



ExxonMobil PNG Limited



ExxonMobil PNG Limited
Production Operations

Biodiversity Implementation and Monitoring Program

PGGP-EH-SSZZZ-000008

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ACRONYMS

ACRONYM	DESCRIPTION
BAA	Biodiversity Assessment Area
BIMP	Biodiversity Implementation and Monitoring Program
CEPA	Conservation and Environment Protection Authority
CH-q	Critical Habitat Qualifying Criteria
E&S	Environmental and Social
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
ESMP	Environmental and Social Management Plan
EMPNG	ExxonMobil PNG Limited
GIS	Geographical Information System
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
KPI	Key Performance Indicator
LNG	Liquefied Natural Gas
METT	Management Effectiveness Tracking Tool
NBSAP	National Biodiversity Strategy and Action Plan
NGO	Non-government organisation
PMA	Programmed Monitoring Activities
PNG	Papua New Guinea
RAP	Rapid Assessment
ROW	Right of Way
SHE	Safety, Security, Health and Environment
WMA	Wildlife Management Area

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PNG LNG is an integrated development that includes gas production and processing facilities, onshore and offshore pipelines and liquefaction facilities. Participating interests are affiliates of Exxon Mobil Corporation (including ExxonMobil PNG Limited as operator), Oil Search Limited, Kumul Petroleum Holdings Limited, Santos Limited, JX Nippon Oil and Gas Exploration and Mineral Resources Development Company.

PREFACE

ExxonMobil PNG Limited (EMPNG) is committed to safeguarding biodiversity in areas where the company operates and, in particular, the biodiversity values in the Upstream area of the Papua New Guinea Liquefied Natural Gas (PNG LNG) Project. This Biodiversity Strategy outlines how impacts on biodiversity will be assessed and managed.

EMPNG manages potential impacts to biodiversity across the Upstream area and the LNG Plant and Marine Facilities area through implementation of its Environmental and Social Management Plan (ESMP). While the ESMP applies to a broad range of land and aquatic environments in which PNG LNG is operating, the largely undisturbed tropical forest in the Upstream area was identified as having the highest biodiversity value. This area is also where most of the biodiversity-related impacts from the construction phase were predicted to occur in the PNG LNG Project Environmental Impact Statement. As such, the Upstream area requires additional biodiversity-related management processes to supplement the measures outlined in the ESMP. The Biodiversity Strategy and this Biodiversity Implementation and Monitoring Program (BIMP) address that need .

The Biodiversity Strategy comprises a suite of inter-linked documents, arranged in a hierarchy. The Strategy is an over-arching document that describes the framework and general approach, and is supported by the BIMP and a set of Programmed Monitoring Activities (PMA), as outlined below.

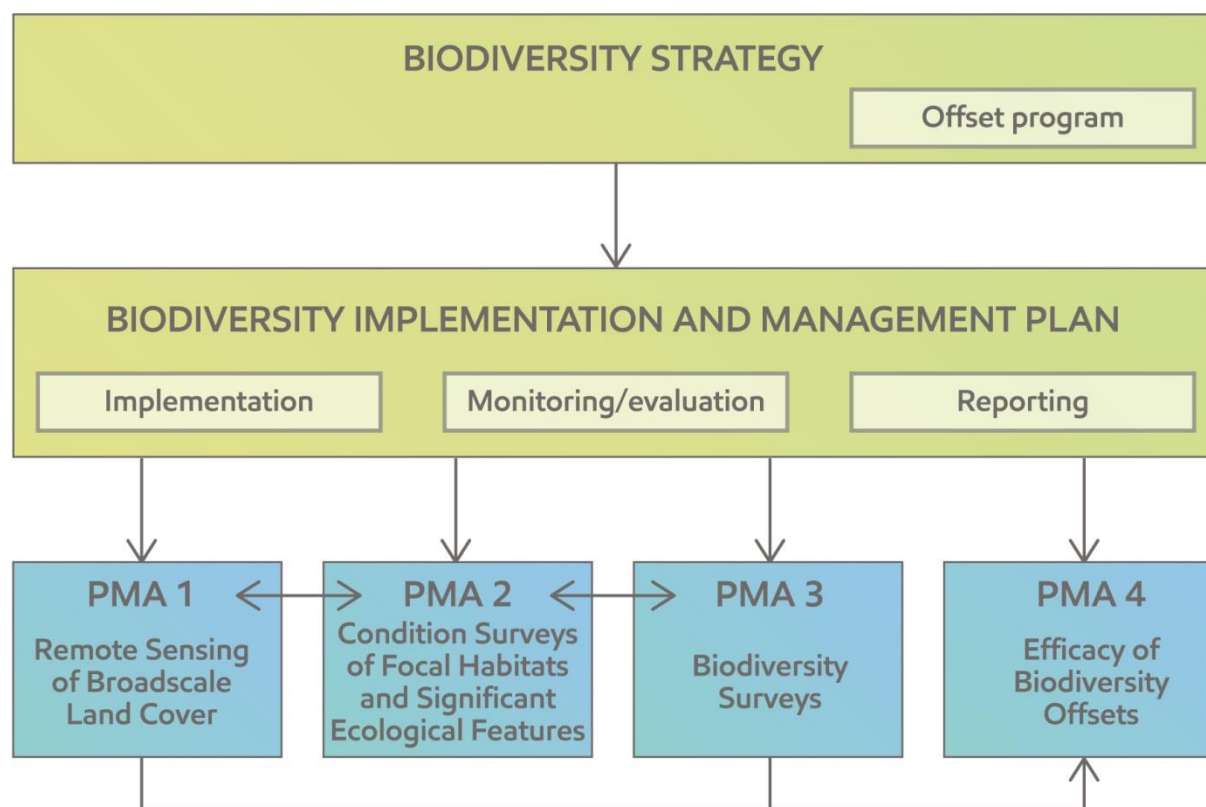


Figure 0-1: Biodiversity Strategy Document Framework

1.0 INTRODUCTION

1.1 Background and Objectives

ExxonMobil PNG (EMPNG) is the operator of the PNG LNG project (the Project). The Project is located in an area of globally important biodiversity and is committed to managing biodiversity in a sensitive and responsible manner, including compliance with the International Finance Corporation's Performance Standards on Social and Environmental Sustainability (IFC, 2006).

The objectives of this Biodiversity Implementation and Monitoring Program (BIMP) are to describe:

- The programs EMPNG is undertaking to achieve its biodiversity goal and objectives, as stated in the Biodiversity Strategy (Table 1-1), and
- The monitoring program being implemented to:
 - verify predicted impacts on biodiversity values
 - confirm (or otherwise) that agreed mitigation measures designed to manage risks and potential impacts to identified biodiversity values and the ecological processes supporting these values are being implemented and are achieving, or are on track to achieving, intended outcomes
 - acquire appropriate data to make informed decisions on the need to adjust monitoring approaches and/or management plans as part of an adaptive management process that facilitates a program of continuous improvement aimed at meeting the stated goal and objectives.

Table 1-1: Biodiversity Strategy Goals and Objectives

Goal: Retain the biodiversity values of the Upstream region for the long-term	
Objective 1	Maintain the intactness of the Upstream area as a whole
Objective 2	Conserve priority ecosystems
Objective 3	Protect focal habitats
Objective 4	Identify, measure and offset significant residual impacts

The BIMP is supported by a set of Protocols that describe the methods and procedures being implemented as part of the BIMP, and a set of activities that are being executed as part of the Project's Environmental and Social Management Plan (ESMP).

1.2 Project Overview

The PNG LNG operation extends from Papua New Guinea's Highlands Region in the north to Caution Bay in the Central Province. The key PNG LNG facilities are the LNG Plant near Port Moresby, the Hides Gas Conditioning Plant, a series of production wells, approximately 800 kilometres of pipelines, and Komo Airfield.

Construction of PNG LNG facilities started in early 2010. The facilities were completed in 2014, with loading of the first LNG cargo on 25 May 2014. During the life of PNG LNG, it is expected that about 250 billion cubic metres of gas will be produced and sold to provide a long-term supply of LNG to customers in Asia.

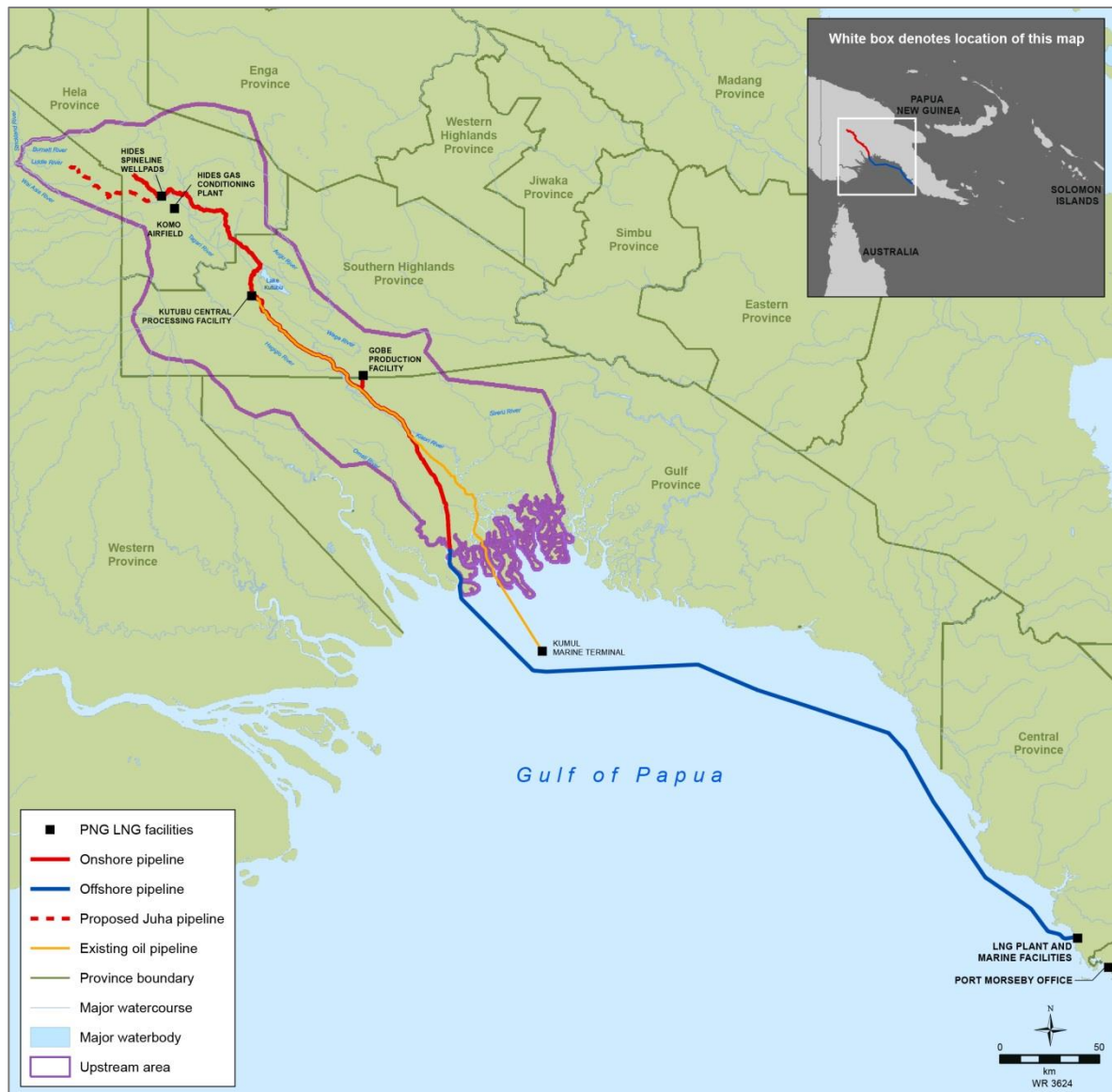


Figure 1-1: Project Location

1.3 Scope

1.3.1 Spatial Scope

The spatial scope of the BIMP is set within the catchment of the Kikori River and parts of the Strickland, Liddle River, Burnett River and Wai Asia river catchments, collectively referred to as the Upstream area (Figure 1-2), with specific focus on a linear infrastructure corridor that includes PNG LNG facilities, the onshore pipeline Right of Way (ROW), PNG LNG roads and access tracks and two priority ecosystems, namely Lake Kutubu Wildlife Management Area (WMA) and Homa¹. The spatial scope also includes biodiversity offset areas located within or outside the linear infrastructure corridor, recognising that some are yet to be defined.

¹ The area encompassed by the linear infrastructure corridor has evolved over time. It originally included the Department of Works-operated Northern Logistics Road used during construction; this was removed in 2017. At the same time linear infrastructure corridor was expanded to encompass the entire Homa Priority Ecosystem rather than the original 64%.

1.3.2 Temporal Scope

The temporal scope covers the production phase of the project which is nominally 30 years.

1.3.3 Technical Scope

The BIMP provides a basis for monitoring and evaluating residual impacts within the spatial scope with respect to the following:

- Habitats and ecosystems that either meet the Critical Habitat qualifying criteria (CH-q) as defined by IFC Performance Standard 6 (IFC, 2006), or are deemed to be a proxy for associated CH-q species
- Habitat condition and change including loss, degradation, fragmentation and changes in diversity and abundance
- CH-q species
- Invasive species and changes in their distribution and abundance
- Changes to priority ecosystem areas
- Implementation and effectiveness of site restoration activities related to biodiversity
- Implementation and effectiveness in achieving the Biodiversity Strategy objectives with reference to Key Performance Indicators (KPIs).

The BIMP also establishes the processes for monitoring and evaluating the offset program outlined in the Biodiversity Strategy and the means for demonstrating No Net Loss of biodiversity.



Figure 1-2: Project Area

1.4 Linkages with other Documents and Programs

The BIMP is linked to the Biodiversity Strategy and the ESMP.

1.5 Structure

Section 2 of the BIMP provides a high-level summary of the biodiversity values of the Upstream area. This summary is based on the original Environmental Impact Statement (EIS) baseline assessment with updates resulting from more recent surveys and assessments.

Section 3 describes the approach to biodiversity monitoring and evaluation, including indicators and priorities.

The core of the BIMP is a set of Programmed Monitoring Activities (PMAs) that are designed to enable the Project meet its biodiversity goal and objectives (Sections 4 and 5). The PMAs describe respective objectives, methods, timing and reporting considerations.

An adaptive management process facilitates a program of continuous improvement. This is described in Section 6 and is followed by a description of the management system components that will allow effective implementation and reporting of the BIMP elements (Sections 7-9).

2.0 BIODIVERSITY VALUES

The identification of biodiversity values of the Upstream area is based on surveys and research conducted over the past 20 years, as well as pre-construction surveys conducted as part of PNG LNG. The Upstream area is ecologically significant not only due to its high species richness, but also because it supports large numbers of species that are endemic to Papua New Guinea, to the extent that the entire Upstream area has been defined as Critical Habitat, pursuant to the IFC's Performance Standards (IFC, 2006).

2.1 Large Scale Biodiversity Values

At the large scale, biodiversity values of the Upstream area have been defined as:

- **Extensive intact forest** – The Upstream area encompasses large expanses of largely undisturbed tropical forest
- **High floristic diversity** – Between 6000 and 12,000 species of plants may exist in the Upstream area, with epiphytes making up 75 percent of floristic diversity in upland forests
- **High faunal diversity** – Over 700 species of terrestrial vertebrates have been recorded to date
- **Endemic species** – 75 percent of non-volant mammals, 40 percent of birds and over 90 percent of frogs found in the Upstream area are endemic to New Guinea.
- **Unique assemblages of species** – The Upstream area is recognised for its high diversity of birds-of-paradise and amphibians
- **Species of conservation concern** – Species of plants and animals classified by the IUCN as Critically Endangered or Endangered, or protected under Papua New Guinean legislation, are located in the Upstream area
- **Biodiversity of importance to local communities for resource use and/or cultural and spiritual purposes** – Communities are linked to biodiversity values through their reliance on subsistence harvesting and a close physical and spiritual relationship to ancestral territories.

2.2 Medium Scale Biodiversity Values

At the medium scale, priority ecosystems have been identified which have noteworthy biodiversity values associated with them. The priority ecosystems are areas deemed to have particularly high biodiversity values associated with them and comprise the following:

- **Forest in the Hides Ridge area** – The high-altitude nothofagus forest on karst above 1800 metres harbours a diverse montane fauna in a largely undisturbed tropical forest. Biological values are naturally maintained by the remoteness and difficulty of access
- **High-altitude forest in the Homa area** – The high-altitude forest, including nothofagus, above 1800 metres contains mature forest with a high diversity of flora and fauna. It has one of the highest mammal diversities in the Upstream area
- **Lake Kutubu area** – Lake Kutubu is the largest perched lake in Papua New Guinea and the second largest lake in the country. It has the highest level of lacustrine endemism of any lake in the New Guinea-Australia region. Lake Kutubu is included in the Lake Kutubu WMA. The lake was listed as a Ramsar wetland in 1998 and the Ramsar boundaries match those of the WMA. The Lake Kutubu WMA covers 25,455 hectares and is the only WMA intersected by PNG LNG facilities
- **Forest in the Juha area** – Juha is a remote region where there has been little human influence on the vegetation and fauna, and its ecological values are maintained primarily by its difficulty of access. Among biodiversity values specifically represented

in this area, Juha contains notable concentrations of unique assemblages of frog species

2.3 Small Scale Biodiversity Values

At the small scale, biodiversity values have been identified in the form of focal habitats and significant ecological features and are as follows:

- **Caves and pinnacles** – Provide important habitats for certain bat species such as the Critically Endangered New Guinea big-eared bat (*Pharotis imogene*), and caves with large entrances in the uplands support colonies of large bats, potentially including the Critically Endangered Bulmer's fruit-bat (*Aproteles bulmerae*)
- **Sinkhole swamps** – Microhabitats at the bottom of dolines, including swamps in sinkholes less than 50 metres deep, in high-altitude karst on Hides Ridge, the only habitats where water-dependent frogs can breed in karst, which tends to have few flowing streams
- **Upland streams** – Torrent-dwelling frogs require fast-flowing, clear and rocky streams. Riparian vegetation along such streams supports birds such as Salvadori's teal (*Salvadorina waigiensis*) and the torrent-lark (*Grallina bruijnii*)
- **Swamps and mangroves** – Including areas of pandanus, sago swamp forest or mangroves support a range of specialist vertebrates, including the twelve-wired bird-of-paradise (*Seleucidis melanoleuca*), and the New Guinea flightless rail (*Megacrex inepta*). Swamp forests may provide an important breeding habitat for freshwater turtles and crocodiles. High-value conservation swamps in the Lower Kikori contain habitats for fish nurseries
- **Stream refuges in unstable landscapes** – In unstable terrain where landslides are common, areas of more mature habitat on pockets of more stable substrates such as in stream heads or small plateaus can act as refuges for flora and fauna.
- **Lowland rivers in stable landscapes** – Provide habitat for crocodiles and freshwater turtles, and some bird species are abundant, including kingfishers and shining flycatchers (*Myiagra alecto*)
- **Off-river waterbodies** – Stable habitat type that provides refuge areas and offers habitat for the breeding of New Guinea freshwater crocodiles (*Crocodylus novaeguineae*). It is created by localised damming of runoff by landslides
- **Flora, fauna and habitats of cultural significance** – Culturally significant areas, habitats and species occur throughout and surrounding settled areas in the Upstream area, varying from small swamps said to harbour spirits, to places where medicinal plants are harvested
- **Lekking trees or grounds** – Bird-of-paradise or bowerbird display trees or grounds.

Further details of biodiversity values in the Upstream area are provided in the PNG LNG EIS (Esso Highlands Ltd, 2009) and in subsequent pre-construction surveys.

3.0 APPROACH

3.1 Introduction

The BIMP has been designed to monitor the implementation and outcome of a range of mitigation measures and related activities that, collectively, are designed to avoid adverse impacts on identified biodiversity values and the ecological processes supporting these values, and where avoidance is not possible, minimize, restore or compensate/offset, as per the mitigation hierarchy concept.

The approach involves four PMAs, complemented by three elements of the Upstream Facilities, Infrastructure and Pipelines Environmental Management Plan (EMP), which is in turn part of the Environmental and Social Management Plan (ESMP). The relevant elements of the EMP are: Access Control, Invasive Species and Regeneration Monitoring.

The PMAs and the ESMP activities are collectively referred to as the ‘monitoring programs’ and the inter-relationships of the components are summarised in Figure 3-1.

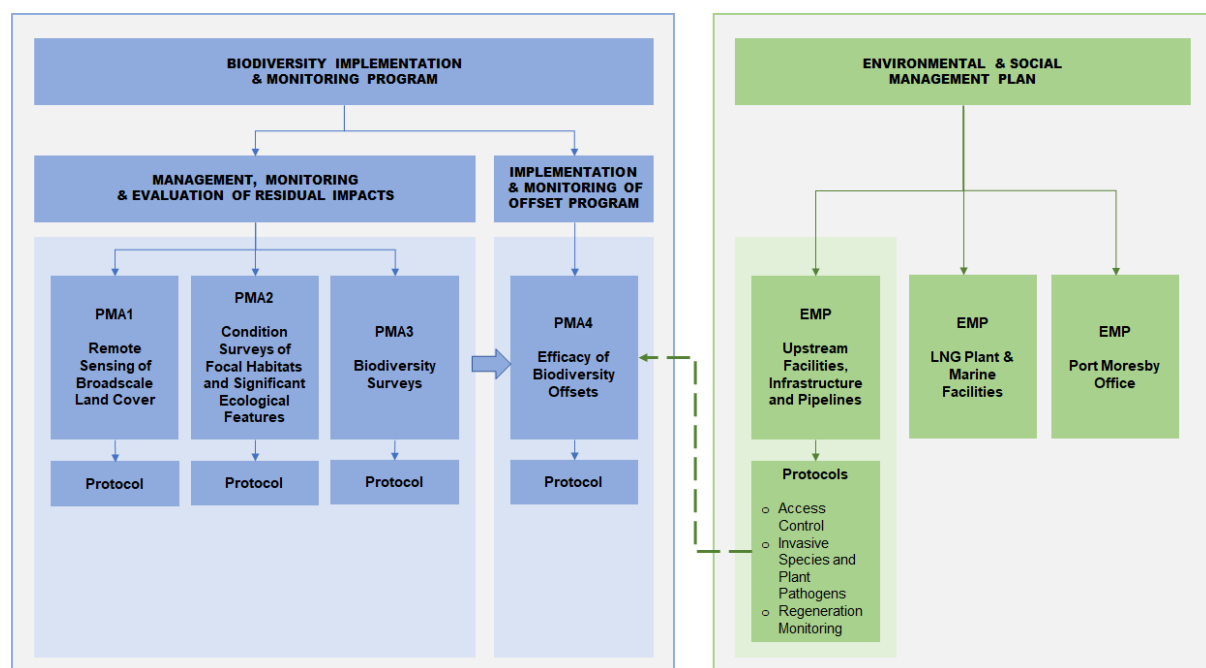


Figure 3-1: Relationship between the BIMP, ESMP and constituent PMAs, Plans and Protocols

Objective 4 of the Biodiversity Strategy² has driven the approach taken in the BIMP, with the origins dating back to the EIS and the initial identification of residual impacts. Subsequent assessments have resulted in the determination of the offset debt resulting from unavoidable impacts to biodiversity values and therefore the target required to achieve No Net Loss (i.e. Biodiversity Strategy goal).

The **Primary Offset Program**, as illustrated in Figure 3-2, defines the activities being implemented to achieve Objective 4. It was developed in recognition of the seven types of residual impacts assessed as having moderate or major potential, and therefore of most significance to biodiversity values, namely: habitat loss in priority ecosystems; edge effects in high-altitude karst; barrier and erosion impacts; steep cuttings in karst; the indirect impacts of fire; the introduction and spread of invasive species and plant pathogens; and enhanced access (Biodiversity Strategy, Section 1.5).

Supporting the Primary Offset Program is an **Incremental Changes Offset Program** which is designed to monitor small changes in land cover occurring in the vicinity of the Project, and

² Objective 4: Identify, measure and offset significant residual impacts

determine whether they are attributable to the Project. If they are, then they most likely meet the definition of a residual impact, in which case their effects on biodiversity values require assessment, and their cumulative significance evaluated in the context of the Project offset target.

In theory, incremental changes could result in the need to revise the offset target, which was determined at the end of the construction phase (PNG LNG, 2015), with recent refinements (TBC, 2018). In practice, this is unlikely due to the very conservative assumptions of the Primary Offset Program, where a notional area of 150,000 hectares has been designed to meet an offset target of 17,410 hectares (Section 5.4.3).

The results of post-construction monitoring, which commenced in full in 2014, provide further confirmation of the conservative nature of the design parameters, supporting the view that the Incremental Changes Offset Program should be regarded as a contingency measure.

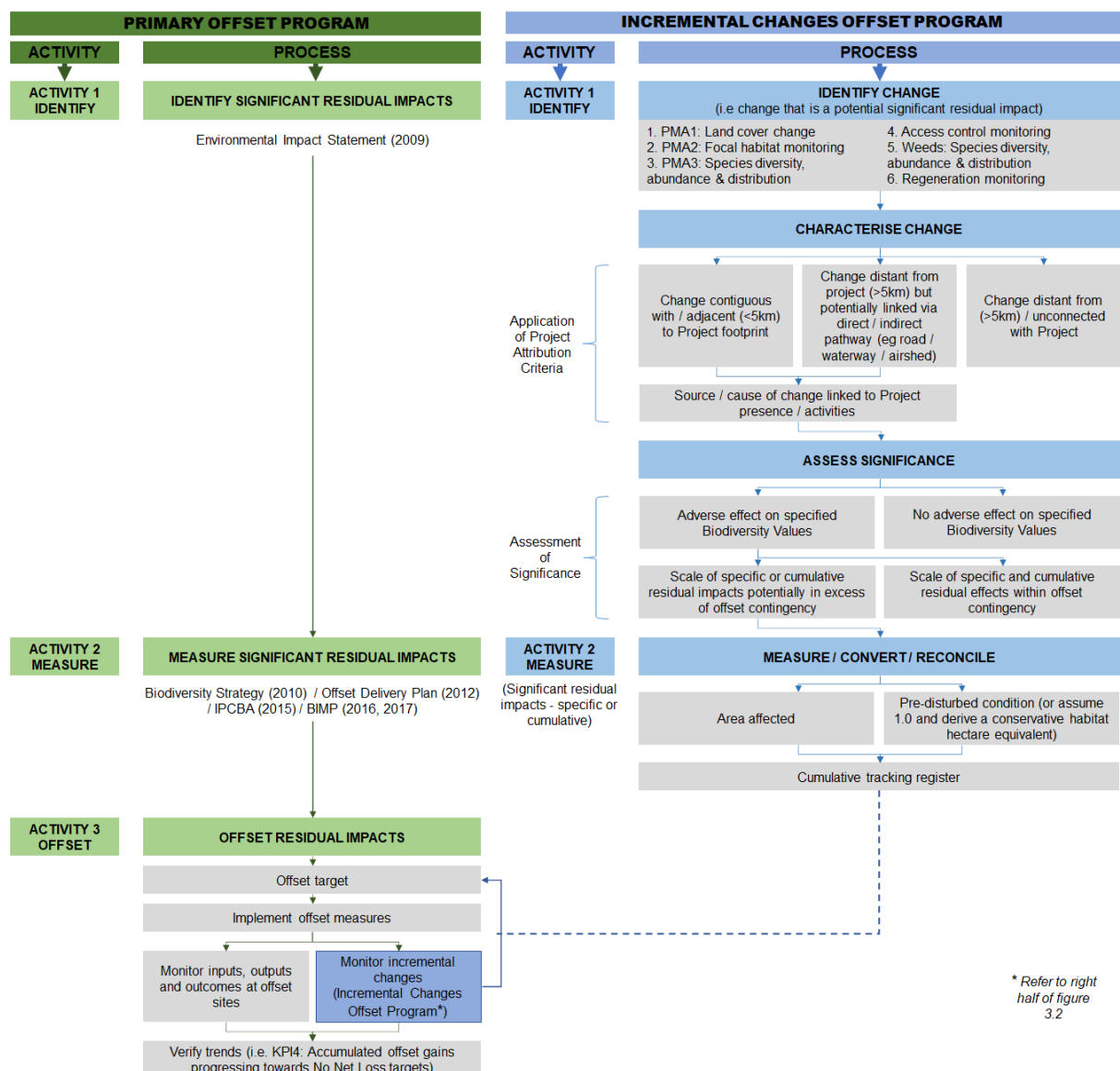


Figure 3-2: Biodiversity Strategy Objective 4: Framework and Approach

3.2 Indicators

The effectiveness of the implementation of mitigation measures, and the outputs and outcomes relative to the Biodiversity Strategy objectives, are monitored via a set of KPIs and supporting indicators.

Establishment of appropriate KPIs and underlying indicators is crucial to the evaluation process. KPIs were selected to reflect the values and objectives defined in the Biodiversity Strategy but may be modified in response to monitoring results, changing circumstances and lessons learned (for example, practicality, interpretability, usefulness).

Criteria for choosing KPIs are summarised in Table 3-1 and the KPIs, supporting indicators and relevant objectives are presented in Table 3-2.

Table 3-1: KPI Selection Criteria

Criteria	Key Requirements
Scope	Relate to the Biodiversity Strategy goal and objectives, inputs, outputs and outcomes
Relevance	Provide information directly relevant to the objectives of the Biodiversity Strategy, the biodiversity values of the Upstream area, the effectiveness of mitigation measures, the significant residual impacts, and the status of high-value biodiversity
Sensitivity	Sensitive to significant change, recognizing natural variability
Clarity	Clear and unambiguous
Reliability	Based on precise and accurate data that is free from bias and can be repeatedly obtained and consistently interpreted.
Measurability	Enable confirmation of the extent to which results and objectives have been achieved
Proportionate	Proportionate to impact significance and potential for management intervention/control, taking account of short- and long-term cost benefit
Cost-benefit	Low incremental measurement cost relative to information provided

3.3 Priorities

The priorities of the BIMP are twofold:

- Monitor the implementation of mitigation measures and supporting activities associated with known and potential residual impacts on high value biodiversity and the ecological processes supporting these values, with the type, extent and frequency of monitoring being commensurate with risk and potential impact
- Track progress towards achieving No Net Loss of biodiversity in the Upstream area.

Table 3-2: Monitoring Framework

BIODIVERSITY STRATEGY OBJECTIVE	BIODIVERSITY VALUE	KPI	SUPPORTING INDICATOR	MONITORING PROGRAM
1. MAINTAIN THE INTACTNESS OF THE UPSTREAM AREA AS A WHOLE The long-term maintenance of biodiversity in the Upstream area, within a natural range of variation, requires the long-term functioning of the constituent ecosystems	LARGE SCALE: THE ENTIRE UPSTREAM AREA			
	Extensive intact forest The Upstream area encompasses large expanses of largely undisturbed tropical forest	1 – Intactness of forest	No evidence of broadscale forest loss or degradation attributable to PNG LNG	PMA1, EMP Access Control, EMP Regeneration Monitoring
	High floristic diversity Between 6000 and 12,000 species of plants may exist in the Upstream area, with epiphytes making up 75 percent of floristic diversity in upland forests	2 – Trends in species diversity and abundance	No evidence or trend indicating a decline of floristic diversity, or a shift in species composition, attributable to PNG LNG	PMA3
	High faunal diversity Over 700 species of terrestrial vertebrates have been recorded to date	2 – Trends in species diversity and abundance	No evidence or trend indicating a decline of faunal diversity, abundance of target species, or a shift in species composition attributable to PNG LNG	PMA3
	Endemic species 75 percent of non-volant mammals, 40 percent of birds and over 90 percent of frogs found in the upstream area are endemic to New Guinea.	2 – Trends in species diversity and abundance	No evidence or trend indicating a decline of endemic diversity, or abundance of target endemic species, attributable to PNG LNG	PMA3
	Unique assemblages of species The Upstream area is recognised for its high diversity of birds-of-paradise and amphibians	2 – Trends in species diversity and abundance	No evidence or trend indicating a decline of component species, attributable to PNG LNG	PMA3
	Species of conservation concern Species of plants and animals classified by the IUCN as Critically Endangered or Endangered, or protected under Papua New Guinean legislation, are located in the Upstream area	2 – Trends in species diversity and abundance	No evidence or trend indicating decline of Endangered or Critically Endangered species attributable to PNG LNG	PMA3

BIODIVERSITY STRATEGY OBJECTIVE	BIODIVERSITY VALUE	KPI	SUPPORTING INDICATOR	MONITORING PROGRAM
	Biodiversity of importance to local communities for resource use and/or cultural and spiritual purposes Communities are linked to biodiversity values through their reliance on subsistence harvesting and a close physical and spiritual relationship to ancestral territories	This value is addressed through the offset program by undertaking an ecosystems services analysis to determine biodiversity values of importance to local communities and includes protection of these as part of the new and/or enhanced WMA(s)		
2. CONSERVE PRIORITY ECOSYSTEMS Some PNG LNG infrastructure is located within priority ecosystems, and therefore it is necessary to demonstrate that these ecosystems do not degrade as a result of construction and/or production activities	MEDIUM SCALE: PRIORITY ECOSYSTEMS			
	Forest in the Hides Ridge area: The high-altitude nothofagus forest on karst above 1800 metres harbours a diverse montane fauna in a largely undisturbed tropical forest. Biological values are naturally maintained by the remoteness and difficulty of access			
	Largely undisturbed forest	1 – Intactness of forest	No evidence of broadscale forest loss or degradation attributable to PNG LNG	PMA1, EMP Access Control
	Epiphytes and ferns are a major component of plant biodiversity	2 – Trends in species diversity and abundance	No evidence or trend indicating a decline of epiphyte and fern diversity or abundance attributable to PNG LNG	PMA3
	Unique assemblages of plants	2 – Trends in species diversity and abundance	No evidence or trend indicating a decline of floristic diversity or abundance, or a shift in species composition, attributable to PNG LNG	PMA3
	Caves providing suitable habitat for bats (including the Bulmer’s fruit bat)	3 – Condition of focal habitats	No evidence of degradation of caves	PMA2
	High-altitude bird-of-paradise species	2 – Trends in species diversity and abundance	No evidence or trend indicating a decline of diversity or abundance of target species attributable to PNG LNG	PMA3
	Restricted-range, endemic high-altitude bird species	2 – Trends in species diversity and abundance	No evidence or trend indicating a decline of diversity or abundance of target species attributable to PNG LNG	PMA3
	Restricted-range frog species	2 – Trends in species diversity and abundance	No evidence or trend indicating a decline of diversity or abundance of target species attributable to PNG LNG	PMA3

BIODIVERSITY STRATEGY OBJECTIVE	BIODIVERSITY VALUE	KPI	SUPPORTING INDICATOR	MONITORING PROGRAM
	Ecosystems void of invasive species (weeds and pests)	4 – Occurrence of invasive species/pathogens	No evidence or trend indicating an increase in the diversity, abundance or distribution of invasive species attributable to PNG LNG	PMA3, EMP Invasive Species, EMP Access Control, EMP Regeneration Monitoring
	Ecosystems void of dieback (pathogens)	4 – Occurrence of invasive species/pathogens	No evidence of new dieback occurrences in proximity to EMPNG activities and/or existing dieback and attributable to PNG LNG	PMA2
	High-altitude forest in the Homa area: The high-altitude forest, including nothofagus, above 1800 metres contains mature forest with a high diversity of flora and fauna. It supports one of the highest mammal diversities in the Upstream area			
	Largely undisturbed forest	1 – Intactness of forest	No evidence of broadscale forest loss or degradation attributable to PNG LNG	PMA1, EMP Access Control
	High floristic diversity	2 – Trends in species diversity and abundance	No evidence or trend indicating a decline of floristic diversity or a shift in species composition, attributable to PNG LNG	PMA3
	High faunal diversity	2 – Trends in species diversity and abundance	No evidence or trend indicating a decline of faunal diversity, or abundance of target species, or a shift in species composition, attributable to PNG LNG	PMA3
	Lake Kutubu area: Lake Kutubu is the largest perched lake in Papua New Guinea and the second largest lake in the country. It has the highest level of lacustrine endemism of any lake in the New Guinea-Australia region. Lake Kutubu is included in the Lake Kutubu WMA. The lake was listed as a Ramsar ³ wetland in 1998 and the Ramsar boundaries match those of the WMA. The Lake Kutubu WMA covers 25,455 hectares and is the only WMA that is intersected by PNG LNG facilities			
	Endemic fish species	Monitoring fish species is not currently part of the offset program or this BIMP. However, if the Lake Kutubu WMA management committee chooses to include fish conservation and monitoring activities in their work plan then EMPNG will support this work. Note that endemic fish in the lake are threatened by non-native fish species (e.g. tilapia) that were previously introduced to the region		

³ Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention).

BIODIVERSITY STRATEGY OBJECTIVE	BIODIVERSITY VALUE	KPI	SUPPORTING INDICATOR	MONITORING PROGRAM
	Largely undisturbed forest	1 – Intactness of forest	No evidence of broadscale swamp forest loss or degradation attributable to PNG LNG	PMA1
	Forest in the Juha area: Juha is a remote region where there has been little human influence on the vegetation and fauna, and its ecological values are maintained primarily due its remote location and difficult accessibility. Among biodiversity values specifically represented in this area, Juha contains notable concentrations of unique assemblages of frog species. Juha is the location of a future development phase of PNG LNG.			
3. PROTECT FOCAL HABITATS	SMALL SCALE: FOCAL HABITATS			
Focal habitats and significant ecological features have been avoided or otherwise managed during construction, and in production, so that the risks of reducing a population of Critically Endangered or Endangered species are as low as practicable	Caves and pinnacles Provide important habitats for certain bat species such as the Critically Endangered New Guinea big-eared bat (<i>Pharotis imogene</i>), and caves with large entrances in the upland area support colonies of large bats, potentially including the Critically Endangered Bulmer's fruit-bat (<i>Aproteles bulmerae</i>)	3 – Condition of focal habitats	No evidence of degradation of caves attributable to PNG LNG	PMA2
	Sinkhole swamps Microhabitats at the bottom of dolines, including swamps in sinkholes less than 50 metres deep, in high-altitude karst on Hides Ridge, the only habitats where water-dependent frogs can breed in karst, which tends to have few flowing streams	3 – Condition of focal habitats	No evidence of degradation of sinkhole swamps attributable to PNG LNG	PMA2
	Upland streams Torrent-dwelling frogs require fast-flowing, clear and rocky streams. Riparian vegetation along such streams supports birds such as Salvadori's teal (<i>Salvadorina waigiensis</i>) and the torrent-lark (<i>Grallina bruijn</i>)	3 – Condition of focal habitats	No evidence or trend of degradation of upland streams attributable to PNG LNG	PMA2

BIODIVERSITY STRATEGY OBJECTIVE	BIODIVERSITY VALUE	KPI	SUPPORTING INDICATOR	MONITORING PROGRAM
	Swamps and mangroves Including areas of pandanus, sago swamp forest or mangroves, support a range of specialist vertebrates, including the twelve-wired bird-of-paradise (<i>Seleucidis melanoleuca</i>), and the New Guinea flightless rail (<i>Megacrex inepta</i>). Swamp forests may provide an important breeding habitat for freshwater turtles and crocodiles. High-value conservation swamps in the Lower Kikori contain habitats for fish nurseries	3 – Condition of focal habitats	No evidence or trend of degradation of swamp forest or mangroves attributable to PNG LNG	PMA2
	Stream refuges in unstable landscapes In unstable terrain where landslides are common, areas of more mature habitat on pockets of more stable substrates such as in stream heads or small plateaus can act as refuges for flora and fauna	3 – Condition of focal habitats	No evidence of degradation of stream refuges in unstable landscapes attributable to PNG LNG	PMA2
	Lowland rivers in stable landscapes Provide habitat for crocodiles and freshwater turtles, and some bird species are abundant, including kingfishers and shining flycatchers (<i>Myiagra alecto</i>)	3 – Condition of focal habitats	No evidence of degradation of lowland rivers in stable landscapes attributable to PNG LNG	PMA2
	Off-river waterbodies Stable habitat type that provides refuge areas and offers habitat for the breeding of New Guinea freshwater crocodiles (<i>Crocodylus novaeguineae</i>). It is created by localised damming of runoff by landslides	3 – Condition of focal habitats	No evidence of degradation of off-river waterbodies attributable to PNG LNG	PMA2
	Flora, fauna and habitats of cultural significance Culturally significant areas, habitats and species occur throughout and surrounding settled areas in the Upstream area, varying from small swamps said to harbour spirits, to places where medicinal plants are harvested	3 – Condition of focal habitats	No evidence of degradation of habitats, flora and fauna of cultural significance attributable to PNG LNG	PMA2

BIODIVERSITY STRATEGY OBJECTIVE	BIODIVERSITY VALUE	KPI	SUPPORTING INDICATOR	MONITORING PROGRAM
	Lekking trees or grounds Bird-of-paradise or bowerbird display trees or grounds	3 – Condition of focal habitats	No evidence of degradation of lekking trees or grounds attributable to PNG LNG	PMA2
4. IDENTIFY, MEASURE AND OFFSET SIGNIFICANT RESIDUAL IMPACTS Impacts to those biodiversity values that were assessed as being significant and that cannot be avoided or otherwise managed (residual impacts) are remedied through an offset approach, to ensure No Net Loss of biodiversity.	Those biodiversity values that were assessed as being significant and that cannot be avoided or otherwise managed (residual impacts)	5 - Accumulated offset gains progressing towards No Net Loss targets.	N/A	PMA4
			Enhanced conservation-enabling environment within government, educational intuitions and local communities, through engagement, capacity building and related support programs	PMA4
			Identification of offset sites in the High, Medium and Lower elevation zones.	PMA4
			Adherence to offset program framework stakeholder engagement activities	PMA4
			Establishment of formal agreements (e.g. Conservation Deeds) in the High, Medium and Lower elevation zones	PMA4
			Developed/updated enhancement/ management plans.	PMA4
			Progressive, phased community support commensurate with the priorities and implementation status of Protected Area management plans.	PMA4
			Averted loss and restoration gains	PMA4

4.0 MANAGEMENT, MONITORING AND EVALUATION OF RESIDUAL IMPACTS

4.1 Programmed Monitoring Activity 1: Remote Sensing of Broadscale Land Cover

4.1.1 Objectives and Indicators

PMA1 involves using remote sensing imagery to collect and analyse data relating to broadscale land cover changes in the Upstream area, and, in combination with ground-truth surveys, determines whether such changes are attributable to PNG LNG.

Specific objectives of PMA1 are to:

- detect and map changes to land cover in the Upstream area
- determine which changes to land cover result from natural processes (for example landslides, changes in river morphology) and those that result from anthropogenic processes
- distinguish between observed anthropogenic processes such as road construction, logging, agriculture, settlement and other activities
- monitor habitat condition in areas that form part of the offset program
- determine which observed anthropogenic processes are attributable to EMPNG and hence represent residual impacts.

PMA1 provides data with which to evaluate fulfilment of Objectives 1, 2 and 4 of the Biodiversity Strategy (Table 1-1).

The KPI, supporting indicator and data/measurement requirements for PMA1 are presented in Table 4-1.

Table 4-1: PMA1 KPI, Supporting Indicator and Data/Measurement

KPI	SUPPORTING INDICATOR	DATA/MEASUREMENT
KPI 1: Intactness of forest	No evidence of broadscale forest loss or degradation attributable to PNG LNG	Forest cover derived from satellite imagery expressed as a percentage

PMA1 data collection, processing and analysis requires specialist technical expertise and is therefore contracted to a specialist organisation, namely the PMA1 Contractor.

4.1.2 Baseline conditions

To detect, monitor and interpret changes to land cover over time through PMA1, it was necessary to establish a baseline against which to measure change over time.

Baseline conditions in the Upstream area were established using moderate spatial resolution satellite imagery (Landsat 5) prior to the commencement of the construction phase. Key land cover or land use categories included undisturbed terrestrial and wetland forest, agriculture (cropped areas and areas under fallow), human settlements, landslides, and existing industrial infrastructure and roads.

4.1.3 Approach

Area of Interest

PMA1 detects, quantifies and reports on changes in land cover within the Upstream area. The Area of Interest has evolved over time, initially comprising the entire Upstream area (as defined in Section 1.3.1) and a buffer zone which collectively covered 35,930 square kilometres. A linear infrastructure corridor was subsequently delineated within the Upstream area to apply greater scrutiny to areas in close proximity to PNG LNG facilities.

The target area was redefined in 2019 to cover the linear infrastructure corridor, portions of the Upstream area containing priority ecosystems, the Lower Kikori region in the south, and

known earthquake-affected regions near the linear infrastructure corridor. In addition, a previously unassessed portion of the Lower Kikori region lying west of the Omati River was added to the southwest portion of the assessment area (Figure 4.1).

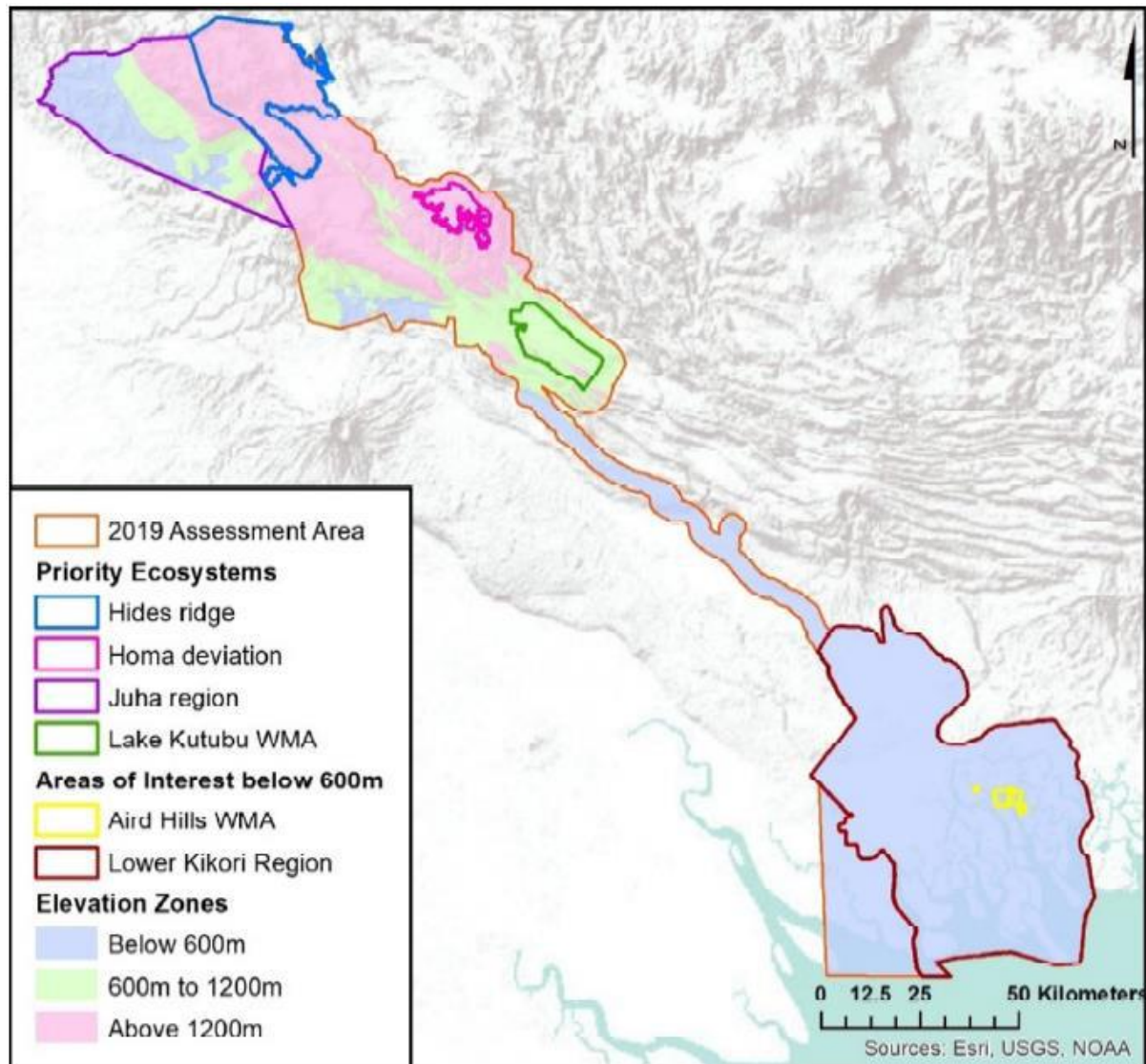


Figure 4-1: PMA1 Assessment Area

Land cover monitoring

Land cover categories that are monitored are undisturbed terrestrial forest and undisturbed wetland forest, with the results informing KPI 1 (Intactness of forest) and the supporting indicator (No evidence of broadscale forest loss or degradation attributable to PNG LNG).

Monitoring of land cover change is achieved using a combination of satellite imagery sources including Sentinel-1, Sentinel-2a, Sentinel-2b (Sentinel-2).

Two separate change detection processes are used. Radar Persistent Change Monitoring (RPCM) identifies change at a Minimum Mapping Unit of 20 m utilizing the SAR instruments from Sentinel-1. Synthetic Aperture Radar (SAR) uses the microwave region of the electromagnetic spectrum and is cloud penetrating, which is ideal for persistently cloudy areas such as Papua New Guinea. Sentinel-1 captures repeat looks every ~10 days. Two-date Optical change detection is an image-based change detection process that uses scale-and-sensor-independent algorithms to highlight areas of vegetation change and human activity.

By drawing immediate attention to areas of change, Two-date Optical change detection eliminates the need to manually scan imagery for feature change⁴.

To collect areas of change seen in optical/multispectral data, and selected “early” and “late” date 10 m Sentinel-2 images covering the target area are used. The date range for early and late date imagery is designed to maximize cloud-free coverage and is as follows:

- Early date: imagery collected between 1 December in the year prior to the assessment year and 31 January 31 of the year of the assessment
- Late date: 1 December of the assessment year and 31 January following the assessment year.

Once RPCM and Two-date Optical change layers are produced, editing and visual verification is performed by referencing a large stack of Sentinel-2 imagery as well as additional high resolution imagery where available/applicable. Regions of significant change are visually verified, and some polygons are manually edited for accuracy. New change polygons⁵ are drawn where both radar and Two-date Optical change data are incomplete based on visual inspection. Overlapping change features (identified using radar or optical data) are then combined for measurement and reporting purposes.

New change polygons that exceed 1 ha are recorded and assessed in terms of their proximity to PNG LNG facilities, with proximity being an indicator of potential association or attribution to PNG LNG. Evidence of disturbances to land cover resulting from natural processes (e.g., landslips) is also assessed.

New change polygons that are proximate to PNG LNG facilities but show no signs of resulting from natural processes are recorded as priority inspection areas, requiring field assessment to determine whether the change can be attributed to PNG LNG and therefore deemed a residual impact. Individual change polygons below the significant change Minimum Mapping Unit of 1 ha are also recorded and monitored in subsequent years to see whether the area of change expands to exceed 1 ha and therefore qualify as a priority inspection area. The recording and subsequent monitoring of change polygons <1 ha also allows the cumulative total to be tracked as part of the incremental changes component of the offset program (Figure 3-2).

The land cover monitoring component of PMA1 is also used to to evaluate the ‘non-protection’ counterfactual (Section 5.4.3).

Habitat condition monitoring

Habitat condition monitoring is confined to offset sites within the Upstream area and has the objective of detecting regeneration that has occurred within designated offset areas, commencing from the date when the offset was established. This activity informs KPI 5 (Accumulated offset gains progressing towards No Net Loss targets) and the restoration component of the supporting indicator (Averted loss and restoration gains).

The land cover categories and corresponding habitat condition scores that form the basis of this assessment are summarized in Table 4-1, with categories 4-9 being the main focus given that it is these that have the potential to improve in condition as a result of the designation of the offset area and implementation of the associated management plan.

Land cover categories 2 and 3 are the same as those monitored in the land cover component described above. It is expected that the condition of these land cover types will remain as 1.0

⁴ Data from Sentinel-1 SAR (20 m resolution) and Sentinel-2 (10 m resolution) satellites is used for RPCM and Two-date Optical change detection, respectively. Sentinel data is subject to a thorough verification and validation process regarding geometric and positional accuracy, thereby mitigating potential georeferencing offsets and facilitating repeated assessments and change detection. Sentinel imagery provides an optimal combination of wide-area coverage and resolution necessary to map small-scale features over time.

⁵ New change polygons are defined as those where land cover has changed sufficiently from the previous assessment period to be detectable

in a offset/protected area regime. However, in the event clearing occurs in these or any categories, it is detected in the land cover monitoring component of PMA1, whereas if degradation occurs in any category, it is detected via the habitat condition monitoring component. In both cases the change is taken into account when calculating offset accruals.

Further details regarding PMA1 are provided in the PMA1 Protocol.

Table 4-1: Land cover categories and corresponding habitat condition scores

PMA1 LAND COVER CATEGORIES		DESCRIPTION	HABITAT CONDITION SCORE FOR NO NET LOSS HABITAT HECTARE METRIC
1	Wetland	Waterways, lakes, bays, estuaries	1
2	Terrestrial Forest	Forested areas with canopy Located on a range of slopes	1
3	Wetland Forest	Forested and grassland areas on low-lying areas	1
4	Modified Forest	Areas which appeared to be experiencing change to vegetation health (positive or negative) and were spectrally dissimilar to neighbouring communities	0.5
5	Easements	Land without vegetation cover Aligned with the vector dataset generated from the source imagery	0.0
8	Non-vegetated	Land predominantly without vegetation cover Could include both natural exposed soil and clearing from anthropogenic activity	0.0
9	Vegetated	Land predominantly with vegetation cover, including grass clearings and land being used for agriculture (including fallow). May contain linear tracks with vegetated cover Will include mixed areas with higher levels of vegetation	0.0
10	Logging	Potentially disturbed terrestrial or wetland forest, identified from context and texture	0.5
11	Mixed	Low levels of vegetation material in close proximity to cleared areas. May contain regrowth and mixed land cover classes with areas below the Minimum Mappable Unit (MMU)	0.0

4.1.4 Reporting

The output from each PMA1 campaign is a technical report prepared by the PMA1 Contractor. This report provides information, supported by maps at an appropriate scale, documenting and describing land cover changes observed within the PMA1 area since the previous campaign, with an analysis of trends where applicable, and land cover and habitat condition changes in designated offset areas. Findings summarised in the publically disclosed PNG LNG Environmental and Social Report series.

4.1.5 Frequency

Data collection, processing, analysis and reporting under PMA1 has been undertaken every two years from 2009 – 2018 and annually since 2019. The frequency is predominantly determined by rate of observed change and may be reviewed subject to monitoring results.

4.2 Programmed Monitoring Activity 2: Condition Surveys of Focal Habitats and Significant Ecological Features

4.2.1 Objectives and Indicators

The objective of PMA2 is to assess the condition and ecological functionality of focal habitats and significant ecological features avoided during the construction of PNG LNG-related roads, the pipeline ROW and other relevant PNG LNG facilities and infrastructure. Periodic surveys provide data to enable the evaluation of performance with regard to Objectives 2 and 3 of the Biodiversity Strategy.

The KPIs, supporting indicators and data/measurement requirements for PMA2 are presented in Table 4-2.

Table 4-2: PMA2 KPIs, Supporting Indicators and Data/Measurement

KPI	SUPPORTING INDICATOR	DATA/MEASUREMENT
KPI 3: Condition of focal habitats	No evidence of degradation of caves attributable to PNG LNG	Presence of caves providing suitable habitat for bats Condition of caves
	No evidence of degradation of sinkhole swamps attributable to PNG LNG	Condition of sinkhole swamps
	No evidence of degradation of lekking trees or grounds attributable to PNG LNG	Condition of lekking trees or grounds
	No evidence or trend of degradation of upland streams attributable to PNG LNG	Condition of upland streams
	No evidence or trend of degradation of swamp forest or mangroves attributable to PNG LNG	Condition of swamp forest and mangroves
	No evidence of degradation of stream refuges in unstable landscapes attributable to PNG LNG	Condition of stream refuges in unstable landscapes
	No evidence of degradation of lowland rivers in stable landscapes attributable to PNG LNG	Condition of lowland rivers in stable landscapes
	No evidence of degradation of off-river waterbodies attributable to PNG LNG	Condition of off-river waterbodies
	No evidence of degradation of habitats, flora and fauna of cultural significance attributable to PNG LNG	Condition of habitats, flora and fauna of cultural heritage
	No evidence of degradation of lekking trees or grounds attributable to PNG LNG	Condition of lekking trees or grounds
KPI 4: Occurrence of invasive species/pathogens	No evidence of new dieback occurrences in proximity to EMPNG activities and/or existing dieback and attributable to PNG LNG	Dieback classified as modified terrestrial forest, based on ground observations

4.2.2 Baseline conditions

Focal habitats and significant ecological features within, and in the immediate vicinity of, the pipeline ROW and other PNG LNG facilities and infrastructure were identified during pre-construction surveys and categorised as follows:

- caves and pinnacles
- sinkhole swamps
- upland streams
- swamps and mangroves
- stream refuges in unstable landscapes⁶
- lowland rivers in stable landscapes
- off-river waterbodies
- flora, fauna and habitats of cultural significance
- lekking trees or grounds.

Details of the baseline conditions of the focal habitats and significant ecological features identified during the pre-construction survey program are maintained in a Focal Habitats and Significant Ecological Features Register and EMPNG's Geographic Information System (GIS) database.

4.2.3 Approach

Direct impacts to focal habitats and significant ecological features during normal operations are expected to be negligible, therefore the focus during production is monitoring for potential indirect residual impacts from the construction phase, recognising that such impacts may manifest, evolve or persist post-construction.

Details of focal habitats and significant ecological features requiring ongoing monitoring are also maintained in the Focal Habitats and Significant Ecological Features Register, which forms the basis of PMA2. EMPNG field environmental personnel oversee an ongoing program of routine inspections and monitoring activities, as well as PMA2-specific data collection.

Not all focal habitats and significant ecological features identified as part of the pre-construction survey program and the Initial Post Construction Biodiversity Assessment (PNG LNG, 2015) require ongoing monitoring. Only those located in the immediate vicinity of the pipeline ROW and other PNG LNG facilities and infrastructure, or those that are otherwise potentially vulnerable to residual impacts that may evolve or manifest during production, need monitoring.

Where new or additional land beyond the construction footprint is required, a pre-disturbance survey of the area to be affected (similar in scope to the pre-construction surveys) will be undertaken. Should new focal habitats or significance ecological features be identified, these will be added to the Focal Habitats and Significant Ecological Features Register and GIS database

Inspection and monitoring is undertaken through a defined schedule of activities in accordance with a protocol based on the Focal Habitats and Significant Ecological Features Register. Inspections consist of ground-based surveys for assessment and verification against a set of criteria (Table 4-3). Ground truthing of priority inspection zones identified in PMA1 is also undertaken as part of PMA2 activities.

⁶ Applicable to the Juha future phase of PNG LNG.

Cultural heritage sensitivities and invasive species (including plant pathogens) identification, for selected Focal Habitats and significant ecological features are also addressed in this scope.

Observed changes in condition are assessed according to a set of risk and response criteria as described in Section 6.

Table 4-3: Focal habitats and significant ecological features monitoring criteria

FOCAL HABITATS AND SIGNIFICANT ECOLOGICAL FEATURES	CONDITION EVALUATION CRITERIA
Caves and pinnacles	Evidence of human interference, including recording evidence of trails leading to caves and footprints at cave entrances
Sinkhole swamps	Evaluation of sinkhole swamps, including water depth and cover of aquatic plants; evidence of human interference such as trails leading to the sinkhole swamp
Upland streams	Evaluation of upland streams, including condition of riverine vegetation and evidence of erosion and/or sedimentation
Swamps and mangroves	Evaluation of swamp forest and mangroves, including the general condition of vegetation and evidence/cause of disturbance
Stream refuges in unstable landscapes ⁷	Evaluation of stream refuges including the general condition of vegetation and evidence/cause of disturbance
Lowland rivers in stable landscapes	Evaluation of lowland rivers including the condition of riverine vegetation and evidence of erosion and/or sedimentation
Off-river waterbodies	Evaluation of off-river waterbodies, including the general condition of vegetation and evidence/cause of disturbance
Flora, fauna and habitats of cultural significance	Evaluation of the general condition of the culturally significant feature and evidence/cause of disturbance Evaluation will include cultural heritage features however subsistence features such as prey fauna species and harvest flora species will not be evaluated
Lekking trees or grounds	Evaluation of condition based on evidence of recent use or disturbance

4.2.4 Reporting

The output from each PMA2 monitoring campaign is a report. This report provides information, supported by appropriate data, which documents and evaluates the condition of relevant focal habitats and significant ecological features. A summary of the report will be provided in the public annual PNG LNG Environmental and Social Report series.

4.2.5 Frequency

PMA2 is an ongoing program of regular inspections. Evidence obtained during inspections will be used to assess the frequency and scope of future monitoring events at each focal habitat and/or significant ecological feature. Where there is evidence to conclude that there has been no impact on a specific focal habitat or significant ecological feature, and that none is likely, then monitoring will be scaled back and will ultimately cease. Similarly, where an impacted site has recovered close to its original condition, monitoring will cease.

⁷ Applicable to the Juha future phase of PNG LNG.

4.3 Programmed Monitoring Activity 3: Biodiversity Surveys

4.3.1 Objectives and Indicators

PMA3 is a program of terrestrial biodiversity surveys designed to collect and analyse data relating to trends in species diversity and abundance in the Upstream area, as well as protected areas enhanced and/or established as part of the offset program in order to:

- ascertain the ongoing health of habitats and fauna to ensure any negative impacts associated with EMPNG are identified and managed
- monitor the health and condition of the biological values of protected areas forming part of the offset program
- provide data to enable the evaluation of performance for Objectives 1, 2 and 4 of the Biodiversity Strategy.

The KPIs, supporting indicators and data/measurement requirements for PMA3 are presented in Table 4-4.

Table 4-4: PMA3 KPIs, Supporting Indicators and Data/M Measurement

KPI	SUPPORTING INDICATOR	DATA/MEASUREMENT
KPI 2: Trends in species diversity and abundance	No evidence or trend indicating a decline of floristic diversity, or a shift in species composition, attributable to PNG LNG	Species inventory (types, diversity and abundance of floristic species)
	No evidence or trend indicating a decline of faunal diversity, abundance of target species, or a shift in species composition attributable to PNG LNG	Species inventory (types, diversity and abundance of faunal species)
	No evidence or trend indicating a decline of endemic diversity, or abundance of target endemic species, attributable to PNG LNG	Species inventory (types, diversity and abundance of endemic species)
	No evidence or trend indicating a decline of component species, attributable to PNG LNG ⁸	Species inventory (types, diversity and abundance of species)
	No evidence or trend indicating decline of Endangered or Critically Endangered species attributable to PNG LNG	Species inventory (type, and abundance of Endangered/Critically Endangered species)
	No evidence or trend indicating a decline of diversity or abundance of target species attributable to PNG LNG ⁹	Species inventory (types, diversity and abundance of target species)
KPI 4: Occurrence of invasive species/pathogens	No evidence or trend indicating an increase in the diversity, abundance or distribution of invasive species attributable to PNG LNG	Invasive species inventory (types, diversity, abundance and distribution)

PMA3 requires appropriate technical expertise, and therefore a specialist organisation, namely the PMA3 Contractor, has been engaged to perform the required tasks.

⁸ With regard to the unique assemblages species biodiversity value

⁹ For example, hunting sensitive mammals including tree kangaroos and echidnas

4.3.2 Baseline Conditions

The first PMA3 biodiversity surveys were conducted during 2015 in two Biodiversity Assessment Areas (BAA), one established at Hides Ridge (BAA 1) and the other on the Agogo Range near Moro (BAA 2). These BAAs were delineated following a review of data collected from a range of biodiversity studies, as described in the Biodiversity Strategy, and including the EIS (Esso Highlands Limited, 2009), and pre-construction surveys.

4.3.3 Approach

There is no single species or group that could be used as an indicator across the range of biodiversity values identified for the Upstream area, and therefore EMPNG considers that systematic biodiversity assessments represent the most effective way to monitor these values. Efficiency of monitoring requires adapting and evolving techniques to local circumstances, and changing the bias of methods in real time to maximise the chances of recording as many species as possible in the time available.

PMA3 uses field surveys to collect quantitative, repeatable data on species presence for monitoring of biodiversity in and around the areas affected by PNG LNG, and in protected areas established or enhanced as part of EMPNG's offset program. To achieve repeatability, biodiversity surveys are being conducted across monitoring transects broadly grouped into BAAs representative of areas where EMPNG has infrastructure.

PMA3 work scope includes:

- The two BAAs referred to above and shown in Figure 4-2) comprising:
 - six monitoring transects to represent high-altitude ecosystems (Hides Ridge)
 - five monitoring transects to represent medium-altitude ecosystems (Agogo Range)
- Protected areas enhanced and/or established as part of the offset program.

Additional BAAs may be established in the future, if required, to sample low-altitude ecosystems where EMPNG has infrastructure.

Sampling and development of species inventories are conducted using a range of quantitative and repeatable techniques that enable appropriate comparisons between sampling periods. Most sampling is conducted on standardised transects with sampling points at increasing distances into the forest from the edge of a PNG LNG road or ROW. Camera trapping techniques are also deployed. These do not use standardised transects.

Core fauna sample groups for PMA3 include native mammals, rodents, bats, birds and frogs. Details of field techniques for each group of fauna are provided in the PMA3 Protocol.

Permanent plots were established to monitor changes in plant diversity and vegetation structure as part of PMA3. This program was discontinued after the 2015 survey, with these aspects being covered by ongoing EMP programs, specifically, vegetation regeneration monitoring, and invasive weeds and plant pathogens.

Further details on monitoring methods are provided in the PMA3 Protocol.

4.3.4 Reporting

Data on species occurrence and abundance allow assessment and reporting of:

- total species richness at each site for each taxon group
- changes in species richness at each site over time
- changes in community composition over time (e.g. are disturbance-tolerant species becoming a larger proportion of the community, even if total diversity remains the same or is increasing)

- changes in abundance of target species over time (for example hunting sensitive IUCN-listed or Papua New Guinea protected species) identified for monitoring during the first field survey
- differences between changes in species diversity and abundance (if any) documented at sites close to, and away from, the pipeline ROW and roads over time
- the colonisation of invasive species, with a particular focus on rodents.

The output from each PMA3 campaign is a technical report, compiled by the PMA3 Contractor, which provides information describing the biodiversity surveys conducted and their findings. The reports provide an assessment of the general condition of forest in the Biodiversity Assessment Areas. They also describe and provide expert advice on the significance of any trends in species diversity, component species, and species abundance that are not within normal expected variation and that are likely to be attributable, directly or indirectly, to EMPNG. Where appropriate the PMA3 Contractor will provide advice on actions to mitigate any ongoing impacts on flora and fauna.

A summary of key results are provided in the PNG LNG annual Environmental and Social Report series.

4.3.5 Frequency

Data collection, processing, analysis and reporting under PMA3 started in 2015 and is undertaken every other year. Additional and/or more frequent surveys may be undertaken as required.

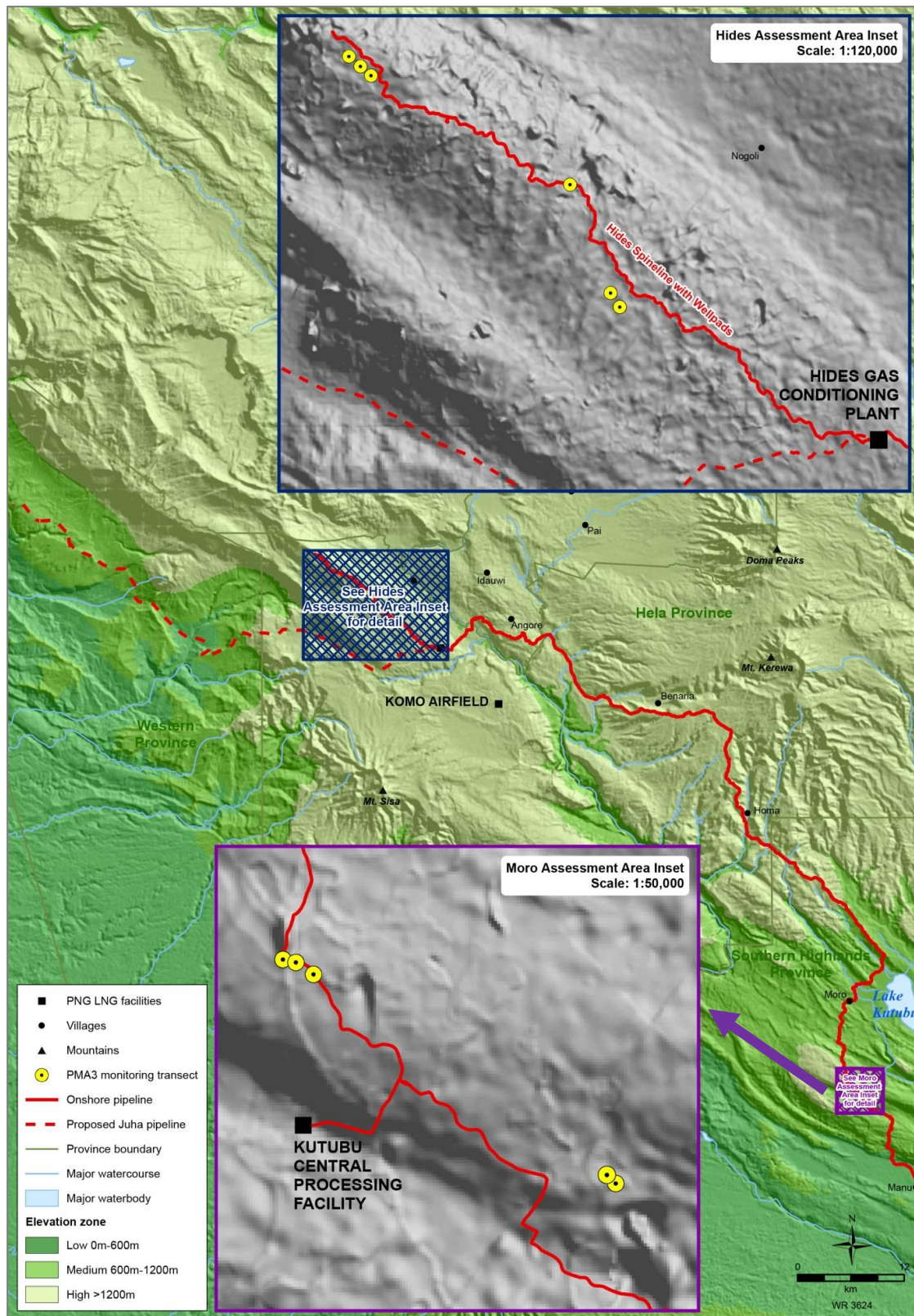


Figure 4-2: PMA3 Monitoring Transects

5.0 OFFSET PROGRAM: IMPLEMENTATION AND MONITORING

5.1 Objectives and Indicators

PMA4: Efficacy of Biodiversity Offsets establishes the process EMPNG is following to monitor and evaluate the offset program outlined in the Biodiversity Strategy. It provides the means for demonstrating No Net Loss of biodiversity in the Upstream area through a combination of qualitative and quantitative assessment methods and comprises a implementation phase and a monitoring phase.

PMA4 comprises five components, many of which are inter-linked, iterative and proceed in parallel. The five components of the offset program and their objectives are:

- **Component 1: Protected area planning** – Support the Papua New Guinea Conservation and Environment Protection Authority (CEPA) in the development of a Protected Area System Plan for the Kikori River Basin.
- **Component 2: Support the national biodiversity strategy** – Support CEPA in enhancing implementation of the National Biodiversity Strategy and Action Plan (NBSAP).
- **Component 3: Build conservation capacity** – Build technical capacity by contributing to the expansion of a training system aimed at developing qualified professionals across a range of disciplines that relate to the offset program.
- **Component 4: Enhance existing protected areas** – Enhance and strengthen the operation of existing WMAs in the Upstream area.
- **Component 5: Establish new protected areas** – Establish new community-based protected areas in the Upstream area that are representative of the biodiversity values recognised by EMPNG.

Components 1-5 collectively support a set of generic work activities, as outlined in the Offset Program Framework (Figure 5-1) and summarised, along with the corresponding key questions being addressed and performance indicators, in Table 5-1.

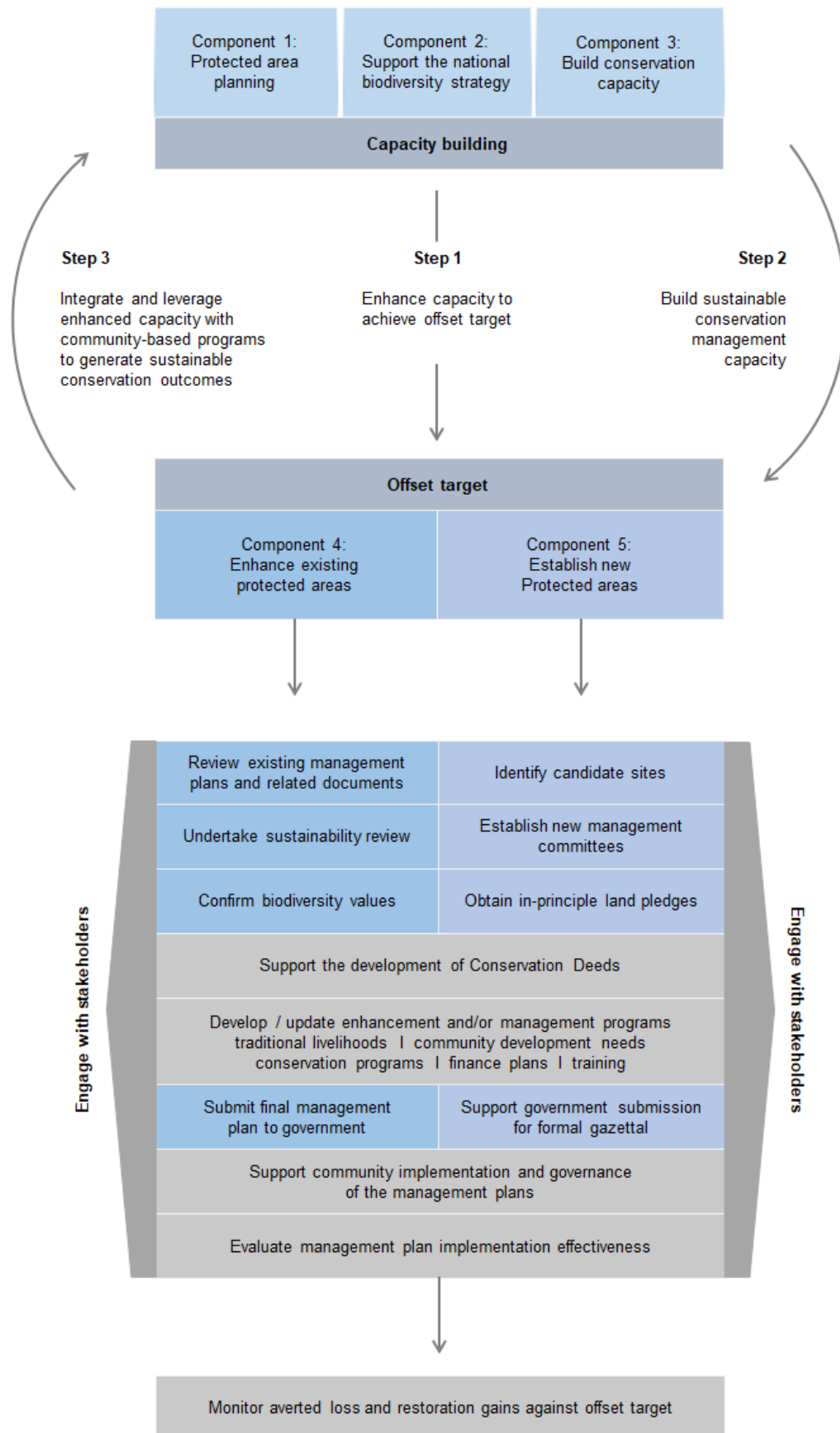


Figure 5-1: Offset Program Framework

Table 5-1: PMA4 KPI, Supporting Indicators and Data / Measurement

PMA4 KPI: Accumulated offset gains progressing towards No Net Loss targets				
PMA4 COMPONENT	KEY QUESTION BEING ADDRESSED/TARGETED	GENERIC WORK ACTIVITY¹⁰	SUPPORTING INDICATOR	DATA / MEASUREMENT
Components 1, 2 and 3	Is there a broad-based conservation-enabling environment in PNG conducive to the establishment and implementation of offset programs?	Capacity building	1. Enhanced conservation-enabling environment within government, educational intuitions and local communities, through engagement, capacity building and related support programs	Record of protected area planning Record of broad-based engagement and communications, including working groups, meetings, conferences and newsletters demonstrating support for the national biodiversity strategy Record of formal and informal conservation training programs
Component 4 and 5	Have representative offset sites been identified?	Identify candidate sites	2. Identification of offset sites in the High, Medium and Lower elevation zones	Record of identification of candidate sites

¹⁰ Refer Figure 5-1: Offset program framework

PMA4 KPI: Accumulated offset gains progressing towards No Net Loss targets				
PMA4 COMPONENT	KEY QUESTION BEING ADDRESSED/TARGETED	GENERIC WORK ACTIVITY¹⁰	SUPPORTING INDICATOR	DATA / MEASUREMENT
Components 1,2,3,4 and 5	Has initial community engagement commenced at offset sites (includes informal agreements/pledges, resource mapping, identification of conservation areas, developing community organisational structures)?	Engage with local stakeholders	3. Adherence to offset program framework stakeholder engagement activities	Record and date of engagements with local communities, relevant management committees, wards, ward development committees, local-level government, provincial government, CEPA and/or other stakeholders. Existing protected areas: - Record of review of existing management plans and related documents - Record of sustainability review - Record of confirmation of biodiversity values. New Protected areas: - Record of new management committees - Record of in-principle land pledges obtained - Record of confirmation of biodiversity values.
Components 4 and 5	What is the area covered by formal agreements (by elevation zone), e.g. Conservation Deeds, gazettal of CCAs, WMAs?	Support the development of Conservation and Benefit Sharing Agreement(s)	4. Establishment of formal agreements (e.g. Conservation Deeds) in the High, Medium and Lower elevation zones	Record of communities engaged Record of in-principle agreements Record of land pledges obtained

PMA4 KPI: Accumulated offset gains progressing towards No Net Loss targets				
PMA4 COMPONENT	KEY QUESTION BEING ADDRESSED/TARGETED	GENERIC WORK ACTIVITY¹⁰	SUPPORTING INDICATOR	DATA / MEASUREMENT
Components 4 and 5	Are management plans being effectively developed and implemented?	Support the updating / development of enhancement / management plans	5.Developed/updated enhancement/ management plans	Record of developed or updated enhancement or management plans including consideration of: • Traditional livelihoods • Community development needs • Conservation programs • Finance plans • Training. Record of submitted final management plan to the government Record of support for submission to government for formal gazettal
Components 4 and 5	Have supporting communities been identified, engaged and provided with appropriate ongoing support?	Support for communities	6. Progressive, phased community support commensurate with the priorities and implementation status of offset program	Record of support for community implementation and governance of the management plans
Components 4 and 5	What are the accrued offset gains resulting from averted loss and restoration?	Conservation outcomes	7. Averted loss and restoration gains	Record of evaluation of effectiveness of management plans (for areas covered by formal agreements only) No Net Loss position (by elevation)- accrual of areas under formal agreements commensurate with offset targets

5.2 Rationale

The success and long-term sustainability of the offset program is partly predicated by the resources and institutional capacity within Papua New Guinea to support such programs. The offset program is therefore built around a set of capacity building enablers (Components 1-3) and an execution phase (Components 4 and 5) that leverages the Papua New Guinea Policy on Protected Areas (Independent State of Papua New Guinea, 2014).

Components 1, 2 and 3 are, by their nature, discrete programs that cease when defined endpoints have been reached, as was the case for Component 1 (refer Section 5.3.1).

Components 4 and 5 form the core of the offset program by providing the mechanism whereby offset credits are accumulated through the natural restoration of degraded areas and averting losses in disturbed and undisturbed areas, leading towards the target of No Net Loss, and monitored to ascertain the rate and trajectory against this target.

5.3 Implementation

5.3.1 Component 1

Component 1 involved collaboration with CEPA to refine and extend the work done to date to identify conservation priorities for a Protected Area System Plan for the Kikori River Basin. It was completed in 2017.

Data generated by Component 1 is being used to support the establishment of legally binding agreements and formal management structures for the Kikori River Basin. CEPA is working to achieve recognition of the Kikori River Basin as a World Heritage site under the *Convention for the Protection of the World Cultural and Natural Heritage*.

EMPNG delivered Component 1 through partnership with conservation NGOs.

5.3.2 Component 2

Component 2 involves supporting CEPA in enhancing its implementation of part of the NBSAP. EMPNG is working with CEPA and a contractor to improve communications and collaboration between the scientific community and relevant stakeholders about conservation best practices using tools such as conservation meetings, conferences and regular newsletters.

Work activities developed to deliver Component 2 are summarised in Table 5-2.

Table 5-2: Component 2 Work Activities

WORK ACTIVITIES	
I	Form a work group between EMPNG and conservation NGO(s) to assist CEPA communications of best management practices in protected areas
II	Develop and distribute quarterly newsletters to share information on best management practices relating to biodiversity topics
III	Conduct biannual conservation meetings to share information on best management practices relating to biodiversity topics
IV	Conduct biology conferences to share information on best management practices relating to biodiversity topics
V	Identify sponsors to continue ongoing work designed to support communication of conservation programs

Component 2 work activities includes engagement with the NGO community to identify sponsors who can continue to work with CEPA to sustain these conservation community aspects of the NBSAP program.

5.3.3 Component 3

This component involves building technical capacity and enhancing community capacity through the development and implementation of an Enhancing Conservation Capacity Program. The Program will advance conservation efforts in Papua New Guinea by enhancing the knowledge of conservation professionals and strengthening institutions and organisations

Work activities developed to deliver Component 3 are summarised in Table 5-3.

Component 3 is being delivered through partnership with a conservation NGO.

Table 5-3: Component 3 work activities

WORK ACTIVITIES	
I	Prepare funding arrangements and undertake supporting administrative tasks to enable continuation of the Strengthening Conservation Capacity Programme
II	Recruit a Program Coordinator and Course Coordinator to fulfil the technical capacity needs of the Strengthening Conservation Capacity Programme
III	Institutionalise programs to deliver Diploma and Masters in Conservation Management degrees at the University of Papua New Guinea
IV	Award Diploma and Masters scholarships to fund tuition and fieldwork
V	Establish mentorship program including placements with field-based conservation-focused NGOs or similar organisations for conservation practitioners

5.3.4 Component 4

Component 4 involves the development and implementation of a Lake Kutubu WMA enhancement program, which establishes the basis for the medium elevation zone element of the offset program. Component 4 also includes the development of a Neiru (Aird Hills) WMA enhancement program, which establishes the basis for the low elevation zone element of the offset program (Figure 5-2). In each case the objective is to avert and/or restore losses to biodiversity values.

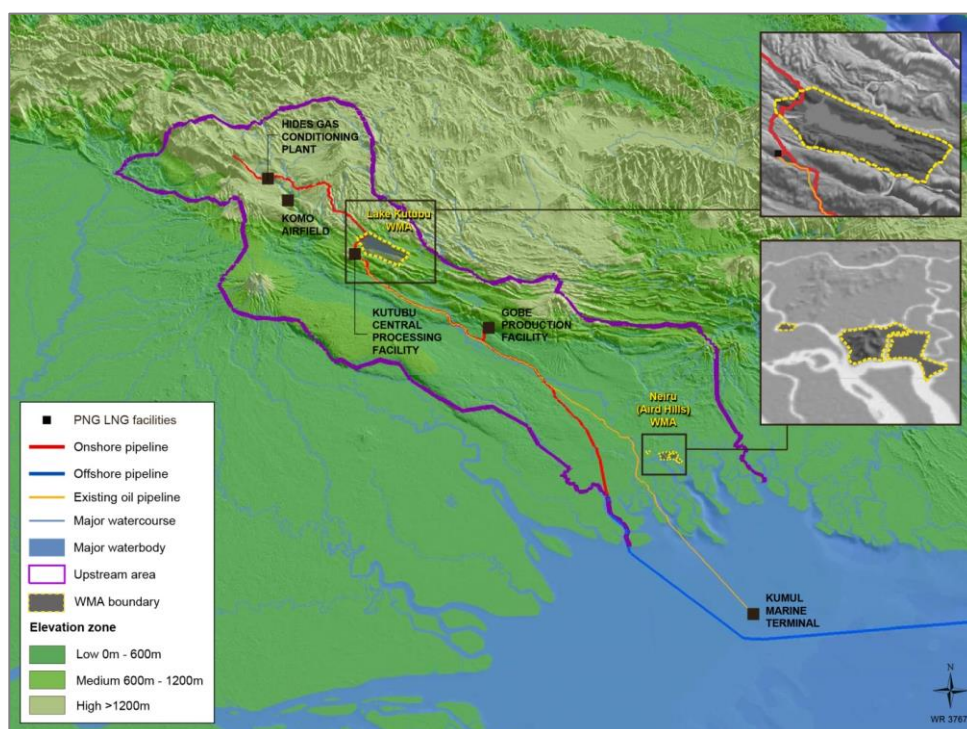


Figure 5-2: Component 4 Wildlife Management Areas

Component 4 follows a series of work activities that are common to both the Lake Kutubu and Neiru (Aird Hills) WMAs, as shown in Table 5-4. Many of these work activities overlap due to the need to work through representative community groups, such as management committees, and the inter-related nature of the activities and their various feedback mechanisms.

Table 5-4: Component 4 Work Activities

WORK ACTIVITIES		
I	Engage with stakeholders	Engage with local communities, relevant management committees, wards, ward development committees, local-level government, provincial government, CEPA and other interested parties
II	Review existing management plans and related documents	Documents for review include those prepared in support of the original gazettal (e.g. biodiversity and socioeconomic baseline studies) and those prepared following gazettal
III	Undertake sustainability review	Review existing management and organisational structures, plans, programs and priorities; community capacity, motivation and support; ecological and financial viability; community development needs and opportunities (e.g. health, education and skills development); and opportunities for enhancement
IV	Confirm biodiversity values	Confirm biodiversity values via surveys
V	Support the development of <i>Conservation Deeds</i>	Support the development of <i>Conservation Deeds</i> that recognise(s) the right of customary landowners to use their biological resources in accordance with their traditional cultural practices, while ensuring the conservation and sustainable management of their resources
VI	Develop/update enhancement and/or management programs	In conjunction with the management committees, develop/update enhancement and/or management programs to potentially include: • support for traditional livelihoods • ecosystem services analysis • community development needs • conservation programs • sustainable and equitable financing plans and instruments • training, support and empowerment of communities, customary landowners and protected area staff to sustainably manage the protected areas (ongoing process) • roles and responsibilities • monitoring and reporting
VII	Support submittal of final management plan to government	Final management plan submission to CEPA for inclusion in the National Protected Area Network
VIII	Support community implementation and governance of the management plans	Support implementation through government and non-government partnerships and ongoing monitoring and evaluation programs that focus on the following indicators: • sustainable finance mechanisms • effective governance of the WMA • achievement of conservation objectives

5.3.5 Component 5

Component 5 involves the establishment of new legally gazetted protected areas and the development of management plans to support the governance of these areas.

The existing Neiru (Aird Hills) WMA in the Kikori River delta area consists of three separate, non-contiguous areas. A conceptual option to create a new protected area that joins the existing WMA areas, and the proposed Wau Creek Protected Area, into one contiguous protected area is being evaluated. ~~At this stage, the option is conceptual, but if~~ agreed, it could form part of Component 5, representing the lower elevation zone element of the offset program. The consultation locations for the lower elevation zone element of the offset program are shown in Figure 5-3.

The evaluation of candidate sites for new protected areas in the high elevation zone element of the offset program is ongoing.

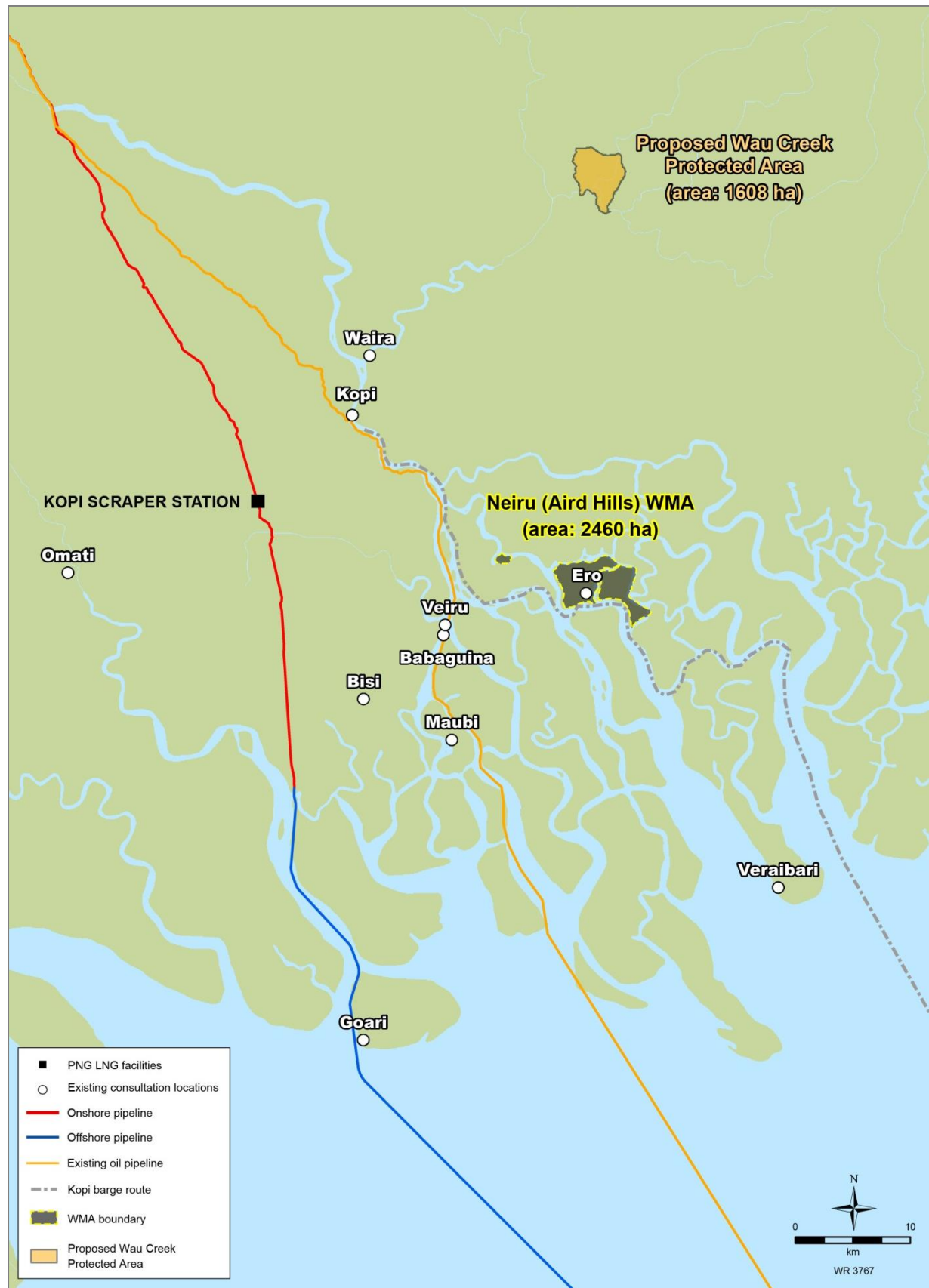


Figure 5-3: Consultation Locations Representing the Lower Elevation Zone Element

As with Component 4, Component 5 involves a series of inter-related and overlapping work activities. These are summarised in Table 5-5.

Table 5-5: Component 5 work activities

WORK ACTIVITIES		
I	Identify candidate sites and engage with stakeholders (initial)	Identify target areas within each elevation zone based on offset principles, biodiversity values and representativeness criteria, taking account of relevant information that may include: • national, provincial and local-level government development plans for the target area. Map existing mining, timber, and special agriculture and business leases in the area of interest, stakeholder and land use information, leveraging information resulting from Component 1 wherever possible • perform initial field scoping of prime candidate conservation locations through a low-profile community engagement process to determine local interest in developing a protected area within each candidate site, taking account of community interest, level of political complexity, governance capacity, motivation, and level of potential commitment where relevant • carry out follow-up field visits to the candidate sites, and conduct due diligence on governance, land tenure, and conservation opportunity
II	Engage with stakeholders (detailed)	Engage with national, provincial and local-level government and community groups: • conduct a review of community aspirations within the candidate sites, as well as individual versus communal benefits from conservation action, ensuring that the benefits of protected areas to the community are understood, allowing for informed decisions by local communities • engage with selected communities that appear to have the greatest potential for a successful outcome, recognising the need for the goals of local communities • in collaboration with the community, detail a plan of action that involves them and their local level government and other appropriate governing bodies in the design and development of the protected area
III	Establish new management committees	Establish a management committee consisting of customary landowners and communities, including both men and women, and other stakeholders with an interest in the protected area, such as: • private enterprise • NGOs interested in the area • CEPA representatives • local-level and provincial government representatives Assist the committee, as needed, in developing a management committee charter, which includes: • organising and facilitating stakeholder and public input into the planning process • facilitating the appointment of staff and ensure appropriate working conditions and training opportunities • ensuring that benefits and opportunities are equitably distributed to customary landowners and communities • periodic assessment of management effectiveness • a list of roles and responsibilities including appropriate checks and balances • a budget planning process
IV	Obtain in-principle land pledges	Obtain in-principle land pledges from community groups (ongoing process and typically verbal in this cultural context)
V	Support the development of <i>Conservation Deeds</i>	Support the development of <i>Conservation Deeds</i> that recognise(s) the right of customary landowners to use their biological resources in accordance with their traditional cultural practices, while ensuring the conservation and sustainable management of their resources

WORK ACTIVITIES		
VI	Support the development of a management plan	Support the management committee with the development of a draft management plan and, following feedback from relevant stakeholders, develop a final management plan. The final management plan is to be based on the Papua New Guinea Policy on Protected Areas (Independent State of Papua New Guinea, 2014), which may include assessments such as: • detailed analysis of tenure and inheritance systems (including understanding of custom, local historical timeline and genealogy) in order to define those who need to be part of the decision making process. • biodiversity baseline assessment and characterisation of biological values • socioeconomic baseline assessment, with a focus on community development needs (e.g. health, education and skills development) • ecosystem services analysis The final management plan may include: • description of conservation objectives and programs • definition of protected area boundaries and internal zoning plans, including areas designated for everyday use, restricted use and no go zones • community development needs • a stakeholder engagement plan • support for traditional livelihoods • training needs that will support and empower communities, customary landowners and protected area staff to sustainably manage the protected areas • roles and responsibilities, • finance plan and instruments that are sustainable and equitable • monitoring and reporting
VII	Support government submission for formal gazettal	Support the preparation of necessary documents for submittal to government for the gazettal of the protected area Support the management committee in obtaining formal agreement and support of customary landowners and communities for the protected area, outlining the management responsibilities with the customary owners and communities, prior to submittal of necessary documents to government for gazettal
VIII	Support community implementation and governance of the management plans	Support for implementation will be in partnership with government and non-government sectors (ongoing process)

5.4 Monitoring

5.4.1 Objectives

The objectives of the monitoring phase of PMA4 are to confirm the effective implementation of Components 1-5 and track progress towards achieving No Net Loss of biodiversity.

5.4.2 Implementation of Components

Effective implementation will be monitored via a set of leading performance indicators (#1-6), each informed by discrete metrics (Table 5-1). The metrics form the basis of a check-list that is used to assess progress at three levels: not commenced; ongoing; completed. Evaluation of effectiveness focuses how well a work activity is being implemented and not simply whether it has been started, is in progress or has been completed.

Check-list criteria relevant to assessing protected area management effectiveness are consistent with the internationally adopted Management Effectiveness Tracking Tool for protected areas (METT), described by Hockings et al (2006) and adapted for use in PNG (Leverington, F et al. 2017). This approach will be in line with future assessments of management effectiveness in protected areas co-ordinated by CEPAC as part of a national assessment program (Leverington, F et al. 2017), recognising that these assessments will be independent of EMPNG.

Component 2 and 3 monitoring involves recording status and assessing progress with respect to a set of activities designed to support the development of an enabling environment for achieving No Net Loss targets

For Components 4 and 5, monitoring is designed to track progress in relation to a range of activities, including: identifying representative offset sites; engagement with local communities associated with candidate and, subsequently, confirmed offset sites; supporting the development of formal agreements (e.g. Conservation Deeds); the area covered by formal agreements; supporting the development/update of enhancement/management plans; support for communities; and conservation outcomes, particularly in respect of averted loss, and gains resulting from the restoration or regeneration of disturbed areas.

5.4.3 Averted loss and restoration gains

Evaluation of progress in terms of averted loss and restoration gains will be initially undertaken every two years, changing to every 3-5 years as the program matures, at appropriate intervals using a lagging performance indicator #7 (Averted loss and restoration gains, Table 5.1). The evaluation process will be informed by the check-lists referred to above and input from relevant local community-based management committees as appropriate.

Monitoring averted loss and restoration and/or regeneration¹¹ of degraded areas will be achieved by tracking the area covered by formal agreements (refer above), evaluating data gathered as part of PMA1, and subsequent assessment of factors such as:

- changes to vegetation cover resulting from natural processes (for example landslides, changes in river morphology) and those that result from anthropogenic activities
- the extent of deforestation, degradation, regeneration and restoration in each protected area compared against the national and/or regional average deforestation rates and/or baseline conditions.

The combined result of these assessments, together with data from PMA1, will allow the measurement of averted losses and gains against offset targets.

The Biodiversity Strategy defined EMPNG's offset target as 13,108 hectares, based on an offset debt of 6,586 habitat hectares. An offset framework comprising a notional area of 50,000 hectares in each of the three elevation zones, giving a combined area of 150,000 hectares, was developed in recognition of the assumptions used to determine the offset debt and corresponding offset target (e.g., relating to edge effects, uncertainty multipliers, Background Forest Loss Rate and baseline primary forest cover), and the challenges associated with implementing an offset program in PNG over a 30 year period). The offset framework approach has the added advantage of allowing incremental changes to the offset debt (and therefore offset target), if required, without the need to revise the overall program and supporting documentation (Section 3-1, Figure 3-2). For example, a recent independent review of the offset program resulted in the original offset debt of 6,586 habitat hectares being revised to 5,357 habitat hectares and the corresponding offset target of 13,108 hectares being revised to 17,410 hectares (Table 5-6 and TBC, 2018), without the need to revise the program.

Calculation of the offset gain/loss will require a number of iterative steps. These have been incorporated in an Offset Calculator that forms part of PMA4 Protocol.

¹¹ Restoration is defined as 'the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed" (IFC, 2012, PS 6), and implies intervention, whereas for the purposes of PMA4 regeneration refers to the re-growth of vegetation and associated ecological functions due to natural processes (i.e. implies no intervention other than potentially the initial stabilisation of land following disturbance, such as along a right of way).

Table 5-6: Offset Debts and Targets

ALTITUDINAL BAND	PROJECT FOOTPRINT (HA) (IPBCA)	BIODIVERSITY STRATEGY OFFSET DEBT (2017) (Total Habitat hectares lost)	UPDATED OFFSET DEBT (TBC, 2018) (Total Habitat hectares lost)
High altitude Above 1200 m asl	1619	3,754	2,855
Medium altitude 600-1200 m asl	284	65	1,070
Low altitude 0-600 m asl	937	2173	1,432
Total	2,840	6,586	5,357
Offset Target (Hectares required to offset loss)	N/A	13,108	17,410

For each protected area within the offset program, the averted loss or gain will be calculated as follows:

- Using data derived from PMA1, quantify the area of each land cover category described in Table 4-1 and present in the protected area at the time it formally becomes part of the offset program (e.g. June 2014 in the case of Lake Kutubu and April 2016 for Neiru (Aird Hills) or, in the case of new protected areas, when the Conservation Deeds have been formalised and therefore the boundaries set)
- Calculate the offset gain arising from:
 - averted loss, achieved where the land cover category and, by implication, the condition of defined biodiversity values, has not changed, as determined by the thresholds set as part of PMA1, or has been added to the offset program since the last offset gain calculation
 - restoration or regeneration, achieved where the land cover category has improved in favour of enhanced biodiversity values, as determined by the thresholds set as part of PMA1, or added to the offset program since the last offset gain calculation
- Calculate the offset loss arising where the land cover category has deteriorated, as determined by the thresholds set as part of PMA1, or if an area of land has been removed from the offset program
- Calculate the net gain or loss.

The cumulative net gains (or losses) will then be compared against the targets outlined in Table 5.6 and the underlying trend and trajectory to year 30, the nominal life span of the Project.

In addition to assessing land cover status in offset areas, as described above, repeat measurements of land cover in the vicinity of offset areas will be conducted to evaluate the 'non-protection' counterfactual. This will establish the 'additional' (to the counterfactual) gains toward the target of No Net Loss accumulated due to the conservation activities that form part of the offsets program. This information will be generated by PMA1 and used in conjunction with the Food and Agricultural Organisation five-yearly Global Forest Resources Assessment updates to verify the assumptions being used for the Background Forest Loss Rate¹². It is not intended that the averted loss verification process be used to change to the offset target; rather, it is intended to verify (or otherwise) the conservative nature of the offset assumptions.

5.4.4 Frequency

Given the nature of many of the work activities, and the essential involvement of local communities to facilitate sustainable outcomes, monitoring frequency will be initially every 2 years ongoing and conducted separately at each of the three elevation zones described in the Biodiversity Strategy, namely: high (>1200m), medium (600-1200m), low (0-600m). Reporting will be linked to the outputs of PMA1 and PMA3.

5.4.5 Reporting

A combination of information from both averted loss and restoration gain indicators and management effectiveness indicators, plus the ecological integrity indicators provided by PMA1 and PMA3, will all contribute towards the assessment of conservation gain and therefore the accrual of credits required to achieve the offset target.

Findings will be summarised in the PNG LNG Environmental and Social Report series every two years.

¹² Background Forest Loss Rate is an input to the Offset Calculator (refer Section 5.4.3)

6.0 ADAPTIVE MANAGEMENT

6.1 Approach

EMPNG has adopted an adaptive management approach to the implementation of the BIMP. This involves an ongoing review of monitoring results and adjustment of monitoring approaches and management interventions as appropriate, as part of a program of continuous improvement. The process involves a series of iterative steps as outlined below and illustrated in Figure 6-1:

- **Plan:** establish the monitoring and evaluation program consistent with the Biodiversity Strategy goal and related objectives; formalise the monitoring and evaluation plan (this BIMP).
- **Do:** implement the PMAs as outlined in this BIMP.
- **Evaluate:** determine the effectiveness of the PMAs using pre-determined KPIs.
- **Act:** the outcomes of evaluation will result in one of four actions:
 - Continue: if the evaluation phase indicates that the phenomena being monitored are meeting the objectives, then reassess the frequency of monitoring, modify as appropriate, and continue
 - Adjust: if the evaluation phase indicates that the phenomena being monitored are not meeting the objectives, assess the level of significance of the variation, and determine and implement a proportionate management response
 - Modify: if the evaluation phase indicates that a KPI or supporting indicator is deficient, can be improved, or supplemented with a new indicator, then modify as appropriate
 - Cease: if the evaluation phase indicates that the phenomena being monitored are consistently meeting the objectives, and if the source of the threat, pressure, stress or impact has ceased and is not expected to re-commence, determine whether a short-term care-and-maintenance program is appropriate (e.g., if delayed effects are possible), or terminate the relevant part of the monitoring and evaluation program.

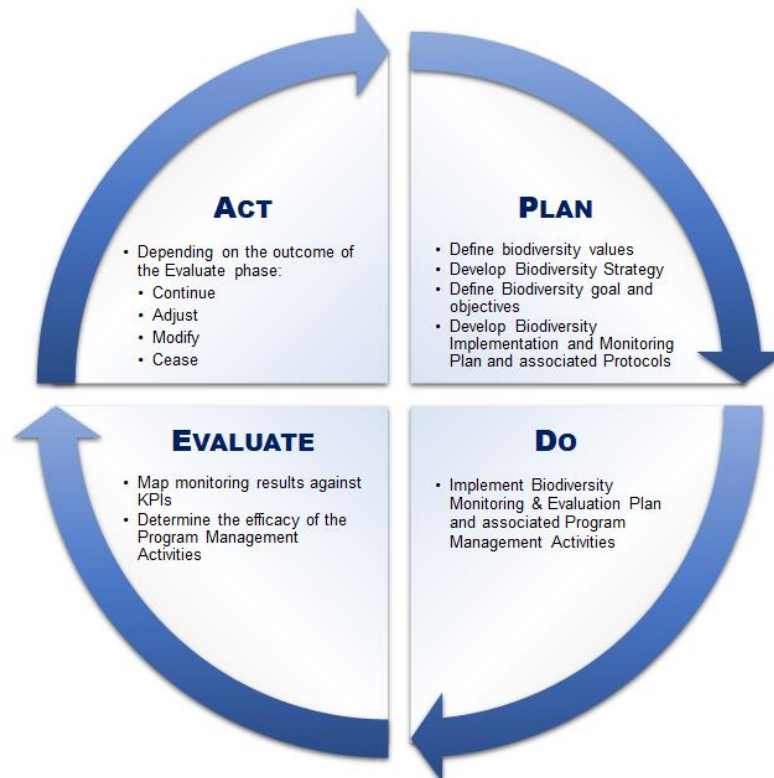


Figure 6-1: Adaptive Management Approach

The BIMP has been designed to be flexible so that the PMAs provide sufficiently accurate and relevant data to measure progress, performance and outcomes with respect to stated objectives and for the duration of the project. Flexibility implies that the PMAs may be modified in response to monitoring results, site conditions and lessons learned, subject to evidence-based justifications consistent with the Biodiversity Strategy goal and objectives.

Adaptation will be through management interventions, which are defined as specific actions required in order that the Biodiversity Strategy goal and objectives can be achieved.

6.2 Management Intervention

The results of the monitoring program will be regularly reviewed to determine whether any aspects of the management plans aren't being implemented as planned, if the intended outcomes of the plans are not as predicted, if mitigation measures can be made more effective or whether there are cost, schedule or resourcing issues that need to be revised. Any of these situations might warrant management intervention.

Specific triggers for management interventions include, but are not limited to:

- a trend indicating an improvement in the diversity of flora and/or fauna, including recurring evidence that KPIs are being met
- evidence that a Biodiversity Strategy objective has been achieved and the endpoint has been reached
- a trend indicating a decline in the diversity of flora and/or fauna, or a change in composition of fauna and flora communities, that is outside the expected range of natural variability
- a trend indicating a decline in the populations of critically endangered or endangered species, or of other focal species that are appropriate indicators of ecosystem health

- introduction and establishment of invasive species expected to have significant deleterious effects on the biological values
- evidence of broadscale forest loss or degradation
- changes to pressures, direct threats or stresses¹³ that have the potential to significantly delay or have a significant adverse effect on the ability of EMPNG to meet its biodiversity objectives.

In the case of improving trends, EMPNG will work with specialist consultants where appropriate and consider scaling down the frequency and scope of monitoring.

Where monitoring indicates a Biodiversity Strategy objective has been achieved or a defined endpoint has been reached, EMPNG will, in consultation with specialist consultants where appropriate, consider scaling down the frequency and scope of monitoring associated with that objective, or discontinuing the relevant Component. In these cases, a care-and-maintenance program may be appropriate to ensure that there is no reversal in the achieved outcome. Additionally, if data can no longer be gathered in respect to an objective, the monitoring associated with that objective may be discontinued if no alternative options are feasible.

In the case of adverse trends, EMPNG will work with specialist consultants where appropriate to interpret and validate monitoring data to assess the significance of the trends or observed change(s) and identify most likely causes, including those that may be project-related activities, the result of resourcing, training, capacity or organisational issues, or natural variation. This will enable the nature and level of response required to remedy the situation to be proportional to the source, timing and potential impact of the observed change(s) or non-conformances.

In relation to PMA4, EMPNG will evaluate monitoring results on a regular basis to confirm that the relevant KPI is being met. In the event that progress is adversely affected by external factors, EMPNG will, in consultation with relevant stakeholders, develop and implement corrective actions such that the overall offset target can be achieved over the life of the Project.

6.3 Assessment of Level of Significance

Table 6-1 outlines a risk-based framework that will be used to assess the potential significance of observed changes, irrespective of cause or attribution, and therefore guide the appropriate level of response. This approach relies on an assessment of the potential magnitude of the impact and the anticipated recovery time. For example, observed changes that have the potential to impact a small proportion of the extent or abundance of the species that constitutes the biodiversity value, and are short-lived, are of lower significance than those that have the potential to affect the majority of a population over a long period of time.

Table 6-1: Levels of Significance of Observed Changes

RELATIVE PROPORTION OF THE BIODIVERSITY VALUE(S) POTENTIALLY AFFECTED	YEARS FOR RECOVERY, WITHOUT INTERVENTION, FROM TIME OF OBSERVATION			
	<3	3-5	5-10	>10
Very high	H	H	H	H
High	M	H	H	H
Moderate	M	M	M	H
Low	L	M	M	M
Very low	L	L	L	M

¹³ **Direct threats:** proximate human activities or processes that have caused, are causing, or may cause the destruction, degradation, and/or impairment of biodiversity targets; synonymous with a *source of stress* and *proximate pressures*. **Stresses:** attributes of a conservation target's ecology that are impaired directly or indirectly by human activities. A stress is not a threat in and of itself, but rather a degraded condition or "symptom" of the target that results from a direct threat. (Salafsky, 2008)

Explicit definitions of the relative proportion of biodiversity values potentially affected (i.e. very high, high, moderate, low and very low) have not been developed. Instead, a non-prescriptive, semi-quantitative approach based on field evidence and professional judgement from individuals with many years of direct experience in Papua New Guinea has been adopted. This approach, when used in conjunction with the adaptive management process described in Figure 6-1, will result in more meaningful and actionable outcomes than from a rigid, prescriptive process applied in a dynamic environment with an evolving scientific knowledge base.

Following classification of the relative significance of the detected change, appropriate action must be determined based on feasibility and proportionality with respect to the level of significance. Table 6-2 provides a simple categorisation for the required actions associated with the levels of significance.

Table 6-2: Actions required for observed change significance levels

SIGNIFICANCE LEVELS	ACTIONS REQUIRED
High	Assess options to mitigate, reverse or offset observed changes or trends in the short-term. May involve increased monitoring frequency and intensity to evaluate efficacy of restorative actions.
Moderate	Assess options to mitigate, slow or reverse observed changes or trends in the medium-term. Continued monitoring necessary to evaluate efficacy of restorative actions. Additional monitoring requirements may be necessary.
Low	No immediate actions required. Continued monitoring recommended. Review monitoring frequency to determine if a reduced frequency is appropriate/necessary.

6.4 Transition to Sustainability

EMPNG recognises that the establishment and operation of protected areas to attain ecologically, economically and socially sustainable conservation outcomes is a long-term process centred on local ownership, and incorporating complementary skills training, community and organisational capacity building and community development incentives.

It may be appropriate for EMPNG to withdraw from being actively involved with the operation and maintenance of protected areas when they become viable and sustainable in their own right. This will depend upon the prevailing circumstances for each protected area. However, in general terms, a protected area will be considered viable and sustainable in its own right when: the WMA/protected area management committee is functional and effective; conservation objectives are being consistently achieved; local communities continue to provide grass-roots support; and a reliable source of ongoing financing is in place. The sustainability of the protected areas, and the successful delivery of the offset program components, is therefore dependent to some extent on external circumstances.

7.0 ORGANISATION

EMPNG has developed, and will maintain, an appropriate organisational structure and sufficient resources to support effective implementation of the Biodiversity Strategy and this BIMP.

EMPNG's biodiversity-focused activities in the Upstream area are managed by the Safety, Health and Environment (SHE) department. The Biodiversity Lead, with the support of Biodiversity Advisors and ExxonMobil subject matter experts and senior technical professionals, manages EMPNG's biodiversity-related activities. The Biodiversity Lead works under the guidance of the Environment and Regulatory Supervisor who reports to the SHE Manager as shown in Figure 7-1. The Biodiversity Lead also liaises regularly with the Community Affairs group.

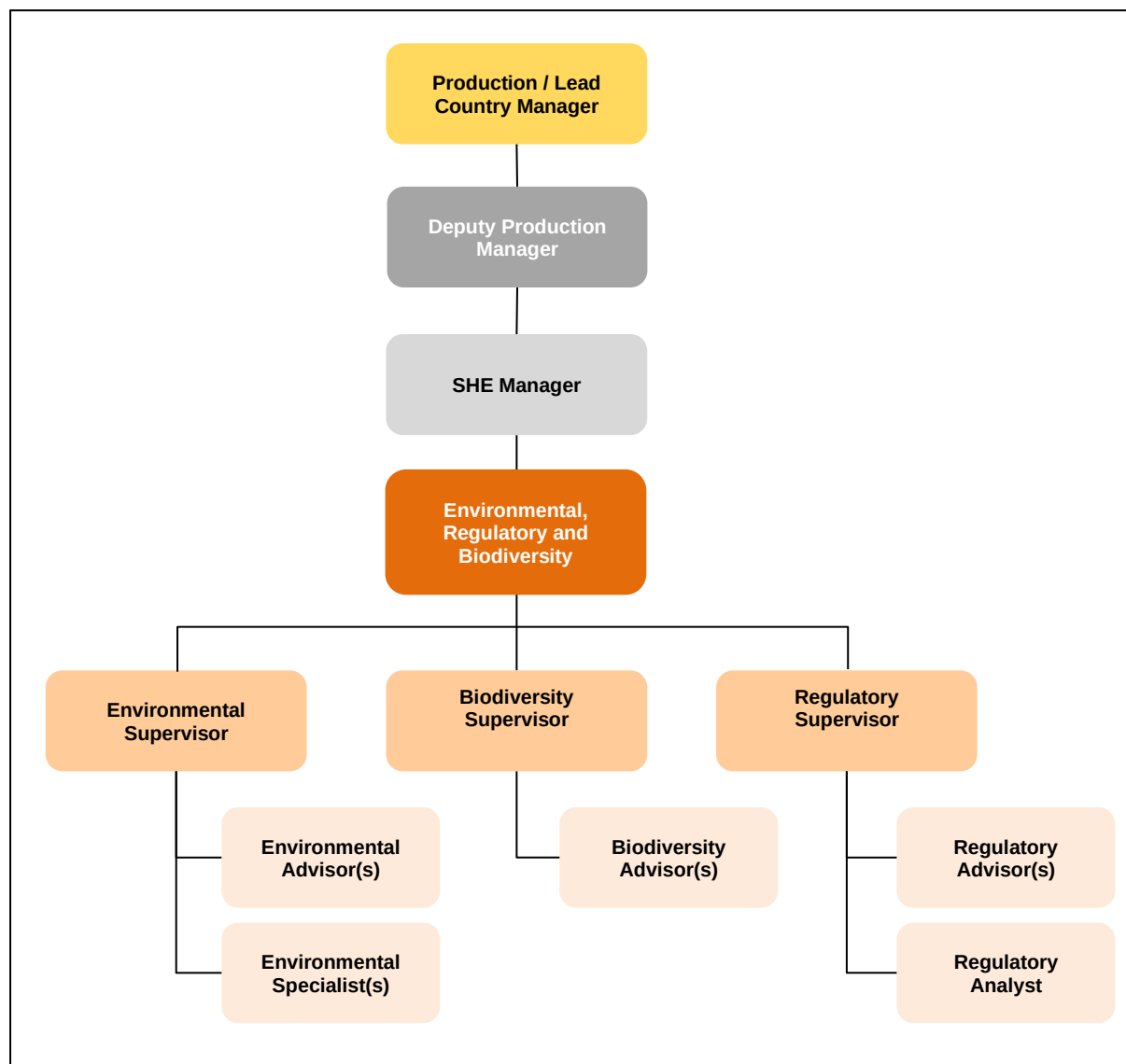


Figure 7-1: Environment and Regulatory Group Organisation

7.1 Roles and Responsibilities

The following job descriptions are examples of the types of roles that pertain to the implementation of the Biodiversity Strategy and this BIMP. As the needs of EMPNG change over time, some roles may be modified, combined or replaced to more appropriately reflect the company's needs at that time.

7.1.1 SHE Manager

The SHE Manager is responsible for:

- overall responsibility for implementation of the Biodiversity Strategy and the BIMP
- ensuring adequate resources and budget are available to meet the objectives of the Biodiversity Strategy and the implementation of this BIMP.

7.1.2 Environmental, Regulatory and Biodiversity Manager

The Environmental, Regulatory Supervisor is responsible for:

- periodic reviews of EMPNG personnel and contractor compliance with scopes of work relevant to the BIMP
- reporting internally and externally on implementation of the Biodiversity Strategy and the BIMP.

7.1.3 Biodiversity Supervisor

The Biodiversity Supervisor is responsible for:

- leading the adaptive management process regarding the Biodiversity Strategy and this BIMP and stewarding the implementation of required changes
- coordinating implementation of the BIMP, with support from EMPNG Biodiversity Advisors, EMPNG's SHE department, ExxonMobil Corporation subject matter experts and senior technical professionals, and third party specialists as necessary
- managing and liaising with third party consultants and other organisations relevant to implementation of the offset program and the PMAs.

7.2 Training and Awareness

EMPNG will ensure that personnel responsible for the execution of the tasks and requirements contained within this BIMP are competent on the basis of education, training and experience. Where necessary training will be conducted to ensure that personnel are fully conversant with aspects of this BIMP relevant to their duties.

EMPNG will ensure that third parties and service providers performing duties related to the implementation of this BIMP have the necessary competencies through the procurement and selection process.

8.0 REPORTING

EMPNG is providing regular reports that include offset program progress, monitoring results and overall progress toward achieving the Biodiversity Strategy goal and objectives.

8.1 Internal Reporting

Regular reports regarding the implementation of the Biodiversity Strategy and this BIMP are compiled and issued to EMPNG management and technical leaders, along with other key internal stakeholders.

Such reports include qualitative and quantitative data, as well the status of the KPIs and information on other biodiversity-related matters as relevant.

The preparation of these reports is coordinated by EMPNG's SHE department, with support from other experienced staff within EMPNG and expert third party consultants as necessary.

8.2 External Reporting

EMPNG provides the publically available PNG LNG Environmental and Social Report series to the Papua New Guinean Government and the Lenders at pre-agreed frequencies. These reports will include qualitative and quantitative data regarding the implementation of the ecological aspects of the EMP's, the offset program components and PMA campaigns undertaken in the reporting period, the status of KPIs and information on other biodiversity-related matters as relevant.

Preparation of the reports is coordinated by EMPNG's SHE department with support from other experienced personnel within EMPNG and expert third party support as necessary.

9.0 MANAGEMENT OF CHANGE

EMPNG has developed local tools and procedures to address management of change. The principles of the management of change process are to:

- manage permanent, temporary and urgent/emergency changes to procedures or process equipment
- provide for a thorough evaluation of the proposed change
- consider factors for the identification and control of potential operations integrity risks associated with the proposed change
- communicate the proposed change to personnel whose job tasks may be affected by the change and who may require training prior to implementing the change
- ensure critical documentation remains up-to-date with changes as they are implemented.

Details of the management of change process are provided in the Production Environmental and Social Management Plan (PNG LNG, 2013).

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