

Papua LNG Project - Downstream

Traffic and Land Use Study

ExxonMobil PNG Antelope Limited



Reference: 754-MELEN300733_R05

19 June 2023

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EXECUTIVE SUMMARY

Tetra Tech Coffey has been commissioned by ExxonMobil PNG Antelope Limited (EMPNGA) to undertake an environmental impact statement (EIS) for the Papua LNG Project – Downstream (the Project). The proposed Project intends to expand the capacity of the existing Papua New Guinea Liquefied Natural Gas Plant (LNG Plant) located in Caution Bay (Central Province), approximately 20 km north-west of Port Moresby. The LNG Plant is a component of the Papua New Guinea Liquefied Natural Gas Project (PNG LNG Project).

This report presents the findings of the traffic and land use study of the Lea Lea Road. The study area for this report encompasses Lea Lea Road, from Motukea Port to the LNG Plant entrance, totalling approximately 12 km.

Lea Lea Road is the primary link connecting key facilities to Port Moresby, such as the Napa Napa refinery, Motukea Port, and the LNG Plant. It also links Motuan villages that stretch along the coastline to Port Moresby. Consequently, this study establishes:

- Land uses surrounding the road, with a focus on sensitive users, such as schools, hospitals, and other activities that may generate pedestrian traffic, such as roadside stalls. Specifically, the land use assessment was designed to identify land users that may be affected by the development of the Project, including the expansion of Lea Lea Road, along with the use of the road for the transportation of project components.
- The indicative baseline daytime traffic conditions on Lea Lea Road, including traffic volume and type, inclusive of road use by public transport vehicles (i.e., public motor vehicles (PMVs)).

Land use

Most of the study area (80%) has been classified as grassland and woodland, followed by industrial (13%); residential (3%), commercial (3%) and community use (1%) land uses account for the smallest proportions of the study area. Community land use within the study area includes informal community markets along the roadside, religious facilities, schools, and daycare facilities.

A roadside market operates daily at the Napa Napa Road junction and Boera junction. During the 2022 field survey, 33 roadside stalls were identified along Lea Lea Road between Motukea Port and the LNG Plant entrance. Of those, 15 stalls were operating at the time of the field investigation.

Although there are no permanent bus stops on Lea Lea Road, several sections are used consistently as informal bus stops by PMVs, including five locations identified during the 2022 field investigation. It is noted that the PMV drop-offs contributed to pedestrian movements observed in this study.

A standardised interview was undertaken with market stallholders in 2019. During these interviews, stallholders reported that the busiest days for trading were generally between Friday and Sunday. The most active trading time was either during lunch hours (12.00 p.m.) or in the afternoon (4.00 p.m. to 6.00 p.m.). Most stallholders operated every day of the week from 7.00 a.m. to 5.00 p.m. However, several stallholders noted that it was common to trade until the evening hours (i.e., 8.00 p.m.).

Stallholders were asked to comment on the safety of the roadside market area and the amenity of the area. Almost all stallholders noted that the lack of pedestrian crossing was a driver of poor perceived safety, combined with the level of traffic. Dust and noise were also consistently reported as the primary amenity issues by stallholders.

Traffic volumes

Traffic volumes were estimated for three sections of Lea Lea Road, referred to as Links:

- **Link 1:** to and from Port Moresby, which includes the Motukea Port
- **Link 2:** to and from Napa Napa, which includes vehicles travelling to Porebada and Roku
- **Link 3:** to and from the LNG Plant and beyond, which is the stretch of Lea Lea Road from Boera Road junction to the LNG Plant.

From 23 to 26 March 2019, vehicle and pedestrian traffic movements were recorded at the Napa Napa Road junction on the roads toward Port Moresby (Link 1), toward Napa Napa (Link 2), with observations of traffic on the road toward Lea Lea (Link 3) complemented by vehicle data recorded by the LNG Plant entrance gates. Traffic levels for Links 1 and 2 were similar, with around 130 vehicles per hour (vph) to 160 vph during the morning and 110 to 140 vph during the afternoon. Traffic volumes were similar on all days except Sunday when the level reduced by around fifty percent. Traffic generated by the LNG Plant ranged from 39 vph to 84 vph in the morning, compared to 34 vph to 69 vph in the afternoon.

Traffic movements were recorded again in 2022, between Wednesday 21 and Thursday 22 September. During this period traffic levels were substantially less than 2019 with approximately 50 vph in the morning and 79 vph in the afternoon. The weekday morning traffic reported on Link 2 was relatively consistent from 2019 to 2022 with 160 vph recorded in the morning and 190 vph recorded in the afternoon. This represented a 30% increase in the level of afternoon traffic recorded. The traffic generated by the LNG Plant (Link 3) included 104 vph in the morning and 88 vph in the afternoon. The vehicle traffic generated by the LNG Plant was much lower in 2019 than in 2022, with a reduction of around 70%.

In 2019, there was a greater level of pedestrian activity during the week compared to the weekend. The total count of persons reduced from 168 persons on Monday and 197 persons on Tuesday, to 115 persons on Saturday and 143 persons on Sunday. In 2022, there was considerably lower pedestrian activity recorded at the Napa Napa junction with 75 persons recorded in the morning and 23 persons in the afternoon. This equates to a reduction of around 33% in the morning and a reduction of around 70% in the afternoon compared to 2019 weekday averages. While it is noted that only one day of data was collected, it does indicate there is less pedestrian activity at Napa Napa junction in 2022 than there was in 2019.

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Appendix A: Observed traffic and pedestrian survey data sheet
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1. INTRODUCTION

Tetra Tech Coffey has been commissioned by ExxonMobil PNG Antelope Limited (EMPNGA) to undertake an environmental impact statement (EIS) for the Papua LNG Project – Downstream (the Project). A traffic and land use study of the Lea Lea Road has been undertaken as part of these services. This road is the primary link connecting facilities to Port Moresby, such as the Napa Napa refinery, Motukea Port, and the LNG Plant. It also links Motuan villages that stretch along the coastline to Port Moresby.

The construction and operation of the Project will include several activities along Lea Lea Road, including:

- Transport of heavy and over-dimensioned loads from Motukea Port to the LNG Plant.
- Transport of international workers from Jacksons International Airport to accommodation facilities at the LNG Plant.
- Transport of Papua New Guinean workers to and from villages surrounding the LNG Plant and Port Moresby.
- Road maintenance and potential road upgrade works, such as improving the road base to accommodate heavy loads.

Consequently, this study establishes:

- Land uses surrounding the road, with a focus on sensitive users, such as schools, hospitals, and other activities that may generate pedestrian traffic, such as roadside stalls. Specifically, the land use assessment was designed to identify land users that may be affected by the development of the Project, including the expansion of Lea Lea Road, along with the use of the road for the transportation of project components.
- The indicative baseline daytime traffic conditions on Lea Lea Road, including traffic volume and type, inclusive of road use by public transport vehicles (i.e., public motor vehicles (PMVs)).

2. PROJECT OVERVIEW

ExxonMobil PNG Limited (EMPNG) is the operator of the PNG LNG Project, an integrated development that is commercialising the gas resources of Papua New Guinea. The Papua LNG Project is a gas development project for the Papua LNG Project Joint Venture participants, which are:

- TotalEnergies EP PNG Limited (TotalEnergies, an affiliate of TotalEnergies SA)
- ExxonMobil PNG Antelope Limited (EMPNGA) and ExxonMobil PNG Elk Limited
- Pac LNG Assets Limited, Pac LNG International Limited, Pac LNG Investments Limited, Pac LNG Overseas Limited and Pac LNG Holdings Limited (affiliates of Santos Limited)
- JX Nippon Oil and Gas Exploration Pty Ltd

ExxonMobil PNG Antelope Limited is the Project proponent and the ExxonMobil affiliate responsible for the construction of the Project. Niugini LNG Operating Company Limited (NLOC) is the ExxonMobil affiliate responsible for the Project once it has been constructed and commissioned.

The Papua LNG Project will involve producing and processing the gas and condensate from the Elk and Antelope gas reserves in Petroleum Retention License 15 (PRL-15), located in Gulf Province, Papua New Guinea and piping them overland, then offshore in the Gulf of Papua, to the existing Papua New Guinea Liquefied Natural Gas Project (PNG LNG Project) producing and exporting facility (LNG Plant) located in Caution Bay (Central Province) approximately 20 km north-west of Port Moresby.

The existing PNG LNG Project commercialises gas reserves in the Hela, Western and Southern Highlands provinces of Papua New Guinea. The gas is transported to the LNG Plant via pipeline, where it is liquefied and exported by ship to international gas markets. The LNG Plant also currently supplies gas to the NiuPower Port Moresby Power Station and the Dirio Central Province Power Station (DCPPS) for the domestic electricity market.

The Papua LNG Project involves two components:

- The Papua LNG Project – Upstream (referred to as the Upstream component)
- The Papua LNG Project – Downstream (referred to as the Downstream component, hereafter referred to as ‘the Project’ and the component addressed in this document).

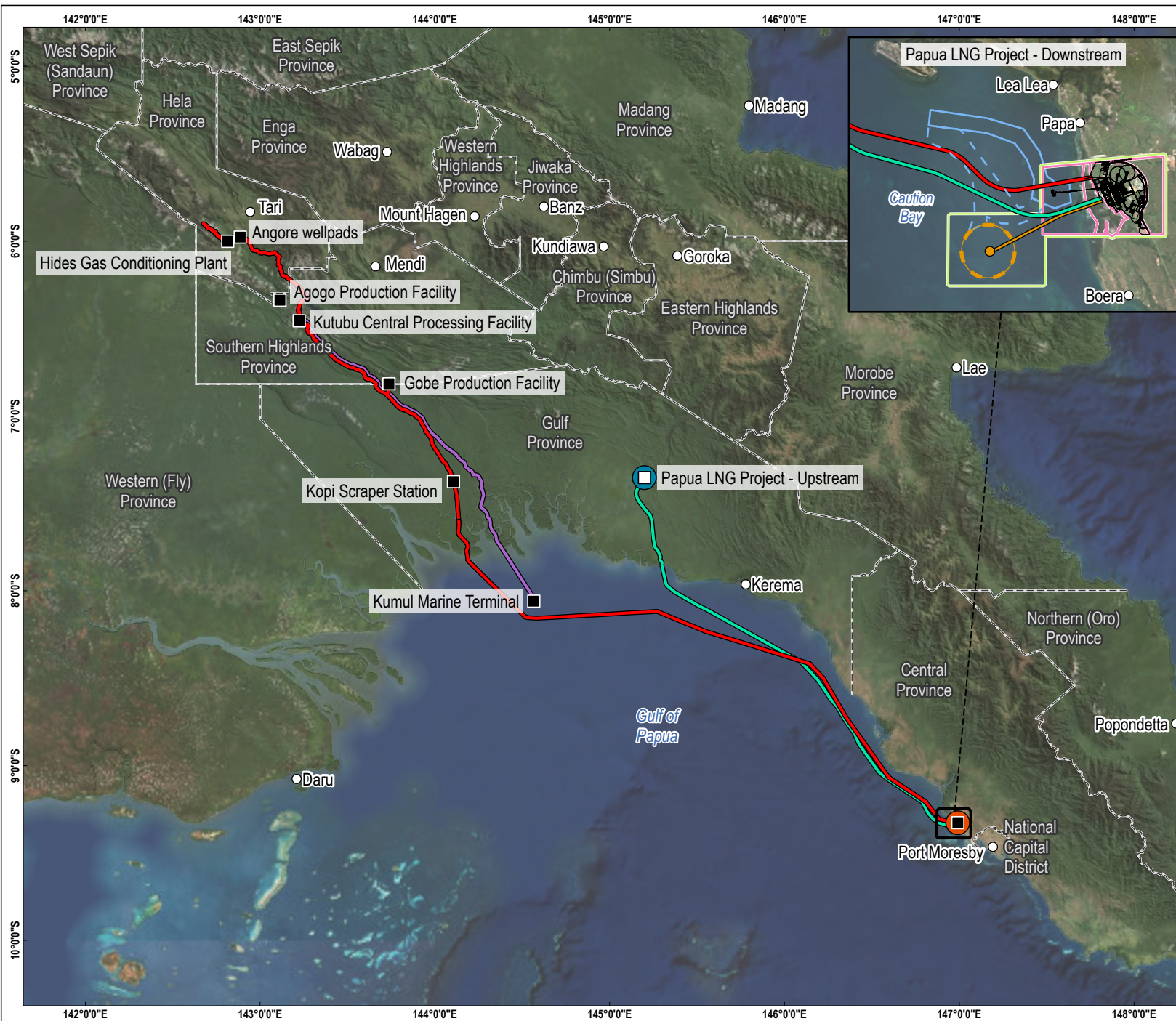
Execution of the Upstream component and the Project is delimited in Caution Bay, with the approximate boundary (i.e., the scope break) between the components located near the fence of the LNG Plant, south of the existing jetty.

A summary of the components of the Project is provided in Table 2.1.

Table 2.1 Project components at the LNG Plant

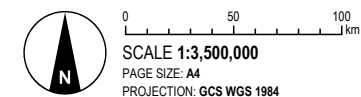
Component	Description
Additional LNG trains	New LNG processing trains and supporting systems including: • Inlet gas receiving and treatment • Dehydration/mercaptan removal • Mercury removal • Heavy-hydrocarbon separation (which contains benzene, toluene, ethylbenzene, and xylenes (BTEX)) • Liquefaction • Stabilisation • Refrigeration system • Fractionation system (naphtha)
Expansion of existing utilities	Existing PNG LNG shared utilities to be expanded include: • Hot oil system • Service and instrument air system • Nitrogen system • Freshwater system • Desalinated water system • Potable water system • Diesel oil storage and distribution system • Open and closed drain systems • Sanitary wastewater treatment systems
New utilities	Options for new separate utilities may include: • Integrated fuel gas system • Power generation system (Combined Cycle Power Plant) • Tempered water system • Highly demineralized water system for the Heat Recovery Steam Generators • Flare system (wet and dry gas) • Thermal oxidizer
Product storage	Product storage will include:

Component	Description
	• New condensate storage tanks with a total storage capacity of up to 110,000 m³.
New marine facilities	Marine facilities will include: • CALM buoy and associated exclusion zones • Pipeline end manifold (Upstream construction component, Project operations component) • Naphtha and condensate export pipelines (Upstream construction component, Project operations component) • New feed pipelines including a gas pipeline and a condensate pipeline (Offshore: Upstream construction and operations; Nearshore Project construction component and Upstream operations component), with landfall and tie-in to the pipelines at the LNG Plant. The pipelines will be located south of the existing LNG Plant jetty. • Alternate shipping channel • Navigation and monitoring systems
Temporary facilities	Temporary construction facilities will be located within the PNG LNG Project's lease boundaries and will include laydown areas, offices, workshops and concrete batching plants.
Waste	Options being reviewed for waste facilities and management being assessed may include: • Temporary onsite storage and segregation of waste, with transport to and disposal at third party waste management facility • New engineered solid waste landfill within existing LNG Plant fence for disposal of non-restricted waste, with limited disposal of restricted waste by specialised service.
Logistics route	Most construction materials will be transported by truck from Motukea Port in Port Moresby to the LNG Plant site via the Lea Lea Road. Repairs or upgrades to the road, or relocation of overhead cables may be required to allow transport of large, heavy loads.
Workforce	Construction: Approximately 5,000 to 7,000 personnel at peak. Operation: Increase of approximately 50 operations and maintenance technicians with support staff anticipated to increase.
Accommodation	Construction: Up to 6,000 bed construction camps. Operation: Up to 500 beds at the existing operations camp.



- LEGEND**
- Papua LNG Project - Downstream
 - Papua LNG Project - Upstream
 - Existing facility
 - Province capital
 - PNG LNG pipeline
 - Proposed Papua LNG pipelines
 - Santos oil pipeline
 - Existing and proposed plant layout
 - PPFL2 boundary
 - APPFL boundary
 - Province boundary
 - Current navigational channel
 - Proposed navigational channel
 - Proposed CALM buoy components**
 - CALM buoy
 - Naphtha and condensate pipelines
 - CALM buoy navigational area

SOURCE
Infrastructure data from EMPNGA and Tetra Tech Coffey (indicative only).
Place names from NGIA.
Provinces from NSO.
Imagery from ArcGIS Online.



EXXONMOBIL PNG ANTELOPE LIMITED
PAPUA LNG PROJECT – DOWNSTREAM

FIGURE 2.1
Papua LNG Project – Downstream Project location



3. STUDY METHOD

This section describes the methods for conducting this study, including the selection of the study area and the approaches to collecting and analysing field and desktop data.

3.1 STUDY AREA

The study area encompasses Lea Lea Road, from Motukea Port to the LNG Plant entrance, totalling approximately 12 km. Figure 3.1 shows the study area and the following study components:

- A 500 m buffer on either side of the road to capture adjacent land uses to inform the land use assessment.
- The locations from which the traffic and pedestrian use surveys were undertaken in both 2019 and 2022.
- The road links that were defined to collect the traffic and pedestrian use surveys.

The study area ceases near the southern boundary of the LNG Plant lease and does not include the road that travels along the eastern boundary of the LNG Plant as there are few sensitive receptors within this area.

3.2 DATA COLLECTION APPROACH

Several data collection methods were used to undertake the traffic and land use study. The following section provides an overview of the methods for each study component, including:

- Land use assessment
- Traffic and pedestrian use survey
- Market stallholder interviews.

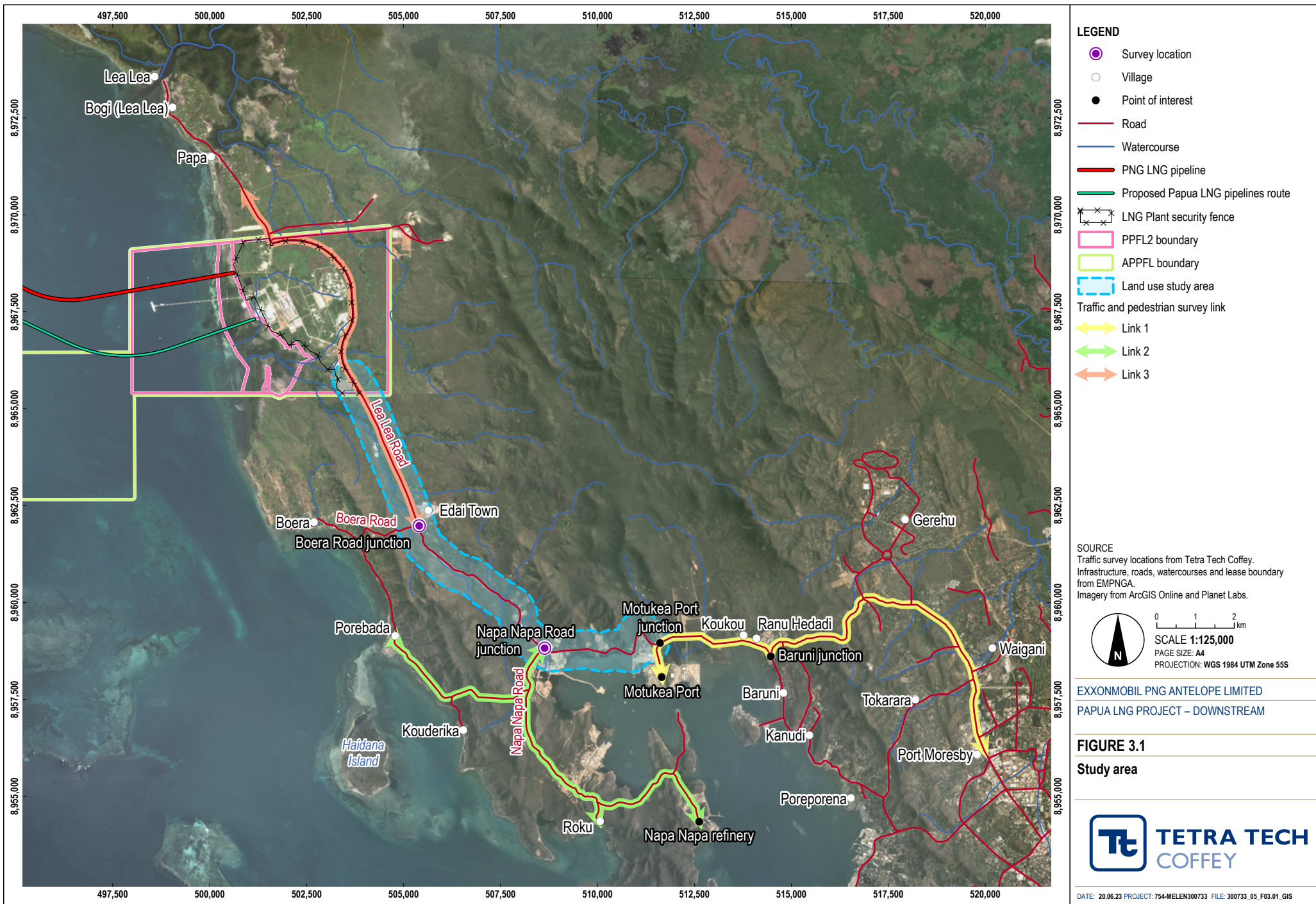
3.2.1 Land use assessment

Land use within the study area was mapped through a desktop review of aerial imagery and through field observations. Land uses were mapped initially using aerial imagery published in January 2022. Approximate extents of land uses were determined based on the type of structures, or lack of structures, present in the area. Broad land use classes were developed based on the *Port Moresby Towards 2030 Strategic Plan* (NCDC, 2020), including:

- Community use, such as informal markets, religious facilities and school or daycare facilities
- Commercial
- Industrial
- Residential
- Grassland and woodland
- Open space.

In December 2022, a land use field survey was conducted to confirm the facilities and land use area identified during the desktop review. Additionally, details of informal markets and other activities taking place along the road were recorded. Details recorded included:

- Coordinates and photographs of structures
- Number of stalls or structures at the location
- Notes on the type of activities taking place, e.g., community market.



3.2.2 Traffic and pedestrian use survey

Two traffic and pedestrian surveys have been conducted to support the Project's EIS. The first survey was undertaken in March 2019, and the second survey was conducted in 2022, the details of which are described below.

The traffic and pedestrian use survey was designed to record traffic volumes and types of traffic at each of the survey locations through manual recording on a standardised spreadsheet (Appendix A). The data collected was input into a Microsoft Excel spreadsheet for analysis by the Tetra Tech Coffey field team. Data analysis was reviewed by a senior social specialist.

The level of roadside trading, social gathering and other activities taking place along the road not related to travel were recorded by the survey team during each traffic count.

Table 3.1 provides the defined vehicle types used to aggregate traffic counts.

Table 3.1 Defined vehicle types

Type	Description
Car	All forms of cars (e.g., sedan, station wagon).
Light vehicle	All utility and four-wheel drive vehicles.
Public motor vehicle (PMV)	All vehicles used for the transportation of people for a fee including both buses and trucks.
Rigid truck	All non PMV trucks including flat bed, semi-trailers and dump trucks etc.
Prime mover and trailer	Large trucks (e.g., fuel truck).
Heavy machinery	Any heavy machinery, including tractors, front end loaders, excavators and bulldozers.
Emergency vehicles	Police, ambulance or fire service vehicles. Does not include private security vehicles.
Bicycle	All bicycles.
Motorbike	All motorbikes.
Pedestrians	All pedestrians.
Other	Anything else.

3.2.2.1 2019 traffic and pedestrian use survey

The 2019 traffic and pedestrian survey was undertaken over four days, from Saturday 23 March to Tuesday 26 March, to capture weekday and weekend daylight road use and market activity. The traffic counts commenced at 7.00 a.m. and finished at 4.00 p.m. The survey team comprised three residents from Porebada Village engaged by Laba Holdings (subcontracted by Tetra Tech Coffey), and one Port Moresby-based Tetra Tech Coffey staff. The three Laba Holdings team members were inducted by Tetra Tech Coffey staff prior to undertaking the survey. The induction confirmed each team member's role, how to identify vehicle types according to specific categories, and how to record the tally of each category into the data form.

Data was collected at a survey location at the Napa Napa Road junction (see Figure 3.1). The survey team undertook observed traffic counts of vehicles travelling to and from the following locations:

- **Link 1:** to and from Port Moresby, which includes the Motukea Port
- **Link 2:** to and from Napa Napa, which includes vehicles travelling to Porebada and Roku.

Observed counts were also made of vehicles and pedestrians stopping at the market located at the Napa Napa junction.

Due to the high summer temperatures at the time, staff observed traffic from the 25-seater coaster bus provided by Laba Holdings. The bus was parked next to the junction, opposite the market with each team member facing their assigned direction, with an unobstructed view.

3.2.2.2 2022 traffic and pedestrian use survey

The 2022 traffic and pedestrian use survey was conducted over two days by three Port Moresby-based Tetra Tech Coffey staff on Wednesday 21 and Thursday 22 September. The survey commenced at 6.30 a.m. and finished at 5.30 p.m. each day.

The survey was undertaken from two locations in 2022 (see Figure 3.1). Observations made on Wednesday 21 September were undertaken at the Napa Napa Road junction at one of the market stalls. Observations made on Thursday 22 September were undertaken at the Boera Road junction.

The survey team undertook observed traffic counts of vehicles travelling to and from **Link 1** and **Link 2** described above. In addition, the survey team undertook observed counts of **Link 3**, which is the stretch of Lea Lea Road from Boera Road junction to the LNG Plant.

Observed counts were also made of vehicles and pedestrians stopping at the market at the Napa Napa junction and at the Boera Road junction.

3.2.2.3 EMPNG data

EMPNG maintains daily traffic logs for vehicles and trucks accessing and departing the LNG Plant (**Link 3**). The vehicle log summary obtained from EMPNG for the surveyed days have been incorporated into the assessment of daytime traffic conditions for 2019 and 2022.

3.2.3 Market stallholder interviews

A roadside market operates daily at the Napa Napa Road junction. This market is recognised to be a major contributor to pedestrian activity and use of the Napa Napa / Lea Lea Road and was chosen for additional field investigation through interviews with market stallholders. The market stallholder interviews were undertaken with roadside stallholders in the vicinity of the village. Roadside stalls are typically located along the main road at the Napa Napa junction.

Market stallholder interviews were held on an opportunistic one-to-one basis with market stallholders located on the Napa Napa Road junction. A one-day field investigation was completed on 23 March 2019 and included 11 adults comprising five females and six males between the age of 21 and 72. All the stallholders were from the nearby Porebada village.

On 2 December 2022, interviews were held with 15 market stallholders along the Napa Napa Road from Motukea to Gate 1 of the LNG Plant. Of the 15 market stallholders interviewed, 14 were female and 1 was male.

A copy of the market stallholder questionnaire is provided in Appendix B.

3.3 STUDY LIMITATIONS

This report is subject to the following limitations:

- The traffic and pedestrian use survey in 2019 commenced at 7.30 a.m. and ended at 4.30 p.m. due to security and logistics requirements. The 2022 observed traffic count survey commenced at 6.30 a.m. and finished at 5.30 p.m. to collect data within these times.
- Laba Holdings staff employment conditions include an hour stand-down for lunch. As a result, the 2019 observed traffic count survey did not collect traffic or pedestrian counts during this time. As a result, it is not possible to assess average daily traffic (ADT) with the survey data available for 2019.
- The daily vehicle log maintained and provided by EMPNG for traffic entering and departing the LNG Plant for the surveyed days did not classify traffic by type in 2019; therefore, the data collected for Link 3 in 2019 is limited.

4. LAND USE ASSESSMENT

This section provides a summary of the land use change in the study area from the start of production of LNG in 2014 to 2022 and a summary of current land use, with a focus on identifying land uses that may be affected by the development of the Project.

4.1 LAND USE OVERVIEW

Lea Lea Road is the only road link between Port Moresby and the LNG Plant. As shown on Figure 4.1, the road supports connectivity for a range of uses, including:

- Connecting the villages of Porebada, Boera, Kouderika, Koukou, Ranu Habadi, Bogi, Baruni, Kanudi, Papa and Lea Lea, and Edai Town to Port Moresby.
- Connecting commercial uses to the LNG Plant and Port Moresby, including the Curtain Brothers Motukea Port, Napa Napa Oil Refinery, and the Total Waste Management industrial waste facility at Roku.

The road from the Baruni junction to the Napa Napa Road junction is the responsibility of the National Capital Development Commission (NCDC), while the road from that location to Lea Lea is the responsibility of the Central Provincial Government. The *Port Moresby Towards 2030 Strategic Plan* (NCDC, 2020) identifies Napa Napa Road as Port Moresby's primary freight route, which acts to link the Ravuvu Wharf, the Via Junction, and the Motukea Port with a number of the city's proposed major centres, including Siriho, Gerehu, 9 Mile, and Dogura, along with the Jacksons International Airport. Parts of Napa Napa Road, including the section of the road from the entrance to Motukea Port and the intersection with Lea Lea Road, are also identified within *Port Moresby Towards 2030* (NCDC, 2020) as areas for protection and future development as foreshore walking areas.

4.2 LAND USE CHANGE - 2014 TO 2022

A review of aerial imagery of the Fairfax Harbour and LNG Plant was undertaken to determine the changes in land use between 2014, 2018 and 2022. Figure 4.2 shows the aerial imagery for Fairfax Harbour and Figure 4.3 shows the imagery for the LNG Plant and its surrounds. Table 4.1 provides a high-level land use and development profile of these areas for 2014, 2018 and 2022.

Table 4.1 High-level land use and development profile of Fairfax Harbour and LNG Plant areas, 2014 to 2022

Location	2014	2018	2022
Via Junction	Limited development present. Area characterised by vegetation. Access routes north of the junction established.	Area cleared; fencing, laydown areas and most of the infrastructure established.	Additional infrastructure established.
Ravuvu Wharf	Clearing of vegetation complete and early stages of construction visible.	Extension of laydown area towards the northeast and extension of the wharf towards the north complete. Construction of additional buildings apparent.	Expansion of laydown areas and roads in the southeast; however, development has slowed.
Motukea Port	Port is operational with limited construction visible.	Port expansion visible adjacent to Napa Napa Road and towards the east. Additional construction occurring adjacent to the port,	New international port in operation. Construction of additional buildings and infrastructure apparent.

Location	2014	2018	2022
		including quarrying towards the northwest.	Clearing of vegetation visible surrounding Ranu Hedadi.
Dirio Power Plant	Limited development present. Area characterised by vegetation. Access between the LNG plant and power plant site established.	Vegetation cleared; fencing and laydown areas established. Construction of some infrastructure has commenced.	Further vegetation cleared and power plant site has been constructed.

4.3 2022 LAND USE

Table 4.2 provides a summary of the estimated areas of each land use class within the study area. Most of the study area (80%) has been classified as grassland and woodland, followed by industrial (13%); residential (3%), commercial (3%) and community use (1%) land uses account for the smallest proportion of the study area.

Table 4.2 Estimated areas of land uses within the study area

Land use	Area (ha)	Percentage of study area
Grassland and woodland	946	80%
Industrial	149	13%
Residential	38	3%
Commercial	35	3%
Community use	15	1%
Total	1,182	100%

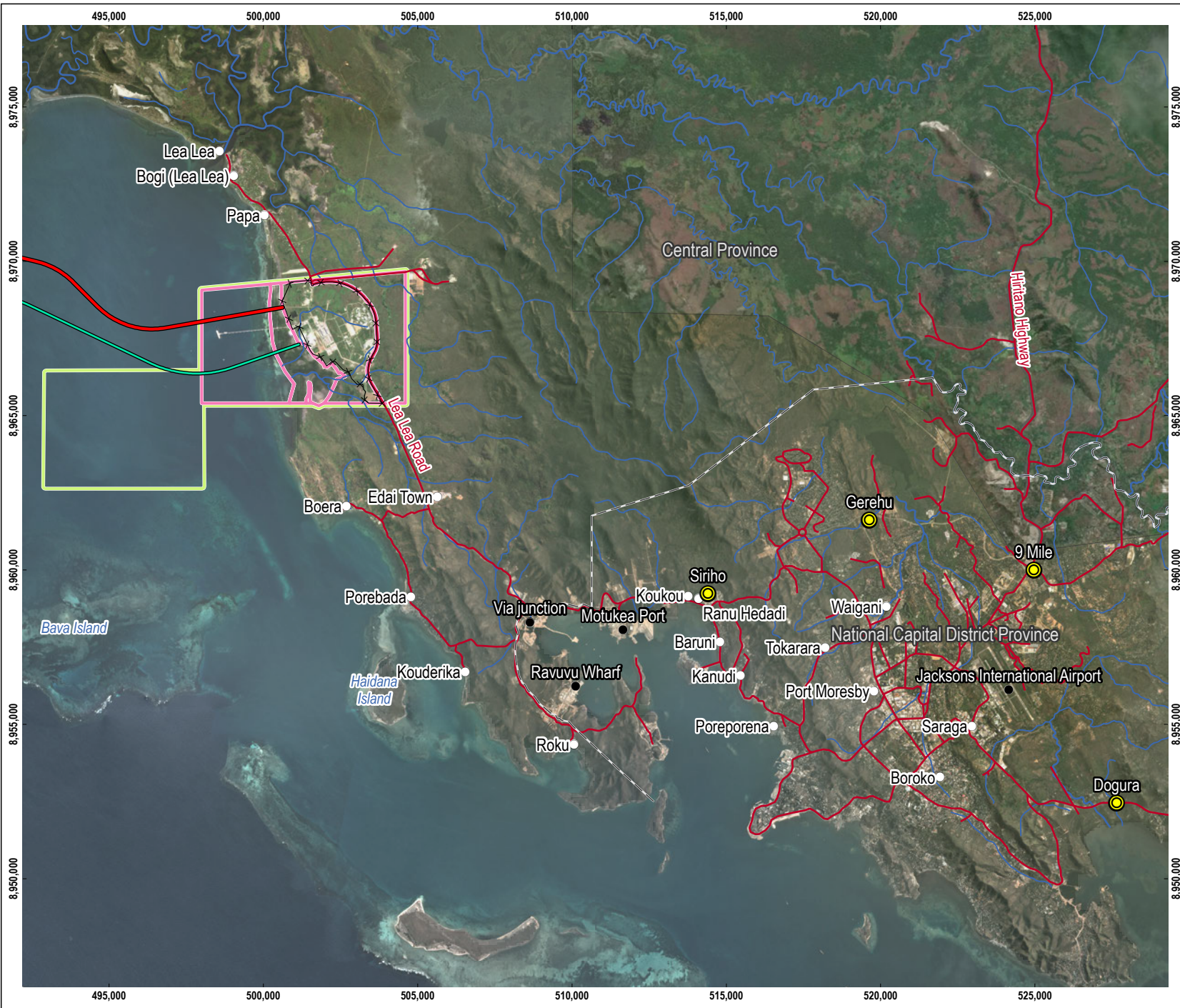
Areas of grassland (Plate 4.1) and woodland occur throughout the study area and occupy 80%, or 946 ha, of the study area. These areas are characterised by vegetation coverage with limited disturbance, including mangroves in Fairfax Harbour (Figure 4.4). Large areas of grassland and woodland occur along Lea Lea Road northwest of Napa Napa Road junction (Figure 4.5 and Figure 4.6) with a smaller area present in the southern portion of the study area.

Within the study area, 149 ha (13%) is classified as industrial land use (Plate 4.2). This land is mostly located near Fairfax Harbour, including Motukea Wharf (see Figure 4.4) and encompasses warehouses, freight processing, workshops, a quarry and smaller trading enterprises. Land within the LNG plant site that intersected with the study area was also classified as industrial use (Figure 4.6).

Residential land use occurs on 38 ha (3%) of the study area. Edai Town is the major residential area within the study area; however, dwellings are scattered throughout the study area.

Commercial land use within the study area is mostly situated near Fairfax Harbour with a smaller area located near Edai Town (see Figure 4.4 and Figure 4.5). Within the study area, commercial land use comprises 35 ha, or 3% of the study area. Commercial facilities in the study area include trading stores, security operations and servicing businesses supporting industrial activities (Plate 4.3), and hospitality.

Community use within the study area includes informal community markets along the roadside, religious facilities and schools and day-care facilities (see Figure 4.4). Land classified as community use occurs on 15 ha (1%) of the study area. Near Via Junction, one church and one school are situated 300 m and 100 m



LEGEND

- Proposed major centre
- Point of interest
- Village
- Road
- Watercourse
- PNG LNG pipeline
- Proposed Papua LNG pipelines route
- Province boundary
- LNG Plant security fence
- PPFL boundary
- APPFL boundary

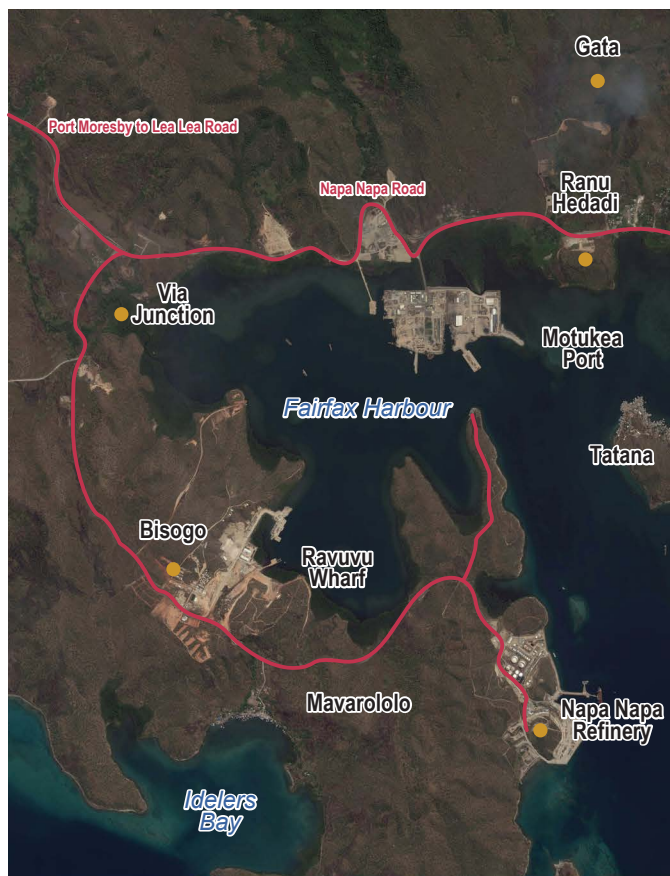
SOURCE
 Major centres and points of interest from Tetra Tech Coffey.
 Infrastructure, roads, watercourses and lease boundary from EMPNGA.
 Province boundary from NSO.
 Imagery from ArcGIS Online and Planet Labs.

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 PROJECTION: WGS 1984 UTM Zone 55S

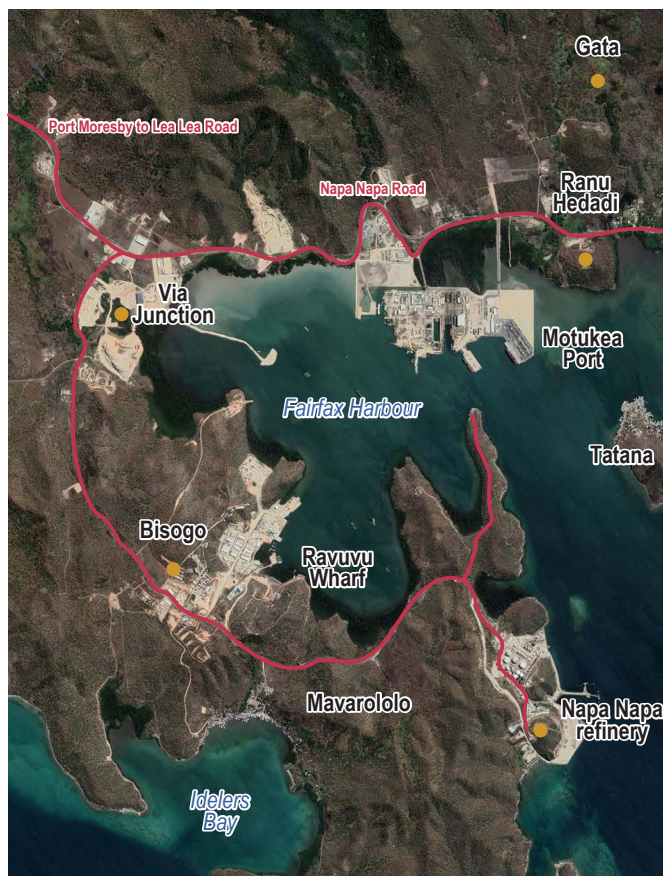
EXXONMOBIL PNG ANTELOPE LIMITED
 PAPUA LNG PROJECT – DOWNSTREAM

FIGURE 4.1
 Land use overview

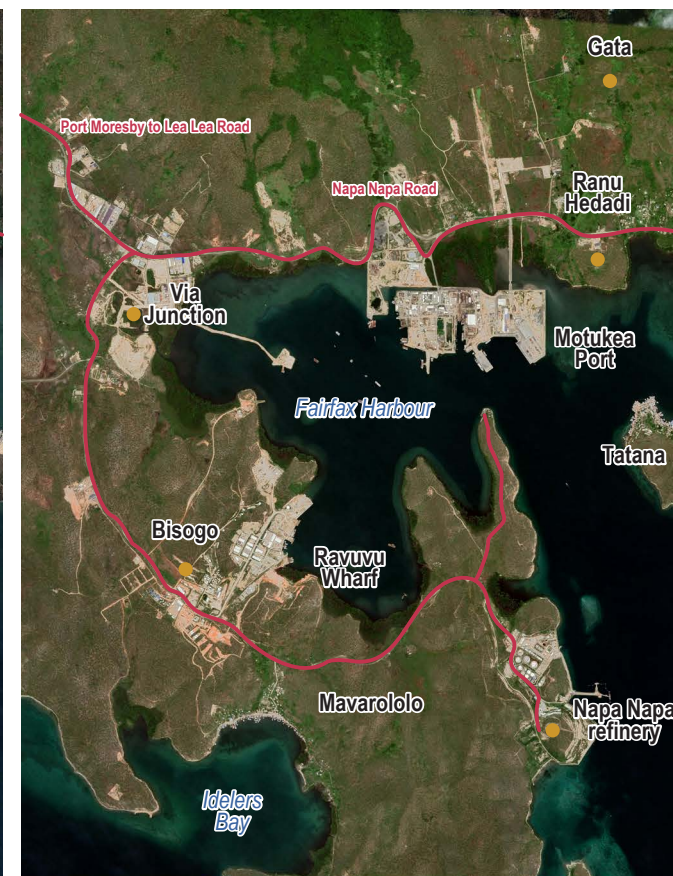




June 2014



June 2018



January 2022

EXXONMOBIL PNG ANTELOPE LIMITED

PAPUA LNG PROJECT – DOWNSTREAM

FIGURE 4.2

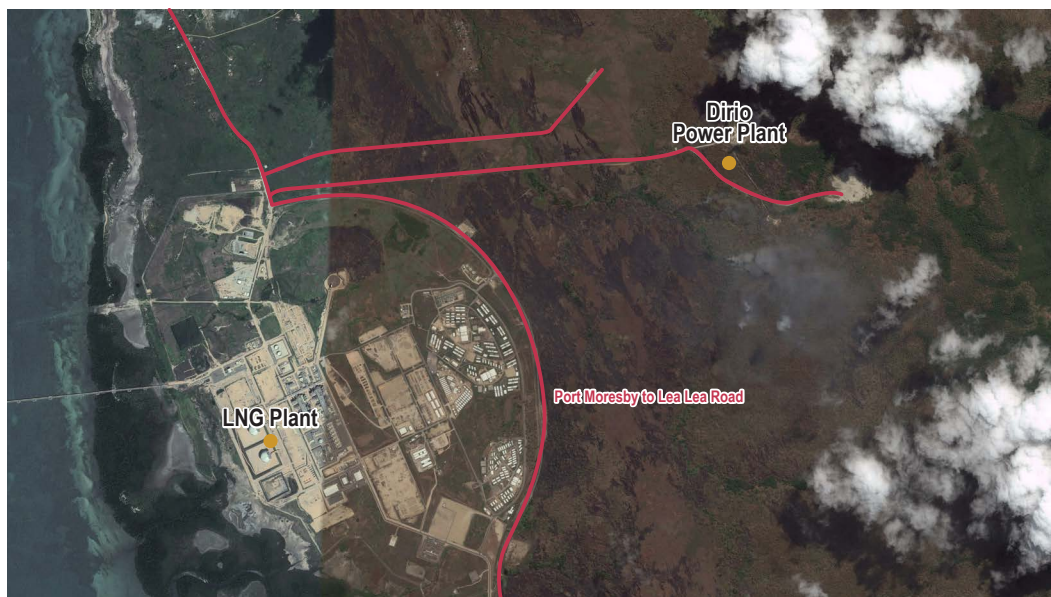
Fairfax Harbour Aerial photos



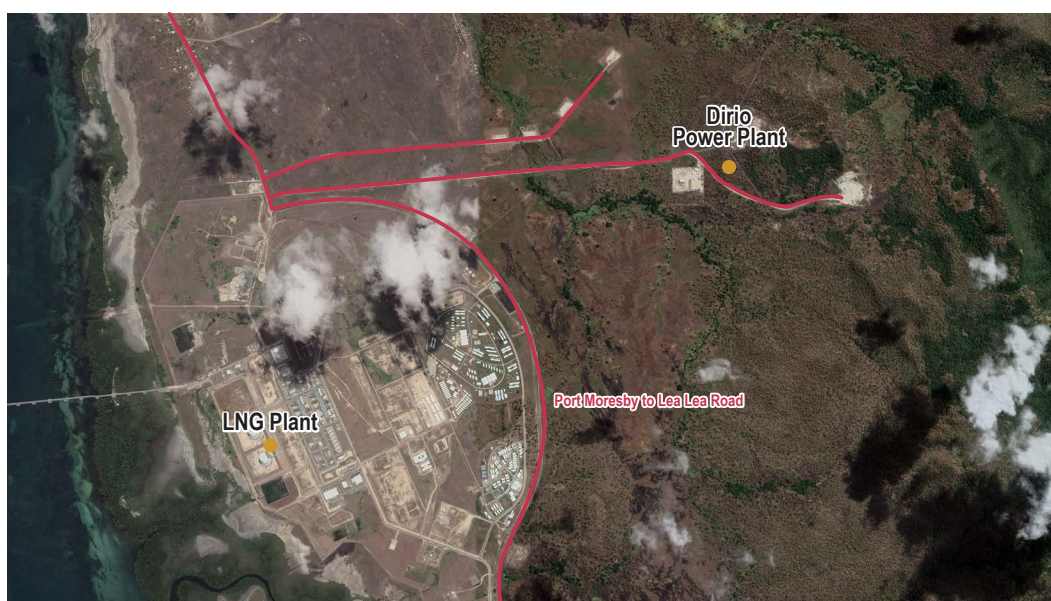
0 1 2 km

SOURCE
Google Earth Imagery, 2014, 2018, 2022





June 2014



July 2018



July 2022

EXXONMOBIL PNG ANTELOPE LIMITED

PAPUA LNG PROJECT – DOWNSTREAM

FIGURE 4.3

**LNG Plant and Gas Power Station
Aerial Photos**

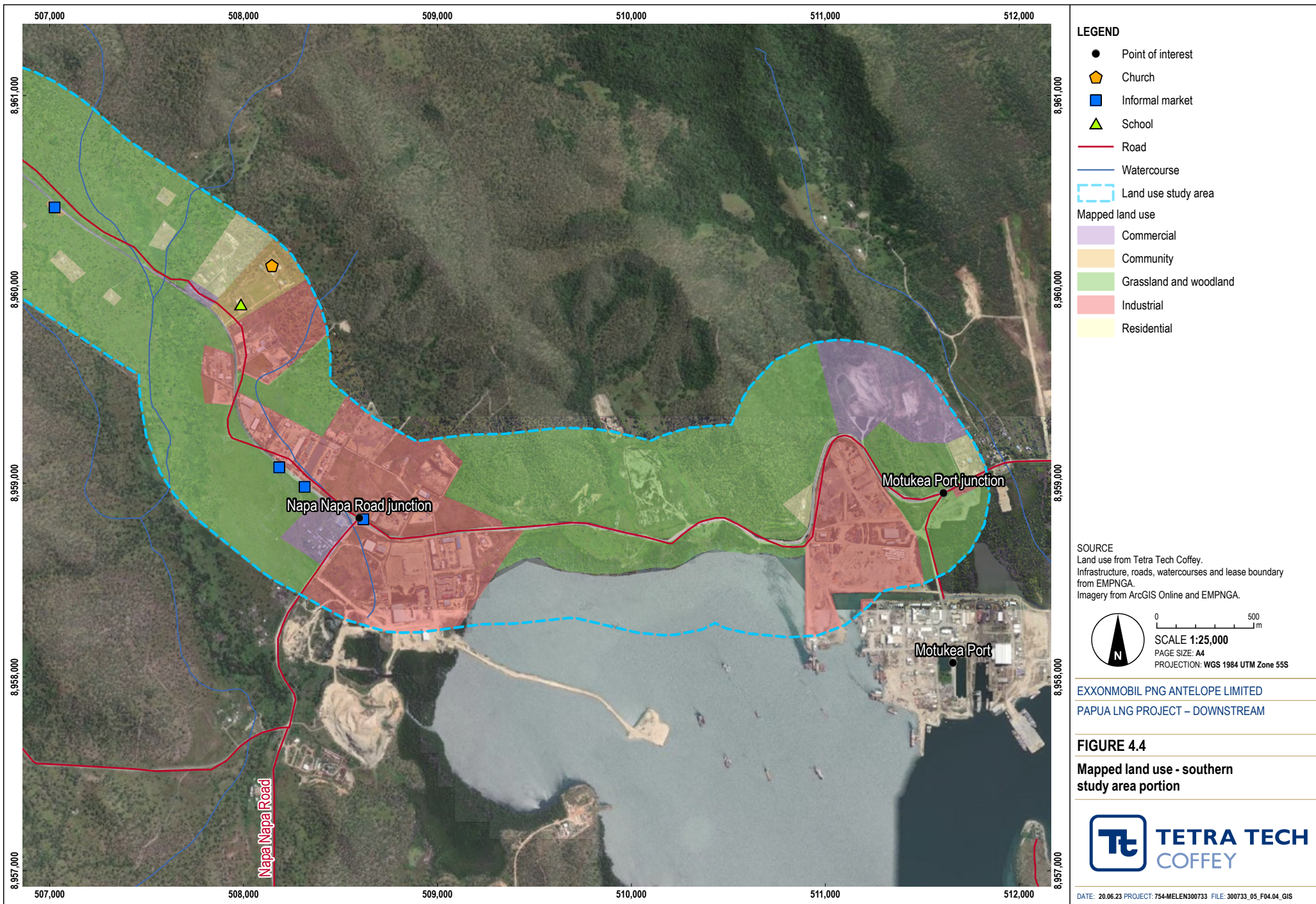


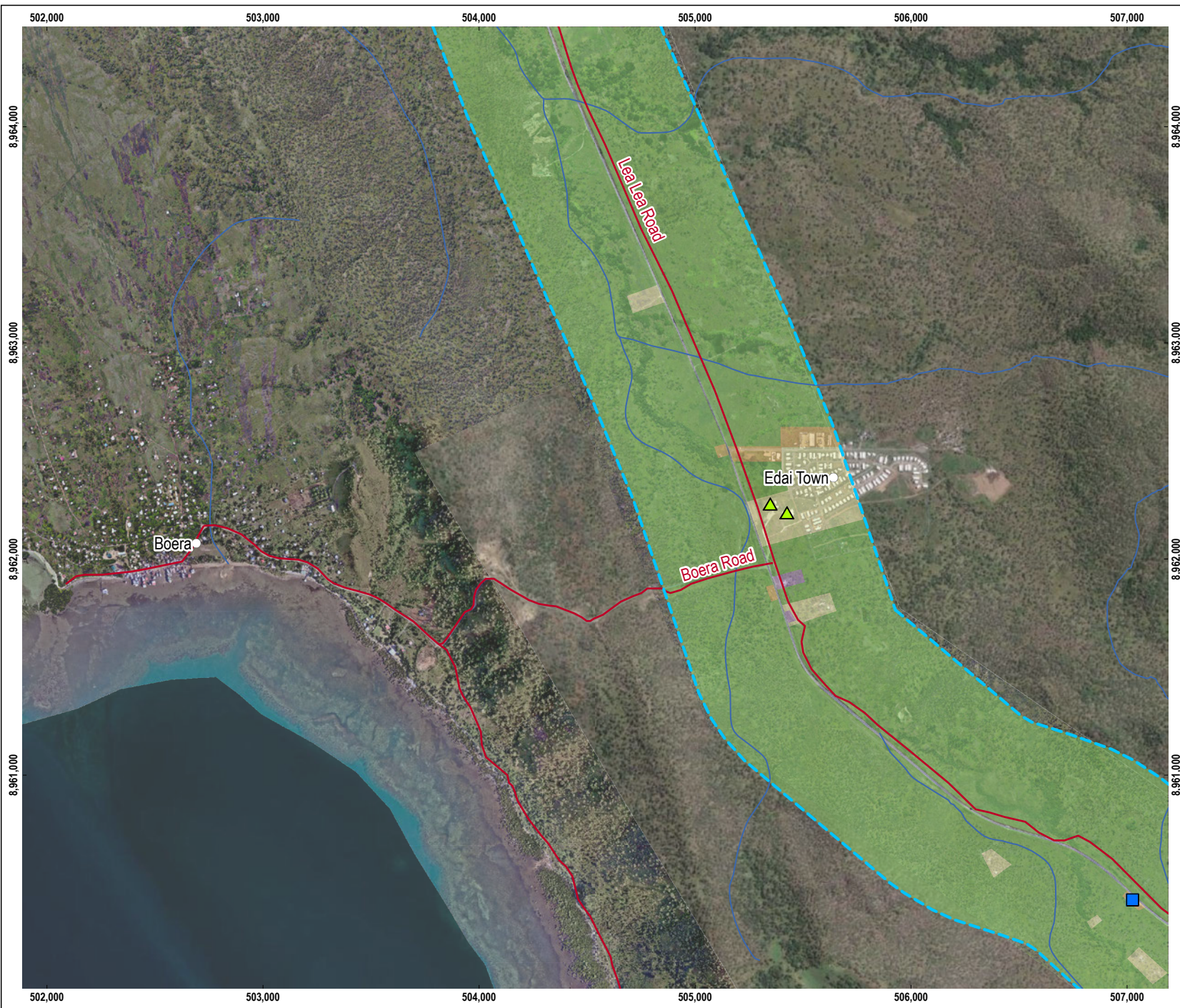
0 1 2 km

SOURCE
Google Earth Imagery, 2014,
2018, 2022



TETRA TECH
COFFEY





LEGEND

- Village
- Informal market
- School
- Road
- Watercourse
- Land use study area
- Mapped land use**
- Commercial
- Community
- Grassland and woodland
- Residential

SOURCE
 Land use from Tetra Tech Coffey.
 Infrastructure, roads, watercourses and lease boundary from EMPNGA.
 Imagery from ArcGIS Online and EMPNGA.



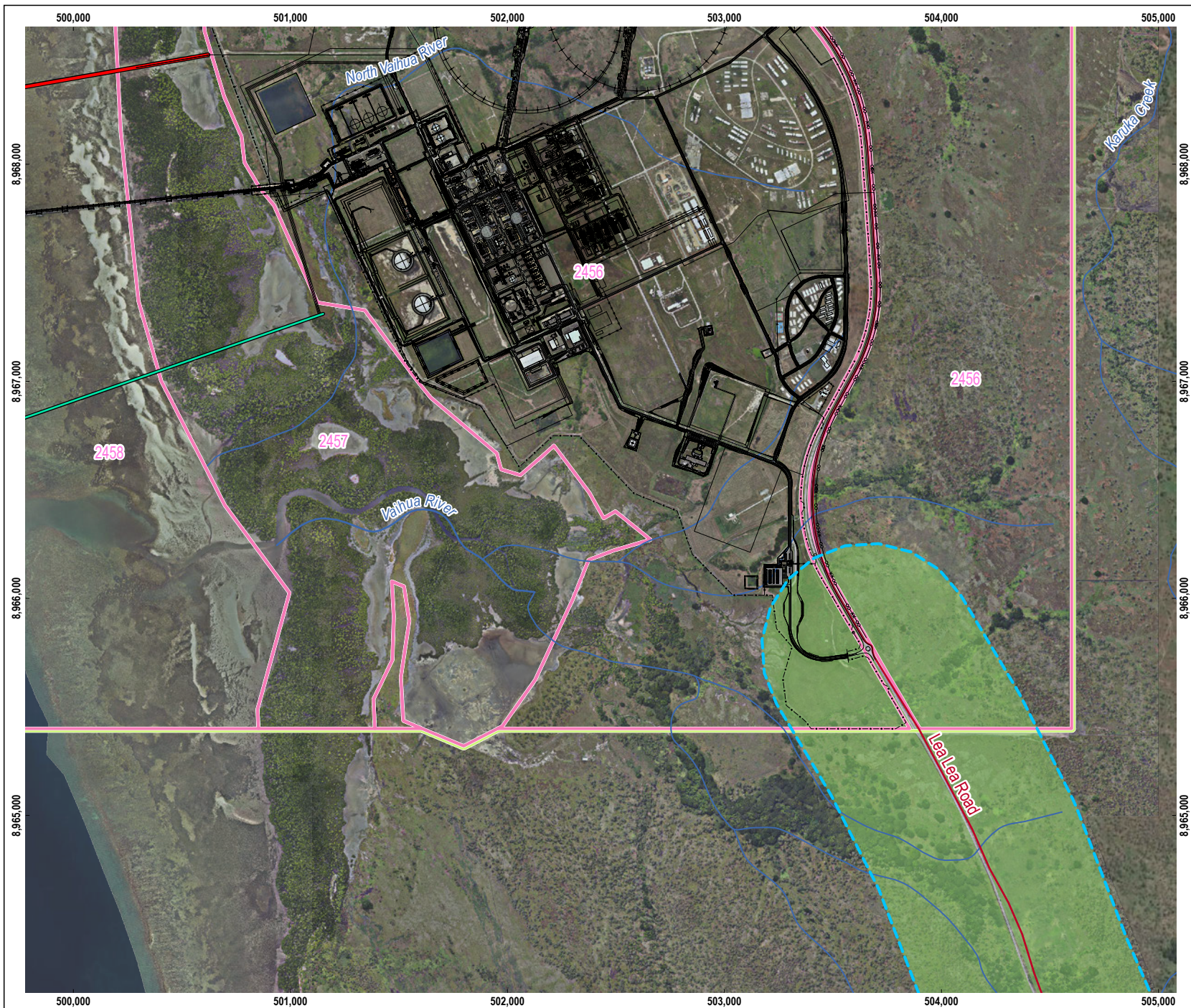
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 PROJECTION: WGS 1984 UTM Zone 55S

EXXONMOBIL PNG ANTELOPE LIMITED
 PAPUA LNG PROJECT – DOWNSTREAM

FIGURE 4.5

Mapped land use - western study area portion





LEGEND

-  Road
-  Watercourse
-  PNG LNG pipeline
-  Proposed Papua LNG pipelines route
-  Existing and proposed plant layout
-  PPFL2 boundary
-  APPFL boundary
-  Land use study area
- Mapped land use**
 -  Grassland and woodland

SOURCE

Land use from Tetra Tech Coffey.
Infrastructure, roads, watercourses and lease boundary
from EMPNGA.
Imagery from ArcGIS Online and EMPNGA.



0 500 m
SCALE 1:25,000
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PROJECTION: WGS 1984 UTM Zone 55S

EXXONMOBIL PNG ANTELOPE LIMITED

PAPUA LNG PROJECT – DOWNSTREAM

FIGURE 4.6

Mapped land use - northern study area portion



TETRA TECH
COFFEY

Plate 4.1
 Grasslands: Grassland with gravel pit
 E: 509342
 N: 8958775
 Photo taken facing north



Photo credit: Tetra Tech Coffey

Plate 4.2
 Industrial: Express Freight Management
 E: 508397
 N: 8958935
 Photo taken facing southeast
 (looking down the Nappa Nappa junction)



Photo credit: Tetra Tech Coffey

Plate 4.3
 Commercial: Service Station
 E: 508558
 N: 8958795
 Photo taken facing northwest



Photo credit: Tetra Tech Coffey

Plate 4.4
 Community Use: Capital City Baptist Church and
 South Pacific International Academy
 E: 507945
 N: 8959867
 Photo taken facing northeast



Photo credit: Tetra Tech Coffey

Plate 4.5
 Residential: Residential with Stall
 E: 507916
 N: 8959791
 Photo taken facing northeast

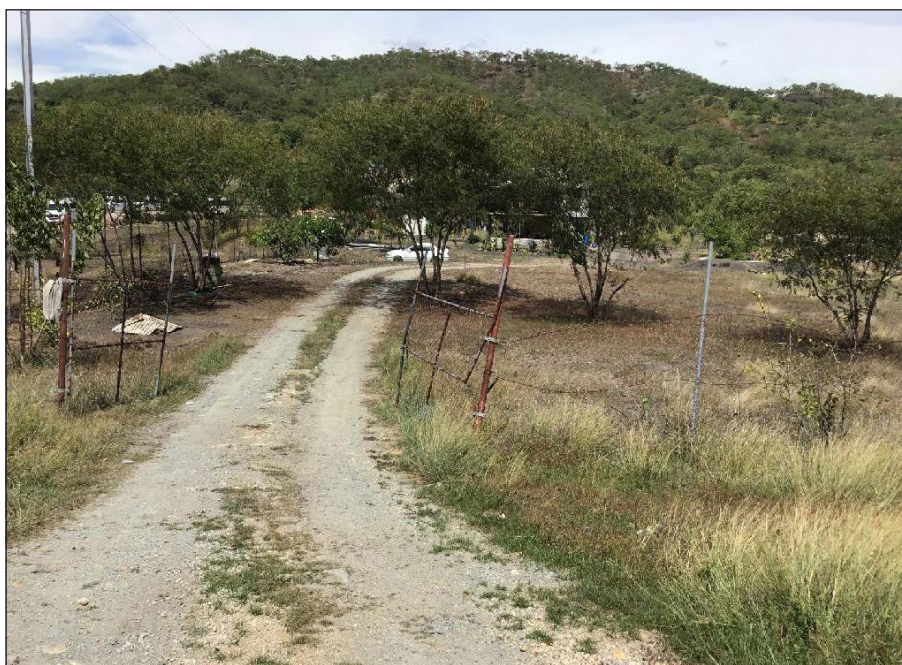


Photo credit: Tetra Tech Coffey

from Lea Lea Road (Plate 4.4). At Edai Town, two education facilities are located approximately 150 m from the road (see Figure 4.5). Several informal community markets occur along the road (Plate 4.5), as described further in Section 4.4.

4.4 PUBLIC TRANSPORT

Public motor vehicles (PMVs) travel to and from Port Moresby to the villages of Papa, Porebada, Lea Lea and Boera. In addition, a private PMV service runs from Edai Town to Port Moresby. Although there are no permanent bus stops on Lea Lea Road, there are several sections that are used consistently as informal bus stops by PMVs, including five locations identified during the 2022 field investigations.

Passengers travelling in PMVs to villages located away from Lea Lea Road, such as Porebada and Boera, are dropped off near these villages and they must make their own way in further into the village (i.e., by walking or with another vehicle). Passengers travelling to Papa or Lea Lea are dropped off in these villages as they are along Lea Lea Road. The PMV drop-offs contributed to pedestrian movements observed in this study.

4.5 ROADSIDE MARKETS

A roadside market operates daily at the Napa Napa Road junction and Boera junction. Each market stall occupies approximately 9 m². During the 2022 field survey, 33 roadside stalls were identified along Lea Lea Road between Motukea Port and the LNG Plant entrance. Of those, 15 stalls were operating at the time of the field investigation.

The market primarily sells food and consumables to passers-by and residents of the surrounding areas.

The land surrounding the roadside market was being developed during the 2019 survey. At the time of the 2022 survey, a service station and mini-mart owned by TotalEnergies had been developed and were fully operational. This market was likely established due to the development within this area (see Section 4.3), as roadside trading was not recorded at the Napa Napa junction or the Boera junction during surveys undertaken for the PNG LNG Project (Goldman, 2009).

During the 2019 interviews with stallholders (n=11), stallholders reported selling a mixture of cooked foods, packaged foods, cigarettes, buai (betel nut), and in a small number of instances fresh vegetables. Stallholders noted that the busiest days for trading were generally between Friday and Sunday, with several respondents stating that market visitation was driven by Port Moresby residents travelling through the area to go picnicking.

The busiest time for trading was either noted to be during lunch hours (12.00 p.m. to 2.00 p.m.) or in the afternoon (4.00 p.m. to 6.00 p.m.). Most stallholders operated every day of the week from 7.00 am to 5.00 p.m.; although several stallholders noted that it was common to trade until the evening hours (i.e., 8.00 p.m.).

Stallholders were asked to comment on the safety of the roadside market area. All stallholders noted that the market is unsafe for pedestrians, the reasons for which are shown in Figure 4.7. Almost all stallholders noted that the lack of pedestrian crossing was a result of poor perceived safety, combined with the level of traffic. Robbery was also raised as a concern for stallholders. Stallholders identified amenity issues as shown in Figure 4.7. Almost all stallholders listed dust and noise as their primary concern regarding amenity.

During the 2019 survey, stallholders were also asked if they considered that an upgrade to Lea Lea Road would be beneficial to business at the market. All except two of the stallholders interviewed believed an upgrade would be beneficial, with the remaining two stating that they believed it would make no difference.

During the 2022 roadside market survey with stallholders (n=15), nine participants (60% of stallholders) stated that they lived in Porebada, while four stallholders (27%) lived in the area surrounding Napa Napa Road junction. The remaining two stallholders (13%) lived in the nearby villages of Papa and Kourderika.

Stallholders noted that the busiest time for trading was generally Friday around midday (12.00 p.m. to 2.00 p.m.), and the slowest days were Monday and Tuesday before 10.00 a.m. This was generally consistent with the findings of the 2019 survey. Stallholders reported that the customers were all male with 73% of customers thought to be local workers. The remaining customers were those travelling to and from Port Moresby.

Stallholders were asked to comment on business demand over the last three years. Around 40% (6 stallholders) indicated that demand for business was about the same, while 33% (5 stallholders) indicated that there was greater demand for business. The remaining 27% (four stallholders) stated that business demand had reduced over the past three years.

During the 2022 survey, stallholders were asked how much they paid for a range of goods compared to the cost paid for the same good in 2019. Combined responses from all stallholders indicated that the costs of goods had increased across all selected items over the past three years (Figure 4.8). The items with the greatest reported cost increase included buai (+ 48%), followed by fuel (+ 42%), rice (+ 32%) and crab (+ 32%).

4.5.1 Roadside market pedestrian and vehicular visitation

Table 4.3 summarises the number of vehicles and pedestrian traffic that visited the roadside market at Napa Napa Road junction in 2019. As shown, observed counts of vehicular traffic were similar across Monday, Tuesday and Saturday, with total vehicles recorded ranging from 196 to 205. The number of vehicles on a Sunday were much lower, with a total of 126 vehicles recorded. However, total pedestrians recorded visiting the roadside market between Saturday and Monday were relatively constant at between 92 and 86. Visitation on Tuesday was lower at 62.

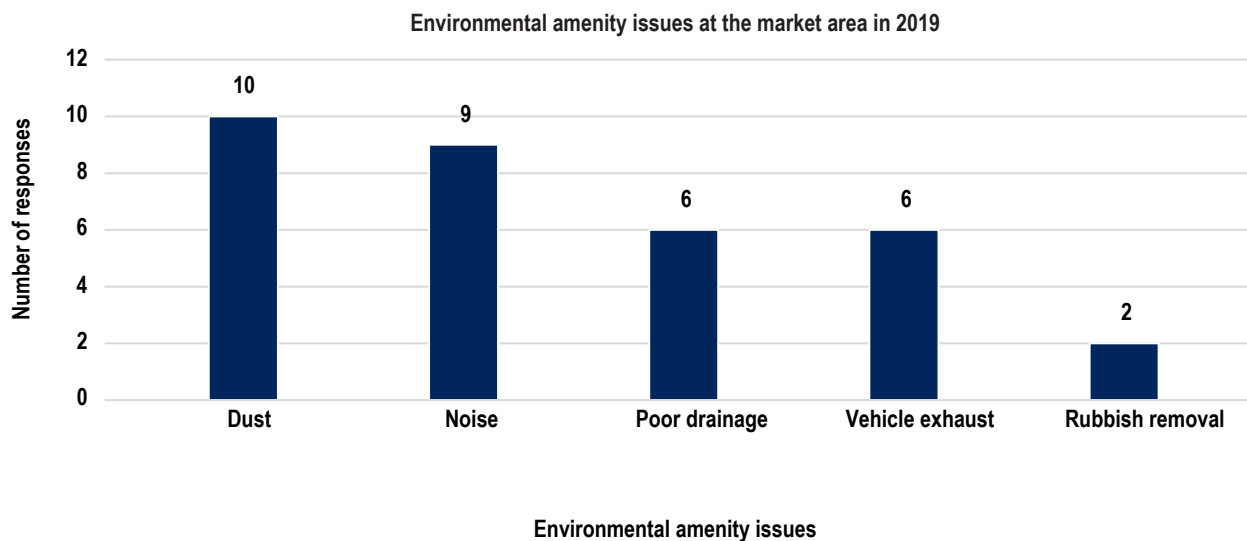
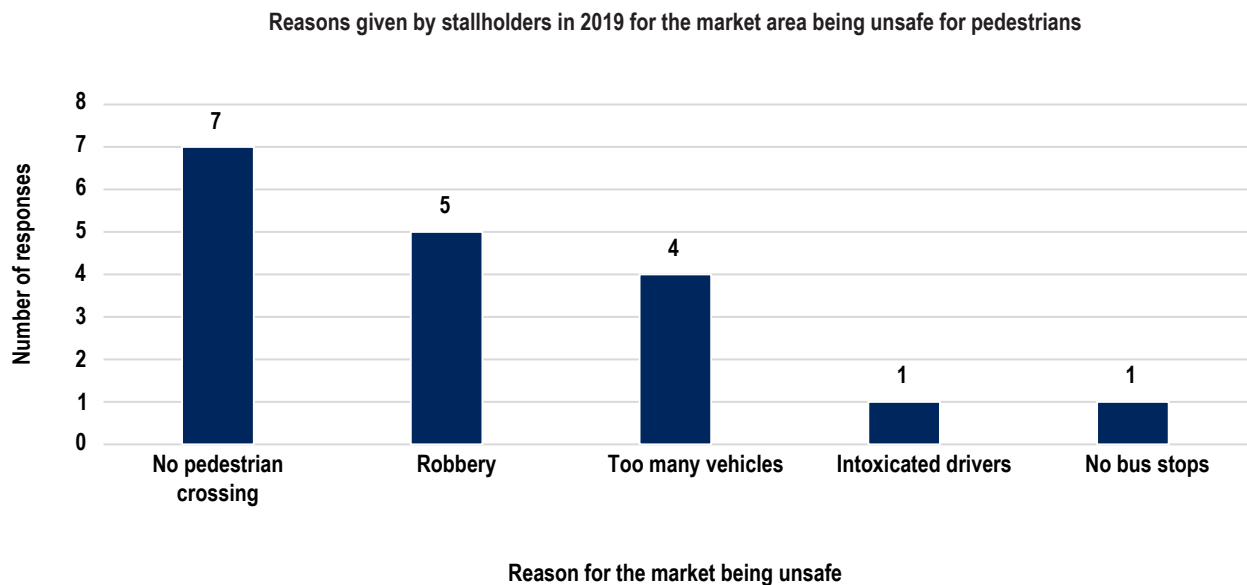
Table 4.3 Total vehicles and pedestrians stopping at the Napa Napa Road junction roadside market, 2019

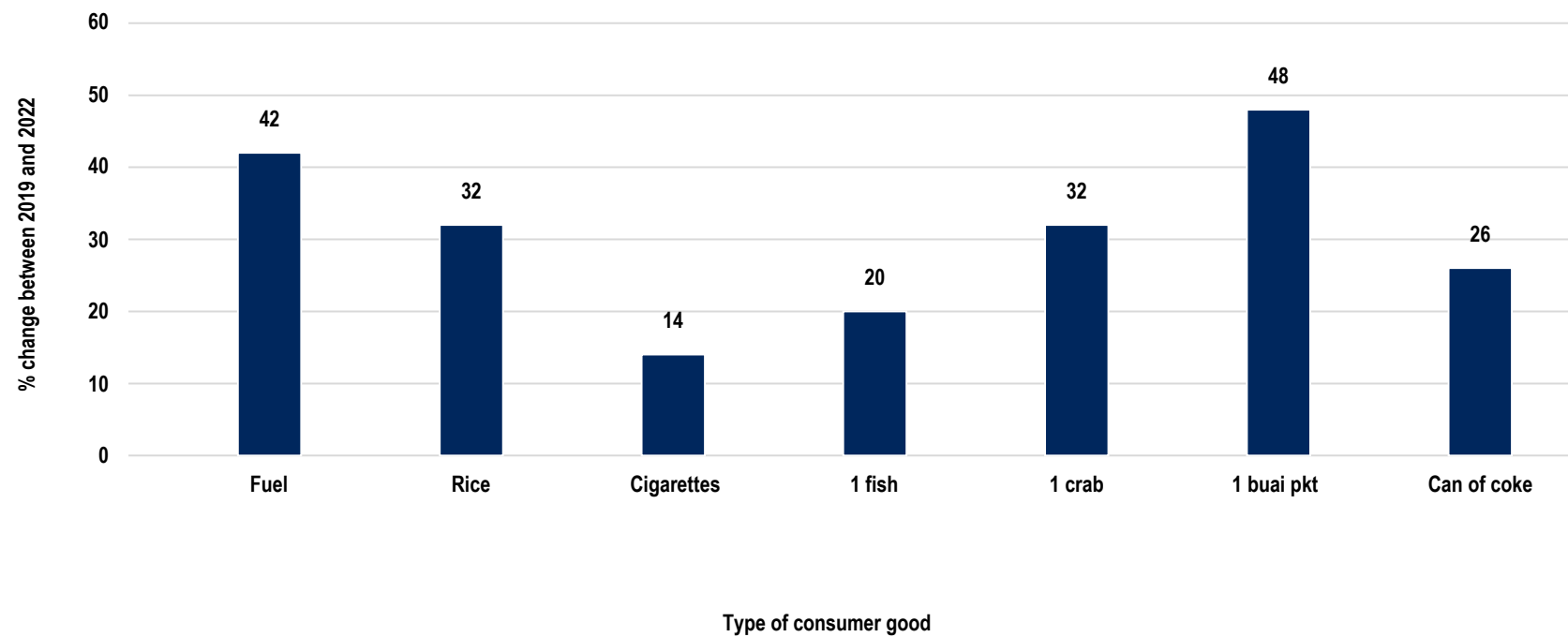
Type	Saturday 23 March	Sunday 24 March	Monday 25 March	Tuesday 26 March
Vehicles	205	126	196	196
Pedestrians	96	86	92	62

Table 4.4 summarises the number of vehicles and pedestrian traffic that visited the roadside markets at the junctions of Napa Napa Road and Boera road in 2022. As shown, the level of visitation at the Napa Napa junction market in 2022 was significantly lower than that recorded in 2019 (see Table 4.3), with the level of vehicular traffic (46 vehicles) less than half that reported in 2022 on the slowest day (Sunday, 126 vehicles) and less than a quarter of that reported on the busiest day (Saturday, 205 vehicles). The number of vehicles stopping at the market and pedestrians (Table 4.4) recorded at Boera junction is lower than that recorded for the Napa Napa Road junction.

Table 4.4 Total vehicles and pedestrians stopping at the Napa Napa junction and Boera junction roadside markets, 2022

Type	Napa Napa junction Wednesday 21 September	Boera junction Thursday 22 September
Vehicles	46	5
Pedestrians	98	14





5. TRAFFIC AND PEDESTRIAN USE

This section summarises the results of the 2019 and 2022 traffic and pedestrian surveys and in doing so provides indicative baseline daytime traffic conditions within the study area, including traffic volume and type, inclusive of road use by public transport vehicles (e.g., public motor vehicles (PMVs)).

5.1 AVERAGE DAILY TRAFFIC AND AVERAGE VEHICLES PER HOUR

Table 5.1 summarises the average daily traffic (ADT) in 2022. Based on the data collected in 2022, the average daily traffic (ADT) was calculated to be 1,933 vehicles per day.

Table 5.1 Average daily traffic (2022)

Survey day	Number of vehicles per day
Wednesday (Link 1 & 2)	2,704
Thursday (Link 3)	1,161
Average daily traffic (ADT)	1,933

Table 5.2 summarises the traffic movements on a vehicle per hour (vph) basis aggregated into morning and afternoon periods for each road link in 2019. Based on the data collected, the following vehicular trends were observed in 2019:

- Traffic levels for Links 1 and 2 were similar, with around 130 vph to 160 vph during the morning and 110 to 140 vph during the afternoon. For these links, the proportion of heavy vehicles in the traffic flow represented between 13% to 28% of traffic. On Link 1, the proportion of heavy vehicle traffic was generally higher in the mornings (19% to 21%) and lower in the afternoons (13% to 23%). On Link 2, the proportion remained generally steady, with a minor increase in the afternoon (25% to 28%) compared to the morning (20% to 25%).
- Traffic levels on Saturday are similar to those reported during weekdays. In the case of Link 1, the Saturday traffic count was the highest of all days reported. Based on the stallholder surveys, this may be due to families travelling on a Saturday to go picnicking or families travelling from Port Moresby to Motu villages along this road.
- Traffic levels on Sunday (70 vph) for Links 1 and 2 were up to 50% lower than traffic on the other days, with less than half of the heavy vehicle component seen on the other days.
- Traffic was not counted for Link 3 in 2019, and only data on the traffic generated by the LNG Plant is available. This data indicates traffic volumes are slightly lower in the morning, ranging from 39 vph to 84 vph, compared to 34 vph to 69 vph in the afternoon. Weekday traffic vph is higher than that recorded during the weekend, with a drop of between 22.9% and 30.8% on Saturday and a drop of 50.0% and 53.6% compared to vph on Monday and Tuesday respectively.

Table 5.2 Morning and afternoon vehicle movements per hour, including the proportion of heavy vehicles (2019)

Survey day	VPH	%HV	VPH	%HV
	Morning		Afternoon	
	To/from Port Moresby (Link 1)			
Saturday	146	21.4%	110	11.5%
Sunday	70	2.8%	71	1.9%
Monday	116	19.2%	128	18.5%
Tuesday	131	20.8%	122	23.3%
	To/from Napa Napa (Link 2)			
Saturday	133	23.5%	141	25.4%
Sunday	74	9.4%	67	5.2%
Monday	141	24.9%	121	28.2%
Tuesday	157	19.9%	134	25.2%
	To/from LNGP and beyond * (Link 3)			
Saturday	65	n.a.	67	n.a.
Sunday	39	n.a.	34	n.a.
Monday	78	n.a.	64	n.a.
Tuesday	84	n.a.	69	n.a.

VPH = Vehicles per hour

HV = Heavy vehicles (rigid truck, prime movers & trailer, heavy machinery)

* = EMPNG Plant gate records

Table 5.3 summarises the traffic movements on a vph basis for morning and afternoon periods for the Boera Road junction and the Napa Napa Road junction in 2022. Based on the data collected, the following vehicular traffic trends were observed in 2022:

- Traffic on Link 1 was 49 vph in the morning and 79 in the afternoon. The proportion of heavy vehicles was 14.6% in the morning and 30.5% in the afternoon, which is a near 50% increase.
- Traffic on Link 2 was 160 vph in the morning and 190 vph in the afternoon. The proportion of heavy vehicles was 16.4% in the morning and 21.2% in the afternoon. This traffic is much greater than that reported on Link 1 and Link 3.
- Traffic data on Link 3 was only counted on Thursday, during which there were 104 vph in the morning and 88 vph in the afternoon. The proportion of heavy vehicles was very low, at between 0.3% in the morning and 1.8% in the afternoon. Based on the observed traffic and the EMPNG LNG Plant gate records, the LNG Plant contributes 26.9% of the traffic in the morning and 31.8% in the afternoon.

Table 5.3 Morning and afternoon vehicle movements per hour, including the proportion of heavy vehicles (2022)

Survey day	VPH	%HV	VPH	%HV
	Morning		Afternoon	
	To/from Port Moresby (Link 1)			
Wednesday	49	14.6%	79	30.5%
	To/from Napa Napa (Link 2)			
Wednesday	160	16.4%	190	21.2%
	To/from LNG Plant and beyond* (Link 3)			
Wednesday	23*	n.a	23*	n.a
Thursday	28*	n.a	28*	n.a
Thursday	104	0.3%	88	1.8%

VPH = Vehicles per hour

HV = Heavy vehicles (rigid truck, prime movers & trailer, heavy machinery)

* =EMPNG LNG Plant gate records

A comparison of vehicle movements between 2019 and 2022 indicates the following:

- There were significantly fewer vehicles observed on Link 1 in 2022 compared to 2019, with the vph observed in 2022 around 60% less than those observed in 2019. However, the proportion of heavy vehicles has increased.
- The weekday traffic reported on Link 2 was relatively consistent with that recorded in 2019 in the morning, although the afternoon traffic was higher, at an increase of around 30%.
- The vph generated by the LNG Plant was much lower in 2019 than in 2022, with a reduction of around 70%.

5.1.1 Hourly traffic analysis

Hourly traffic levels were assessed to determine whether there were peak periods throughout the day. This analysis is shown in Figure 5.1 to Figure 5.3 in 2019, and Figure 5.4 for 2022. Analysis of the 2019 data indicates that:

- There does not appear to be a distinct morning peak on Links 1 and 2, with traffic levels rising rapidly to a consistent hourly rate throughout the morning. There are indications that there may be a slight lull in traffic in the middle of the day, before rising to a higher level in the mid-afternoon (1.30 p.m. to 3.30 p.m.) prior to levels then dropping substantially.
- From LNG Plant gate records (Link 3), there appears to be a double peak, with the first around 6.30 a.m. to 7.30 a.m. in the morning on weekdays, followed by a second from 8.30 a.m. to 9.30 a.m. This may reflect shift changes and the transport of workers back to Port Moresby.

5.1.2 Pedestrian movements

Table 5.4 summarises the pedestrian movements observed at the Napa Napa junction during the 2019 survey and at the Napa Napa junction (Wednesday), and at the Boera junction (Thursday) during the 2022 survey. These movements are shown on an hourly basis in Figure 5.5 for data recorded in 2019 and in Figure 5.6 for data recorded in 2022. Based on the data collected, the following pedestrian traffic trends were observed:

- In 2019, there was a greater level of pedestrian activity during the week, over that observed during the weekend, reducing from a total count of 168 persons on Monday and 197 persons on Tuesday, to 115 persons on Saturday and 143 persons on Sunday.
- Across both the 2019 and 2022 surveys, there was also generally a greater level of activity during the morning, particularly on the weekend, where there was often almost double the level of pedestrian activity compared to the afternoon.
- In 2022, there was considerably lower pedestrian activity recorded at the Napa Napa junction, equating to a reduction of around 33% in the morning and a reduction of around 70% in the afternoon compared to 2019 weekday averages. However, while it is noted that only one day of data was collected, it does indicate there is less pedestrian activity at Napa Napa junction. The roadside market stalls established at the Boera junction between 2019 and 2022 may have drawn pedestrian traffic from Napa Napa junction.

The pedestrian traffic observed at Boera junction was greater in the afternoon, which is a distinct pattern from that recorded at Napa Napa junction.

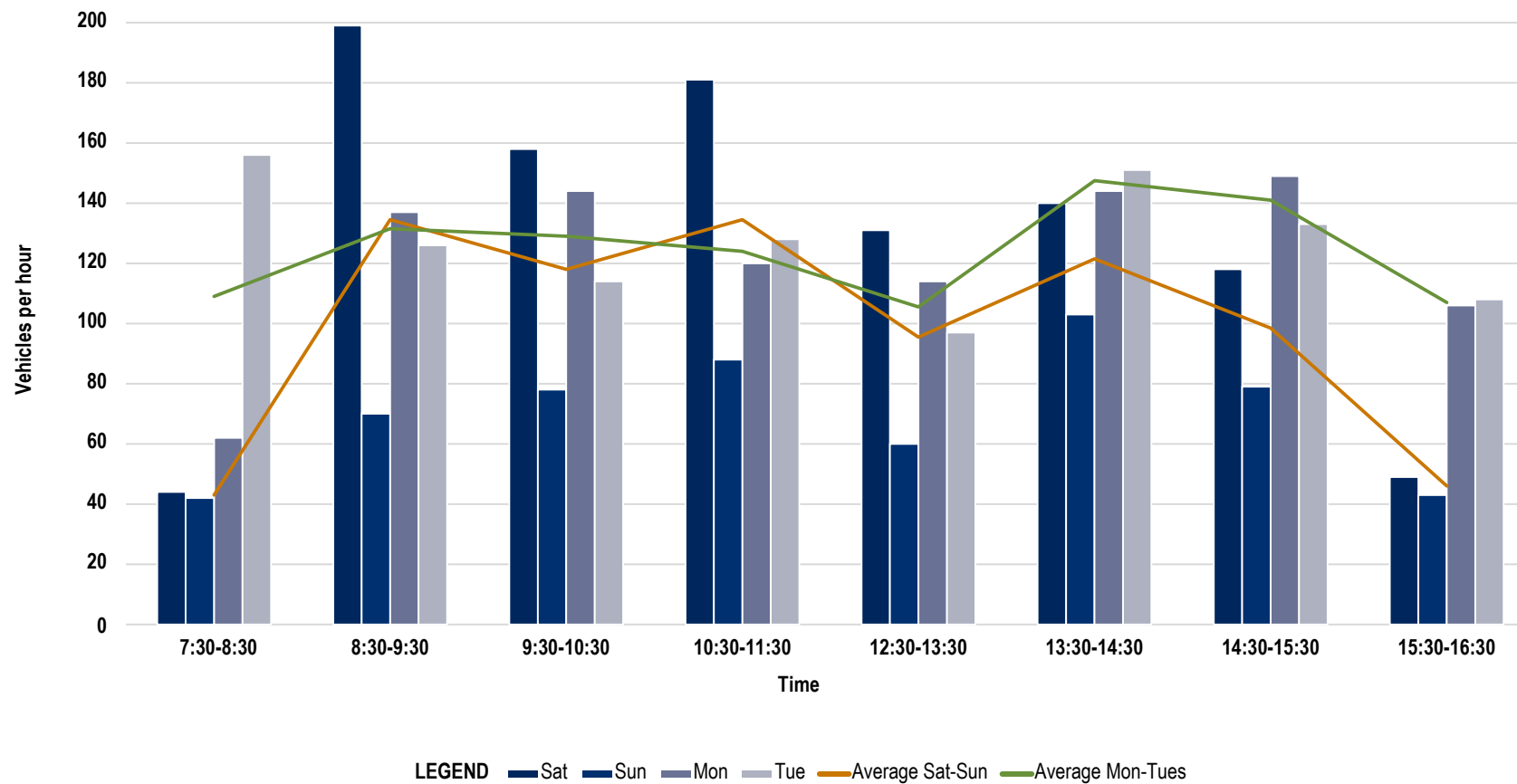
Table 5.4 Number of pedestrians observed on Lea Lea Road

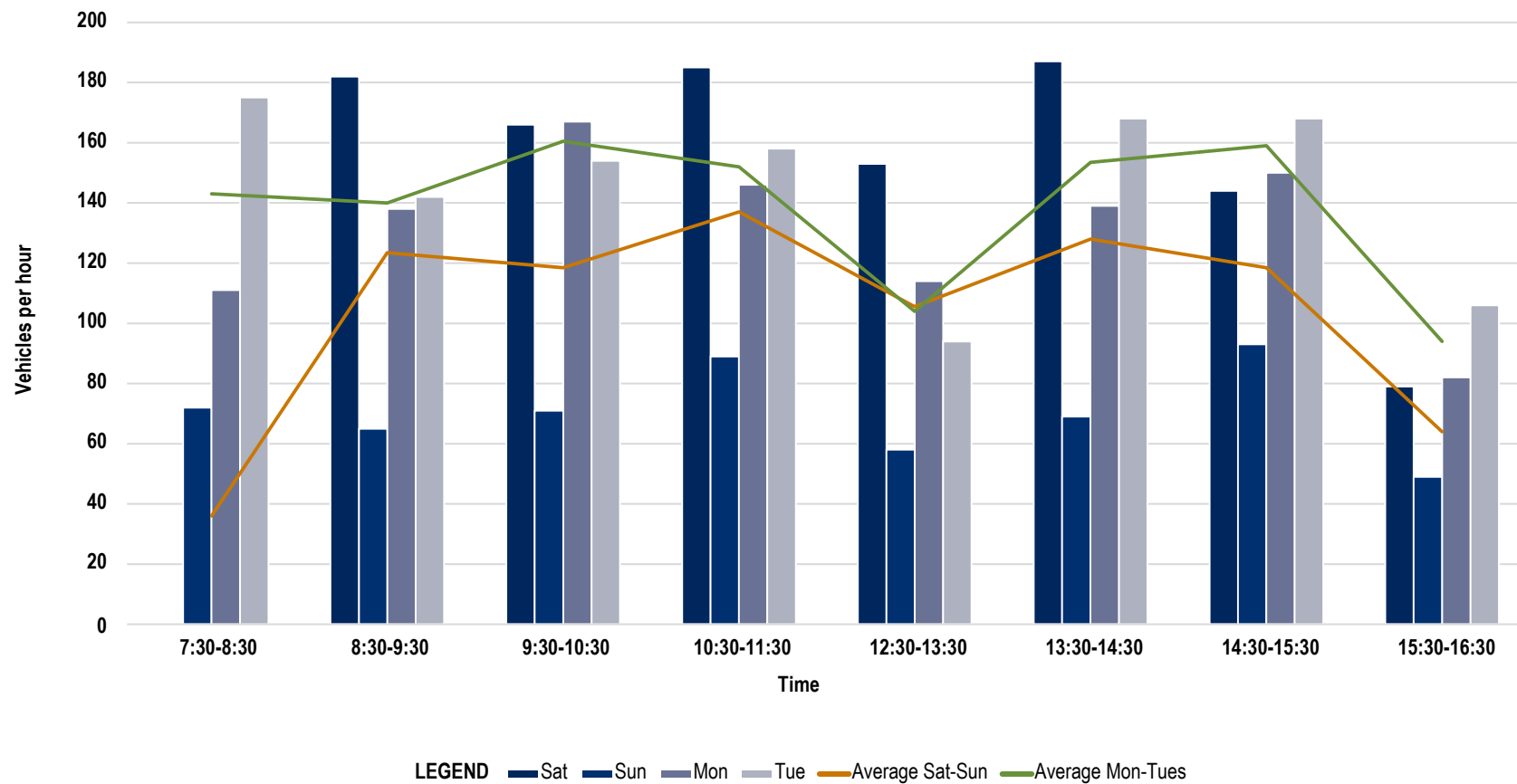
Year	Survey day	Location	Morning	Afternoon
2019	Saturday	Napa Napa junction	70	45
	Sunday		96	47
	Monday		110	87
	Tuesday		107	61
2022	Wednesday	Napa Napa junction	75	23
	Thursday	Boera junction	38	56

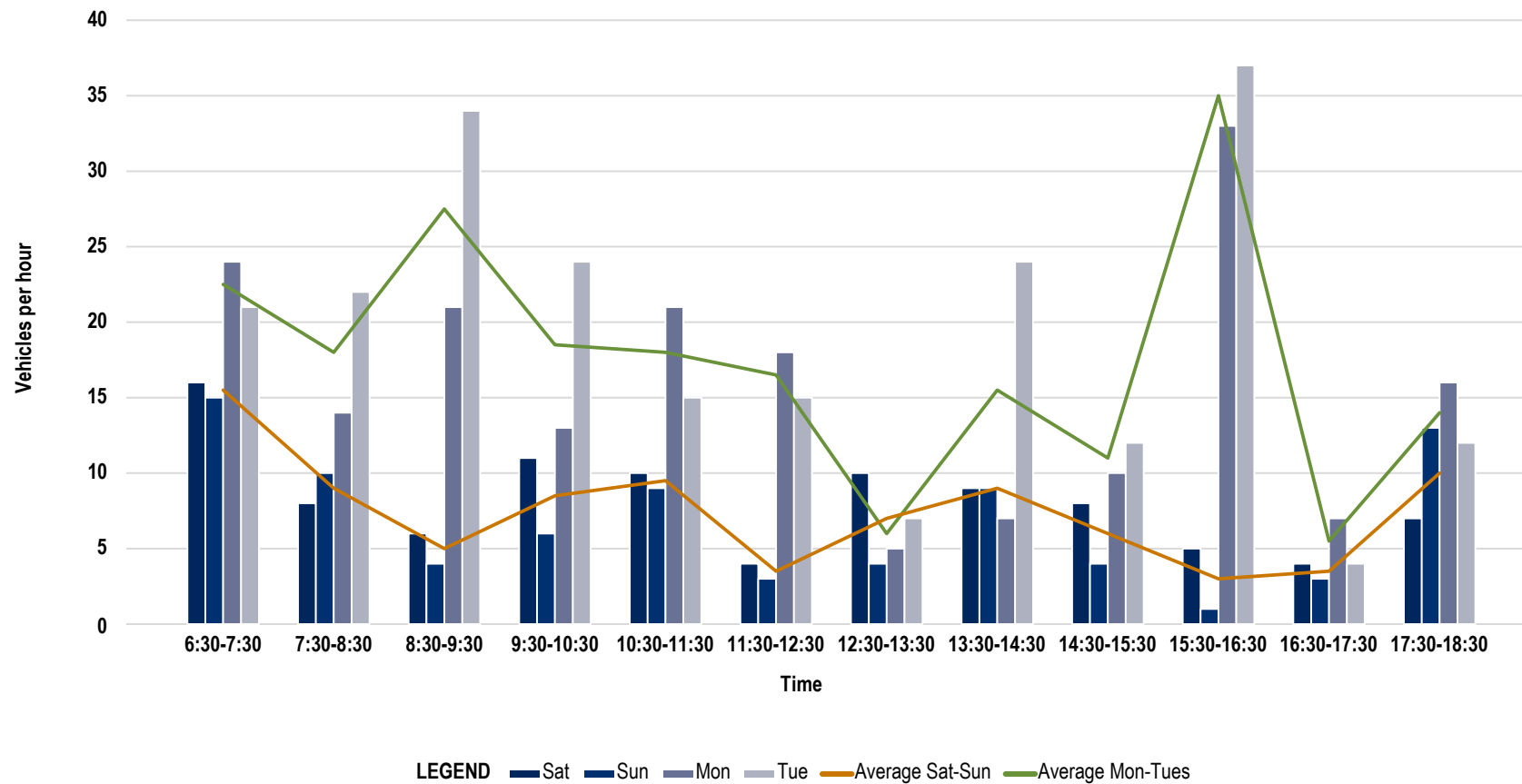
5.2 TYPES OF TRAFFIC

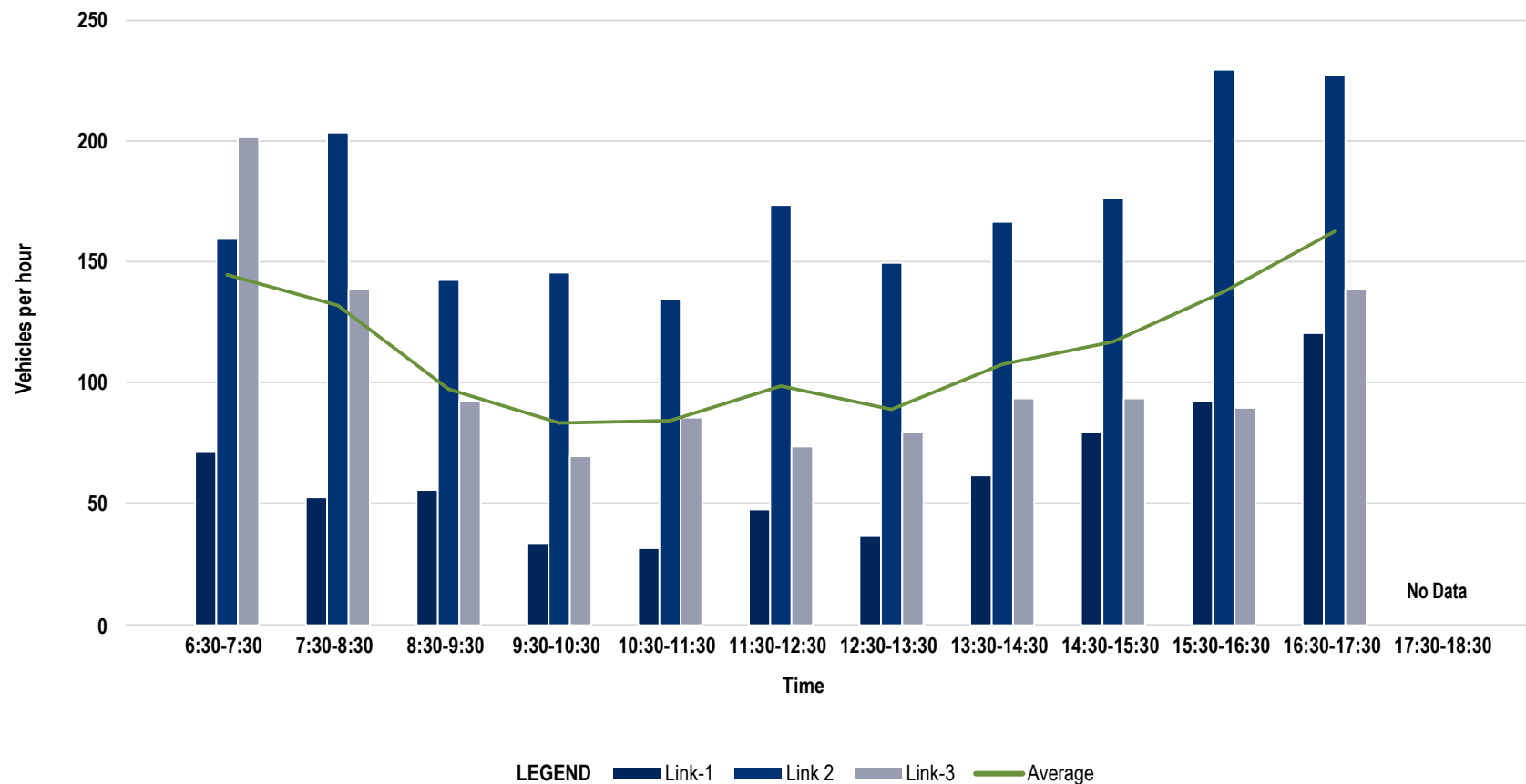
Figure 5.7 shows the proportion of all recorded vehicle types at Napa Napa Road junction in 2019 and 2022. In 2019, light vehicles were the most common, accounting for over 37.0% of all recorded vehicle movements, followed by PMVs (22.4%) and cars (20.8%). In 2022, cars (22.7%) and light vehicles (33.5%) account for more than 50% of road users, followed by PMV buses and trucks (20%), rigid trucks (12%), prime movers (6.7%) and heavy machinery (0.6%). Rigid trucks, prime movers and trailers and heavy machinery were observed either travelling from the Napa Napa Road to Port Moresby or from Express Freight Management (EFM) logistics base near Napa Napa junction to Port Moresby. There was less movement of heavy equipment past the EFM yard towards the LNG Plant and beyond.

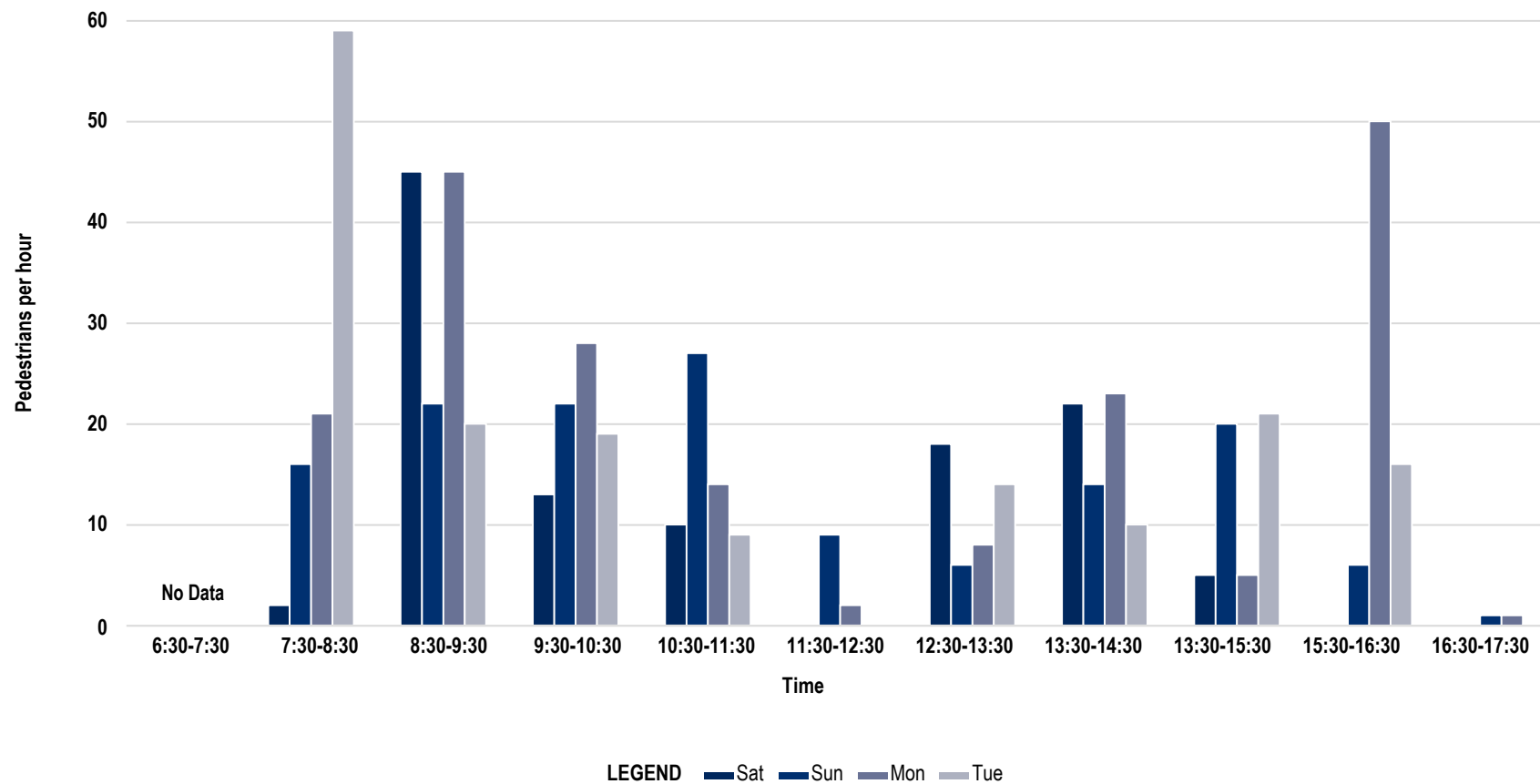
Figure 5.8 shows the proportion of all recorded vehicles at the Boera Road junction on the Lea Lea Road (Link 3) in 2022. Cars (33%) and light vehicles (34%) make up more than 60% of road users, followed by PMV buses and trucks (23.3%). In contrast to the Napa Napa Road junction, rigid trucks represented a minority of vehicular traffic (0.9%). Other vehicles include taxis and emergency services.

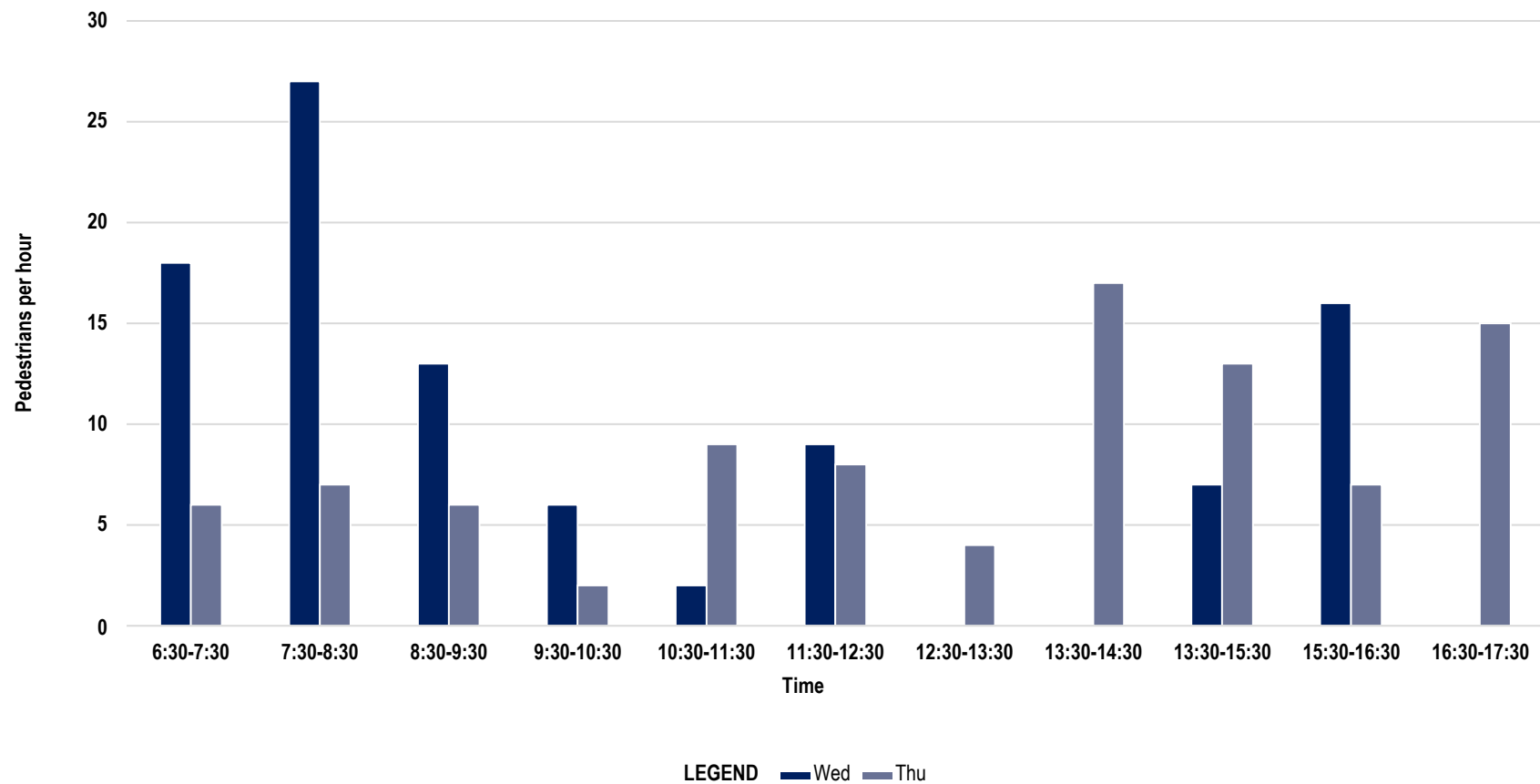


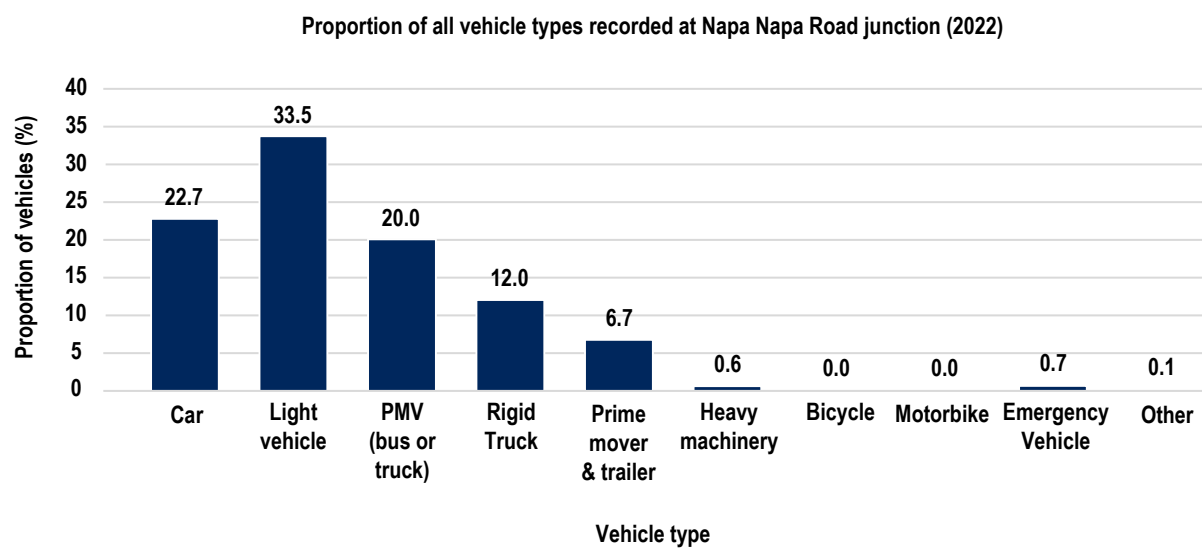
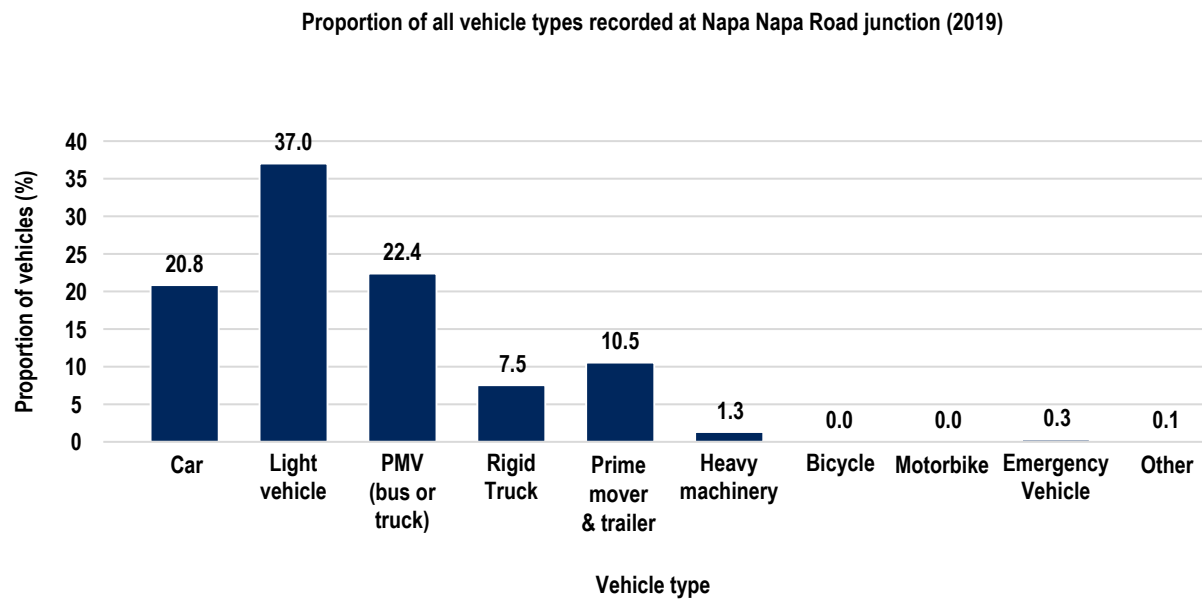


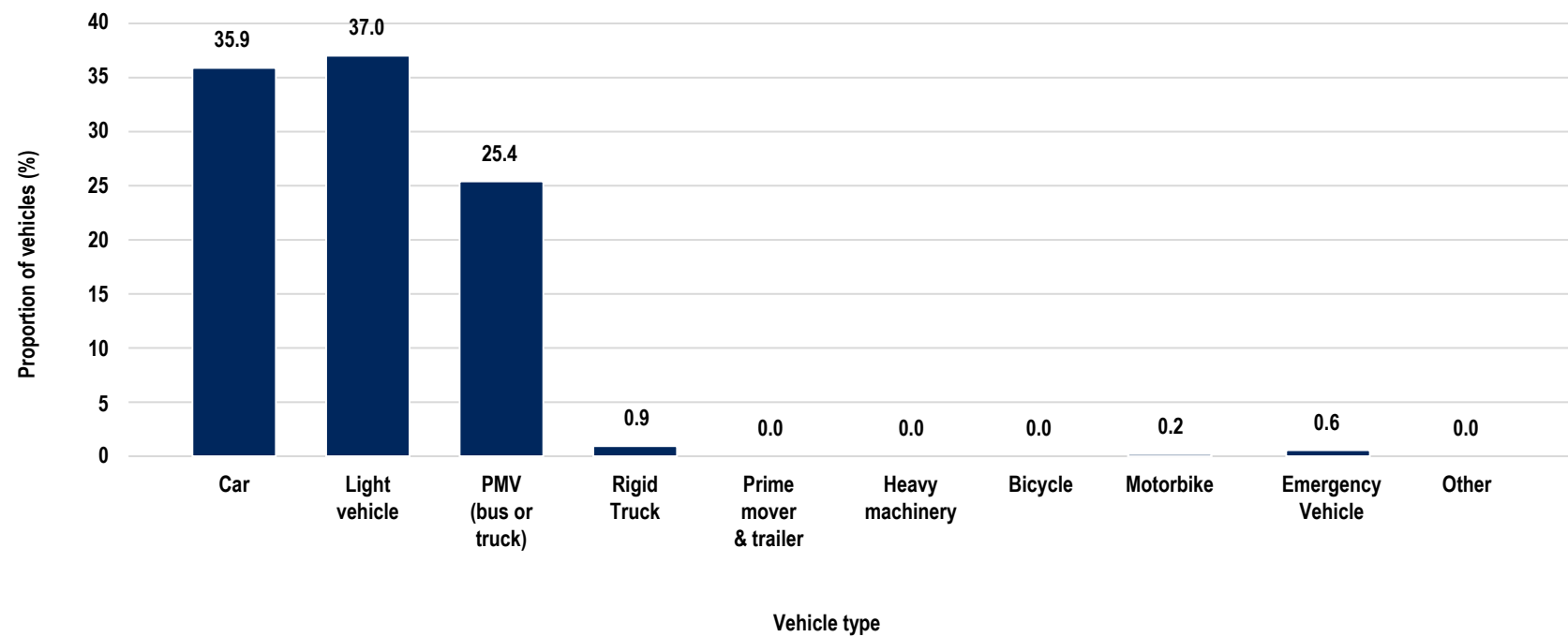












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APPENDIX A: OBSERVED TRAFFIC AND PEDESTRIAN SURVEY DATA SHEET

Traffic Observation Survey

Road: Pom to Lealea_ Location: __Napa Napa Junction__

Day/Date: _____ Surveyor Name: _____

Lane Direction:

 To POM

 From POM

[illegible]

APPENDIX B: STALLHOLDER QUESTIONNAIRE

Stallholder/ Trade Store Questionnaire

Good afternoon/morning. I am conducting a survey for ExxonMobil PNG and would be grateful if you could answer some questions. Before starting we want to be sure that you understand why we are collecting information and that you accept to participating

Your identity, feedback and answers will be kept confidential and you may withdraw at any time if you do not wish to proceed.

Do you agree to participate in this survey? Yes No

A - Setting

A1 Place of Interview A2 Date of Interview//2019

A3 Interviewer

B – Respondent profile

Record the names of interviewees if possible (this is optional).

B1 First Name Last Name

B2 Resident of (village)

B3 Age

B4 Gender

☐☐

Male Female

C – Stall information

C1 Do you own this stall/ store? ☐ Yes ☐ No

C2 If not, who owns it? ☐ Friend ☐ Relative ☐ My Employer

C3 What do you sell at this stall?

REF	Item sold for income	Tick	Sales in past week (Kina)
	Cooked food / cold drinks		K
	Clothing		K
	Consumables (Packaged food, cigarettes, phone card, buai etc)		K
	Other		K
			K

C4 What days do you operate the stall?

Everyday	Mon	Tue	Wed	Thu	Fri	Sat	Sun

C5 What days are best for trading?

Everyday	Mon	Tue	Wed	Thu	Fri	Sat	Sun

Why?

D – Road safety for stallholders

D1 Do you think this market area is safe for vehicles to stop?

☐ Yes

☐ No

If no, why is it unsafe?

D2 Is this market area safe for pedestrians? ☐ Yes

☐ No

If no, why is it unsafe?

D3 How often do you observe pedestrian-vehicle accidents?

☐ Every week

☐ Every couple of weeks

☐ Not very often

E – Environment amenity

E1 What are the main amenity issues at this market area?

- ☐ Dust ☐ Noise ☐ Poor drainage when raining ☐ Vehicle Exhaust fumes
- ☐ Pipia removal

Please share any additional comments.

Thank you for taking the time to fill out our survey. Your input is greatly appreciated.