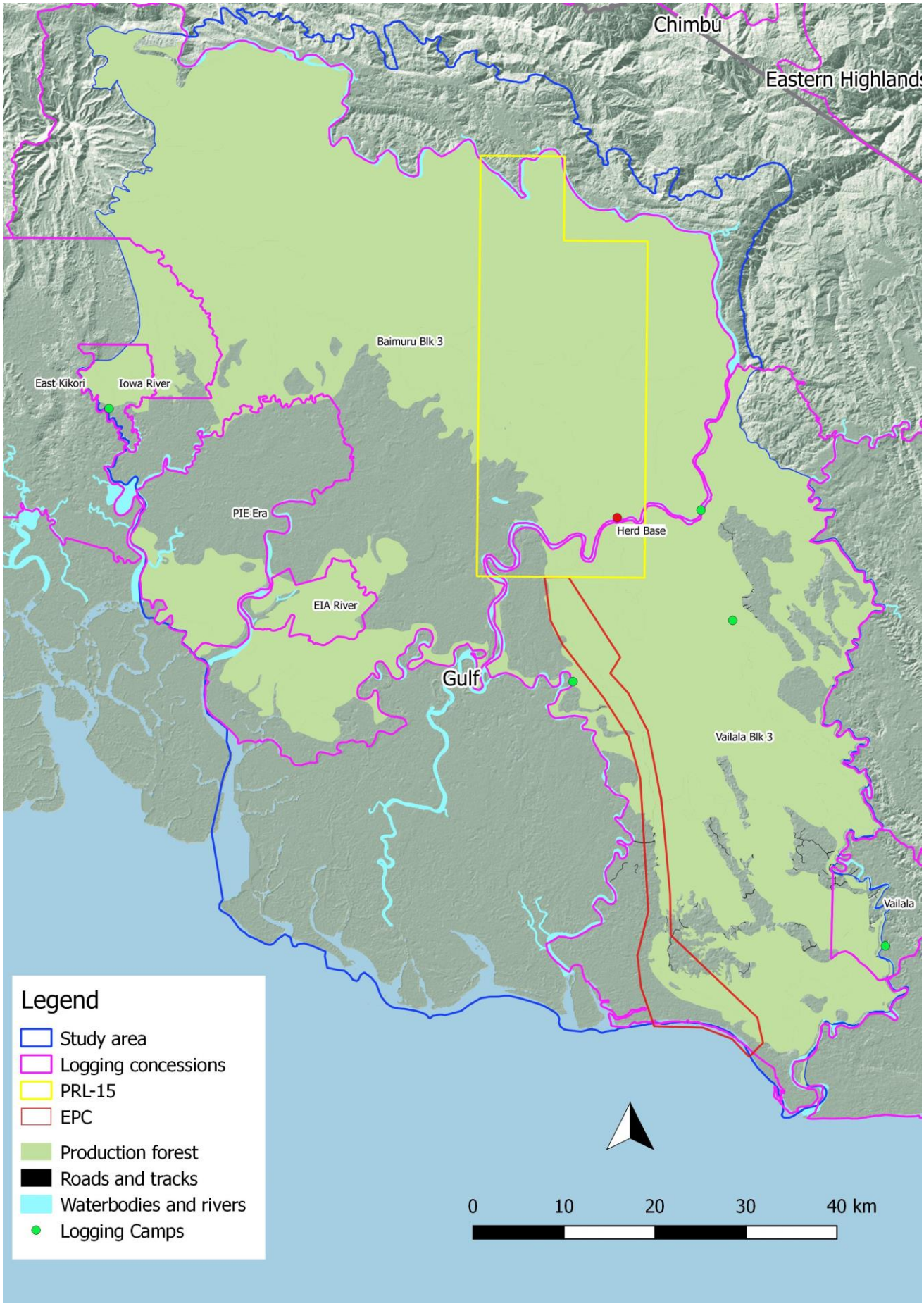
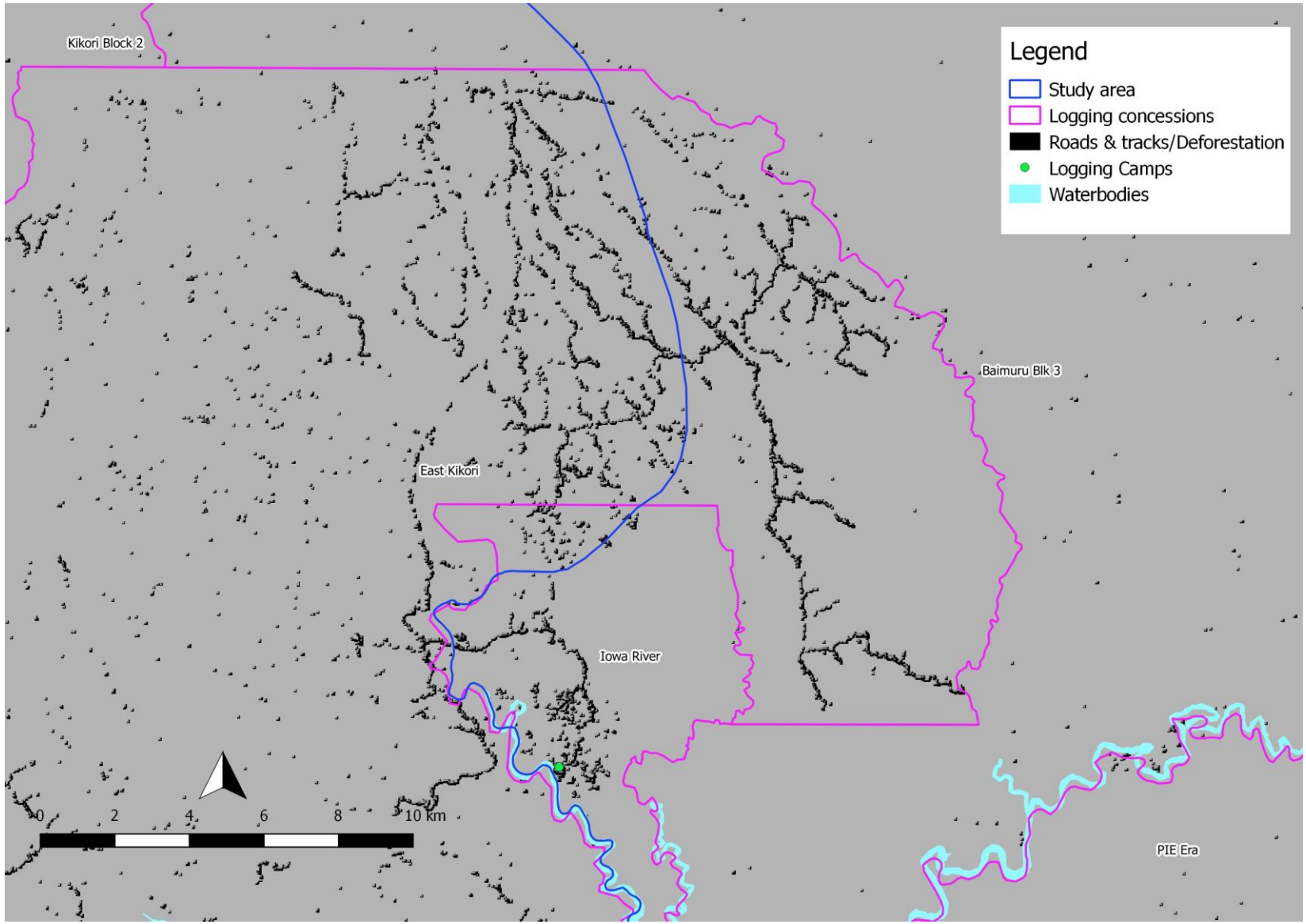


Figure 6-2 Logging roads and tracks/deforestation in the East Kikori and Iowa River TRPs



6.2 PRODUCTION FORESTS

The gross area of production forests in the study area is the area of forest that has been classified by the PNGFA as production forest (i.e., the FMAs). These represent the gross areas of forest that are of sufficient quality (species composition, size and merchantable volume) to be of value for large-scale logging, but does not account for terrain and access constraints, or areas of non-production forest/vegetation that occur within the FMAs. For the purposes of this study the net production forest was determined by excluding vegetation types within the FMA's that are not forest. Mangroves and forests subject to regular inundation (Swamp forest (Fsw) and Swamp woodland (Wsw)) were also excluded since they are not considered suitable for logging by the Gulf Province Provincial Forest Plan (GPG, 2008). The plan considers regular inundation to be an extreme physical limitation to logging. The production forest areas include inoperable areas where the commercial volumes are too low to make harvesting economic and steep terrain, buffer zones and any other areas where logging is prohibited by the Papua New Guinea Logging Code of Practice.

Based on this analysis the total net area of production forest in the study area is 395,422 ha which comprises 293,723 ha of hill forest and 101,699 ha of alluvial forest. It is also possible small areas of Swamp forest (Fsw) may be logged where inundation is not severe, and seasonal conditions are sufficiently dry to support logging machinery, particularly in drought years. The production forest and non-production areas are summarised in Table 6-2. Areas of production forest are mapped in Figure 6-1.

Table 6-2 Net production forest area in the study area

Vegetation/Land Use	Area (ha)
Alluvial forest (Pl, Ps & Po)	101,699
Hill forest (Hm & Hs)	293,723
Total net production forest	**395,422**
Swamp forest (Fsw)	73,386
Seral forest (Fri)	242
Littoral forest (B)	96
Grassland/Swamp grassland (G & Gsw)	325
Herbaceous swamp (Hsw)	3,971
Swamp woodland (Wsw)	50,265
Mangroves (M)	12,297
Land use (O & U)	2,613
Rivers E	6,250
Total non-production areas	**149,445**

6.3 COMMERCIAL SPECIES AND MERCHANTABLE VOLUME

Historical forest inventory data from PNGRIS (Hammermaster and Saunders, 1995) indicates that the study area falls within the Kerema Forest Inventory Zone which covers a very extensive area from the Kikori River in Gulf Province to the Angabunga River in Central Province and inland to the boundaries with Morobe and the Highland Provinces. Across the entire inventory zone the merchantable species are dominated by *Terminalia* and *Pometia*, which account for 10% of volume. However, the inventory data is based on samples (inventory areas) within different areas across the zone and in different forest types. Relevant inventory areas listed in Hammermaster & Saunders (1995) include the Purari and Vailala Block 1. The exact location of the sample sites is not provided in the literature.

For the Purari inventory area, hill forest is dominated by *Terminalia*, *Pometia*, *Buchanania* and *Endospermum*. *Terminalia* and *Pometia* are Group 1 species which are the highest quality and most preferred commercial species (PNGFA, 1996c). *Buchanania* is a Group 3 species and *Endospermum* is a Group 2 species. The alluvial forest complex Open alluvial forest/Freshwater swamp forest (Po/Fsw) is dominated by *Pometia*, *Buchanania*, *Terminalia* and *Nauclea*, which is a Group 4 species which is the lowest quality.

For the Vailala Block 1 inventory area hill forest (Hm/Hs) is dominated by *Pometia*, *Terminalia*, *Canarium* (Group 1 species) and *Endopsermum*. Alluvial forest (Pl/Po) is dominated by three Group 1

species, *Terminalia*, *Pometia* and *Canarium*, and the lower quality Group 4 species *Neonauclea*. Species percentages for each inventory area are provided in Table 6-3.

Large-scale logging operations require a minimum harvestable volume of approximately 14 m^3/ha to be commercially viable over at least 200,000 ha. The harvestable volume is determined based on the volume of standing trees ≥50 cm diameter at breast height (DBH) that are straight and free of major defects (e.g., signs of obvious decay or poor form). For the Kerema Inventory Zone gross volume for standing trees ≥50 cm DBH is provided for each inventory areas in Table 6-3. Gross volume refers to the total volume of standing trees rather than the volume of merchantable trees, i.e. trees free of defect that can be harvested and sold. Based on the gross volumes, Hill forest (Hm) is most likely to have the highest merchantable volume since it has a very high gross volume of 87 m^3/ha but the hill forest complex Medium crowned/Small crowned hill forest is likely to have the lowest volume, with a gross volume of 38 m^3/ha. However, across Gulf Province the estimated merchantable volume is only 18 m^3/ha which is the equal lowest of all the provinces (PNGFA, 1996a). The low volumes are likely to reflect low growth rates associated with high rainfall, and shallow and heavily leached infertile sedimentary soils across the hill forest areas. In particular, the widespread occurrence of Small crowned hill forest (Hs) suggests environmental constraints limit forest productivity in the study area.

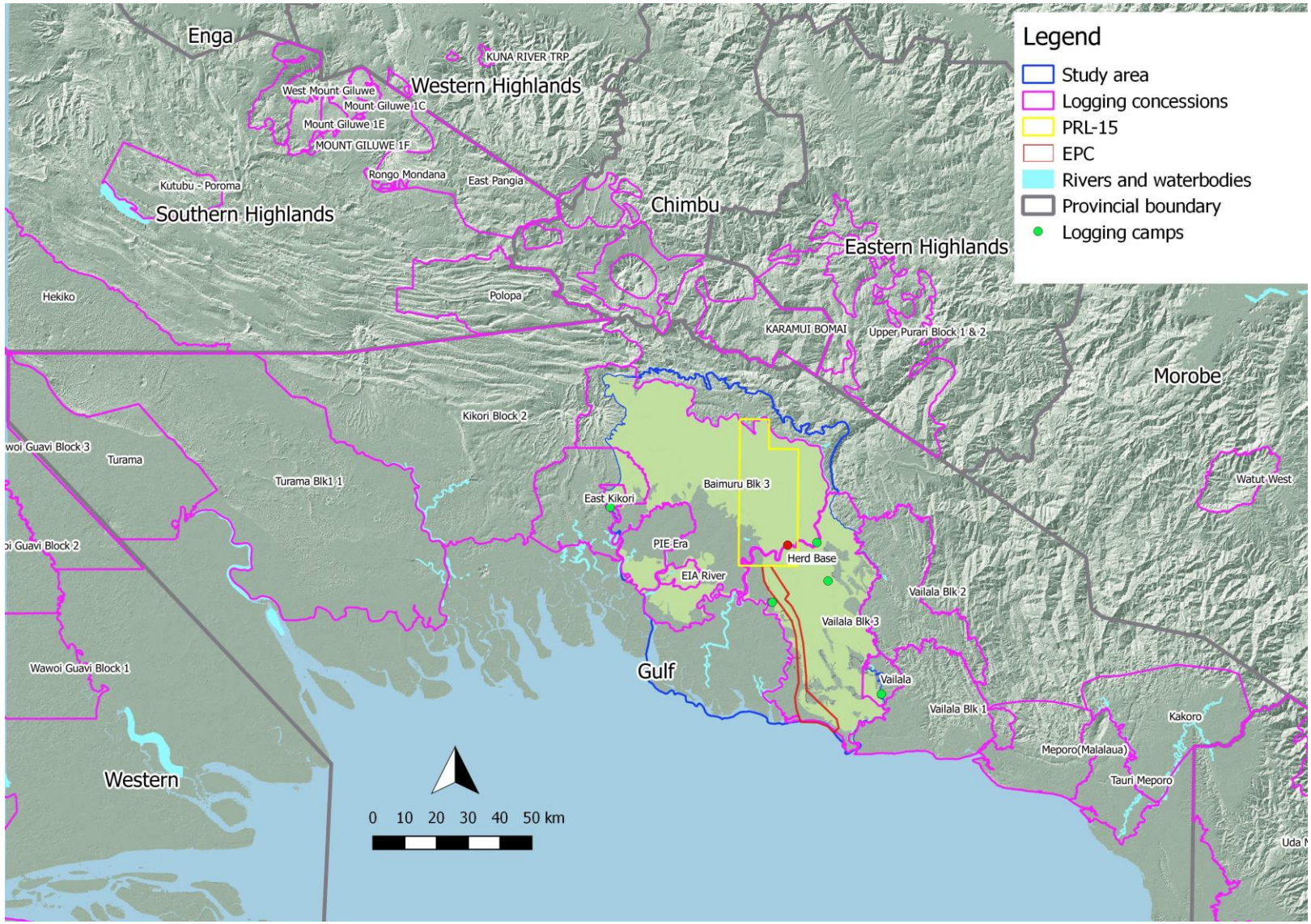
Table 6-3 Species percentages by forest type by inventory area for the main species

Purari (Hm)		Purari (Po/Fsw)		Vailala Blk 1 (Hm/Hs)		Vailala Blk 1 (Pl/Po)	
Species	%	Species	%	Species	%	Species	%
Terminalia	10	Pometia	12	Pometia	11	Terminalia	17
Pometia	7	Buchanania	9	Terminalia	7	Pometia	7
Buchanania	5	Terminalia	8	Canarium	7	Canarium	7
Endospermum	5	Nauclea	6	Endospermum	5	Neonauclea	6
Celtis	4	Elmerrillia	5	Celtis	5	Intsia	5
Syzygium	4	Endospermum	4	Pterygota	5	Endospermum	4
Myristica	4	Cryptocarya	4	Pterocymbium	3	Mastixiodendron	4
Gluta	4	Celtis	3	Mastixiodendron	3	Homalium	3
Canarium	3	Palaquium	3	Elmerrillia	2	Buchanania	3
Pterygota	3	Aglaia	3	Palaquium	2	Aglaia	3
Gross volume (m^3/ha)	87	Gross volume (m^3/ha)	51	Gross volume (m^3/ha)	38	Gross volume (m^3/ha)	40

6.3.1 Limitations of the forest inventory zone data

The reliability and representativeness of the data from the Kerema Forest Inventory zone is uncertain. At the time of the inventory there would have been little or no access to much of the forest within the study area due to its remoteness and lack of roads. Therefore, the inventory data is provided as a guide only and typically the data overestimates merchantable volumes.

Figure 6-3 Kerema Forest Inventory Zone



7 SMALL-SCALE LOGGING

Throughout Papua New Guinea small-scale logging provides timber for community needs for local infrastructure and for commercial sale. These projects typically use a Lucas Mill, which is a portable sawmill that can be dismantled and carried into the forest and reassembled adjacent to the log that is to be processed. This is a labour-intensive process and is usually limited to operating to within 1-2 km of the nearest road, or at a location where the sawn timber will be used. Where the timber is harvested for community use no logging permit is required, but where timber is harvested for commercial sale a Timber Authority is required. A TA-01 permit allows an annual harvest of 5,000 m^3 of logs.

For the study area, there is only one known portable sawmill, which operates out of Paevera (Plate 7-1).

Plate 7-1 Small-scale forestry equipment at Paevera

8 HIGH-VALUE NON-TIMBER FOREST PRODUCTS

In addition to the commercial timber species, the forests of the study area are a potential source of two high value non-timber forest products, Eaglewood and Massoy. These are discussed in the following sections.

8.1 EAGLEWOOD

The highly valued Eaglewood, known in Tok Pisin as gold diwai (the gold tree) occurs in hill and alluvial forests and is reported by landowners as being present within the forests of the study area, although no specific locations were identified. Eaglewood is known for its fragrant resinous wood and refers to the species *Gyrinops ledermanii*, *Gyrinops caudate* and *Aquilaria filaria* (Plate 8-1). The value of the tree is in the resin known as gaharu which is found in a small percentage (3 – 8%) of trees that are mainly harvested from *Aquilaria filaria*. The resin is produced from the tree's defensive response to injury from insects. The resin is highly sought after for religious, medical, ceremonial and domestic activities by Asian Buddhists and Muslims. Middle Eastern countries and Japan are major users. The

product is also gaining demand from users in Europe and North America for perfumery and medicinal uses (Gunn *et al.*, 2003). It is potentially a very high value product. Asian buyers pay up to 2,000 – 3,000 Kina/kg (US$730 – 1,100) for the best grade (Super A grade), however it has an even higher end value of up to US$10,000/kg in Middle Eastern countries (Pers. Com. Joseph Kerowa, Marketing Officer, PNGFA, Port Moresby, 21/09/2016).

Currently there is no known Eaglewood harvesting in the study area, which appears to reflect lack of knowledge about how to identify the species, where it is located, how to harvest the resin and who to sell the product to.

Plate 8-1 The Eaglewood species *Aquilaria filaria*

(Source: National and regional governments of Papua New Guinea and the State Government of New South Wales)

8.2 MASSOY

Massoy bark is harvested from the tree *Cryptocarya massoy* for its oil content which is used in aromatherapy. Massoy was originally harvested on a commercial basin in Papua New Guinea in East and West Sepik Provinces in the early 1970s to early 1980s after which interest declined. Harvesting has been subject to renewed interest from buyers, particularly from 2009-2011 when there was a dramatic increase in harvesting that was considered unsustainable, and resulted in a total ban on harvesting from 31st May 2012 until a management plan was developed (PNGFA, 2015).

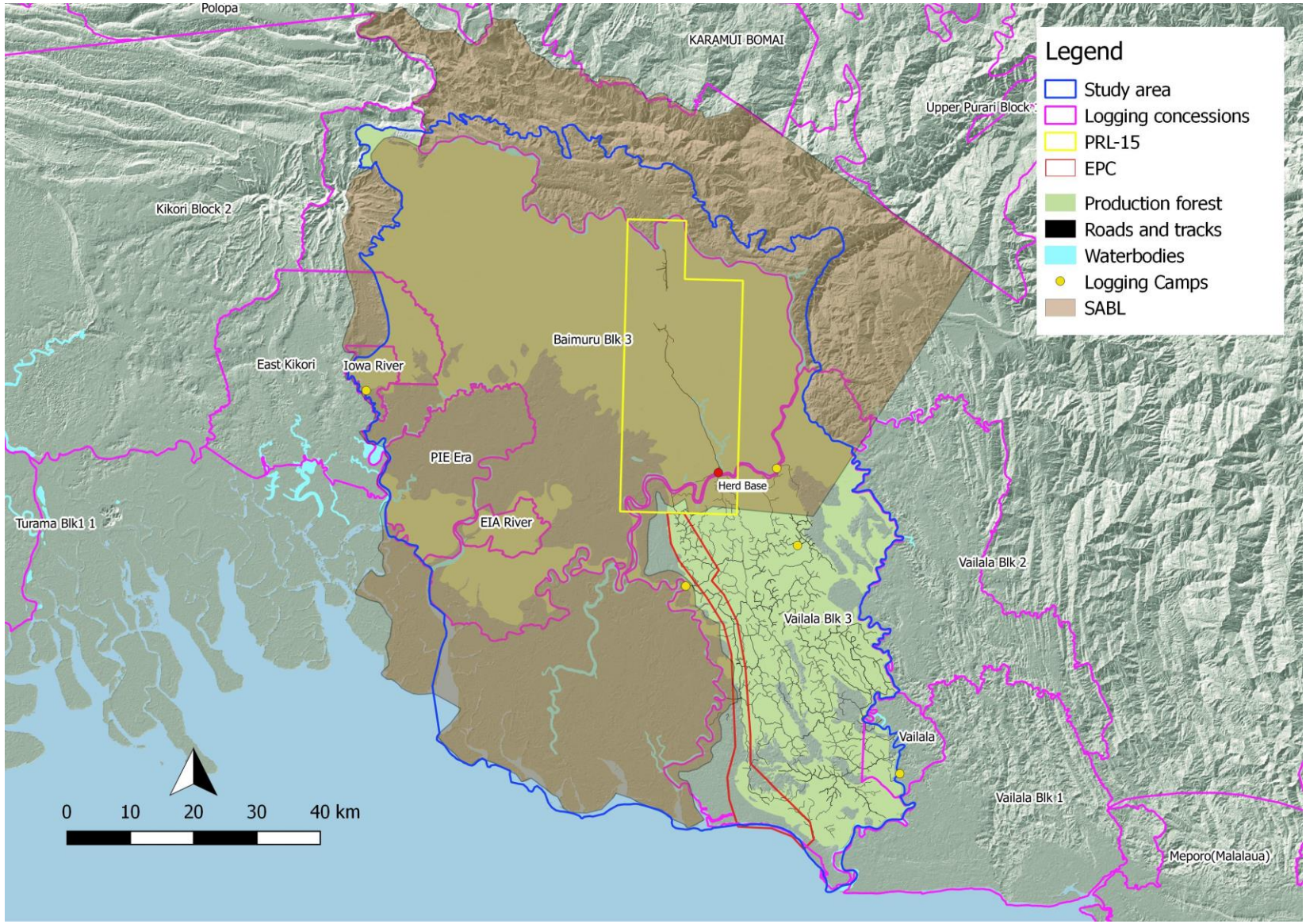
The distribution of Massoy in the study area is not known, largely because landowners are not familiar with its identification, harvesting and potential value. However, it is likely to occur since a landowner at Evara who had worked for the logging company Frontier Resources in Vailala Block 1, stated that the Malaysian workers had shown him the tree and how to harvest the bark. Moreover, it is known to occur near Kikori and Kerema and its distribution extends into West Papua (PNGFA, 2015).

9 SPECIAL AGRICULTURE AND BUSINESS LEASES IN THE STUDY AREA

Most of the study area (86%) is included in the Purari SABL which was gazetted on the 20th January 2011 and is shown on survey catalogue No. 37/123. The SABL covers a total land area of 656,034 ha and is described as Portion 8 C, Millinch of Auri, Fourmil Kikori and Karimui within Baimuru District of Gulf Province. The SABL is mapped in Figure 9-1 and overlaps approximately 566,600 ha of the study area.

The Purari SABL was subject to the Commission of Inquiry into SABLs which identified several anomalies, the main one being the absence of the Land Investigation Report ("LIR"). A SABL cannot be granted unless an investigation is carried out on the parcel of land for which the SABL is sought.

Figure 9-1 The Purari SABL



10 AREAS AT HIGH RISK FOR FORESTRY DEVELOPMENT

Areas at high risk for forestry development will vary depending on whether forest is suitable for small-scale or large-scale-forestry operations. Small-scale operations can only operate within 1 – 2 km of a road, but can target any areas of forest that have large trees of commercial species, including large remnant trees that are located within areas dominated by land use. However, access to merchantable trees is heavily constrained by transport availability and road conditions. Currently the risk of small-scale forestry is limited to the Paevera area where a Lucas Mill is located (Plate 7-1).

Large-scale logging operations are restricted to operating within an FMA, TRP or SABL. For the study area, all the potentially production forest is allocated to FMA's or TRPs. These concessions must operate within the 24 key standards, defined by the Papua New Guinea Logging Code of Practice and require large areas of primary forest to be economically viable. Once approval for logging has been permitted, factors that impact on an area of forest's potential to be developed include:

- Extent of the forest area: For an FMA, ideally at least two hundred thousand hectares of primary forest are required for a large-scale operation to be economically viable. The area must be able to support an annual log harvest of 70,000 m^3. All the FMAs within the study area are presumed to have been allocated based on this requirement. This requirement is not applicable to the superseded TRP system.
- Merchantable volume: A minimum merchantable volume of 14 m^3/ha is required of trees ≥ 50 cm DBH for an operation to be economically viable.
- Forest condition: The forest should be in good condition free of large-scale disturbance such as extensive gardens, settlements, and regrowth.
- Terrain: Selective logging is prohibited for the following terrain and ground conditions:
  - Slopes > 30°.
  - Areas of high relief on slopes steeper than on average of 25°.
  - Permanently inundated forest.
  - Limestone country (e.g., extreme karst).
  - Mangrove areas.
- Transport: Extensive roads and/or navigable rivers are required to transport logs from the log landings to export shipping.

Therefore, based on the data provided in this report all the areas identified as production forest in Figure 6-1 that have not been logged are at high risk of forestry development (i.e. large scale logging). The only exception to this is where slopes are greater than 30° and areas of high relief on slopes steeper than on average of 25°. Areas of slopes greater than 30° are mapped in Figure 10-1. It is assumed that where slopes greater than 30° are present the overall rugged terrain is limited to large-scale logging. The slope data was derived from the Global Digital Elevation Model, which has a resolution of 30 m.

Despite all production forest being at risk from logging the different production forest types are likely to be associated with different logging intensities (i.e. levels of damage) based on terrain and merchantable volumes. The larger the number of trees per hectare (i.e. trees > 50 cm DBH) and the less hilly the terrain, the higher the logging intensity and associated damage to the residuals (remaining trees) is likely to be. High intensity logging is excessively destructive and is not considered sustainable, and causes a further decline in the basal area[10] of the residuals which continue to die up to ten years after logging (Alder, 1998), and can cause a 30 – 70% loss of the residual stems (Cameron and Vigus, 1993). This is in stark contrast to well planned low intensity small scale portable sawmill logging which causes stand damage of 4-9% only of the forest area (Rogers, 2010).

Variation in the intensity of logging is partly evident based on variation in the logging road/skid track density, which provides a guide to the extent of logging in the Vailala Block 3 FMA (Figure 10-1). A map of potential logging intensity is provided in Figure 10-2, which covers the entire study area to

[10] Basal area is the total cross-sectional area of all stems in a stand measured at breast height, and is expressed on a per hectare basis.

reflect the risk that areas outside the logging concessions are potentially at from small scale logging if accessibility improves in the future. The different levels of potential logging intensity risk are defined in Table 10-1 which indicates Alluvial forest (Pl) as having the highest potential logging intensity with Small crowned hill forest (Hs) and Small crowned alluvial (Ps) forest having the lowest, because of lower merchantable volumes.

Table 10-1 Categories of potential logging intensity

Production forest type	Potential logging intensity	Positives for logging	Negatives for logging
Alluvial forest (Pl)	High	Typically, higher volumes of larger diameter trees on flat terrain.	Seasonal inundation. Restricted distribution
Small crowned alluvial forest (Ps)	Low	Flat terrain	Seasonal inundation. Restricted distribution. Smaller diameter trees. Potential to be peat forest
Open alluvial forest (Po)	Medium	Flat terrain	Seasonal inundation and swampy soils. Typically, lower volumes than Alluvial forest (Pl)
Hill forest (Hm)	Medium	Widespread. Well drained soils	Volumes variable. Some steep slopes > 30°
Small crowned hill forest (Hs)	Low	Widespread. Well drained soils	Lower volumes and smaller diameter trees. Some steep slopes > 30°
All above forest types	Low	Not applicable	Low volumes due to heavy disturbance. FIMS disturbance code 4 or less

Figure 10-1 Production forest and slopes greater than 30 degrees

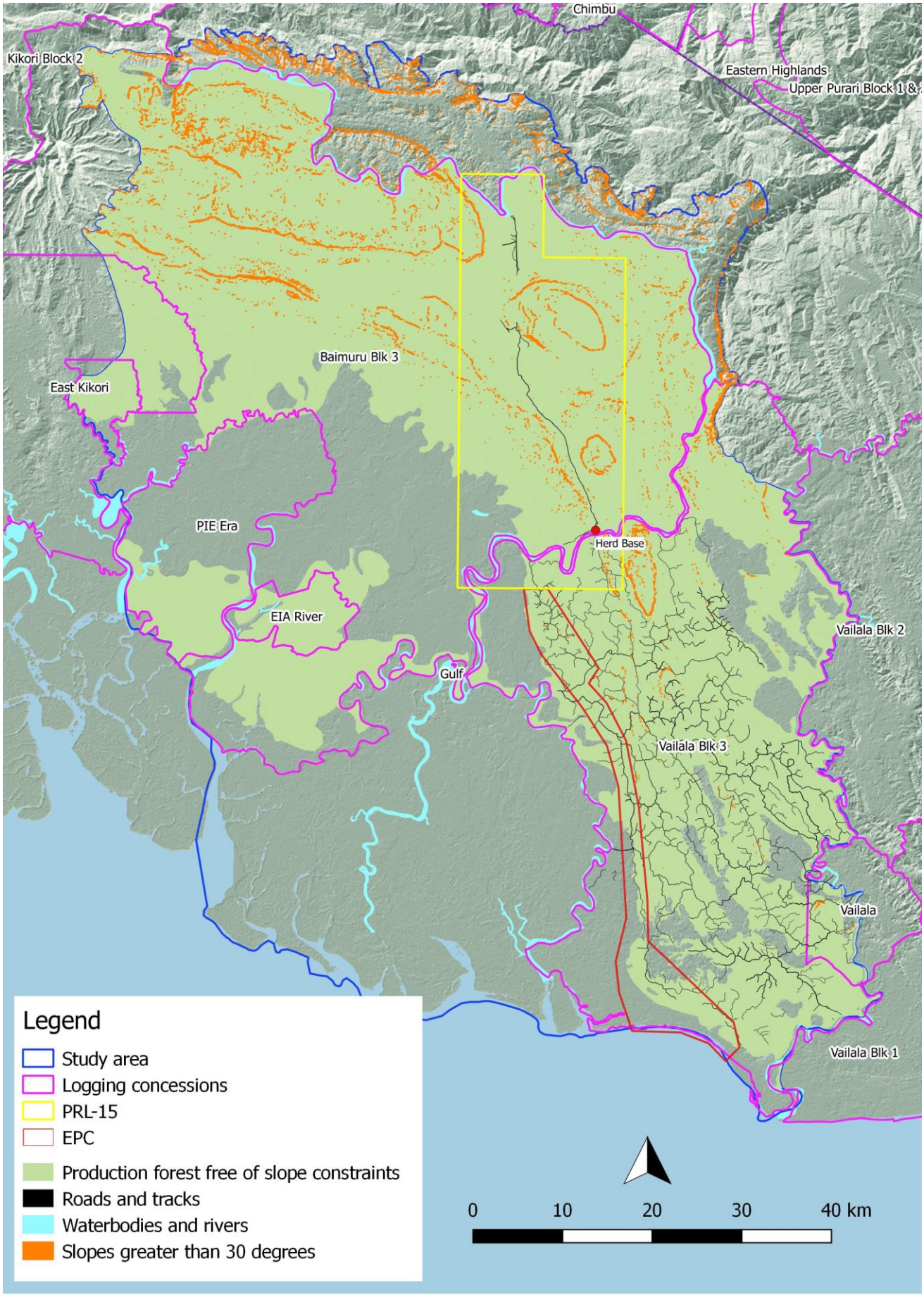
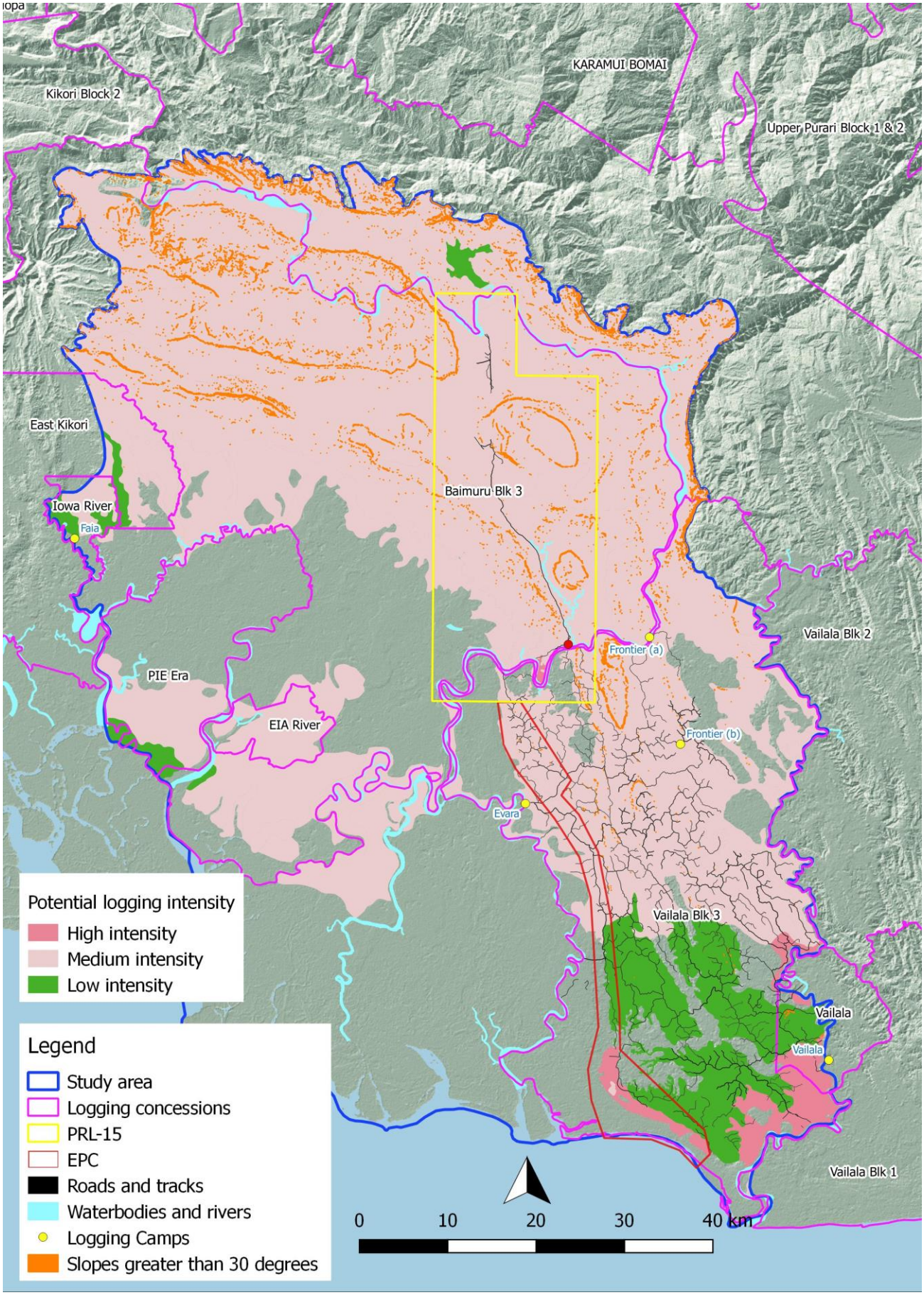


Figure 10-2 Potential logging intensity



11 INTERACTIONS OF THE PROJECT WITH FORESTRY ACTIVITIES

The main forestry activities that may potentially interact with the Project relate to logging barge traffic on the Purari River, logging truck movements between harvesting locations and the Evara logging camp and forest based harvesting activities. Approximately 1 – 2 log barges depart Evara logging camp each month to travel downstream to load the logs to ships for export. There are daily logging truck movements between the northern portion of Vailala Block 3 and Evara logging camp along the main haul roads, however when the roads are wet there are no logging truck movements.

There may also be potential interactions with the Project in the Baimuru Block 3 FMA however this concession is unlikely to be developed for another five years. For this concession, there is unlikely to be any logging barge traffic upstream of Herd Base because the river is too shallow. Logs may be transported via the East Kikori TRP, which appears to have a log export facility located in the Iowa River TRP (See Section 6.1).

There is a further potential interaction if the Project upgrades old logging roads which provide reduced log haul truck transport times or improved access to unlogged forest for FMA concession holders.

12 CONCLUSION

The forestry study has achieved the baseline objective of identifying the key forestry resources of the study area, assessment of the interaction of forestry activities with the project, and the identification of areas at high risk of forestry development as a consequence of the project.

Forestry is an important commercial activity across the production forests of the lowlands of Papua New Guinea, including Gulf Province, which has the largest expanse of lowland forest compared to any of the other provinces. Commercial forestry will continue to be a significant industry in Gulf Province, and in the study area until at least 2045 when the Vailala Block 3 and Baimuru Block 3 FMAs expire, which overlap the export pipeline corridor and PRL-3 respectively. However, the focus of commercial forestry in the study area will shift from south of the Purari River where Vailala Block 3 is located, which has mostly been logged, to Baimuru Block 3 north of the Purari River where logging has not yet commenced at the time of this assessment.

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APPENDIX A

VEGETATION TERMINOLOGY

Major vegetation group/FIMS code	FIMS Group/Description	Biodiversity Study term
Natural vegetation types		
Hill forest		
H	***Low altitude forest on uplands (below 1,000 m)***	***Hill forest***
Hm	Medium crowned forest	Hill forest
Hm.Ar	Medium crowned forest - Presence of *Araucaria* noted	Hill forest, *Araucaria* noted
Hm/Hs	Complex: Medium/Small crowned forest	Hill forest/small crowned hill forest
Hm/Sc	Complex: Medium crowned forest/Scrub	Hill forest/Scrub
Hs	Small crowned forest	Small crowned hill forest
Alluvial forest		
P	***Low altitude forest on plains and fans (below 1,000 m)***	***Alluvial forest***
Pl	Large to medium crowned forest	Alluvial forest
Po	Open forest	Open alluvial forest
Po/Fsw	Complex: Open forest/Mixed swamp forest	Open alluvial forest/Swamp forest
Po/Fsw/M	Complex: Open forest/Mixed swamp forest/Mangrove	Open alluvial forest/Swamp forest/Mangrove
Po/Wsw	Complex: Open forest/Swamp woodland	Open alluvial forest/Swamp woodland
Ps	Small crowned forest	Small crowned alluvial forest
Fri	***Seral forest***	
Fri	Riverine mixed successions	Riverine seral forest
Freshwater swamp habitats		
Fsw	***Swamp forest***	
Fsw	Mixed swamp forest	Swamp forest
FswC	Swamp forest with *Campnosperma*	Swamp forest with *Campnosperma*
Fsw/Gsw	Complex: Mixed swamp forest/Swamp grassland	Swamp forest/Swamp grassland
Fsw/M	Complex: Mixed swamp forest/Mangrove	Swamp forest/Mangrove
Fsw/Wsw	Complex: Mixed swamp forest/Swamp woodland	Swamp forest/Swamp woodland
W	***Woodland***	
Wsw	Swamp woodland	Swamp woodland
Wsw/Gsw	Complex: Swamp woodland/Swamp grassland	Swamp woodland/Swamp grassland
Wsw/Hsw	Complex: Swamp woodland/Herbaceous swamp	Swamp woodland/Herbaceous swamp
G/Hsw	***Grassland and herbland***	
Gri	Riverine successions dominated by grass	Riverine successional grassland
Gsw/Fsw	Complex: Swamp grassland/Mixed swamp forest	Swamp grassland/Swamp forest
Gsw/Wsw	Complex: Swamp grassland/Swamp woodland	Swamp grassland/Swamp woodland
Hsw	Herbaceous swamp	Herbaceous swamp

Major vegetation group/FIMS code	FIMS Group/Description	Biodiversity Study term
Hsw/Wsw	Complex: Herbaceous swamp/Swamp woodland	Herbaceous swamp/Swamp woodland
Marine tidal		
M	***Estuarine Communities***	
M	Mangrove	Mangrove
Littoral forest		
B	***Littoral forest***	
B	Mixed forest	Littoral forest
Non-vegetation/areas dominated by land use		
E	Lakes and large rivers	Rivers and lakes
O	Non-forest areas dominated by land use	Land use
U	Larger urban areas	Urban areas