



Papua LNG Project – Downstream

Environmental Impact Statement

VOLUME 1

Executive Summary

ExxonMobil PNG Antelope Limited

JULY 2023



ExxonMobil





Environmental Impact Statement Executive Summary

Papua LNG Project – Downstream

Environmental Impact Statement – Executive Summary

Report reference: 754-MELEN300733

July 2023

Prepared for	Prepared by
ExxonMobil PNG Antelope Ltd ExxonMobil Haus Jacksons Parade 7 Mile NCD Papua New Guinea	Tetra Tech Coffey Level 11 2 Riverside Quay, Southbank VIC 3006 Australia p: +61 3 9290 7000 ABN 55 139 460 521

Revision	Description	Date	Prepared By	Endorsed	Approver
Rev0	Issued for use	July 2023	<i>Kristen Hall</i> Kristen Hall Tetra Tech Coffey	<i>Gene Weber</i> Gene Weber Sr Project Manager	<i>Fadi Ayache</i> Fadi Ayache SSHE Manager

Restriction on Disclosure and Use of Data

This document has been prepared by Tetra Tech Coffey Pty Ltd (We, Us or Our) at the request of ExxonMobil PNG Antelope Limited (Client). Unless agreed otherwise in writing by Us, this document is for the exclusive benefit of the Client and may only be used for the purpose for which it was commissioned as stated in the contract between the Client and Us. The Client must not disclose any part of this document to a third party without Our prior written consent. No third party may use or rely on this document unless otherwise agreed by Us in writing. We accept no liability or responsibility whatsoever if any part of this document is used or relied on by the Client for any unauthorised purpose or by any unauthorised third party. Unauthorised use of or reliance on this document in any form is prohibited.



Guide to the Environmental Impact Statement

The Papua LNG Project – Downstream Environmental Impact Statement is presented in four volumes.

Volume 1: Executive Summary (in English, Tok Pisin and Motu)

Volume 2: EIS Main Report

The Project	Chapter 1	Introduction
	Chapter 2	Project Description
	Chapter 3	Assessment of Project Alternatives
	Chapter 4	Legal, Administrative and Planning Framework
	Chapter 5	Overview of Impact Assessment Method
	Chapter 6	Stakeholder Engagement
Existing Environment	Chapter 7	Receiving Environment: Onshore
	Chapter 8	Receiving Environment: Marine
	Chapter 9	Social Environment
	Chapter 10	Cultural Heritage Environment
Impact Assessment and Mitigation	Chapter 11	Environmental Impact Assessment: Onshore
	Chapter 12	Environmental Impact Assessment: Marine
	Chapter 13	Social and Cultural Impact Assessment
	Chapter 14	Cumulative Impact Assessment
	Chapter 15	Greenhouse Gases and Climate Change
	Chapter 16	Waste Management
	Chapter 17	Environmental Hazard and Risk Management
	Chapter 18	Environmental and Social Management, Monitoring and Reporting
Resources	Chapter 19	Glossary
	Chapter 20	Bibliography
	Chapter 21	Study Team

Volume 3: EIS Attachments

Attachment	Name
1	Reconciliation with relevant Independent State of Papua New Guinea Guidelines and CEPA-approved Environmental Inception Report
2	ExxonMobil Operations Integrity Management System
3	Management measures register

Volume 4: EIS Appendices

Part	Appendix	Name
1	A	Cultural Heritage Impact Assessment
	B	Community Health Baseline
	C	Social Baseline
	D	Traffic and Land Use
2	E	Nearshore Marine Baseline
3	F	Greenhouse Gas Assessment
	G	Noise Impact Assessment
	H	Groundwater Baseline
	I	Flood Assessment
	J	Air Quality Assessment
	K	LNG Plant Weed Survey
	L	Caution Bay Fisheries Resource Use Study

Contents

1. INTRODUCTION	1
1.1 Overview	1
1.2 Project proponent	1
1.3 Purpose of the EIS	3
2. DESCRIPTION OF THE PROPOSED DEVELOPMENT	5
2.1 Project overview	5
2.2 Project objectives and justification	6
2.3 Development timeline	7
2.4 Assessment of alternative development options	7
3. PROJECT SETTING	9
3.1 Receiving environment: LNG Plant	9
3.2 Receiving environment: Marine	12
3.3 Social environment	14
3.4 Cultural environment	16
4. STAKEHOLDER ENGAGEMENT	19
4.1 Overview	19
4.2 Requirements	19
4.3 Engagement plan	20
4.4 Activities	20
4.5 Grievance redress mechanism	20
5. IMPACT ASSESSMENT	23
5.1 Environmental impact assessment	23
5.2 Social impact assessment	28
5.3 Cultural heritage impact assessment	29
5.4 Cumulative impact assessment	30
5.5 Greenhouse gases and climate change	32
5.6 Waste management	33



6. ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING 35

6.1	Overview	35
6.2	Environmental and social management plan	35
6.3	Monitoring	37
6.4	Reporting	37
6.5	Assessment and audit	37

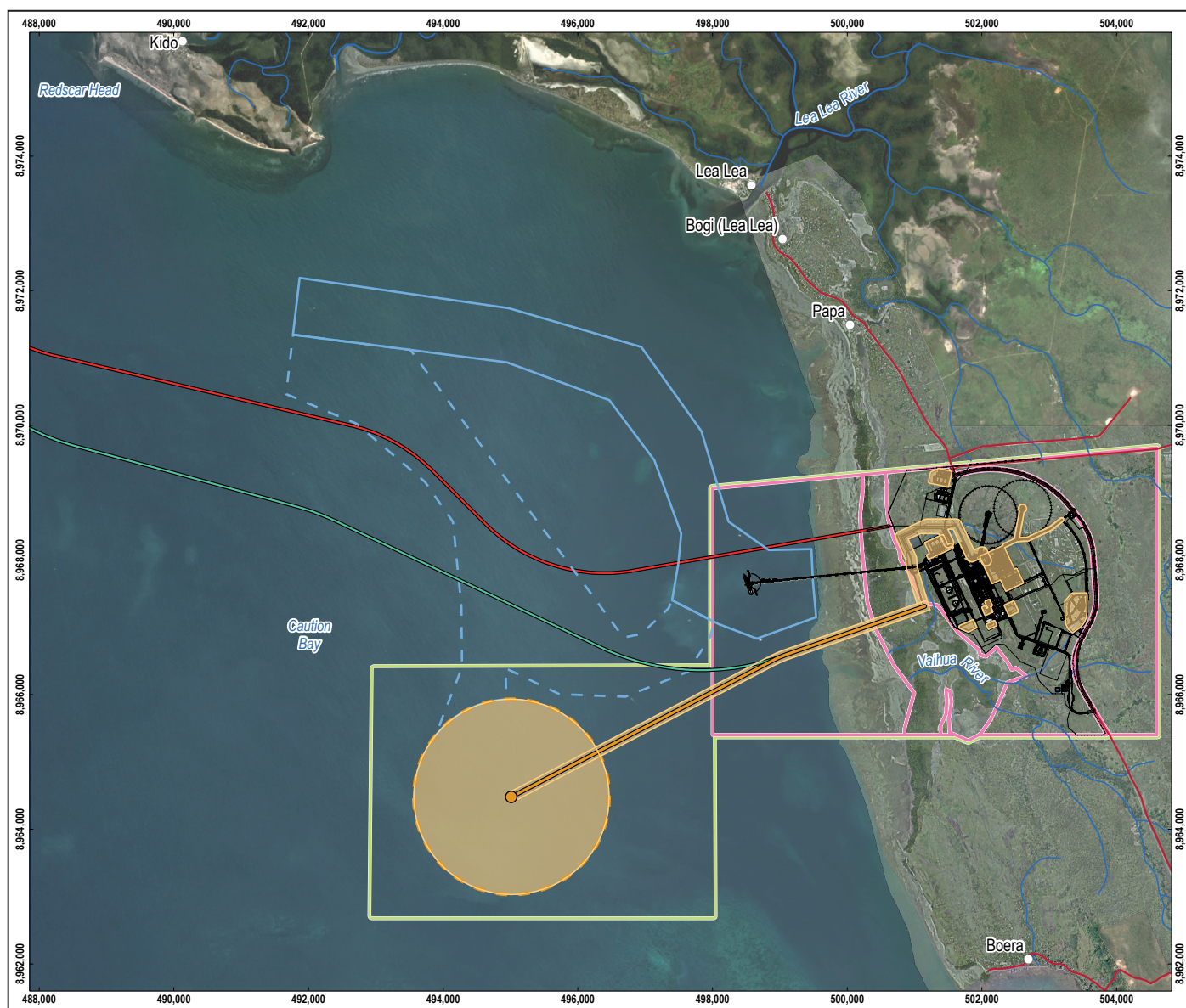
7. FURTHER INFORMATION AND SUBMISSIONS 39

LIST OF TABLES

Table ES1	Summary of separation of responsibilities for the Papua LNG Project	3
Table ES2	Predicted Scope 1 GHG emissions for the Integrated LNG Plant	32

LIST OF FIGURES

Figure ES1	Papua LNG Project – Downstream location	vi
Figure ES2	Proposed onshore facilities for the Project	2
Figure ES3	Indicative development timeline	7
Figure ES4	Terrestrial biodiversity study area and habitat classification, and fauna survey transects (April 2008)	10
Figure ES5	Catchments at the LNG Plant and surrounds	11
Figure ES6	Caution Bay marine habitat map	13
Figure ES7	LNG Plant social study area	15
Figure ES8	Construction noise contours, prevailing weather conditions	25
Figure ES9	Location of credible projects	31
Figure ES10	Project Environmental and Social Management System framework overview	36



LEGEND

- Village
- Road
- Watercourse
- PNG LNG pipeline
- Proposed Papua LNG pipelines route
- Existing and proposed plant layout

- PPFL2 boundary
- APPFL boundary
- Current navigational channel
- Proposed navigational channel
- Proposed new and upgraded facility

- Proposed CALM buoy components
- CALM buoy
- Naphtha and condensate pipelines
- CALM buoy navigational area



0 1 2 km
PROJECTION: WGS 1984 UTM Zone 55S

SOURCE
Infrastructure, roads, watercourses and lease boundary
from EMPNGA.
Imagery from EMPNGA and Planet Labs.

Figure ES1 Papua LNG Project – Downstream location





1. Introduction



1.1 Overview

1.1.1 Background

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. PNG LNG production operations commenced in 2014. PNG LNG facilities include gas production and processing facilities, onshore and offshore pipelines, and liquefaction facilities. The PNG LNG Project has the capacity to produce over 8 million tonnes of LNG each year, with the LNG shipped to customers in Asia. The PNG LNG Project's existing facilities for liquefaction of natural gas are called the "LNG Plant"¹, and are located in Caution Bay (Central Province), approximately 20 km north-west of Port Moresby (Figure ES1).

1.1.2 Papua LNG Project overview

The Papua LNG Project now proposes to build on and increase the capacity of the existing LNG Plant to process hydrocarbons supplied from the Elk and Antelope reservoirs in Petroleum Retention Licence 15 (PRL 15) in Kikori District (Gulf Province). Combined, the development of the Elk and Antelope gas reservoirs and the associated expansion of the LNG Plant is called the Papua LNG Project. **This Environmental Impact Statement (EIS) describes and assesses the expansion of the LNG Plant's existing onshore and marine facilities in Caution Bay. This is referred to as the 'Papua LNG Project – Downstream' or 'the Project'.**

The Project will construct gas treatment facilities and new liquefaction trains at the existing LNG Plant site adjacent to the existing PNG LNG liquefaction Trains 1 and 2 as shown in Figure ES2. The treatment facilities will remove water, heavy hydrocarbons, and other contaminants from the upstream feed gas, after which the treated gas will be sent to the existing trains and the new trains for liquefaction. Marine facilities include installation of an offshore catenary anchor leg mooring (CALM) buoy.

The new LNG processing trains will expand the capacity of the LNG Plant by approximately 4 million tonnes per annum (mtpa) stream day capacity (SDC), while also providing gas to utilise up to 2 mtpa of latent capacity of the existing LNG trains. This expansion will bring the total capacity of the integrated LNG Plant to approximately 12.8 mtpa SDC.

The development of the Elk and Antelope gas reservoirs and associated activities are referred to as the Papua LNG Project – Upstream with the environmental and social aspects of this addressed in a separate Papua LNG Project – Upstream EIS.

1.2 Project proponent

The Papua LNG Project is a gas development project for the Papua LNG Project Joint Venture participants, which at the date of this EIS 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.²

¹ Also referred to as "the existing LNG Plant", where required for clarity.

² JX Nippon Oil and Gas Exploration Pty Ltd became a Papua LNG Project Joint Venture participant on 6 July 2023. Some documents associated with this EIS, such as technical appendices, were completed before this date. Consequently, the list of Papua LNG Project Joint Venture participants in some EIS documents may not include JX Nippon Oil and Gas Exploration Pty Ltd.

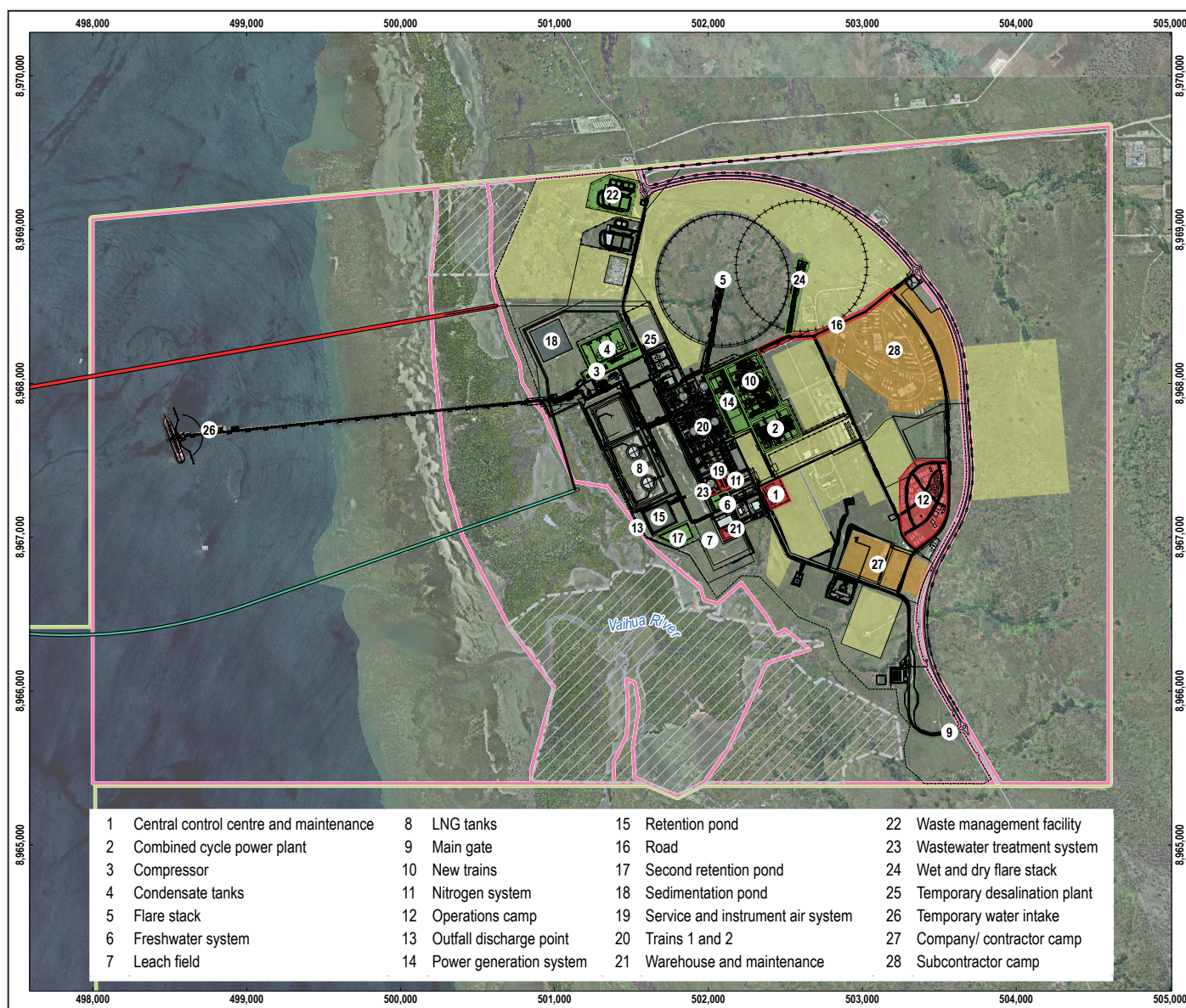


Figure ES2 Proposed onshore facilities for the Project

Table ES1 Summary of separation of responsibilities for the Papua LNG Project

Aspect	Construction	Operations
Upstream Facilities ▪ Wellpads, Central Processing Facility, etc.	TotalEnergies	TotalEnergies
Midstream Facilities ▪ Feed gas and field condensate pipelines	TotalEnergies	TotalEnergies
Caution Bay Marine Facilities ▪ CALM Buoy	EMPNGA	NLOC
Caution Bay Marine Facilities ▪ Export condensate pipelines* and PLEM	TotalEnergies	NLOC
LNG Plant expansion and onshore pipeline construction	EMPNGA	NLOC (integrated LNG Plant)

*TotalEnergies will be responsible for construction up to the designated scope break

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. For the purposes of this EIS, references to 'ExxonMobil' refers to EMPNGA or NLOC, or both, as the case requires. Nothing in this EIS is intended to override the corporate separateness of any entity.

EMPNG has developed and operated the PNG LNG Project since 2009, with the first liquefied natural gas (LNG) export in May 2014.

Table ES1 summarises the separation of responsibilities for the Papua LNG Project.

EMPNGA and NLOC are committed to developing and operating the Project to meet the environmental and social performance standards of the existing PNG LNG Project, as well as the standards and requirements applicable to the Papua LNG Project.

1.3 Purpose of the EIS

This EIS has been prepared as the statutory basis for the environmental and social assessment of the Project under the *Environment Act 2000*. The assessment will inform a decision from the Papua New Guinea Environment Council and Minister for Environment and Conservation on whether this Project should proceed and, if so, under what conditions. The existing LNG Plant has a current petroleum processing facility licence, and environment permit EP-L3(210). The Project will require a separate petroleum processing facility licence for its activities. EMPNGA has applied for

an Environment Permit for the Papua LNG Project – Downstream. The scope of EMPNG's EP-L3(210) will be appropriately amended to facilitate operations at the integrated LNG Plant by ExxonMobil.

The EIS consists of the following parts:

- The **EIS Executive Summary** (this report).
A non-technical summary of the proposed development, the Project's setting, the main findings of the impact assessment process, stakeholder engagement and how stakeholders can view and comment on the EIS.
- The **EIS Main Report** (chapters 1 through 21).
A detailed description of the Project, regulatory context, statement of the findings of technical studies including potential physical, biological, social, and cultural impacts of the Project, the management measures to be implemented and residual impacts and benefits. Stakeholder engagement and consultation activities are also discussed.
- **Technical studies** (appendices A to L).
Appendices to the EIS include various technical studies conducted to characterise the existing environmental, social, and cultural heritage values, and where relevant, assist with identifying the potential impacts of the Project.

The EIS provides more detailed information than presented in this Executive Summary. The EIS has been prepared with reference to the approved Environmental Inception Report and the Department of Environment and Conservation (now known as CEPA) Information Guideline (GL-Env/02/2004) for Conduct of Environmental Impact Assessment and Preparation of Environmental Impact Statement.



2. Description of the Proposed Development

2.1 Project overview

An overview of the Papua LNG Project activities and facilities relevant to the EIS is provided below. This has been separated into those aspects associated with the Project and therefore the subject of this EIS, and those aspects associated with the Papua LNG Project – Upstream, which are outside the scope of this EIS.

2.1.1 Papua LNG Project – Downstream (this EIS)

The Project will construct gas treatment facilities and new liquefaction trains at the existing LNG Plant (Plate ES1), adjacent to the existing liquefaction Trains 1 and 2 (Plate ES2). The treatment facilities will remove water, heavy hydrocarbons, and other contaminants from the upstream feed gas, after which the treated gas will be sent to the existing trains and the new trains for liquefaction.

The main products produced by the Project are LNG and naphtha. Naphtha is a colourless, volatile liquid distilled and fractionated from LNG. Naphtha recovered from the inlet treating system will be blended with the Papua LNG field condensate and stored in new storage tanks.

A catenary anchor leg mooring (CALM) buoy will be designed, constructed, and operated as part of the Project. The CALM buoy will delink the non-LNG liquids (naphtha and condensate) from LNG offloading at the existing berth. Establishment of the CALM buoy will require a new navigation channel and marine exclusion zones. The CALM buoy will require a pipeline end manifold (PLEM) and approximately 7 km of subsea export pipeline(s) for the naphtha and condensate that will be constructed as part of the Upstream component (see Section 2.1.2), though these pipelines will be operated as part of the Project operations and, as such, the operation of



Plate ES1
LNG Plant site facilities,
facing northeast



Plate ES2
LNG Plant site with LNG
tanks, facing north

the PLEM and export pipelines is assessed in this EIS. For the landfall portion of the export pipelines, these pipelines will be co-located with the Papua LNG feed gas pipelines and installed within the same onshore trench.

The LNG, via the existing berth, and the naphtha and condensate, via the CALM buoy, will be exported by ship to international markets.

Existing as well as new facilities and infrastructure will be required to support the operation of the new liquefaction trains. The shared facilities will be common to existing and new liquefaction trains and will use the available capacity of the existing LNG Plant systems with some modifications and upgrades to provide expanded capacity where required. New facilities will be required for the operation of the new liquefaction trains such as an integrated fuel gas system and wet and dry flare systems.



Temporary facilities required during construction include laydown areas, offices, workshops, a temporary desalination facility and concrete batching plants. These facilities will be located within the existing LNG Plant lease boundaries.

Most construction material will be imported by ship via Motukea Port and trucked to site along the Lea Lea Road. The road may require repairs or upgrade, including relocation of overhead cables, to accommodate transport of large modules. Transport of construction and operations personnel from Port Moresby will also occur along this road.

Commissioning activities will be required to test the modified shared facilities and new facilities at the integrated LNG Plant. During operation, the monitoring, inspection, and maintenance procedures are expected to be similar to those in place at the existing LNG Plant.

The Project facilities described in this EIS are subject to further refinement and optimisation during the front-end engineering and design (FEED) process currently being undertaken, as well as during detailed design and construction. CEPA will be advised if changes during this process materially adversely affect the impacts currently described in this EIS.

2.1.2 Papua LNG Project – Upstream (outside the scope of this EIS)

Separate to this EIS, the Papua LNG Project – Upstream development will comprise activities and facilities in the offshore and onshore environment of Caution Bay (and elsewhere). Their impacts and management are included in the scope of the Papua LNG Project – Upstream EIS process; they are outlined below for context but are outside the scope of this EIS.

Two new feed gas pipelines (referred to as the ‘Papua LNG pipelines’), one each for gas and condensate, will be installed as part of the Upstream component of the Papua LNG Project. The Papua LNG pipelines are to be located on the southern side of the existing LNG Plant jetty and traverse the existing LNG Plant lease boundaries. In addition to the Papua LNG pipelines, two additional export pipelines will also be constructed, along with the PLEM as part of the Upstream component. The new export pipelines will convey naphtha and condensate from the LNG Plant to the CALM buoy outlined in Section 2.1.1.

The Papua LNG pipelines and the export pipelines will share the same corridor for shore crossing, which is being addressed as part of the Upstream EIS. The current design has the export pipelines in one trench and the feed gas pipeline in another trench from the start of the shore crossing to the landfill. Once onshore, all pipelines will be placed in single trench.

Further detail regarding the Upstream development is provided in the Papua LNG Project – Upstream EIS.

2.2 Project objectives and justification

The objectives of the Project are to:

- Expand the processing and export capacity of the LNG Plant to process hydrocarbons from the Elk and Antelope reservoirs through leveraging latent capacity and constructing new facilities and infrastructure.
- Minimise the Project’s impacts on the environment and affected communities by largely constructing and operating the onshore portion of the Project within the existing LNG Plant footprint, in accordance with applicable government requirements and good industry practice, building on EMPNG’s legacy of excellence in environmental and regulatory performance in Papua New Guinea.
- Enhance existing economic and associated social benefits from the LNG Plant to the Independent State of Papua New Guinea and landowners, through the financial as well as national content and social investment contributions by the Project to the State, local businesses, and communities in the Project area.

Demand for natural gas continues to rise in the Asia-Pacific (and Papua New Guinea) domestic markets. Asia-Pacific countries are increasing the proportion of natural gas in their energy portfolios and the LNG generated from the new liquefaction trains will assist with meeting this demand. The Project will create further benefits for Papua New Guineans, including in the form of:

- Local business development opportunities through supply of equipment and materials required for construction and operation of the integrated LNG Plant.
- Employment and training opportunities for Papua New Guineans.

The Project will add to the substantial benefits resulting from the development of the PNG LNG Project, including extending the longevity of the LNG Plant.

Papua New Guinea promotes the development of its mineral resources through various policies to encourage investment. The government prioritises benefits to Papua New Guineans from the development of the country's resources. The development of the Project is consistent with the Constitution which includes national goals and directives that outline the aspirations and principles for the development of the nation.

2.3 Development timeline

Construction for the Project is expected to occur between 2024 to 2028. The indicative development timeline, subject to a final investment decision (FID), is presented in Figure ES3.

2.4 Assessment of alternative development options

This Project has assessed a range of alternatives for increasing the current capacity of the LNG Plant through commercialisation of gas supplied

from the Elk and Antelope reservoirs. The main alternative development options considered were marine facilities, onshore pipelines, logistics routes, LNG processing technology, equipment optimisation and water sources.

The alternative development options for the Project were assessed against primary constraints that would impact their implementation and feasibility. Aspects considered included economic, physical, environmental and social constraints.

Because the Project is a relatively modest expansion to the existing LNG Plant and because it will mainly use existing disturbed areas, the environmental and social impacts of the Project are expected to be limited and significantly less than those which would occur with a new development. They are expected to be incremental to the environmental and social impacts from the PNG LNG Project to date. The combination of construction of the offshore facilities for the Papua LNG Project will further reduce the combined environmental and social impacts of the Papua LNG Project in Caution Bay compared to having two separate projects constructing separate facilities in the same location.

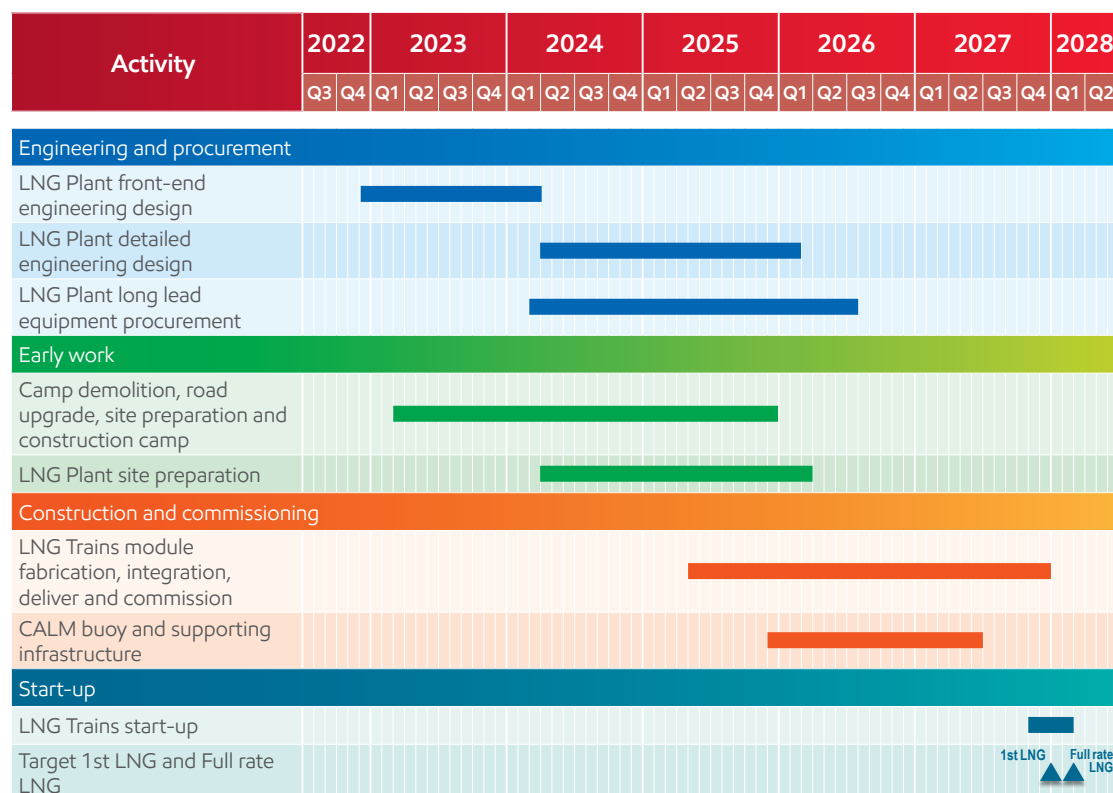


Figure ES3 Indicative development timeline





3. Project setting

The Project intends to expand the capacity of the existing LNG Plant near Port Moresby. As such, the Project's environmental, social, and cultural aspects onshore are set within a 'brownfield' context, in addition to the 'greenfield' context of the expanded marine facilities.

3.1 Receiving environment: LNG Plant

Baseline investigations were undertaken before the construction of the existing LNG Plant to support the PNG LNG Project EIS. Onshore investigations for the PNG LNG Project EIS included a number of studies including soils and landforms, groundwater, hydrology and sediment transport, water and sediment quality, air, noise, terrestrial biodiversity and aquatic fauna.

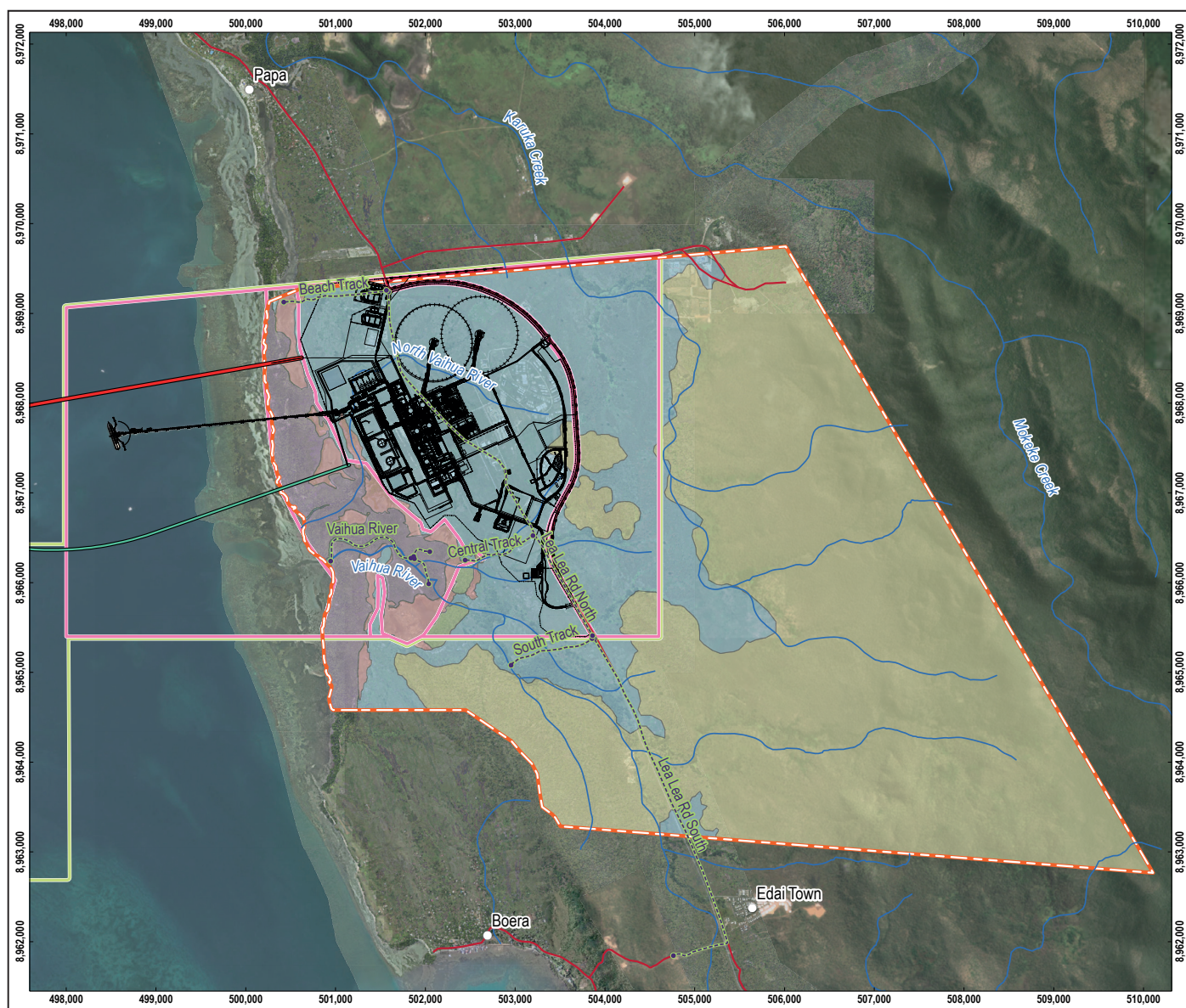
In 2019 and 2022, additional studies for groundwater, hydrology (flood modelling), air and noise were undertaken to inform the preparation of the Project EIS and supplement the baseline data that was collected for the PNG LNG Project.

The onshore baseline environment for the Project is a disturbed area as a result of the construction and operation of the existing LNG Plant and associated facilities. The existing LNG Plant and associated facilities are a predominant feature of the landscape. The landform around the LNG Plant is a coastal plain with low hills of predominantly savanna and grassland, sloping gently seaward. This area was largely cleared of vegetation in the early 20th century for agricultural purposes. Construction of the LNG Plant was completed in 2014, including land clearing within the Project footprint. Most of the area adjacent to the LNG Plant remains substantially modified due to frequent grassfires that occur during the dry season, restricting the recovery of naturally occurring eucalypt woodland.

A coastal strip of mangroves exists on the shoreline, which includes beach ridges that support forest patches and grassland. Behind the mangroves (inland) and beach ridges, there are open mudflats that receive intermittent tidal inundation during spring high tides via the Vaihua River and tidal creeks. When not inundated, the mudflats become dried and are called salt flats. Behind the swamps and mudflats, the land rises gently into savanna grassland vegetation that has been invaded by patches of weeds. Further inland, open eucalypt-melaleuca woodland occurs on low-lying hills, and patches of riparian forest and grassland occupy riverine areas. The estuarine, fresh water and terrestrial habitat of the Vaihua River provide seasonal habitat for various waterbirds, including migratory shorebirds. The estuaries support a higher abundance and diversity of aquatic fauna than any other habitat on the LNG Plant site. Habitat classification is shown in Figure ES4, as well as the terrestrial biodiversity study area for the PNG LNG Project EIS.

The LNG Plant area is located across three main catchments comprising the Vaihua River, the North Vaihua River and the Karuka Creek, and a minor coastal catchment (Figure ES5). Routine water quality monitoring of process water on the LNG Plant as well as at the Vaihua River (within the estuarine zone) and stormwater channels within the LNG Plant during operations has shown that LNG Plant site discharges comply with water quality goals and the requirements of the environment permit.

The main groundwater resources in the vicinity of the LNG Plant are associated with alluvial deposits of the coastal plain (clayey and silty, sand and gravels). Alluvial aquifers hosted by these sediments are 5 m to 15 m thick and are typically overlain by 5 m to 10 m of low permeability clayey sediments.



LEGEND

- Village
- Fauna survey transect
- Road
- Watercourse
- PNG LNG pipeline
- Proposed Papua LNG pipelines route
- Existing and proposed plant layout
- PPFL2 boundary
- APPFL boundary
- Terrestrial Biodiversity Study Area

Biodiversity habitat classification

- Grassland/open woodland
- Grassland (rocky)
- Mangrove
- Mudflat/saltflat
- River
- Savanna

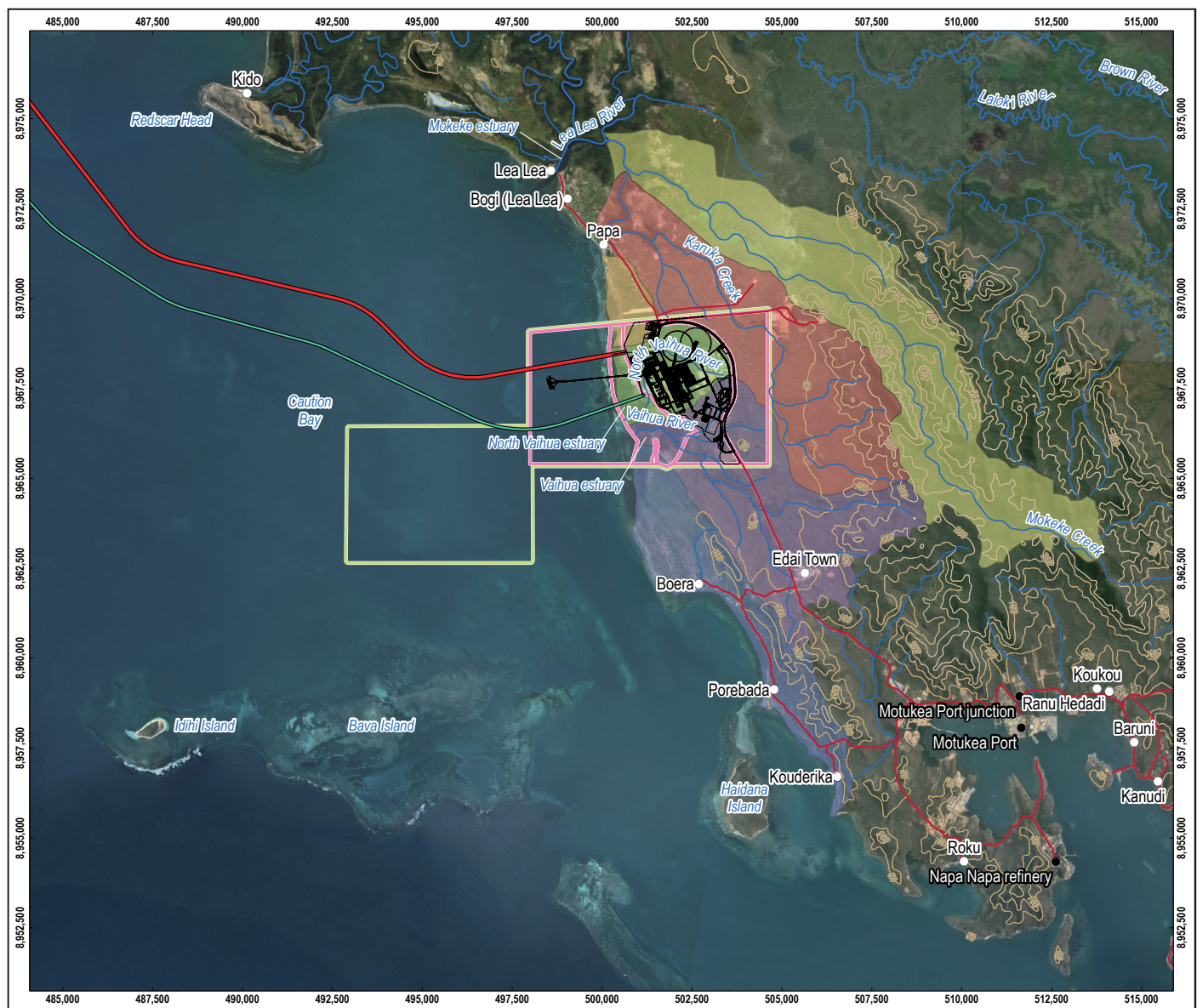


0 0.5 1 km
PROJECTION: WGS 1984 UTM Zone 55S

SOURCE
Survey transects, habitat classification, study area,
infrastructure and lease boundary from EMPNGA.
Imagery from EMPNGA and Planet Labs.

Figure ES4 Terrestrial biodiversity study area and habitat classification, and fauna survey transects (April 2008)





LEGEND

- Village
 - Point of interest
 - Road
 - Watercourse
 - Contour (50 m interval)
 - PNG LNG pipeline
 - Proposed Papua LNG pipelines route
 - Existing and proposed plant layout
 - PPFL2 boundary
 - APPFL boundary
- | Catchment area | |
|----------------|------------------------------------|
| Red | Karuka Creek catchment |
| Yellow | Moreke Creek catchment |
| Green | North Vaihua River catchment |
| Purple | Vaihua River catchment |
| Orange | Minor coastal catchment |
| Blue | Series of minor coastal catchments |



0 1 2 km
PROJECTION: WGS 1984 UTM Zone 55S

SOURCE
Catchments, contours, infrastructure, roads, watercourses and
lease boundary from EMPNGA.
Imagery from ArcGIS Online and Planet Labs.

Figure ES5 Catchments at the LNG Plant and surrounds



The existing LNG Plant operations, the Port Moresby Power Station (NiuPower) and the Dirio Central Province Power Station are the main existing sources of local air emissions. Other sources of air emissions in the area include domestic and agricultural activities carried out in the villages surrounding the LNG Plant (Lea Lea, Papa, Boera and Porebada), as well as traffic related emissions from the roads that service them.

Noise monitoring at the nearest sensitive receptors in 2019 did not detect noise emitted by the existing normal operation of the LNG Plant. Results from operator-attended baseline noise surveys indicated that the noise sources at all monitoring locations were similar in character, with the main noise sources being of natural origin, such as wind in foliage, insects, birds, and people talking. Vehicle movements also accounted for a large portion of noise generation.

3.2 Receiving environment: Marine

Nearshore marine baseline studies completed for the EIS indicate that environmental conditions in Caution Bay in the vicinity of the Project marine infrastructure appear similar to those observed during previous studies conducted for the PNG LNG Project, and that the general composition and distribution of observed subtidal habitats and associated ecological communities is largely defined in relation to water depth and distance from shore (Figure ES6).

The mangrove species observed during field surveys adjacent to the LNG Plant are commonly recorded elsewhere in Papua New Guinea and neighbouring countries, with most survey transects indicating healthy mangrove communities typical of Australasian and southeast Asian bioregions. Localised mangrove dieback has been observed in various areas in the vicinity of the LNG Plant over time, including adjacent and downstream of the LNG Plant retention pond mixing pit, as well as to the south of the LNG Plant jetty and LNG Plant pipeline disturbance areas. Change analysis has indicated that mangrove coverage increased within the LNG Plant retention pond discharge areas from 2010 to 2022, primarily attributable to an increase in *Avicennia marina* density, a species suited to frequent tidal inundation, and associated with outflows from the LNG Plant retention pond influencing hydrodynamic conditions. The mangrove species observed to be the most affected by dieback are the yellow mangrove and Indian mangrove (*Ceriops* spp.), that primarily inhabit the landward edge of the mangrove habitat.

Where present, seagrass communities are typically well-established. Substantial meadows of *Sargassum* (a brown seaweed) and turf algal cover on much of the rocky and rubble substrates adjacent the fringing reef, the proliferation of which may have resulted from prior habitat disturbance, and subsequently contributed to the present context where a relatively low abundance and diversity of fish and live corals occur in most locations.

Due to various natural and historical influences, habitat surveys in the vicinity of the LNG Plant indicate that the area does not presently support high levels of coral and fish biodiversity. Natural sedimentation due to the presence of nearby riverine habitats such as the Vaihua River and Lea Lea River, influences reef development in some parts of Caution Bay. Overall, fringing reef habitat and associated coral growth has generally been observed in a variable but typically degraded state. Large and established corals are primarily present in the Project study area colonies, rather than as part of large tracts of reef habitat. Coral recovery from prior disturbances is apparent in some locations. The existing coral taxa in Caution Bay are likely to comprise species that are widely distributed across the Indo-Pacific.

Beyond the fringing reef crest, substrates are largely homogeneous and comprise soft sediments and silt of low complexity and habitat value that support a variable benthic infauna, with patch reefs and isolated bommies existing sporadically amidst the soft-sediment seafloor that occasionally support well-established coral communities including hard and soft corals, and typical reef fish fauna.

Aggregations of large fish, marine mammals or other marine megafauna have not been observed during field surveys in Caution Bay or documented in literature. Marine megafauna in Caution Bay is primarily transient, rather than resident, with no indications of favoured nesting, breeding, or feeding locations recorded in the vicinity of the LNG Plant for the species that have been observed such as dolphins.

Sediment and water quality analysis indicates that contamination has largely not been detected from 2009 to 2022, and most results do not exceed applicable regulations and criteria. Where exceedances have occurred, these are primarily due to the natural variation and occurrence of various metals and metalloids in the environment.

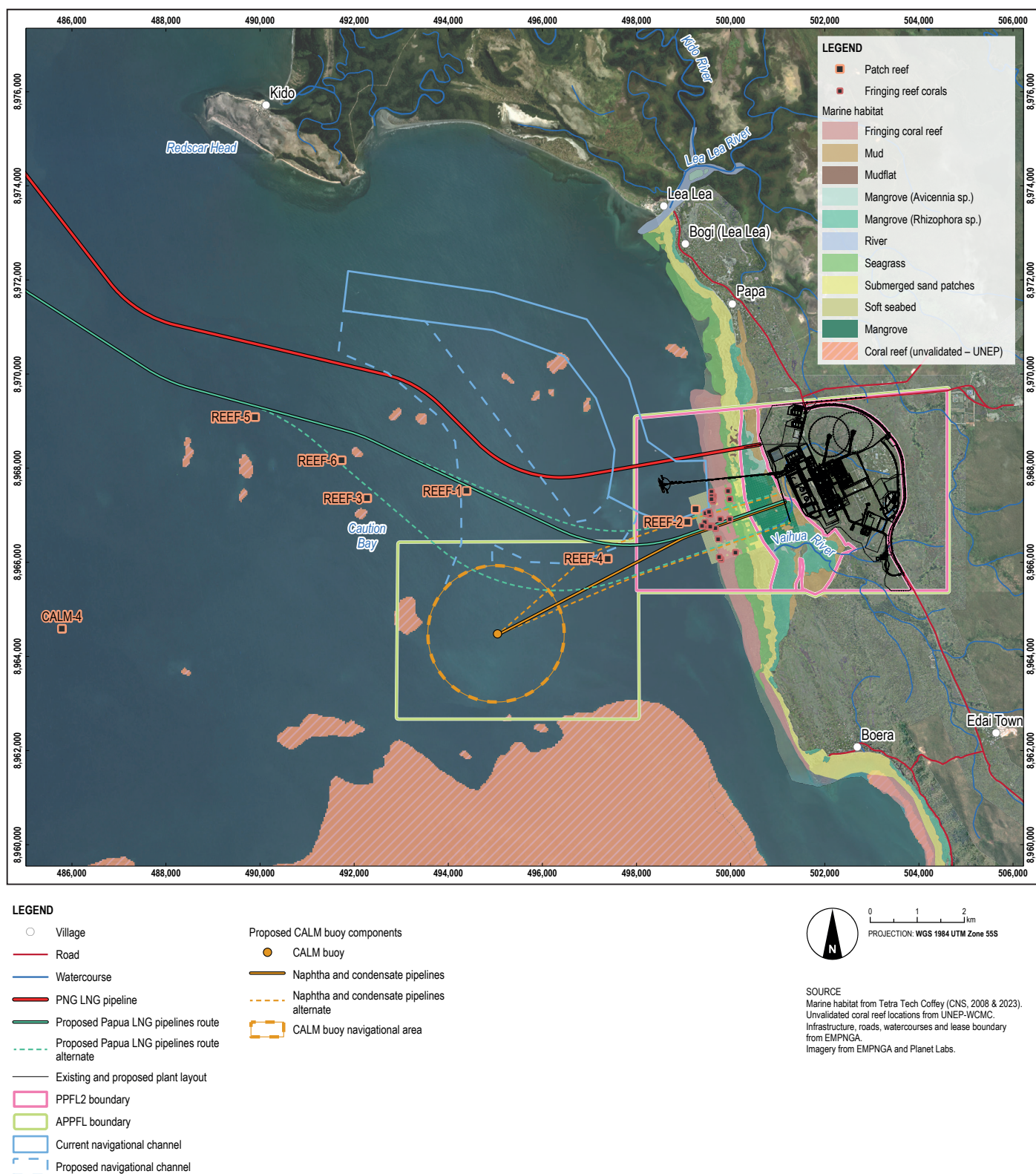


Figure ES6 Caution Bay marine habitat map



3.3 Social environment

The LNG Plant social study area (Figure ES7) includes land, infrastructure and communities expected to experience change from the construction and operation of the Project. The study area begins at the north-western boundary of the National Capital District and extends north into Central Province to Lea Lea village. The eastern boundary of the study area is located 3 km inland from the LNG Plant and extends to the west to encompass Caution Bay. Landowner villages in the study area include Porebada, Boera, Papa and Lea Lea. The study area also includes Edai Town, a gated community located approximately 3 km east of Boera.

The principal elements supporting livelihoods in the LNG Plant study area are subsistence resource use, human resources (or labour) and hard and soft infrastructure and services supporting engagement in marketing activity. Most of the study area residents rely (not exclusively) on the harvest of natural resources for their livelihood. Marine resources are relied upon but are under pressure from lack of resource management and, according to household surveys in 2019, there is a perception within the fishing community that the existing marine project infrastructure (e.g., LNG Plant jetty) is attracting fish to an area that cannot be targeted by fishers due to the safety exclusion zone and therefore increasing the required fishing effort to maintain catch levels, and potentially reducing fish stocks in other areas.

Traditional use of land and other terrestrial resources, particularly subsistence gardening, is important to LNG Plant study area residents. The main constraints to gardening staples or vegetables are poor soil fertility, lack of water during Port Moresby's dry seasons and limited time availability, which is indicative of households where wage employment has become the main livelihood activity. Poor soil and lack of water are well-known characteristics of the Motu coastal villages and being time-poor is a characteristic of the transition from a subsistence to a peri-urban economy.

The study area's proximity to industrial areas (e.g., LNG Plant, Motukea Port and Napa Napa Refinery) and the city of Port Moresby provides opportunities for formal employment. However, less than half of surveyed households in LNG Plant communities receive income from wage employment. The sale of natural resources (i.e., fish and garden produce), along with the sale of general goods (e.g., baked goods, cigarettes, betelnut) is a key livelihood strategy.

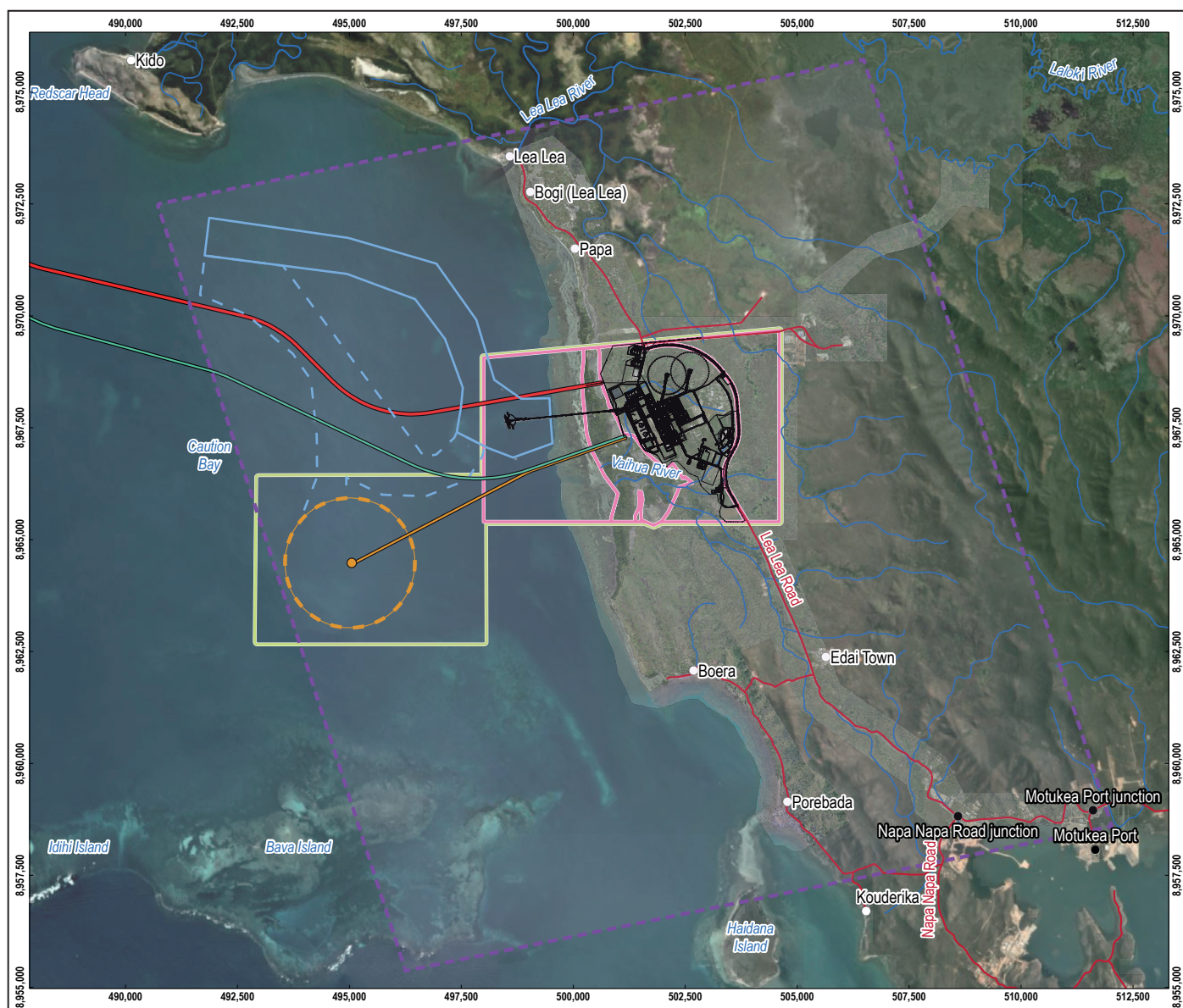
There is an ongoing cultural transition occurring in the study area as the local communities become increasingly urbanised and transition to a modern outlook. This cultural transition is driven by several factors including, population growth, marriages across groups, land disputes and an increase in wage employment. Elements of traditional activities, such as fishing and gardening, still occur in the study area; however, increasing reliance on wage income and store-bought foods is likely to diminish the importance of these traditional means of livelihood support.

The existing infrastructure and services within the LNG Plant study area are moderately supportive of personal and family health, safety, and security, although it is noted that there shortfalls remain in capacity. Formal law and order services and facilities in the LNG Plant study area are limited.

The provision of educational services in the LNG Plant study area is limited due to a lack of facility maintenance and shortages of teachers. Attendance, condition, and resources vary for each facility. The PNG LNG Project recently funded the construction of additional classrooms, the refurbishment of existing facilities and donated desks and chairs. There are five health facilities located across the LNG Plant study area although the health services and facilities are limited, with the condition of existing facilities being generally poor and lacking in basic equipment and resources. There is also no functioning emergency medical response system across the study area.

Five social values were identified for the Project and were grouped into three overarching themes:

- **Livelihood:**
 - Social value 1: the capacity to support livelihoods based on the harvest of natural resources.
 - Social value 2: availability of opportunities for participation in the cash economy.
- **Culture:**
 - Social value 3: the ability to sustain cultural identity and traditions.
- **Personal and community well-being:**
 - Social value 4: an environment supportive of personal, family and community health, safety, security, and social wellbeing.
 - Social value 5: the availability of services and institutions supportive to community wellbeing.



LEGEND

- Village
- Point of interest
- Road
- Watercourse
- PNG LNG pipeline
- Proposed Papua LNG pipelines route
- Existing and proposed plant layout

- PPFL2 boundary
- APPFL boundary
- Current navigational channel
- Proposed navigational channel
- LNG Plant study area

- Proposed CALM buoy components
- CALM buoy
- Naphtha and condensate pipelines
- CALM buoy navigational area



0 1 2 km
PROJECTION: WGS 1984 UTM Zone 55S

SOURCE
Study area from Tetra Tech Coffey.
Infrastructure, roads, watercourses and lease boundary
from EMPNGA.
Imagery from EMPNGA and Planet Labs.

Figure ES7 LNG Plant social study area



3.4 Cultural environment

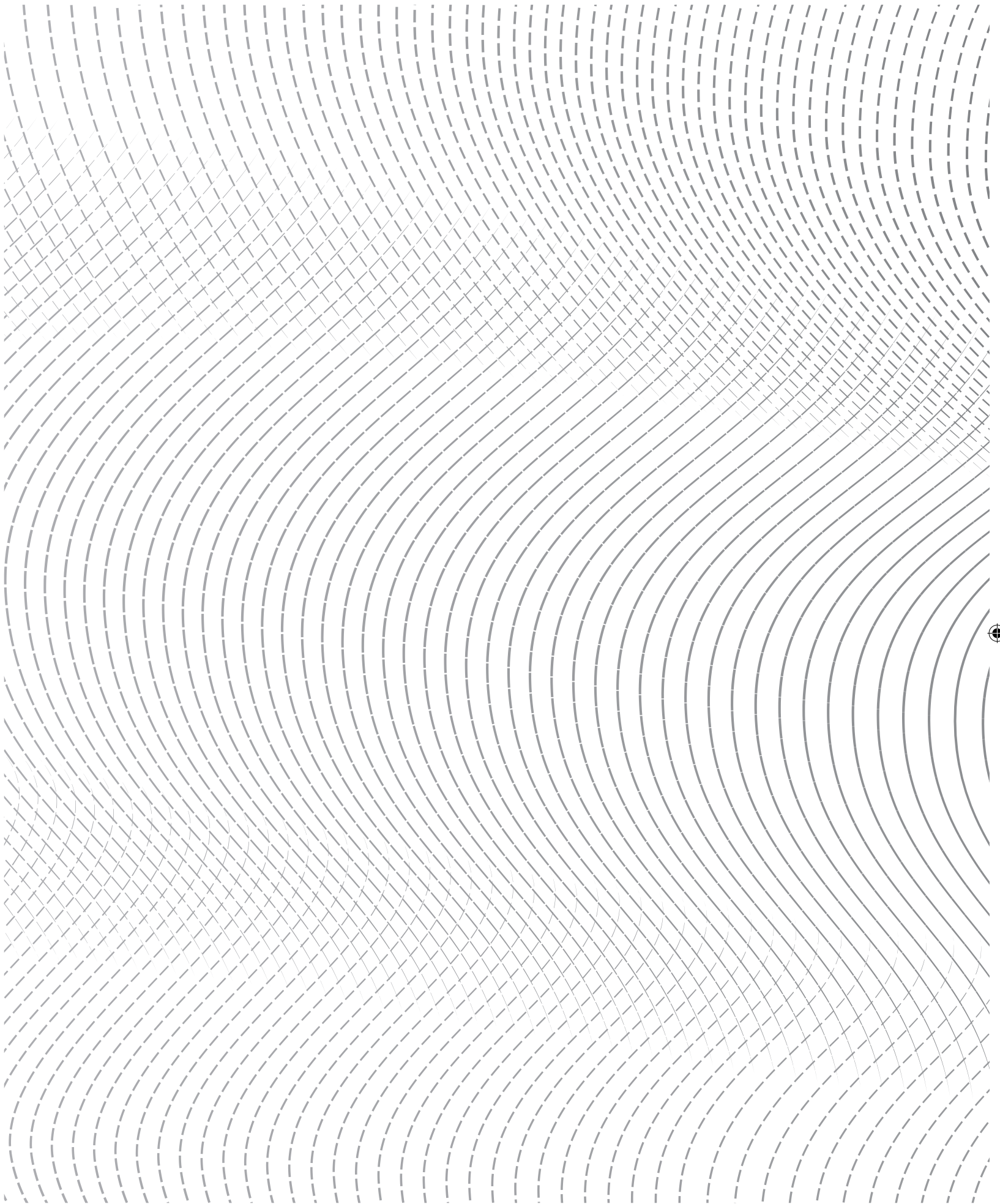
The four closest villages to the LNG plant consist of two cultural groups: the Motu and the Koita (also known as the Koitabu by the Motu). These two groups are categorised as:

- Porebada: Western Motu.
- Boera: Motu (more closely linked to Western Motu than Eastern Motu).
- Papa: Koita.
- Lea Lea: Western Motu.

Extensive cultural heritage surveys and salvage investigations have previously been undertaken from 2009 to 2013 within and along the boundary and bypass road prior to and during the construction of the LNG Plant. The original cultural heritage assessment completed for the PNG LNG Project EIS identified cultural heritage types as present or likely to be present within or near the LNG Plant site, including oral tradition sites, and archaeological sites pre- and post-contact. Seven of these previously recorded sites are located within the laydown area, outside of the security fence. The remaining 244 of the previously recorded sites located within the existing LNG Plant were managed during construction of the LNG Plant in 2010 to 2012 in accordance with the approved PNG LNG Cultural Heritage Management Plan.

Cultural material recorded in an additional field survey in the proposed eastern laydown area for the Project in 2019 included plain and decorated pottery fragments, flaked stone artefacts, and whole shells and shell fragments (including gastropods and bivalves). Culturally worked basalt fragments and a ground-edge basalt axe-adze were also identified. In addition to seven sites previously identified, 81 newly recorded sites are located within the study area. The size and density distributions of newly recorded sites located in the study area were consistent with site size and density distributions recorded in the region (including the study area) during the PNG LNG Project EIS fieldwork program. Of the 81 newly recorded sites identified in the study area during the 2019 field program, 74 (90%) are small low-density sites.

The cultural heritage values identified within the study area included archaeological sites only. No oral tradition sites or other forms of intangible heritage value have been identified in the study area to date. Cultural heritage site types present within the study area include isolated stone, pottery, and shell artefacts, and scatters of stone, pottery and shell in varying combinations. Pottery and shell are the dominant cultural heritage site types represented in the assemblage.







4. Stakeholder engagement

4.1 Overview

There is a strong program of stakeholder engagement activity for the PNG LNG Project. The experiences of the PNG LNG Project offer a unique base of experience from which meaningful lessons learnt can be used to guide future and ongoing engagement related to the Project. These lessons learnt will be applied as needed.

EMPNGA will conduct both initial and ongoing regular engagement activities to cover issues related to the EIS, and to adequately consult with and inform relevant stakeholders about the Project during EIS disclosure activity.

An Integrated Stakeholder Engagement Team has been developed for the Project, comprising:

- Papua LNG Project representatives.
- EMPNG Land and Community Affairs (L&CA).
- Specialist third party contractors.

The Integrated Stakeholder Engagement Team will gather, share, and review information/findings in an integrative way to achieve the following key outcomes:

- Relationships are initiated, developed, and sustained with stakeholders.
- Engagement with stakeholders is implemented in a timely, effective and efficient manner, and aligns with schedule milestones, particularly where they relate to the EIS.
- Consistency is achieved in key messages and information across the team and delivered to stakeholders.

4.2 Requirements

Papua New Guinea legislation, international standards and EMPNGA standards collectively frame the requirements for stakeholder engagement that apply to the process of environmental approvals and preparation and submission of the EIS for the Project.

The Project is subject to assessment, approval and development under the *Environment Act 2000* and the *Oil and Gas Act 1998*, both of which have requirements for stakeholder engagement activities.

International standards considered for stakeholder engagement to be undertaken in support of this EIS include the requirements of the Equator Principles IV (EPIV) and the International Finance Corporation's Performance Standards for Environmental and Social Sustainability (2012).

EMPNGA has human safety, health, environment, and product safety policies that outline commitment to conducting business in a manner that considers the needs of the communities in which it operates. These policies are implemented through EMPNGA's Operations, Integrity Management System (OIMS) and the Socioeconomic Management Standard, which contains requirements relating to stakeholder engagement.



4.3 Engagement plan

The Papua LNG Project – Downstream Stakeholder Engagement Plan (the Plan) will outline EMPNGA's approach to stakeholder engagement during the development and construction of the Project. The Plan will be developed in accordance with international standards, Papua New Guinea legislation and EMPNGA policy. The Plan is interlinked with the PNG LNG Project Stakeholder Engagement Plan which is currently used to manage engagement at the LNG Plant site. EMPNGA will use a computer-based information management system to manage the information generated through stakeholder engagement. This information management system will continue to be used during the construction and development of the Project.

4.4 Activities

Stakeholder engagement activities completed to date have included government engagement by the Integrated Stakeholder Engagement Team, and community engagement as part of pre-awareness for EIS baseline field surveys, which can be summarised as:

- **Government engagement.** Formal meetings were conducted to update key government stakeholders on Project development and progress. Informal meetings and discussions with a broad cross-section of governmental and non-governmental stakeholders were also held.
- **Project survey awareness.** Survey awareness sessions were held with local communities prior to the commencement of field surveys for the Project. These sessions briefed the communities on the planned field survey activities, including when they would be occurring and what would happen during the surveys.
- **Field survey community engagement.** Comprehensive field surveys were undertaken to collect data to establish an environmental, social, cultural and health baseline in areas close to Project infrastructure as part of the EIS process.

Limited feedback on the Project has been received to date.

Feedback and input from LNG Plant communities and other stakeholders will continue to be sought throughout the EIS disclosure process. CEPA will invite members of the public to make written submissions about their views on the EIS.

Stakeholder engagement will continue throughout the life of the Project. The frequency and nature of engagement will vary between stakeholders and will continue to be modified and refined in response to stakeholder feedback and learnings from the Project. The Project will record all feedback received on the Project which will be stored in the stakeholder information management system.

EMPNGA will provide ongoing, cultural and gender appropriate engagement in a format that is understandable to stakeholders. Examples of this may include:

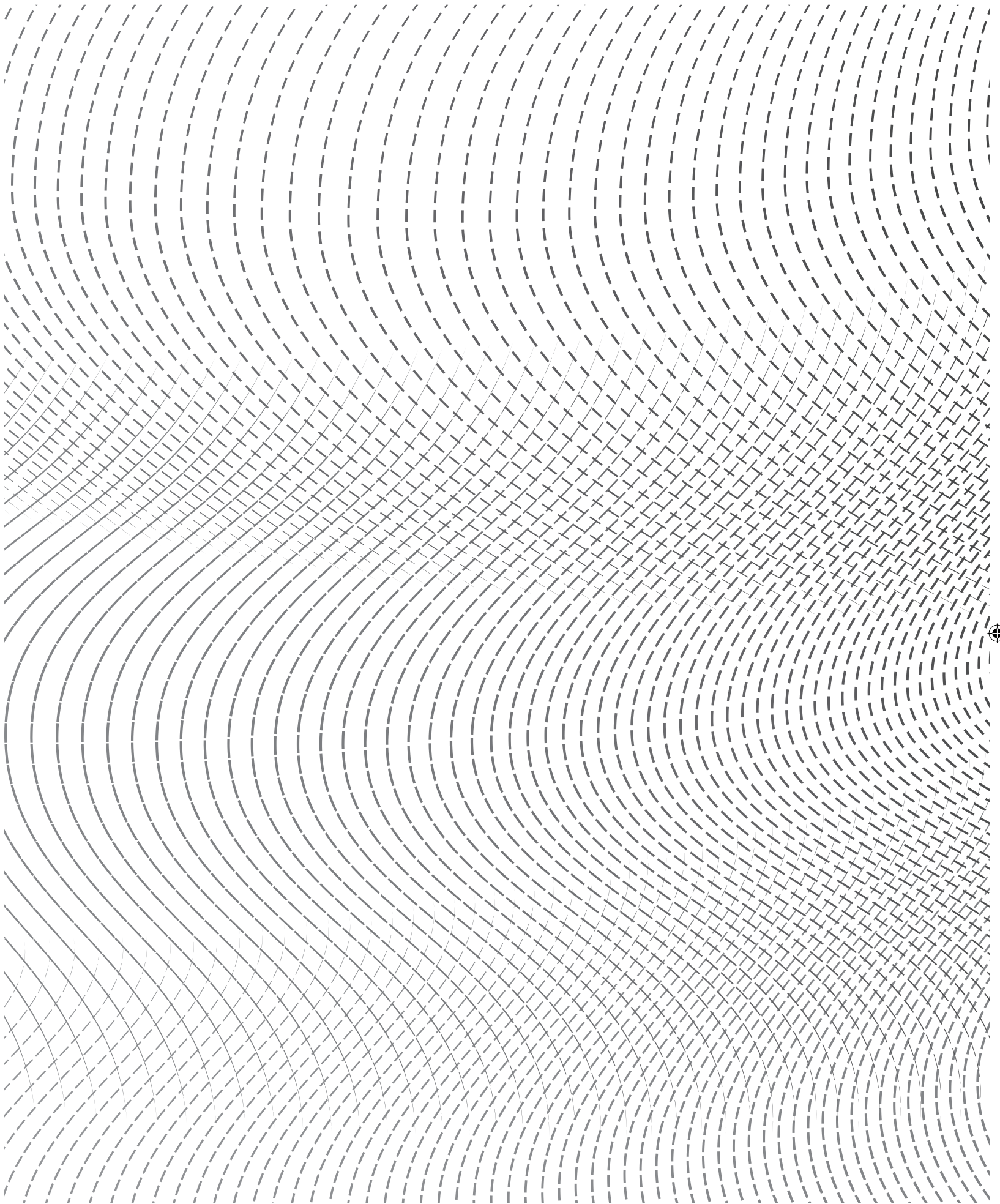
- Multi-language spoken and written presentation materials.
- Graphics and visual aids with personnel available to record comments for lower-literacy participants.
- Feedback-and-response mechanisms.
- Allowing sufficient time for stakeholders to fully comprehend and respond with comments and concerns.

Public disclosure of the EIS will be conducted in accordance with the requirements of the *Environment Act 2000* and will include an EIS engagement campaign, which will be conducted by EMPNGA and Tetra Tech Coffey in collaboration with CEPA, with officers from CEPA and Department of Petroleum and Energy expected to attend. The EIS engagement campaign will provide a final summary of the findings from the EIS and address issues previously raised by stakeholders.

The timing for the EIS engagement campaign will be determined and planned by CEPA in conjunction with EMPNGA but is likely to be between three and six months following the submission of the EIS.

4.5 Grievance redress mechanism

The stakeholder engagement plan prepared for the Project outlines the Grievance Management Process, which provides for grievances to be received, investigated and responded to in an understandable, transparent, confidential, culturally appropriate, and timely manner. Grievances can be raised at no cost and without retribution.







5. Impact assessment

5.1 Environmental impact assessment

The environmental setting for the Project is highly disturbed due to previous clearing in the area, and the construction and operation of the LNG Plant and associated infrastructure in onshore and marine areas. The environmental impact assessment for the Project has therefore been undertaken in this context.

5.1.1 LNG Plant

Project onshore impacts are expected to be incremental to changes to the environment associated with construction and operation of the LNG Plant. Most of the areas to be disturbed as part of the Project are already cleared, apart from the new laydown area located within the lease boundary and outside the security fence.

The key residual impacts to the onshore environment from the Project, which are primarily related to air and noise, are summarised below. Residual impacts groundwater, surface water, terrestrial biodiversity, and aquatic ecology, from construction and operation of the Project to be expected to be minor based on the localised and primarily short-term nature of the impacts, which are expected to be similar to existing impacts from the LNG Plant, and can be effectively addressed with standard management controls. The reader is directed to the main EIS report for detail regarding these aspects.

5.1.1.1 Air quality

Short-term and localised increases in dust concentrations associated with construction areas, particularly during vegetation clearance and earthworks, and Project-related traffic, are anticipated during the four-year construction phase, with no long-term air quality impacts expected. Revegetation of cleared areas as soon

as practicable following disturbance and implementation of erosion control measures where required (e.g., designated stockpile areas) will promote stabilisation of exposed soils and reduction of fugitive dust emissions.

With implementation of good practice air quality management and measures included in the Project's Construction Environmental and Social Management Plan (ESMP), impacts to air quality as a result of construction are expected to be localised, short-term and will be managed through targeted dust suppression, such as water trucks, water sprays or dust suppressants.

During operations, the primary air emissions will result from burning of fuel gas in gas turbines for power generation and to drive compressors, as well as from flaring. Small quantities of fugitive emissions of volatile organic compounds (VOCs) from the LNG Plant and the Project facilities will also be generated.

Based on air quality modelling, operational emissions for air pollutants including nitrous oxides (NO_x), carbon monoxide (CO), sulphur dioxide (SO₂), particulate matter (i.e., PM₁₀) and benzene at sensitive receptors predicted that concentrations for normal and upset operating scenarios were below the relevant ambient air quality criteria.

While off-site exceedances of some parameters were predicted, due to the location of the exceedances, there is unlikely to be exposure to sensitive receptors. No air quality impacts at these off-site locations are therefore expected.

5.1.1.2 Noise

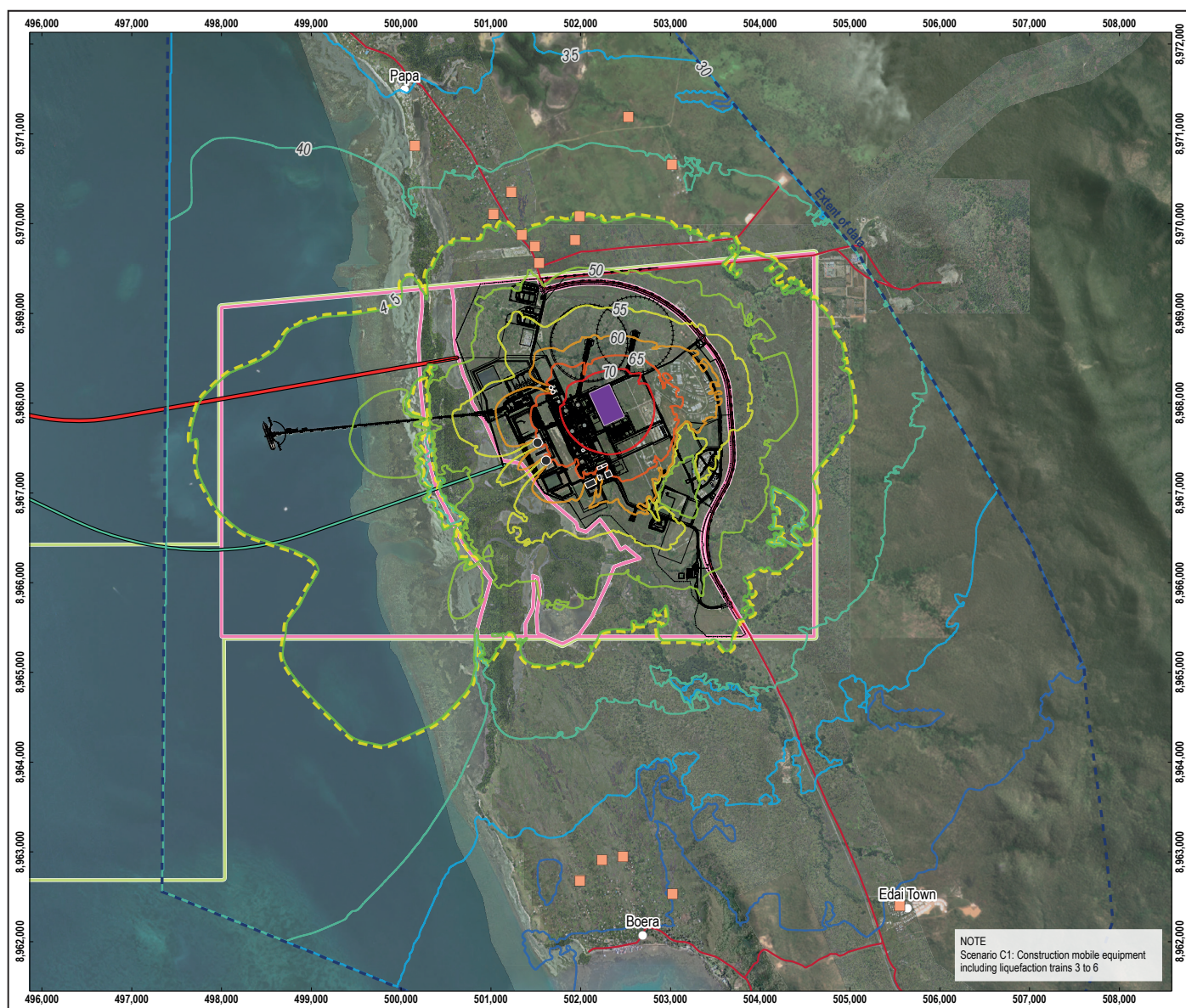
A change of up to 3 dBA in the level of a sound is difficult for most people to detect, while a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness, while a 10 dB(A) change corresponds to an approximate doubling or halving in loudness.

During Project construction, incremental noise exceedances of the current PNG LNG Project EP-L3(210) night-time noise criterion (45 dBA LAeq (10pm to 7am)) by up to 3 dBA are predicted at three sensitive receptor locations north of the LNG Plant site including (Residence 1 (NSR 12) Residence 2 (NSR 13) and Residence 4 (NSR 15)) as shown on Figure ES8. Exceedances of these night-time noise criterion are also predicted at the perimeter fence line; however, no noise-related impacts are expected due to these exceedances based on the absence of sensitive receptors located at the fence line.

Based on the conservatism of the modelling results and construction noise exceedances being minor, along with the implementation of good industry practise noise management measures as planned by the Project, it is expected that noise levels will comply with criteria in the current PNG LNG Project EP-L3(210) regarding noise. This would permit construction activities to take place 24 hours a day without adverse noise impacts to sensitive receptors.

During normal operations, the predicted noise increases at sensitive receptors due to the new trains compared to the existing normal operation range between 2 to 5 dBA, corresponding to a small but noticeable change in loudness. Combined noise from the new trains, existing train 1 and 2, the 58 MW NiuPower power plant is predicted to meet noise criteria in the current PNG LNG Project EP-L3(210) and adopted background noise levels at all sensitive receptors modelled assuming normal operations.

An exception to this is noise at Residence 1 (NSR12), where levels are predicted to marginally (by 1 dBA) exceed the 45 dBA LAeq (10 p.m. to 7 a.m.) noise criterion. The source of the exceedance is refrigeration noise for which, if noise control was applied, there would be no noise exceedance at NSR12. During normal and upset operations, exceedances of day and night noise criteria in the current PNG LNG Project EP-L3(210) are predicted in the absence of control measures; however, no noise-related impacts are expected due to these exceedances based on the absence of sensitive receptors located at the fence line and planned noise control measures.



LEGEND

- Village
- Noise sensitive receptor
- Road
- PNG LNG pipeline
- Proposed Papua LNG pipelines route
- Existing and proposed plant layout
- PPFL2 boundary
- APPFL boundary
- Area source
- Building
- - - Extent of data

Scenario C1 noise contour (dBA)

- 30
- 35
- 40
- 45
- 50
- 55
- 60
- 65
- 70
- 45 dBA criteria line



0 0.5 1 km
PROJECTION: WGS 1984 UTM Zone 55S

SOURCE
Noise contours from SLR.
Monitoring locations, infrastructure, roads,
watercourses and lease boundary from EMPNGA.
Imagery from ArcGIS Online and Planet Labs.

Figure ES8 Construction noise contours, prevailing weather conditions



5.1.2 Marine

Marine facilities are required to accommodate the increased LNG Plant production rates and subsequent increase in the number of vessels. Various Project activities during construction and operation, several of which represent incremental changes to pre-existing conditions that are already occurring in association with the PNG LNG Project, have the potential to affect marine environmental values including:

- Seabed disturbance occurring during CALM buoy installation and operation
- Additional wastewater discharges including those from the LNG Plant retention ponds (foundation and expansion) and other sources that may cause contamination (e.g., hydrotesting, surface run-off, wastewater, and brine concentrate from desalination)
- Additional illumination from lights installed in association with the LNG Plant, CALM buoy, vessels, or other marine infrastructure
- Increased vessel traffic.

These Project activities and components have the potential to result in the following effects:

- Direct physical impacts to and degradation of coastal and marine habitats
- Increased volumes of suspended sediment and sedimentation rates
- Contamination of sediments and a reduction in water quality
- Generation of light and underwater noise
- Introduction of invasive species.

These effects associated with Project activities can impact the following marine environmental values:

- Coastal and marine habitats including coral reefs, seagrass, macroalgae, and mangroves
- Marine fauna.

To minimise the potential impacts to the marine environment, industry good practice will be adhered to. This will include measures consistent with the PNG LNG Project Ecological Management Plan.

Habitat deterioration due to direct physical impact and also sedimentation associated with seabed disturbance will occur during the installation and operation of the CALM buoy. The CALM buoy will be located approximately 6 km from shore at the 20 m depth contour, in an area of seabed

characterised by soft sediment habitats that are colonised by a benthic infauna and limited diversity of epifauna (mainly sea whips and sea fans), that is present elsewhere in Caution Bay. Existing habitats in the direct disturbance footprint of the CALM buoy infrastructure will be lost, with mortality expected for immobile fauna present in these habitats. Installation and operation of the CALM buoy will affect a relatively small footprint of seafloor, representing less than 0.010% of the unconsolidated soft sediment habitat widespread in Caution Bay. As the direct disturbance, sedimentation and noise-related impacts associated with CALM buoy installation are low (short timeframe, small disturbance footprint and low intensity pile-driving activity occurring at the seafloor as opposed to water surface), specific mitigations such as silt or bubble curtains are not proposed.

Wastewater from various sources will be sent to the LNG Plant retention pond for settling and dilution in the mixing pit to meet the required water quality criteria before final discharge into Caution Bay. Due to the inputs of freshwater, brine, nutrients, and chemical contaminants, potential exists for these discharges to impact receiving waters and habitats in Caution Bay.

This can lead to ecological health disruptions and reduced disease resilience in nearby communities such as mangroves, where a localised change in conditions has occurred, as evidenced by observations of dieback and an induced transition in mangrove community composition. Localised change in the adjacent mangrove community composition is expected to continue due to ongoing water quality and hydrodynamic fluxes associated with the LNG Plant retention pond discharge. The residual impact associated with wastewater discharge is predicted to be low, based on:

- Observations indicating that although retention pond discharge is having a localised influence on the immediately adjacent mangrove community composition, no observable effects are evident on the functions of the broader habitat at Caution Bay.
- Assumptions that wastewater discharge characteristics for the Project are similar to those currently occurring for the PNG LNG Project and compliance with environment permit criteria.



The LNG facilities are currently lit for safety and security purposes during operation. A relatively small amount of additional lighting will be required for safety, navigation, and maintenance purposes associated with the CALM buoy. It is anticipated that the CALM buoy will be illuminated at night given the marine facilities will be designed for 24-hour mooring and loading operation. The level of light during proposed Project activities is not expected to significantly increase beyond that already experienced at the site. Artificial lighting can impact various behaviours in marine fauna, particularly those related to predation, avoidance, and attraction. There have been no known light-related impacts on marine fauna caused by PNG LNG Project activities and there are no documented turtle nesting beaches in a reasonable proximity of the Project marine facilities. Project design measures will be implemented to reduce, where practicable, artificial illumination of the marine environment during CALM buoy installation and operation. Given these factors, the residual impact of light-related effects on the marine environment is predicted to be low.

The expansion of the LNG Plant will increase vessel traffic by approximately 60 to 70 additional LNG carriers and 10 to 12 condensate cargos per year. Collisions between marine megafauna such as marine mammals and turtles and Project-related vessels are unlikely to occur because:

- Marine mammals are not known to be resident in the parts of Caution Bay that will be traversed by the pipelines or in the vicinity of the CALM buoy. Marine turtles and dolphins are highly mobile and observed sporadically but not commonly.
- Sounds associated with marine vessel movements and marine construction activities should temporarily deter marine mammals and turtles from entering the immediate area of activity.
- While support vessels (tugs and supply boats) may travel at greater speeds than product export vessels, they travel at speeds not exceeding 10 knots and their noise characteristics typically enable mobile marine megafauna species such as dolphins and turtles to avoid them, in a similar manner to existing shipping traffic.

Underwater noise will be generated by several different sources during construction and operations. Vessels associated with construction and operation activities include lay barges, tugs, LNG carriers and naphtha/condensate carriers. During construction, Project-related noise generation at sea will be limited to the period required to install the CALM buoy, while during operations these effects will largely be intermittent and primarily associated with scheduled vessel movements. While there will be an increased frequency of vessel movements, the types of underwater noise from Project-related vessels are expected to be similar those of existing shipping activities for the PNG LNG Project and are insufficient to cause physiological harm, except to animals approaching to within a few tens of metres.

To minimise potential noise-related disturbance to nearby marine fauna, the Project will adopt 'soft start' procedures during construction (i.e., gradual increase from lower noise emissions to higher noise emissions). 'Soft start' procedures are intended to reduce the likelihood of startling nearby marine fauna and allow mobile marine fauna in the vicinity the opportunity to move away before sound levels reach thresholds where the potential for adverse effects is more likely.



5.2 Social impact assessment

A social impact occurs when changes are experienced by people and communities. Potential social impacts were identified through an understanding of how Project-related activities may result in changes to aspects of the social environment that are valued by people. The technical studies that have informed this EIS show that there is potential for the Project to result in beneficial and adverse social impacts.

5.2.1 Potential beneficial impacts

The Papua LNG Project is expected to result in a range of beneficial social impacts. As part of the Papua LNG Project, the Project is expected to result in an increase in employment opportunities, opportunities for skill development and an increase in household income.

The Project's workforce requirements are estimated to be between 5,000 and 7,000 full-time equivalent positions over a planned four-year construction period between 2024 and 2028. The permanent operation and maintenance workforce is expected to increase by approximately 50 technician personnel to support the integrated LNG Plant, with support staff anticipated to increase. The Project's construction is expected to increase wage-based employment opportunities within LNG Plant communities, the provincial area and the NCD. Although the quantum of employment during operation will be lower, opportunities will be long-term.

There is an established contracting sector in Papua New Guinea that provides services to the mining and oil and gas sectors. The Project's construction will generate opportunities for contracting with Papua New Guinean suppliers. Based on the Project's understanding of the Papua New Guinean market and the Project's likely construction activities, it is anticipated that there will be material opportunities for Papua New Guinean suppliers, with a focus on representative landowner companies.

The Project's direct, indirect, and induced employment is likely to stimulate the cash economy within the LNG Plant communities, which in turn is expected to result in increased demand for the range of activities that occur within the informal economy in the LNG Plant communities.

5.2.2 Potential adverse impacts

Potential direct and indirect adverse impacts have been assessed for communities within the LNG Plant study area. The Project is expected to result in an increase in household income, population, and changes in the broader social and physical environment. The following potential impacts were identified, that have been grouped based on the aspect of the social environment that is valued by people that may be affected:

- Terrestrial resources: an influx of people into LNG Plant communities may lead to increased pressure on the availability of subsistence and natural resources. The impact of this will vary depending on the household and the level of reliance on terrestrial resources; for households that have limited access to cash incomes, the impact could result in predominantly short-term livelihood challenges. Similarly, population growth along with Project-induced in-migration may contribute to a reduction in the ability of LNG Plant communities to access and sustain an attachment to land over the long-term.
- Artisanal and subsistence fishing activities: the implementation of a new 500-m-radius marine exclusion zone associated with the CALM buoy will expand the marine area that cannot be used or otherwise accessed by fishermen. Although the area is limited, it may have a greater effect on those who have customary use of this area (and therefore may not have access to fishing in other areas). This exclusion zone will also increase the area that must be avoided by artisanal and subsistence fishers, increasing the time and cost associated with transit to access fishing grounds.
- Community and household health: an increase in household income may lead to a potential increase in risky and unhealthy behaviours, primarily during the Project's construction, such as consumption of processed foods (leading to non-communicable diseases), alcohol and drug abuse, transactional sex, and family and sexual violence. Changes in the broader social and physical environment during the Project may contribute to reduced community health outcomes, such as an increase in communicable diseases (e.g., COVID-19, tuberculosis, sexually-transmitted infections), sanitation diseases, mosquito-borne diseases, and an increase in traffic incidents. Evidence from large-scale construction projects in Papua New Guinea and elsewhere has demonstrated that mobile workforces are associated with increases in transactional sex.



- Community cohesion: there is potential for additional or re-emergence of community tension and intra-personal conflict due to the governance of landowner companies and the potential unequal distribution of Project benefits, such as employment and business contracts. Potential unequal benefit distribution on community cohesion could extend for some time after construction is completed.

For each social impact identified, management and mitigation measures are proposed to manage adverse effects and enhance positive impacts where this is within Project control or influence. These measures include closed camps for the external Project workforce, as well as other measures as set out in four social management plans:

- Project Induced In-Migration Management Plan
- Community Development Support Plan
- Workforce Relations and Working Conditions Management Plan
- Community Health, Safety and Security Management Plan.

5.3 Cultural heritage impact assessment

Tangible cultural heritage sites identified within the Project's cultural heritage study area have the potential to be impacted by Project activities as a result of:

- Direct disturbance of archaeological site locations due to on-ground works including vegetation clearance, topsoil stripping, subsoil excavation and construction.
- Direct disturbance of archaeological sites due to the movement of project employees and contractors and their vehicles.
- Restricted physical access of communities to archaeological sites due to project activities and operational requirements.

Direct impacts have the potential to affect cultural heritage sites through:

- Loss of connection between people and their places of cultural value through the destruction or damage of a site.
- Loss of information which could otherwise be gained by conducting research today.
- Loss of the archaeological resource for future research using methods and addressing questions not available today.
- Permanent loss of the physical record.

Most (if not all) of the 251 archaeological sites that were identified during the preparation of the PNG LNG Project EIS, which are situated west of the LNG Plant's perimeter fence within the current study area, were managed during construction of the LNG Plant in 2010 to 2012 in accordance with the approved PNG LNG Cultural Heritage Management Plan (CHMP). On this basis it is unlikely that the construction and operation activities of the Project will further impact the 244 sites situated within the Project impact footprint west of the perimeter security fence and they have been excluded from the impact assessment.

Of the 88 sites included in the impact assessment all but one of the archaeological sites, DS021, were assessed as being of low cultural heritage significance. The potential for significant impacts to cultural heritage sites was assessed as Moderate in all instances except for DS021, which was assessed as being Major.

The Project CHMP will include the new cultural heritage sites and the management measures within it implemented for the Project. Assuming the successful implementation of the avoidance, management and mitigation measures, residual impacts to the 88 sites included in the impact assessment are:

- The impact response for 78 sites (89%) is No Action given that these sites almost uniformly contain 10 or less artefacts and mostly comprise heavily weathered undecorated ceramic fragments. The impact significance for these sites remains unchanged (Moderate).
- The impact significance for nine sites (10%) is reduced from Moderate to Minor.
- The impact significance for site DS021 is reduced from Major to Nil (due to avoidance).



5.4 Cumulative impact assessment

A cumulative impact assessment aims to identify and assess where effects from individual projects or activities may overlap, interact, and accumulate and therefore result in a cumulative impact on environmental, social, and cultural value. A cumulative impact on an environmental, social, or cultural value is only achievable where there is a credible project, and a spatial and temporal relationship exists between that project and the Project.

Credible projects considered in the cumulative impact assessment are shown on Figure ES9.

The cumulative impact assessment found that, of the mechanisms identified from Project activities that may lead to cumulative impacts, only the following were of note:

- Increased shipping vessel movements and navigation lighting due to Project activities and the Central Cement and Lime Project leading to localised displacement of marine fauna in Caution Bay.
- Delays for road users on Lea Lea Road due to Project-related traffic and construction-generated traffic from the Central Cement and Lime Project, which has indicated that Lea Lea Road will be used by construction and operation traffic, and Edai Town, which connects with Lea Lea Road.
- Shipping congestion at Motukea Port.
- An increase in economic activity and the perceived opportunity to engage with project benefits of the Project and the Central Cement and Lime Project may act to increase in-migration to LNG Plant communities during this timeframe and exacerbate social impacts associated with in-migration.

The Project will minimise the contribution of cumulative impacts by implementing management measures contained within the Project ESMP. Providers of goods and services to the Project will be required to meet safety, environmental and social performance standards, further limiting the potential contribution to cumulative impacts.

If similar approaches to management of impacts are implemented by the operators of the projects included in the assessment, where relevant, potential significant negative cumulative impacts will be further reduced.

Proposed strategies for management of cumulative impacts include:

- Implementing appropriate traffic management and community awareness programs to minimise cumulative impacts on local and regional traffic.
- Liaising with PNG Ports Corporation to coordinate shipping movements between multiple projects.
- Managing, in consultation with relevant provincial and national government agencies, the effects of the influx of skilled workers on communities.

The Project will engage with relevant project proponents and government agencies regarding these strategies.

5.5 Greenhouse gases and climate change

5.5.1 Greenhouse gas emissions

The Project will contribute to production from the PNG LNG Project's LNG Plant. The greenhouse gas (GHG) emissions were estimated for the construction, commissioning and operation phases of the Project to determine the contribution to Papua New Guinea's GHGs.

The major sources of emissions for the Project will be flaring and combustion of fuel gas for power and production of liquefied natural gas during commissioning and operations. Table ES2 lists the predicted Scope 1 GHG emissions for the Project and the integrated LNG Plant; Scope 1 emissions are emissions that directly result from activities including combustion of fuels due to transport, on-site power generation and construction activities.

There is forecast to be an improved emissions intensity for the integrated LNG Plant upon commencement of operation of the Project, with an estimated reduction of around 1.6 tonnes CO₂-equivalent per 100 tonnes of product available to market (i.e., 18.7 down to 17.1 tonnes CO₂-equivalent per 100 tonnes of product available to market).

The estimated the Scope 1 emissions in 2022 for the LNG Plant of approximately 1,742 kt CO₂-equivalent is 20% of the reported total

energy sector emissions for Papua New Guinea in 2017 (the most recent data available). From full commissioning in 2029, Scope 1 emissions for the integrated LNG Plant are predicted to be 27% higher than Scope 1 emissions in 2022 for the LNG Plant, which is predicted to increase Papua New Guinea's energy sector emissions by around 5%, and Papua New Guinea's national emissions (from 2017) by approximately 4%.

5.5.2 Greenhouse gas abatement initiatives

The Project's proposed design incorporates energy efficiency measures that support the minimisation of GHG emissions and is consistent with engineering, design and procurement approaches set out in the EMPNG *Environmental Management Plan: LNG Plant and Marine Facilities* for the LNG Plant. Specifically, the following priorities were identified for the Project's plant design in relation to GHG emissions mitigation:

- Identifying design choices that have the potential to improve the GHG performance of the LNG Plant, with any design choices that change the projected GHG emissions by 5 kt CO₂-e/annum or greater to be communicated to management for further investigation.
- Providing a plant design that does not preclude subsequent projects at the site that may reduce GHG emissions intensity.

Optimisation of energy use and minimisation of GHG emissions will be a key consideration throughout the detailed design phase of the Project.

Table ES2 Predicted Scope 1 GHG emissions for the Integrated LNG Plant

Phase	Emission sources	GHG emissions (kt CO ₂ - equivalents per annum)
Construction (four years)	▪ Combustion of diesel by plant and equipment ▪ Vehicle movements transporting staff and equipment ▪ Portable power generators ▪ Solid waste incineration	124 (peak) 57 (average)
Commissioning (one year)	▪ Combustion of diesel for mobile sources ▪ Emissions from gas turbines ▪ Start-up flaring	650
Operations	▪ Supply of raw gas and condensate ▪ Fuel gas combustion ▪ Flaring ▪ Fugitive emissions ▪ Vehicle movements transporting staff and equipment ▪ Management of solid waste	1,067
Existing LNG Plant (2022)	▪ Supply of raw gas and condensate ▪ Fuel gas combustion ▪ Flaring ▪ Fugitive emissions ▪ Vehicle movements transporting staff and equipment ▪ Management of solid waste	1,742
Integrated LNG Plant	▪ Existing LNG Plant ▪ Combustion of fuel gas in the Combined Cycle Power Plant providing power to both the Project and existing LNG Plant ▪ Existing trains 1 and 2 processing gas from the Project	2,212



5.5.3 Climate change

The predicted effects of climate change may increase in frequency and/or severity over time. Potential implications for the Project resulting from climate change effects could include:

- Enhanced erosion and runoff from increased rainfall and storm intensity
- More frequent and intense coastal and inland flooding
- More frequent heat waves
- Changed seawater to freshwater interface due to sea level rise leading to possible regression of freshwater environments
- Changed land use due to drought, inundation and enhanced productive capacity (higher rainfall)
- More favourable (humid) conditions for outbreak and spread of water-borne and vector diseases (e.g., malaria), plant pathogens and pest plants and animals.

The effects and potential impacts of climate change have been considered in designing project infrastructure.

The waste management objectives for this Project are to:

- Comply with relevant environmental policies
- Prevent or manage the environmental, safety and human health impacts associated with waste
- Comply with applicable Papua New Guinea waste management-related regulatory requirements
- Set goals for the inclusion of waste minimization considerations in the Project's design
- Verify that wastes that are not treated/disposed of onsite are recycled, treated or disposed of at properly licensed/permitted and approved waste management facilities
- Apply the waste management hierarchy:
 - Avoid
 - Reduce
 - Reuse
 - Recycle
 - Dispose

5.6 Waste management

The LNG Plant has existing waste management facilities and procedures for storage, segregation, and collection, including engineered landfills for non-restricted wastes. Waste is managed according to the waste management hierarchy within the existing Environmental and Social Management Plans established for the PNG LNG Project. Regular waste management performance reports are conducted and shared with the government and other key external organisations to track operational compliance.

While existing facilities can be utilised as needed, a new onsite landfill with expanded capacity to accommodate additional Project requirements is anticipated to be required. EMPNGA may also consider utilising approved third-party waste management facilities.





6. Environmental and social management and monitoring

6.1 Overview

The management of Project environmental and social activities and impacts, and the design of facilities and other equipment, will be governed by criteria defined in applicable Papua New Guinea Government legislation, EMPNGA policies and guidelines, and other applicable standards and regulations, including those of the International Finance Corporation.

Environmental and social management and monitoring for the Project will be reflected in the overarching Environmental and Social Management System (ESMS) developed for the Papua LNG Project, as well as the Project Construction Environmental and Social Management Plan (Construction ESMP). The ESMS framework is shown in Figure ES10.

EMPNGA will be responsible for environmental and social management during construction and NLOC will be responsible for the integrated LNG Plant and responsible for environmental and social management during operations.

The Project will maintain an appropriate organisational structure and sufficient resources to support effective implementation of the Construction ESMP. The organisational structure and reporting relationships for the implementation and monitoring of the construction and operations stages of the Project will reflect those developed for the PNG LNG Project and be detailed in the Project Construction ESMP.

6.2 Environmental and social management plan

The Project Construction ESMP will be comprised of a main document that describes the overall environmental and social management processes applicable to the Project and a series of appendices which are detailed plans covering each of the topics discussed in the main document.

The Project Construction ESMP will capture the EIS commitments and conditions of approval stipulated by the Papua New Guinea Government, as well as the potential requirements of lending institutions associated with the Project. The Construction ESMP will also define the framework that contractors will be required to follow when preparing their more detailed construction Contractor Implementation Plans. Contractors working on the Project will be contractually obligated to comply with the requirements, specifications and procedures set out in the Project ESMP, as applicable to their specific scope of works.

An Operations ESMP will be prepared prior to the commencement of operations.

ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM

Overarching 'system' document							
Theme-based							Activity-based
Pollution prevention	Natural resources	Biodiversity	Community	Labour	Occupational health, safety & security	Emergency response	Activity specific
• Air quality, greenhouse gases and energy efficiency • Noise • Waste • Hazardous materials • Spill prevention and response	• Water use and effluent discharges • Raw materials • Acid sulphate soils • Erosion and sediment control	• Biodiversity • Invasive species, pathogens and pests	• Stakeholder engagement • National content • Community development • Community health, safety and security • Cultural heritage management • Project-induced in-migration management • Livelihood support	• Workforce relations and working conditions	• SIMOPS management strategy • Work permissions management strategy	• Emergency response	• Restoration and rehabilitation • Hydrotesting • Marine operations • Traffic and transport • Camp and accommodation requirements • Trenching

LEGEND

	Environmental
	Socioeconomic
	OHSS
	Multi-discipline

Figure ES10 Project Environmental and Social Management System framework overview



6.3 Monitoring

ExxonMobil and its contractors will implement an environmental and social monitoring plan for the Project as required by the ESMP.

The objectives of the ESMP will be to:

- Define environmental monitoring requirements.
- Summarise ExxonMobil's process for inspection and verification of management and mitigation commitments for periodic assessment and audit to evaluate the implementation and effectiveness of the environmental program.
- Summarise ExxonMobil's process for reporting to CEPA and other applicable government agencies in relation to monitoring, verification, audit, and assessment programs.

Monitoring programs will be developed as the Project proceeds into detailed design to take into consideration the requirements of the *Environment Act 2000* that may arise from the EIS approvals process. The types of parameters to be measured and potential measurement methods are typically stipulated in regulatory permits and licences.

Monitoring requirements will be revisited and expanded with specific key performance indicators, monitoring locations and frequencies in the Project and contractor ESMPs. These will be individually tailored for each project component and each stage of the Project (construction, operations, and closure) once the final design and location of the Project facilities have been determined.

ExxonMobil and its contractors will establish and maintain a record system so that the environmental management systems are in place and effectively implemented.

6.4 Reporting

6.4.1 Internal

Monitoring results from the implementation of the EMP, including any non-conformances and associated corrective actions, will be periodically reported to ExxonMobil.

Contractors will provide a regular (monthly) environmental and social report commensurate with their work scope and potential impacts, as they relate to Project activities. These reports will include both contractor and subcontractor data.

6.4.2 External

The Project will comply with notification and reporting requirements in accordance with applicable permits and licenses and any other applicable law.

Annual environment reports are also currently prepared for the PNG LNG Project and submitted to CEPA; the Project will maintain this convention. The structure, content, and format of reporting documentation will be agreed with CEPA, and likely align with that prepared for the PNG LNG Project.

6.5 Assessment and audit

Periodic assessments and audits may be undertaken to evaluate the implementation and effectiveness of Project environmental and social activities, monitoring programs, and work sites. These assessments and audits will be undertaken in accordance with predetermined agreed-upon protocols, as relevant.

Upon completion of the assessments and audits, draft assessment and audit reports will be provided. The reports will be discussed between relevant parties as appropriate at review meetings, following which a final audit report will be provided.





7. Further information and submissions

Hard copies of the EIS will be on public display at the following locations:

- Conservation and Environment Protection Authority (CEPA), Port Moresby
- Department of the Petroleum and Energy (DPE), Port Moresby

As part of its assessment of the EIS, the Conservation and Environment Protection Authority (CEPA) will invite members of the public to make written submissions about their views on the EIS. Guidance on how to do this can be obtained from:

Managing Director
Conservation and Environment Protection Authority
Stratos Avenue, Savannah Heights
PO Box 6601
Waigani, National Capital District
Papua New Guinea



ExxonMobil

Papua LNG Project – Downstream
Environmental Impact Statement
Executive Summary