Prepared for the Department of Climate Change, Energy, the Environment, and Water

Borumba Pumped Hydro Energy Storage Project – Exploratory Works Offset Area Management Plan

DOCUMENT NUMBER: BR-NA-NON-EBO-PLN-00001

OCTOBER 2025

Contents

Figures

Tables

Photos

Acknowledgement of Country

In the spirit of reconciliation, Queensland Hydro acknowledges the Traditional Custodians of Country throughout Queensland and, in particular the lands, skies and waters on which we operate. We celebrate the diversity of Aboriginal peoples and their ongoing cultures and connections to the lands, skies and waters of Queensland.

Queensland Hydro pays respect to Elders past and present honouring their continuing spiritual and cultural connections to Country.

Acronyms and abbreviations

Abbreviation	Description
ACR	Annual compliance report
AHD	Australian Height Datum
Asl	Above sea level (in reference to contours)
ANPC	Australian Network for Plant Conservation
AU	Assessment unit
BBBQ	Black-breasted button-quail
BS	brush sophora
DBH	Diameter at breast height (used to measure width of trees)
DETSI	Department of Environment, Tourism, Sustainability and Innovation (Qld)
DPI	Department of Primary Industries (Qld)
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Cth)
DETSI	Queensland Department of Tourism, Sustainability and Innovation
DLGWV	Department of Local Government, Water and Volunteers
EDL	Ecologically dominant layer
EEC	Endangered ecological community
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EWP	Elevated work platform
FMU	Forestry management unit
GBC	glossy black-cockatoo
GG	Greater glider
GIS	Geographic information system
ha	Hectares
HDPE	High density polyethylene
HQS	Habitat quality scores
km	Kilometres
KoRV	koala retrovirus
LOO	Likelihood of occurrence
LNP	long-nosed potoroo
MHQA	Modified habitat quality assessment
MNES	Matters of national environmental significance
MW	Megawatt
MWh	Megawatt hour
NC Act	*Nature Conservation Act 1992* (Qld)
NSW	New South Wales
OAG	Offset Assessment Guide
OAMP	Offset Area Management Plan
PBFD	Psittacine Beak and Feather Disease
PHES	Pumped Hydro Energy Storage

Abbreviation	Description
PMAV	Property Map of Assessable Vegetation
Qld	Queensland
QFD	Queensland Fire Department
QPWS	Queensland Parks and Wildlife Service
ReCER	Research Centre for Ecosystem Resilience
RE	Regional ecosystem
RFTEC	Lowland Rainforest Threatened Ecological Community
SAT	SPOT Assessment Technique
SEQ	South-east Queensland
SI	Significant Impact
ST	scrub turpentine
SQP	Suitably qualified person
TEC	Threatened ecological community
VDec	Voluntary Declaration
VM Act	*Vegetation Management Act 1999*
WCP	Weed control program
WIR	Weed infestation register
WMP	Weed Management Plan
WoNS	Weeds of national significance
YBG	Yellow-bellied glider

1. Introduction

1.1 Background

Queensland Hydro is the proponent of the Borumba Pumped Hydro Energy Storage (PHES) Project (the Borumba PHES Project). The Borumba PHES Project is a 2,000 megawatt (MW), 48,000-megawatt hour (MWh), hydroelectric scheme to store, generate and supply energy through a pumped hydroelectric structure linked to the existing Borumba Dam (Lake Borumba). It is located approximately 13 kilometres (km) southwest of the township of Imbil, 48 km southwest of Gympie, and 180 km northwest of Brisbane, within the Yabba Creek sub catchment of the Mary River Basin.

The Borumba PHES Project proposes to use the increased capacity of Lake Borumba and a new upper reservoir as a way of storing energy. In a decarbonised energy market, excess wind and solar renewable energy drawn from the grid will be used during low demand periods to pump water from Lake Borumba to the upper reservoir, essentially converting the upper reservoir into a giant battery.

The stored energy will then be released by returning the water to Lake Borumba through a turbine, producing electricity. Electricity can be generated almost immediately and at any time, making it possible for the power to be fed into the grid when it is needed, to balance the variability of renewable energy generation with the patterns of energy demand of Queensland homes and businesses. The Borumba PHES Project can also produce large amounts of electricity over a long duration providing reliable, dispatchable energy at times when wind and solar energy is not available.

In September 2022, the Borumba PHES Project was announced as a priority project to support Queensland achieving the state's renewable energy target. In June 2023, the then state government provided $6 billion in equity investment towards the Borumba PHES Project as a long-term investment in Queensland's electricity infrastructure. The Borumba PHES Project ultimately supports the decarbonisation of Queensland's, and Australia's, energy system to ensure the health, diversity and productivity of the environment are maintained or enhanced for future generations.

The Borumba PHES Project includes two project phases:

- Exploratory Works – the geological investigations at key locations, the supporting infrastructure and activities required to inform the development of the Borumba PHES Project (the Exploratory Works Project or the Project)
- Main Works – the PHES Project, including the power infrastructure (powerhouse, water and access tunnels), an upper reservoir, and a lower reservoir (Lake Borumba) (the Main Works Project).

The Project locality is illustrated in Figure 1.

The Borumba PHES Project – Exploratory Works (referred to as the Project or Exploratory Works Project) are the geological investigations, supporting infrastructure and activities needed to inform the development of the separate and related Borumba PHES Project – Main Works. Investigation where key project infrastructure associated with the Main Works (e.g., powerhouse) is proposed for construction is vital, as geological uncertainty is a significant risk for the Borumba PHES Project. The Exploratory Works Project will determine if the Borumba PHES Project can proceed or if material changes to the Main Works reference design are necessary. The technical information needed primarily comprises investigations of geology at the proposed locations of the:

- upper and lower reservoir dam foundations – to be verified by surface geotechnical investigations
- underground tunnels and caverns – to be verified by geotechnical exploratory tunnel drilling and subsurface geotechnical investigations.

The disturbance footprint associated with the Exploratory Works Project is illustrated in Figure 2 and the total area of the disturbance footprint is 90.3 ha. As far as possible, the Project has been designed to minimise clearing of native vegetation through siting of the project in predominantly cleared areas of lower biodiversity values, wherever possible. However, the location of geotechnical investigations is necessarily dictated by the location of the proposed infrastructure for the Main Works Project, which is partially located in vegetated areas and therefore requires vegetation clearing. A total of 38 ha of native vegetation is anticipated to be cleared for the Project, with clearing required in all work areas.

The Exploratory Works actions are spread out over a large area and, in most instances, involve small areas of disturbance that are temporary in nature, and are not intended to remain in use for an extended duration, unless required for property access and maintenance (e.g. some access tracks). Temporary works areas will be rehabilitated with an overarching long-term objective to re-instate native vegetation in all temporarily disturbed areas. The Borumba Pumped Hydro Energy Storage Project – Exploratory Works Preliminary Documentation (Preliminary Documentation), which includes a Decommissioning and Rehabilitation Strategy, provides further details (refer to Section 6.3.2 and Appendix C of the Preliminary Documentation).

Key components of the Exploratory Works Project are:

- Geotechnical investigations – comprising test pits, boreholes (deep and shallow, including some conversion to groundwater monitoring bores), geophysics.
- Spoil disposal – two dedicated areas (tunnel spoil disposal area and Kingaham spoil disposal area) for the storage and management of excess material from exploratory tunnelling, geotechnical drilling and construction activities, as well as stockpiling of stripped topsoil.
- Site access – activities associated with:
  - construction of new access tracks, and upgrades to existing tracks, including waterway crossings to enable access to geotechnical investigation sites, spoil disposal areas, and supporting infrastructure.
  - the realignment of a section of Bella Creek Road, referred to as the Kingaham Creek bypass.
- Other supporting infrastructure – establishment of temporary water infrastructure and a civil construction compound (laydown area).
- Exploratory tunnel infrastructure – comprising a portal pad, staging pad, explosives store, and associated access tracks, and exploratory tunnels.

The design and layout of the Exploratory Works Project has been refined through the iterative application of the environmental mitigation hierarchy to avoid, reduce and mitigate potential impacts on Matters of National Environmental Significance (MNES). Further details are provided in Section 6 of the Preliminary Documentation. This has included changing exploration methods to reduce the extent of vegetation clearing required, adjustments to the location of new access tracks to avoid threatened ecological communities (TECs) and threatened flora species, locating the spoil disposal areas in existing cleared land, and relocating the portal pad to be within an existing cleared area, avoiding impacts to an area of Lowland Rainforest of Subtropical Australia TEC.

The Exploratory Works Project was referred to the Commonwealth Minister for the Environment and Water in February 2023. On 30 March 2023 the Minister determined the Project to be a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC 2023/09461) to be assessed by preliminary documentation. Listed threatened species and communities (Sections 18 and 18A of the EPBC Act) are the relevant controlling provisions.

Preliminary Documentation prepared by Queensland Hydro provides detailed information regarding the Exploratory Works Project including an assessment of the potential for significant impacts (SI) in accordance with the Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (DEWHA 2013) to occur to MNES as a result of the proposed works. This Preliminary Documentation has informed the environmental offset requirements and supports this management plan.

1.2 Purpose and structure

The purpose of this Offset Area Management Plan (OAMP) is to describe how unavoidable SI to MNES will be offset as a result of the Exploratory Works Project. The OAMP demonstrates how SI to MNES will be offset in accordance with the EPBC Act Environmental Offsets Policy (DSEWPC, 2012).

The OAMP provides a description of habitat quality being impacted by the Project, a description of the proposed offset areas being provided, the MNES they support and habitat quality, along with the specific completion criteria and conservation outcomes to be achieved for each MNES. Management actions, ongoing monitoring and reporting is also outlined to demonstrate how the offset outcomes will be achieved and progressively reviewed to ensure final habitat quality scores and completion criteria are met.

This OAMP presents:

- Section 2 – the regulatory framework and the offsets policy that has guided the development of the OAMP.

- Section 2.2.2 – describes how this OAMP has met the eight overarching principles that determine the suitability of an offset in accordance with the EPBC Environmental Offsets Policy.
- Section 3 – the proposed offset package including:
  - approach to delivering the required offsets
  - the methodology employed to determine offset land suitability
  - description of the proposed offset areas
- Section 3.1 – summarises the MNES with a significant, residual impact required to be offset and associated impact areas.
- Section 4 – description of habitat quality assessments completed across the impact and offset areas.
- Section 4.4 – habitat quality scores for impact site and offset areas associated with each MNES.
- Section 5 – offset assessment guide inputs
- Section 6 – management actions for each offset area including tailored management activities for each MNES.
- Section 7 –interim milestones and completion criteria for the offset area.
- Section 8 – the proposed offset monitoring program.
- Section 9 – roles and responsibilities.
- Section 10 – reporting.
- Section 11– auditing requirements for this OAMP.
- Section 12 – corrective actions proposed.
- Section 13 – a risk assessment demonstrating that the OAMP will help ensure the delivery of Queensland Hydro's offset obligation associated with the Exploratory Works in a manner that is consistent with the EPBC Act offsets framework.
- Section 14 – legal security of the proposed offset areas.

1.3 Environmental overview

The Project locality and Exploratory Works disturbance footprint is illustrated in Figure 1 and Figure 2.

The Exploratory Works are located in Yabba Creek catchment in the Upper Mary River Basin, approximately 258 km from the tidal barrage and 318 km from the mouth of the Mary River. The Mary River discharges into the Great Sandy Strait. The nearshore coastal environment comprises sensitive estuarine and freshwater ecosystems, with K'gari (formerly Fraser Island) a short distance offshore.

The Borumba PHES Project and the Exploratory Works Project are located within the South East Queensland bioregion, which is characterised by moderate to high rainfall (between 800-1500 mm per year) with warm to hot summers and cool winters. The Borumba PHES Project and the Exploratory Works Project are also located within two subregions: Burringbar-Conondale Ranges and Gympie Block. Burringbar-Conondale Ranges subregion, also known as the Southeast Hills and Ranges subregion, is moist and hilly to mountainous. It is comprised of metamorphic geology with some acid volcanic intrusions. The vegetation is characterised by eucalypt tall open forests, complex Notophyll rainforest and Araucarian notophyll rainforest. The Gympie Block subregion comprises low hilly landscapes on old sedimentary rocks, metamorphics and intermediate and basic volcanoes. The relatively fertile soils support extensive patches of Araucarian notophyll and microphyll rainforest and mixed eucalypt forests.

The region surrounding the Borumba PHES Project and the Exploratory Works Project is characterised by rural agricultural holdings, small towns, native vegetation, and nature conservation areas. The current surrounding landscape comprises:

- agricultural land, predominately grazing operations
- native vegetation
- watercourses
- scattered residential dwellings/outbuildings
- minor roads that connect smaller townships and residential areas to regional centres

- Lake Borumba and recreational facilities on the foreshores
- the peaks of Mount Kandanga (557 m) to the north, Mount Borumba (624 m) to the south and Yabba Range to the west
- native and plantation forestry associated with Yabba State Forest and Imbil State Forest
- Conondale Resources Reserve, Conondale National Park and Imbil State Forest (Figure 1).

The Project Study area consists of steep terrain with rugged and relatively inaccessible areas (Photo 1) with the elevation ranging from about 120 m Australian height datum (AHD) up to 550 m AHD. Much of the current Lake Borumba inundation area is surrounded by the steep slopes of the Yabba Range, Conondale Range and Kandanga Range to the south, southeast and north respectively. These ranges rise to in excess of 370 m above the current Lake Borumba surface level and it is this variation in elevation that makes the site such a good option for a pumped hydro energy storage project. The lower reservoir ranges between 100 m and 170 m AHD. The open valleys on the main arms of Lake Borumba contain more gently sloping land, often associated with local alluvium.

Photo 1: Example of steep terrain in Project area.

Forestry activities occur in Yabba State Forest and Imbil State Forest. Yabba State Forest is located west of the Project. Imbil State Forest borders the southern bank of Lake Borumba, east of the Conondale National Park. Access tracks and geotechnical drilling are both proposed within the Imbil State Forest at the existing dam wall site.

The locality supports land which has been cleared of vegetation and used for grazing (Photo 2). Historical imagery shows that the riparian zone of Yabba Creek and Sandy Creek were cleared in the past along with areas where the explosive storage site is located.

Photo 2: Example of cleared land used for grazing

There are existing access tracks in and around Lake Borumba and through the State Forests and Queensland Hydro-owned land. Existing access tracks are generally unsealed, single lane tracks (Photo 3).

Photo 3: Example of eucalypt woodland and existing access track

The Preliminary Documentation summarises the desktop assessments and field ecology survey effort that has been completed to date to assess the potential for MNES to occur within the Exploratory Works Project area. Field surveys were undertaken by SMEC, Umwelt, Hydrobiology and Attexo from May 2022 to November 2024 across a number of seasons and included both terrestrial and aquatic ecology surveys. More recently, protected plant surveys have occurred across the extent of the Exploratory Works disturbance footprint and habitat quality assessments undertaken. This has been supplemented with additional terrestrial and aquatic surveys as part the of the Main Works EIS process. A broad summary of the field ecology surveys completed to date which have informed the impact and offset assessments, are summarised in Appendix A of this OAMP. Full details are provided in Section 4.1 of the Preliminary Documentation (Queensland Hydro, 2024).

Based on these results, a likelihood of occurrence (LoO) has been prepared and the potential for SI to occur to those MNES that are known, likely or have potential to occur completed (refer to Section 4.3 of Preliminary Documentation).

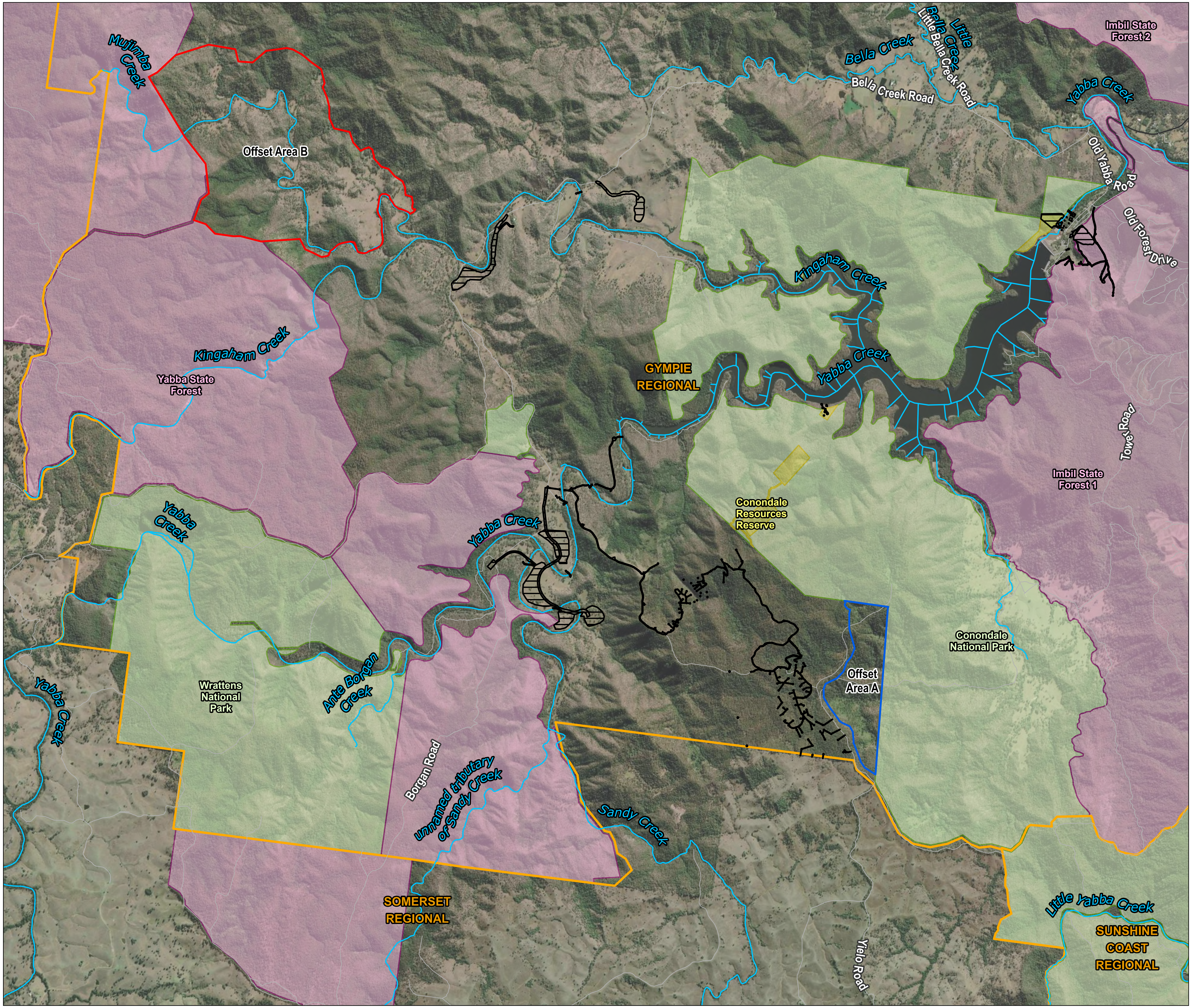
1.4 Assessment of significant impacts

Queensland Hydro has completed significant impact assessments for the Project for MNES that are considered as known, likely, or with potential to occur. These significant impact assessments are provided in Section 7 and Appendix J of the Preliminary Documentation (Queensland Hydro, 2025). The impact assessments include the identification of measures that have been taken to refine the design and construction methods of Exploratory Works to avoid and reduce impacts on MNES, and additional management measures that can be applied during construction and operation of the Project to further minimise residual impacts on MNES. The impact assessments have considered the relevant criteria outlined the Department of the Environment, Water, Heritage and the Arts (2013) Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (Significant Impact Guidelines).

Activities relevant to the Exploratory Works that have potential to directly impact on MNES include the removal of vegetation, ground disturbance and vehicle strike. Impacts considered to inform whether a SI is predicted to occur included:

- loss of habitat
- degradation of habitat quality
- injury or mortality
- fragmentation of habitat and loss of connectivity
- disturbance to species from noise, light and vibration
- disruption to breeding cycles
- spread of invasive species.

A summary of the MNES found to have a SI as a result of Exploratory Works Project, and that will be offset under the EPBC Offsets Policy, is provided in Section 3.1, Table 2 of this OAMP.



Queensland Hydro

GDA2020 MGA Zone 56

N

0 1300 m

1:50,000 @ A3

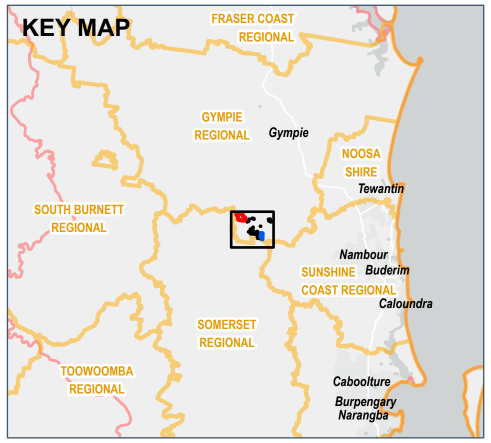
LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Offset Area A
- Offset Area B
- Watercourse [defined by Water Act 2000]
- Major road
- Local road or track
- Local government area
- Biogeographic region

Protected Areas

- National park
- Resources reserve
- State forest

KEY MAP



Data Sources:
Basemap © Roads and tracks: © State of Queensland (Department of Resources) 2023
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar
Vegetation management regional ecosystem; Cadastre; Local government area; Roads and tracks: © State of Queensland (Department of Resources) 2025
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019
Protected areas and forests of Queensland; Biogeographic region: © State of Queensland (Department of Environment and Science) 2023
Cities and Towns: © State of Queensland (Department of Natural Resources and Mines) 2016

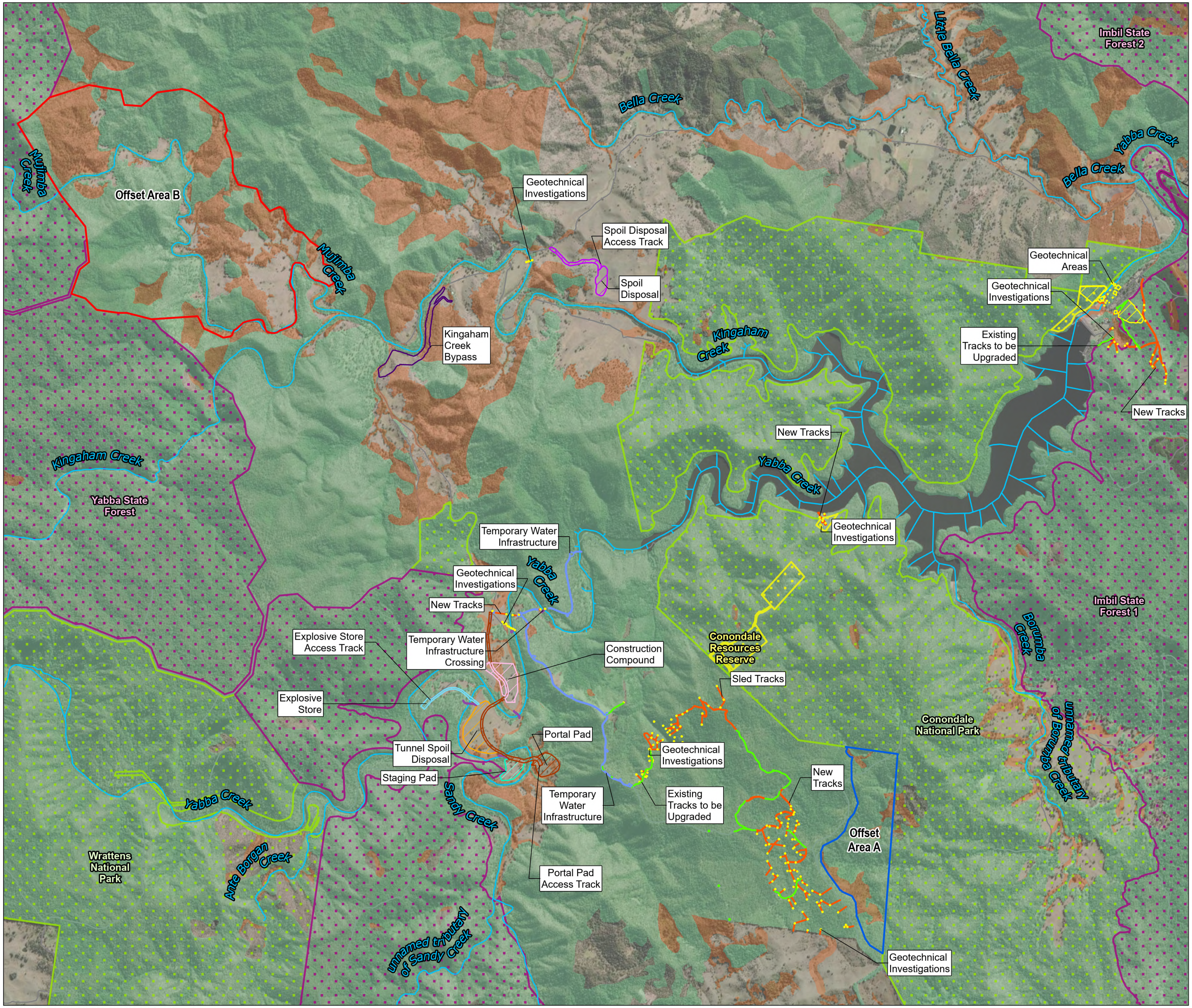
Borumba PHES Project
Offset Area Management Plan

LOCATION OF THE PROJECT AREA & OFFSET AREA

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	25/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 1

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 1



Queensland Hydro

GDA2020 MGA Zone 56

N

0 — 1100 m

1:42,000 @ A3

LEGEND

- Offset Area A
- Offset Area B

Exploratory Works Project Footprint (EPBC Only)

- Construction Compound
- Existing Tracks to be Upgraded
- Explosive Store and Access Track
- Geotechnical Investigations
- Kingaham Creek Bypass
- New Tracks
- Portal Pad and Access Track
- Spoil Disposal and Access Track
- Staging Pad
- Temporary Water Infrastructure
- Temporary Water Infrastructure Crossing
- Tunnel Spoil Disposal

Vegetation Management Status

- Remnant
- Regrowth

Protected Areas

- National park
- Resources reserve
- State forest
- Watercourse [defined by Water Act 2000]
- Major road
- Local road or track

Data Sources:
Basemap © Roads and tracks: © State of Queensland (Department of Resources) 2023
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar
Vegetation management regional ecosystem; Cadastre; Local government area; Roads and tracks: © State of Queensland (Department of Resources) 2025
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019
Protected areas and forests of Queensland; Biogeographic region: © State of Queensland (Department of Environment and Science) 2023

Borumba PHES Project
Offset Area Management Plan

LOCATION OF THE DISTURBANCE FOOTPRINT

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	28/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 2

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 2

2. Regulatory framework

2.1 *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act is the Commonwealth Government's principal piece of environmental legislation. The EPBC Act is designed to protect MNES, which include threatened species of flora and fauna, TECs and migratory species.

The EPBC Act seeks to:

- protect the environment
- conserve biodiversity
- protect and manage important natural and cultural places
- assess the environmental impact of projects, and decide whether to approve them
- control how plants and animals, including specimens and products, move in and out of Australia
- promote ecologically sustainable development through careful use of natural resources
- appreciate the role of Indigenous peoples in protecting and sustainably using the environment
- promote using Indigenous peoples' knowledge, with their permission and cooperation.

Approval is required under the EPBC Act for any action that has the potential to, or will, significantly impact MNES. Proponents of projects that will have or are likely to have a significant impact on MNES are required to refer the action to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) for a determination on whether the action requires assessment under the EPBC Act.

The Exploratory Works Project was referred under the EPBC Act on 1 February 2023. Following consideration of the referral and supporting documentation, on 30 March 2023 a delegate for the Commonwealth Minister for the Environment and Water determined the Exploratory Works Project to be a controlled action (EPBC 2023/09461) to be assessed by preliminary documentation. Listed threatened species and communities (Sections 18 and 18A of the EPBC Act) are the relevant controlling provisions for the action.

Following consultation with the DCCEEW regarding the Exploratory Works Project it was noted that an OAMP should be provided and approved prior to significant impacts occurring to MNES. This OAMP has been prepared in accordance with the requirements of the EPBC Act Environmental Offsets Policy (DSEWPC, 2012), which is discussed in further detail in following sections.

2.2 The EPBC Act Offsets Policy

The EPBC Act Environmental Offsets Policy (DSEWPC, 2012) outlines the Commonwealth's approach to the use of environmental offsets and the requirements for an offset package to be deemed suitable.

In assessing the suitability of an offset, the government decision-making will be informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty (DSEWPC, 2012). Environmental offsets should align with conservation priorities for the impacted protected matter.

The EPBC Act Environmental Offsets Policy (DSEWPC, 2012) includes an offset principle that offsets will be built around direct offsets but may include other compensatory measures. The policy specifies a minimum of 90% direct offsets are required when offsetting a significant impact on MNES. As per Section 4.2.1 (page 8) deviation from the 90% direct offset requirement will only be considered where:

- it can be demonstrated that a greater benefit to the protected matter is likely to be achieved through increasing the proportion of other compensatory measures in an offsets package, or
- scientific uncertainty is so high that it isn't possible to determine a direct offset that is likely to benefit the protected matter.

Direct offsets must provide a measurable net conservation gain for an impacted protected matter. This conservation gain is the benefit that an offset delivers, which maintains or increases its viability, or reduces any threats of damage, destruction, or extinction (averted loss). Offsets should align with conservation priorities for the impacted protected matter and be tailored specifically to the attribute of the protected matter that is impacted in order to deliver a conservation gain. For instance, if the proposed action is likely to have impacts on foraging habitat for a particular protected matter, then the offset should create, improve, protect and/or manage foraging habitat (DSEWPC, 2012).

When assessing the potential suitability of an offset area, a number of key factors should be considered. For impacts on habitat for threatened species, migratory species and threatened ecological communities, any direct offset must meet, as a minimum, the quality of the habitat at the impact site. Where a proposed offset site has a lower habitat quality than that of the impact site, the offset must be managed and resourced over a defined period of time so that its habitat quality is improved to meet the quality of habitat originally impacted.

Other considerations include, but are not limited to:

- current land tenure and the proposed method of securing and managing the offset
- the time it will take to achieve the proposed conservation gain
- the level of certainty that the proposed offset will be successful
- the suitability of the offset area; including connectivity, proximity to the impact area and ability of offset to support the MNES.

The Offsets Assessment Guide (OAG) (DSEWPC, 2023) (also referred to as the offset calculator) gives effect to these requirements and provides a decision-making framework for the Department to consider the appropriateness and adequacy of proposed offsets for listed threatened species and ecological communities.

2.2.1 Policy principles

The EPBC Act Environmental Offsets Policy (DSEWPC, 2012) is intended to provide transparency around how the suitability of offsets is determined. The EPBC Act Environmental Offsets Policy notes there are different ways to achieve good environmental outcomes and provides flexibility in delivering those outcomes.

There are five key aims, being:

1. Ensure the efficient, effective, timely, transparent, proportionate, scientifically robust and reasonable use of offsets under the EPBC Act.
2. Provide proponents, the community and other stakeholders with greater certainty and guidance on how offsets are determined and when they may be considered under the EPBC Act.
3. Deliver improved environmental outcomes by consistently applying the policy.
4. Outline the appropriate nature and scale of offsets and how they are determined.
5. Provide guidance on acceptable delivery mechanisms for offsets.

Having regard to the five key aims of the EPBC Act Environmental Offsets Policy, the Commonwealth has developed a set of overarching principles that are required to be considered by proponents and the Commonwealth when developing an offset and determining its suitability:

Suitable offsets must:

- Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action.
- Be built around direct offsets but may include other compensatory measures.
- Be in proportion to the level of statutory protection that applies to the protected matter.
- Be of a size and scale proportionate to the residual impacts on the protected matter.
- Effectively account for and manage the risks of the offset not succeeding.
- Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs.
- Be efficient, effective, timely, transparent, scientifically robust and reasonable.
- Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

In assessing the suitability of an offset, government decision-making will be:

- Informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty.

- Conducted in a consistent and transparent manner.

The policy principles along with a justification of how this OAMP has taken into consideration and complies with each principle has been further discussed in Section 2.2.2.

2.2.2 Compliance with EPBC Act Offset Policy

The EPBC Environmental Offsets Policy (DSEWPC 2012) provides the overarching principles that are applied in determining the suitability of an offset. A description of how these principles have been met by this OAMP has been provided in Table 1.

Table 1: Policy principles and how they are addressed in this OAMP

Principle	Offset Strategy Compliance
Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environmental law and affected by the proposed action	The offset package proposed will directly contribute to the ongoing viability of the MNES required to be offset through the protection and management of habitat within the proposed offset areas from future loss (such as vegetation clearing in non-remnant areas and future development), improvement in habitat quality, increase availability of foraging and breeding resources, and result in a reduction of threatening processes (including weeds, pest animals and inappropriate fire regimes). The proposed offset area is known to support the MNES relevant to the Project, or there is high potential for the offset area to support the relevant MNES due to proximity of records, suitability of habitat and connectivity of habitats. Further baseline surveys will be conducted in year 1 of offset implementation to gather species population data so that numbers of individuals present can be monitored and tracked over the life of offset, with the objective to increase species stocking rates in the offset area. The proposed management actions will deliver conservation outcomes for each MNES over the life of the offset. The management actions have been tailored to each MNES based on identified threats so meaningful conservation outcomes can be achieved. Tailored management actions are described in Section 6.3. Additional outcomes include the prevention of further vegetation clearing and degrading land uses in non-remnant areas. Grazing will be excluded from the offset areas. Without the offset being put in place native regrowth and regenerating vegetation does not have any protection from future clearing by landowners. All offset vegetation is currently at threat from inappropriate fire regimes, weeds and pest animals and these degrading land practices will be actively managed. This OAMP and associated management actions will also support regeneration and restoration of habitat including revegetation of koala (*Phascolarctos cinereus*), greater glider (*Petauroides volans*) and glossy black-cockatoo (*Calyptorhynchus lathami lathami*) food trees, contributing to an increase in the availability of foraging habitat for these species, as well as breeding habitat as hollows develop. The offset proposal also includes supplementing breeding habitat in the short term with natural, salvaged hollows and carved hollows, providing breeding resources while hollows develop naturally. These types of hollows will have longevity in the environment and thermal properties similar to natural tree hollows. The proposed offset areas will contribute to the resilience of the MNES by increasing landscape connectivity. The offset areas are strategically located adjacent to Conondale National Park and Yabba State Forest, riparian corridors and other large tracts of remnant vegetation to improve their long-term viability as well as extend dispersal opportunities for MNES. In lieu of land-based offsets for the critically endangered scrub turpentine (*Rhodamnia rubescens*) compensatory measures consisting of providing financial support to a research program is proposed. Since the arrival of the Myrtle rust (*Austropuccinia psidii*) pathogen into Australia in 2010, it has become apparent that these species in the Family Myrtaceae are particularly susceptible to infection, leading to leaf, flower, and fruit death, branch dieback, and tree death. scrub turpentine and native guava (*Rhodomyrtus psidioides*) (not impacted by the Exploratory Works Project) have subsequently recently been classified as

Principle	Offset Strategy Compliance
	Critically Endangered under the EPBC Act due to the devastating impacts of Myrtle rust. Further details pertaining to these proposed compensatory measures are provided in Section 3.2.2 and Appendix F. To demonstrate the land-based offsets are appropriate to compensate for identified impacts, modified habitat quality assessments (MHQA) have been completed which includes field assessments of existing vegetation communities and habitats as described in Section 4 of this OAMP. The MHQAs demonstrate the habitat quality gains that can be achieved through delivery of the proposed offset and are summarised in Section 4.4 and Appendix C of the OAMP. As per the EPBC Offsets Policy, the DCCEEW OAG for relevant MNES has been applied to determine the extent of offset area required. Calculators are provided in Appendix D.
Suitable offsets must be built around direct offsets but may include other compensatory measures	The offset package is predominantly comprised of 100% land-based offsets for each MNES except scrub turpentine. Offsets for scrub turpentine are proposed to be 100% compensatory measures as this species is under extreme threat from Myrtle rust which is present onsite and a financial contribution to research and its conservation from this threat will be of greater conservation benefit to the species. This is outlined in Section 3.2.2 and an Indirect Offsets Plan, providing details on the compensatory actions to be implemented for scrub turpentine, is outlined in Appendix F. Proposed land-based offsets have been assessed applying the OAG and inputs are provided in Appendix D and demonstrate the percentage provided by the proposed offsets.
Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter	Anticipated offset requirements have been calculated using the OAG (Section 4 and Appendix D of the OAMP). The OAG considers the listing status of each MNES and their probability of annual extinction. The use of these measurements in the OAG ensures that the appropriate level of statutory protection is applied. All threats to MNES, and reasons for their listing status as outlined in the Conservation Advices have been considered and those relevant to the Project and area (impact and offset) are addressed in this OAMP. The location of the offset areas, habitat types included, management actions proposed, and habitat quality gains have all been tailored to each MNES and are consistent with information provided in relevant Conservation Advices (refer Section 6.3).
Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter	Offset requirements have been built around the disturbance area likely to occur from the Exploratory Works Project (Table 2 of the OAMP). Anticipated offset requirements have been calculated using MHQA (Section 4) and the OAG (Section 4 and Appendix D), which considers the conservation status of the protected matter, area of impact to habitat, starting habitat quality on impact and offset sites, risk of loss with and without the offset, time it will take to yield a conservation gain and future habitat quality. The proposed offset presents habitat commensurate in type (like-for-like) to habitat within the impact area. The total offset required has been determined using the disturbance area for the Project, application of the OAG inputs, and MHQA which includes both site specific data from impact area and offset area. The size and scale of the proposed land-based offset is appropriate and will deliver conservation gains for each MNES. The offset areas will deliver at least 100% of offset requirement, with some MNES substantially exceeding 100%. Scrub turpentine is proposed as 100% compensatory measures. The size and scale of land-based offsets are also sustainable as they are strategically located adjacent to other large tracts of remnant vegetation including existing protected areas and are of sufficient size to be viable in long-term and support known and potential habitat for the respective MNES. The offsets are also within mapped biodiversity corridors as described and mapped in Figure 6.

Principle	Offset Strategy Compliance
Suitable offsets must effectively account for and manage the risks of the offset not succeeding	A risk assessment has been prepared and provided in Section 13 in accordance with the qualitative risk assessment methodology outlined in the DCCEEW Environmental Management Plan Guidelines (DCCEEW, 2024). The risk assessment identifies the potential risks to the offset not achieving the performance outcomes and completion criteria, and how those risks can be addressed. Management and mitigation measures are identified to address each assigned risk, including corrective actions. Risks considered relate both to the delivery of the offset management actions and achieving associated habitat quality gains, but also in the administration of the offset. Key factors that have been adopted to reduce risks in offset delivery include: • Selecting offset areas that are strategically located in the landscape, and adjacent to other suitable habitats for MNES to enhance connectivity and deliver improved resilience. • The offset areas contain suitable habitat attributes for each MNES that can be legally protected, maintained and improved over time through recognised effective management actions. • Offset areas include degraded areas that can be regenerated and are subject to threatening processes that can be reduced (such as weeds and pest animals). • Management actions will be implemented by suitably qualified and experienced contractors. • Regular monitoring and auditing will occur to ensure management actions have been completed, the offset is progressing towards interim targets and any issues are identified and acted on early. • Strong governance and clear responsibilities assigned. • Adaptive management will be applied.
Suitable offsets must be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action)	Legally securing the offset areas in perpetuity will ensure existing and future landowners are prohibited from conducting degrading land uses, including vegetation clearing, native forestry and grazing. At present there is a lawful ability for landowners to clear regrowth vegetation in mapped non-remnant areas and remnant vegetation for certain purposes including: • Clearing to construct or maintain necessary buildings and structures where less than 2 ha. • To source construction timber to establish or maintain necessary buildings and structures. • To establish a necessary fence, road or vehicular track to maximum of 10 m wide. • To establish or maintain necessary firebreaks to maximum width of 20 m or 1.5 times the height of the tallest adjacent tree. Native vegetation will be protected from future clearing through implementation of the OAMP and landholder being legally bound to comply with the OAMP. The offset proposal also allows for land use to be managed including the exclusion of grazing and other rural activities currently permitted in the rural zoning. At present, there are no statutory requirements to control all species of weeds on the offset areas. Landowners are not required to manage weeds beyond their General Biosecurity Obligation (not spreading weed, minimising the risk of introducing new weeds etc.) under the *Biosecurity Act 2014*. Intensification of weeds can lead to habitat loss, habitat degradation and promote more intense fires. Implementation of the OAMP would ensure management of weeds would occur above and beyond what is currently required for each offset area under relevant legislation. Weed species such as Coral berry (*Rivina humilis*) and lantana (*Lantana camara*) will be controlled and reduced in their extent as they

Principle	Offset Strategy Compliance
	are a threat to ecological values of the area including the Lowland Rainforest TEC. There is also no statutory requirement for landowners to undertake active and appropriate bushfire management for biodiversity outcomes. Inappropriate fire regimes can cause destruction of habitat via hot, intensive fires or prevent regeneration if fires are too frequent. If fires are not appropriately managed, they threaten existing and future hollow-bearing trees, Lowland Rainforest TEC, kill young saplings, and could result in mortality of MNES individuals. Under the OAMP controlled burns are proposed to manage fuel loads in woodlands, and other forms of biomass management (predominantly weed control) will be conducted in the Lowland Rainforest TEC, and a 50 m buffer around the TEC, and other vine thicket communities (where the buffer is within the offset area or on land owned by Queensland Hydro). Without the offset there is an increased risk of mortality or injury to MNES species by predators. Although landholders have a general biosecurity obligation under the Qld *Biosecurity Act 2014*, there is no obligation for general pest animal control. The OAMP proposes active pest animal control of species that are known to impact MNES species or their habitat. Landowners also have no obligation to revegetate degraded land or maintain or improve connectivity. The OAMP proposes to conduct restoration activities including revegetation. Achieving conservation gains for each MNES requires management actions that go beyond standard land management and legislated requirements (Section 6). The proposed offset includes a number of actions that are 'above and beyond' what would occur if the offset was not put in place which are broadly summarised below: • MNES habitats will be legally secured on title to protect both existing native vegetation communities as well as regenerating native vegetation from inappropriate land uses. • Increase the extent of native vegetation within non-remnant areas by protecting offset areas from the threat of clearing of regrowth vegetation and removing livestock to support natural regeneration. • Increase MNES foraging and breeding resources including through installation of supplementary hollows for greater glider, yellow-bellied glider and glossy black-cockatoo. • Improve connectivity and dispersal from protected areas to adjacent lands. Connectivity will be improved through revegetation in non-remnant areas of Offset Area B. • Improve the condition of riparian vegetation. • Decrease in pest animals and weeds. • Appropriate fire regimes will occur. • Increase in MNES species occurrence.
Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable	<u>Efficient and Effective</u> • The offset areas are strategically located adjacent to existing large tracts of remnant vegetation, protected areas and biodiversity corridors. The offset proposal will increase habitat availability and patch size in the non-remnant areas. • Management actions will ensure efficient and effective delivery of conservation outcomes over the offset areas and proactive management, monitoring and reporting will ensure response/corrective actions are timely and focused. • Management methods are based on best practice and most up to date government guidelines to increase their effectiveness in achieving desired outcome. • The proposed offset areas are not presently protected or managed for conservation outcomes. Protection and management of the offset areas in

Principle	Offset Strategy Compliance
	accordance with this OAMP aims to deliver an overall improved conservation outcome for each MNES. Timely • Remnant vegetation will deliver habitat quality gains in a shorter timeframe due to being established habitat, and significant improvements can be made in first five years such as reduction in non-native cover. • Increasing habitat attributes such as large trees will take longer and the full 20 years is required to achieve gains for these attributes. • Reduction in pest animal populations can be achieved quite quickly. Substantial gains can be made within the first five to 10 years. • Increasing denning availability for greater glider, yellow-bellied glider (*Petauroides australis australis*) and glossy black-cockatoo can be achieved quite quickly through the installation of natural, salvaged hollows and carved hollows in the first few years. Other project examples have shown that greater glider will start to use nest boxes in the first six months of installation (B. Nottidge pers comm, 2024). This will allow time for hollows to develop in revegetation areas. • Increase in koala and glossy black-cockatoo foraging resources can also be delivered in first 10 years with many revegetation projects showing koalas using planted trees within first 10 years (Rhind et al 2014). • It is anticipated that the full habitat quality gains will be achieved within 20 years. • The offset areas will initially be legally secured through a declaration under VM Act within six months of the OAMP being approved. • Corrective actions will be implemented in a timely manner. Transparent • The OAMP has a number of measures to maintain transparency including an annual compliance report. This report will be published on the Queensland Hydro website and include details of offset management actions completed, any corrective actions that are required to be implemented, monitoring outcomes and how the offset is progressing. • Every five years a monitoring report will be prepared and made publicly available on the Queensland Hydro website. This monitoring report will include all monitoring results, compare previous monitoring rounds, and assess whether the offset has achieved the interim performance criteria for that stage. Any adaptive management changes will be proposed including a review of OAMP itself. • A final report at end of 20 years will also be published. Scientifically robust • The proposed offset areas were assessed by qualified and experienced Ecologists from SMEC, Umwelt, Attexo and EMM. The offset and associated vegetation communities, species habitats and MHQA scores have been informed from field surveys in accordance with approved guidelines (refer Appendix A). • The management actions proposed are known to be effective based on case studies and literature. They are tailored to each MNES based on latest scientific literature and Conservation Advice and Recovery Plans. • Management actions will be implemented by suitably qualified and experienced contractors. Queensland Hydro will manage these contracts directly and ensure the right personnel are engaged with demonstrated knowledge and capabilities. • Ongoing management and monitoring actions will be conducted in collaboration with other qualified ecologists and regeneration specialists to achieve the outcomes specified within the EPBC Act approval and this OAMP.

Principle	Offset Strategy Compliance
	• The baseline surveys conducted for the offset areas will be scientifically robust, reliable and repeatable, ensuring the monitoring and compliance reporting are consistent and relate back to the overall conservation outcomes. Baseline monitoring is set out in Section 8.
Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	This OAMP establishes clear guidance regarding the ongoing management and monitoring requirements to improve or maintain the viability of the protected matters. The offset areas will be protected on title in perpetuity as outlined in Section 14. The OAMP provides a transparent and detailed methodology to deriving habitat quality scores (MHQA) for each MNES (Appendix B). A comprehensive monitoring program has been developed which is set out in Section 8 which will allow for the progress of the offset to be tracked, but also provide important information on the presence, abundance and distribution of MNES in the offset. Roles and responsibilities for the implementation of this OAMP are outlined in Section 9, providing clear governance arrangements. Auditing arrangements and clear identification of persons responsible for delivery actions have been identified and are set out in Section 11.
In assessing the suitability of an offset, government decision-making will be informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific uncertainty	A variety of data sources, including Commonwealth approved guidance documents and additional information sources (e.g., state guidance documents and scientific literature), have been consulted throughout the environmental impact assessment process and development of the OAMP to ensure the best available scientific data and evidence are utilised to plan and deliver the offset. Government documents, scientific literature and latest project information to help inform best practice approaches have been clearly referenced throughout the OAMP.

3. Exploratory Works offset package

3.1 Exploratory Works MNES offset requirements

The following MNES have been determined to have a SI and are therefore proposed to be offset. The residual impact to be offset is detailed in Table 2.

Table 2: MNES proposed to be offset

MNES	EPBC Status	Impact Area (ha)
Lowland Rainforest of Subtropical Australia TEC	Critically Endangered	2.5
Threatened Flora		
Brush sophora (known habitat)	Vulnerable	0.3
Scrub turpentine (known habitat)	Critically Endangered	0.7
Threatened Fauna		
Black-breasted button-quail	Vulnerable	0.2
Glossy black-cockatoo (breeding and foraging)	Vulnerable	27.9
Greater glider	Endangered	35.2
Yellow-bellied glider (denning and foraging)	Vulnerable	35.3
Koala (breeding and foraging)	Endangered	35.3
Koala (dispersal and refuge)	Endangered	52.3
Long-nosed potoroo	Vulnerable	38

3.2 Proposed approach to offset delivery

3.2.1 Land based offsets

The primary approach to securing offsets for the Project is to deliver land-based offsets that will improve habitat quality for the impacted MNES, revegetate new areas of habitat (non-remnant), restore regrowth and improve connectivity and dispersal. Increasing availability of foraging and breeding resources is also proposed. Offsets will be like-for-like, providing conservation gains that are compliant with requirements of the EPBC Act Environmental Offsets Policy. For all MNES, other than scrub turpentine, the proposed land-based offsets will deliver 100% of the Project's offset requirements. For the scrub turpentine compensatory measures are proposed due to the key threats facing this species being Myrtle Rust. Further detail for the proposed offset for this species is provided in Section 3.2.2 and Appendix F.

The identification of suitable offset areas has taken into account the presence of native vegetation communities that contain, or will contain in the future, the habitat attributes required for the relevant MNES species and ecosystem function impacted, to provide like-for-like offsets. In addition, the proposed offset areas are known to support, or are highly likely to support, the MNES based on results of desktop assessments and targeted field surveys. The identified habitat is subject to existing threatening processes that can, with appropriate management actions, reduce these threats and improve habitat quality over time. Another key consideration was connectivity and the need for the proposed offset areas to be well connected in the landscape, as well as improve connectivity in the landscape, to ensure species can disperse, vegetation patches would not be isolated, and these areas are sustainable in the long-term.

The proposed offsets are consistent with relevant State and local government environmental policies and principles. For example, while the Exploratory Works Project is just outside the South East Queensland (SEQ)region the offsets package includes koala habitat restoration and revegetation to support a net gain of habitat and enhanced connectivity for this species consistent with outcomes of South East Queensland Koala Conservation Strategy (2020-2025) (DES, 2020). The proposed offsets also lie within State mapped terrestrial wildlife corridors supporting broader conservation outcomes for the region by assisting to expand on existing protected areas and conserving and improving land in these mapped biodiversity corridors. These biodiversity outcomes are consistent with the South East Queensland Regional Plan (Shaping SEQ) (Department of State Development, Infrastructure, Local Government and Planning (DSDILGaP), 2023) which includes commitments for maintaining and enhancing connectivity of regional biodiversity corridors, and identifying opportunities for regeneration to maximise biodiversity outcomes. Similarly, the Queensland Biodiversity Conservation Strategy (State of Queensland, 2022) includes a goal for restoring and recovering biodiversity through restoration of habitat in areas with important landscape connectivity to provide climate change resilience to habitat.

Securing suitable offset lands near the areas impacted by Exploratory Works is the preferred option, due to the proximity to the impacted values (i.e. offset will benefit locally impacted species populations) and an increase in conservation land and improvements to connectivity are made in the local area around the Project.

3.2.2 Offset approach for scrub turpentine

The Exploratory Works Project is predicted to result in the loss of 0.7 ha of known habitat for this species. However, the primary threat to scrub turpentine is myrtle rust, not habitat loss. The continued decline of mature plants and lack of successful regeneration threaten the long-term viability of scrub turpentine in the wild (Carnegie et al., 2015). Therefore, a compensatory offset will offer more suitable measures for protecting scrub turpentine populations into the future.

The proposed compensatory measures for impacts arising to the scrub turpentine from the Exploratory Works Project are to deliver funding for further research, with aims to deliver meaningful outputs for the ongoing survival of the species and build on the body of research currently being undertaken by the Department of Primary Industries (DPI).

Researchers on the conservation of species at risk of decline due to myrtle rust agree that the most urgent action in the conservation of scrub turpentine is the collection of germplasm to initiate conservation collections and provide plant material for future research and resistance breeding programs (F. Giblin, personal communication, July 16 2024; G. Pegg, personal communication, August 13 2024). Consistent with the Myrtle Rust National Action Plan and NSW SoS Operational Plan for Myrtle Rust, future conservation strategies of the species that require additional funding suggested by these experts include:

- collecting germplasm and cuttings from healthy individuals for propagation
- propagating plants and creating seed orchards then managing Myrtle Rust within these orchards and maintaining a healthy population to reproductive stage
- using the seed orchards to conduct various research strategies including:
- fungicide trials
- RNA trials
- conducting resistance breeding programs
- planting the species into conservation areas that can be managed long term with the eventual goal to replant wild populations with resistance to myrtle rust.

The Project proposes to provide an appropriate level of funding towards these strategies to meet the Exploratory Works offset requirements. Additional information on the compensatory measures proposed and justification for suitability of this approach is provided in Appendix F.

3.3 Overview of the proposed offset

3.3.1 Desktop assessment and offset selection criteria

A desktop assessment to identify potential offset sites was undertaken. This desktop assessment focused on areas surrounding the Exploratory Works Project with a preference for localised offsets that have the ability to benefit local populations of the impacted threatened species and ecological communities. Being able to improve local connectivity, increase habitat availability and strategically locate offsets near existing protected areas was a priority. Offsets being located close to the area of impact and within the same local government area is also referenced in the Queensland Environmental Offsets Policy (DES, 2023) and sought out by local community groups and conservation groups for environmental offsets to benefit their local environment and region.

Key considerations in offset site selection were:

- The area and associated vegetation are suitable to support the species or community, and there is a high degree of confidence MNES would occur.
- There is good connectivity between the offset areas and adjacent vegetation and/or habitats.
- Where possible, offset areas are strategically located adjacent to existing protected areas to expand areas for conservation and have long-term security of tenure.
- The offset areas provide the opportunity for habitat quality gains to be achieved; for example, this could be through the restoration of vegetation in a more degraded condition.
- The offset areas were subject to threatening processes that could be minimised and therefore the risk of loss could be reduced.
- Landholder was supportive of the land being secured and managed as an environmental offset.
- The offset area would also be consistent with other local and state planning instruments and conservation strategies.

The offset areas being assessed consisted of assessment units which meet three main condition states being:

- Meet the definition of 'remnant' under *Vegetation Management Act 1999* (VM Act) with varying levels of degradation.
- Non-remnant area under VM Act that supports regrowth native vegetation; habitat quality has levels of degradation and opportunities for habitat quality improvements.
- Non-remnant area under VM Act that is largely cleared, high levels of degradation with significant opportunity for habitat quality improvements.

3.3.2 Desktop review and field surveys

Extensive surveys have been completed for MNES within the Borumba Exploratory Works Survey area and Borumba PHES Project area (as summarised in Section 4.1 of the Preliminary Documentation). These surveys have supported an understanding of MNES and associated habitats present in both the Project footprint and offset areas located proximate to the impact areas.

A desktop review was undertaken to identify listed threatened species and ecological communities with the potential to occur in the offset areas. The findings of this desktop review, along with State and ground-truthed regional ecosystem (RE) mapping, identified potential MNES habitat and areas to target for field survey.

Field surveys to support habitat quality assessments followed the general guidelines in the BioCondition Assessment Manual (Version 2.2) (Eyre et al., 2015) and the Guide to determining terrestrial habitat quality (Version 1.2) (DEHP, 2017). The number of habitat quality assessment sites, the location of the sites and the assessment units were determined as per the guidelines and are shown in Figure 8. Further information on habitat quality is provided in Section 4 of this OAMP.

Field survey efforts associated with the impact area and broader Borumba PHES Project area have consisted of flora assessments, terrestrial fauna assessments and aquatic assessments conducted during periods recommended by the respective survey guidelines for each assessment. The survey program targeted threatened species and communities identified as either potentially, likely or known to occur in the impact area based on the likelihood of occurrence assessment.

All surveys were conducted by experienced ecologists and botanists from SMEC, Umwelt, Attexo and EMM.

Field surveys for flora included:

- vegetation mapping involving quaternary and secondary vegetation surveys
- condition of the habitat quality assessment sites, determined using the BioCondition method
- TEC assessments verifying the presence of mapped TECs the project footprint
- targeted flora searches (protected plant survey and threatened flora searches)

Terrestrial fauna surveys included:

- habitat assessments
- koala spot assessment technique (SAT) points

- diurnal searches
- spotlighting surveys
- targeted amphibian survey
- passive and active acoustic detection surveys
- bioacoustics surveys
- diurnal bird surveys
- camera trapping for introduced predators and MNES species
- Elliot trap surveys
- pitfall trapping.

Habitat assessments for each threatened species were conducted to measure foraging and sheltering opportunities for each MNES. The attributes measured for each species and the methodology used is listed in Appendix B.

A total of 87 BioCondition surveys have been completed across all RE types and condition thresholds, including remnant, regrowth and non-remnant areas associated with proposed offset areas. Forty-two BioCondition surveys were completed in and near the Project footprint. A description of surveys that have been completed across offset areas is provided in Appendix A. The location of the BioCondition transects and other targeted surveys are provided in Figure 7 and Figure 8.

3.3.3 Offset area description

Based on a combination of desktop assessments and field surveys priority offset areas were selected. These offset areas needed to cater for the combination of MNES offset requirements. There are eight MNES values proposed to be offset using land-based offsets (Table 2), and the areas chosen provide suitable habitats for these values as well as meeting other considerations outlined in Section 3.3.1.

It is relevant to note that only those areas that fall outside both the Exploratory Works and Main Works disturbance footprint have been considered as potential offset locations.

The proposed offset is made up of two discreet offset areas referred to as Offset Area A and Offset Area B, with a total area of 788.5 ha (Figure 3). Offset Area A is 122.5 ha and Offset Area B is 666 ha which includes the state owned watercourse. When the watercourse corridor through Offset Area B is excluded, as the watercourse itself is State land, the offset area to be legally secured is 658 ha, totalling a combined offset area of 780.5 ha. Registered owners are summarised in Section 3.3.4 and include Queensland Hydro and Department of Local Government, Water and Volunteers (DLGWV).

The offset areas were selected to ensure that all MNES (except the scrub turpentine) required to be offset via land-based offsets as a result of the Project were catered for, suitable habitats were present, the relevant threatened species are known to occur or could occur in the future, and the areas chosen provide for habitat quality gains and provide sufficient area to meet the OAG requirements were available.

Where possible co-location of MNES was achieved through selection of vegetation communities and habitats that would support a number of impacted species such as eucalypt woodlands that provide suitable habitat for koala, glossy black-cockatoo and greater glider.

3.3.3.1 Suitability of Offset Area A

Offset Area A is situated on Lot 1 LX2754 and the offset is a total area of 122.5 ha (Figure 3).

Tenure and land use

Offset Area A is located on Lot 1 LX2754.This lot is 799 ha in area (of which 122.5 ha will be offset) and is a reserve (for electrical purposes) for which Queensland Hydro is the trustee. The lot was secured in the 1980s, along with several other lots totalling 2,360 ha for the purposes of hydroelectric development and is currently designated for the proposed Borumba PHES Project.

The Exploratory Works and the Main Works are located to the west of the offset area and there is a minimum buffer of 70 m between the current Project footprint and the offset area boundary, with the buffer up to 120 m in other areas.

The property has historically been used for agricultural practices, including cattle grazing, and timber harvesting. An existing lease over the land recently expired and cattle were recently removed from the property for safety reasons due to investigations commencing for the Exploratory Works and the Main Works. As part of the historical grazing activities, the broader site has been frequently burned with fires generally occurring in the winter months. There was a significant fire in 2014/2015 which had a significant impact on the area including the area of vegetation associated with Walkers Top Road.

The offset land has been allocated by the Queensland Government as a Forest Management Unit (FMU). FMUs denote areas where the State owns the forest products on the land under the *Forestry Act 1959* and has a commercial interest in managing the forest products through the Forest Products unit within DPI. Without the offset being put in place, this area can be allocated to a timber mill which would result in the loss of some large trees providing habitat for threatened species and communities including; koala, greater glider, yellow-bellied glider, glossy black-cockatoo, long-nosed potoroo and Lowland Rainforest of Subtropical Australia (Lowland Rainforest) TEC. Timber harvesting would occur in accordance with Queensland's Code of Practice for native forest timber production on Queensland's State forest estate 2020 (DES 2020) and does not require referral to DCCEEW.

Native forest practice in remnant vegetation is also an exempt activity under Queensland Vegetation Management framework as long as the activity complies with the requirements of the *Vegetation Management Act 1999* (VM Act) to notify and conduct activities in accordance with the Queensland Government's 'Managing a native forest practice accepted development vegetation clearing code'.

Landscape context and connectivity

The eastern and northern boundary of the site borders the Conondale National Park and is indirectly connected to other large tracts of bushland including Conondale Resources Reserve and Imbil State Forest (Figure 6). Several threatened species have been recorded within this area during surveys including the greater glider, brush sophora, scrub turpentine and yellow-bellied glider. glossy black-cockatoos and koalas have also been recorded near this offset area (Figure 5). Conondale National Park and Imbil State Forest are also known to support greater glider, koala and glossy black-cockatoo populations and there is good connectivity between the offset area and adjacent habitats for the species.

The offset area lies within a mapped State terrestrial biodiversity corridor which connects coastal vegetation with Mapleton National Park, Imbil State Forest, Conondale National Park, Yabba State Forest and Wrattens National Park. Several small creek lines (stream order 1) occur within the offset area and flow east into the Conondale National Park and eventually join Borumba Creek and flow into Lake Borumba.

Vegetation

Offset Area A is predominantly remnant eucalypt woodlands but also contains approximately 22 ha of regrowth eucalypt woodlands and vine thickets that also support some cleared weedy areas (Photo 4).

Regeneration and recruitment of tree species in both remnant and regrowth sites is average with only around half of the sites sampled meeting the benchmark for regeneration of tree species. This could be attributed to the high abundance of weeds such as lantana (*Lantana camara*) and fire history (Photo 5).

Although most of the vegetation in Offset Area A is mapped as remnant (Photo 6), there are cleared areas and areas experiencing heavy weed infestations throughout this remnant vegetation. Weed abundance is average to high with the majority of the sites having at least some weed cover. Some areas have a high abundance of weeds with lantana being 100% of groundcover in some gullies, and some sites (both remnant and regrowth) having over 80% cover of weeds. Other weeds include stinking Roger (*Tagetes minuta*), wild tobacco (*Solanum mauritianum*), giant devils fig (*Solanum chrysotrichum*) and billygoat weed (*Ageratum conyzoides*), which are dominant in many areas and likely impacting regeneration of new eucalypts (Photo 6). Some of these species are also known threats to MNES values associated with the Project.

Preferred foraging trees suitable for greater glider, koala and yellow-bellied glider are in moderate abundance (mean cover by these species was 40% across relevant MHQA sites) and richness (mean number of foraging species was five across relevant MHQA sites) across the majority of the offset area. Preferred foraging species present within the offset site include *E. tereticornis*, *Corymbia intermedia*, *E. eugenioides* and *E. grandis*.

Photo 4: RE 12.12.15 in Offset Area A

Photo 5: Regrowth areas within Offset Area A showing a dense lantana infestation

Photo 6: Regrowth area within Offset Area A showing weed diversity and density in a disturbed area

3.3.3.2 Suitability of Offset Area B

Offset Area B, being land to be legally secured is 658 ha in total area and situated to the north-west of the Project area (Figure 3).

Tenure and land use

Offset Area B is situated across Lot 77 LX2546 and Lot 24 LX2529 (Figure 3). Both lots are freehold title and currently owned by the Queensland Government Department of Local Government, Water and Volunteers (DLGWV).

The offset area is currently used for livestock grazing and has historically been cleared and selectively logged. This is shown through a lack of large trees on lower flats both in remnant and regrowth areas. There is an existing grazing lease on the property that permits cattle grazing to continue. The landholder also has a lawful right under Queensland legislation to continue to remove any regenerating native vegetation and regrowth trees that occur in the non-remnant areas without a permit. There are also exemptions to clear remnant vegetation for a range of activities including weed management, fence lines and access tracks up to a width of 10 m. The lessee is also noted as conducting frequent hazard burns on the property to maintain grass cover for livestock which is resulting in poor native species ground cover and a lack of recruitment of trees.

As part of the historical grazing activities, the broader site has been frequently burned with fires generally occurring in the winter months. There was a significant fire in 2014/2015 which had a significant impact on the region.

Landscape context and connectivity

Offset Area B partially lies within a mapped State terrestrial biodiversity corridor that links Yabba State Forest and Conondale and Wrattens National Parks in the area to vegetation on the coast (Figure 6). The south-western boundary borders Yabba State Forest which is directly connected to several other protected areas including Wrattens National Park, Gallangowan State Forest, Elgin Vale State Forest and Upper Kandanga State Forest.

The site contains several stream order 1 creeks which flow into Mujimba Creek (stream order 4) within the offset area. Mujimba Creek flows into Kingaham Creek and ultimately into Lake Borumba. These creeks are likely to be important movement corridors for fauna.

Koalas have been recorded on multiple occasions within this offset area and glossy black-cockatoo have been recorded four times, three times in the north-western corner and once in north-eastern corner of the offset area. A greater glider has been recorded just under 1 km from the south-eastern offset area boundary, within State mapped remnant RE 12.11.15 vegetation. Threatened species records are shown in Figure 5.

Vegetation

Offset Area B is dominated by eucalypt woodland communities in both remnant and non-remnant conditions. It also supports approximately 55.7 ha of vine thicket communities including the Lowland Rainforest TEC (41.8 ha).

Regrowth and non-remnant eucalypt woodland areas are dominated by lantana, which has 100% cover in some areas. Other weeds including wild tobacco, giant devil's fig and billygoat weed were also dominant in many areas (Photo 7) and were likely inhibiting regeneration of new eucalypts. Regeneration of eucalypts did not meet the benchmark in more than 50% of the plots sampled, which was likely a result of high weed abundance, grazing pressures and burn regime. Management of weed species will positively affect regeneration.

Large tree abundance is very low across the site with none of the plots sampled meeting the benchmark for large trees abundance and several areas having no large eucalypts present. This suggests the offset area has been selectively logged in the past. However, large trees do exist and support hollows suitable for hollow-dependent species such as the greater glider (Photo 8).

Canopy cover is generally less than the benchmark across the majority of the offset area. Less than a quarter of the plots sampled met the benchmark for canopy cover with the average cover just 38%. Canopy cover, particularly in regrowth, can be improved over time as canopy trees grow and canopy cover increases.

The non-remnant areas are currently grazed and dominated by introduced and native grasses (Photo 8). The areas have little regeneration and a completely absent canopy and mid-storey.

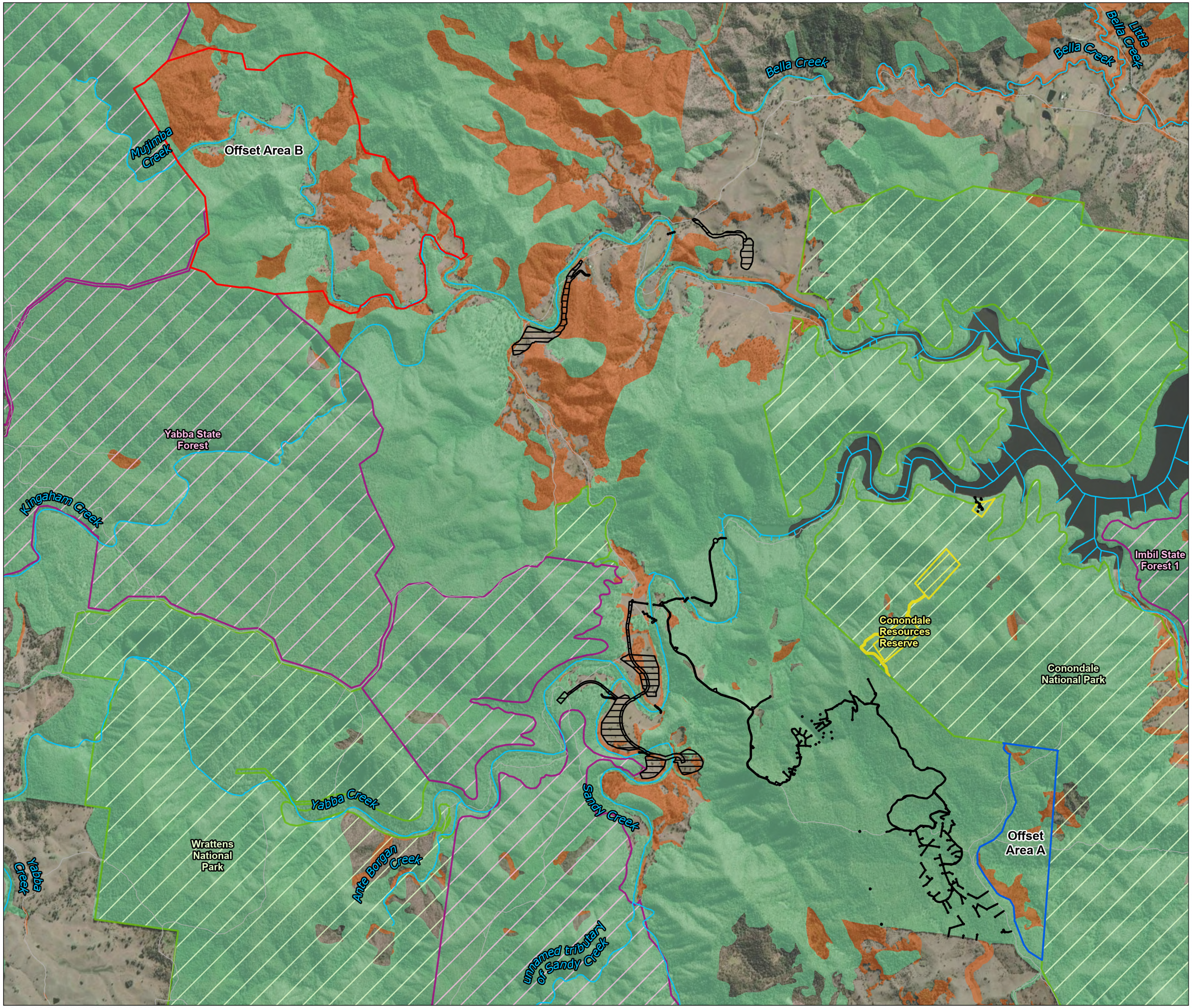
Pest animals are in high abundance across the offset site and adjacent areas including large numbers of feral deer (*Rusa* spp.) being observed (Photo 19). Feral deer are particularly having an impact on younger native trees and regeneration, with deer known to rub up against trees and trample and eat saplings.

Photo 7: Non-remnant area within Offset Area B showing little mid-storey cover and abundant weeds

Photo 8: Offset Area B with areas for regeneration in foreground and larger trees on slopes

Photo 9: Vegetation and habitat within Offset Area B

Top left – Non-remnant RE 12.11.14 displaying a mix of native and exotic grasses and no canopy
Top right- RE 12.12.23
Bottom left – Non-remnant RE 12.11.15 showing native and exotic grasses with scattered mature trees
Bottom right – hollow-bearing tree suitable for glossy black-cockatoo.



Queensland Hydro

GDA2020 MGA Zone 56

N

0 1000 m

1:40,000 @ A3

LEGEND

- Offset Area A
- Offset Area B
- Exploratory Works Project Footprint (EPBC Only)
- Watercourse [defined by Water Act 2000]
- Local road or track

Protected Areas

- National park
- Resources reserve
- State forest

Vegetation Management Status

- Remnant
- Regrowth

Data Sources:
Basemap © Roads and tracks: © State of Queensland (Department of Resources) 2023
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar
Vegetation management regional ecosystem; Cadastre; Local government area; Roads and tracks: © State of Queensland (Department of Resources) 2025
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019
Protected areas and forests of Queensland: © State of Queensland (Department of Environment and Science) 2023

Borumba PHES Project
Offset Area Management Plan

PROPOSED OFFSET AREAS

PROJECT NO: 30032677
CREATED BY: NC17428
MODIFIED ON: 25/08/2025
VERSION: A
AMENDED BY: NC17428

FIGURE 3

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 3

3.3.4 Land encumbrances and land use

Table 3 provides a summary of the relevant lot and plans within the offset area, and any registered interests on title or exploration tenements.

Table 3: Land encumbrances and land use

Offset Site	Lot Plan	Registered interests	Exploration tenements	Current land use
A	1 LX2754	Nil	Nil	Reserved for pumped hydro Forestry lease: Forestry Management Unit K-WI13527
B	24 LX2529	Nil	Exploration permit minerals (EPM)28176, EPM27475 Held by Fig Tree Valley Pty Ltd for gemmology and mineralogy	Grazing lease
	77 LX2546	Nil	EPM28176, EPM27476, EPM27475 Held by Fig Tree Valley Pty Ltd for gemmology and mineralogy	Grazing lease

Lot 1 LX2754 has been allocated by the Queensland Government as an FMU. Without the offset being put in place, this area has potential to be allocated to a timber mill, which would result in the loss of some large trees providing habitat for threatened species and communities including; koala, greater glider, yellow-bellied glider, glossy black-cockatoo, long-nosed potoroo and Lowland Rainforest of Subtropical Australia (Lowland Rainforest) TEC. Timber harvesting would occur in accordance with Queensland's Code of Practice for native forest timber production on Queensland's State forest estate 2020 (DES 2020) and does not require referral to DCCEEW.

Native forest practice in remnant vegetation is also an exempt activity under Queensland Vegetation Management framework as long as the activity complies with the requirements of the VM Act to notify and conduct activities in accordance with the Queensland Government's Managing a native forest practice accepted development vegetation clearing code.

3.3.5 Habitat types in offset areas

The following habitat types are represented in the offset areas and a broad description of these habitats are provided below. Table 4 includes a summary of each regional ecosystem (RE), what offset area it occurs in, associated MNES, and habitat quality plots undertaken within each RE.

3.3.5.1 Eucalypt dominated woodlands and forests

Offset Areas A and B support eucalypt dominated woodlands on landzone 11 (hills on metamorphic rocks) and landzone 12 (hills on igneous rocks). These include REs:

- RE12.12.15 Mixed open forest including combinations of *E. propinqua*, *E. siderophloia, Corymbia intermedia, E. microcorys*, *Lophostemon confertus* open forest on Mesozoic to Proterozoic igneous rocks.
- RE12.12.12 *E. tereticornis, Corymbia intermedia, E. crebra* +/- *Lophostemon suaveolens* woodland on Mesozoic to Proterozoic igneous rocks.
- RE12.12.23 E. *tereticornis subsp. tereticornis or E. tereticornis subsp. basaltica* +/- *E. eugenioides* woodland to open forest on crests, upper slopes and elevated valleys and plains on Mesozoic to Proterozoic igneous rock (Photo 8).
- RE12.11.14 *E. crebra, E. tereticornis, Corymbia intermedia* woodland on metamorphics +/- interbedded volcanics.
- RE12.11.15 *E. tereticornis, Corymbia intermedia* open woodland with *Xanthorrhoea johnsonii* understorey on serpentinite.

- RE12.11.3 *E. siderophloia, E. propinqua* +/- *E. microcorys, Lophostemon confertus, Corymbia intermedia, E. acmenoides* open forest on metamorphics +/- interbedded volcanics.
- RE12.11.3a *Lophostemon confertus* +/- *Eucalyptus microcorys*, *E. carnea, E. propinqua, E. major, E. siderophloia woodland*. Occurs in gullies and exposed ridges of Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics.RE12.11.9 *Eucalyptus tereticornis* subsp. *tereticornis* or *E. tereticornis* subsp. *basaltica* open forest on metamorphics +/- interbedded volcanics, usually on ridges, crests and upper slopes.

These eucalypt dominated communities provide foraging and breeding opportunities for many MNES fauna species including the koala, greater glider and glossy black-cockatoo. RE12.12.15 often occurs in wetter gullies which would provide preferred habitat for the yellow-bellied glider and long-nosed potoroo. Example of eucalypt woodland on steep slopes is shown in Photo 10.

Approximately 24% (186.5 ha) of the two offset areas are regrowth woodlands and vine thicket and 11% (89.1 ha) are non-remnant cleared land. These areas would be suitable for assisted regeneration or restoration.

Recruitment of new trees in mapped eucalypt woodlands, particularly in regrowth and non-remnant areas was low, likely due to impacts from grazing, fires and weed abundance. Canopy cover met the benchmark in most remnant areas but was lower in regrowth and non-remnant areas suggesting that tree density is lower than expected. Similarly, the number of large trees (eucalypts and non-eucalypts) was low with most of the sites containing less than 50% of the expected number of large trees. This suggests that both Areas A and B may have had some clearing or selective logging in the past. Many areas had low species richness of grasses, shrubs and forbs which can be indicative of grazing or past fire history.

Many of the regrowth sites are dominated by weeds with weed cover at 90% in some areas. Dense lantana would likely prohibit the movement of fauna in some areas as shown in Photo 11. A site where regenerating eucalypts are present is shown in Photo 12.

Photo 10: Example of eucalypt woodland on steep slopes

Photo 11: Lantana in the offset area which would prohibit the movement of koala and other MNES

Photo 12: Regrowing eucalypts and other native species within RE 12.11.15 in Offset Area B

3.3.5.2 Subtropical rainforest and vine forest

A total of 70.49 ha of subtropical rainforest and vine forests are located across both offset areas. These habitats include REs:

- RE12.12.16 Notophyll vine forest on Mesozoic to Proterozoic igneous rocks.
- RE12.11.10 Notophyll vine forest +/- Araucaria cunninghamii on metamorphics +/- interbedded volcanics.
- RE12.11.11 Araucarian microphyll vine forest on metamorphics +/- interbedded volcanics, usually in southern half of bioregion.

The communities are dominated by rainforest trees such as *Araucaria cunninghamii, Dendrocnide photinophylla, Diospyros geminata, Diploglottis australis, Elattostachys xylocarpa, Mallotus philippensis* and *Lophostemon confertus*. These communities are structurally complex and diverse and provide foraging and sheltering opportunities for many threatened flora and fauna species (Photo 13).

Two of these REs, 12.12.16 (17.42 ha) and 12.11.10 (39.1 ha) are also consistent with the Lowland Rainforest TEC and will be used to offset significant impacts associated with the Project to the Lowland Rainforest TEC.

The condition of the patches varies, with large patches having very little disturbance and other areas impacted by weed incursion. Species richness for trees, shrubs, grasses, and forbs was generally below the benchmarks. Some regrowth areas of these communities had very high weed abundance including lantana, *Passiflora edulis, Ageratum houstonianum,* and *Megathyrsus maximus* while others had very low weed abundance, which is probably reflective of past disturbances. The abundance of large trees was low with all of the patches of RE 12.12.16 not meeting the benchmark for large trees. This may indicate past logging with logging known to occur onsite and is evident in historic mapping.

The community is habitat for brush sophora, scrub turpentine and the black-breasted button-quail.

Photo 13: Vine forest within Offset Area A

3.3.5.3 Eucalypt riparian woodlands

Offset Area B contains riparian vegetation that has been ground-truthed as RE 12.3.7 (*E. tereticornis, Casuarina cunninghamiana subsp. cunninghamiana* +/- *Melaleuca spp*. fringing woodland) (Photo 14). This community is vital providing ecological function as wildlife corridors and refuges during droughts. It provides important sheltering opportunities in the form of hollow bearing trees, mature trees with large canopies and dense shrubs and grasses for ground dwelling mammals. Foraging opportunities in the form of fruiting and flowering trees are usually abundant and these resources can last longer than the surrounding habitats due to the presence of water.

These habitats were in average condition due to the abundance of weeds and impacts from cattle. RE 12.3.7 (woodland fringing waterways) had an average weed cover of 65% and the mid-storey was dominated by lantana. These sites are important for koala (due to the presence of water and preferred food trees) but some areas would currently not be utilized by koala due to difficulty moving through the dense weeds. Trampling and damage to small trees was evident and recruitment was low across all sites sampled, likely due to weed density and impacts from cattle.

The community provides important habitat for koala, greater glider and glossy black-cockatoo. RE 12.3.7 vegetation is not located within Offset Area A.

Photo 14: Riparian woodlands along waterways within Offset Area B

3.3.5.4 Wetlands, watercourses and open water

Offset Area B contains Mujimba Creek (stream order 4) and some of its tributaries (stream order 1). Mujimba Creek is likely to contain water, either permanently or seasonally, while the tributaries are likely to only contain water after rain. The creeks could provide habitat for aquatic species and foraging and water resources for many least concern and threatened species.

3.3.5.5 Cleared grazing land

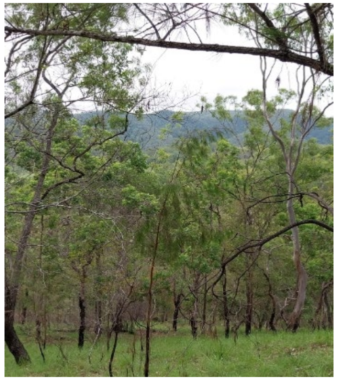
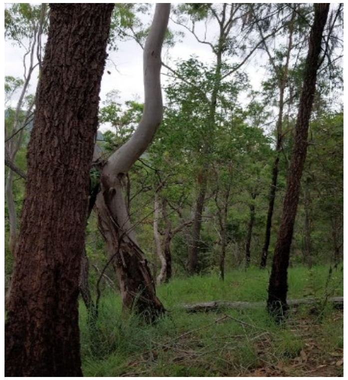
Approximately 89.1 ha of Offset Area B is currently mapped as non-remnant and has been cleared for grazing (Photo 15). These areas are mostly centred on the flats along Mujimba Creek and its tributaries. Some areas have been completely cleared and contain little to no shrubs and trees while other areas contain some eucalypt and vine thicket regrowth (Photo 16). The pre-clear REs suggest that the areas were eucalypt woodlands REs 12.3.7, 12.11.15, and 12.11.14. These areas are highly suitable for restoration and to deliver conservation gains for koala, greater glider, and glossy black-cockatoo, as well as improved landscape connectivity.

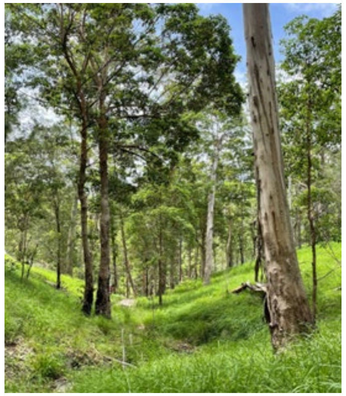
Photo 15: Non-remnant cleared areas within Offset Area B

Photo 16: Non-remnant cleared area with some regrowth of eucalypts within the Offset Area B

Table 4: Offset area vegetation communities

AU	RE Present	Vegetation Description	Target MNES *	Associated HQA	Offset Area Present	Photos
1	12.11.10 Regrowth	Notophyll vine forest +/- *Araucaria cunninghamii* on metamorphics +/- interbedded volcanics.	Future habitat for BBBQ, koala (dispersal), YBG, LNP, RFTEC, BS, ST	HQA310, MHQA726	B	
2	12.11.10 Remnant	Notophyll vine forest +/- *Araucaria cunninghamii* on metamorphics +/- interbedded volcanics. On site RE is remnant.	BBBQ, koala (dispersal), YBG, LNP, RFTEC, BS, ST	HQA212, HQE003, HQE004, MHQA719, MHQA739, MHQA740, DRB007	A & B	 
3	12.11.11 Regrowth	Araucarian microphyll vine forest on metamorphics +/- interbedded volcanics, usually in southern half of bioregion.	Future habitat for BBBQ, koala (dispersal), YBG, LNP, BS, ST	HQA304, HQA314	B	

AU	RE Present	Vegetation Description	Target MNES *	Associated HQA	Offset Area Present	Photos
4	12.11.11 Remnant	Araucarian microphyll vine forest on metamorphics +/- interbedded volcanics, usually in southern half of bioregion.	BBBQ, koala (dispersal), YBG, LNP, BS, ST	HQA30, HQA305	B	
5	12.11.14 Regrowth	*E. crebra, E. tereticornis, Corymbia intermedia* woodland on metamorphics +/- interbedded volcanics.	Koala (foraging), GG, YBG, GBC	HQA46, MHQA702, MHQA703, MHQA715, MHQA727	B	 
6	12.11.14 Remnant	*E. crebra, E. tereticornis, Corymbia intermedia* woodland on metamorphics +/- interbedded volcanics.	Koala (foraging), GG, GBC	HQE001, HQE002, MHQA704, MHQA705, MHQA735, MHQA747	B	 

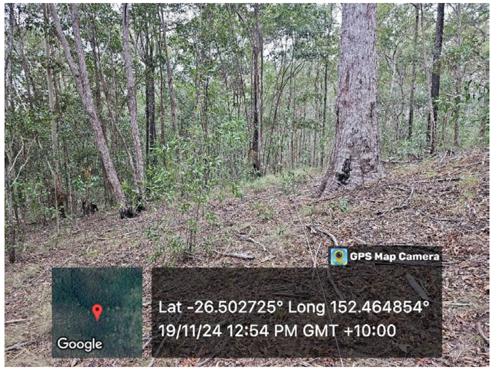
AU	RE Present	Vegetation Description	Target MNES *	Associated HQA	Offset Area Present	Photos
7	12.11.15 Non-remnant	*E. tereticornis, Corymbia intermedia* open woodland with *Xanthorrhoea johnsonii* understorey on serpentinite.	Future habitat for koala, GG, YBG, GBC, BS	HQA217, HQA47, MHQA729, MHQA741, MHQA742, DRB008	B	
8	12.11.15 Regrowth	*E. tereticornis, Corymbia intermedia* open woodland with *Xanthorrhoea johnsonii* understorey on serpentinite.	Future habitat for koala (foraging), GG, YBG, GBC	MHQA732, MHQA743, MHQA744, DRB004, DRB006	B	
9	12.11.15 Remnant	*E. tereticornis, Corymbia intermedia* open woodland with *Xanthorrhoea johnsonii* understorey on serpentinite.	koala (foraging), GG, YBG, GBC, BS	HQA306, HQA307, HQA44, HQA51, HQA52, MHQA736, MHQA745, MHQA746	B	 

AU	RE Present	Vegetation Description	Target MNES *	Associated HQA	Offset Area Present	Photos
10	12.11.3 Regrowth	*E. siderophloia, E. propinqua* +/- *E. microcorys, Lophostemon confertus, Corymbia intermedia, E. acmenoides* open forest on metamorphics +/- interbedded volcanics. On site RE is undetermined.	koala (foraging) YBG, LNP, GBC, GG BS, ST	HQA301, HQA303, MHQA706, MHQA716	A	 
11	12.11.3 Remnant	*E. siderophloia, E. propinqua* +/- *E. microcorys, Lophostemon confertus, Corymbia intermedia, E. acmenoides* open forest on metamorphics +/- interbedded volcanics. On site RE is remnant.	koala (foraging), GG, YBG, LNP, GBC, BS, ST	HQA, 302, 313, HQE013, HQE014, MHQA720, MHQA721	A & B	 
12	12.12.15 Regrowth	Mixed open forest including combinations of *E. propinqua, E. siderophloia, Corymbia intermedia, E. microcorys, Lophostemon confertus* open forest on Mesozoic to Proterozoic igneous rocks.	koala (foraging), GG, YBG, LNP, GBC, ST, BS	HQA62, MHQA723, MHQA724	A	 

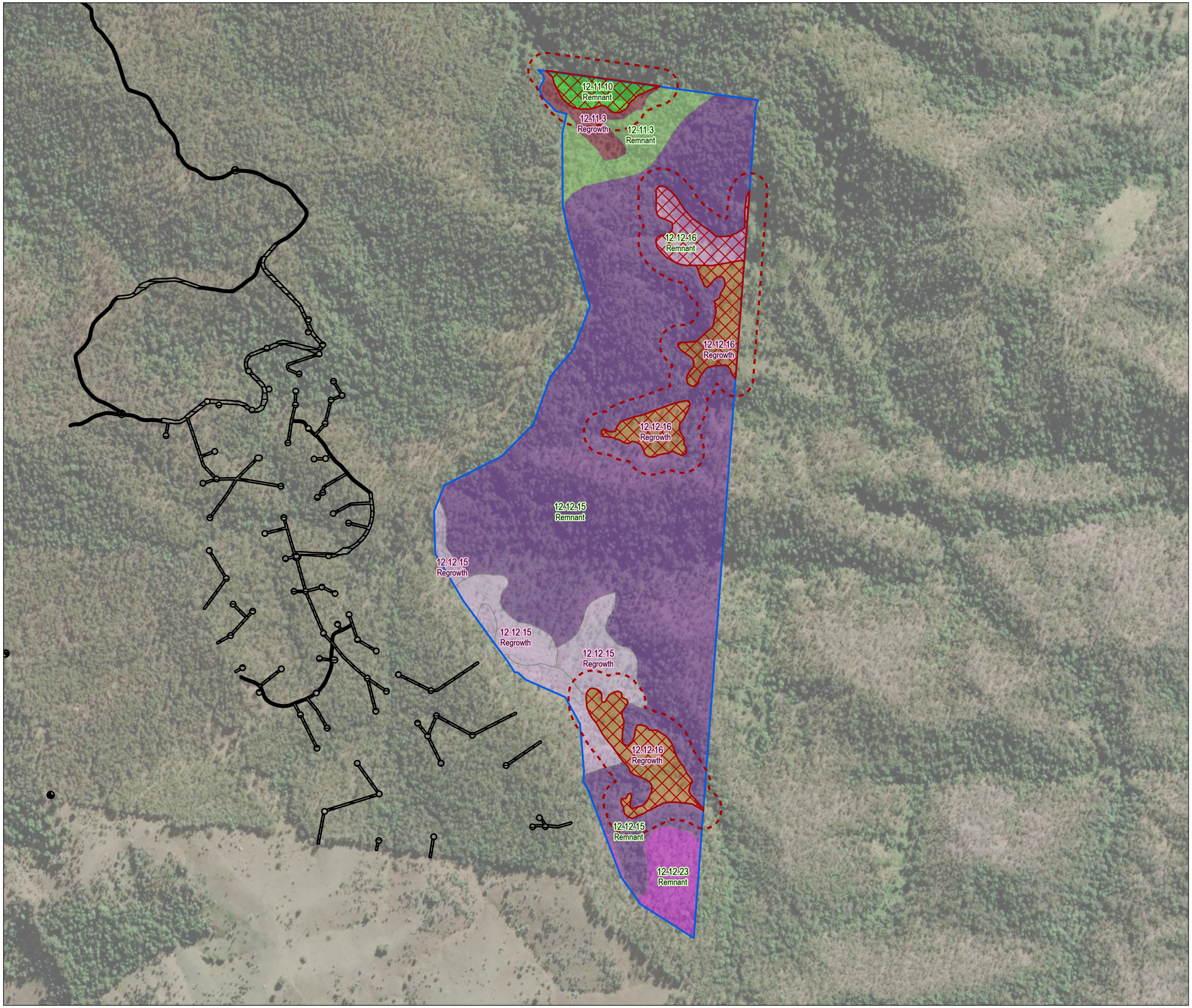
AU	RE Present	Vegetation Description	Target MNES *	Associated HQA	Offset Area Present	Photos
13	12.12.15 Remnant	Mixed open forest including combinations of *E. propinqua, E. siderophloia, Corymbia intermedia, E. microcorys, Lophostemon confertus* open forest on Mesozoic to Proterozoic igneous rocks.	YBG, LNP, GBC, GG, koala (foraging) BS	HQA203, HQA28, HQA308, HQA61, HQA81, MHQA718, MHQA722, MHQA725	A & B	 
14	12.12.16 Regrowth	Notophyll vine forest on Mesozoic to Proterozoic igneous rocks.	koala (dispersal), LNP, BBBQ, RFTEC, BS	HQA 202, 32, 98	A	 
15	12.12.16 Remnant	Notophyll vine forest on Mesozoic to Proterozoic igneous rocks.	koala (dispersal), LNP, RFTEC, BBBQ, BS	HQE009, HQE010, MHQA708, MHQA714	A	 

AU	RE Present	Vegetation Description	Target MNES *	Associated HQA	Offset Area Present	Photos
16	12.12.23 Remnant	*E. tereticornis subsp. tereticornis* or *E. tereticornis subsp. basaltica* +/- *E. eugenioide*s woodland to open forest on crests, upper slopes and elevated valleys and plains on Mesozoic to Proterozoic igneous rocks.	BS, koala (foraging), GG, YBG, GBC,	HQA201, MHQA728	A	 
18	12.3.7 Non-remnant	*E. tereticornis, Casuarina cunninghamiana subsp. cunninghamiana* +/- *Melaleuca* spp. fringing woodland.	Future habitat for GBC, GG, koala (foraging), YBG, LNP, BS	MHQA730, MHQA731	B	
19	12.3.7 Regrowth	*E. tereticornis, Casuarina cunninghamiana subsp. cunninghamiana* +/- *Melaleuca* spp. fringing woodland.	GBC, GG, koala (foraging), YBG, LNP, BS	MHQA711, MHQA712	B	 

AU	RE Present	Vegetation Description	Target MNES *	Associated HQA	Offset Area Present	Photos
20	12.3.7 Remnant	*E. tereticornis, Casuarina cunninghamiana subsp. cunninghamiana +/- Melaleuca* spp. fringing woodland.	koala (foraging), GG, YBG, LNP, GBC, BS	HQA311, MHQA717, MHQA734, MHQA737, DRB003, DRB005	B	 
21	12.11.9 Remnant	*Eucalyptus tereticornis* subsp. *tereticornis* or *E. tereticornis* subsp. *basaltica* open forest on metamorphics +/- interbedded volcanics, usually on ridges, crests and upper slopes.	BS, koala (foraging), GG, YBG, LNP, GBC,	HQE007, HQE008, MHQA733, MHQA738	B	 

AU	RE Present	Vegetation Description	Target MNES *	Associated HQA	Offset Area Present	Photos
22	12.11.3a Remnant	*Lophostemon confertus +/- Eucalyptus microcorys, E. carnea, E. propinqua, E. major, E. siderophloia* woodland. Occurs in gullies and exposed ridges of Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics.	BS, koala (foraging), GG, YBG, LNP, GBC,	HQE011, HQE012	B	
23	12.11.14 Non-remnant	*E. crebra, E. tereticornis, Corymbia intermedia* woodland on metamorphics +/- interbedded volcanics.	Future habitat for koala (foraging), GG, YBG, GBC	DRB001, DRB002	B	 

AU – assessment unit
RE – regional ecosystem
MNES – matters of national environmental significance
HQA = habitat quality assessment.
* BBBQ – black-breasted button-quail, GG = greater glider, YBG – yellow-bellied glider, LNP = long-nosed potoroo, GBC = glossy black-cockatoo, RFTEC = Lowland rainforest TEC, BS = brush sophora, ST = scrub turpentine.



Queensland Hydro

GDA2020 MGA Zone 56

N

0 260 m

1:10,000 @ A3

LEGEND

- Offset Area A
- Exploratory Works Project Footprint (EPBC Only)

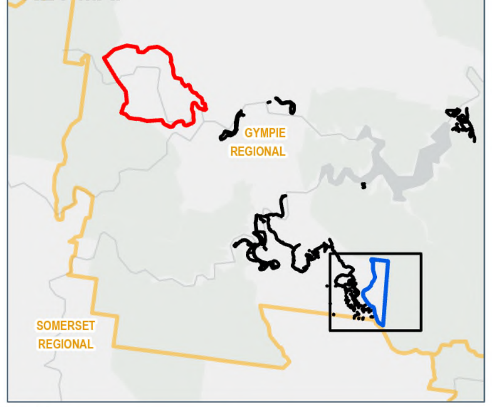
Ground-truthed Vegetation

- AU2, 12.11.10, Remnant
- AU10, 12.11.3, Regrowth
- AU11, 12.11.3, Remnant
- AU12, 12.12.15, Regrowth
- AU13, 12.12.15, Remnant
- AU14, 12.12.16, Regrowth
- AU15, 12.12.16, Remnant
- AU16, 12.12.23, Remnant

Threatened Ecological Communities

- Lowland Rainforest TEC
- Lowland Rainforest TEC 50m Buffer

KEY MAP



Data Sources:
Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar
Vegetation management regional ecosystem; Cadastre; Local government area; Roads and tracks: © State of Queensland (Department of Resources) 2025
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019

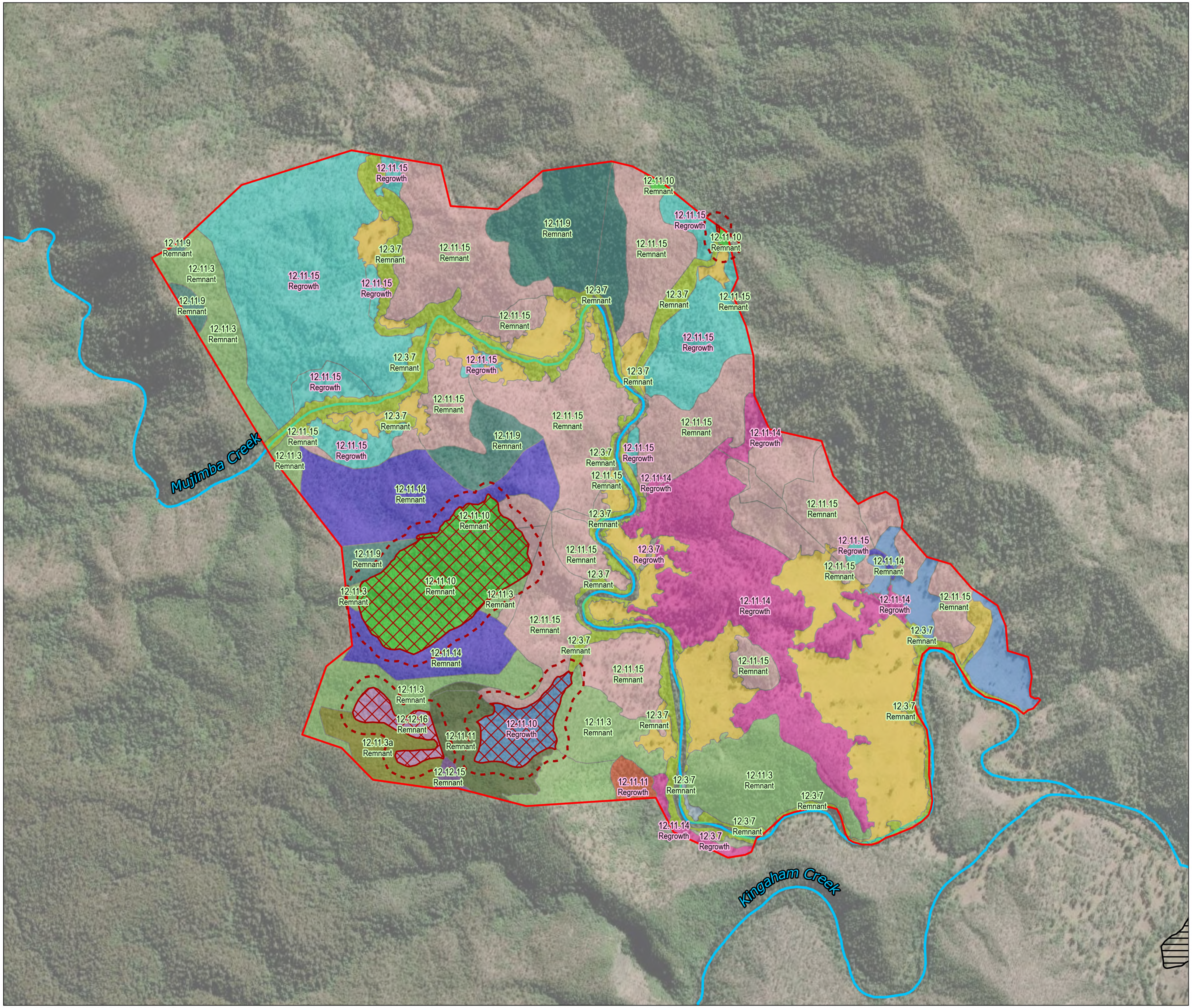
Borumba PHES Project
Offset Area Management Plan

GROUND-TRUTHED VEGETATION WITHIN OFFSET AREAS

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	25/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 4-A

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 4



Queensland Hydro

GDA2020 MGA Zone 56

N

0 390 m

1:15,000 @ A3

LEGEND

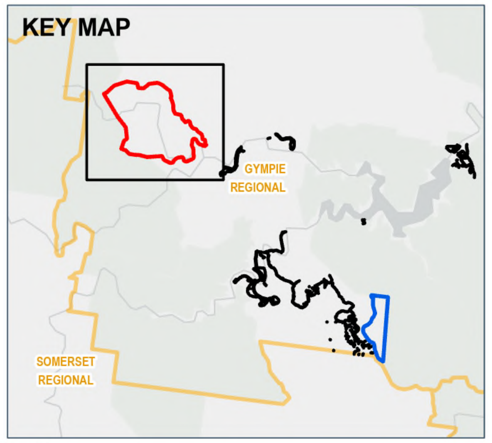
- Offset Area B
- Exploratory Works Project Footprint (EPBC Only)
- Watercourse [defined by Water Act 2000]

Ground-truthed Vegetation

- AU1, 12.11.10, Regrowth
- AU2, 12.11.10, Remnant
- AU3, 12.11.11, Regrowth
- AU4, 12.11.11, Remnant
- AU5, 12.11.14, Regrowth
- AU6, 12.11.14, Remnant
- AU7, 12.11.15, Non-remnant
- AU8, 12.11.15, Regrowth
- AU9, 12.11.15, Remnant
- AU11, 12.11.3, Remnant
- AU13, 12.12.15, Remnant
- AU15, 12.12.16, Remnant
- AU18, 12.3.7, Non-remnant
- AU19, 12.3.7, Regrowth
- AU20, 12.3.7, Remnant
- AU21, 12.11.9, Remnant
- AU22, 12.11.3a, Remnant
- AU23, 12.11.14, Non-remnant

Threatened Ecological Communities

- Lowland Rainforest TEC
- Lowland Rainforest TEC 50m Buffer



Data Sources:
Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar
Vegetation management regional ecosystem; Cadastre; Local government area; Roads and tracks: © State of Queensland (Department of Resources) 2025
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019

Borumba PHES Project
Offset Area Management Plan

GROUND-TRUTHED VEGETATION WITHIN OFFSET AREAS

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	25/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 4-B

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 4

3.4 Suitability of the offsets for MNES

The proposed offset areas have been selected with the goal to increase the quality of habitat for each MNES, to increase the availability of breeding and foraging resources, and for all offsets to be connected or improve connectivity to surrounding protected areas and/or species habitats. MNES have either been recorded within the offset areas, or close to the offset areas, which is discussed in more detail for each MNES in sections below.

The proposed offset areas are strategically located adjacent to the Conondale National Park, Yabba State Forest, and existing large tracts of remnant vegetation and in mapped biodiversity corridors as shown on Figure 6.

The proposed offset area includes approximately 89.1 ha of cleared non-remnant land to be restored for species such as the koala, greater glider, yellow-bellied glider, and glossy black-cockatoo. Restoration methods will include some revegetation of eucalypt woodlands to improve connectivity from these areas to adjacent tracts of remnant woodlands and riparian corridors as shown in Figure 6. It will also increase availability of foraging resources. Refer to Section 6.2 for further detail on management actions and proposed restoration efforts.

A description of how connectivity will be achieved for each MNES is provided in the below sections and specific habitat mapping for each MNES is provided in Appendix E.

3.4.1 Koala

3.4.1.1 Habitat suitability

Woodland and forest patches and corridors with a sufficient amount of food, shelter and connectivity are essential for the koala. The key habitat attributes for the koala are rooted in the availability of resources for foraging, survival, growth, movement, and reproduction (DAWE, 2022).

REs suitable for koala foraging and breeding within the Offset Areas A and B include RE 12.11.14, 12.11.15, 12.11.9, 12.11.3, 12.11.3a 12.12.15, 12.12.23, and 12.3.7. These REs are dominated by koala food trees including *E. tereticornis*, *E. crebra*, *E. propinqua*, *E. siderophloia*, *Corymbia intermedia*, *E. microcorys* and *Lophostemon confertus*. Further information about the suitability of REs within the offset area can be found in Appendix B.

The remnant areas include large eucalypts which would provide significant foraging and breeding opportunities for the species. The non-remnant contain sparse foraging opportunities but would provide dispersal habitat for animals moving through the landscape. Vine forest areas provide little foraging habitat but would provide some shelter/refuge during dispersal (Table 5). Koala habitat within the offset areas is shown in Appendix F.

Table 5: Habitat available within each offset area for koala.

Koala Habitat	Assessment Units	Offset Area A (ha)	Offset Area B (ha)	Total Area (ha)
Remnant woodlands for foraging and breeding	6, 9, 11, 13, 16, 20, 21, 22	94.7	360.2	454.9
Regrowth woodlands for foraging and breeding	5, 8, 10, 12, 19	13	153	166
Remnant vegetation that may be used for dispersal and refuge	2, 4, 15	5.1	44.9	50
Regrowth vegetation that may be used for dispersal and refuge	1, 3, 14	9.7	10.8	20.5
Cleared land for restoration and support dispersal	7, 18, 23	0	89.1	89.1
Total		**122.5**	**658**	**780.6**

3.4.1.2 Connectivity

Connectivity between habitat is important for the long-term survival of koala populations. koalas require connectivity to maximise this movement between habitat areas, breed and establish territories. koalas are predominantly tree-dwellers and only venture onto the ground to move between trees for foraging. The connectivity of vegetation is essential for safe movement between resources and creates safer intervening ground in larger patches for travel between trees.

There are no large-scale objects or physical structures in or adjacent to the proposed offset areas that prevent dispersal or limit access through the area, including the future inundation areas for the Main Works. Regrowth and non-remnant areas are present in the offset areas and these areas have value as dispersal habitat, but also usually contain varying levels of weed infestation that may restrict koala movements. These dispersal habitat areas will be managed to re-establish remnant native vegetation in accordance with the OAMP which would provide for safe movement and make them suitable as koala breeding and foraging habitat.

The surrounding conservation reserves and the proposed offset areas are part of an area of relatively contiguous habitat made up of Conondale National Park, Imbil State Forest and numerous surrounding forests and parks (Amamoor, Mary's Creek, Gallangowan, Elgin Vale, Yabba, Diaper, Squirrel Creek, Jimna, Maleny). Increasing the habitat quality and connectivity of the surrounding landscape such as the offset areas will allow resident populations to move more freely throughout the region and increase their access to suitable habitat.

3.4.1.3 Presence in the offset area

The proposed offset area contains extensive areas of woodland and forest communities, supporting an abundance of large eucalypt trees which may be used for both koala breeding and foraging. The offset areas also support regrowth eucalypt woodlands that will provide foraging resources and support their dispersal through different areas.

Koalas are widespread across the region with numerous records within nearby Conondale National Park, Imbil State Forest and Yabba State Forest as well as extensive records within the Gympie Regional Council and greater Sunshine Coast region.

Koala records are abundant throughout the local area. Koalas were recorded in Offset Areas A and B during field surveys (Photo 17), and it is likely that the species use the areas frequently. Five records of koala were observed within the proposed offset areas (four in site B and one in site A). An additional 30 records are in close proximity (<500 m) (Figure 5).

Photo 17: Koala within Lowland Rainforest (RE 12.12.16) in Offset Area B.

3.4.1.4 Conservation outcomes

The offset proposal for koala will improve the quality of 454.9 ha of already existing remnant koala foraging and breeding habitat and 50 ha of remnant refuge habitat. The offset will restore another 166 ha of regrowth koala foraging habitat and 20.6 ha of regrowth koala dispersal habitat. (Table 5). Existing habitat will be improved through a reduction in weed cover, reduction in pest animals, an improvement in large trees and canopy cover. Further details regarding habitat gains for koalas are set out in Section 7 and Appendix C.

The restoration of non-remnant and regrowth land is a conservation gain for the species because the current poor condition of the regrowth and non-remnant habitat is likely to reduce its use by koala and these areas currently provide for some level of dispersal only. Through restoration actions, including replanting koala food trees, Koala foraging resources will be increased and their safe movement across these areas to adjacent habitats enhanced. Improving the quality of the non-remnant dispersal habitat (89.1 ha) is also likely to benefit the species through reducing weeds, increasing recruitment and the number of large trees which is also likely to improve the ability of koala to safely move through these patches and improve its use as sheltering habitat.

3.4.2 Greater glider

3.4.2.1 Habitat suitability

Greater gliders are restricted to the eucalypt woodlands and forest of eastern Australia and are in higher abundance in tall, montane moist eucalypt forests on fertile soils with an abundance of hollow and relatively old trees (DCCEEW, 2022). Canopy productivity, the amount of foliage within the forest, stand age, overstorey basal areas, tree hollow abundance, patch size, levels of foliar nutrients and connectivity are key features of suitable habitat.

Areas of cool microclimates are important for this species and include sheltered high elevation areas, coastal lowland areas, southern slopes, and protected gullies. Unburnt habitat within or adjacent to recently burnt areas are important short-term and or long-term post-fire refuges, allowing for gliders to recover, persist and repopulate burnt areas (DCCEEW, 2022).

REs suitable for greater glider within Offset Areas A and B include REs 12.11.14, 12.11.15, 12.11.9, 12.11.3, 12.11.3a 12.12.15, 12.12.23, and 12.3.7. These REs are dominated by greater glider food trees including *E. tereticornis, E. crebra, E. propinqua, E. siderophloia, Corymbia intermedia, E. microcorys* and *Lophostemon confertus* and are likely to contain hollow bearing trees. Further information about the suitability of REs within the offset area can be found in Appendix B.

The remnant areas include large eucalypts that would provide denning opportunities for the species. The non-remnant and regrowth areas contain sparse foraging opportunities but are likely to provide only limited denning opportunities due to the scarcity of hollow bearing trees.

Rainforest and vine thicket areas provide little foraging habitat and are not likely to be habitat for the species.

The areas of remnant, regrowth and non-remnant habitat within each offset area are shown in Table 6. Greater glider habitat within the offset areas is shown in Appendix F.

Table 6: Habitat within each offset area available for greater glider

Greater Glider Habitat	Assessment Units	Offset Area A (ha)	Offset Area B (ha)	Total Area (ha)
Remnant woodlands for foraging and breeding	6, 9, 11, 13, 16, 20, 21, 22	94.7	360.2	454.9
Regrowth woodlands for foraging	5, 8, 10, 12, 19	13	153	166
Cleared land for restoration	7, 18, 23	0	89.1	89.1
Total		**107.7**	**602.3**	**709.9**

3.4.2.2 Connectivity

Habitat connectivity is essential for the greater glider. Large contiguous areas of eucalypt forest are critical for the glider and must have mature hollow-bearing trees with a diverse range of preferred food species in the particular region (DCCEEW,2022). The species diet is mainly folivorous and is largely made up of eucalyptus leaves, buds and flowers (Kehl & Borsboom, 1984; Kavanagh & Lambert, 1990). Smaller or fragmented patches of habitat must be connected to larger patches that can facilitate species dispersal and or enable recolonisation (DCCEEW,2022).

The surrounding conservation reserves and the proposed offset areas are part of an area of relatively contiguous habitat made up of Conondale National Park, Imbil State Forest and numerous surrounding forests and parks (Amamoor, Mary's Creek, Gallangowan, Elgin Vale, Yabba, Diaper, Squirrel Creek, Jimna, Maleny). Increasing the habitat quality and connectivity of the surrounding landscape such as the offset areas will allow resident populations to move more freely throughout the region and increase their access to suitable habitat.

3.4.2.3 Presence in the offset area

Targeted surveys have been undertaken in Offset Areas A and B. Greater glider were recorded on three occasions within Offset Area A in RE 12.12.15 (Figure 5). The species was not detected within Offset Area B but was recorded within connected vegetation around 1 km south of the offset area in RE 12.3.7 (Figure 5). The species is therefore known to utilise Offset Area A and is considered likely to utilise Offset Area B due to suitable habitat being present within the offset area, including existing hollow-bearing trees, along with the area being contiguous with large tracts of woodlands in Yabba State Forest.

3.4.2.4 Conservation outcomes

The offset proposal for greater glider will improve the quality of 454.9 ha of already existing greater glider foraging and breeding habitat and restore 255.1 ha of regrowth and non-remnant habitat. Existing habitat will be improved through a reduction in weed cover, reduction in pest animals, an improvement in large trees and canopy cover. Further details regarding habitat gains for greater glider are set out in Section 7 and Appendix C.

The restoration of non-remnant and regrowth areas will provide a conservation gain for the species as the current poor condition of the regrowth and non-remnant habitat, including lack of hollow bearing trees suitable for denning and large trees suitable for foraging, means these habitats are unlikely to be used by greater glider. With the implementation of the management actions in Section 6, regeneration of new eucalypts will increase, canopy cover and height will improve (with time), and foraging tree diversity will increase. In addition to habitat quality improvements, the installation of supplementary hollows will compensate for lost hollows at the impact site and improve useability of the areas by greater glider while natural hollows form. Further information on supplementary hollows including types and installation is provided in Section 6.3.9.

3.4.3 Glossy black-cockatoo

3.4.3.1 Habitat suitability

Glossy black-cockatoos nest in hollows, therefore a critical habitat feature is the presence of very mature Eucalypt trees (both dead and alive) (Higgins, 1999). Key species utilised by glossy black-cockatoos for nesting hollows are narrow-leaved ironbark (*Eucalyptus crebra*), blue-leaved ironbark (*E. nubila*), Blakely's red gum (*E. blakelyi*) and river red gum (*E. camaldulensis*) (Cameron & Cunningham, 2006).

The presence of sheoak trees is also critical for glossy black-cockatoos as they can spend up to 88% of their day feeding and foraging (Clout, 1989), almost exclusively targeting the seeds of sheoak trees for feeding (*Allocasuarina* spp. and *Casuarina* spp.) (Higgins, 1999). Glossy black-cockatoos will show a strong preference to individual feed trees and are known to not feed on many other proximate trees of the same tree species (DCCEEW, 2022). In south-east Queensland, glossy black-cockatoos prefer black sheoak (*A. littoralis*) and forest sheoak (*A. torulosa*) (Glossy Black Conservancy, 2010).

REs suitable for glossy black-cockatoo within Offset Areas A and B include REs 12.11.14, 12.11.15, 12.11.9, 12.11.3, 12.11.3a, 12.12.15, 12.12.23, and 12.3.7. These REs include glossy black-cockatoo food trees such as black sheoak and forest sheoak, along with key species utilised for nesting. Further information about the suitability of REs within the offset area can be found in Appendix B.

The area of remnant, regrowth and non-remnant habitat within each offset area are shown in Table 7. Glossy black-cockatoo habitat within the offset areas is shown in Appendix F.

Table 7: Habitat within each offset area available for glossy black-cockatoo

glossy black-cockatoo habitat	Assessment Units	Offset Area A (ha)	Offset Area B (ha)	Total Area (ha)
Remnant woodlands for foraging and breeding	6, 9, 11, 13, 16, 20, 21, 22	94.7	360.2	454.9
Regrowth woodlands for foraging	5, 8, 10, 12, 19	13	153	166
Cleared land for restoration	7, 18, 23	0	89.1	89.1
Total		**107.7**	**602.3**	**709.9**

3.4.3.2 Connectivity

A major threat to this species is the loss of habitat and fragmentation which is directly decreasing the extent of occurrence, area of occurrence and population size (DCCEEW, 2022). The existence of native corridors with their preferred habitat tree species are critical for the species survival due to the niche habitat and foraging requirements.

Glossy black-cockatoos may travel over 10 km from nesting sites to reach their preferred feed trees (Glossy Black Conservancy, 2010). Connectivity of habitat ensures that birds can move safely between food, water and roosting resources and vegetated cover offers connection between the species subpopulations, ensuring genetic diversity and reducing risk of extinction. Landscape connectivity can be achieved by the presence of corridors that can facilitate movement through different environments.

Offset Areas A and B are well connected to protected areas and are part of larger patches of vegetation. There are opportunities to improve connectivity and increase the presence of corridors through revegetation of regrowth and cleared land.

3.4.3.3 Presence in the offset area

WildNet includes records of glossy black-cockatoo in Imbil State Forest, Yabba State Forest and Conondale National Park. The Atlas of Living Australia has numerous records throughout the Sunshine Coast region with several records in the State Forests surrounding the Project area and the offset areas and a high density of records in Conondale National Park.

Glossy black-cockatoo have been recorded immediately adjacent to Offset Area A. It is very likely that the species occurs within Offset Area A due to the presence of suitable foraging resources, nesting habitat and their large dispersal range. The species has been observed foraging within Offset Area B.

3.4.3.4 Conservation outcomes

The offset proposal for glossy black-cockatoo will improve the quality of 454.9 ha of already existing glossy black-cockatoo foraging and breeding habitat and restore 255.1 ha of regrowth and non-remnant habitat. The restoration of non-remnant and regrowth areas is a conservation gain for the species as the current poor condition of the regrowth and non-remnant habitat, including lack of hollow bearing trees suitable for denning and lack of preferred foraging tree species, means it is very unlikely to be used by glossy black-cockatoos. With the implementation of the management actions in Section 6, regeneration of new eucalypts and casuarina trees will increase, and preferred food trees can be planted. Over time canopy cover and height will improve and foraging tree diversity and food resources will increase. In addition to habitat quality improvements, the installation of supplementary hollows will compensate for lost hollows at the impact site and improve useability of the areas by glossy black-cockatoo while natural hollows form. Further information on supplementary hollows including types and installation is provided in Section 6.3.9.

3.4.4 Long-nosed potoroo

3.4.4.1 Habitat suitability

This species occurs in a range of vegetation types from coastal scrub and heathy woodland to wet sclerophyll forest and rainforest (Norton, French, & Claridge, 2010; Andren, Milledge, Scotts & Smith, 2013; DAWE, 2022b). They are also often found near creeks or gullies, providing refuge during drought and fire (Andren, Milledge, Scotts

& Smith, 2013; Martin & Temple-Smith, 2012). Essential habitat requirements for this species are a dense understorey including grass-trees, ferns, sedges, heath or low shrubs of tea trees (NSW Government, 2018).

This species is matrix-sensitive, making its ideal habitat wooded environments with a dense understorey layer offering cover and sufficient open space beneath the sub-canopy to allow for foraging (Norton, French, & Claridge, 2010; Andren, Milledge, Scotts, & Smith, 2013). These forested habitats need to ideally be remnant vegetation patches larger than 0.1 km^2 as the species will rarely occur in smaller patches (Martin & Temple-Smith, 2012; DAWE, 2022). Key environmental variables of potoroo habitat include nearby areas of vegetative cover, dense undergrowth cover, average annual temperature and average annual rainfall (Trent, 2015).

For the impact assessment (see the Preliminary Documentation for the Project) all remnant and regrowth REs were assumed to be potential habitat for long-nosed potoroo due to the possibility that the species may move through less suitable habitat to get to preferred habitat. This method may overestimate long-nosed potoroo habitat but ensures an appropriate offset is secured to fully cover potential impacts.

REs suitable for long-nosed potoroo within Offset Areas A and B include REs 12.11.9, 12.11.10, 12.11.11, 12.11.3, 12.11.3a, 12.12.15, 12.12.16, and 12.3.7. These REs contain the general broad habitat requirements for the species although some areas within these REs may not be suitable for the species due to lack of micro-habitat features such as low cover and dense undergrowth for protection from predators.

Not all of the REs used in the impact assessment (i.e. RE 12.11.14, 12.12.23) were included as potential habitat at the offset areas as these REs generally have sparser understoreys dominated by grasses and little cover which the species require for foraging and breeding. Future management of these areas (e.g. weed control) will not make these REs more suitable for the species and the species is unlikely to use these habitats for foraging and breeding so they have not been included in the offset for this species. Further information about the suitability of REs within the offset area can be found in Appendix B. Over time microhabitats will be improved with active management.

The area of remnant, regrowth and non-remnant habitat within each offset area are shown in (Table 8). Long-nosed potoroo habitat within the offset areas is shown in Appendix F.

Table 8: Habitat within each offset area available for long-nosed potoroo.

Long-nosed Potoroo Habitat	Assessment Units	Offset Area A (ha)	Offset Area B (ha)	Total Area (ha)
Remnant vegetation for foraging and breeding	2, 4, 11, 13, 15, 20, 21, 22	95.7	205.8	301.5
Regrowth vegetation for foraging	1, 3, 10, 12, 14, 19	22.7	11.7	34.4
Cleared land for restoration	18	0	0.5	0.5
Total		**118.4**	**218.0**	**336.4**

3.4.4.2 Connectivity

As generally solitary animals, the long-nosed potoroo has limited dispersal capabilities, high site fidelity and a small home range (Frankham, Reed, Fletcher, & Handasyde, 2011). High connectivity is most important for safe movement between fragmented habitat patches, access to resources and connection of critical habitat linkages, being a species that does not tend to travel large distances (DAWE, 2022b).

Offset Areas A and B are well connected to large, protected areas and are on the edges of very large contiguous patches of vegetation. Rehabilitation of the areas will improve connectivity between habitat within the offset areas and the adjacent protected areas without crossing a fragmentated landscape.

3.4.4.3 Presence in the offset area

Suitable habitat within the offset areas comprises REs 12.11.9, 12.11.10, 12.11.11, 12.11.3, 12.11.3a, 12.12.15, 12.12.16, and 12.3.7 Many of these woodland and forest communities support a mosaic of dense and less dense understorey, which is essential for shelter and breeding. REs such as 12.11.14 and 12.12.23 were not included as potential habitat at the offset areas, as these REs generally have sparser understoreys and little cover which the species require for foraging and breeding.

There are records of the long-nosed potoroo in Conondale National Park to the south and in Imbil State Forest to the east. Records of the species in Atlas of Living Australia indicate it is present in protected areas throughout the Sunshine Coast Region.

Potential unconfirmed signs (diggings) of the long-nosed potoroo were recorded within Offset Area B, while the species was recorded from habitat directly adjacent to Offset Area A. The species has not been specifically targeted within the offset areas but is considered likely to occur given the records observed within the Exploratory Works footprint, records within adjacent habitat in State Forests and National Parks and there are no significant barriers between these areas and the proposed offset areas.

3.4.4.4 Conservation outcomes

The offset proposal for long-nosed potoroo will improve the quality of approximately 301.5 ha of already existing long-nosed potoroo foraging and breeding habitat and restore approximately 35 ha of regrowth and non-remnant habitat. The restoration of regrowth areas will provide a conservation gain for the species as the current poor condition of the regrowth, including dense weed cover or lack of suitable cover, means it is very unlikely to be used by long-nosed potoroo in its current state. Further, predator risks within the offset areas for this species are significant, with feral cats (*Felis catus*), European red fox (*Vulpes vulpes*) and wild dog (*Canis familaris*) recorded within the offset areas. With the implementation of the management actions in Section 6, the predation risk will decrease, weed abundance will decrease and regeneration of native cover will increase, which will improve the conservation outcomes for the species.

3.4.5 Yellow-bellied glider

3.4.5.1 Habitat suitability

The species is known to utilise eucalypt dominant forests and woodland including wet and dry sclerophyll forests, with abundance largely dependent on the suitability of habitat determined by the floristics and forest age of the area (Kavanagh, Debus, Tweedie, & Webster, 1995; Rees, Paull, & Carthew, 2007; Woinarski, Burbidge, & Harrison, 2014). Living hollow bearing trees are a major preference for denning and large areas of forest are essential for the maintenance of population viability, as groups live in large exclusive home ranges.

The persistence of large contiguous areas of floristically diverse eucalyptus forest is essential. They must be dominated by winter-flowering and smooth-barked eucalypt species and include living mature hollow-bearing trees for denning and sap trees for food (Milledge, Palmer, & Nelson, 1991; Eyre & Smith, 1997; Incoll, Loyn, Ward, Cunningham, & Donnelly, 2001; van der Ree, Ward, & Handasyde, 2004; Kavanagh, Mclean, & Stanton, 2021).

REs suitable for yellow-bellied glider within Offset Areas A and B include REs 12.11.14, 12.11.15, 12.11.3, 12.11.3a 12.12.15, 12.12.23, and 12.3.7. These REs are dominated by yellow-bellied glider food trees including *E. tereticornis, E. propinqua, Corymbia intermedia* and *Acacia* spp. and are likely to contain hollow bearing trees.

These woodland and forest communities support a limited number of large, hollow-bearing trees, which are an important denning and breeding resource. Offset Areas A and B contains large mature trees (30-70 cm diameter at breast height (DBH)) that are preferred and required for arboreal species for mobility, movement, and gliding (Smith et al. 2007). The non-remnant and regrowth areas contain sparse foraging opportunities but are likely to provide only limited denning opportunities due to the scarcity of hollow bearing trees.

Rainforest and vine thicket areas provide little foraging habitat are not likely to be habitat for the species.

The area of remnant, regrowth and non-remnant habitat within each offset area are shown in (Table 9). Yellow-bellied glider habitat within the offset areas is shown in Appendix F.

Table 9: Habitat within each offset area available for yellow-bellied glider

Yellow-bellied Glider Habitat	Assessment Units	Offset Area A (ha)	Offset Area B (ha)	Total Area (ha)
Remnant woodlands for foraging and breeding	6, 9, 11, 13, 16, 20, 21, 22	94.7	360.2	454.9
Regrowth woodlands for foraging	5, 8, 10, 12, 19	13	153	166
Cleared land for restoration	7, 18, 23	0	89.1	89.1
Total		**107.7**	**602.3**	**709.9**

3.4.5.2 Connectivity

Habitat corridors are critical for the species, offering pathways and facilitating dispersal between habitat patches, enable recolonisation and avoidance from threats. Connectivity to den sites is also important for this species and corridors between existing glider habitat minimises inbreeding, allows supplementation and the recolonisation of subpopulations. Lack of connectivity between habitat patches and discontinuous glider habitat is a leading threat to the species. Effective habitat corridors within areas of fragmentation are essential for the survival and continuation of species populations.

The surrounding conservation reserves and the proposed offset areas are part of an area of relatively contiguous habitat made up of Conondale National Park, Imbil State Forest and numerous surrounding forests and parks (Amamoor, Mary's Creek, Gallangowan, Elgin Vale, Yabba, Diaper, Squirrel Creek, Jimna, Maleny). Increasing the habitat quality and connectivity of the surrounding landscape such as the offset areas will allow resident populations to move more freely throughout the region and increase their access to suitable habitat.

3.4.5.3 Presence in the offset area

Suitable habitat comprises REs 12.11.14, 12.11.15, 12.11.9, 12.11.3, 12.11.3a, 12.12.15, 12.12.23, and 12.3.7.

Wildnet has numerous records of this species within nearby Conondale National Park and a few sightings within Imbil State Forest to the east and Yabba State Forest to the west. According to Atlas of Living Australia there are multiple records of the species in protected areas to the southwest and northwest of the Project area.

The species was recorded within the Exploratory Works footprint and within Offset Area A. (Figure 5). The number of records in habitat outside of but contiguous with Offset Area A suggest that there is an important population in the area. No individuals were observed in Offset Area B at this time.

3.4.5.4 Conservation outcomes

The offset proposal for yellow-bellied glider will improve the quality of 454.9 ha of already existing yellow-bellied glider foraging and breeding habitat and restore 255.16 ha of regrowth and non-remnant habitat. The restoration of remnant and regrowth areas will provide a conservation gain for the species as the current poor condition of the regrowth and non-remnant habitat, including lack of hollow bearing trees suitable for denning and large trees suitable for foraging, means it is very unlikely to be used by yellow-bellied glider. With the implementation of the management actions in Section 6, regeneration of new eucalypts will increase, canopy cover and height will improve (with time), and foraging tree diversity will increase. In addition to habitat quality improvements, the installation of supplementary hollows will compensate for lost hollows at the impact site and improve useability of the areas by yellow-bellied glider while natural hollows form. Further information on supplementary hollows including types and installation is provided in Section 6.3.9.

3.4.6 Black-breasted button-quail

3.4.6.1 Habitat suitability

The black-breasted button-quail is predominantly recorded in vine thicket forests with a closed canopy, deep litter layer in areas with annual average rainfall of between 800-1200 m (Garnett, Szabo & Dutson, 2011). The species prefers softwood scrubs in the Brigalow belt, mature hoop pine plantations (especially with *Lantana camara* present), vine scrub regrowth, dry sclerophyll forest adjacent to rainforest and Acacia and Austromyrtus scrubs on sandy coastal soils (TSSC, 2015; Marchant & Higgins, 1993; Hamley, Flower & Smith, 1997; DCCEEW. 2022c, Mathieson & Smith, 2009).

Observations of this species within the local area have typically been made from REs 12.11.10 and 12.11.3. All sites where the species was recorded were in proximity to watercourses. Leaf litter appears to be a driver of presence, with all observations made from areas where depth of leaf litter provides a higher availability of ground dwelling insects.

REs suitable for black-breasted button-quail within the Offset Areas A and B include REs 12.11.10, 12.11.11, 12.12.16. These REs contain the general broad habitat requirements for the species although some areas within these REs may not currently be suitable for the species due to lack of micro-habitat features such as dense leaf litter. Further information about the suitability of REs within the offset area can be found in Appendix B.

The areas of remnant and regrowth habitat within each offset area are shown in (Table 10). Black-breasted button-quail habitat within the offset areas is shown in Appendix F.

Table 10: Habitat within each offset area available for black-breasted button-quail

Black-breasted Button-quail Habitat	Assessment Units	Offset Area A (ha)	Offset Area B (ha)	Total Area (ha)
Remnant vine thickets for foraging and breeding	2, 4, 15	5.1	44.9	50
Regrowth vine thickets for foraging	1, 3, 14	9.7	10.8	20.5
Total		**14.8**	**55.7**	**70.5**

3.4.6.2 Connectivity

The species is a susceptible to impacts from fragmentation as it prefers areas with cover for protection from predators. Large gaps in vegetation are unlikely to be crossed. Offset Areas A and B are bordered by protected areas. The proposed offset areas are part of an area of relatively contiguous habitat made up of Conondale National Park, Imbil State Forest and numerous surrounding forests and parks (Amamoor, Mary's Creek, Gallangowan, Elgin Vale, Yabba, Diaper, Squirrel Creek, Jimna, Maleny). Increasing the habitat quality and connectivity of the surrounding landscape such as the offset areas will allow resident populations to move more freely throughout the region and increase their access to suitable habitat.

Offset Areas A and B are well connected to large, protected areas and are on the edges of very large contiguous patches of vegetation. Rehabilitation of the areas will improve connectivity between habitat within the offset areas and the adjacent protected areas without crossing a fragmentated landscape.

3.4.6.3 Presence in the offset area

Indirect observations (distinctive platelets) for this species have been recorded at a number of locations within the Project Study area including along the riparian zone of Yabba Creek (Figure 5). Suitable habitat attributes have been found within the offset areas, and it is likely this species occurs in both offset areas. Over time microhabitats will be improved with active management.

WildNet includes records of the species in Imbil State Forest to the east, Yabba State Forest to the west and Conondale National Park to the south of the Project.

Photo 18: Platelet potentially left by black-breasted button-quail in Borumba PHES Study area

3.4.6.4 Conservation outcomes

The offset proposal for black-breasted button-quail will improve the quality of 50 ha of already existing black-breasted button-quail foraging and breeding habitat and restore approximately 20.5 ha of regrowth habitat. The restoration of regrowth will provide a conservation gain for the species as the current poor condition of the regrowth habitat, including dense weed cover, means it is very unlikely to be used by black-breasted button-quail in its current state. Restoration will also improve leaf litter depths, an essential attribute for foraging for the species, with the attribute scoring below the benchmark in three of the six AUs within the offset areas. Further, predator risks within the offset areas for this species are significant with feral cats, European fox and wild dog recorded within offset areas. With the implementation of the management actions in Section 6, the predation risk will decrease, weed abundance will decrease and regeneration of native cover will increase which will improve the conservation outcomes for the species.

3.4.7 Brush sophora

3.4.7.1 Habitat suitability

This species prefers moist habitats in hilly terrain at altitudes between 60 m and 660 m. It occurs in wet sclerophyll forest and along rainforest margins on shallow stony to shaly soils in eucalypt forests or in the large canopy gaps in closed forest communities (Queensland CRA/RFA Steering Committee, 1998). The species often occurs in association with *Corymbia citriodora*, *E. carnea*, *E. microcorys*, *E. acmenoides*, *E. propinqua* and *Lophostemon confertus (*Queensland Government, 2024).

The majority of the collections of this species have been made within the coastal ranges of SEQ, including Conondale National Park which is in close proximity to the Exploratory Works Project and the proposed offset areas (Queensland Government 2024). Nearby records indicate that this species is most commonly associated with REs 12.11.2 (not within the offset areas) and 12.11.3, frequently presenting in proximity to or within RE 12.11.10 and RE 12.11.1 (not within the offset area). Records located further to the south near Kilcoy show the species occurring in REs 12.3.7 and 12.12.15 (ALA, 2024).

The species was recorded within the Exploratory Works Survey area in open eucalypt woodland near the top of ridgelines and where fire has been prominent. The records are generally within 50 m of patches of Lowland Rainforest. There are also records from the Conondale National Park which adjoins Offset Area A. Although suitable habitat for this species also occurs within Offset Area B, Offset A offers the best quality habitat for the species with wet sclerophyll forests that border rainforest. Further surveys will be conducted to determine the presence of the species within the offset areas. The area of remnant and regrowth habitat within Offset Area A is shown in (Table 11). Brush sophora habitat within the offset areas is shown in Appendix E.

Table 11: Habitat within each offset area available for brush sophora

Brush Sophora Habitat	Assessment Units	Offset Area A (ha)	Total (ha)
Remnant vegetation (REs 12.11.10, 12.11.3, 12.12.15, 12.12.16, 12.12.23)	2, 11, 13 15, 16	99.8	99.8
Regrowth REs (12.11.3, 12.12.16, 12.12.15)	10, 12, 14	22.7	22.7
Total		**122.5**	**122.5**

3.4.7.2 Connectivity

Offset Area A adjoins Conondale National Park to the south and west (Figure 5), and provides connectivity for this species to large patches of protected vegetation. The establishment of Offset Area A will protect a patch of vegetation that adjoins the larger patch of suitable habitat for the species.

3.4.7.3 Presence in the offset area

The species was recorded within the Exploratory Works footprint, in areas adjacent to Offset Area A (Figure 5). Further surveys will be undertaken within the offset areas to determine this species presence. There are also database records of brush sophora within Conondale National Park and many records located to the east and south in the Sunshine Coast and Somerset regions.

3.4.7.4 Conservation outcomes

The offset proposal for brush sophora will protect 99.8 ha of remnant habitat and 22.7 ha of regrowth habitat suitable for this species. This habitat is affected by dense weed cover in some areas and restoration of these habitats will improve habitat quality for this species will lead to conservation gain by reducing competition from weeds.

3.4.8 Lowland Rainforest TEC

3.4.8.1 Habitat suitability

REs suitable within the offset areas which are characteristics of the TEC include RE 12.11.10 and RE 12.12.16. The TEC patches have been confirmed to be a suitable RE; however, some of the patches are in a degraded condition due to gaps in the canopy, dense lantana in some areas and lack of species richness and do not currently meet the condition thresholds for the TEC. None of the BioCondition sites sampled in Assessment Units 14 and 15 in Offset Area A met the condition threshold for the TEC due to weed cover and cover of native vegetation. Although some patches do not currently meet the TEC condition requirements, these patches could meet the requirement with restoration making them perfect for offsets.

Other confirmed patches of Lowland Rainforest TEC occur within the Project area and near the offset areas. There are also many patches in the broader landscape of the Mary River catchment.

Remnant REs associated with the TEC are present throughout the Gympie and Sunshine Coast regions. However, it is unclear how much of this vegetation meets the listing criteria.

The area of remnant and regrowth habitat within each offset area are outlined in Table 12. There is 56.5 ha of remnant and regrowth REs characteristic of the TEC within the offset areas. Lowland Rainforest TEC habitat within the offset areas is shown in Appendix E.

Table 12: Habitat within each offset area available for Lowland Rainforest TEC

Lowland Rainforest TEC	Assessment Units	Offset Area A (ha)	Offset Area B (ha)	Total (ha)
Remnant vegetation (REs 12.11.10 and 12.12.16)	2, 15	5.1	33.4	38.5
Regrowth vegetation (REs 12.11.10 and 12.12.16)	1, 14	9.7	8.3	18
Total		**14.8**	**41.7**	**56.5**

3.4.8.2 Connectivity

The location of the offset areas means they are well connected to large patches of vegetation which will support longer term sustainability of the patches and adjacent vegetation provides a buffer to the TEC to help prevent further degradation from bushfire and weeds. The patches of Lowland Rainforest TEC characteristic REs selected for offsets are directly adjacent to other large tracts of remnant vegetation. These adjacent tracts of vegetation will support ecological function of the TEC and help to provide connectivity for flora and fauna species that utilise the TEC.

3.4.8.3 Presence in the offset area

There is confirmed patches of REs characteristic of the Lowland Rainforest TEC within the two offset areas totalling 56.5 ha in size. Many of the patches within Offset Area A have been surveyed as not currently meeting the requirements of the TEC due to the size of the patch, low canopy cover, abundance of weeds and species richness. It is likely that with weed management and restoration these patches will meet condition Class C. The patches of suitable RE within Offset Area B were confirmed to meet condition class B of the TEC.

3.4.8.4 Conservation outcomes

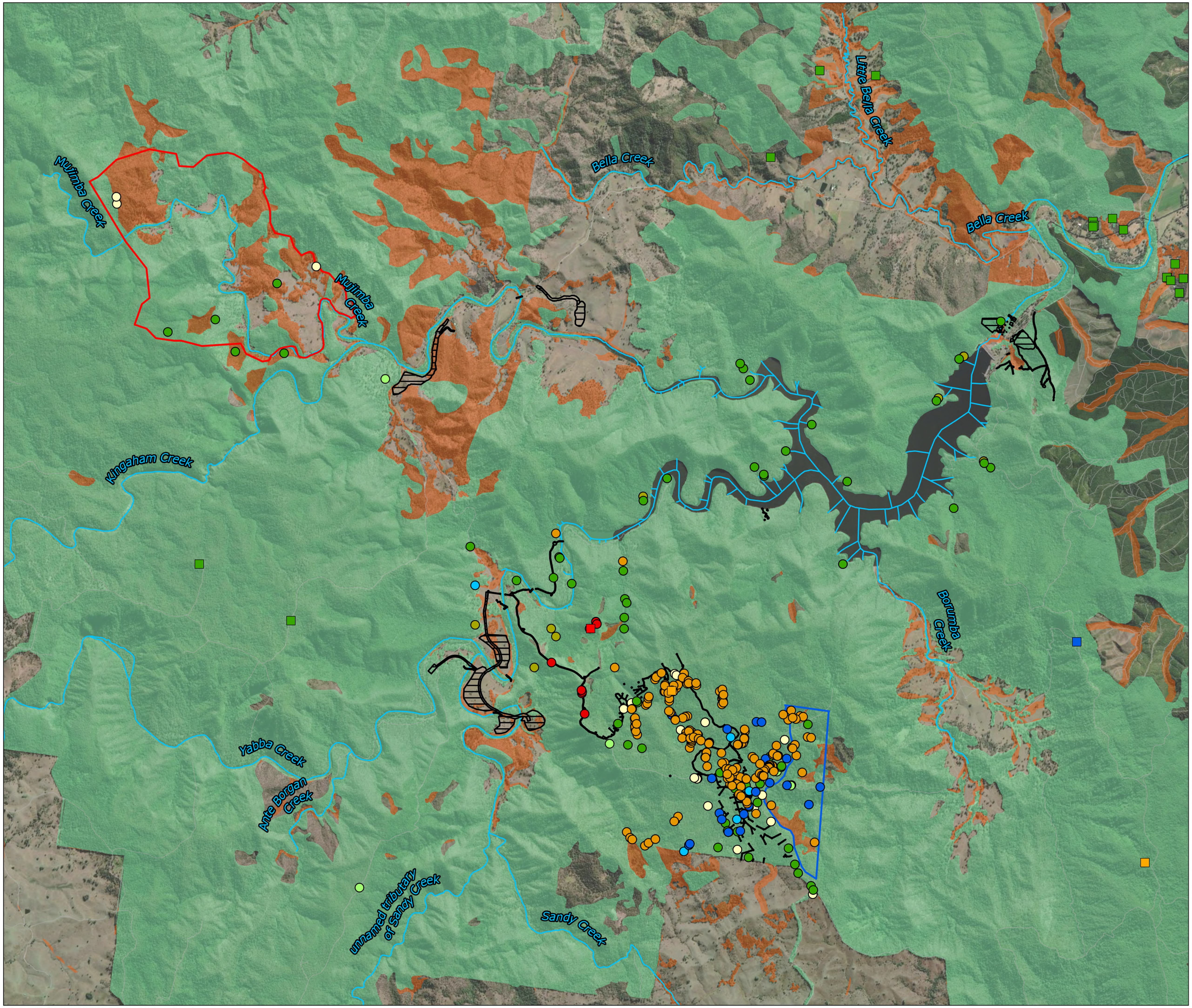
Lowland Rainforest TEC is listed as critically endangered, and protection of both remnant and regrowth areas will benefit the community. Restoration of both remnant regrowth patches, both of which are heavily infested with weeds and poor in species richness, will lead to a conservation gain by increasing the area of vine thicket that meets the condition requirements of the TEC. The restoration of Lowland Rainforest TEC proposed in the offset will increase the size and quality of the remnant TEC, which in turn improves the biodiversity value and condition of the patch as a whole and the viability of the vegetation within the patch.

3.4.9 Summary of suitability of the offset areas

Table 13 shows the suitable assessment units for each MNES and the area available for each species across the three proposed offset areas. Both offset areas together contain suitable habitats for all of the relevant MNES and deliver the required offset areas based on applying the OAG as described in Section 4.7.

Table 13: Suitable assessment units for each MNES and the amount of habitat within each offset area

AU	RE	Condition	Glossy black-cockatoo	Greater glider	Yellow-bellied glider	Koala-foraging and breeding	Koala-dispersal and refuge	Black-breasted button-quail	Long-nosed potoroo	Lowland Rainforest TEC	Brush sophora (A only)	Area in offset A (ha)	Area in offset B (ha)
1	12.11.10	regrowth					Y	Y	Y	Y			8.3
2	12.11.10	remnant					Y	Y	Y	Y	Y	2.04	28.78
3	12.11.11	regrowth					Y	Y	Y				2.55
4	12.11.11	remnant					Y	Y	Y				11.41
5	12.11.14	regrowth	Y	Y	Y	Y							60.15
6	12.11.14	remnant	Y	Y	Y	Y							38.82
7	12.11.15	non-remnant	Y	Y	Y		Y						75.74
8	12.11.15	regrowth	Y	Y	Y	Y							91.95
9	12.11.15	remnant	Y	Y	Y	Y							160.41
10	12.11.3	regrowth	Y	Y	Y	Y			Y		Y	2.15	
11	12.11.3	remnant	Y	Y	Y	Y			Y		Y	5.5766.66	
12	12.12.15	regrowth	Y	Y	Y	Y					Y	10.86	
13	12.12.15	remnant	Y	Y	Y	Y			Y		Y	85.01	1.12
14	12.12.16	regrowth					Y		Y		Y	9.65	
15	12.12.16	remnant					Y	Y	Y	Y	Y	3.10	4.67
16	12.12.23	remnant	Y	Y	Y	Y						4.11	
18	12.3.7	non-remnant	Y	Y	Y		Y		Y				0.49
19	12.3.7	regrowth	Y	Y	Y	Y			Y				0.9
20	12.3.7	remnant	Y	Y	Y	Y			Y				45.03
21	12.11.9	remnant	Y	Y	Y	Y			Y				39.45
22	12.11.3a	remnant	Y	Y	Y	Y			Y				8.7
23	12.11.14	non-remnant	Y	Y	Y		Y						12.83
Total habitat			**709.9**	**709.9**	**709.9**	**620.8**	**159.5**	**70.5**	**336.4**	**56.52**	**122.4**	**122.5**	**658**



Queensland Hydro

GDA2020 MGA Zone 56

N

0 1300 m

1:50,000 @ A3

LEGEND

- Offset Area A
- Offset Area B
- Exploratory Works Project Footprint (EPBC Only)
- Watercourse [defined by Water Act 2000]
- Major road
- Local road or track

Desktop Threatened Species Records

- Brush sophora
- Scrub turpentine
- Koala
- Yellow-bellied glider

Field Threatened Species Records

- Brush sophora
- Scrub turpentine
- Black-breasted button-quail
- Glossy black-cockatoo
- Greater glider
- Koala record
- Long-nosed potoroo
- Yellow-bellied glider

Vegetation Management Status

- Remnant
- Regrowth

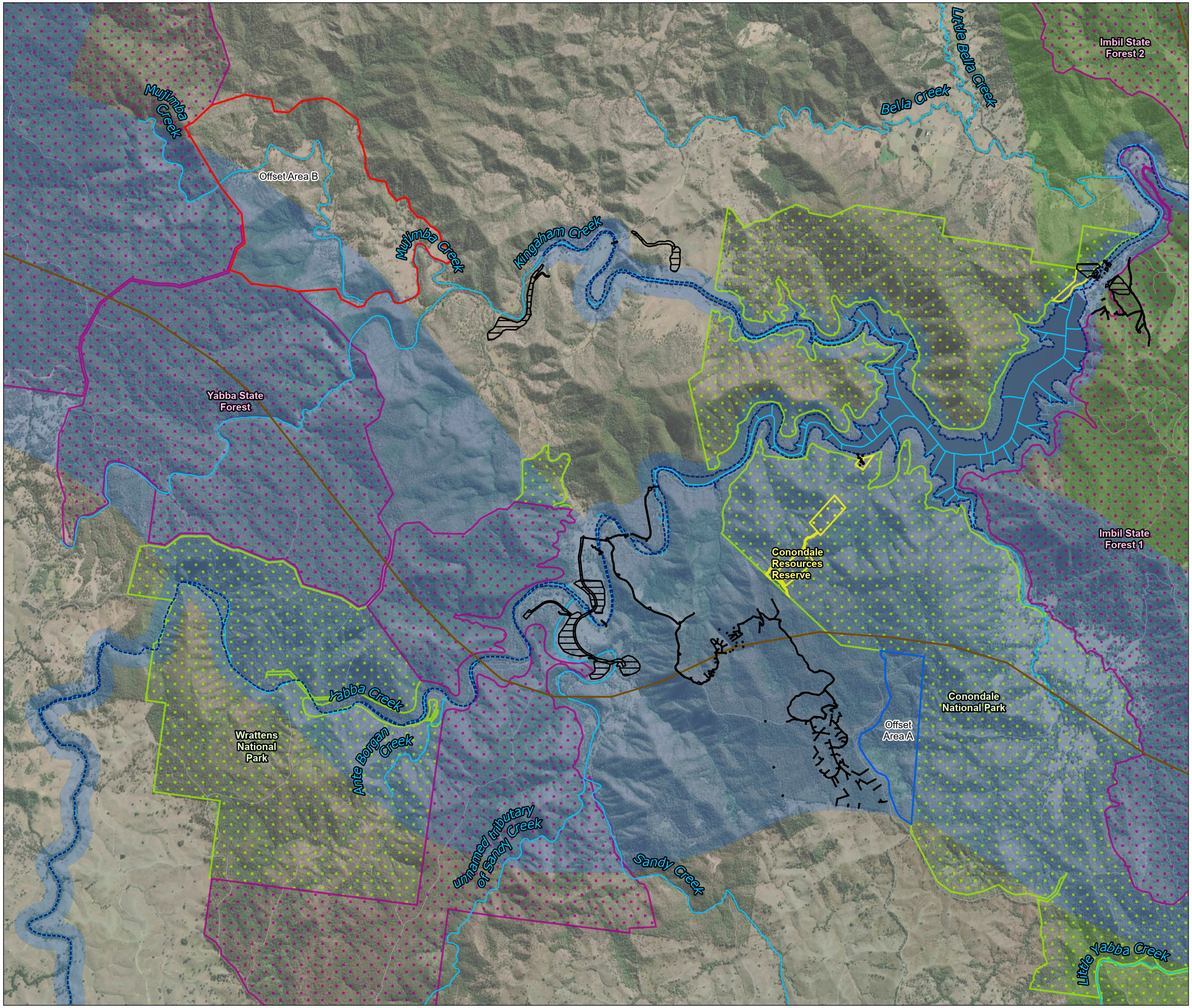
Data Sources:
Basemap © Roads and tracks: © State of Queensland (Department of Resources) 2023
Desktop Threatened Species Records: © State of Queensland (Department of Environment and Science)
World Imagery: Maxar
Vegetation management regional ecosystem; Cadastre; Local government area; Roads and tracks: © State of Queensland (Department of Resources) 2025
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019

Borumba PHES Project
Offset Area Management Plan

THREATENED SPECIES RECORDS IN THE OFFSET AREAS AND SURROUNDS

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	25/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 5



Queensland Hydro

GDA2020 MGA Zone 56

N

0 1300 m

1:50,000 @ A3

LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Offset Area A
- Offset Area B
- Watercourse [defined by Water Act 2000]
- Major road
- Local road or track

State Bioregional Corridors

- Terrestrial centrelines
- Riparian centrelines

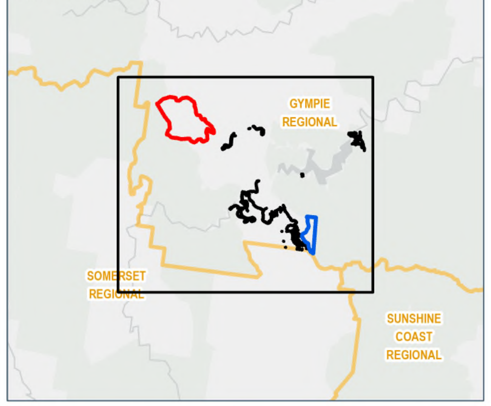
Corridor Buffers

- State
- Regional

Protected Areas

- National park
- Resources reserve
- State forest

KEY MAP



Data Sources:
Basemap © Terrestrial corridor centrelines: © State of Queensland (Department of Environment and Heritage Protection) 2017
Roads and tracks: © State of Queensland (Department of Resources) 2023
Riparian corridor centrelines: © State of Queensland (Department of Environment and Heritage Protection) 2017
World Imagery: Earthstar Geographics
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Corridor Buffers: © State of Queensland (Department of Environment and Heritage Protection) 2017
Vegetation management regional ecosystem; Local government area; Roads and tracks: © State of Queensland (Department of Resources) 2025
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019
Protected areas and forests of Queensland; Biogeographic region: © State of Queensland (Department of Environment and Science) 2023

Borumba PHES Project
Offset Area Management Plan

CONNECTIVITY AND PROTECTED AREAS

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	28/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 6

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 6

4. Habitat quality assessment

4.1 Methodology

As specified by DCCEEW, the assessment of habitat quality at the impact and offset area was completed in accordance with the MHQA method. The MHQA tool derives habitat quality scores using an adaptation of the 'Guide to determining terrestrial habitat quality' version 1.2 (the Guide) (DEHP 2017). The MHQA method is a best-practice approach to derive Habitat Quality Scores (HQS) that can be used to calculate offset obligation for SI to MNES on both the impact area and offset area.

The MHQA methods are intended to generate a HQS that represents:

- key habitat values provided by a site (Site Condition)
- values of its surrounding landscape (Site Context).

When applied to threatened species, HQS also quantifies:

- the value of both the site and the species population (Species Stocking Rate) (flora and fauna)
- the value of species-specific habitat attributes (Species Habitat Index) (fauna only).

HQS are derived by assessing a range of habitat attributes and species-specific indicators based on data collected in the field, Geographic Information System (GIS) interrogation and desktop information. In addition to methods outlined in the Guide, the MHQA also incorporates methodologies outlined in the Queensland BioCondition Assessment Manual Version 2.2 (BioCondition Manual) (Eyre et al. 2015).

A comprehensive summary of the methodology applied to the habitat quality assessment, scoring and species-specific habitat attributes for each MNES proposed to be offset have been provided in Appendix A.

4.2 Description of Assessment Units

Applying the BioCondition Manual methodology, the Project footprint and offset areas have been stratified into 19 and 22 Assessment Units (AUs) respectively. A total of 42 BioCondition and habitat quality scoring sites were established across these AUs in the impact area and 87 BioCondition and habitat quality scoring sites were established in the two offset areas as shown in Figure 7.

With respect to the locations selected for the BioCondition and habitat quality scoring sites within the Project footprint it is noted that some sites are not within the Project footprint. This is because much of the Project footprint is narrow and linear in nature, with many areas also located along and near existing tracks and disturbance. Conducting the assessments in these locations is likely to have resulted in a non-representative score of the broader supporting vegetation community (i.e., would have over-represented the level of disturbance within the Project footprint). As such, in line with the BioCondition Manual, sites were relocated so they were within areas considered to more accurately represent the vegetation community being assessed.

A summary of the area, RE and condition of each AU in the offset areas is presented in Table 14 and shown in Appendix C. A summary of the area, RE and condition of each AU in the impact area is presented in Table 15 and shown in Appendix C.

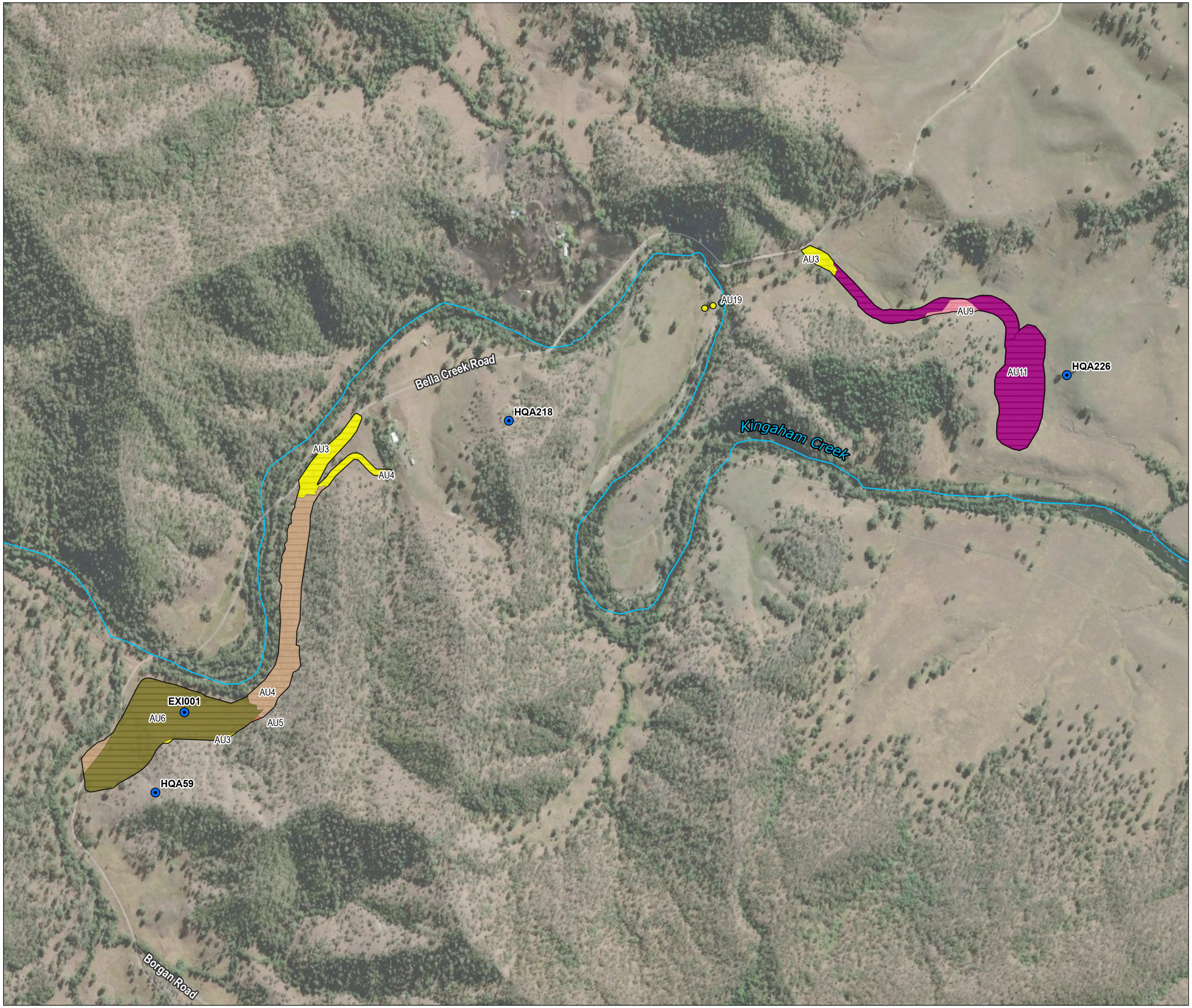
Table 14: Offset area assessment units and survey sites

Assessment unit	RE	Condition	Offset Area A area (ha)	Offset Area B area (ha)	No. sites	Site reference
1	12.11.10	Regrowth	Not present	8.3	2	**B:** HQA310, MHQA726
2	12.11.10	Remnant	2.04	28.78	7	**A:** HQA212, MHQA719; **B:** HQE003, HQE004, MHQA739, MHQA740, DRB007
3	12.11.11	Regrowth	Not present	2.55	2	**B:** HQA304, HQA314
4	12.11.11	Remnant	Not present	11.41	2	**B:** HQA30, HQA305
5	12.11.14	Regrowth	Not present	60.15	5	**B:** HQA46, MHQA702, MHQA 703, MHQA715, MHQA727
6	12.11.14	Remnant	Not present	38.82	4	**B:** HQE001, HQE002, MHQA735, MHQA747
7	12.11.15	Non-remnant	Not present	75.74	6	**B:** HQA217 HQA47, MHQA729, MHQA741, MHQA742, DRB008
8	12.11.15	Regrowth	Not present	91.95	5	**B:** MHQA732, MHQA743, MHQA744, DRB004, DRB006
9	12.11.15	Remnant	Not present	160.41	8	**B:** HQA306, HQA307, HQA44, HQA51, HQA52, MHQA736, MHQA745, MHQA746
10	12.11.3	Regrowth	2.15	Not present	2	**A:** HQA301, MHQA706;
11	12.11.3	Remnant	5.57	66.66	6	**A:** MHQA720, MHQA721; **B:** HQA302, HQA313, HQE013, HQE014
12	12.12.15	Regrowth	10.86	Not present	3	**A:** HQA62, MHQA723, MHQA724
13	12.12.15	Remnant	85.01	1.12	8	**A:** HQA203, HQA28, HQA61, HQA81, MHQA722, MHQA725; **B:** HQA308, MHQA718
14	12.12.16	Regrowth	9.65	Not present	3	**A:** HQA202, HQA32, HQA98
15	12.12.16	Remnant	3.1	4.67	4	**A:** MHQA708, MHQA714; **B:** HQE009, HQE010;
16	12.12.23	Remnant	4.1	Not present	2	**A**: HQA201, MHQA728
18	12.3.7	Non-remnant	Not present	0.49	2	**B:** MHQA730, MHQA731
19	12.3.7	Regrowth	Not present	0.9	2	**B:** MHQA711, MHQA712
20	12.3.7	Remnant	Not present	45.03	6	**B:** HQA311, MHQA717, MHQA734, MHQA737, DRB003, DRB005
21	12.11.9	Remnant	Not present	39.45	4	**B:** HQE007, HQE008, MHQA733, MHQA738
22	12.11.3a	Remnant	Not present	8.7	2	**B:** HQE011, HQE012
23	12.11.14	Non-remnant	Not present	12.83	2	**B:** DRB001, DRB002
Total			**122.5**	**658**	**87**	

Table 15: Impact area assessment units and survey sites

Assessment unit	RE	Condition*	Impact area (ha)	No. sites	Site reference
1	12.11.10	Non-remnant	1.05	1	HQA318
2	12.11.10	Remnant	2.51	3	HQA68, HQA319, EXI009
3	12.11.14	Non-remnant	37.81	2	HQA107, HQA108
4	12.11.14	Regrowth	7.33	3	HQA218, HQA64, HQA59
5	12.11.14	Remnant	9.21	7	HQA7, HQA83, HQA317, HQA8, EXI004, EXI005, EXI006,
6	12.11.15	Non-remnant	6.88	1	EXI001
9	12.11.3	Remnant	9.09	9	HQA20, HQA208, HQA210, HQA71, HQA86, HQA93, HQA94, EXI008, EXI010
10	12.11.9	Remnant	0.65	2	EXI002, EXI003
11	12.12.12	Non-remnant	5.81	2	HQA226, HQA227
12	12.12.12	Remnant	1.31	1	HQA315
14	12.12.15	Remnant	4.57	4	HQA29, HQA74, HQA78, HQA82
15	12.12.16	Remnant	0.21	2	HQA76, EXI007
16	12.12.23	Non-remnant	0.05	1	HQA101
17	12.12.23	Remnant	1.13	1	HQA316
19	12.3.7	Remnant	2.53	3	HQA40a, HQA41, HQA72
Total			**90.3^**	**42**	

* Non-remnant REs are based on Queensland pre-clear mapping and/or regrowth vegetation observed during field surveys. ^ the total includes 0.16 ha of water.



Queensland Hydro

GDA2020 MGA Zone 56

N

0 260 m

1:10,000 @ A3

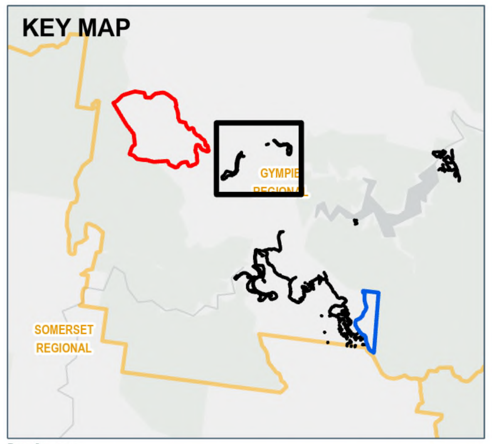
LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Watercourse [defined by Water Act 2000]
- Local road or track
- MHQA sites

Modified Habitat Assessment Units

- AU9, 12.11.3, Remnant
- AU6, 12.11.15, Non-remnant
- AU5, 12.11.14, Remnant
- AU4, 12.11.14, Regrowth
- AU3, 12.11.14, Non-remnant
- AU11, 12.11.12, Non-remnant
- AU19, 12.3.7, Remnant

KEY MAP



Data Sources:
1. Basemap © Roads and tracks: © State of Queensland (Department of Resources) 2023
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

Borumba PHES Project
Offset Area Management Plan

MODIFIED HABITAT QUALITY ASSESSMENT SITES & ASSESSMENT UNITS WITHIN DISTURBANCE FOOTPRINT

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	25/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 7-A

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 7

Queensland Hydro

GDA2020 MGA Zone 56

N

0 260 m

1:10,000 @ A3

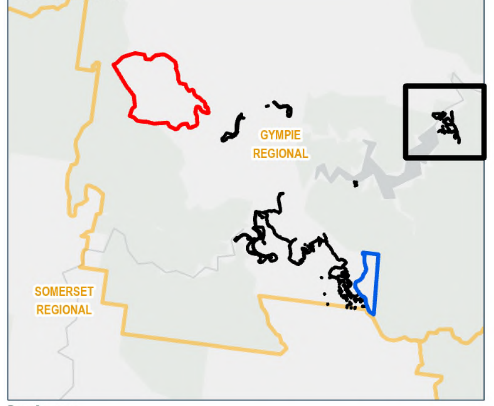
LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Watercourse [defined by Water Act 2000]
- Major road
- Local road or track
- MHQA sites

Modified Habitat Assessment Units

- AU1, 12.11.10, Non-remnant
- AU9, 12.11.3, Remnant
- AU5, 12.11.14, Remnant
- AU4, 12.11.14, Regrowth
- AU2, 12.11.10, Remnant
- AU10, 12.11.9, Remnant
- AU18, 12.3.1a, Non-remnant
- AU19, 12.3.7, Remnant

KEY MAP



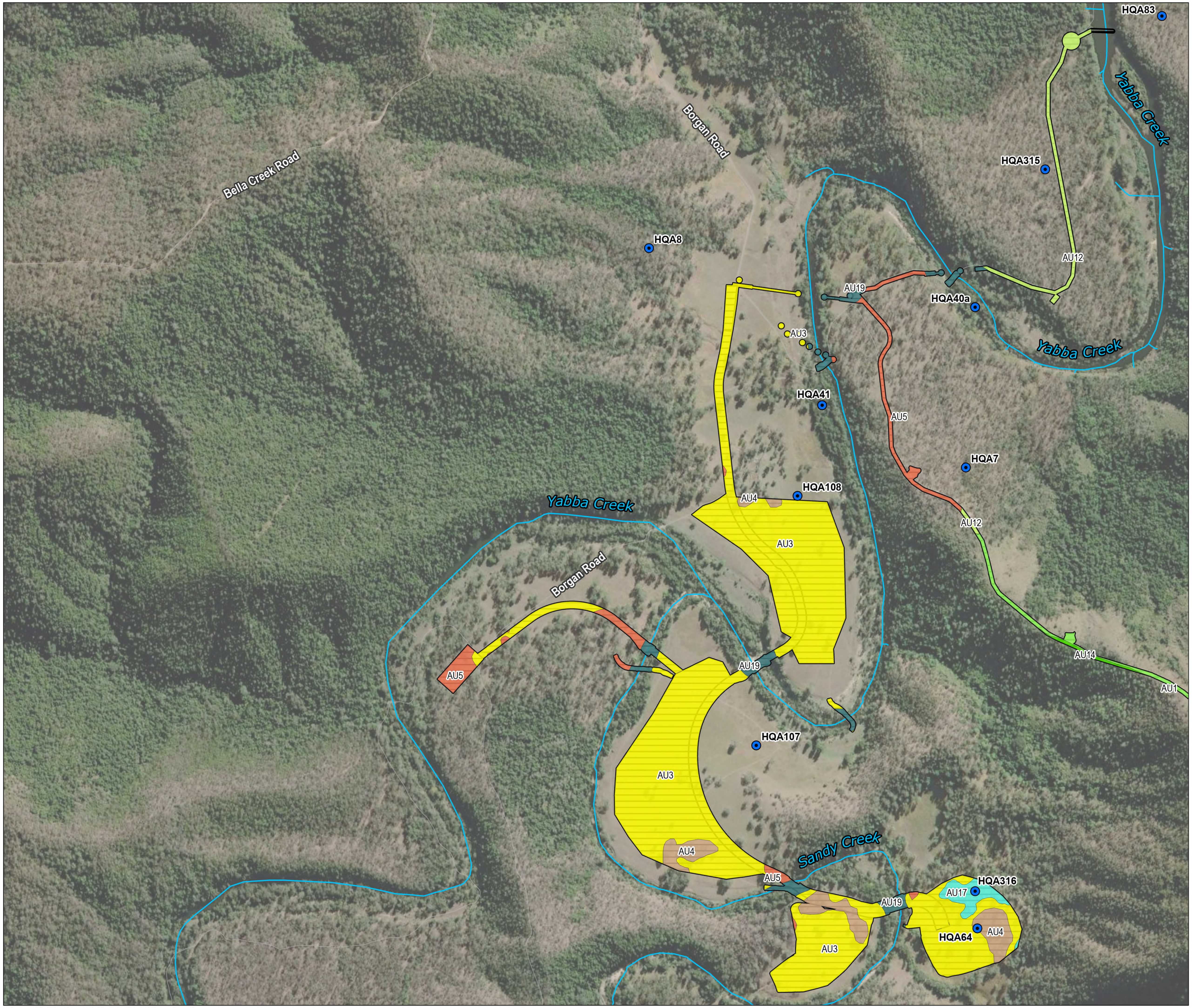
Data Sources:
1. Basemap © Roads and tracks: © State of Queensland (Department of Resources) 2023
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

Borumba PHES Project
Offset Area Management Plan

MODIFIED HABITAT QUALITY ASSESSMENT SITES & ASSESSMENT UNITS WITHIN DISTURBANCE FOOTPRINT

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	25/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 7-B



Queensland Hydro

GDA2020 MGA Zone 56

N

0 260 m

1:10,000 @ A3

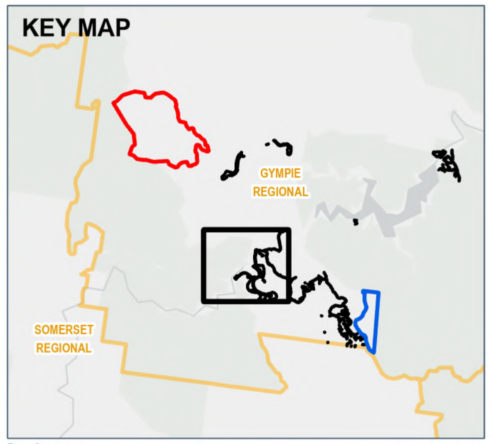
LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Watercourse [defined by Water Act 2000]
- Local road or track
- MHQA sites

Modified Habitat Assessment Units

- AU1, 12.11.10, Non-remnant
- AU5, 12.11.14, Remnant
- AU4, 12.11.14, Regrowth
- AU3, 12.11.14, Non-remnant
- AU12, 12.11.12, Remnant
- AU14, 12.12.15, Remnant
- AU17, 12.12.23, Remnant
- AU19, 12.3.7, Remnant

KEY MAP



Data Sources:
1. Basemap © Roads and tracks: © State of Queensland (Department of Resources) 2023
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

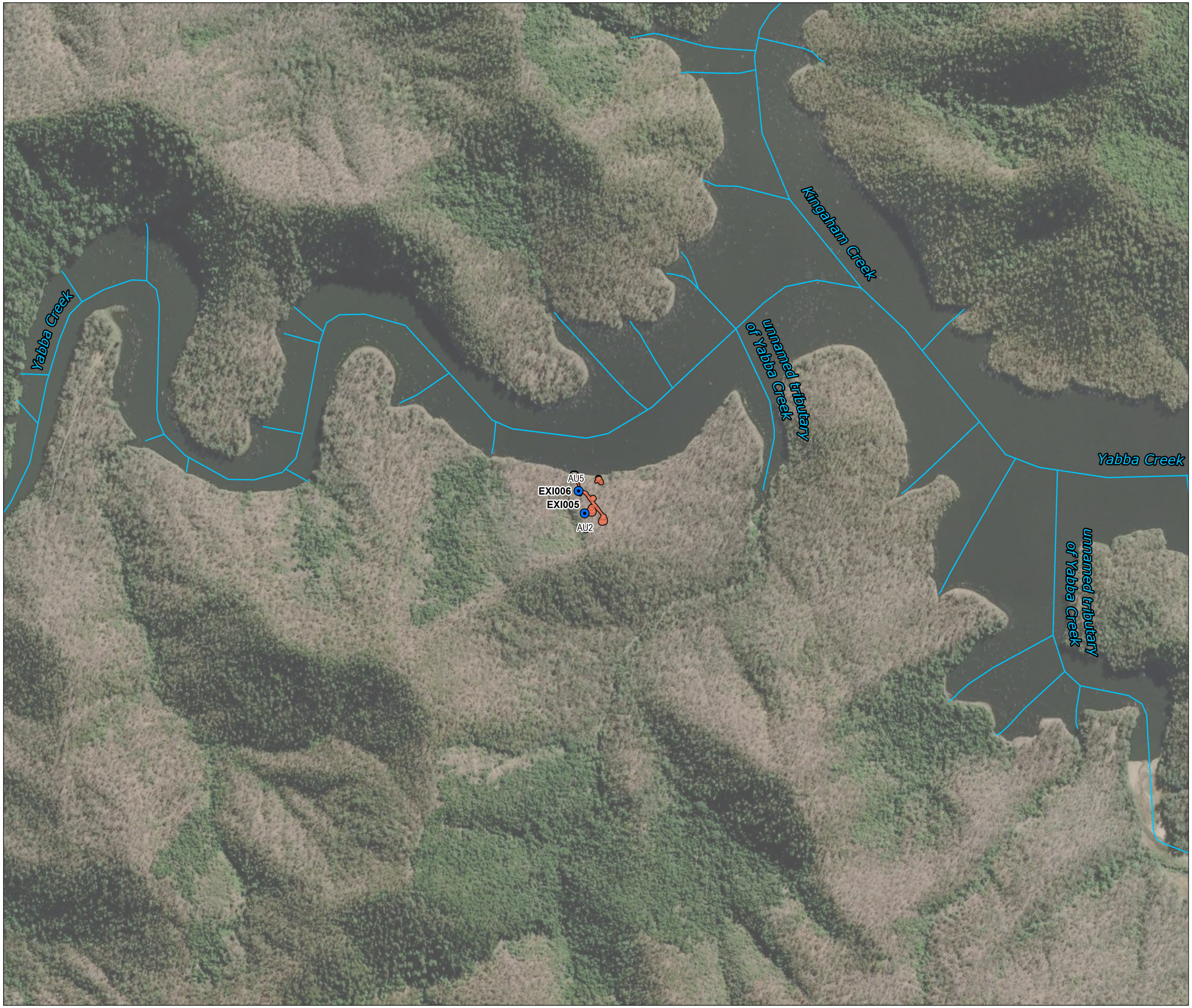
Borumba PHES Project
Offset Area Management Plan

MODIFIED HABITAT QUALITY ASSESSMENT SITES & ASSESSMENT UNITS WITHIN DISTURBANCE FOOTPRINT

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	25/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 7-C

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 7



GDA2020 MGA Zone 56

N

0 260 m

1:10,000 @ A3

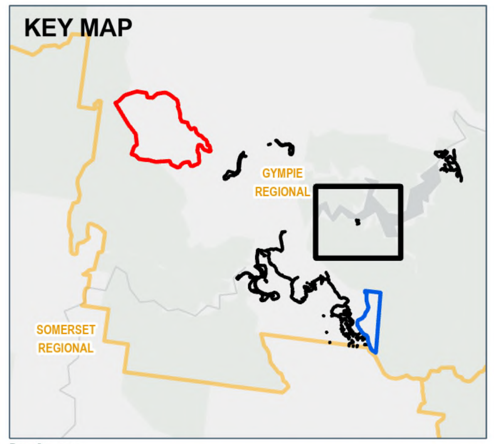
LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Watercourse [defined by Water Act 2000]
- Local road or track
- MHQA sites

Modified Habitat Assessment Units

- AU5, 12.11.14, Remnant
- AU2, 12.11.10, Remnant

KEY MAP



Data Sources:
1. Basemap © Roads and tracks: © State of Queensland (Department of Resources) 2023
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

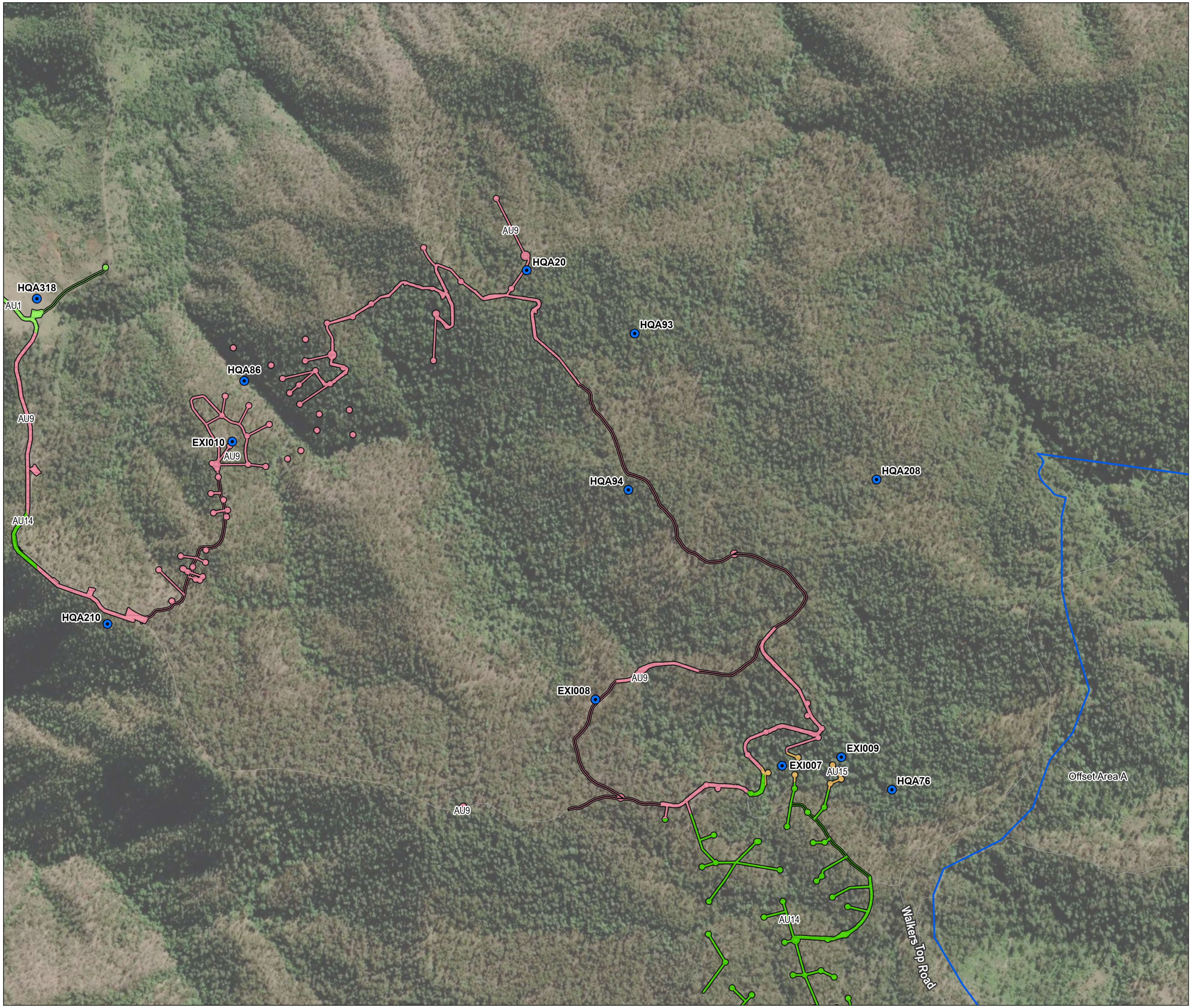
Borumba PHES Project
Offset Area Management Plan

MODIFIED HABITAT QUALITY ASSESSMENT SITES & ASSESSMENT UNITS WITHIN DISTURBANCE FOOTPRINT

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	25/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 7-D

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 7



Queensland Hydro

GDA2020 MGA Zone 56

N

0 260 m

1:10,000 @ A3

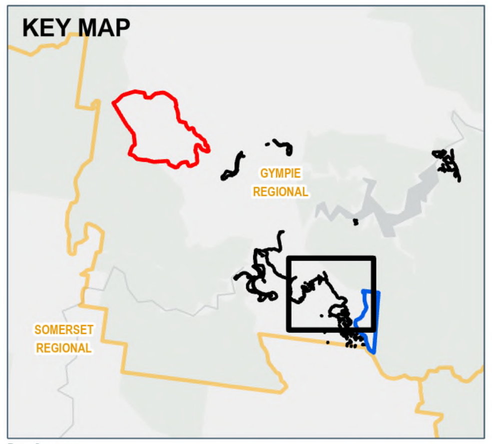
LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Offset Area A
- Local road or track
- MHQA sites

Modified Habitat Assessment Units

- AU1, 12.11.10, Non-remnant
- AU9, 12.11.3, Remnant
- AU14, 12.12.15, Remnant
- AU15, 12.12.16, Remnant

KEY MAP



Data Sources:
1. Basemap © Roads and tracks: © State of Queensland (Department of Resources) 2023
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

Borumba PHES Project
Offset Area Management Plan

MODIFIED HABITAT QUALITY ASSESSMENT SITES & ASSESSMENT UNITS WITHIN DISTURBANCE FOOTPRINT

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	25/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 7-E

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 7

Queensland Hydro

GDA2020 MGA Zone 56

0 260 m

1:10,000 @ A3

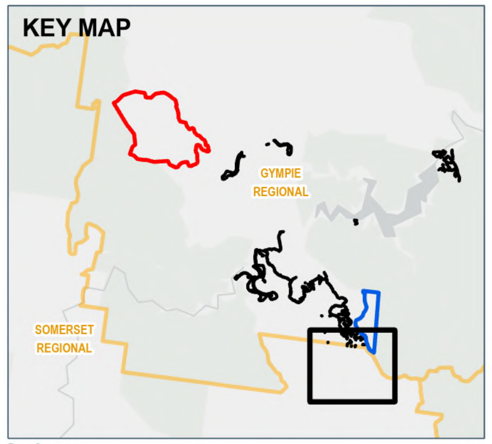
N

LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Offset Area A
- Watercourse [defined by Water Act 2000]
- Local road or track
- MHQA sites

Modified Habitat Assessment Units

- AU14, 12.12.15, Remnant
- AU16, 12.12.23, Non-remnant
- AU17, 12.12.23, Remnant



Data Sources:
1. Basemap © Roads and tracks: © State of Queensland (Department of Resources) 2023
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

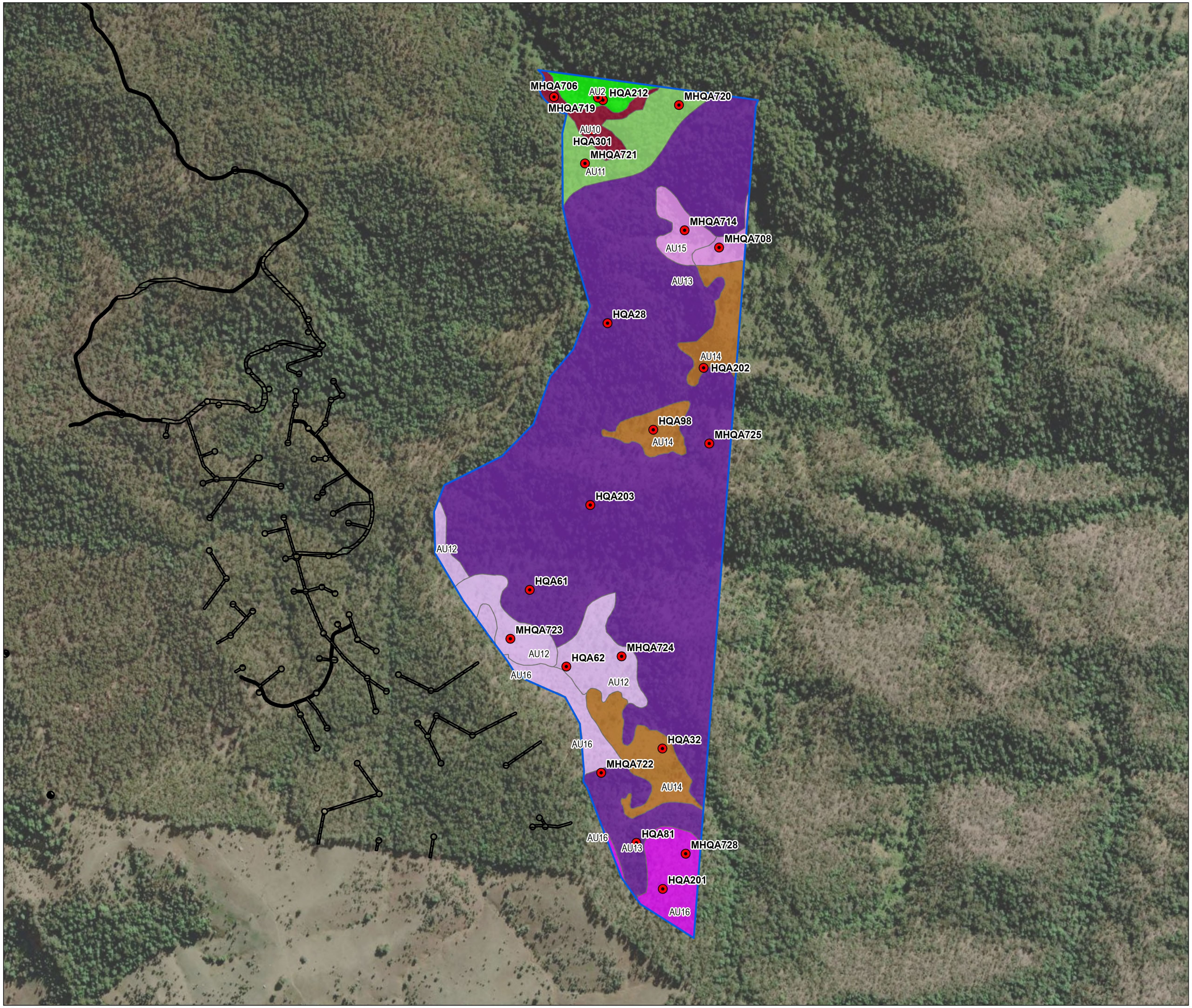
Borumba PHES Project
Offset Area Management Plan

MODIFIED HABITAT QUALITY ASSESSMENT SITES & ASSESSMENT UNITS WITHIN DISTURBANCE FOOTPRINT

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	25/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 7-F

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 7



GDA2020 MGA Zone 56

N

0 260 m

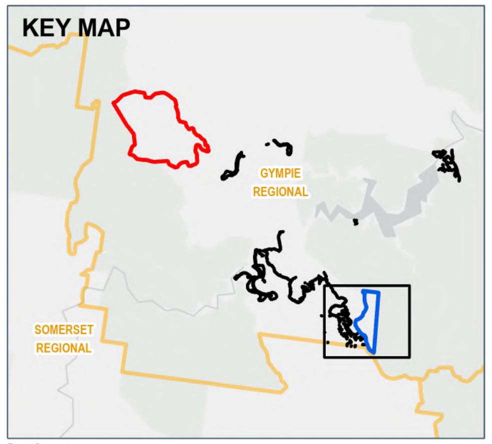
1:10,000 @ A3

LEGEND

- Offset Area A
- Exploratory Works Project Footprint (EPBC Only)
- MHQA sites

Modified Habitat Assessment Units

- AU2, 12.11.10, Remnant
- AU10, 12.11.3, Regrowth
- AU11, 12.11.3, Remnant
- AU12, 12.12.15, Regrowth
- AU13, 12.12.15, Remnant
- AU14, 12.12.16, Regrowth
- AU15, 12.12.16, Remnant
- AU16, 12.12.23, Remnant



Data Sources:
1. Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

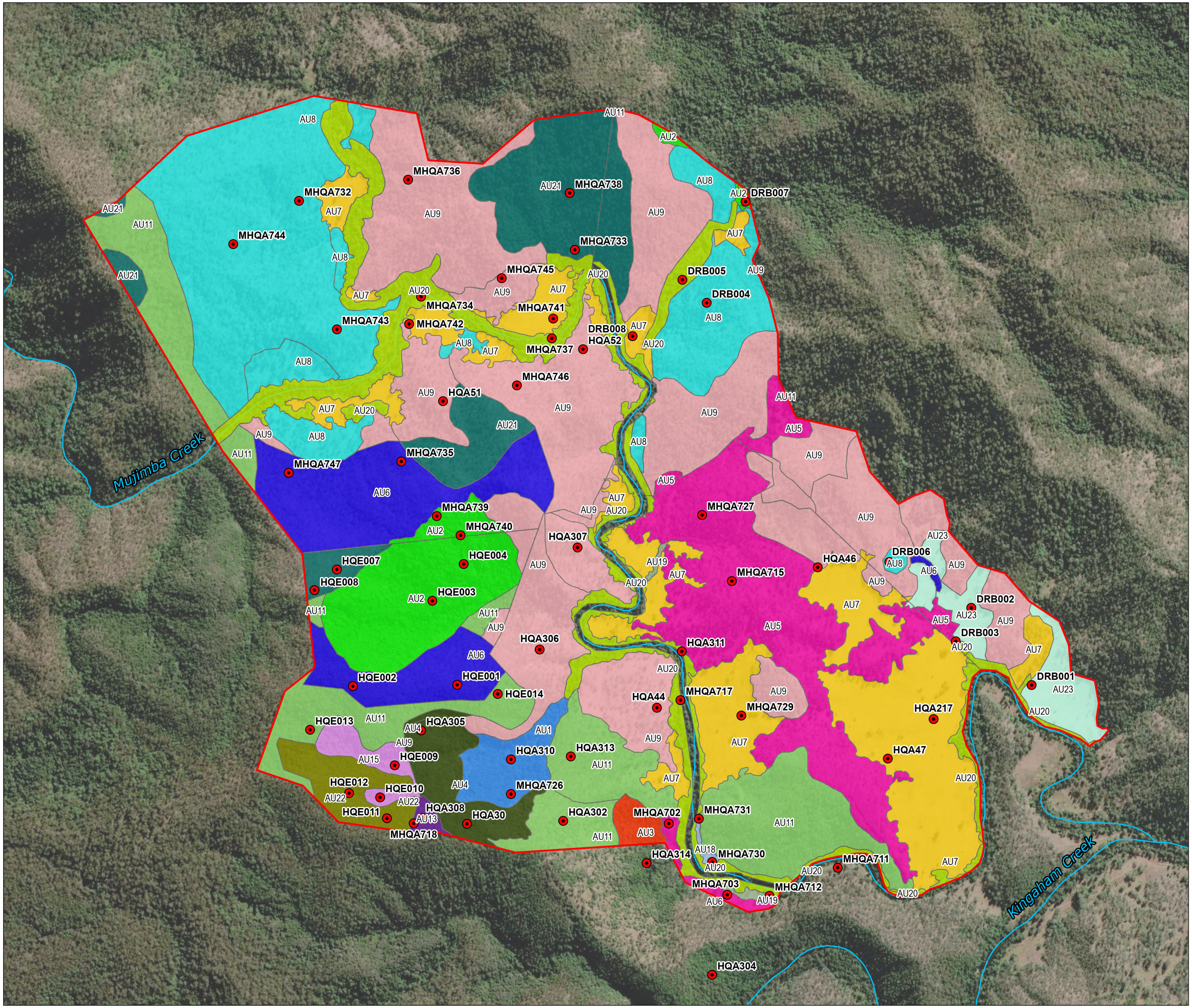
Borumba PHES Project
Offset Area Management Plan

MODIFIED HABITAT QUALITY ASSESSMENT SITES & ASSESSMENT UNITS WITHIN OFFSET AREA A

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	25/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 8-A

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 8



GDA2020 MGA Zone 56

N

0 340 m

1:13,000 @ A3

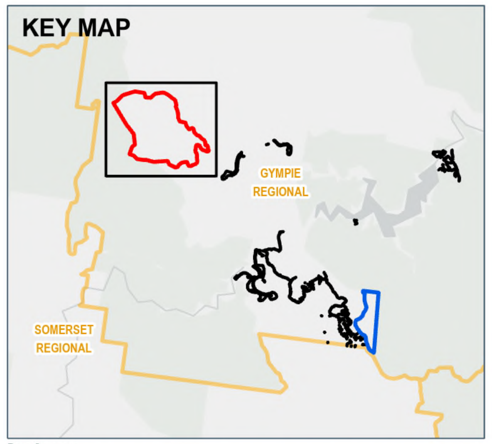
LEGEND

- Offset Area B
- MHQA sites
- Watercourse [defined by Water Act 2000]

Modified Habitat Assessment Units

- AU1, 12.11.10, Regrowth
- AU2, 12.11.10, Remnant
- AU3, 12.11.11, Regrowth
- AU4, 12.11.11, Remnant
- AU5, 12.11.14, Regrowth
- AU6, 12.11.14, Remnant
- AU7, 12.11.15, Non-remnant
- AU8, 12.11.15, Regrowth
- AU9, 12.11.15, Remnant
- AU11, 12.11.3, Remnant
- AU13, 12.12.15, Remnant
- AU15, 12.12.16, Remnant
- AU18, 12.3.7, Non-remnant
- AU19, 12.3.7, Regrowth
- AU20, 12.3.7, Remnant
- AU21, 12.11.9, Remnant
- AU22, 12.11.3a, Remnant
- AU23, 12.11.14, Non-remnant

KEY MAP



Data Sources:
1. Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

Borumba PHES Project
Offset Area Management Plan

MODIFIED HABITAT QUALITY ASSESSMENT SITES & ASSESSMENT UNITS WITHIN OFFSET AREA B

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	25/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 8-B

4.3 Impact area habitat quality scores

As presented in the Preliminary Documentation, habitat quality scoring was completed for each MNES considered to have an SI within the impact area. A summary of the MNES proposed to be offset, the respective impact areas, and weighted habitat quality scores on the impact site, based on application of MHQA, is presented in Table 16.

Full calculator scoring sheets are provided in Appendix C.

Table 16: Habitat quality scores - impact area

MNES	Habitat Quality Score	
	Impact Area (ha)	Current Habitat Quality (weighted average)
Lowland Rainforest of Subtropical Australia	2.5	7
Threatened Flora		
Brush sophora	0.3	7
Scrub turpentine	0.7	7
Threatened Fauna		
Black-breasted button-quail	0.2	6
Glossy black-cockatoo	27.9	8
Greater glider	35.2	7
Koala (foraging and breeding)	35.3	8
Koala (dispersal and refuge)	52.3	4
Long-nosed potoroo	38.0	7
Yellow-bellied glider	35.3	7

4.4 Offset area habitat quality scores

A summary of the unweighted habitat quality scores for each MNES value within the two Offset Areas (A and B) is provided in Table 17 (Offset Area A) and Table 19 (Offset Area B). The unweighted scores are averages across all the sites within an assessment unit but they are not weighted by how much area is available. The weighted final scores (area weighted average of all assessment units) are presented in Table 18 and Table 20. It is the weighted numbers that are rounded to accommodate the requirements of the OAG calculator. Both the starting habitat quality score and future habitat quality score are provided, and the offset area proposed to be delivered and percentage acquitted.

These habitat quality scores have been applied in the DCCEEW OAG (v1.04) calculator which are provided in Appendix D.

4.4.1 Offset Area A

Table 17 shows the unweighted habitat quality scores for each assessment unit in Offset Area A for each MNES. The mean scores represent the average unweighted scores for each MNES. The weighted scores that were used in the offset calculators can be found in Appendix C and are summarised (and rounded) in Table 18.

Table 17: Habitat quality scores (unweighted) for each relevant assessment unit for each MNES - Offset Area A

MNES	AU2	AU10	AU11	AU12	AU13	AU14	AU15	AU16	Mean
Lowland Rainforest of Subtropical Australia TEC	5.57					4.48	4.93		**4.99**
Threatened Flora									
Brush sophora	4.03	5.46	5.89	3.30	4.34	3.36	3.84	4.61	**4.35**
Threatened Fauna									
Black-breasted button-quail	6.52					5.99	6.3		**6.27**
Glossy black-cockatoo		7.53	7.81	6.78	7.59			7.72	**7.48**
Greater glider		7.46	8.15	6.68	7.64			7.84	**7.55**
Koala (foraging and breeding)		7.39	8.12	6.63	7.69			8.22	**7.61**
Koala (dispersal and refuge)	6.12					5.80	5.66		**5.86**
Long-nosed potoroo	7.15	7.68	8.29	6.76	7.67	6.60	6.84		**7.28**
Yellow-bellied glider		7.0	8.09	6.5	7.56			7.65	**7.36**

The offset area for each MNES (Table 18) has been determined through application of various inputs into the OAG calculator. Calculator inputs for each MNES are justified in Section 5 and Appendix D. Table 18 shows the current habitat quality scores (weighted and rounded) for each MNES in Offset Area A and the results of the offset calculator.

Table 18: Current and future (weighted) habitat quality scores for each MNES and the offset area required to acquit the offset obligation - Offset Area A

MNES	Current Habitat Quality (rounded)	Future Habitat Quality	Offset Area proposed (ha)	Percentage of obligation acquitted
Lowland Rainforest of Subtropical Australia TEC	5	7	14.8	36.3%
Threatened Flora				
Brush sophora	4	6	122.5	8,967%
Threatened Fauna				
Black-breasted button-quail	6	7	14.8	1,007%
Glossy black-cockatoo	8	9	107.7	39.4%
Greater glider	8	9	107.7	29.3%
Koala (foraging and breeding)	8	9	107.7	25.5%
Koala (dispersal and refuge)	6	8	14.8	8.9%
Long-nosed potoroo	7	8	118.4	36.3%
Yellow-bellied glider	7	8	107.7	35.6%

4.4.2 Offset Area B

Table 19 shows the unweighted habitat quality scores for each assessment unit in Offset Area B for each MNES. The means represent the average unweighted scores across sites for each MNES. The weighted scores that were used in the offset calculators can be found in Appendix C and are summarised (and rounded) in Table 20.

Table 19: Habitat quality scores (unweighted) for each relevant assessment unit for each MNES - Offset Area B

MNES	AU1	AU2	AU3	AU4	AU5	AU6	AU7	AU8	AU9	AU10	AU11	AU13	AU15	AU18	AU19	AU20	AU21	AU22	AU23	Mean
Lowland Rainforest of Subtropical Australia TEC	6.50	7.09											7.04							**6.88**
Threatened Flora																				
Brush sophora	Only Offset Area A used																			
Threatened Fauna																				
Black-breasted button-quail	6.84	6.97	6.91	7.19									7.11							**7.01**
Glossy black-cockatoo					7.58	7.47	4.82	7.06	7.59		7.42	7.98		6.25	7.23	7.41	7.06	7.04	5.33	**6.94**
Greater glider					7.65	7.72	4.18	7.05	7.73		7.72	8.3		5.57	7.25	7.17	7.41	7.35	5.01	**6.93**
Koala (foraging and breeding)					7.85	7.75		7.52	7.95		7.9	7.77			6.46	7.49	7.37	7.46		**7.55**
Koala (dispersal and refuge)	6.64	6.31	6.80	7.08			4.31						5.88	4.37					4.58	**5.75**
Long-nosed potoroo	5.98	7.09	7.53	7.87							7.63	8.10	6.61	4.75	7.15	7.26	7.17	6.98		**7.01**
Yellow-bellied glider					6.61	7.0	4.39	6.19	6.69		7.07	7.24		4.11	6.22	6.41	7.29	7.06	3.03	**6.10**

The offset area for each MNES (Table 20) has been determined through application of various inputs into the OAG calculator. Calculator inputs for each MNES are justified in Section 5 and Appendix D. Table 20 shows the current habitat quality scores (weighted and rounded) for each MNES in Offset Area B and the results of the offset calculator.

Table 20: Current and future habitat quality scores (weighted) for each MNES and the offset area required to acquit the offset obligation - Offset Area B

MNES	Current Habitat Quality	Future Habitat Quality	Offset Area proposed (ha)	Percentage of obligation acquitted
Lowland Rainforest of Subtropical Australia TEC	7	9	41.7	102.5%
Threatened Flora				
Brush sophora	Only Offset Area A used			
Threatened Fauna				
Black-breasted button-quail	7	8	55.7	3,790%
Glossy black-cockatoo	7	8	602.2	220.2%
Greater glider	7	8	602.2	163.6%
Koala (foraging and breeding)	8	9	513.1	121.7%
Koala (dispersal and refuge)	5	7	144.7	87.2%
Long-nosed potoroo	7	8	218	66.9%
Yellow-bellied glider	6	7	602.2	199%

4.5 Offset area future habitat quality

Future habitat gains will be achieved through implementing the management actions discussed in Section 6. A summary of the actions to be implemented to improve habitat quality for each MNES is listed in Table 21. Most of the gains in habitat quality will be through ongoing weed management, phased removal of grazing from all offset areas, implementing an appropriate fire regime (which includes excluding fire from some areas) and assisted regeneration (particularly in regrowth areas) and revegetation. These actions will be monitored and measured against the interim milestones and final year 20 score (Table 42).

Table 21: Management actions to improve habitat quality within the offset areas

MNES	Management actions contributing to future habitat quality increase
Lowland Rainforest of Subtropical Australia TEC	• Phased removal of grazing (with exclusion by the end of Year 1) from the TEC and 50 m buffer around TEC (where buffer occurs on land owned by Queensland Hydro) will reduce trampling and weed spread. • Reduction in weeds to less than 5% cover across offset areas. • Increase in species richness by at least one MHQA score through removal of competition with weeds. • Increase in canopy cover to within 70% of the benchmark. • Increase in large tree abundance to at least 20% of benchmark. • Exclusion of controlled burns from TEC patches in the offset areas. Controlled burns will also not be carried out within 50m buffer zone from the TEC where the buffer occurs on land owned by Queensland Hydro. This is to improve regeneration of sensitive rainforest and vine thicket species.

MNES	Management actions contributing to future habitat quality increase
	• Control of weeds in 50 m buffer zone (where that buffer is on land owned by Queensland Hydro) which will assist in fuel load reduction, reduce reintroduction of weeds to the area and provide a buffer against disturbance which encourages weed spread. • Removal of all logging within the offset areas to allow large trees to remain and remove sources of disturbance.
Threatened Flora	
Brush sophora	• Reduction in weeds to less than 5% cover. • Reduction in uncontrolled fires to protect the species from inappropriate fire regimes that could result in mortality of the species and/or degradation of habitat. • Actively manage fire regimes to allow for cooler, mosaic burning in eucalypt woodlands but exclusion of fire from vine thicket and rainforest communities including a 50 m buffer (where that buffer is on land owned by Queensland Hydro). • Installation and management of fire breaks. • Increase in canopy cover to within 70% of the benchmark. • Increase in species richness to more than 90% of the benchmark through removal of competition with weeds.
Threatened Fauna	
Black-breasted button-quail	• Reduction in weeds to less than 5% cover and natural regeneration with native cover. In areas where natural native cover may be slow to regenerate, supplementary plantings may be considered. • Reduction in predation threats through control of feral cats and European foxes to a level where established baseline numbers have been reduced for at least two monitoring sessions. • Increase in native mid-storey and shrub layer cover to at least 40% cover. • Reduction in uncontrolled fires to protect foraging and sheltering habitat through the installation of fire breaks and controlled burning. • Reduction in Feral pig abundance to below the established baseline leading to reduction in pig damage and spread of weeds.
Glossy black-cockatoo	• Increase in regeneration of new foraging trees to 100% of the benchmark. • Increase cover of foraging and nesting tree species to more than 5% cover through phased removal of grazing, reduction in weeds and protection of logging. • Reduction in the abundance of predators (feral cats) to below the established baseline for at least two monitoring sessions. • Reduction in uncontrolled fires to protect foraging and denning habitat through the installation of fire breaks and controlled burning. • Installation of supplementary hollows to provide additional denning resources (Section 6.3.9). • Increase in large trees to at least 40% of the benchmark (at all remnant and regrowth sites) through protection from logging and impacts from grazers.
Greater glider	• Increase in regeneration of new foraging trees to 100% of the benchmark. • Increase cover of foraging and denning tree species to at least 40% of the benchmark through phased removal of grazing, reduction in weeds and protection from logging. • Reduction in the abundance of predators to below the benchmark, for at least two monitoring sessions to reduce the threat of feral cats. • Reduction in uncontrolled fires to protect foraging and denning habitat through the installation of fire breaks and controlled burning. • Increase in large trees to at least 40% of the benchmark (at all remnant and regrowth sites) through protection from logging and impacts from grazers.

MNES	Management actions contributing to future habitat quality increase
	• Installation of supplementary hollows to provide additional denning resources (Section 6.3.9). • Reduction in weeds to less than 5% cover.
Koala (foraging and breeding)	• Increase in regeneration of new foraging trees to 100% of the benchmark. • Increase cover of foraging and shelter tree species to at least 40% of the benchmark through phased removal of grazing, reduction in weeds and protection from logging. • Reduction in weeds to less than 5% cover to increase the ability of the species to move through the site, particularly the removal of lantana. • Control of predation threats to below the established baseline through control of European foxes, feral cats and wild dogs. • Control of introduced grazers to below the established baseline including deer, to reduce impacts on regenerating trees. • Reduction in uncontrolled fires to protect foraging habitat through the installation of fire breaks and controlled burning. • Increase in large trees to at least 40% of the benchmark (at all remnant and regrowth sites) through protection from logging and impacts from grazers.
Koala (dispersal and refuge)	• Phased removal of grazing from cleared grassland areas by the end of Year 3 to help keep fuel load and weeds down while preparations are underway for revegetation • Increase in regeneration of new foraging trees to 100% of the benchmark. • Increase cover of foraging and shelter tree species to at least 20% of the benchmark (at all non-remnant woodland sites) through phased removal of grazing, reduction in weeds and active restoration. • Reduction in weeds to less than 5% cover to increase the ability of the species to move through the site, particularly the removal of lantana. • Control of predation threats through control of European foxes, feral cats and wild Dogs to below the established baseline for at least two monitoring sessions. • Reduction in uncontrolled fires to protect dispersal habitat through the installation of fire breaks and controlled burning.
Long-nosed potoroo	• Reduction in weeds to less than 5% cover and gradual replacement with native cover. • Reduction in predation threats through control of feral cats and European foxes to below the established baseline for a minimum of two monitoring sessions. • Reduction in uncontrolled fires to protect foraging and sheltering habitat through the installation of fire breaks and controlled burning. Fire will be excluded from vine thicket and rainforest communities and 50 m buffer. • Reduction in Feral pig abundance leading to reduction in pig damage and spread of weeds to below the established baseline.
Yellow-bellied glider	• Increase in regeneration of new foraging trees to 100% of the benchmark. • Increase cover of foraging and denning tree species to at least 40% of the benchmark (in remnant and regrowth sites) through phased removal of grazing, reduction in weeds and protection from logging. • Removal of predation threats through control of feral cats to below the established baseline for at least two monitoring sessions. • Reduction in uncontrolled fires to protect foraging and denning habitat through the installation of fire breaks and controlled burning. • Installation of supplementary hollows to provide additional denning resources (Section 6.3.9). • Increase in large trees to at least 40% of the benchmark (at all remnant and regrowth sites) through protection from logging and impacts from grazers.

4.6 Offset area habitat quality reductions

For the purpose of this assessment, it is assumed that reduction in habitat quality will not occur over time in the absence of the active and intentional management actions associated with the offset and under continued as-of-right uses of the land.

As there is no calculated reduction in habitat quality without management, the offset area baseline score has been maintained for the purposes of habitat quality score calculations in the OAG.

4.7 Summary of MNES per cent acquitted across offset areas

Table 22 provides a summary of each MNES where an SI is likely as a result of the Project and the total offset percentage met by using Offset Areas A and B based on the relevant OAG.

For all MNES a combination of the two proposed offset areas will deliver more than 100% of the Exploratory Works offset requirements.

As some MNES have larger impact areas and/or a higher listing status than other values they generate larger offset area requirements (e.g. koalas and Lowland Rainforest TEC). MNES values that can be co-located in these habitat types are generating large offset credits (e.g. black-breasted button-quail). Therefore, as set out in Section 4.7.1, if the Borumba PHES Main Works Project proceeds, it is proposed that the surplus offsets in this offset proposal could be used to contribute to offsets for the Main Works Project in the future .

4.7.1 Offset credit surplus towards Main Works Project

The proposed Exploratory Works Project offset is anticipated to result in offset credits for all eight MNES being offset. The total per cent (%) of acquittal for each MNES is outlined in Table 22.

How the offset credits may be applied will be discussed and agreed with DCCEEW prior to offset areas being legally secured.

Table 22: Total offset percentage met and in credit for each MNES

MNES	Offset Area and Per Cent Acquitted			Credits
	Area A (%)	Area B (%)	Total (%)	Credit (%)
Lowland Rainforest TEC	36.3	102.5	138.8	38.83
Brush sophora	8,967	N/A	8,967.0	8,867
Black-breasted button-quail	1,007	3,790	4,797.0	4,697
Glossy black-cockatoo	39.4	220.2	259.7	159.7
Greater glider	29.3	163.6	192.9	92.9
Koala (foraging and breeding)	25.5	121.7	147.2	
Koala (dispersal and refuge)	8.9	87.2	96.1	
Koala combined			**143.4**	**43.4**
Long-nosed potoroo	36.3	66.9	103.27	3.3
Yellow-bellied glider	35.6	199	234.6	134.6

5. EPBC offset assessment guide inputs

To demonstrate the offset package adequately offsets the impacts on MNES from the Exploratory Works Project, DCCEEW OAG (v1.04) has been applied for each MNES value with an SI where a land-based offset is proposed.

A description of the key inputs and methodology used to derive those scores is summarised in Table 23 and tailored responses and justification for each MNES is provided in Appendix D.

Table 23: Inputs to the Offsets Assessments Guide

Calculator input	Justification
Impact Area	The area of significant residual impact for each MNES value, as presented in Section 3.1.
Impact Area Score	The habitat quality scores within the Project footprint for each MNES value are presented in Table 16. Methodologies for habitat quality scoring are described in Appendix B and a more detailed breakdown of scoring for each MNES is provided in Appendix C.
Time over which loss is averted	20 years. The maximum allowable value has been used here.
Time until ecological benefit	At present a maximum of 20 years has been applied for all MNES. It is anticipated that the ecological benefit (i.e. future habitat quality score) will be realised after 20 years of active management, monitoring and adaptive management including corrective actions as set out in this OAMP.
Start area (ha)	The size of offset area required for each MNES value has been derived based on the application of the OAG. The inputs for each MNES are summarised in Appendix D. The final offset area for each MNES has been based on a number of considerations including the size of offset required to reach 100% in the OAG, co-location of MNES and associated habitats, practical on ground boundaries and using vegetation that delivers habitat quality gains. Therefore, the final offset area proposed may exceed 100%. This demonstrates that additional offset areas are being provided above and beyond what the policy would require. Final offset areas for each MNES in each offset area are summarised in Table 5 - Table 12.
Starting quality	The starting weighted habitat quality scores for each MNES and offset area are presented in Table 17 and Table 19. Methodologies for habitat quality scoring are described in Appendix B and a more detailed breakdown of scoring for each MNES is provided in Appendix C.
Risk of loss (%) without offset	DCCEEW have provided feedback that the Department is no longer using the 'Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act' (Maseyk, F.J.F et al 2017). 0% risk of loss has been applied to all MNES.
Future quality without offset	For the purpose of this OAMP, no reduction in habitat quality without the offset has been included. DCCEEW required additional data to demonstrate that there would be a reduction in habitat quality over 20 years under continued as-of-right uses. Queensland Hydro will investigate gathering this data for Main Works, however due to timing of Exploratory Works has decided to progress without a habitat reduction. As there is no calculated reduction in habitat quality without management, the offset area baseline score has been maintained for the purposes of habitat quality score calculations.
Risk of loss (%) with an offset	With the offset in place there is a much lower risk of the MNES values being completely lost. The offset will be legally secured on title to prevent future clearing in non-remnant areas and requires landowners to comply with the OAMP (e.g. removing cattle from offset area). Active management and restoration of native vegetation and habitat values such as bushfire management, feral animal control, weed control, managing regrowth and undertaking revegetation will ensure habitat quality is improved and maintained. In addition, there will be regular monitoring, auditing and reporting. Where required corrective actions will be put in place. Therefore risk of loss with the offset has been set at 0%.

Calculator input	Justification
Future quality with offset	The future habitat quality scores (or completion criteria) and interim milestones are presented in Table 42 and Table 43. These scores are based on undertaking a range of management actions including phased removal of grazing, weed management, pest management and fire management (as described in Section 6). Managing natural regeneration and restoring habitat is also proposed to improve habitat quality over 20 years. These gains are guided by MHQA for each MNES. Habitat gains are outlined in Appendix C.
Confidence in result (%)	There is a high degree of confidence the future habitat quality scores can be achieved. There is strong evidence of existing threats and degrading vegetation condition and habitat attributes that can be improved. Management actions such as phased removal of livestock and reduction in pests such as deer will improve recruitment (Nilar et.al, 2019). Reducing weed cover, reducing pest animal predation on MNES, managing natural regeneration and implementing revegetation, improving canopy cover and height will all improve scores. Management, monitoring, auditing and reporting measures proposed provide increased confidence that the offset areas will improve in habitat quality. Use of experienced and qualified contractors to undertake the management and monitoring and review the offsets progress also increases the confidence in completion criteria being achieved. The confidence in result of achieving the habitat quality gains has been set at 85% where there is a one point increase of habitat quality over 20 years. There is a high degree of confidence these gains can be achieved using proven management methods. For those MNES where a two point increase is proposed due to the offset including a combination of regrowth and restoration actions, a confidence in result has been set at 80%. The confidence in result that the offset values will not be lost due to putting the offset in place is set at 90%.

6. Management actions

This section outlines the management actions that will be implemented across each of the offset areas to ensure habitat quality gains and the final completion criteria for each MNES can be achieved.

The intention of these management actions is to improve the condition of the offset areas, increase availability of foraging and breeding resources, and ensure a suitable conservation outcome is achieved which improves or maintains habitat for the species and communities significantly impacted by the Project.

Section 6.1 discusses the overarching management actions that will be implemented and Section 6.2 and 6.3 summarises those actions which are tailored specifically to an MNES and habitat quality attributes to be improved.

Section 6.40 discusses additional administrative measures that will also be enforced across the offset areas to ensure that these goals and conservation outcomes are achieved. The management actions discussed in this section have been developed through a review of relevant guidelines, information contained within approved conservation advice documents for each MNES value, and other publicly available management plans and reports where these management actions have been shown to be effective.

A summary of the key threatening processes identified for each MNES value has been provided in Table 24. This information was used to ensure that the management measures proposed are addressing the relevant known threatening processes for the MNES values. Some key threatening processes that cannot be managed by the Project (e.g. climate change), have no management actions listed.

Ongoing monitoring and reporting requirements (as discussed in Section 8 and 10) will be undertaken to ensure that these management measures are effective and will help to determine if additional corrective actions will be required to ensure that the final completion criteria are achieved. Corrective actions are outlined in Section 12.

Table 24: Key threatening processes identified for each MNES

Relevant MNES	Key Threatening Processes for each MNES	Proposed management actions that address relevant literature
Threatened Ecological Communities		
Lowland Rainforest of Subtropical Australia	Conservation advice for the TEC (DSEWPaC 2011) identifies the following as relevant key threatening processes: • Vegetation clearing • Private native forestry • Impacts associated with fragmentation of remnants • Weeds and Myrtle Rust • Predation by European fox • Loss and degradation of native plant and animal habitat by invasion of escaped garden plants (including aquatic plants) • The biological effects (including ingestion) of cane toads (*Rhinella marina*). • Grazing • Fire	• Restriction on vegetation clearing (other than permitted for maintenance of access tracks, fence lines and safety etc within the OAMP). • Fragmentation will be reduced across the offset areas by restoring regrowth and cleared land improving species connectivity between habitats. • Regeneration and restoration works will improve connectivity to the adjacent protected areas. • Weed cover will be reduced to less than 5% cover. • Management measures to be focussed on minimising spread of myrtle rust. • Phased removal of grazing from this community (including areas which are to be restored to this TEC), with complete removal of cattle by the end of Year 1. • Establishment of temporary or permanent fauna friendly fencing to exclude cattle, while allowing native fauna movement. • Fire management will be implemented to reduce likelihood of bushfires occurring in Lowland Rainforest TEC. No controlled burns to occur in the TEC or 50 m buffer (where the buffer is on Queensland Hydro owned land), but will occur in adjacent land of the offset to reduce fuel loads and lower risk of bushfires getting to the TEC patches.
Threatened Flora		
Scrub turpentine (*Rhodamnia rubescens*)	Conservation advice for this species (TSSC 2020) identifies that the key threat to this species is infection by Myrtle Rust.	• *Being delivered as a compensatory measure* • Management measures on offset lands to be focussed on minimising spread of myrtle rust.
Brush sophora (*Sophora fraseri*)	Conservation advice for this species (DEWHA 2008) identifies the following as relevant key threatening processes: • Loss of habitat through clearing, agriculture and development • Timber harvesting activities	• Reduction in weed cover to less than 5% cover. • Unplanned bushfires will be managed to ensure that fire regimes are suitable for the species.

Relevant MNES	Key Threatening Processes for each MNES	Proposed management actions that address relevant literature
	• Weed infestation such as *Lantana camara* • Inappropriate fire regimes (too frequent).	• Restriction on vegetation clearing (other than permitted for maintenance of access tracks, fence lines and safety etc within the OAMP). • Increase in canopy cover to within 70% of the benchmark. • No timber harvesting permitted. Logging rights removed from Offset A.
Threatened Fauna		
Black-breasted button-quail (*Turnix melanogaster*)	Conservation advice for this species (TSSC 2015) identifies the following as relevant key threatening processes: • Habitat degradation as a result of domestic livestock and feral pigs (*Sus scrofa*) • Habitat loss or degradation from fires of increasing intensity or frequency • Predation by feral animals such as feral cats and European foxes • Habitat loss from agriculture or plantations.	• Weed cover will be reduced to less than 5% cover, while increasing native cover to ensure shelter requirements are maintained. • Fire management will be implemented to reduce likelihood of bushfires occurring in Lowland Rainforest TEC and habitats for black-breasted button-quail. No controlled burns to occur in vine thicket communities but will occur in adjacent land to reduce fuel loads and lower risk of bushfires getting to these patches. • Predator control will be implemented to reduce abundance of pests to below the established baseline • Cattle grazing will be phased out and ceased at end of Year 3 in regrowth and non-remnant areas. In ecologically sensitive areas, which include patches of Lowland Rainforest TEC, riparian vegetation corridors and remnant vegetation, cattle grazing will be phased out in Year 1 with fauna friendly exclusion fencing established to prevent access to these areas.
Glossy black-cockatoo (south-eastern) (*Calyptorhynchus lathami lathami*)	Conservation advice for this species (DCCEEW 2022d) identifies the following key threatening processes: • Habitat loss, degradation and fragmentation including inappropriate fire regimes, clearing of native vegetation/timber harvesting, habitat fragmentation, grazing and invasive weeds. • Climate change including increased likelihood of extreme events (i.e., heatwave and drought), and temporal or spatial shift of resource availability as a result of climate change. • Competition for resources including competition for nest hollows.	• Unplanned bushfires will be managed to ensure that fire regimes are suitable for the species and their habitat. • Weed cover will be reduced to less than 5% cover, while increasing native cover to ensure shelter requirements are maintained. • Cattle grazing will be phased out and ceased at end of Year 3 in regrowth and non-remnant areas. In ecologically sensitive areas, which include patches of Lowland Rainforest TEC, riparian vegetation corridors and remnant vegetation, cattle grazing will be phased out in Year 1, with fauna friendly exclusion fencing established to prevent access to these areas.

Relevant MNES	Key Threatening Processes for each MNES	Proposed management actions that address relevant literature
	• Diseases and predation including Psittacine Beak and Feather Disease (PBFD) and predation. • Illegal avian trade including bird and egg collection.	• Timber harvesting will be prohibited into the future which will increase foraging opportunities and denning opportunities. • Revegetation will occur in Offset Area B to increase availability of foraging resources and connectivity between habitats. • Supplementary hollows will increase denning opportunities for glossy black-cockatoo in Offset Area B. • Predator control will be implemented to reduce abundance of pests to below the baseline.
Greater glider (southern and central) (*Petauroides volans volans*)	Conservation advice for this species (DCCEEW 2022a) identifies the following key threatening processes: • Habitat loss, disturbance and modification including inappropriate fire regimes, habitat clearing and fragmentation, timber harvesting. • Barbed wire fencing (entanglement). • Climate change including increased temperatures and changes to rainfall patterns. • Over-abundant native species including hyper-predation by owls and competition from sulphur-crested cockatoos (*Cacatua galerita*). • Introduced species including predation by feral cats and European foxes.	• Unplanned bushfires will be managed to ensure that fire regimes are suitable for the species and their habitat. • Weed cover will be reduced to less than 5% cover while increasing native cover to ensure shelter requirements are maintained. • Cattle grazing will be phased out and ceased at end of Year 3 in regrowth and non-remnant areas. In ecologically sensitive areas, which include patches of Lowland Rainforest TEC, riparian vegetation corridors and remnant vegetation, cattle grazing will be phased out in Year 1, with fauna friendly exclusion fencing established to prevent access to these areas. • Timber harvesting will be prohibited into the future which will increase foraging and denning opportunities. • Predator control will be implemented to reduce abundance of pests to below the established baseline. • Barbed wire fencing that exists within the offset will be removed, and any boundary barbed wire fencing will be removed where adjoining landholder consents. • Revegetation will occur in Offset Area B to improve connectivity of habitats between non-remnant areas and remnant woodlands. • Supplementary hollows will increase denning opportunities for greater glider in Offset Area B.
Koala (combined population of QLD, NSW, ACT)	Conservation advice for this species (DAWE 2022a) identifies the following as relevant key threatening processes: • Climate change driven processes and drivers including loss of climatically suitable habitat; increased intensity/frequency of	• Unplanned bushfires will be managed to ensure that fire regimes are suitable for the species such as avoiding hot intensive fires that can result in koala mortality, and too frequent fire that can prevent regeneration of koala food trees.

Relevant MNES	Key Threatening Processes for each MNES	Proposed management actions that address relevant literature
(*Phascolarctos cinereus*)	drought, heatwaves and bushfire; and declining nutritional value of foliage. • Human related activities including clearing and degradation of koala habitat. • Mortality from interactions with vehicles and dogs. • Disease and health including koala retrovirus (KoRV) and chlamydia (*Chlamydia percorum*).	• Weed cover will be reduced to less than 5% cover while increasing native cover to ensure shelter requirements are maintained. • Cattle grazing will be phased out and ceased at end of Year 3 in regrowth and non-remnant areas. In ecologically sensitive areas, which include patches of Lowland Rainforest TEC, riparian vegetation corridors and remnant vegetation, cattle grazing will be phased out in Year 1, with fauna friendly exclusion fencing established to prevent access to these areas. • Timber harvesting will be prohibited into the future which will increase foraging opportunities and shelter. • Predator control will be implemented to reduce abundance of pest animals to below the established baseline. This will include targeting wild dogs which are a known threat to threats to koalas. • Vehicle speed limits will be managed on the existing tracks to reduce vehicle strikes. • Connectivity of habitats will be improved and additional foraging habitat provided through revegetation.
Long-nosed potoroo (northern) (*Potorous tridactylus tridactylis*)	Conservation advice for this species (DAWE 2022b) identifies the following as relevant key threatening processes: • Fire including inappropriate fire regimes (too frequent and broadscale), and increased frequency and intensity of bushfires. • Invasive and domestic species including predation by European red fox, cats, and wild dogs; herbivory and trampling by livestock; competition with feral pigs. • Invasive weeds. • Changing weather patterns including increasing drought, mean temperatures and decreasing precipitation. • Habitat loss, degradation and fragmentation including land clearing (from urban, residential and agricultural land development and change) causing habitat fragmentation, forest dieback caused by *Phytophthora cinnamomi* (root rot) or *Manorina melanophrys* (bell miner), and timber harvesting.	• Weed cover will be reduced to less than 5% cover while increasing native cover to ensure shelter requirements are maintained. • Cattle grazing will be phased out and ceased at end of Year 3 in regrowth and non-remnant areas. In ecologically sensitive areas, which include patches of Lowland Rainforest TEC, riparian vegetation corridors and remnant vegetation, cattle grazing will be phased out in Year 1, with fauna friendly exclusion fencing established to prevent access to these areas. • Unplanned bushfires will be managed to ensure that fire regimes are suitable for the species. • Predator control will be implemented to reduce abundance of pest animals to below the established baseline (including wild dogs, feral cats and European foxes) and reduce direct threats to long-nosed potoroo.

Relevant MNES	Key Threatening Processes for each MNES	Proposed management actions that address relevant literature
	• Predation and competition from native species including competition with overabundant native species for fungal food resources. • Disease including toxoplasmosis caused by *Toxoplasma gondii*.	
Yellow-bellied glider (southern subspecies) (*Petaurus australis australis*)	Conservation advice for this species (DAWE 2022c) identifies following as relevant key threatening processes: • Climate change • Altered fire regimes • Habitat clearing • Predation by invasive species • Mortality by barbed wire fencing • Habitat fragmentation • Timber harvesting.	• Unplanned bushfires will be managed to ensure that fire regimes are suitable for the species and their habitat. • Weed cover will be reduced to less than 5% cover. • Cattle grazing will be phased out and ceased at end of Year 3 in regrowth and non-remnant areas. In ecologically sensitive areas, which include patches of Lowland Rainforest TEC, riparian vegetation corridors and remnant vegetation, cattle grazing will be phased out in Year 1, with fauna friendly exclusion fencing established to prevent access to these areas. • Timber harvesting will be prohibited into the future which will increase foraging opportunities and denning opportunities. • Predator control will be implemented to reduce abundance of pest animals to below the established baseline (including feral cats and European foxes) and reduce threats to yellow-bellied glider. • Barbed wire fencing that exists within the offset will be removed, and any boundary barbed wire fencing will be removed where the adjoining landholder consents. • Revegetation will occur in Offset Area B to improve connectivity of habitats between non-remnant areas and remnant woodlands. • Supplementary hollows will increase denning opportunities for yellow-bellied glider in Offset Area B.

6.1 Offset Area A and B

The following management actions have been developed based upon the known threats of the MNES values discussed in this OAMP, and to ensure habitat quality gains are achieved. These topics are degrading processes and have the potential to result in a loss of MNES occurring within this local region over time.

6.1.1 Weed management

Management and reduction of weeds will be a key management action and a key focus to achieve habitat quality gains for all MNES within the offset areas. During surveys of the offset areas the following weed species were noted in high abundance and are considered to be a threat:

- lantana (*Lantana camara*)
- giant rat's tail grass (*Sporobolus pyramidalis*)
- Guinea grass (*Megathyrsus maximus*)
- balloon cottonbush (*Gomphocarpus physocarpus*)
- blue billygoat weed (*Ageratum houstonianum*)
- red natal grass (*Melinis repens*)
- thatch grass (*Hyparrhenia rufa* subsp*. rufa*)
- wild tobacco (*Solanum mauritianum*).

MHQA assessments found that regrowth and non-remnant areas were high in non-native plant cover with some locations having up to 95% weed cover.

Weedy Sporobolus Grasses (e.g. giant rat's tail grass (*Sporobolus pyramidalis*)) management in the pastoral areas is a key concern raised by the local stakeholders and environmental groups. These groups have noted the proliferation of these species not only as a result of poor grazing practices, but also following destocking of land if other controls are not established, which has occurred in the Borumba area. The proliferation of Weedy Sporobolus Grasses will have a significant impact on the effectiveness of the offset management in terms of cost and resources, and increase the risk that wide spread application of herbicides such as flupropanate poses to the local water catchment if this situation eventuates.

The most effective approach will be the maintaining and establishing native pastures, or revegetation/restoration; however, it will be a number of years before the open pasture areas are ready to be planted due to the need for detailed restoration planning, the need to prioritise restoration works in other higher areas (e.g. black-breasted button-quail habitat, glider and koala habitat areas etc.), and plan for the planting of the pasture areas. As such Queensland Hydro proposes an integrated management approach in the short term, such as slashing, fire, temporary cattle grazing, and spot spraying to manage Weedy Sporobolus Grass.

It is proposed that a comprehensive baseline weed survey will be completed in Year 1. This will confirm weed species distribution and abundance across the offset areas so that a reduction in weed species and weed cover can be tracked over the life of the offset. Large infestations will be mapped, and permanent photo monitoring points will be established at strategic locations including near access roads, riparian areas and other sensitive environments such as the Lowland Rainforest TEC and habitats for threatened flora.

Management outcomes for weed cover (regarding the specific reduction in cover being sought across the offset area) are prescribed in Section 6.1.4 for each 5-year interval. A more detailed Weed Management Plan (WMP) will be prepared after the baseline survey is completed. The WMP will set priority areas, target species and control methods to be used. The WMP should be reviewed annually to ensure it is adequately responding to results of monitoring and adaptive to site conditions. Weed management will be implemented by suitably qualified persons.

Triggers for corrective actions will be based on data collected during the baseline survey and include:

- new areas of weed outbreaks being identified (using distributions mapped during baseline surveys)
- weed abundance increasing from previous baseline surveys across HQ monitoring sites
- new weed species being identified.

Corrective actions to be implemented for weed control will include:

- altering weed management strategy to target problematic species and/or outbreaks

- increasing frequency of weed management events, which may include greater focus on areas showing increase in weed outbreaks
- review of hygiene protocols to ensure weeds are not being introduced and/or spread by vehicles, people, etc.
- changing weed control methods and evaluating if they are more effective in managing the particular weed species.

The weed management measures to be detailed in the WMP will be implemented across the offset areas to help ensure that interim milestones and final completion criteria can be achieved and habitat quality improved. These measures will align with those discussed in the Biosecurity Management Plan that Queensland Hydro has developed for the entire Borumba PHES Project due to proximity of the offset areas to the Project. To help prevent any additional weed infestations from becoming established within the offset areas, or spread of weeds, a weed control program (WCP) has been developed and is outlined in Table 25. This WCP aligns with the control strategies that will be implemented as part of the Project.

Table 25: Offset area weed control program

Control Action	Description	Timing
Comprehensive weed survey	To ensure that the current weeds within the offset areas have been identified and to ensure that they can be appropriately managed, a comprehensive weed survey will be conducted across the entire offset areas. This survey will be conducted by a suitably qualified bush regeneration contractor and/or suitably qualified ecologist and will follow the methodology outlined in the Field Manual for Surveying and Mapping Nationally Significant Weeds (McNaught et al. 2006). Whilst this survey will focus on the identification of all declared (restricted or prohibited) weed species under the *Biosecurity Act 2014* and/or Weeds of National Significance (WoNS), it will also focus on the detection of the following weed species identified as key threatening processes for MNES values above (Table 24): • lantana (*Lantana camara*) • cat's claw creeper (*Macfadyena unguis-cati).*	Year 1
Weed hygiene protocols	Queensland Hydro will implement weed hygiene protocols for the offset areas, including the movement of cattle from and around Offset Area B. No vehicle will be permitted to enter the offset areas unless it has had a washdown to remove any weed material or seeds. Vehicles will be required to stay on designated access tracks.	Ongoing
Establishment of a Weed Infestation Register	Following the completion of the comprehensive weed survey in Year 1, an active weed infestation register will be developed to help focus and track the progress of weed management activities across the offset areas. This weed register will be provided to any contractors brought in to manage weeds across the offset areas. This register will be updated every year and incorporated into the 5-yearly Monitoring Reports.	Year 1
Weed Monitoring	Every year, contractors undertaking weed control will advise on effectiveness of weed control methods (including cattle grazing) and Queensland Hydro will review and adapt the WMP if required. Weed monitoring will also occur as part of BioCondition assessments. This will assess non-native plant cover across the area, as well as record the presence of weed species observed. Weed monitoring surveys will be conducted annually for the first five years across the offset areas, focusing on areas previously identified in the weed register. New investigations will be documented and included in the weed register to help coordinate future management actions.	Years 1, 2, 3, 4 and 5 Years 10, 15, 20

Control Action	Description	Timing
	Weed monitoring will then go to every 5 years or as specified in the Restoration Plan.	
Weed control	Following weed monitoring and based on the weed infestation register and the habitat quality monitoring, areas with significant weed abundance will be targeted for weed control using the methods in Table 26 or other best practice methods deemed appropriate by the weed management contractor. Weed control works will be undertaken as a minimum quarterly for the first year, six monthly in years 2 and 3, yearly in years 4 and 5 and then as indicated by monitoring. Further detail in relation to weed control methods and frequency will be provided in a Restoration Plan to be developed in Year 1. Weeds will be controlled in a way that reduces the impact to MNES habitat.	Ongoing

Control of each weed species will be undertaken according to best practice methods by a qualified weed management contractor. Suggested methods for control for weeds recorded which could potentially impact MNES are listed in Table 26.

Table 26: Control methods for weeds that could potentially impact MNES

Weed	Qld Biosecurity Act Status	WoNS	Treatment method
Lantana (*Lantana camara*)	Restricted- Category 3	Yes	Foliar spray, cut-stump or mechanical removal
Guinea grass *(Megathyrsus maximus)*	Not prohibited or restricted	No	Foliar spray
Common pear *(Opuntia stricta)*	Restricted- Category 3	Yes	Cut-stump or basal bark
Crofton weed (*Ageratina adenophora)*	Not prohibited or restricted	No	Foliar spray, mechanical removal, cultivation and burn
Blue billygoat weed (Ageratum houstonianum)	Not prohibited or restricted	No	Foliar spray, mechanical removal
Mistflower (*Ageratina riparia*)	Not prohibited or restricted	No	Foliar spray, mechanical removal
Giant rat's tail grass (*Sporobolus pyramidalis*)	Restricted- Category 3	No	Foliar spray, mechanical removal and burn
Wild tobacco (*Solanum mauritianum*)	Not prohibited or restricted	No	Ringbark, mechanical removal, herbicide
Red natal grass (*Melinis repens*)	Not prohibited or restricted	No	Foliar spray, mechanical removal
Devil's fig (*Solanum torvum*)	Not prohibited or restricted	No	Cut and paint, foliar spray or basal bark
Noogoora burr (*Xanthium occidentale*)	Not prohibited or restricted	No	Foliar spray
Brazilian nightshade (*Solanum seaforthianum*)	Not prohibited or restricted	No	Mechanical removal, foliar spray
Balloon cottonbush (*Gomphocarpus physocarpus, G. fruticosus*)	Not prohibited or restricted	No	Mechanical removal, foliar spray, slashing
Cat's claw creeper (*Dolichandra unguis-cati*)	Restricted- Category 3	Yes	Cut, scrape and paint, foliar spray

Weed	Qld Biosecurity Act Status	WoNS	Treatment method
Praxelis (*Praxelis clematidea*)	Not prohibited or restricted	No	Foliar spray

In addition to the control actions outlined in the WCP, general hygiene protocols will be adopted across the offset areas. These hygiene protocols have been developed to reduce the likelihood that new restricted matters are not introduced into the offset areas, to reduce the likelihood that existing weed infestations are spread and to avoid the spread of myrtle rust between sites.

These hygiene protocols will be implemented for all plant and equipment brought to the offset areas, except where they have come from the active Borumba PHES Project area, and include:

- Washdown all vehicles/machinery prior to entry of the offset areas. Vehicles must retain a valid weed hygiene certificate whilst on site and provide it upon request. Vehicle washdown procedures have been outlined in Table 27.
- These weed hygiene protocols will be reviewed in accordance with Biosecurity Management Plan that is currently being updated for the Exploratory Works Project.
- All clothing, shoes and other equipment are to be cleaned regularly between activities, especially when leaving known weed or pathogen infested areas.

Table 27: Offset area weed hygiene measures

Procedure	Description
Pre-washdown	1. Position vehicle/equipment safely and ensure stability (i.e. brakes applied). 2. Remove excessive debris (i.e. mud, branches) for appropriate disposal using a dry cleaning method before wet where practicable (e.g. scrape off mud before pressure hose applied). 3. Detach removable items or parts and decontaminate individually (if practicable).
Decontamination of external surfaces	1. Start top-down of vehicle or equipment. 2. Wet decontamination procedure: apply disinfectant/detergent and leave for appropriate contact time (usually 10 minutes) then rinse with clean water. 3. If other techniques e.g. heat, fumigation for tools, equipment and other things are required, ensure exposure requirements are met as required by disease/pest guidelines.
Decontamination of internal surfaces	1. Only necessary if internal surfaces are exposed to potential contamination. 2. Protective covers (i.e. seat covers, dash covers) will be removed and cleaned or appropriately disposed of. 3. Remove solid materials with a vacuum, cloth or brush. 4. Air filters will be removed, replaced and cleaned (technician may be required). 5. Surfaces can be wiped or sprayed with 70% alcohol or another appropriate disinfectant.

6.1.2 Pest management

Pest animal management measures outlined in this section will be implemented across the offset areas to control pest animal populations, reduce degradation of ecosystems and habitat quality, and reduce predation on MNES species. These pest control measures will also be incorporated into the Biosecurity Management Plan that Queensland Hydro have developed for the entire Borumba PHES Project for greater effectiveness and coverage.

Several pest animal species have been recorded in the offset areas and local region. They include feral pigs (Photo 19), rabbits (*Oryctolagus cuniculus*), feral cats, feral horses (*Equus caballus*), deer and European foxes. These pest animals pose threats to the MNES species and communities through predation and habitat degradation.

It is known that feral pigs and deer occur throughout the local area including nearby Conondale National Park and are a threat to water quality and are potential disease carriers, especially of *Giardia*. Feral pigs are widespread in the National Park, transient and cause particular impacts at creek lines and wherever there are new earthworks.

Feral pigs refuge in wet areas during dry conditions, causing increased water turbidity and decreased water quality that impact on stream frogs and crayfish. Feral pigs are currently disrupting succession and regrowth of palms. Aerial and ground baiting, occasional trapping and photo monitoring occurs through a pest initiative project (DESI 2013). Feral cats are noted as widespread in the National Park, and foxes have also been recorded but numbers are unknown (DESI 2013), while wild dogs are a key concern for Somerset Regional Council biosecurity staff.

MNES species including long-nosed potoroo and black-breasted button-quail are particularly susceptible to predation from feral cats and European foxes. Greater gliders are also known to be predated on by feral cats (B. Nottidge pers. comm) as evidenced through a feral animal monitoring program in central Queensland.

Additional assessments of pest animals will be undertaken as part of a comprehensive baseline survey to be undertaken in year one. These pest animal surveys will form part of an ongoing monitoring program and will consist of surveys to assess the presence and abundance of pest animals within the offset area and provide a baseline level of activity in the offset that can be monitored and measured over time. With the aim to show that pest animal control is reducing pest animal populations. These surveys will aim to be undertaken in conjunction with surveys for the Exploratory Works Project, along with the adjacent protected estates.

Photo 19: Pest animals within the Offset Areas

Clockwise from top left – Pig damage adjacent to Lowland Rainforest TEC in Offset Area B, wild dog, red deer within riparian area RE 12.3.7 (Offset Area B), red deer in non-remnant area, feral pigs and pig damage within RE 12.3.7 (Offset Area B) and European red fox.

Pest animal controls will be undertaken in accordance with the *Biosecurity* Act 2014 and DPI guidelines and proposed management methods for target species are summarised in Table 28. The use of baits will be dependent on other monitoring programs for example baiting cannot overlap with any detection dog works.

Table 28: Pest control methods

Procedure	Description
Baseline survey	A baseline survey in year 1 will focus on the deployment of camera traps throughout the offset areas. Preliminary camera trap surveys have been completed to support MHQA scoring. It is proposed additional cameras are deployed across all offset areas in year 1 and spotlighting transects completed to develop a more comprehensive baseline number of pest animals for each AU. These surveys can then be repeated over duration of the management program to review effectiveness of pest control and measure pest animal number changes.
Feral pigs	Control of feral pigs can be undertaken using following methods. Where possible feral pig control would be undertaken in collaboration with neighbouring properties. Ground baiting • Using 1080 baits following at least three nights and up to two weeks of 'free-feeding' with unpoisoned bait material to attract animals. • HOGGONE meSN feral pig bait is currently available as a manufactured bait from Animal Control Technologies Australia – https://animalcontrol.com.au/products/hoggone. This product must be used in conjunction with the HogHopper bait delivery system. Shooting • Used opportunistically to follow up and maintain numbers after initial knockdown program. Should be conducted in the early morning, late evening and throughout the night when pigs are most active. Trapping • Used as a follow-up method after initial knockdown program and as a maintenance technique to prevent numbers from building back up quickly. Trap using a relatively small, enclosed area with a one-way gate.
European rabbits	It is recommended that an assessment of rabbit abundance and impact is undertaken to determine the appropriate level of management required. Impact of rabbits may be less than the impact of management actions. An integrated control approach, combining different control methods with land management practices is most effective. Suggested methods include: Warren ripping • Rip all warrens. Note that warren ripping is most appropriate in agricultural environments and may cause damage to native vegetation and native fauna using warrens for shelter. Fumigation may be used as an alternative where ripping is not suitable. Poison baiting • Using 1080-sodium fluoroacetate or Pindone in the non-breeding season and when food sources are low. Pre-feeding should be undertaken to accustom rabbits to the new food sources. Trapping • A mix of cage traps and barrel traps, followed by humanly euthanising. Traps will be put in place and left open for 2-3 days to allow rabbits to be accustomed to the trap before trapping begins. Shooting • A means to target remaining individuals following other control measures. Shooting is most effective when Rabbits are active (early morning, late afternoon or night).
Feral cats	Successful feral cat control requires multiple methods combined with land management practices. Suggested methods include: Trapping • Cage traps baited with meat or fish can be used.

Procedure	Description
	• True Feral cats may avoid cage traps using a visual stimulus as an attractant may be used if other control methods are ineffective. Shooting • Night shooting when cats are foraging. Poison baiting • Poisoning using fresh meat baits is known to have low uptake when using existing approved prescriptions due to degradation of the bait, removal of bait by non-target species and placement along tracks which cats tend not to use. 'Eradicat' baits deployed aerially have shown more effectiveness. • Queensland Hydro will investigate the potential to deploy some 'Felixers' which are being trialled for feral cat control across Australia. The Felixers are box-like units, which use lasers and cameras to distinguish feral cats or foxes from native animals by their shape and gait and then shoot eight milligrams of toxic gel onto the animal. The feral cat or fox then dies after licking itself to remove the toxic gel. The device has been approved by federal authorities for feral cat management across the country (ABC, 2023). A specific animal ethics permit will be required to deploy the units. Should units be deployed Queensland Hydro will report on their effectiveness in annual reporting and review their ongoing use by end of Year 5.
European red fox	Control methods should be determined depending on the local requirements and will likely include multiple control methods. It is recommended that fox baiting take place in conjunction with surrounding landholders to improve long term success. Suggested methods include: Poison baiting • 1080 and PAPP as fresh meat baits placed along tracks and fence lines, approximately 200-500 m apart and buried approximately 8-10 cm underground and covered with loose soil. • 1080 baiting may be continuous and ongoing in most programs targeting the conservation of native fauna. • Canid pest ejectors have also been shown to be effective for foxes. • Felixer devices have been shown to be effective for fox control as well as feral cats (CISS, 2021), deployment for feral cats will also contribute to fox control. Shooting • The success varies depending on the skill of the shooter and the wariness of foxes. Young unwary juveniles are most likely to be controlled and the technique may not reduce impacts on wildlife. Trapping • Predominantly used in urban areas where poisoning and shooting are restricted. Investigate use of new devices such as the Collarum or Ecotrap. Trapping is generally known to have low efficacy for broadscale reduction of fox populations and is labour intensive. • May be suitable for problem individuals.
Feral deer	Control methods should be determined depending on the local requirements and ideally would be part of a collaborative local scale control program to maximise chance of success. Shooting • Although time consuming and labour intensive, ground shooting is considered to be the most effective and humane technique currently available for reducing Feral deer populations. Shooting is usually done at night from a vehicle, with the aid of spotlights.
Wild dog	Control methods should be determined depending on the local requirements and ideally would be part of a collaborative local scale control program in conjunction with Gympie Regional Council to maximise chance of success. Gympie Regional Council can support landowners to conduct 1080 baiting programs for wild dogs. If there is a particular wild dog/s that have been observed during monitoring these may be targeted by an opportunistic shooting campaign in the particular area the dog/s are known to frequent. Shooting should be consistent with the National Standard Operating Procedure (NATSOP-DOG003). Shooting may also be conducted at select times each year to reduce wild dog numbers.

Procedure	Description
	Baiting • Lethal baiting is considered to be the most effective method of wild dog control currently available; however not all poisons are equally humane. • Poisoning using processed manufactured baits or fresh meat baits with 1080 or PAPP. • Baits may be selectively positioned to avoid killing non-target species, as ‘wild dogs' keen sense of smell enables them to find baits intentionally buried in sand or otherwise hidden. Baits may also be tied to prevent their loss to non-target species. • A full month is required to understand the effectiveness of the control. Those target species which avoid baits can be controlled through shooting as an additional response. • Baiting would also need consider the impact on detector dogs, with detector dogs to be used as part of the monitoring program.

6.1.3 Bushfire management

Bushfire management strategies will be implemented across the offset areas to manage fuel loads and reduce risk of hot bushfires occurring as these hot bushfires will impact on regeneration and restoration activities. The intent of fire management will be to ensure adequate infrastructure is in place, such as access tracks, fire breaks and firefighting resources, so that fire can be appropriately managed and fire regimes support and enhance biodiversity in the offset areas, whilst also keeping fuel loads at an appropriate level to not create a fire hazard for adjoining landowners or impact on any revegetation activities.

It is relevant to note that the offset areas are not currently subject to any form of prescribed burn, and there is no active management to prevent hot bushfires occurring in rainforest communities. There are no specific legislative obligations to undertake prescribed burns for ecological values. Furthermore, there are limited measures in place to control the risk of unplanned bushfires in the offset areas. Consequently, management of fire within the offset areas will go beyond what currently occurs and any relevant legislative obligations.

Management of fire in the offset areas (and surrounds on adjacent land owned by Queensland Hydro) will reduce the likelihood of threatened species mortality and habitat degradation due to uncontrolled and intense bushfire. Fire management will also be used as a method to control biomass of native and invasive species and will form part of an integrated management approach for key weed species.

Bushfire preventative measures will include:

- Educating employees and contractors on general fire awareness and response procedures.
- Creation and maintenance of access tracks and fire breaks for fire control where necessary.
- Monitoring of ground fuel loads to prevent accumulation of hazardous fuel loads over time. Reducing the fuel load will minimise the impact of uncontrolled fires (e.g. from lightning strike).
- When necessary, fuel management (e.g. hazard reduction burns prior to the dry season) will be undertaken in consultation with the Queensland Fire Department (QFD). Local fire wardens will be consulted, and fire permits will be obtained prior to hazard reduction burns.
- Mosaic burning for certain species at appropriate intervals to promote regeneration and germination of native vegetation communities and certain flora species will be undertaken.
- Any hazard reduction burns or ecological burns will be done in such a way that the Lowland Rainforest TEC patches, vine thickets, and 50 m buffers around them are not burnt. This will apply to buffer areas in control of Queensland Hydro. Fuel loads will be kept low in areas adjacent to vine thicket communities and the buffer including through undertaking controlled burns burning back from these areas.

Hot bushfires and inappropriate fire regimes are a recognised threat for a high number of MNES being offset. Lowland Rainforest TEC requires the exclusion of fire. For this reason, no controlled burns will occur in this TEC or vine thicket communities. To better protect these communities from bushfire, managing fuel loads and having appropriate fire breaks established in surrounding areas should be a key driver in management practices. Whilst the TEC and vine thickets will be avoided, the adjacent Eucalypt woodlands will be managed in order to slow fire velocity, reduce bushfire load connectivity and minimise bushfire incursion. The Lowland Rainforest TEC and vine thickets will not be burnt (or vegetation within 50 m of these communities on land owned by Queensland Hydro);

management of the surrounding landscape will allow for effective bushfire control without significantly altering these rainforest communities. Bushfire fuel load within these communities will be managed by weed control.

Eucalypt woodlands providing breeding and foraging habitat for species such as greater glider, yellow-bellied glider and koala require exclusion of hot bushfires but require burns at varying intervals and intensities to support various structural elements and regeneration. Glossy black-cockatoo habitat prefers more frequent burns to assist with regeneration of preferred foraging resources. Recommended fire intervals by DETSI for each RE type are summarised in Table 29.

A more detailed Bushfire Management Plan is to be prepared and will be consistent with the Restoration Plan. These two documents will contain some overlapping information, will need to be consistent, and together support restoration outcomes. The Bushfire Management Plan to be finalised by end of Year 1 will set out a proposed strategy to manage hot wildfires and more proactively undertake controlled burns for fuel reduction and to achieve biodiversity outcomes. Noting that a Bushfire Management Plan is currently being developed for land managed by Queensland Hydro.

The Bushfire Management Plan will support this OAMP and be developed in Year 1 in consultation with stakeholders such as neighbouring landholders, Kabi Kabi representatives, HQ Plantations, Seqwater, Queensland Parks & Wildlife Service (QPWS) and QFD. This will be an operational level document mapping out specific fire breaks, access tracks, assessing fuel loads and fire risk, identifying vegetation patches and proposed burn regimes, firefighting equipment and emergency responses and monitoring and reviews.

Low-intensity controlled burns will be utilised to help manage standing and accumulated fuel loads throughout the offset areas (excluding the Lowland Rainforest TEC, 50 m buffer from TEC on land managed by Queensland Hydro, and vine thickets). The need for these controlled burns will be determined by assessing the available fuel load and the vegetation community in question. Controlled burns will be carefully planned to avoid impacts to specific habitat features for listed MNES values, along with known threatened species populations and/or breeding places. This includes but not limited to, planning burns when native grasses are not seeding and ensuring that hollow bearing trees are not impacted.

Low-intensity controlled burns can also be used to effectively control weed infestations. These programs will ensure that a mosaic of grassy and shrubby understory species is maintained to promote regrowth of native species in these areas. Consideration will also be given to maintaining ground litter and fallen timber habitats by conducting these burns only when there is sufficient soil moisture. Burning will aim to produce fine scale mosaics of burnt and unburnt areas. Variability in season and fire intensity is important, as well as spot ignition in cooler or moister periods to encourage mosaics.

Table 29: Bushfire management guidelines for REs mapped within the offset area [DES, 2021]

Regional Ecosystem	Fire Management Guidelines
12.11.10	Do not burn deliberately. Fire exclusion.
12.11.11.	Do not burn deliberately. Fire exclusion.
12.11.14	SEASON: Summer to late-autumn. INTENSITY: Low. INTERVAL: 3-6 years. STRATEGY: Aim to burn 40-60% of any given area.
12.11.15	SEASON: Summer to winter. INTENSITY: Low to moderate. INTERVAL: 4-25 years. STRATEGY: Aim for 40-60% mosaic burn.
12.11.3/12.11.3a	SEASON: Summer to winter. INTENSITY: Plan for low to moderate. Unplanned occasional high intensity wildfire will occur. INTERVAL: 4-8 years maintains a healthy grassy system. 8-20 years for shrubby elements of understorey. STRATEGY: Aim for 40-60% mosaic burn.
12.11.9	SEASON: Summer to winter. INTENSITY: Plan for low to moderate. Unplanned occasional high intensity wildfire will occur. INTERVAL: 4-8 years maintains a healthy grassy system. 8-20 years for shrubby elements of understorey. STRATEGY: Aim for 40-60% mosaic burn.
12.12.15	SEASON: Summer to winter. a, b: Late summer to autumn. INTENSITY: Plan for low to moderate. Unplanned occasional high intensity wildfire will occur. a, b: Moderate to high. INTERVAL: 4-8 years maintains a healthy grassy system. 8-20 years for shrubby elements of understorey. a, b: Minimum 20 years, maximum unknown, requiring further research. Aim for 40-60% mosaic burn.

Regional Ecosystem	Fire Management Guidelines
12.12.16	Do not burn deliberately. Fire exclusion.
12.12.23	SEASON: Summer to winter. INTENSITY: Plan for low to moderate. Unplanned occasional high intensity wildfire will occur. INTERVAL: 4-8 years maintains a healthy grassy system. 8-20 years for shrubby elements of understorey. STRATEGY: Aim for 40-60% mosaic burn.
12.3.7	Avoid intentionally burning this fringe vegetation. Burn surrounding ecosystems in conditions that would minimise fire incursion.

6.1.4 Disease and pathogen management

It is critical that new or existing disease (such as myrtle rust, which is a key threat to scrub turpentine) and a threat to Lowland Rainforest TEC are not introduced and spread into unaffected areas, especially the transfer of disease from the Exploratory Works footprint into surrounding National Parks, State Forests and pastoral properties and offset areas.

Hygiene protocols will be implemented to reduce the likelihood of disease spread associated with Exploratory Works activities, including appropriate vehicle and machinery washdown procedures, regular cleaning and personal hygiene measures (i.e., clothing, shoes and other equipment regularly cleaned), training and inductions for contractors, and the potential to implement wet decontamination, heat and/or fumigation procedures and techniques as required.

As a minimum, the following hygiene protocols will be implemented across the offset areas to help avoid the spread of disease:

- All vehicles and machinery are to be washed down at an appropriate washdown facility regularly during works, especially when transferring between sites and when working in areas where weed infestations are known. A washdown bay will be provided on site and the location will be clearly identified for all personnel to use.
- All vehicles and machinery are to be certified weed free before commencing work on site (Weed Hygiene Declarations).
- All clothing, shoes and other equipment are to be cleaned regularly between activities, especially when leaving an area and starting work in a new area, and before leaving known weed infested areas.
- Soil, gravel or fill from infected areas should not be moved to uncontaminated areas, unless absolutely necessary.
- Appropriate waste disposal system: strategies or facilities to contain contaminated materials and disposal away from adjacent native vegetation and waterways.
- Training and inductions are to be provided for contractors and workers about the importance of pest, weed and disease control, including a briefing on appropriate hygiene measures.
- Decontamination practices will be implemented for all personnel upon entering the site, when working within a known contaminated area within the site, and prior to exiting the contaminated area. To reduce the transfer of weed vegetation, seed, mud or soil material, the following decontamination procedure at washdown bays is recommended:
  - Position vehicle/equipment safely and ensure stability (i.e. brakes applied).
  - Remove excessive debris (i.e. mud, branches) for appropriate disposal using a dry-cleaning method before wet where possible (e.g. scrape off mud before pressure hose applied).
  - Detach/removal items or parts and decontaminate individually as required.
  - Start top-down of vehicle or equipment.
  - Vehicles and equipment with moving parts (i.e. wheels, trays, buckets) will need to be removed to access all areas.
  - The use of a wet decontamination procedure may also be required, which involves the application of disinfectant/detergent and leave for appropriate contact time (usually 10 minutes) then rinse with clean water.
  - If other techniques (e.g. heat, fumigation for tools, equipment and other things) are required, ensure exposure requirements are met as required by disease/pest guidelines.

6.1.5 Grazing management

Offset Area A has historically been grazed. Livestock were recently (2024) removed from most of the land managed by Queensland Hydro, including Offset Area A, for safety reasons. The intent at this time is that livestock will continue to be excluded due to the proposed Exploratory Works and then Main Works projects.

Offset Area B has historically been logged and grazed and is currently utilised for cattle grazing under lease arrangements with the landholder, DLGWV. There is evidence of grazing impacts through trampling and soil compaction in some areas, decreased regeneration of tree species and shrubs, including under canopy, and a higher presence of non-native cover. To optimise the recruitment of tree species and establishment, and to achieve the interim performance targets and final completion criteria of ground layer species richness and cover, it is proposed that grazing be gradually excluded from the offset areas to assist the recovery and management of the various ecological communities, species and habitat. Gradual removal of stock while planning for long-term management has been shown to be effective in areas that have had long term grazing (Corangamite CMA, n.d), including the in the control of Weedy Sporobolus Grasses. Noting that there are limitations with grazing that need to be effectively managed.

A destocking and grazing strategy will be developed with the landholder/leaseholder to support destocking and grazing onsite, including minimising the spread of weed seed from dirty to clean areas, specific strategies for dealing with grazing in relation to drought, significant rainfall and natural regeneration of areas, and the process for destocking and excluding cattle from areas within Offset Area B. Further detail will also be included in the restoration plan.

It is proposed that grazing is completely excluded from ecologically sensitive areas in Offset Area B in the first year, which is estimated to be 60-85% of Offset Area B. This gives Queensland Hydro time to install the fauna-friendly temporary fencing from the date of commencement. Ecologically sensitive areas would include patches of Lowland Rainforest TEC, riparian vegetation corridors, and remnant vegetation (which provides habitat for MNES), and populations of threatened flora and fauna for whom cattle are a threat (e.g. brush sophora, black-breasted button-quail). Cattle would be excluded from these sensitive areas with temporary fencing that consists of solar powered electric tape strung between star pickets. Electric tape can be moved to avoid impacting native vegetation and can be easily adjusted to ensure ongoing protection of native vegetation and active restoration areas as they progress. It also enables native fauna, including MNES, to move around the site unaffected, as they can go under or over the tape.

For Offset Area B, a phased approach to the removal of cattle from existing open pastures (representing about 15% of Offset Area B) is recommended. This would involve retaining and managing livestock within the existing open pasture areas to assist the management of fuel loads, facilitate access into and around the site for restoration works and monitoring, and prevent the mass germination and growth of weeds such as Weedy Sporobolus Grasses, lantana, wild tobacco, and tall annuals, and greater volumes (density and height) of exotic grasses. It is very common in south east Queensland for there to be a significant increase in weeds post the removal of cattle, which was raised by local landholders and environmental groups, and this in turn increases the fuel loads, bushfire risk and threat to other ecosystems and areas on site, and the difficulty of site preparation (and cost) once it is time to plant.

It will be several years before the open pasture areas are ready to be planted due to the need for detailed restoration planning, the prioritisation of restoration works on other higher priority areas (e.g. black-breasted button-quail habitat, glider and koala habitat areas etc.), and plan for the planting of the pasture areas. To safely and efficiently move around the site (i.e. for restoration practitioners, pest animal management specialists and those carrying out fire management), Offset Area B will likely require:

- upgrades to some infrastructure such as tracks
- the possible installation of fencing to protect planted stock from impacts from deer (this will be further assessed during the restoration planning phase)
- the collection and propagation of genetically appropriate seed.

It should be noted that recent publications from CSIRO regarding the collection of seed for restoration projects, suggest seed should be collected across multiple years to ensure genetic diversity and greater resilience in a changing climate. If the pasture areas did not have cattle to assist in managing the open areas, subsequent restoration works and the management of the site becomes infinitely more difficult and expensive (with potential increased use of herbicides) and the risk to other more sensitive areas across the site (and landscape) increases.

As areas are prepared for plantings (revegetation) and/or restoration works commence, the cattle will be removed from these areas. For example, there will be no grazing in areas where tubestock have been planted to prevent them impacting on these trees. Grazing will be excluded from active restoration areas, area by area as the restoration works progresses, using solar powered electric tape. Allowing the use of grazing in these more cleared and highly disturbed paddocks is not expected to impact on MNES habitat or restoration works. The presence of cattle in these areas will assist in keeping fuel loads down and reduce the prevalence of weeds until Queensland Hydro have improved an area to a point where active restoration works can start, as time will be required initially to upgrade tracks, collect and propagate genetically appropriate seed, and prepare the ground for planting etc. This process would occur over the first three years, with all restoration works proposed to be underway by the end of Year 3, and by this time all cattle will have been completely removed from all areas of Offset Area B.

New fencing is not required for Offset Area A due to the removal of all livestock however, it is required adjacent to Offset Area B as grazing will be maintained in adjacent properties under lease arrangements. Existing and new fencing will be used to manage access to and demarcate areas within Offset Area B, including exclusion of livestock and deer. Existing tracks will be used to move livestock through the Offset Area B to other paddocks outside of the offset area. New fencing may be required to allow movement of stock through Offset Area B to ensure cattle do not stray from the existing tracks. If and where additional fencing is required to be installed, and temporary electric tape is not suitable, it should preferably be constructed of 1.4 m high, 4-strand plain wire, with the bottom wire set 350 mm from the ground to allow native wildlife access.

Any existing barbed wire fencing, subject approval from the adjacent landholders, will be removed in the first year of the offset management and replaced with wildlife friendly fencing. Alternatively, fencing may be made more visible for fauna to reduce the likelihood (e.g. tags, electric tape, flagging tape or poly-pipe) and or retro-fit the existing fence by replacing barb wire with plain wire (for livestock), on at least the top two strands and bottom strand. No barbed wire is to be used on site in order to protect native wildlife.

Monitoring of deer populations and the impacts of livestock grazing (including the effectiveness in managing Weedy Sporobolus Grasses) in the offset areas will likely be required and may warrant the installation of deer proof fencing and possibly tree guards to protect revegetation, along with the exclusion and destocking of livestock from areas.

6.1.6 Erosion and sediment control

Programmed baseline surveys will be used to identify areas of existing erosion or unstable soils. Depending on the outcome of these surveys, the following measures may be implemented:

- Access to sites for maintenance or monitoring may be limited during high rainfall events until deemed safe to access without causing excessive erosion and sediment mobilisation.
- Parts of the offset areas are on steep and sloping ground, consequently the approach to restoration and planting will need to take into account the possibility of sheet flows in the event of significant rainfall events.
- Vehicles to be restricted to established access routes or defined access points (i.e. no new access tracks or points to be established for implementation or monitoring). Where necessary, entry points and access tracks needed for site management shall be gate locked or have a suitable barrier installed. Review of access track requirement is to be undertaken with progressive closure and rehabilitation of access tracks to occur.
- Erosion control installed if evidence of soil loss or sedimentation of downstream waterways is identified. Any installed erosion control measures are to be maintained as needed. Consideration will be given to the measures contained within the Preliminary Erosion and Sediment Control Plan for the Exploratory Works Project.
- A photo point will be established to monitoring existing erosion identified on site and where applicable the effectiveness of any controls.

6.2 Restoration management zones

Restoration of remnant, regrowth and non-remnant areas will be categorised into six zones based on BioCondition scoring, ground-truthed conditions, and management approaches needed. Each zone will have tailored management actions, with the objective of achieving the habitat quality gains listed in Table 18 and Table 20 within 20 years. The management zones and locations will be refined as part of preparing the Offset Restoration Plan in Year 1. Figure 9 shows the indicative locations of the zones within Offset Areas A and B but these may be adjusted once a qualified restoration ecologist has completed supplementary on-ground surveys to determine more site-specific management actions.

6.2.1 Management Zone 1 – Reintroduction

Management Zone 1 consists of non-remnant areas that have been cleared for grazing or timber production. They generally have little to no canopy but may contain some scattered remnant trees or regrowth of characteristic canopy trees. Restoration is likely to include large scale planting according to pre-existing REs.

The planting design and numbers required per hectare will be determined during the restoration planning stage and are influenced by the pre-existing RE and landscape's capacity for recovery; providing habitat attributes that are needed for target species and land stability.

Cattle grazing will likely continue in these areas within Offset Area B until Year 3, with further information outlined in Section 6.1.5.

6.2.2 Management Zone 2 – Combined regeneration and reintroduction

In Management Zone 2, regeneration activities will occur in areas where existing native vegetation is present (as regrowth or remnant trees) and planting will be undertaken in more open areas where the seed bank may be limited. Species selection and density will be based on the pre-existing RE, level of resilience (capacity for recovery), likely trajectory, and neighbouring vegetation (and its ability to expand). Plantings will speed up habitat quality improvements and provide improvements in soil health and protection.

Cattle grazing will likely continue in these areas within Offset Area B until Year 3, with further information outlined in Section 6.1.5.

6.2.3 Management Zone 3 – Facilitated natural regeneration (regrowth)

In Management Zone 3 there is high quality, more advanced regrowth, which has more consistent cover but may still have areas that may benefit from supplementary plantings in small areas. These areas may have significant weed infestations and will require more consistent weed control and monitoring. Annual monitoring post weed control (primary, follow up and maintenance) will assist determining if additional planting is required.

Cattle grazing will likely continue in these areas within Offset Area B until Year 3, with further information outlined in Section 6.1.5.

6.2.4 Management Zone 4 – Facilitated natural regeneration (low quality remnant)

Management Zone 4 consists of remnant vegetation that has some level of disturbance and weed infestation. These areas may have the canopy cover and height requirements to meet remnant status but have low habitat quality due to weed abundance, low richness, low recruitment, and/or low cover due to fire history, grazing, pests (deer, pigs etc.) or weeds. Some supplementary reintroduction of certain plant species (e.g. koala foraging species) may be required in some areas. This will be determined following initial management actions and follow up and weed control maintenance (approximately 5-7 years post initial work). It is likely that more significant management (fire, pest, weed etc) is required in these areas compared to Zone 5. Cattle grazing will also be excluded from these areas in Year 1.

6.2.5 Management Zone 5 – Spontaneous and facilitated natural regeneration (high quality remnant)

Management Zone 5 consists of patches of high quality remnant vegetation usually within or connected to large patches of other remnant vegetation. These areas have little to no disturbance so currently have high habitat quality scores. These areas will have less frequent management and monitoring and are likely to require some localised pest, weed and fire management. Cattle grazing will also be excluded from these areas in Year 1.

6.2.6 Management Zone 6 – Vine thickets including lowland rainforest

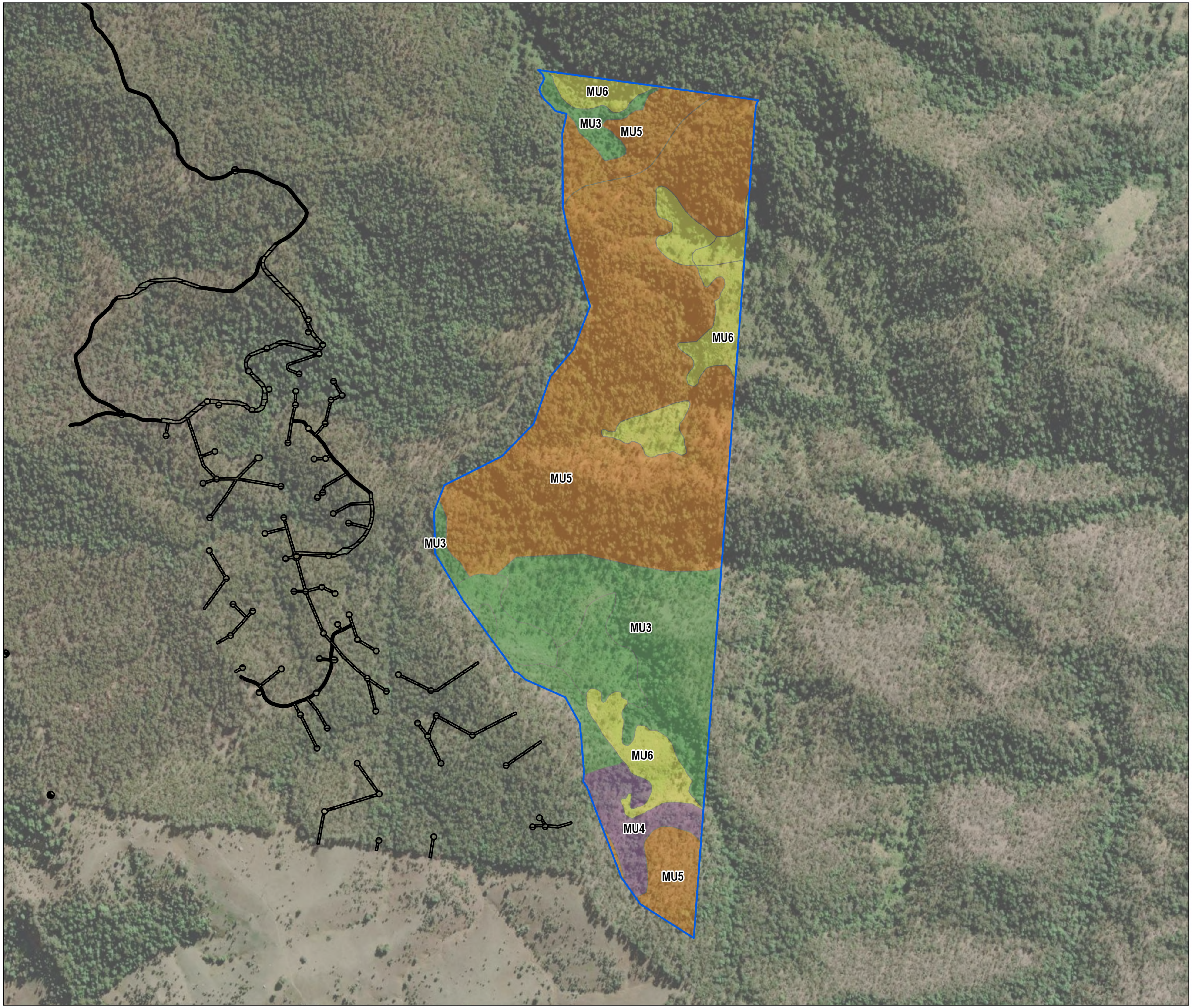
Management Zone 6 includes all areas of lowland rainforest (TEC) and vine thicket. These zones will require a combination of restoration techniques (reintroduction, facilitated natural regeneration, or spontaneous regeneration) depending on the quality of vegetation and existing disturbances but will require additional protection from fire, weeds and pests. This may involve additional management of fuel loads or weeds in adjacent vegetation to act as a buffer for the patches or more specialised weed management techniques to ensure habitat for threatened plants and fauna is more carefully managed. Cattle grazing will also be excluded from these areas in Year 1. Each patch in this zone will be assessed individually and a customised plan for each one will be included in the Offset Restoration Plan.

6.2.7 Management and schedule

The works described in Section 6.2 will be detailed in the Offset Restoration Plan, which will be prepared in Year 1 of OAMP implementation. This plan will include:

- confirmation and mapping of the management zones
- the restoration approach(es) required for the different management zones
- whether reintroduction (planting) is needed and/or when and where any supplementary planting might be required if recovery does not occur
- the model of planting to suit an area / zone and goals for that area including spacing between plants, species, extras (e.g. plant guards, mulch vs jute mat squares)
- species that need to be planted (e.g. in some circumstances, pioneer and early secondary stage species may be all that is required if adjacent to remnant as other more mature phase species may move in over time)
- details for plantings including the time of year, which will be influenced by a range of factors including whether it is an El Niño and La Niña year, planting densities, planting species, soil preparation, and watering and maintenance regimes
- details of seed collection requirements if required to ensure genetic resilience
- role of fire in management and the overlaps with the Bushfire Management Plan
- approach to grazing phase out including densities of cattle, locations of temporary fencing, areas requiring complete exclusion
- monitoring and control schedules
- responsible personnel.

The Offset Restoration Plan will be developed by a suitably qualified and experienced restoration ecologist.



Queensland Hydro

GDA2020 MGA Zone 56

N

0 260 m

1:10,000 @ A3

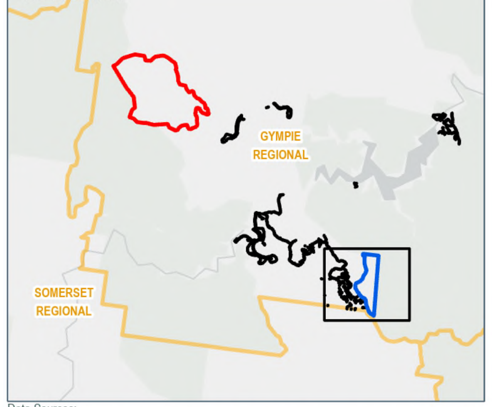
LEGEND

- Offset Area A
- Exploratory Works Project Footprint (EPBC Only)

Management Units

- MU3
- MU4
- MU5
- MU6

KEY MAP



Data Sources:
Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar
Local government area; Roads and tracks: © State of Queensland (Department of Resources) 2025
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019

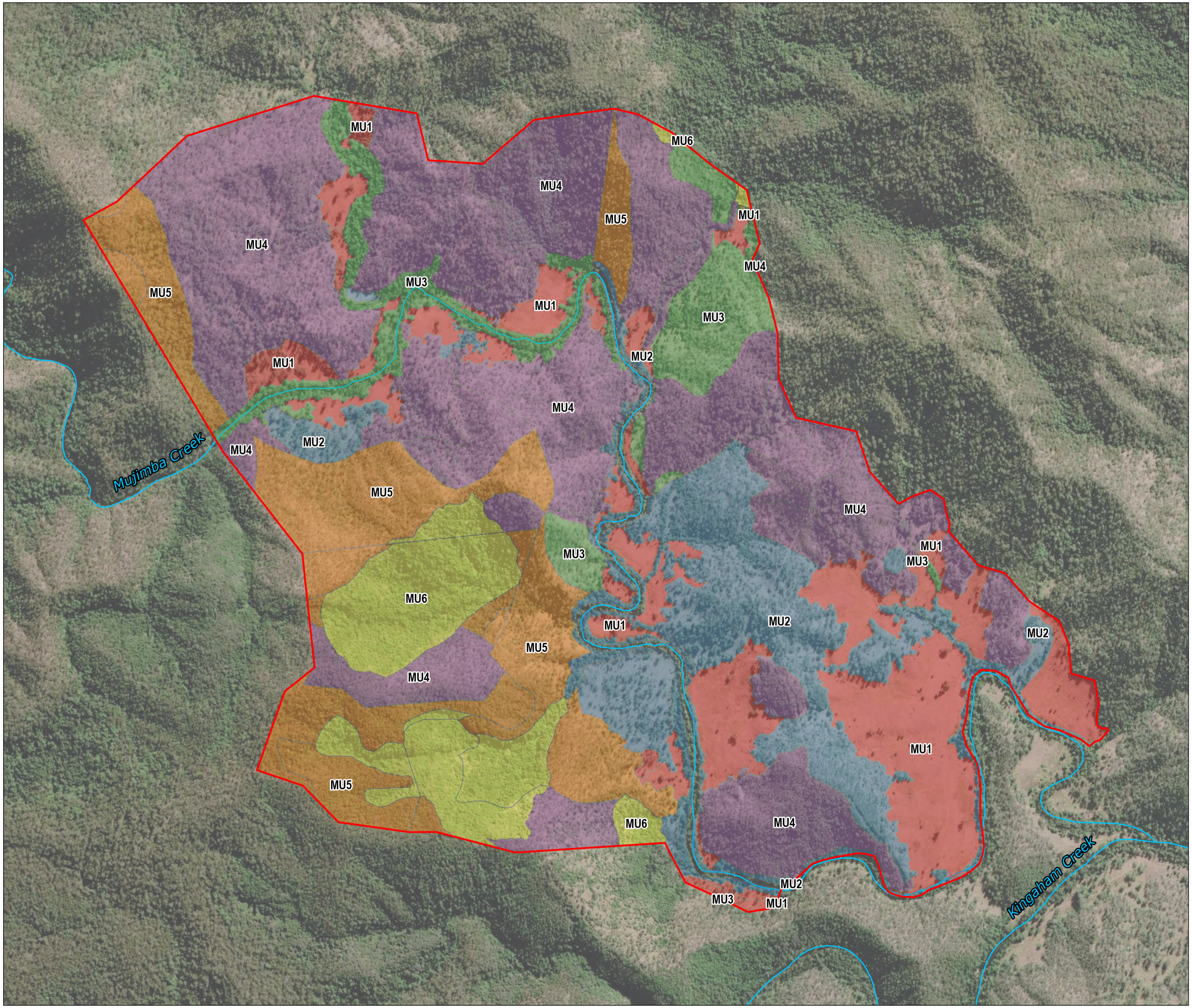
Borumba PHES Project
Offset Area Management Plan

RESTORATION AND IMPROVEMENT AREAS

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	28/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 9-A

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 9



Queensland Hydro

GDA2020 MGA Zone 56

N

0 340 m

1:13,000 @ A3

LEGEND

Offset Area B

Watercourse [defined by Water Act 2000]

Management Units

MU1

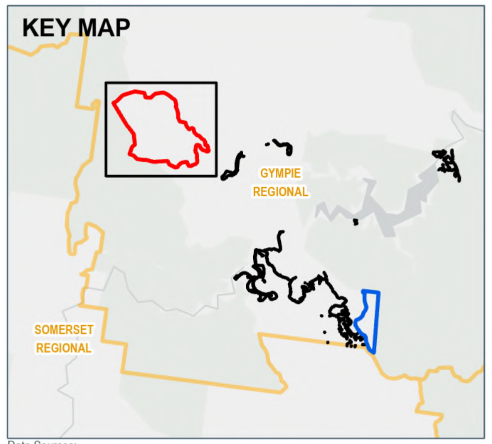
MU2

MU3

MU4

MU5

MU6



Data Sources:
Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar
Local government area; Roads and tracks: © State of Queensland (Department of Resources) 2025
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019

Borumba PHES Project
Offset Area Management Plan

RESTORATION AND IMPROVEMENT AREAS

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	28/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE 9-B

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\Figure 9

6.3 MNES specific management actions and performance outcomes

The following sections summarise how the management measures outlined above achieve species outcomes for each MNES and identify MNES specific management actions that will address known threats and support achieving the interim and final performance outcomes and habitat quality scores (Table 42 and Table 43).

6.3.1 Lowland Rainforest TEC

Specific management actions that will be implemented within the offset areas to protect and enhance the Lowland Rainforest TEC, and address known threats, are listed in Table 30.

Table 30: Species specific management actions: Lowland Rainforest TEC

Threat	Performance Outcome	Management Actions
Fragmentation	• Improvement in overall habitat quality of Lowland Rainforest TEC and 50 m buffer areas (where situated in the offset area). • Limited vegetation clearing will be allowable for maintenance of access roads and fire breaks. However, no clearing will occur for fire management or access in Lowland Rainforest TEC or 50 m buffer to same. • Improvement in connectivity of Lowland Rainforest TEC patches.	• Grazing will be excluded from Lowland Rainforest TEC in Year 1. • Native forestry will be prohibited in the offset area. • Limited vegetation clearing will be allowable for maintenance of access roads and fire breaks. No clearing will occur for fire management or access in Lowland Rainforest TEC and where possible the 50 m buffer. • Native vegetation within 50 m of the Lowland Rainforest TEC will be managed as part of the offset proposal with the aim to improve habitat quality. • Weed control will occur throughout the whole offset area and 50 m buffer from the TEC (where buffer is on land managed by Queensland Hydro). • Manage natural regeneration of regrowth Lowland Rainforest TEC so they meet threshold criteria, and in turn will improve connectivity between TEC patches.
Bushfire	• Controlled burns are excluded from Lowland Rainforest TEC and 50 m buffers. Bushfire can be managed across the offset and land owned by Queensland Hydro.	• Manage fuel loads through weed management in TEC patches. • Maintain access tracks and fire breaks to reduce likelihood of wildfires occurring. • Manage fuel loads in surrounding areas to the TEC through measures summarised in Section 6.1.3. • Exclusion of fire from Lowland Rainforest TEC and 50 m buffers. Fire can be managed in buffer areas where the land is owned or managed by Queensland Hydro.
Weeds	• Reduction of weed cover.	• Undertake weed control to reduce weed cover to less than 5% cover across the offset areas. Target weed species will include lantana, Cats claw creeper, Gomphocarpus physocarpus which are most damaging to the TEC.

6.3.2 Glossy black-cockatoo

Species specific management actions that will be implemented within the offset areas to protect and enhance glossy black-cockatoo habitat are listed in Table 31.

Table 31: Species specific management actions: glossy black-cockatoo

Threat	Performance Outcome	Management Actions
Habitat loss, degradation and fragmentation	• Overall improvement in glossy black-cockatoo habitat quality. • Increase in number of large trees. • Increase in available denning resources. • Increase in glossy black-cockatoo habitat through restoration of eucalypt woodlands and preferred foraging resources.	• Prohibit timber harvesting and any future clearing unless expressly authorised by OAMP (such as for access track maintenance and fire breaks). • Exclusion of grazing from ecologically sensitive areas, including remnant vegetation, in Year 1 and other parts of Offset Area B by end of Year 3 to improve natural regeneration and ensure restoration activities are effective. • Reduction in non-native plant cover. Invasive weeds can change the floristic and structural characteristics of habitat, thereby changing resource availability (French & Zubovic 1997). Furthermore, some weeds may increase the flammability of the habitat, amplifying wildfire risks (DCCEEW 2022b). • Existing hollow-bearing trees will be retained across the offset areas and new hollows will continue to develop naturally. Bushfire including fuel loads will be managed to minimise risk of a hot bushfire occurring that can threaten existing hollow-bearing trees and kill younger trees still to form hollows. • Increasing the large tree density to more than 50% of the benchmark at all remnant and regrowth sites and more than baseline score at all non-remnant sites. This will increase nesting opportunities for glossy black-cockatoos into the future. • 153 ha in Offset Area B and 13 ha in Offset Area A of regrowth vegetation in non-remnant areas will be prevented from being cleared and actively managed to allow it to further develop large trees and form hollows. These areas will also provide important foraging resources and connectivity to other remnant tracts of habitat. • 89.1 ha of habitat will be revegetated. This will include revegetation with preferred foraging resources such as *Allocasuarina* and *Casuarina* species. Preferred foraging species for the local area will be noted and included in plantings. • Supplementary hollows will be installed in areas with a low density of hollows or areas with no hollows. Refer to Section 6.3.9. • Increase in cover of foraging trees species to at least 5% of the cover in relevant Assessment Units.

Threat	Performance Outcome	Management Actions
Wildfires and inappropriate fire management regimes	• Hot bushfires are prevented. Appropriate fire regimes and intervals are implemented to increase foraging resources and protect denning resources.	• Wildfire is a major on-going threat for glossy black-cockatoos, which could affect both their habitats and the birds directly. Burning of fire-sensitive tree species (e.g., *Allocasuarina littoralis* and *A. torulosa*) may render feeding habitat unsuitable for a long time (Garnett & Crowley 2000; Garnett et al. 2011). • An appropriate fire regime that will manage fuel loads and maintain fire breaks to reduce hot wildfires occurring will be implemented. Also fire regimes that encourage regeneration of foraging resources will be implemented through cooler, mosaic burns. Ensuring a diversity of age classes within foraging habitat is important. As such, fire management, including the frequency and timing of planned burning, should consider and incorporate each specific region's ecological requirements (DCCEEW 2022b).
Grazing and invasive weeds	• Decrease in non-native cover. • Increase in native species recruitment. • Increased abundance of preferred foraging resources.	• Reducing weed cover to less than 5% cover at all monitoring sites. • Exclusion of grazing from ecologically sensitive areas in Year 1 and other parts of Offset Area B by end of Year 3. Fencing will be in place to ensure livestock in adjoining land are excluded from the offset areas. • Through phased removal of grazing pressure native species recruitment will increase, and in turn an increase in foraging resources.
Mortality and injury from pest animals	• Reduction in feral cat and European fox populations.	• Feral cats and foxes (known predators) will be actively controlled across the offset areas via a combination of management techniques (Section 6.1.2) reducing predation pressure. • Reduce feral cat and European fox populations to below the baseline.

6.3.3 Greater glider

Species specific management actions that will be implemented within the offset areas to protect and enhance greater glider habitat are listed in Table 32.

Table 32: Species specific management actions: greater glider

Threat	Performance Outcome	Management Actions
Habitat loss and fragmentation	• Overall improvement in greater glider habitat quality. • Increase in number of large trees. • Increase in available denning resources. • Increase in greater glider habitat through restoration of eucalypt woodlands	• Exclusion of grazing from ecologically sensitive areas, including remnant vegetation, in Year 1 and other parts of Offset Area B by end of Year 3 to improve natural regeneration and ensure restoration activities are effective. • Reduction in non-native plant cover, including vines such as cat's claw creeper which have potential to degrade tree canopies and restrict glider movement. • Existing hollow-bearing trees will be retained across the offset area and new hollows will continue to develop naturally. Bushfire including fuel loads will be managed to minimise risk of a hot bushfire occurring that can

Threat	Performance Outcome	Management Actions
		threaten existing hollow-bearing trees and kill younger trees still to form hollows. • Increasing the large tree density to more than 50% of the benchmark at all remnant and regrowth sites and more than baseline score at all non-remnant sites. This will increase denning opportunities for greater glider into the future. • 153 ha in Offset Area B and 13 ha in Offset Area A of regrowth vegetation in State mapped non-remnant areas will be prevented from being cleared and actively managed to allow it to further develop large trees and form hollows. These areas will also provide important foraging resources and connectivity to other remnant tracts of habitat. • 89.1 ha of habitat will be restored using reintroduction techniques. This will include planting with preferred foraging resources such as Eucalyptus species. Preferred foraging species for the local area will be noted and included in plantings. • Supplementary hollows will be installed in areas with a low density of hollows or areas with no hollows. Refer to Section 6.3.9.
Mortality and injury from pest animals	• Reduction in feral cat and fox populations.	• Feral cats and foxes (a known predator) will be actively controlled across the offset areas via a combination of management techniques (Section 6.1.2) reducing predation pressure. • Reduce feral cat and European fox populations to below the established baseline.
Mortality and injury from wildfire	• Reduce frequency and intensity of fires within greater glider habitat. • Increased survival of greater glider post fire events.	• Weed control will be undertaken across all offset areas, and fuel/biomass control will be undertaken in all areas (except >50 m outside of Lowland Rainforest TEC and in vine thicket communities), to reduce fuel loads and risk of high intensity to catastrophic fires. Further, these measures will be designed to ensure they do not have negative impacts on other habitat features such as regeneration. Hazard reduction burns and/or cool burns will be undertaken in consultation with the Queensland Rural Fire Service to further reduce this risk. • These measures will provide an increased level of protection for the greater glider reducing the risk of both mortality and habitat loss because of fire. This will provide benefits for local populations as well the regional population through ensuring an available source population should fires have detrimental impact on regional populations. • Through the protection and active management of offset areas, including increasing size of vegetation patches and connectivity to riparian communities and moister gullies, this will provide refuge to great gliders in times of bushfire.
Mortality and injury from collision with barbed wire fencing	• Reduced threat from barbed wire fencing.	• Over course of Year 1 any existing barbed wire inside the offset area will be removed and replaced with wildlife friendly fencing. Boundary barbed wire fencing will be removed where adjoining landholder consents to this occurring.

6.3.4 Yellow-bellied glider

Species specific management actions that will be implemented within the offset area to protect and enhance yellow-bellied glider habitat are listed in Table 33.

Table 33: Species specific management actions: yellow-bellied glider

Threat	Performance Outcome	Management Actions
Habitat loss and fragmentation	• Overall improvement in yellow-bellied glider habitat quality. • Increase in number of large trees. • Increase in available denning resources. • Increase in yellow-bellied glider habitat through restoration of eucalypt woodlands.	• Exclusion of grazing from ecologically sensitive areas, including remnant vegetation, in Year 1 and other parts of Offset Area B by end of Year 3 to improve natural regeneration and ensure restoration activities are effective. • Reduction in non-native plant cover, including vines such as cat's claw creeper which have potential to degrade tree canopies and restrict glider movement. • Existing hollow-bearing trees will be retained across the offset area and new hollows will continue to develop naturally. • Bushfire including fuel loads will be managed to minimise risk of a hot bushfire occurring that can threaten existing hollow-bearing trees and kill younger trees still to form hollows. • Increasing the large tree density to more than 50% of the benchmark at all remnant and regrowth sites and more than baseline score at all non-remnant sites. This will increase nesting opportunities for glossy black-cockatoos into the future. • 153 ha in Offset Area B and 13 ha in Offset Area A of regrowth vegetation in State mapped non-remnant areas will be prevented from being cleared and actively managed to allow it to further develop large trees and form hollows. These areas will also provide important foraging resources and connectivity to other remnant tracts of habitat. • 89.1 ha of habitat will be restored using reintroduction techniques. This will include revegetation with preferred foraging resources such as Eucalyptus species. Preferred foraging species for the local area will be noted and included in plantings. • Supplementary hollows will be installed in areas with a low density of hollows or areas with no hollows. Refer to Section 6.3.9.
Mortality and injury from pest animals	• Reduction in feral cat populations.	• Feral cats (a known predator of greater glider and likely predator for yellow-bellied glider) will be actively controlled across the offset areas via a combination of management techniques (Section 6.1.2) reducing predation pressure. • Reduce feral cat and European fox numbers to below the established baseline for two monitoring sessions.
Mortality and injury from wildfire	• Reduce frequency and intensity of fires within yellow-bellied glider habitat. • Increased survival of yellow-bellied glider post fire events.	• Weed control will be undertaken across all the offset areas, and fuel/biomass control will be undertaken in areas outside of Lowland Rainforest TEC and vine thicket communities, to reduce fuel loads and risk of high intensity to catastrophic fires. • Further, these measures will be designed to ensure they do not have negative impacts on other habitat features such as regeneration. Hazard reduction burns and/or cool burns will be undertaken in consultation with the Queensland Rural Fire Service to further reduce this risk.

Threat	Performance Outcome	Management Actions
		• These measures will provide an increased level of protection for the yellow-bellied glider reducing the risk of both mortality and habitat loss because of fire. This will provide benefits for local populations as well the regional population through ensuring an available source population should fires have detrimental impact on regional populations. • Through the protection and active management of offset areas, including increasing size of vegetation patches and connectivity to riparian communities and moister gullies, this will provide refuge to great gliders in times of bushfire.
Mortality and injury from collision with barbed wire fencing	• Reduced threat from barbed wire fencing.	• Over the course of Year 1 any existing barbed wire inside the offset area will be removed and replaced with wildlife friendly fencing (plain wire for at least the top two and bottom two strands). Boundary barbed wire fencing will be removed where adjoining landholder consents to this occurring.

6.3.5 Black-breasted button-quail

Species specific management actions that will be implemented within the offset areas to protect and enhance black-breasted button-quail habitat are listed in Table 34.

Table 34: Species specific management actions: black-breasted button-quail

Threat	Performance Outcome	Management Actions
Habitat loss and fragmentation	• Overall improvement in black-breasted button-quail habitat quality. • Reduction in weed cover. • Increase in native shrub cover.	• Exclusion of grazing from ecologically sensitive areas, including remnant vegetation, in Year 1 and other parts of Offset Area B by end of Year 3 to improve natural regeneration and ensure restoration activities are effective. • Reduction in non-native plant cover to less than 5% cover, including lantana while also increasing native shrub cover so that sheltering opportunities are maintained. • Bushfire including fuel loads will be managed to minimise risk of a hot bushfire occurring that can threaten habitat and reduce cover.
Mortality and injury from pest animals	• Reduction in feral cat, feral pig and European red fox populations.	• Feral cats, pigs and foxes will be actively controlled across the offset areas via a combination of management techniques (Section 6.1.2) reducing predation pressure. • Reduce feral cat and European fox to below the baseline.
Mortality and injury from wildfire	• Reduce frequency and intensity of fires within black-breasted button-quail habitat.	• The black-breasted button-quail is sensitive to wildfire as too frequent fire eliminates shrubby understorey and reduces foraging opportunities. Fire will be generally excluded from this species habitats and 50 m buffer to retain leaf litter depths. Fire can be managed in buffer zones where the land is owned by Queensland Hydro. • Manage fuel loads through weed management in Lowland Rainforest TEC and vine thicket patches. • Maintain access tracks and fire breaks to reduce likelihood of wildfires occurring. • Manage fuel loads in surrounding areas to these habitats through measures summarised in Section 6.1.3.

Threat	Performance Outcome	Management Actions
Vehicle strike	• Avoid and minimise vehicle strike on black-breasted button-quail.	• Vehicle speed will be restricted in the offset areas to 60 km/hr. Signage will be installed at key intervals on access tracks to remind drivers to be alert and maintain slow speeds. Vehicle usage of the offset areas will be low and restricted to personnel involved in land management and/or monitoring. • Queensland Hydro will investigate an ability to install black-breasted button-quail signage on local roads providing access as well as reduce vehicle speeds in identified 'hot spots'.
Grazing	• Remove grazing from suitable habitat.	• Exclusion of grazing from ecologically sensitive areas, including remnant vegetation, in Year 1 and other parts of Offset Area B by end of Year 3 to improve natural regeneration and ensure restoration activities are effective.

6.3.6 Long-nosed potoroo

Species specific management actions that will be implemented within the offset area to protect and enhance long-nosed potoroo habitat are listed in Table 35.

Table 35: Species specific management actions: long-nosed potoroo

Threat	Performance Outcome	Management Actions
Habitat loss and fragmentation	• Overall improvement in long-nosed potoroo habitat quality. • Reduction in weed cover. • Increase in native shrub cover.	• Exclusion of grazing from ecologically sensitive areas, including remnant vegetation, in Year 1 and other parts of Offset Area B by end of Year 3 to improve natural regeneration and ensure restoration activities are effective. • Reduction in non-native plant cover, including lantana while also increasing native shrub cover so that sheltering opportunities are maintained. • Bushfire including fuel loads will be managed to minimise risk of a hot bushfire occurring that can threaten habitat and reduce cover.
Mortality and injury from pest animals	• Reduction in feral cat, feral pig and European red fox populations.	• Feral cats and foxes will be actively controlled across the offset areas via a combination of management techniques reducing predation pressure. • Predator control will be implemented to reduce abundance of pest animals to below the established baseline
Mortality and injury from wildfire	• Reduce frequency and intensity of fires within long-nosed potoroo habitat.	• The long-nosed potoroo is sensitive to wildfire as too frequent fire eliminates shrubby understorey and reduces protection from predators. Fire frequency will be managed in suitable habitats for this species in order to manage leaf litter depths. • For habitats associated with vine thickets fire will be excluded from the habitat to retain leaf litter and shrubby understorey. Land within 50 m of the vine thicket community will also be excluded from controlled burns to maintain native vegetation cover where it exists in the buffer. Where the buffer is vegetated fuel load will be reduced through weed

Threat	Performance Outcome	Management Actions
		removal to minimise fire impacting on long-nosed potoroo habitat. • Manage fuel loads through weed management in Lowland Rainforest TEC and vine thicket patches. • Maintain access tracks and fire breaks in Eucalypt forests to reduce likelihood of wildfires occurring. Manage fuel loads in surrounding areas to these habitats through measures summarised in Section 6.1.3.
Vehicle strike	• Avoid and minimise vehicle strike on long-nosed potoroo.	• Vehicle speed will be restricted in the offset areas to 60 km/hr. Signage will be installed at key intervals on access tracks to remind drivers to be alert and maintain slow speeds. Vehicle usage of the offset areas will be low and restricted to personnel involved in land management and/or monitoring. • Queensland Hydro will investigate an ability to install long-nosed potoroo signage on local roads which provided access as well as reduce vehicle speeds in identified 'hot spots'.
Grazing	• Remove grazing from suitable habitat.	• Exclusion of grazing from ecologically sensitive areas, including remnant vegetation, in Year 1 and other parts of Offset Area B by end of Year 3 to improve natural regeneration and ensure restoration activities are effective.

6.3.7 Koala

Species specific management actions that will be implemented within the offset areas to protect and enhance koala habitat are listed in Table 36.

Table 36: Species specific management actions: koala

Threat	Performance Outcome	Management Actions
Habitat loss and fragmentation	• Overall improvement in habitat quality. • Increase in koala habitat extent – including increase in number of locally important koala food trees. • Increase in koala connectivity through landscape.	• Exclusion of grazing from ecologically sensitive areas, including remnant vegetation, in Year 1 and other parts of Offset Area B by end of Year 3 to improve natural regeneration and ensure restoration activities are effective. • Reduction in non-native plant cover, including lantana, which has potential to restrict koala movement. • Revegetate 89.1 ha of koala habitat with locally important koala food trees and native vegetation endemic to the offset areas. • Through growth of regrowth vegetation and revegetation of eucalypts over time these areas will become koala foraging resources and improve connectivity, allowing for safe movement for koalas through the offset areas to adjacent connecting vegetation.
Climate change and drought	• Providing refuge habitat for koalas. • Reduce frequency and intensity of fires within koala habitat.	• Drought and incidences of extreme heat are identified as a threat to the koala and may cause significant mortality in populations (DAWE 2022a). Seabrook et al (2011) identified that drought significantly reduced populations in south-east Queensland and koalas contracted to critical riparian habitats.

Threat	Performance Outcome	Management Actions
	• Increased survival of koalas post fire events.	• Through the protection and active management of offset areas, including increasing size of vegetation patches and connectivity to riparian communities and moister gullies, this will provide refuge to koalas in times of drought or bushfire. • Fuel loads and fire management regimes will be managed appropriately to prevent hot bushfires occurring. Fire breaks and fire access tracks will be maintained.
Mortality and injury from wildfires	• Hot wildfires are prevented.	• Climate change and resultant increased risk of fire is identified as an increasing threat to the koala, resulting in mortality and range reductions (DAWE 2022a). The recent 2019/2020 bushfire 'black summer' resulted in significant losses of koala habitat. • Weed control will be undertaken across all the offset areas, and fuel/biomass control will be undertaken in areas outside of Lowland Rainforest TEC and vine thicket communities, to reduce fuel loads and risk of high intensity to catastrophic fires. • Hazard reduction burns will be undertaken in consultation with the Queensland Rural Fire Service to further reduce this risk when necessary. • These measures will provide an increased level of protection for the koala within the offset areas, reducing the risk of both mortality and habitat loss because of fire. This will provide benefits for local populations as well the regional population by facilitating the survival of a source population should fires have detrimental impacts on regional populations outside the offset area.
Vehicle strike	• Avoid and minimise vehicle strike on koalas.	• Vehicle speed will be restricted in the offset areas to 60 km/hr. Signage will be installed at key intervals on access tracks to remind drivers to be alert and maintain slow speeds. Vehicle usage of the offset areas will be low and restricted to personnel involved in land management and/or monitoring. • Queensland Hydro will investigate an ability to install koala signage on local roads required for access as well as reduce vehicle speeds in identified 'hot spots'.
Injury and mortality from predation	• Avoid and minimise predation of koalas from pest species (including wild dogs)	• Pest management control will be undertaken across the offset areas to limit the occurrence of pest species which prey on koala (including wild dogs). • Predator control will be implemented to reduce abundance of pest animals to below the established baseline

6.3.8 Brush sophora and scrub turpentine

Species specific management actions that will be implemented within the offset areas to protect and enhance brush sophora and scrub turpentine habitat are listed in Table 37. Although scrub turpentine is being offset indirectly, the management actions will improve the habitat for the individuals within the offset areas.

Table 37: Species specific management actions: brush sophora and scrub turpentine

Threat	Performance Outcome	Management Actions
Habitat loss and fragmentation	• Overall improvement in brush sophora and scrub turpentine habitat quality. • Reduction in weed cover.	• Reduction in non-native plant cover, including lantana, to reduce competition with these species. • Bushfire including fuel loads will be managed to minimise risk of a hot bushfire occurring that can threaten habitat and reduce cover.
Mortality and injury from wildfire	• Reduce frequency and intensity of fires within brush sophora and scrub turpentine habitat.	• The brush sophora is sensitive to wildfire as too frequent fire depletes the soil bank. Fire frequency will be managed in suitable habitats for this species. • Scrub turpentine is sensitive to wildfire as resprouting leaf material is highly susceptible to infection by myrtle rust.
Grazing	• Remove grazing from suitable habitat.	• Grazing will be excluded from Offset Area A. • In Offset Area B, exclusion of grazing from ecologically sensitive areas, including populations of brush sophora in Year 1, and regrowth and non-remnant areas by end of Year 3.
Myrtle Rust	• Minimise spread of Myrtle Rust in the offset area.	• Implement plant disease spread hygiene protocols and monitor effectiveness as summarised in Section 6.1.4. • Fire frequency will be managed in suitable habitats for this species to avoid increasing the infection rate in adult trees.

6.3.9 Supplementary hollows for greater glider, yellow-bellied glider and glossy black-cockatoo

To compensate for a loss of hollow-bearing trees associated with clearing for Exploratory Works it is proposed artificial hollows, tailored to the three arboreal species, greater glider, yellow-bellied glider and glossy black-cockatoo, are installed in Offset Area B. Offset Area B contains a mixture of remnant and regrowth eucalypt woodlands that have shown to be lacking in natural hollows and these species would benefit from additional denning resources in this area to supplement the existing hollows.

A preference will firstly be the use of natural, salvaged hollows taken from the Exploratory Works impact area, with carved hollows used to supplement salvaged hollows where necessary. Natural, salvaged hollows and carved hollows provide good thermal properties similar to a natural hollow and have longevity in the environment. Queensland Hydro also propose to supplement these hollows with Cyplas nest boxes, tailored to each species requirements, as they can be built to have good insulation properties and last approximately 30 years. Cockatube designs for glossy black-cockatoos may also be installed to supplement loss of hollows for the species.

6.3.9.1 Greater glider

Greater gliders have been observed selectively denning in trees of a DBH greater than 50 cm (Hofman, Gracanin, & Mikac 2023) and have other hollow requirements including a minimum depth of 30 cm, minimum entrance diameter of 10 cm and a minimum of 8 m height above ground (DCCEEW, 2022a). The supplementary hollow program will evolve with the project and consider the feasibility of install locations, availability of hollow resources and environmental factors. Importantly, nest boxes will be tailored to greater gliders and installed into remnant and regrowth areas where existing hollows are lacking.

Large gliders are known to be sensitive to temperature extremes (Hofman et al. 2022), and this will be accommodated when designing and installing all types of nest boxes. For example, placing the boxes in preferred denning tree species with good canopy cover, and orientated in similar directions as the natural hollows known and expected to support the species, for example avoiding orientations that directly face hot afternoon sun and the dominant direction of severe storms.

6.3.9.2 Yellow-bellied glider

Extensive studies into yellow-bellied glider denning preferences show that the species prefers to nest in large living trees ranging from around 70-160 cm DBH, despite this, the entrance of the hollow may be quite narrow (~10 cm). Hollows are often widely dispersed due to their large home range of 30-60 ha (Craig 1985; Goldingay and Kavanagh 1993; Goldingay and Quin 2004),

Yellow-bellied gliders display similar nesting habits to greater gliders, namely large trees with deep hollows on average 9 m above ground (Goldingay et al. 2018) and accordingly, supplementary hollows program design for this species will largely mirror that of greater gliders.

6.3.9.3 Glossy black-cockatoo

Glossy black-cockatoos are selective with their breeding hollows, preferring those situated at a height at least 8-10 m above ground (Forshaw 2002; Cameron 2006) of large, senescent or dead eucalypts with a DBH generally at least 40 cm and with a hollow entrance diameter of at least 15 cm in stems or branches at a maximum angle of 45º from vertical (Cameron 2006). Hollow stems, stumps and cavities in alive or dead trees are all suitable for glossy black-cockatoo nesting (Garnett et al. 1999; 2002; Cameron 2006).

The species tends to prefer nest boxes or nesting when they are within proximity to other nesting pairs and show strong fidelity to nesting sites in subsequent years (Garnett et al. 1999; Mooney & Pedler 2005). On this basis, known feeding or roosting sites should influence the placement of supplementary hollows for this species, focussing on grouped installations in suitable habitat within proximity to food (< 12 km) and water resources (<1.5 km). Importantly, the angle of installation should be as close to vertical as possible for this species.

6.3.9.4 Salvaged natural hollows

One of the hollow options is to salvage felled hollows from the impact site during the Project and later attach them to host trees to act as a natural hollow (Photo 20, Photo 21). Salvaged hollows are naturally shaped, have more stable thermal properties when compared to nest boxes (Griffiths et al. 2018) and will last long-term in the environment. This option offers a naturally formed, ready-made alternative to nest boxes and provides a range of possible entrance and hollow types that may be appropriate for the different target species (i.e. cavity type hollows suited to glossy black-cockatoos).

All salvaged hollows will ideally include a pre-formed entrance to be cut above and below the hollow, giving the gliders and cockatoos a natural lid and base. Some hollows that are salvageable in the Project area may only provide the hollow ‘shell’ and require a cap to be placed at either end with an entrance hole to be created. Marine grade plywood should be used as a minimum for any capping requirements and be sealed with waterproofing to prevent warping and splitting. Salvaged hollows can also be attached to and combined with constructed artificial hollows (Biodiversity Conservation Trust, 2020). It is recommended that the external condition of the salvaged hollows is checked at least once every 6-12 months to ensure they are still in suitable condition and not damaged by the tree (Biodiversity Conservation Trust, 2020). Ensuring the salvaged hollows are suitable for attachment to the host tree is important and security of the attachment needs to be monitored overtime. Although this is a preferred approach, this method is limited to the number of salvaged hollows available and the ability to safely install these in areas where the ground is steep and uneven.

The Exploratory Works Preliminary Documentation outlines a strategy to salvage natural hollows. It is estimated up to 70% of hollows could be salvaged, converted to a hollow as shown below, and installed into Offset Area B.

Photo 20: Example of salvaged hollow for gliders

Photo 21: Example of salvaged hollow suitable for glossy black-cockatoo (DBCA 2023)

6.3.9.5 Carved hollows

Another type of hollow is the process of mechanically carving a hollow into a live or dead tree, often referred to as a 'carved hollow' and is a relatively new method being implemented to supplement habitat for hollow-dependent animals (Griffiths et al., 2018). Studies on carved hollows are limited but one pilot study found five species of small mammal utilising the chainsaw carved hollows (Rueegger 2017) while others have found smaller arboreal mammals, possums and birds to be utilising or visiting these artificially constructed hollows (Griffiths, 2019; Terry, Goldingay & van der Ree 2021). This emerging, more natural approach has seen cases of higher rates off occupation and preference compared to nest boxes by several hollow-dependent species (Terry, Goldingay, & van der Ree, 2021; Griffiths, 2019). These results suggest that carved hollows may be better suited to smaller species such as small gliders, parrots and microbats (Biodiversity Conservation Trust 2020).

Ideally, artificial hollows need to provide the same or better thermal suitability; however, documentation on the thermal suitability of nest boxes is unclear (Rowland, Briscoe & Handsasyde, 2017). Nest boxes have been found to exhibit patterns of rapidly warming in the morning, remaining above ambient temperature throughout the day, then rapidly cooling in the early even to fall below ambient temperatures at night; this obviously not being thermally suitable for small marsupial gliders (Griffiths, 2019). A benefit of carved hollows is that they display similar thermal and physical properties to natural hollows and can maintain a microclimate more suitable for hollow-dependent fauna than a nest box (Griffiths et al., 2022). They tend to experience smaller thermal fluctuation and given that greater gliders are sensitive to weather extremes, it is possible that a carved hollow would provide a more suitable climate for this species. Despite the improved thermal qualities of carved hollows, a limitation to this approach is that greater gliders and yellow-bellied gliders require deep (more than 30 cm deep) hollows.

Generally, only trees over 40 cm DBH have been selected to be host trees for carved hollows (Griffiths et al. 2018; Biodiversity Conservation Trust 2020), as little is known about survivability of trees once a hollow is carved into them. Callous regrowth and signs of deformity has been shown within a 2.5 year period in a relatively recent study, confirming that periodic maintenance of chainsaw hollows is likely required for this method to ensure their longevity (Terry, Goldingay & van der Ree, 2021). Carved hollows may prove to be a suitable choice for glossy black-cockatoos due to their ability to provide natural chewing materials potentially reducing the need for maintenance. Although it is not well known if carved hollows have been adopted by glossy black-cockatoos, the smaller, sulphur-crested cockatoo, has been recorded utilising carved hollows on a South-east Queensland property (LFWSEQ 2023).

There is also anecdotal evidence that in some cases carved hollows can fill with water, leading to reproductive failures. Selection of tree species is important for this as it can impact the hollows susceptibility to fail, form growths and retain moisture (Terry, Goldingay & van der Ree, 2021). This can be monitored with scheduled maintenance which is also required with other artificial hollow methods.

In places where there are trees large enough to support carved hollows and carved hollows can be installed safely, carved hollows will be constructed on a trial basis. It is recommended that in line with studies, the 40 cm DBH host tree minimum is adopted for the offset area. If this method is successful, additional carved hollows could be installed in other parts of the offset areas.

6.3.9.6 Nest boxes

Nest boxes are frequently used to offset the loss of hollow-bearing trees. Nest boxes are multi-species use, meaning those designed for greater glider, which are of similar dimensions to those designed for yellow-bellied gliders, are appropriate supplementary habitat for both glider species.

Many successful examples are emerging with confirmed use of nest boxes by greater gliders, including a Central Queensland project where over 500 nest boxes have been installed that include a combination of timber, recycled plastic and natural salvaged hollows.

Based on nest box monitoring completed over three separate events for this project, it has been found a high number of greater gliders are using the nest boxes for denning. This included mothers and their young. Uptake of the supplementary dens has been increasing with each monitoring event.

Greater glider have been recorded using salvaged hollows, timber boxes and Cyplas boxes, suggesting greater glider will accept different denning options as long as they meet the requirements for size, entrance location and thermal properties. Hollow Log Homes, a leading manufacturer of nest boxes, have reported successful use of their greater glider boxes by greater gliders in projects since 2015 (Hollow Log Homes 2024).

There is evidence of the yellow-bellied glider using nest boxes (Goldingay et al 2020), and the installation of artificial hollows using nest boxes or carved hollows is a conservation and management priority as per the Conservation advice for the species (DAWE 2022c). Although there is no published evidence of glossy black-cockatoo using boxes on the mainland, evidence from a nest box program designed for the Kangaroo Island subspecies has led to high success rates in breeding, doubling the population in the study area in 20 years with reports of >50% of breeding pairs nesting in artificial hollows (Berris et al. 2023).

Successful nest box installations by Hollow Log Homes included in 2015/16 where plywood boxes (Photo 22) were developed and photographic evidence was recorded of a greater glider occupying a box. Since then, the nest box design has been utilised by greater gliders in Nebo Junction, documented by Base Consultancy, the Pomona area around Noosa documented by Noosa Landcare and throughout southeast Queensland by Queensland glider network (Hollow Log Homes 2024).

Nest boxes will be installed with the 'Habisure System' (Franks & Franks 2006) to prevent inadvertent tree damage. CYPLAS Boxes (Photo 23) - Made from 100% Recycled HDPE (High density polyethylene) are Termite and rot proof and have a lifespan of at least 30 years (Hollow Log Homes 2024). These CYPLAS nest boxes have had success with target species utilisation, with one project reporting signs of fauna use in 63% of boxes (Hollow Log Homes 2024).

Nest boxes for gliders will have an entrance diameter of 10 cm, which is consistent with the conservation advice for greater gliders (DCCEEW 2022a). The entrance will be at the rear of the box. Both designs are white with heat reflective paint to keep them better insulated. Nest boxes for glossy black-cockatoos may be either PVC, tubular or traditional nest box style (marine ply) with entrances on either the top or front of the box.

The design and installation of greater glider nest boxes includes:

- inner width/height of 250x300 mm
- depths of 400 mm
- entrance diameter of 10 cm
- height above ground above 8 m
- rear entranced to face the host tree trunk.

6.3.9.7 Cockatube

The Cockatube nesting box was developed by Landcare SJ Inc. in collaboration with the Western Australian Museum and the Department of Parks and Wildlife (DPAW) (Photo 29). It has been specifically designed for the three black cockatoo species occurring in Western Australia but is suitable for use by all black cockatoo species across Australia (Landscare SJ Inc. 2025). The Cockatube has an anticipated lifespan of over 50 years, with the artificial nest boxes made of a durable recycled black polyethylene (PE) tube which can be repurposed from mining waste (Birdlife Australia 2013). Features included in the design are galvanised mesh ladder, wood chip nesting material, solid base with drainage holes, and sacrificial timber strip installed on the interior. Dimensions of the tube are 1200 mm (L) x 375 mm (D).

Research into the use and effectiveness of artificial nest hollows for black cockatoos commenced in Western Australia in the 1990s and continues today, with monitoring of both wooden nest boxes and PE tubes at multiple sites across the south-west (Johnstone & Kirby 2019). A key focus has been to design artificial hollows that are suitable for cockatoos but less accessible to feral bees and native competing species. Findings from this work demonstrate that PE polytubes, designed specifically for black cockatoos, are highly effective and significantly enhance breeding success.

While formal effectiveness studies are still largely confined to Western Australia, the installation of Cockatubes within Queensland Hydro offset sites could be trialled to assess their effectiveness as an artificial hollow for the glossy black-cockatoo.

Photo 22: Greater glider using a plywood nest box (EMM 2024)

Photo 23: Example of a CYPLAS rear entry glider box (Hollow Log Homes 2024)

Photo 29: Example of a Cockatube artificial hollow (Landcare SJ 2025)

6.3.9.8 Implementation

In order to provide supplementary denning habitat for animals to move into once vegetation clearing begins, a total of 50% of the nest boxes and carved hollows will be installed prior to habitat removal. The remaining 50% of nest boxes and carved hollows will be installed within three months of vegetation clearing commencing. Salvaged hollows will be progressively installed as they become available during clearing process.

The supplementary hollows will be regularly monitored with the first monitoring event occurring six months after installation and then at least annually after that. During these monitoring inspections each nest box will be checked for use, its condition will be evaluated to ensure it is in good condition and doesn’t require maintenance or replacement, and it will be assessed for any use by pest species such as wasps and if these need to be removed. Inspections will preferably be conducted via an elevated work platform (EWP) or tree climber as this provides the most accurate and robust dataset, and allows for maintenance to be completed at the time of monitoring. The monitoring will also confirm the presence of any greater gliders, yellow-bellied gliders, glossy black-cockatoos or other species, and their numbers.

Focus of supplementary hollows for all three species is Offset Area B. Target areas and trees will be confirmed in the field. Subject to assessment of individual trees, nest boxes will generally be installed into structurally sound trees between 20 – 30 cm DBH and trees of at least 40 cm DBH will be used for carved hollows to ensure integrity of tree is maintained. Offset Area A may be used as a secondary area for installation of carved hollows for the target species due to presence of larger DBH trees. Greater gliders maintain home ranges and are unlikely to move far from existing hollows in order to take advantage of new habitat. Therefore, supplementary hollows will first be installed within 100-150 m of vegetation with hollow bearing trees to allow animals to move into adjacent vegetation without going far from familiar hollows. This method has had success on projects in central Queensland. Once these boxes have been utilised by greater glider, additional boxes within 100-150 m will be installed, progressively installing more boxes in areas further from their known distribution in the offset area.

Yellow-bellied gliders have a larger home range than greater gliders, meaning nest box installation may occur in suitable habitat further out from initial 100-150 m installation area. This approach also provides an additional resource for greater gliders, which may also use the multi-species boxes and salvaged hollows installed in the broader area. Glossy black-cockatoo nest boxes should be installed vertically, at least 8 m above ground, in groups and within proximity to known food (<12 km) and water resources (<1.5 km).

Due to the limited availability of salvaged hollows, the total salvaged during vegetation clearing will ideally be split equally between the three target species based on their natural characteristics and suitability to the target species. Salvaged hollows that mimic the favoured hollow type (i.e. vertical) for glossy black-cockatoos will be reserved for this species. The total number of hollows for each species may vary due to their natural variability. A summary of the hollow installation, monitoring and maintenance plan, which includes performance indicators, planned outcomes, trigger values for corrective actions and corrective actions if trigger values are reached can be found in Table 40 and further details around the MNES monitoring regime can be found in Section 8.2.3.

Photo30: Hollow-bearing tree within Offset Area B

6.3.9.9 EPBC Offset Assessment Guide

Hollow-bearing tree surveys were conducted within the disturbance footprint and 20 m buffer. The surveys were completed on foot and aided by the use of binoculars. The location of the hollow-bearing tree, the number of all hollows, and the number of hollows greater than 10 cm in diameter (which is the minimum size considered suitable for the greater glider) were recorded. In some locations approximate counts were made because access to the exact location of each tree was deemed unsafe. It is recognised that there are inherent limitations with the accuracy of hollow-bearing tree surveys and, in particular, the estimate of the number of hollows present. Based on hollow-bearing tree surveys of the disturbance footprint it is estimated 136 hollows suitable for greater glider, yellow-bellied glider and glossy black cockatoo (i.e. >10 cm) may be cleared.

The EPBC OAG was used (based on the greater glider status of endangered) to determine the number of hollows required to replace the removed hollows using the input outlined in Table 38. Using the OAG as summarised in

Table 38, 217 supplementary hollows would be required to be installed to offset the potential loss of 136 hollows within the disturbance footprint and meet 100% of the OAG.

To account for the uncertainty in the number of hollows lost, another 66 supplementary hollows (283 total supplementary hollows) will be installed, which equates to 130% of the obligation met.

Table 38: EPBC offset assessment guide calculator inputs and result for offsetting the loss of hollows from the Exploratory Works disturbance footprint

Calculator input	Value	Justification
No. hollows to be removed	136This is the number of hollows suitable for greater glider, yellow-bellied glider and glossy black-cockatoo (i.e. >10 cm) within the disturbance footprint. It is possible all three species utilised these larger hollows. Only a proportion of the 136 would be used by glossy black-cockatoo as they require a larger size hollow to the gliders.	
Time horizon	20 years	Supplementary hollows would be used by target species within this timeframe.
Start Value	0	There are currently no supplementary hollows in the offset areas.
Future value without the offset	0	There would be no supplementary hollows if the offset does not take place.
Future value with offset	217	This is the number of supplementary hollows proposed to offset the loss of hollows in the disturbance footprint, which reaches 100.55% of the offset requirement
Confidence	80%	Based on other case studies and proposed tailored approach for each species it is considered a high likelihood that the supplementary hollows will be effective and 80% confidence has been given.
No. hollows required to meet 100% of the offset obligation	217	EPBC OAG, plus additional boxes to account for uncertainty in survey method.
% of the offset obligation acquitted	100.55	This is the confidence that the supplementary hollows will successfully replace the hollows removed. There are many case studies confirming greater glider use supplementary hollows.
Total no. of hollows to be installed to account for uncertainty	283	Another 66 supplementary hollows will be installed on top of the required 217. This will ensure 130% of the offset obligation is met in case additional hollows that were not counted are removed.

Table 39 shows the number of each type of hollow to be installed within the offset areas for each species. Most of these hollows will be installed in Offset Area B where there are currently fewer available hollows and there will be more restored habitat and opportunities to enhance breeding habitat and connectivity. A small number may be installed in Offset Area A.

Table 39: Type and number of supplementary hollows that will be installed in the offset areas

Supplementary hollow type	Number to be installed for gliders	Number to be installed for glossy black cockatoo	Justification
Salvaged hollows	101	51	70% of the impacted hollows are expected to be salvaged, meaning 152 salvaged hollows. Other projects in central Queensland clearing large numbers of hollow bearing trees have found around 70% of hollows are generally salvageable. The remaining 30% are not a shape suitable for relocating, too heavy to relocate, or are damaged in the salvaging process.
Carved hollows	35	30	The remaining 30% of the hollows required to meet the obligation will be done as carved hollows; 65 carved hollows are required. Carved hollows will need to be different sizes for gliders as opposed to glossy black-cockatoo. Therefore 35 carved hollows are proposed for the gliders and 30 for glossy black-cockatoo as it is likely there will be fewer larger size hollows in Project footprint.
Cyplas nest boxes and Cockatube artificial hollows	33	33	These boxes are in addition to what is required to meet the offset obligation. Sixty-six artificial nest boxes/hollows are proposed to be installed to increase the offset to 130% of the obligation and account for uncertainty in number of hollows lost and use by various species. Specially designed Cyplas boxes are proposed for the gliders and glossy black-cockatoo. These boxes are long lasting and relatively easy to install. Fifty percent of the additional nest boxes/hollows are proposed to be Cyplas next boxes designed for gliders. The remaining nest box/hollow offset obligation is to be for glossy black-cockatoos. Both Cyplas nest boxes and Cockatube designs will be utilised, with a 50:50 split proposed.

6.3.9.10 Performance outcomes

A set of performance outcomes for the installation of supplementary hollows is outlined in Table 40 including triggers for and proposed corrective actions.

Table 40: Supplementary hollow installation, monitoring and maintenance plan

Performance indicator	Performance outcome	Trigger values for corrective actions	Proposed corrective action
Supplementary hollows to be installed	In total, 283 supplementary hollows will be installed.	Cyplas nest boxes are not able to be provided by supplier on schedule.	• Explore other suppliers. • Seek time extension from DCCEEW. • Option to increase number of carved hollows.
		There are not enough suitable large trees for carved hollows in Offset Area B	• Install carved hollows into Offset Area A. • Increase number of Cyplas boxes installed to cover carved hollow deficit.
Installation timeframes	50% of the nest boxes and carved hollows shall be installed prior	Hollows are not installed by the proposed deadline	• Review reasons for delay. • Revised timeline provided to DCCEEW for approval with justification.

Performance indicator	Performance outcome	Trigger values for corrective actions	Proposed corrective action
	to vegetation clearing commencing.		• Additional resources brought in for installation.
	All supplementary hollows shall be installed within three months of vegetation clearing commencing	Hollows are not installed by the proposed deadline	• Review reasons for delay. • Revised timeline provided to DCCEEW for approval with justification. • Additional resources brought in for installation.
	Salvaged hollows will be installed progressively.	Less than 77 salvaged hollows are available for installation.	• Explore potential to salvage hollows from other nearby projects that may not be required to reuse them. • Investigate increasing number of carved hollows and Cyplas boxes to compensate for lack of salvaged hollows.
Monitoring and maintenance	Monitoring and maintenance is proposed for six months after installation and at least annually after that	Damaged boxes are observed.	• Investigation into cause of damage (i.e. weather, tampering, incorrect installation) • Fix damaged box and reinstall. • Redeployment of nest boxes may be done in a more suitable tree or location.
		Hollows are found to be malfunctioning, installed incorrectly or harbouring pest / unwanted species during monitoring period.	• Within 30 business days the hollow will be rectified. This may be fixing damaged hollow, removing pest species, and reinstalling. • Re-evaluate monitoring schedule if issues are occurring more frequently.
Supplementary hollow utilisation	Utilisation is expected to be at 3% across all supplementary hollow types within 24 months of installation. 3% utilisation can be by any of the three target species.	Hollow utilisation goal is not met within 24 months of installation.	• Undertake additional targeted surveys to confirm presence of the species in the installation area. Look to confirm if target species are present and using natural hollows nearby. • Investigate why supplementary hollows aren't being used and corrective actions that would be suitable. • Re-locate some nest boxes to different locations to see if results improve. • Install additional nest boxes and trial different designs.

6.4 Additional management actions and land use restrictions

In addition to the management measures outlined in Section 6, other administrative and land use restrictions (outlined in Table 41) will also be implemented across the offset areas to help ensure that the interim milestones and final completion criteria can be achieved.

Table 41: Additional management actions and land use restrictions for the OAMP

Restriction	Description
Staff awareness/training	All Queensland Hydro staff, external contractors and landholders will be made aware of this OAMP, its management actions and land use restrictions as they pertain to operational activities. Prior to anyone accessing the offset area personnel will be required to undergo a site induction which provides information on entry requirements and biodiversity values of the area. Entry requirements will include sign in, vehicle washdown, staying within speed limits, no disposing rubbish on site, no domestic pets allowed on site, and any observations of threatened fauna or feral animals are to be reported to Queensland Hydro offset manager.
Unauthorised access	Access to the offset area will be minimised to authorised personnel only. Only the landholder and authorised Queensland Hydro personnel/contractors will be granted access to the offset area. Queensland Hydro will advise the landholder (with one weeks' notice) of upcoming management or monitoring works being conducted within the offset area. Gates to the offset area will be locked, with the keys managed by the landholder and Queensland Hydro. Existing fencing and locks will be maintained, and new fencing and locks established where required for access restriction. Signage will be established at all access points of the offset area that states the area is protected for conservation purposes and is restricted to authorised personnel only. The offset area will be demarcated on all site plans.
Access tracks	Vehicle movement will be restricted to designated access tracks, existing firebreaks and fence lines which will be maintained for the duration of the offset. Tracks will be maintained no wider than 10 m and vegetation disturbance is to be minimised. Usage of access tracks during poor weather should be restricted wherever practicable. Gully crossings will be repaired following rainfall events as required to maintain access.
Speed restrictions	All vehicles will be restricted to speeds of 60 km/h throughout the offset areas to reduce the potential of fauna strikes (especially koalas and long-nosed potoroos). Driving should be avoided at night wherever practicable.
Vegetation Clearing	Vegetation clearing unless expressly permitted in this OAMP is prohibited. Minor clearing may be required for ongoing maintenance of all pre-existing access tracks, firebreaks and fencing. Ensuring public safety or as directed by emergency management response personnel in the event of uncontrolled fire or another emergency procedure.
Timber harvesting and firewood collection	No timber harvesting and/or firewood collection is permitted within the offset areas.
Fodder harvesting	No harvesting of vegetation for fodder is permitted within the offset areas.
Erosion and Monitoring and Maintenance	Erosion monitoring will be conducted across the offset area on an annual basis in conjunction with the firebreak, access track and fence line monitoring requirements. Areas identified as being impacted by erosion will be appropriately managed by Queensland Hydro.
Disease management	A weed hygiene procedure will be developed and communicated to all personnel entering the offset area. The procedure will include details on how people (hands, boots and clothing), vehicles, machinery and equipment must be washed prior to entering the offset areas. The procedure will also include education about how myrtle rust is spread and how to reduce the likelihood of spreading it within the offset area. This information will also be included in all induction material supplied to contractors and staff entering the site.

7. Interim milestones and completion criteria

This section outlines the interim and completion criteria that will be achieved for each MNES value, for each offset area, to achieve the respective nominated future habitat quality scores (Table 42 and Table 43). The interim milestones and final habitat quality scores are presented below to illustrate the proposed progression of improvement in the quality of habitat for each MNES value over the duration of 20 years.

Interim milestones have been established at 5-yearly intervals (Table 45 and Table 46) and monitoring (which will include repeating the same MHQA assessments as set out in Appendix C) will be undertaken to establish that those interim milestones have been achieved. Further details on monitoring methods are provided in Section 8.

The Year 20 (predicted) scores have been applied in the OAG and ensure that in total across all offset areas that at least 100% is achieved. Justification for the OAG inputs are provided in Appendix D.

To ensure that these interim milestones are achieved, various ongoing management actions will be undertaken (Section 6). To confirm that these management actions are being implemented and to confirm the quality of the offset area is tracking towards these interim milestones, monitoring reports will be prepared by suitably qualified ecologists to quantify this progress (Section 10).

Completion criteria for each MNES and offset area will be the final habitat quality scores as set out in the 'Final Habitat Quality (Year 20)' in Table 42 and Table 43. Several of the species have a final modelled habitat quality gain greater than that specified in Table 18 and Table 20. The habitat gains stated in Table 18 and Table 20 are the minimum habitat quality gains that are expected as a result of the management actions proposed. These gains have been used in the OAG to determine the offset obligation and are conservative to ensure that the potential impacts to species are mitigated. The modelled gains shown in Table 42 and Table 43 suggests that the final habitat quality score for several species may be higher than those used in the calculator. Monitoring in Year 20 will confirm if these habitat quality scores have been achieved and a final completion report submitted to DCCEEW.

Habitat quality gains for each MNES are outlined in Section 4.5. These gains will be achieved through the management actions (refer Section 6), comprehensive monitoring program (refer Section 8) and adaptive management to be applied to ensure the habitat gains stay on track over the course of the 20 years.

Table 42: Interim and final completion criteria- Offset Area A

MNES	Starting Habitat Quality Score (weighted unrounded)	Interim Milestones			Final Habitat Quality Year 20 (weighted unrounded)
		Year 5	Year 10	Year 15	
Threatened Ecological Communities					
Lowland Rainforest of Subtropical Australia	4.7	5.3	5.9	6.5	7
Threatened Flora					
Brush sophora	4.2	4.6	5.0	5.5	6.2
Threatened Fauna					
Black-breasted button quail	6.1	6.5	7.2	7.5	7.8
Glossy black-cockatoo	7.5	7.6	8.0	8.5	8.6
Greater glider	7.5	7.7	8.1	8.6	8.8
Koala (foraging/breeding)	7.6	7.9	8.3	8.8	8.9
Koala (dispersal and refuge)	5.8	6.2	7.2	7.4	7.8

MNES	Starting Habitat Quality Score (weighted unrounded)	Interim Milestones			Final Habitat Quality Year 20 (weighted unrounded)
		Year 5	Year 10	Year 15	
Long-nosed potoroo	7.4	7.7	8.1	8.6	8.7
Yellow-bellied glider	7.4	7.6	7.9	8.5	8.6

Table 43: Interim and final completion criteria- Offset Area B

MNES	Starting Habitat Quality Score (weighted and unrounded)	Interim Milestones			Final Habitat Quality Year 20 (weighted and unrounded)
		Year 5	Year 10	Year 15	
Threatened Ecological Communities					
Lowland Rainforest of Subtropical Australia	6.9	7.2	7.9	9.0	9.4
Threatened Fauna					
Black-breasted button quail	7.0	7.2	7.5	7.9	8.0
Glossy black-cockatoo	7.0	7.1	7.4	7.8	8.3
Greater glider	7.0	7.1	7.4	7.9	8.4
Koala (foraging and breeding)	7.7	7.8	8.1	8.5	8.8
Koala (dispersal and refuge)	5.1	5.4	5.8	6.6	7.7
Long-nosed potoroo	7.3	7.5	7.7	8.1	8.5
Yellow-bellied glider	6.3	6.3	6.6	7.1	7.4

8. Offset monitoring program

This section outlines the monitoring program that will be implemented to evaluate the progress and overall success of the management actions described in this OAMP, and track progress of the offset areas against the interim milestones and completion criteria for each MNES (Section 7).

Monitoring will assist to determine:

- Land uses in the offset area are consistent with this OAMP.
- Required management actions have occurred in the last monitoring timeframe.
- Effectiveness of management actions.
- Habitat quality is improving as per interim milestones and timeframes.
- Rehabilitation and regeneration of native vegetation is occurring.
- If MNES are present in the offset area.
- If pest animals are present and numbers are reducing.
- Success of particular measures such as artificial tree hollows.

The monitoring programs proposed are outlined in following sections.

8.1 Baseline surveys

In Year 1 it is proposed that baseline surveys across the offset areas are undertaken to provide a benchmark and guidance for particular management and monitoring activities including weeds, pest animals and fire. These baseline surveys will be led by suitably qualified persons with relevant experience contracted by Queensland Hydro. Further details on the baseline survey methods are provided in Table 45.

After Year 1 additional monitoring programs will be implemented as outlined in following sections.

8.2 Monitoring methods

8.2.1 Habitat quality assessment

To track the progress of the offset areas towards the interim milestones and completion criteria, one of the key components to be monitored is ecological condition of vegetation communities and species habitats. This monitoring will provide MHQA scores that are derived in a consistent manner to those of the starting habitat quality scores (as outlined in Section 4), and support tracking of key elements and conservation gains such as reduced non-native weed cover, recruitment, an increase in large trees, canopy cover and height, species richness and coarse woody debris.

The MHQA sites to be monitored are shown in Figure 8 and will be completed in Years 5, Year 10, Year 15, and Year 20. There is an allowance in Year 1 for additional sites to be completed if deemed necessary.

A consolidated summary of the MHQA data inputs required to be scored for each of the MNES values at each of the offset areas has been provided in Table 44.

Table 44: Habitat quality monitoring methodology

Attribute	Methodology
Site Condition	
Site-based attributes: • Recruitment of woody perennial species in the ecologically dominant layer (EDL) • Native plant species richness – trees, shrubs, grasses and forbs • Tree canopy height • Tree canopy cover • Shrub canopy cover • Native grass cover • Organic litter • Large native trees • Coarse woody debris • Non-native plant cover	Attributes will be assessed in accordance with the BioCondition Assessment Manual (Eyre et al. 2015): • Chapter 3: The assessment unit and site selection • Chapter 5: Assessment of site-based attributes Attributes will be scored out of a maximum of **80 points**. RE Benchmarks published by Queensland Herbarium will be used to assess site condition for existing REs within the offset areas. In addition to collecting these site-based attributes, directional photographs will be taken at each BioCondition site to keep a visual record of the offset areas. Photos are to be taken from 1.5 m above the ground, in a landscape orientation for north, east, south and west directions. The 87 established BioCondition sites across the offset areas will be re-assessed over the 20 years. It is proposed these site-based attributes are surveyed every five years between March and May for consistency and post warmer temperatures and rainfall when ground cover is likely at its highest.
Species habitat attributes: • Quality and availability of food and foraging habitat • Quality and availability of shelter	These attributes will be scored by incorporating several species-specific indicators and using the site-based attributes to develop a rating scale for each indicator. Species specific criteria are outlined in Appendix B of this OAMP. Attributes scored out of a maximum of **20 points**. The species habitat attributes will be assessed every five years at the same time as the site-based attributes.
Site Context	
Landscape-scale attributes: • Size of patch • Connectivity • Context • Ecological corridors	These attributes will be assessed in accordance with Chapter 6.2: Undertaking a site context assessment from the Guide (DEHP, 2017) and Chapter 6.1 Fragmentated landscapes from the BioCondition Assessment Manual (Eyre et al. 2015). Attributes to be scored out of a maximum of **26 points.** Assessment Units within the offset areas are to be identified as occurring or not occurring within a fragmented landscape. Size of patch: The Guide (DEHP, 2017) includes only remnant or regrowth vegetation in the measurement of the size of a patch. To score this for the MHQA, measurements must include all habitat for the MNES value. For example, koala habitat includes any forest or woodland containing species that are known koala food trees, or

Attribute	Methodology
	shrubland with emergent food trees as defined in the Conservation Advice for *Phascolarctos cinereus* (koala) (DAWE 2022). To assess at an AU scale, the Guide (DEHP, 2017) states that measurements should be conducted as a landscape-scale approach, providing the total area of vegetation in which the assessment unit is located and all directly connected areas of remnant vegetation outside of the Project area boundary. <u>Connectivity:</u> To assess connectivity and the absence of barriers to movement, the Guide (DEHP 2017) measures connectivity based on the length of shared boundaries between the assessment unit and surrounding vegetation. To score this for the MHQA, connectivity includes any boundaries where the MNES value can move into adjacent habitat. For example, a boundary adjacent to a narrow strip of cleared land/track which koalas would use to move into adjacent habitat would be 'connected' to adjacent habitat. <u>Context:</u> To assess context, the Guide (DEHP 2017) measures the percentage of remnant vegetation contained within a 1 km buffer. <u>Ecological Corridors:</u> To assess connectivity for this MHQA, 'sharing a common boundary with' an ecological corridor includes any boundaries where the MNES value can move into adjacent corridors that are state, bioregional, regional or sub-regional corridors (terrestrial or riparian). For example, if a boundary adjacent to a narrow strip of cleared land/track which koalas would use to move into adjacent corridors would be considered to be a shared common boundary.
Species habitat attributes: • Role of site location to overall population • Threats to species • Species mobility capacity	These attributes will be assessed in accordance with the Guide (DEHP 2017): • Chapter 2.6: Undertaking a site context assessment • Chapter 7.2: Undertaking a species habitat index assessment. Attributes scored out of a maximum of **30 points.** The role of the site location to overall population and threats to species' attributes will be determined by reviewing available peer reviewed literature, published recovery plans and expert opinions to provide references in support of the nominated score. Species mobility capacity will be calculated for each MNES value incorporating specific species-specific attributes which are supported by referenced peer reviewed literature. The criteria used to assess these attributes are described in Appendix B.

Attribute	Methodology
Species Stocking Rate (SSR)	
Species presence and usage attributes: • Presence detected on or adjacent to site (neighbouring property with connecting habitat) • Species usage of the site (habitat type & evidence usage) • Approximate density (per ha)	These attributes are to be derived from DCCEEW's MHQA. Criteria applied are summarised in Appendix B. Attributes will be scored out of a maximum of **55 points**. Presence detected on or adjacent to site will be determined based upon sighting data and indirect evidence (i.e. scats and scratches) observed within the offset areas. Species usage of the site is to be derived from available peer reviewed literature and expert advice surrounding the habitat types present within the offset areas (i.e. foraging, dispersal, breeding). Approximate density will be determined based on species records observed within the offset area and referenced peer-reviewed literature.
Role/importance of species population on site	Score derived from SSR Supplementary table (see below). Attributes scored out of a maximum of **15 points.**
Species Stocking Rate (SSR)- Supplementary table	
Sub-attributes: • Key source population for breeding • Key source population for dispersal • Necessary for maintaining genetic diversity • Near the limit of the species range	These attributes which are internally scored out of **30 points** are used to calculate the score for the Role/importance of species population on site for each MNES value. These sub-attributes scores are determined from available peer reviewed literature, expert advice, recovery plans and other related EPBC policy documents that have been developed for each MNES value. Scores for these sub-attributes must be supported by scientific evidence, surveys or studies and species distribution mapping. Criteria applied are summarised in Appendix B.

8.2.2 Baseline surveys and ongoing monitoring

Table 45 describes the baseline surveys that will be carried out in Year 1 of offset implementation, as well as ongoing monitoring over the course of the offset to track progress of management actions as well as success of the offset.

Table 45: Baseline and ongoing monitoring surveys

Survey type	Monitoring method	Timing	Justification
Habitat quality	• MHQA using the method outlined in Section 8.2.1	May be required in Year 1 if additional sites are required Years 5, 10, 15 and 20	• MHQA provides a repeatable method which will allow determination of progress towards interim milestone and completion criteria.
Weed extent survey	• For each assessment unit at least one permanent weed transect and one permanent photo monitoring point will be surveyed. For assessment units >5 ha two transects will be completed. • Weeds will also be monitored at each MHQA site (weed species present and % cover). • This is to ensure sufficient coverage across the offset areas and varying conditions.	Year 1 (preference for post wet season) then annually	• Weed transects are a repeatable survey method done across the same area to evaluate changes in weed species and coverage. • MHQA sites also provide weed information that can be consistently repeated at those locations over time. • Establishing photo points across the offset also assists to record any changes in weed presence and abundance. • Results of weed monitoring will inform effectiveness of weed control measures.
Pest animal survey	• Motion sensor cameras will be deployed at key areas across the offset areas (such as near tracks, riparian corridors, where signs of their presence have been noted). • The cameras will be put out at these same locations each monitoring event. • 30 cameras will be deployed across the offset areas for a period of 14 consecutive nights. • Spotlighting will occur along access tracks. The same tracks will be spot lit each monitoring event.	Year 1 then Years 5, 10, 15 and 20	• Motion sensor cameras are a proven and effective method of detecting pest animals. The cameras can be set up near access tracks they use to move between areas (Meek, Ballard & Fleming 2012). • Cameras won't be baited to be consistent with the pest animal cameras deployed to determine starting quality. By baiting cameras this can attract more pests to the area and give false results. • Spotlighting is also effective in detecting prey species such as feral pigs, foxes and feral cats (Department of Agriculture and Fisheries 2023).
Fire management	• Assess fuel loads • Finalise mapping of access tracks, exclusion zones and fire breaks and assess their condition • Determine fuel load reduction areas to be established • Entry and exit points • Location of fire fighting equipment and access to water	Year 1 then annually	• Baseline assessment of bushfire management requirements will be completed. • Key firefighting resources and access will be established to ensure readiness for any unplanned bushfires.

8.2.3 MNES monitoring

Monitoring surveys tailored to each MNES that will occur over the 20 years of active management to support an evaluation of the progress of the OAMP towards both interim and completion criteria for each MNES are outlined in Table 46. These tailored monitoring programs for each MNES being offset will demonstrate the conservation outcomes being achieved and changes in species presence and abundance. Monitoring will also support the identification of risks and if corrective actions might be required.

Table 46: MNES specific monitoring surveys

Baseline Survey	Monitoring method	Timing	Justification
MNES specific monitoring			
Lowland Rainforest TEC	MHQA	Year 1 if any additional MHQA sites are required Years 5, 10, 15 and 20	• MHQA is an accepted method for assessing and tracking habitat quality improvements. • MHQA will provide an understanding of the health and condition of the TEC as it is tailored to vegetation community attributes and tracking improvements over time
Brush sophora	MHQA	Year 1 if any additional MHQA sites are required Years 5, 10, 15 and 20	• MHQA is an accepted method for assessing and tracking habitat quality improvements.
	Direct count surveys and health assessments	Year 1, 5, 10, 15 and 20	• The first survey will be carried out in Year 1. The targeted flora survey will be to confirm the species presence in Offset Area A and estimate total abundance. • Health assessments of the individuals recorded will be completed and figures prepared showing presence and distribution within the offset area. • Map populations • A control site will also be surveyed to support future monitoring events and to compare overall health of individuals and recruitment. • The survey will be repeated every five years to gauge any change in the population numbers, distribution and health.
Koala	Thermal drone survey	Years 1, 5, 10, 15 and 20	• A thermal drone survey will be conducted across Offset Area A and B in Year 1. It is preferred the survey is conducted in winter in cooler months for improved detectability. • The same flight paths, at the same time of year will be repeated every five years to support an understanding of koala populations utilising the offset areas. • Thermal drone surveys are a recognised efficient and effective survey method of detecting koalas (Howell et al. 2021).

Baseline Survey	Monitoring method	Timing	Justification
Koala (cont.)	Detection dog surveys and daytime searches	Years 1, 5, 10, 15 and 20	• The purpose of these surveys is to detect the presence of koala scats, and then assist to identify presence of koalas in trees. • These surveys are done during the day therefore ecologists can also assess the health of koala individuals, assess their age and identify presence of any joeys. • These surveys will occur at a different time of year to thermal drone surveys to provide two different survey windows. • Detection dog surveys are a recognised effective method of detecting koalas and provide a scat based survey method.
Greater glider	Thermal drone survey	Years 1, 5, 10, 15 and 20	• During koala thermal drone surveys, they will also look out for presence of greater glider. • greater gliders have successfully been observed during thermal drone surveys (Vinson, Johnson & Mikac 2020). They also proved effective in detecting gliders during baseline surveys for the Borumba PHES Project.
	Scat detection dogs	Year 1, 5, 10, 15 and 20	• This method is proving to be more effective in detecting greater gliders as opposed to spotlighting. • A baseline survey will be conducted in Year 1 that is then repeated in a consistent manner.
	Supplementary denning habitat - artificial hollows	Twice per year for first two years post installation. Checked in spring and winter Installation is expected to occur towards end of Year 1 and Year 2 Annually Year 4 to Year 20	• greater gliders are known to use artificial hollows based on other projects monitoring results as outlined in Section 6.3.9. • Monitoring will be important to determine if greater gliders are using the artificial hollows installed, and if there seems to be a preference for a certain type. • Monitoring will also identify if there are any issues with the hollows such as the hollows being used by bees or require maintenance. • Monitoring methods will depend on the type of artificial hollow. Salvaged hollows, CYPLAS boxes and carved hollows can be monitored via tree climbers. • If on flat ground salvaged hollows and CYPLAS boxes can also be monitored with an elevated work platform.

Baseline Survey	Monitoring method	Timing	Justification
Yellow-bellied glider	Thermal drone survey	Years 1, 5, 10, 15 and 20	• Thermal drone surveys for presence of the presence of arboreal including the yellow-bellied glider. • Gliders have successfully been observed during drone surveys (Howell et al. 2021).
	Acoustic detectors - one detector per AU deployed for 12 nights (Whisson et al. 2021)	Year 1, 5, 10, 15 and 20	• Acoustic detectors have been used successfully to determine the presence of this species (Whisson et al. 2021). • The length of time should account for weather variability and ensure the conditions are suitable for the recording the species.
	Supplementary denning habitat - artificial hollows	Twice per year for first two years post installation. Checked in spring and winter. Installation is expected to occur towards end of Year 1 and Year 2. Annually Year 4 to Year 20	• yellow-bellied gliders are known to use artificial hollows based on other projects monitoring results as outlined in Section 6.3.9. • Monitoring will be important to determine if yellow-bellied gliders are using the artificial hollows installed, and if there seems to be a preference for a certain type. • Monitoring will also identify if there are any issues with the hollows such as the hollows being used by bees or require maintenance. • Monitoring methods will depend on the type of artificial hollow. Salvaged hollows, CYPLAS boxes and carved hollows can be monitored via tree climbers. • If on flat ground salvaged hollows and CYPLAS boxes can also be monitored with an elevated work platform.
Glossy black-cockatoo	Diurnal bird surveys will be conducted to determine presence of the species. These surveys will include looking for chewed orts and listening for their calls.	Years 1, 5, 10, 15 and 20	• The proposed survey methods are consistent with survey guidelines for the species.

Baseline Survey	Monitoring method	Timing	Justification
Glossy black-cockatoo (cont.)	Supplementary denning habitat - artificial hollows	Twice per year for first two years post installation. Checked in spring and winter. Installation is expected to occur towards end of Year 1 and Year 2. Annually Year 4 to Year 20	• Monitoring will be important to determine if glossy black-cockatoos are using the artificial hollows installed, and if there seems to be a preference for a certain type. • Monitoring will also identify if there are any issues with the hollows such as the hollows being used by bees or require maintenance. • Monitoring methods will depend on the type of artificial hollow. Salvaged hollows, CYPLAS boxes and carved hollows can be monitored via tree climbers. • If on flat ground salvaged hollows and CYPLAS boxes can also be monitored with an elevated work platform.
Long-nosed potoroo	Motion sensor cameras will be deployed in representative habitat areas for the species. Two cameras per suitable assessment unit.	Years 1, 5, 10, 15 and 20	• Motion sensor cameras are a known technique for detecting this species (Eyre et al. 2022).
Black-breasted button-quail	Motion sensor cameras will be deployed in representative habitat areas for the species (DCCEEW, 2022) Two cameras per suitable assessment unit.	Year 1, 5, 10, 15 and 20	• Motion sensor cameras are a known technique for detecting this species (DCCEEW, 2022f).
	Searches for evidence of their presence across habitat patches. One transect per assessment unit.	Year 1, 5, 10, 15 and 20	• Searches for platelets is a recognised technique for detecting this species (DCCEEW,2022f)

8.3 Routine monitoring

The offset monitoring program will also include monitoring of more routine management actions such as weed control, pest animal control and things like fencing. Below is a description of these monitoring events to support tracking of offset progress and effectiveness of certain management actions.

8.3.1 Weed control program

To monitor the abundance and distribution of weed species and avoid the introduction and spread of other weed species into the offset areas, a Weed Infestation Register (WIR) will be established following the weed survey undertaken in Year 1. An active weed register and supporting map will be developed to help focus and track the progress of weed management activities within the offset areas, including the effectiveness of cattle grazing in Offset Area B in the management of weeds.

This weed register will be provided to any contractors brought into manage weeds across the offset areas. Guided by the WIR, monitoring of weed management actions, where implemented within the offset areas, will be undertaken every five years or following heavy rainfall events that can result in increased weed abundance and distribution or following fires. Following the completion criteria for the offset areas being met in Year 20, post-completion weed monitoring activities will continue every 5 years in Autumn. New investigations will be documented and included in the weed register to help coordinate future management and monitoring actions. This register will be updated every five years and incorporated into the 5-yearly monitoring reports (Section 10.1).

8.3.2 Pest control monitoring

Ongoing pest animal monitoring is proposed to occur in Years 5, 10, 15 and 20. The pest monitoring will be consistent with the baseline survey in Year 1 in terms of the same number of remote cameras and camera locations.

8.3.3 Maintenance monitoring

Additional monitoring for erosion, maintenance of firebreaks, condition of access tracks and fence lines within the offset areas will be undertaken on an annual basis. Areas identified as being impacted by erosion will be appropriately managed by Queensland Hydro.

8.3.4 Revegetation area progress

Monitoring of the regeneration and revegetation areas will occur to assess the health and growth of the regenerating species. This will involve suitable transects and/or plots to measure canopy cover, canopy height, groundcover, tree health and photo monitoring to show progress of plantings and woodland maturity. These transects will be monitored for the first three years following revegetation.

Representative BioCondition transects can also be placed into the revegetation areas post Year 3 to start to establish habitat quality scores and assist in tracking progress of site-based elements such as tree height, canopy cover, groundcover, coarse woody debris etc.

8.4 Monitoring schedule

A consolidated summary of monitoring actions and timing for their implementation within the offset areas after approval of this OAMP and for the duration of the Exploratory Works approvals is provided in Table 47. Additional weed management, restoration activities, and monitoring may be detailed in and conducted as part of the Offset Area Restoration Plan which will be developed within one year of the approval of the OAMP.

Table 47: Monitoring schedule

Activity	Monitoring events	Management years																					Survey timing / effort	Comments
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Post 20 years - remainder of Project duration		
Baseline surveys	Weed extent survey	✓																					Preference for post wet season	Weed survey conducted in conjunction with MHQA surveys. See section 8.1.2
	Pest animal survey	✓																					Baseline in Year 1 and repeated in a consistent manner every 5 years	
	Fire management	✓																					BMP will be developed in Year 1 following baseline surveys	
Habitat quality	Monitoring of MHQA sites					✓					✓					✓					✓		Every 5 years between March and May Completion Report will be Year 20	See Section 4.1 and Appendix B
Lowland Rainforest TEC	MHQA					✓					✓					✓					✓		Every 5 years	Conducted with MHQA monitoring. See Section 4.1 and Appendix B
Brush sophora	MHQA					✓					✓					✓					✓		Every 5 years	Conducted with MHQA monitoring. See Section 4.1 and Appendix B
	Direct count surveys and health assessments	✓				✓					✓					✓					✓		Baseline in Year 1 and repeated every 5 years	Baseline will include a survey across the offset plus a control site.
Koala	Thermal drone survey	✓				✓					✓					✓					✓		Preferred in cooler months for improved detectability and	Survey to be conducted across the whole offset area.

Activity	Monitoring events	Management years																					Survey timing / effort	Comments
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Post 20 years - remainder of Project duration		
																							repeated at the same time every 5 years	
	Detection dog surveys and daytime searches	✓				✓					✓					✓					✓		Completed during the daytime Baseline in Year 1 and repeated every 5 years	Ecologists can also assess any koalas located during survey.
Greater glider	Thermal drone survey	✓				✓					✓					✓					✓		Preferred in cooler months for improved detectability and repeated at the same time every 5 years	To be completed with koala thermal drone surveys.
	Scat detection dogs	✓				✓					✓					✓					✓		Baseline in Year 1 and repeated in a consistent manner every 5 years	
	Supplementary denning habitat - nest boxes	✓✓	✓✓	✓ ✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		Twice per year for the first two years in spring and winter Annually Year 4 to Year 20	
	Nest box monitoring	✓✓	✓✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		Twice per year for first two years after installation then annually	
Yellow-bellied glider	Thermal drone survey	✓				✓					✓					✓					✓		Preferred in cooler months for improved detectability and repeated at the same time every 5 years	To be completed with koala thermal drone surveys.
	Acoustic detectors	✓				✓					✓					✓					✓		One detector per Assessment Unit for a minimum of 6 nights and up to 12 nights. Baseline in Year 1 and repeated every 5 years	The length of recording time should account for weather variability. See Section 8.2

Activity	Monitoring events	Management years																				Post 20 years - remainder of Project duration	Survey timing / effort	Comments
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
	Nest box monitoring	✓✓	✓✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		Twice per year for first two years after installation then annually	
Glossy black-cockatoo	Bird survey - TBC	✓				✓					✓					✓					✓		During breeding season between March – August Baseline in Year 1 and repeated every 5 years	
	Nest box monitoring	✓✓	✓✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		Twice per year for first two years after installation then annually	
Long-nosed potoroo	Motion sensor cameras	✓				✓					✓					✓					✓		Baseline in Year 1 and repeated every 5 years	Two cameras per suitable assessment unit.
Black-breasted button-quail	Motion sensor cameras	✓				✓					✓					✓					✓		Baseline in Year 1 and repeated every 5 years	Two cameras per suitable assessment unit.
	Active searches for presence across habitat patches	✓				✓					✓					✓					✓		Baseline in Year 1 and repeated every 5 years	One transect per assessment unit.
Routine monitoring	Weed control program					✓					✓					✓					✓	✓	Every five years, following heavy rainfall events or until assessed completely eradicated	Register will be incorporated into the 5-yearly monitoring reports (Section 10). See Section 8.3.1
	Maintenance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Annual basis	Monitoring is for erosion, maintenance of firebreaks, firefighting infrastructure, access tracks and fence lines. See Section 8.3.3

Activity	Monitoring events	Management years																					Survey timing / effort	Comments
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Post 20 years - remainder of Project duration		
	Revegetation area progress			√		√					√					√					√	√	Monitor regeneration and tubestock Years 1-3 BioCondition transects implemented post Year 3 and monitored.	Monitoring of the health and growth of the revegetated species. See Section 8.3.4
	Pest animal monitoring	√				√					√					√					√	√	Baseline in Year 1 and repeated in a consistent manner every 5 years	See Section 8.3.2
Reporting	Annual compliance report	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		By June 30 each year	See Section 10.1
	5 yearly reports					√					√					√					√		Every 5 years. Completion Report will be Year 20	See Section 10.1
	Baseline monitoring report	√																					Following completion of baseline surveys	See Section 10.4

9. Roles and responsibilities

The responsibility for the satisfaction of conditions relating to this OAMP belongs to Queensland Hydro.

Queensland Hydro will ultimately be responsible for the management of the offset areas in accordance with this OAMP.

Queensland Hydro will engage the following specialist contractors as required in accordance with this OAMP:

- suitably qualified person/s (SQP) to undertake baseline and monitoring surveys
- planting contractors to undertake replanting and rehabilitation programs
- weed control contractors to undertake weed management programs
- pest animal control contractors to implement pest control
- contractors for maintenance or installation activities, such as fencing
- SQP with appropriate licences to undertake fire management activities including controlled burns.

It will be the responsibility of these contractors to undertake their operations in accordance with this OAMP, as applicable and as directed by Queensland Hydro.

10. Reporting

10.1 Annual compliance reports

Environmental offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced. To support transparent governance arrangements, and demonstrate compliance with the OAMP, regular compliance and monitoring reporting is proposed to occur.

An Annual Compliance Report (ACR) will be prepared and submitted to DCCEEW for their information.

The ACR is proposed to be submitted by 30 June each year. This date is to allow for the main monitoring periods in late Summer – early Autumn each year to be completed, and adequate time for report preparation to occur.

The ACR will be prepared by suitably qualified persons with experience in offset management and threatened species, and will be signed off by Queensland Hydro.

The report will include:

- description of all management actions that have been completed in that 12-month period
- description of the monitoring activities that were completed and results, including comparison against previous monitoring events
- habitat quality scores (for those years when they are required to be done) and how they are tracking against relevant interim milestones
- identification of any constraints to monitoring and management actions over that timeframe (e.g. inability to access offset area due to flooding, etc)
- how any risks or threats have impacted on the area (e.g. drought period therefore lack of growth)
- photos from photo monitoring points
- identification of any risks or potential threats to the offset and offset values that have become apparent and how they will be addressed
- any corrective actions implemented during the 12 month period
- any learnings from implementation of the OAMP and monitoring
- any changes to the OAMP that may be proposed and justification.

At Years 5, 10 and 15 the ACR will become a 5 yearly compliance report that provides the above information plus includes additional information to evaluate the performance of the offset against the established, relevant interim criteria and final completion criteria as set out in Section 7. This will be a more detailed evaluation informed by MHQA that was completed earlier that year.

In Year 20 a Final Report will be produced.

10.2 Reporting non-compliance

Non-compliances with the actions in this OAMP, or the conditions of approval, will be reported to DCCEEW in writing in accordance with the conditions of approval.

A non-compliance will be reported as soon as possible and no later than 30 business days after becoming aware of the non-compliance.

10.3 Adaptive management

An adaptive implementation program will be used to ensure uncertainty is reduced over time, and that completion criteria are attained and maintained over the period of approval. As more information becomes available following ongoing performance monitoring, the management and monitoring regime will be reviewed and revised to maximise the likelihood of attaining and maintaining the outcomes to be achieved by implementing the OAMP.

Any updates to the OAMP which do not result in a material change to the environmental outcomes or completion criteria will be made by Queensland Hydro without the requirement of informing DCCEEW. If material amendments likely to alter the environmental outcomes, or performance and completion criteria are proposed to the OAMP, the amendments and justification for the contingency measures will be provided to DCCEEW in writing for their review and approval.

An example of adaptive management will be revisions to the OAMP to include information following the baseline monitoring surveys proposed for Year 1 of offset implementation. The following information may be updated in the OAMP as part of an annual review:

- Figures showing types and locations of features to be targeted for management, with the aim of achieving the ecological outcomes (such as weed infestations to be targeted, areas to be revegetated/regenerated, access restrictions, infrastructure such as fences and tracks to be maintained or removed, disturbances/threats to be managed, additional records or sightings).
- Figures showing monitoring sites (as outlined in 8.2).
- Update of management measures as appropriate and for site-specific requirements.
- Update of MNES species information and utilisation of habitats.

Adaptive management may also allow for:

- assimilation of new data or information - such as, updates to conservation advice or new threat abatement plans
- new information that becomes available on survey techniques or management actions.

10.4 Baseline monitoring survey report

Following baseline monitoring surveys in Year 1 as described in Section 8.2.2, a baseline survey report will be prepared by Queensland Hydro. Baseline survey data will then be used to establish a benchmark for key attributes including weeds, pest animals and presence of MNES in the offset areas. These results can then be compared with future monitoring data to measure changes in offset area habitat quality, updates on species presence and populations, and for identifying progress towards the interim milestones and completion criteria. Remedial action or adaptive management will be implemented based on monitoring results.

Reporting of baseline results will include:

- Targeted weed infestation areas, target weed species and cover at representative sites.
- Pest animal abundance.
- Evidence of species recruitment (species, type, abundance) at representative sites in non-remnant areas to inform management of natural regeneration/revegetation actions.
- MNES species abundance and distribution.
- Mapping showing:
  - Monitoring survey sites
  - Boundaries of TEC patches
  - With respect to buffer zones to TEC, mapping showing vegetated buffer zones by vegetation type
  - Extent of target weed infestations
  - Location of disturbances and clearings to be targeted for planting/regeneration
  - Infrastructure such as fences and tracks
  - Disturbances/threats to be managed or removed
  - Locations of plots/survey sites and photo monitoring points
  - Baseline/monitoring photographs from monitoring points.

10.5 Data management

Queensland Hydro will ensure that all data collected as part of the OAMP implementation is managed and stored appropriately. A data management framework will be established to ensure proper data quality assurance, storage and protection occurs.

Key features of the data management will be:

- Spatial data collection proformas for use in the field to ensure robust data is collected, and in a consistent manner.

- Establishment of a geodatabase for management of spatial data.
- Standardised data collection methods by qualified personnel, particularly for monitoring so that it is completed consistently each year to enable comparison of results.
- Quality assurance review process by suitably qualified persons.
- Version control of data and reports.
- Appropriately stored information for future use and reference.

11. Auditing

Internal audits will be conducted by Queensland Hydro on a regular basis to check that the required management actions and monitoring are being carried out by the appointed contractors in accordance with this OAMP. Contractors will be required to submit evidence of work completed with their invoicing in accordance with contractual arrangements.

The OAMP will be internally reviewed every 5 years as part of the compliance reporting process following the scheduled monitoring events as set out in Section 10.1. Any relevant changes to the timeframes to achieve the interim or completion criteria will be formally submitted to DCCEEW for approval.

Independent audits will be undertaken upon request by DCCEEW in accordance with the Conditions of the EPBC approval.

12. Corrective actions

Table 48 identifies a range of corrective actions that will be considered in the event that monitoring indicates that the management and mitigation measures are not achieving the habitat quality objectives and/or the interim milestones established.

Table 48: Corrective actions and their triggers

Risk	Trigger	Corrective Actions to be Considered and Implemented
Unapproved vegetation clearing	• Vegetation clearing occurs within the offset areas which is not consistent with this OAMP.	• Notify DCCEEW within 10 business days of becoming aware of the clearing. • Upon being notified or becoming aware of unapproved clearing Queensland Hydro to investigate how clearing occurred. • Review existing access restrictions and inspect signage and offset area fencing within 14 days of detection of the clearing. • Prepare and implement a revegetation/restoration plan of the unauthorised/unplanned clearing areas which has been reviewed and approved by DCCEEW. • OAMP to be revised and updated if required with such changes communicated to DCCEEW.
Increase in weed density/range/ diversity	• Non-native cover increasing or remaining the same as baseline across the offset areas. • New declared or WoNS weed species recorded in the offset areas.	• Review current weed hygiene procedures to ensure compliance and update restrictions if deemed necessary. • Review timing and frequency of weed management measures. Increase weed control effort and adjust timing if needed. • Investigate alternative weed management control actions (e.g. spot spraying and/or injection of herbicides) and implement. • Review the effectiveness of the cattle in managing weeds in within the areas subject to grazing, noting cattle grazing within Offset Area B will phased out by Year 3 (and in some sensitive areas in Year 1). • Undertake additional weed management measures until weed populations are reduced. • OAMP to be revised and updated if required with such changes communicated to DCCEEW.
Inappropriate grazing regimes	• Cattle or evidence of cattle recorded in areas where cattle have been excluded or in the offset areas post-phased removal.	• Investigate and repair damaged boundary fencing within 10 business days of detection. • Construct additional fencing if required. • Remove cattle from the offset area within five business days of detection.
Invasive animals are increasing in numbers	• Increase in invasive animal abundance above baseline.	• Review compliance and nature of pest animal management actions. • Investigate potential sources or reasons for increases in pest animal numbers or diversity and rectify if possible. An increase may be due to climatic conditions outside of Queensland Hydro's control. • Amend the invasive pest animal control measures in response to monitoring and in accordance with

Risk	Trigger	Corrective Actions to be Considered and Implemented
		relevant guidelines. This may include increasing the frequency or type of control or changes to the location of control measures. Collaboration with adjoining landowners is likely to be required. • OAMP to be revised and updated if required with such changes communicated to DCCEEW.
Unplanned fire	• An unplanned fire within the offset areas.	• All occurrences of unplanned fire are to be recorded during monitoring and routine land management. • If an uncontrolled bushfire has impacted the offset area (including if controlled burning becomes out of control), review the fire management strategies and compliance with these strategies. • All fire breaks will be inspected, maintained, and repaired if required. • Amendments to fire management practices as required including fire safety and containment management. • OAMP to be revised and updated if required with such changes communicated to DCCEEW.
Habitat degradation and direct impact to MNES due to unauthorised access to offset area.	• Evidence of unauthorised access to the offset areas.	• Upon being notified or becoming aware of prohibited access to the offset area, Queensland Hydro is to review access protocols, signage and general access within 14 days. • Additional fencing and locked gates may be required. • Damage to signage and fences will be repaired within one month of noting the damage. • If there are areas that have been negatively impacted by unauthorised access, the regeneration of those areas will be undertaken, and these areas added to the ongoing monitoring sites. • OAMP to be revised and updated if required with such changes communicated to DCCEEW.
Failure to attain interim or completion criteria	• Interim or completion habitat quality scores not met by target dates.	• Within one month of becoming aware of failure to attain an interim target – investigation is to be completed into the reasons as to why targets aren't being met. • Any investigation is to focus on the suitability and frequency of management measures and identify appropriate corrective actions. • Review the Offset Area Restoration Plan • Any corrective actions are to be specifically targeted towards addressing the elements of the management actions and objectives that have contributed most to the reduced score. • Corrective actions are to commence within two months of corrective actions being identified. • Findings are to be presented in the relevant annual report. • OAMP to be revised and updated if required with such changes communicated to DCCEEW.

13. Risk assessment

A risk assessment was undertaken using the qualitative risk assessment process outlined in Section 4 of the DCCEEW Environmental Management Plan Guidelines. The purpose of this assessment is to assess the risks associated with failing to achieve the objectives outlined in this OAMP for mitigating impacts to MNES.

For each identified risk, the potential consequence of the risk (Table 49) was assessed against the likelihood of that risk occurring (Table 50) to determine an overall risk rating using the matrix in Table 51. The consequence and likelihood of each risk occurring was reassessed following the implementation of the management and mitigation measures (i.e. control measures) to provide a residual risk rating (Table 52).

Table 49: Qualitative measure of consequences (what will be the consequence/result if this does occur rating)

Consequence	Description
Minor (Mi)	Minor incident of environmental damage that can be reversed
Moderate (Mo)	Isolated by substantial instances of environmental dames that could be reversed with intensive efforts
High (H)	Substantial instances of environmental damage that could be reversed with intensive efforts
Major (Ma)	Major loss of environmental amenity and real danger of continuing
Critical (C)	Severe widespread loss of environmental amenity and irrecoverable environmental damage.

Table 50: Qualitative measure of likelihood (how likely is it that this event/issue will occur after control strategies have been put in place)

Likelihood	Description
Highly likely (Hl)	Is expected to occur in most circumstances
Likely (L)	Will probably occur during the life of the project
Possible (P)	Might occur during the life of the project
Unlikely (U)	Could occur but considered unlikely of doubtful
Rare (R)	May occur in exceptional circumstances

Table 51: Risk rating

		Consequence				
		Minor	Moderate	High	Major	Critical
Likelihood	Highly likely	Medium	High	High	Severe	Severe
	Likely	Low	Medium	High	High	Severe
	Possible	Low	Medium	Medium	High	Severe
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Low	Medium	High

Table 52: Final risk assessment for the OAMP management measures

Risk event	Risk Description	Initial Risk Rating: Likelihood	Initial Risk Rating: Consequence	Initial Risk Rating: Risk Rating	Management Measures/Actions	Residual Risk Rating: Likelihood	Residual Risk Rating: Consequence	Residual Risk Rating: Risk Rating	Corrective Actions
Habitat/Vegetation loss through unplanned clearing	Inappropriate site preparation and/or controls in place that result in unplanned or unnecessary vegetation clearing in the offset.	L	H	High	During clearing for exploratory works the boundaries of the approved footprint will be clearly delineated and planned clearing footprints will be established and communicated to all Queensland Hydro personnel and contractors. The offset areas will be clearly signed and fenced where appropriate. Any contractors working in the offset areas will be advised of what activities are permitted or not permitted. This will be done through site inductions. No new vegetation clearing is required. Clearing may only be permitted for maintenance of existing tracks and fence lines.	P	Mo	Medium	Review education process for contractors to ensure that they understand the boundaries of clearance. Prepare a revegetation plan for any unplanned clearing. Implement the revegetation plan.
Increase in weed density/range/ diversity	Invasive weed species outcompeting regeneration of native flora species and degrading habitat values such as ability for koalas to disperse along the ground. Weeds were prevalent across most survey sites. Areas that have undergone historical disturbance have, in parts, experienced incursion of weeds, particularly lantana camara. lantana thickets can act as a barrier to fauna movement and prevent recruitment of canopy tree species resulting in a reduction of canopy cover. Weeds, particularly woody weeds, also increase fuel loads which in turn increases risk of hot bushfires.	Hi	Mo	High	Weed management will occur on an annual basis (minimum) across all offset areas (refer Section 6.1.1.). Monitoring will also occur annually to determine effectiveness of weed control actions and ensure weed cover is reducing (refer Section 8.2 and 8.3).	P	Mo	Medium	Review WMP and control methodology. Increase weed effort. Investigate origins of weed spread, e.g. vehicles, fill. Review weed hygiene procedures. Review the effectiveness of the cattle in managing weeds in within the areas subject to grazing, noting cattle grazing within Offset Area B will phased out by Year 3 (and in some sensitive areas in Year 1) . Amend WMP and weed hygiene procedures.
Increase in feral animal density/range/ diversity	Red deer, pig, fox, wild dogs and feral cats have all been recorded during Project and offset-associated surveys. Disturbance from deer and pigs was evident due to the presence of wallows and game trails. Feral animals may predate on native animals and cause disturbance to offset areas resulting in vegetation mortality and/or increase the time to offset realisation.	HI	Mo	High	Implementation of feral animal management to improve habitat quality for MNES, reduce competition for resources and reduce predation. Pest animal management is outlined in Section 6.1.2. Monitoring of effectiveness of pest control is outlined in Section 8.3.2.	P	Mo	Medium	Review pest control methods and change methods if required. Increase pest control effort. Investigate possible reasons for increase in abundance.
Inappropriate grazing in the offset areas	Livestock on adjacent areas of the offset area and/or adjacent properties and herbivorous fauna entering the offset areas can lead to loss of vegetation from competition, erosion, waterway degradation, and grazing and trampling pressure.	L	Mo	Medium	Queensland Hydro will ensure that livestock are gradually excluded from all offset areas using fencing. There may be some adjacent properties that are grazed so it will be important that fencing is in place and maintained to ensure cattle cannot gain entry. A phased destocking approach is recommended so that native tube stock are not outcompeted by exotic grasses. Grazing is proposed to be phased out by the end of Year 3, though in ecologically sensitive areas, such as the Lowland Rainforest TEC, remnant vegetation and riparian areas, grazing will be excluded in Year 1. Grazing from pest animals like deer on any planted or regenerating trees will use tree guards to reduce grazing impacts if observed.	P	Mi	Low	Review type, condition and location of fencing. Review the effectiveness of grazing to manage weeds and fuel loads. Investigate reasons for uncontrolled grazing. Liaise with lease holder to reduce risk of unintended grazing of the site and remove cattle.

Risk event	Risk Description	Initial Risk Rating			Management Measures/Actions	Residual Risk Rating			Corrective Actions
		Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating	
Unauthorised access	Risk of humans accessing the site without authorisation, causing disturbance.	Hl	Mo	High	Installation of additional access restrictions (e.g. exclusion fencing, signage) if unauthorised access to the sites is recorded and considered to be having a negative impact. These restrictions will prohibit public access to the offset areas.	P	Mi	Low	Review signage and site security. Educate construction or operational staff about access to the offset areas and reporting unauthorised access to the site.
Offset fails to achieve the interim performance targets and completion criteria within the 5, 10, 15 and/or 20-year time intervals.	Inadequate vegetation management leading to failure to achieve interim performance targets and completion criteria within the intended time intervals. This could be as a result of any or all of the risk events listed in this table.	L	H	High	Adherence to management measures/actions listed in Section 6. Regular monitoring to occur as outlined in Section 8 to ensure management actions have been implemented, and offset areas are achieving the set interim milestones (as set in Section 7). If these objectives are not on track to be achieved, re-evaluation of management measures/actions will be undertaken, and appropriate corrective actions selected and implemented. Adaptive management will be important to be applied to ensure learnings are identified and changes are made to keep the offset on target. Corrective actions are outlined in Section 12.	U	Mo	Low	Investigate potential reasons for the unmet target e.g. drought, herbivory, weeds. Review management actions in this OAMP and the Offset Restoration Plan. Implement additional management actions to improve habitat quality.
Unplanned bushfire	Fire has the potential to alter the species composition of the offset which could lead to a change in the species composition of the offset vegetation community. Fire may also increase the time to offset realisation.	L	H	High	Fire management will occur across the offset areas. Fire management activities are outlined in Section 6.1.3. Implementation of appropriate fire management regimes in line with relevant RE guidelines can reduce the risk of severe fire within fire-prone broad habitat types. Some MNES are also fire sensitive such as Lowland Rainforest TEC therefore management will exclude fire from these areas. Baseline surveys will include identification of existing firebreaks and locations where firebreaks may require maintenance. Fuel loads will also be evaluated. Where a considerable risk in the offset area is identified, fire breaks may be implemented outside of offset area. If an extreme risk of fire to the site is identified that cannot be mitigated in other ways, investigation into hazardous fuel load reduction through the surrounding areas with local councils or state government may be considered. Queensland Hydro are preparing a Bushfire Management Plan for the Project site and fire management for the offset areas will have regard and be consistent with this plan.	P	Mo	Medium	Investigate origin of the bushfire, should an unplanned bushfire occur. If the origin is from a Project source, implement additional mitigation measures to reduce the risk of another. Implement additional controls e.g. fire breaks, fuel reduction burns to reduce the chance of spread.
Drought	Prolonged periods without rainfall may cause plant stress and/or death and increase the time to offset realisation.	Hl	H	High	If revegetation occurs in periods of low rainfall which is causing stress to the plants additional watering will occur. Watering will continue until plants are self-sustaining. Monitoring will be used to assess the need for supplementary watering and / or replacement planting as summarised in Section 8.3.4. Focus of offset area is on assisted natural regeneration rather than active revegetation which will help to ensue natural resilience develops within the community to the fluctuations of soil moisture	Hl	Mo	High	Review management actions and, if necessary, modify to take into account ongoing drought e.g. watering schedules, pest control. Implement additional controls.
Severe weather (Cyclone, Tropical low, River flooding)	Severe weather events such as cyclones, tropical lows, and river flooding, can severely disturb the offset areas and cause vegetation mortality. These events have the potential to remove existing vegetation, alter the species composition of an area and/or increase the time to offset realisation.	Hl	Ma	Severe	Offset areas will have some natural resilience to these weather events. If there is damage to native vegetation in the offset areas from a weather event, the extent of damage will be assessed on the ground and any loss of habitat quality. The progress of the offset will be reviewed and if additional time is needed to achieve the completion criteria this will be raised with DCCEEW and OAMP revised if needed. Limiting revegetation activities to areas that may be subject to flooding, with a preference on assisted natural regeneration to aid in resilience of the community. Species selection and placement will consider the impacts of severe weather events on species during planting. Tree guard can mitigate the impacts of flood on vegetation. Remedial action may be required following a severe weather event, relative to the size, extent and intensity of the disturbance. Corrective actions would be implemented based on the outcome of monitoring post event – particularly with regard to the need for additional planting and ground stabilisation.	Hl	Mo	High	Review management actions and, if necessary, modify to take into account severe weather e.g. watering schedules, pest control, monitoring of the site. Review OAMP and revise where required.

Risk event	Risk Description	Initial Risk Rating			Management Measures/Actions	Residual Risk Rating			Corrective Actions
		Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating	
Timber harvesting and unplanned clearing	The local area has undergone historical logging. Future timber harvesting could lead to loss of habitat for MNES species.	L	H	High	Protection of offset areas on title will occur to ensure threats from future timber harvesting and unplanned clearing will not occur. Information on legally binding mechanism is provided in Section 14. Protection of existing harvestable timber in longer term will provide habitat for MNES species that rely on hollow resources for denning and refuge habitat such as greater glider and yellow-bellied glider. Use of site controls to prevent uncontrolled access for illegal clearing. Use of signage and fencing during construction and post-construction to avoid unplanned clearing	U	Mo	Low	Ensure legally binding mechanism is in place in timeframe agreed. Educate staff about access to the offset areas and reporting unauthorised access to the site
Direct mortality through fencing and vehicle collisions	Direct mortality of fauna and flora through vehicle collisions and barb-wire fencing.	P	Mo	Medium	Removal of barbed wire and implementation of fauna friendly fencing within offset areas to reduce impacts to greater glider and yellow-bellied glider. Where the fence is on the boundary with another landholder that landholder will need to agree to any fencing changes. Reduce vehicle speeds on access tracks through the offset areas.	U	Mi	Low	Review fencing types and location. Change fencing to fauna friendly fencing. Review speed limits in the offset areas and educate staff about speed limit.
Introduction and spread of flora and fauna diseases	Spread of plant and animal disease can lead to impacts on MNES.	P	H	High	Hygiene procedures to be implemented for all vehicles, people (clothing and boots), machinery and equipment entering the offset area. Disease hygiene procedures to be included in all induction material for all people entering the site and inspections should be undertaken to ensure compliance with the procedure. Training for all environmental site staff to ensure they understand the correct way to clean vehicles, people (clothing and boots), machinery and equipment entering the site. Signage on site entrances to remind people entering that the site has disease hygiene requirements, and that Myrtle Rust is present in the area. Disease and pathogen management is outlined in Section 6.1.4.	L	M	Low	Review disease hygiene procedures. Investigate possible sources of spread e.g. vehicles from outside the offset area (noting that natural spread is possible). Increase hygiene requirements and education of staff.

14. Legal security

The offset lands will initially be legally secured using a Declaration process under the VM Act as an area of high nature conservation value within six months of the OAMP approval .

The Declaration will be recorded against the property's title and is binding on current and future landholders. The landholder and each person who has an interest in the land is bound to comply with the OAMP (whether or not they signed the OAMP), and it will be linked to the legally binding mechanism. The OAMP establishes permitted and prohibited land uses, prohibition of vegetation clearing unless expressly authorised, and allow access to approved contractors and Queensland Hydro for offset implementation and management actions to be completed.

Once the declaration has been recorded on the property title, the offset area will be mapped as a Category A area on the Property Map of Assessable Vegetation (PMAV).

An additional protection mechanism will be placed over the offset areas within an agreed timeframe post Project commencement. Options being considered include a nature refuge agreement under *Nature Conservation Act 1992* or covenant under the *Land Title Act 1994*.

15. Declaration of accuracy

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth). The offence is punishable on conviction by imprisonment or a fine, or both.

I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed:

Full Name:

Title:

Organisation:

Date:

16. References

ABC News (2023) Felixer grooming trap to be rolled out as part of Australia-first strategy to control feral cats. URL: https://www.abc.net.au/news/2023-06-28/deadly-tool-unveiled-as-part-of-crackdown-in-australia-first/102535300

Andren, M., Milledge, D., Scotts, D., & Smith, J. (2013). The distribution of long-nosed potoroo *Potorous tridactylus tridactylus* habitat on the far north coast of New South Wales. Australian Zoologist, 494–506.

Bennett SC (1985). The distribution and status of the Black-breasted button-quail *Turnix melanogaster*. Emu 85, 157–162.

Benson D, McDougall L (1998) Ecology of Sydney plants. Part 6: Dicotyledon family Myrtaceae. Cunninghamia 5, 809–986.

Berris, K., Welz, T. and Leigh, S. (2023). Kangaroo Island glossy black-cockatoo 2023 breeding season report. Kangaroo Island Landscape Board KILB. Kingscote, KILB Publication Number KILB-2023-11-R2. 15 pp.

Biodiversity Conservation Trust. (2020). Biodiversity Conservation Trust Guideline for Artificial Hollows. Biodiversity Conservation Trust.

Birdlife Australia, 2013, Cocky Notes: New resource for farmers. Available online at https://library.dbca.wa.gov.au/static/Journals/080672/080672-21.pdf.

Cameron M, Castley G, Teixiera D, Menkhorst PW & Garnett ST (2021) South-eastern Glossy Black Cockatoo *Calyptorhynchus lathami lathami*. In The Action Plan for Australian Birds 2020. (Eds ST Garnett and GB Baker) pp.. CSIRO Publishing, Melbourne.

Cameron, M., & Cunningham, R. B. (2006). Habitat selection at multiple spatial scales by foraging glossy black-cockatoos. Austral Ecology, 31(5), 597-607.

Carnegie, A. J., Kathuria, A., Pegg, G. S., Entwistle, P., Nagel, M., & Giblin, F. R. (2016). Impact of the invasive rust Puccinia psidii (myrtle rust) on native Myrtaceae in natural ecosystems in Australia. Biological Invasions, 127–144.

Centre for Invasive Species Solutions (CISS), 2021, 'Felixers: For fox control too?. Presentation at 18th Australasian vertebrate pest conference, 25-27 May 2021. https://www.youtube.com/watch?v=SXFpDCgyoCM

Clout, M. N. (1989). Foraging Behaviour of Glossy Black Cockatoos. Wildlife Research, 16, 467-473.

Commonwealth of Australia. (2022). State of the Climate. CSIRO and The Bureau of Meteorology.

Corangamite CMA, n.d. Victorian Volcanic Plains Native Vegetation Management Guide, Corangamite CMA and Glenelg Hopkins CMA, URL: https://ccma.vic.gov.au/wp-content/uploads/2022/07/VVP-FACT-SHEET-5.pdf

Craig, A (1985) Social organization, reproduction and feeding behaviour of a population of yellow-bellied gliders, *Petaurus australis* (Marsupialia: Petauridae). Australian Wildlife Research. 12 (10), 1-18.

Crowley GM & Garnett ST (2001) Food Value and tree selection by Glossy Black Cockatoos *Calyptorhynchus lathami*. Austral Ecology 26, 1, 116-126.

DEHP. (2017). Guide to determining terrestrial habitat quality. Brisbane: Department of Environment and Heritage Protection.

Department of Agriculture, Fisheries and Forestry. (2023). Biosecurity and Trade. Retrieved from Priority pest animals: https://www.agriculture.gov.au/biosecurity-trade/pests-diseases-weeds/pest-animals-and-weeds/priority-pest-animals

Department of Agriculture, Water and the Environment (DAWE) (2022a). Conservation Advice for *Phascolarctos cinereus* (koala) combined populations of Queensland, New South Wales and the Australian Capital Territory.

Department of Agriculture, Water and the Environment (DAWE) (2022b). Conservation Advice for *Potorous tridactylus tridactylus* (northern long-nosed potoroo).

Department of Agriculture, Water and the Environment (DAWE) (2022a). Conservation Advice for *Phascolarctos cinereus* (koala) combined populations of Queensland, New South Wales and the Australian Capital Territory.

Department of Agriculture, Water and the Environment (DAWE) (2022b). Conservation Advice for *Potorous tridactylus tridactylus* (northern long-nosed potoroo).

Department of Agriculture, Water and the Environment (DAWE) (2022c). Conservation Advice for *Petaurus australis australis* (Yellow-bellied Glider (south-eastern)).

Department of Climate Change, Energy, the Environment and Water (DCCEEW). (2022c). National Recovery Plan for black-breasted button-quail (*Turnix melanogaster*). Brisbane: Commonwealth of Australia.

Department of Climate Change, Energy, the Environment and Water (DCCEEW). (2023, October 23). Offsets assessment guide. Retrieved from https://www.dcceew.gov.au/environment/epbc/approvals/offsets/guidance/offsets-assessment-guide

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2022a). Conservation Advice for *Petauroides volans* (greater glider (southern and central)).

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2022b). Conservation Advice for *Calyptorhynchus lathami lathami* (South-eastern Glossy Black Cockatoo).

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2024). Environmental Management Plan Guidelines. URL: https://www.dcceew.gov.au/sites/default/files/documents/environmental-management-plan-guidelines.pdf

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2022d). Conservation Advice for *Calyptorhynchus lathami lathami* (South-eastern Glossy Black Cockatoo).

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2022f) National Recovery Plan for Black-breasted button-quail (*Turnix melanogaster*), Commonwealth of Australia.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2024) Myrtle rust (*Austropuccinia psidii*). https://www.dcceew.gov.au/environment/invasive-species/diseases-fungi-and-parasites/myrtle-rust

Department of Environment & Climate Change (DECC) New South Wales 2005b, brush sophora – Priority actions (New South Wales Threatened Species Priority Action Statement), viewed 10 Nov 2011, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/pas_profile.aspx?id=10764 >.

Department of Environment and Science (DES). (2023). Queensland Environmental Offsets Policy. Brisbane: State of Queensland.

Department of Environment, Science and Innovation (DESI) (2013). Conondale National park Management Statement

Department of Planning and Environment (DPE) (2024) scrub turpentine (*Rhodamnia rubescens*): Saving our Species strategy. Saving our species. https://savingourspecies.environment.nsw.gov.au/project/1406

Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (2011). Approved Conservation Advice for the Lowland Rainforest of Subtropical Australia.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (2011). Approved Conservation Advice for the Lowland Rainforest of Subtropical Australia.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (2012) Environment Protection and Biodiversity Conservation Act 1999- Environmental Offsets Policy. Department of Sustainability, Environment, Water, Population and Communities. URL: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.dcceew.gov.au/sites/default/files/documents/offsets-policy_2.pdf

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008a). Approved Conservation Advice for *Sophora fraseri*.

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008a). Approved Conservation Advice for *Sophora fraseri*.

DES. (2020). Code of practice for native forest timber production on Queensland's State forest estate. Brisbane: State of Queensland.

DES. (2020). South East Queensland Koala Conservation Strategy 2020–2025. Brisbane: Department of Environment and Science.

DEWHA. (2013). Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. Canberra: Department of the Environment, Water, Heritage and the Arts.

Doyle, C. (2023) Genetics is helping save plant species decimated by myrtle rust. Botanic Gardens. https://www.botanicgardens.org.au/discover-and-learn/watch-listen-read/genetics-helping-save-plant-species-decimated-myrtle-rust

DSDILGaP. (2023). ShapingSEQ South East Queensland Regional Plan. Brisbane: Department of State Development, Infrastructure, Local Disclaimer Government and Planning.

Eyre TJ, Ferguson DJ, Smith GC, Mathieson MT, Venz MF, Hogan, LD, Hourigan CL, Kelly, AL & Rowland, J. 2022. Terrestrial Vertebrate Fauna Survey Assessment Guidelines for Queensland, Version 4.0. Brisbane: Department of Environment and Science, Queensland Government.

Eyre, T. J. (2004). Distribution and conservation status of the possums and gliders of southern Queensland. In R. L. Goldingay, & S. M. Jackson, The Biology of Australian Possums and Gliders (pp. 1–25). Chipping Norton: Surrey Beatty and Sons.

Eyre, T. J., & Smith, A. P. (1997). Floristic and structural habitat preferences of yellow-bellied gliders (*Petaurus australis*) and selective logging impacts in southeast Queensland, Australia. Forest Ecology and Management, 281-295.

Eyre, T. J., Kelly, A. L., Neldner, V. J., Wilson, B. A., Ferguson, D. J., Laidlaw, M. J., & Franks, A. J. (2015). BioCondition Manual A Condition Assessment Framework for Terrestrial Biodiversity in Queensland Assessment. Brisbane: The State of Queensland (Department of Science, Information Technology, Innovation and the Arts).

Floyd AG (1990) Australian rainforests in New South Wales. Surrey Beatty and Sons, Sydney

Forshaw, J, and Cooper, W (2002). ‘Australian Parrots’. Alexander Editions: Robina, Qld.

Frankham, G. J., Reed, R. L., Fletcher, T. P., & Handasyde, K. A. (2011). Population ecology of the long nosed potoroo (*Potorous tridactylus*) on French Island, Victoria. Australian Mammalogy, 73-81.

Franks, A., & Franks, S. (2006). Nest Boxes for Wildlife: A Practical Guide. Melbourne: Blooming Books.

French, K., & Zubovic, A. (1997). Effect of the Weed *Chrysanthemoides monilifera* (Bitou Bush) on Bird Communities. Wildlife Research, 24(6), 727-735.

Garnett, S. T., & Crowley, G. M. (2000). The Action Plan for Australian Birds 2000. Canberra: Environment Australia.

Garnett, S. T., Szabo, J. K., & Dutson, G. (2011). The Action Plan for Australian Birds 2010. CSIRO Publishing: Collingwood, Victoria.

Garnett, S., Pedler, L., & Crowley, G (1999). The breeding biology of the Glossy Black-Cockatoo *Calyptorhynchus lathami* on Kangaroo Island, South Australia. Emu 99, 262-279.

Glossy Black Conservancy. (2010). Glossy Black Cockatoo Conservation Guidelines: For South Eastern Queensland and far North-Eastern New South Wales. Glossy Black Conservancy.

Goldingay RL, Rohweder D & Taylor BD (2020) Nest box contentions: Are nest boxes used by the species they target? Ecological Management & Restoration 21, 115-122.

Goldingay, R. L., and Quin, D. G. (2004). Components of the habitat of the yellow-bellied glider in north Queensland. In ‘The Biology of Australian Possums and Gliders’. (Eds R. L. Goldingay and S. M. Jackson.) pp. 369–375. (Surrey Beatty: Sydney.).

Goldingay, R. L., Carthew, S. M., & Daniel, M. (2018). Characteristics of the den trees of the yellow-bellied glider in western Victoria. Australian Journal of Zoology.

Goldingay, R., Kavanagh, R. (1993) Home-range estimates and habitat of the yellow-bellied glider (*Petaurus australis*) at Waratah Creek, New South Wales. Wildlife Research. 20(3) 387-403.

Griffiths, S., Lentini, P., Semmens, K., Watson, S. J., Lumsden, L., & Robert, K. A. (2018). Chainsaw-Carved Cavities Better Mimic the Thermal Properties of Natural Tree Hollows than Nest Boxes and Log Hollows. Forests.

Griffiths, S. (2019). Preliminary Investigations into the Effectiveness of Chainsaw-Carved Hollows. Treenet.

Griffiths, S. R., Robert, K. A., & Jones, C. S. (2022). Chainsaw hollows carved into live trees provide well insulated supplementary shelters for wildlife during extreme heat. Wildlife Research, 596-609.

Gympie Regional Council (2020) koala Habitat Rehabilitation Guidelines

Hamley, T., Flower, P., & Smith, G. C. (1997). Present and past distribution of the black-breasted button-quail *Turnix melanogaster* (Gould) in Queensland. Sunbird, 27, 1–21.

Higgins, P. J. (1999). Handbook of Australian, New Zealand and Antarctic Birds. Volume 4: Parrots to Dollarbird. Oxford University Press.

Hofman, M., Gracanin, A., & Mikac, K. (2022). greater glider (*Petauroides volans*) den tree and hollow characteristics. Australian Mammalogy.

Hollow Log Homes. (2024). Nesting Boxes For Wildlife In Australia. Retrieved from Hollow Log Homes: https://www.hollowloghomes.com.au/

Howell, L. G., Clulow, J., Jordan, N. R., Beranek, C. T., Ryan, S. A., Roff, A., & Witt, R. R. (2021). Drone thermal imaging technology provides a cost-effective tool for landscape-scale monitoring of a cryptic forest-dwelling species across all population densities. Wildlife Research, 66-78.

Incoll, R. D., Loyn, R. H., Ward, S. J., Cunningham, R. B., & Donnelly, C. F. (2001). The occurrence of gliding possums in old-growth forest patches of Mountain Ash (*Eucalyptus regnans*) in the Central Highlands of Victoria. Biological Conservation, 77-88.

Johnstone, R. E., & Kirkby, T. (2019). *Black Cockatoo Research Project – Final Report for Housing Authority 2019*. Western Australian Museum. Retrieved August 29, 2025, from Western Australian Museum website

Kavanagh, R. P., & Lambert, M. (1990). Food selection by the greater glider: is foliar nitrogen a determinant of habitat quality? Australian Wildlife Research, 17, 285–299.

Kavanagh, R. P., Debus, S., Tweedie, T., & Webster, R. (1995). Distribution of nocturnal forest birds and mammals in north-eastern New South Wales: relationships with environmental variables and management history. Wildlife Research, 359–377.

Kavanagh, R. P., Mclean, C., & Stanton. (2021). greater glider and Yellow-bellied Glider population responses to the 2019-2020 wildfires in north-eastern NSW and south-eastern NSW. Canberra: Unpublished Report to the Department of Agriculture, Water and Environment.

Kehl, J., & Borsboom, A. (1984). Home range, den tree use and activity patterns in the greater glider (*Petauroides volans*). In A. P. Smith, & I. D. Hume, Possums and Gliders (pp. 229–236). Chipping Norton: Surrey Beatty and Sons.

Keith D (2004) ‘Ocean shores to desert dunes - the native vegetation of New South Wales and the ACT’. (NSW Department of Environment and Conservation: Hurstville, NSW).

Land for Wildlife South-east Queensland (LFWSEQ) (2023) Land for Wildlife Newsletter August 2023, 17 (3). URL: https://www.lfwseq.org.au/wp-content/uploads/2023/08/J019093-LfW-August-2023_Web.pdf.

Landcare SJ Inc. (n.d.) 2025. *Cockatube artificial nest boxes saving Black Cockatoos*. Available online at <https://landcaresj.com.au/cockatubes-saving-black-cockatoos/>.

Makinson RO, Pegg GS, Carnegie AJ, (2020) Myrtle Rust in Australia – a National Action Plan, Australian Plant Biosecurity Science Foundation, Canberra, Australia.

Marchant, S., & Higgins, P. J. (1993). Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings. Melbourne: Oxford University Press.

Martin, D., & Temple-Smith, P. (2012). National recovery plan for the long-nosed potoroo *Potorous tridactylus tridactylus*. Melbourne: Victorian Government.

Maseyk, F. J., Evans, M. C., & Maron, M. (2017). Guidance for deriving ‘Risk of Loss’ estimates when evaluating biodiversity offset proposals under the EPBC Act. Brisbane: The University of Queensland.

Mathieson, M. T., & Smith, G. C. (2009). National recovery plan for the buff-breasted button-quail *Turnix olivii*. Report to Department of the Environment, Water, Heritage and the Arts, Canberra. Brisbane: Department of Environment and Resource Management.

McNaught, I., Thackway, R., Brown, L., & Parsons, M. (2006). A field manual for surveying and mapping nationally significant weeds. Bureau of Rural Sciences, Canberra.

Meek, P., Ballard, G., & Flemming, P. (2012). An introduction to camera trapping for wildlife surveys in Australia. Orange: NSW Department of Primary Industries.

Menkhorst P, Rogers D, Clarke R, Davies J, Marsack P & Franklin K (2017) The Australian Bird Guide. CSIRO Publishing, Clayton South.

Milledge, D. R., Palmer, C. L., & Nelson, J. L. (1991). Barometers of change: the distribution of large owls and gliders in Mountain Ash forests of the Victorian Central Highlands and their potential as management indicators. Conservation of Australia's forest fauna Royal Zoological Society of New South Wales, 55-65.

Mooney, P and Pedler, L (2005). Recovery plan for the South Australian subspecies of the Glossy Black-Cockatoo (*Calyptorhynchus lathami halmaturinus*): 2005-2010. Department of Environment and Heritage: South Australia.

Nilar, H., Maute, K., Dawson, M.J., Scarborough, R., Hudson, J., Reay, J. and Gooden, B (2019). Effectiveness of different herbivore exclusion strategies for restoration of an endangered rainforest community. Forest Ecology and Management. 435, 18-26.

North HM, Lamont RW, Ogbourne SM & Conroy GC (2020) Feeding profitability is associated with glossy black-cockatoo (*Calyptohynchus lathami ssp. lathami*) feed tree selection. Emu. DOI:10.1080/01584197.2020.1812405.

Norton, M. A., French, K., & Claridge, A. W. (2010). Habitat associations of the long-nosed potoroo (*Potorous tridactylus*) at multiple spatial scales. Australian Journal of Zoology, 303–316.

NSW Government. (2018). long-nosed potoroo *Potorous tridactylus*. Sydney: Office of Environment and Heritage.

Pegg GS, Giblin FR, McTaggart AR, Guymer GP, Taylor H, Ireland KB, Shivas RG, Perry S (2014) *Puccinia psidii* in Queensland, Australia: disease symptoms, distribution and impact. Plant Pathology 63, 1005–1021.

Pizzey G and Knight F (1997). Field Guide to the Birds of Australia. Angus and Robertson, Australia.

PlantNET (The NSW Plant Information Network System). Royal Botanic Gardens and Domain Trust, Sydney. https://plantnet.rbgsyd.nsw.gov.au [accessed 19 December 2024]

Queensland CRA/RFA Steering Committee. (1998). Survey of Threatened Plant Species in South East Queensland Biogeographical Region. Queensland Department of Environment.

Queensland Government. (2024, May 20). Species profile—*Sophora fraseri* (brush sophora). Retrieved from Species information: https://apps.des.qld.gov.au/species-search/details/?id=10791#:~:text=Sophora%20fraseri%20is%20a%20subtropical,a%20range%20of%20rainforest%20types.

Queensland Hydro (2025). Preliminary Documentation for the Borumba Pumped Hydro Energy Storage Project-Exploratory Works Preliminary Documentation. An unpublished report to Department of Climate Change, Energy, the Environment and Water.

Rees, M., Paull, D. J., & Carthew, S. M. (2007). Factors influencing the distribution of the yellow-bellied glider (*Petaurus australis australis*) in Victoria, Australia. Wildlife Research, 228-233.

Reuugger, N. (2017). Artificial tree hollow creation for cavity-using wildlife – Trialling an alternative method to that of nest boxes. Forest Ecology and Management, 404-412.

Rhind, S., Ellis, M., Smith, M. and Lunney, D. (2014) Do koalas *Phascolarctos cinereus* use trees planted on farms? A case study from north-west New South Wales, Australia. Pacific Conservation Biology, 20(3), 302-312.

Rowland, J. A., Briscoe, N. J., & Handsasyde, K. A. (2017). Comparing the thermal suitability of nest-boxes and tree-hollows for the conservation-management of arboreal marsupials. Biological Conservation, 341-348.

Schodde R, Mason IJ & Wood JT (1993) Geographical Differentiation in the Glossy Black Cockatoo *Calyptorhynchus lathami* (Temminck) and its History. Emu 93, 3, 156-166.

Seabrook, L., McAlpine, C., Baxter, G., Rhodes, J., Bradley, A., & Lunney, D. (2011). Drought-driven change in wildlife distribution and numbers: a case study of koalas in south west Queensland. Wildlife Research, 509-52.

Smith, G. C., Mathieson, M., & Hogan, L. (2007). Home range and habitat use of a low-density population of greater gliders, *Petauroides volans* (Pseudocheiridae: Marsupialia), in a hollow-limiting environment. Wildlife Research, 472-483.

State of Queensland (2022). Conserving Nature – a Biodiversity Conservation Strategy for Queensland.

Terry, W., Goldingay, R. L., & van der Ree, R. (2021). Can chainsaw carved hollows provide an effective solution to the loss of natural tree cavities for arboreal mammals? Forest Ecology and Management.

Threatened Species Scientific Committee (TSCC) (2020). Conservation Advice for *Rhodamnia rubescens* scrub turpentine.

Threatened Species Scientific Committee (TSSC) (2015). Conservation Advice *Turnix melanogaster* black-breasted button-quail.

Trent, S. W. (2015). Assessment of habitat factors and development of a species distribution model for the long nosed potoroo (*Potorous tridactylus tridactylus*) in SEQ. Masters of Science.

van der Ree, R., Ward, S. J., & Handasyde, K. A. (2004). Distribution and conservation status of possums and gliders in Victoria. In R. L. Goldingay, & S. M. Jackson, The Biology of Australian Possums and Gliders (p. 91−110). Sydney: Surrey Beatty and Sons.

Vinson, S. G., Johnson, A. P., & Mikac, K. (2020). Thermal cameras as a survey method for Australian arboreal mammals: a focus on the greater glider. Australian Mammalogy.

Ward, S (2024) Recent biodiversity offsets change in NSW: A perverse outcome? https://www.emmconsulting.com.au/news-and-insights/recent-biodiversity-offsets-change-in-nsw-a-perverse-outcome

Whisson, D. A., McKinnon, F., Lefae, M., & Rendall, A. R. (2021). Passive acoustic monitoring for detecting the Yellow-bellied Glider, a highly vocal arboreal marsupial. PLoS ONE.

Woinarski, J. C., Burbidge, A. A., & Harrison, P. L. (2014). The Action Plan for Australian Mammals 2012. Collingwood: CSIRO Publishing.

Appendix A
Impact area and offset area surveys

A-1 Impact area survey effort

As presented in the Preliminary Documentation (Queensland Hydro 2024) and summarised below in Table A-1 and Table A-2, a range of seasonal terrestrial and aquatic ecology surveys have been completed associated with the Borumba PHES Main Works EIS and Exploratory Works Project EPBC referral. Surveys have been completed by SMEC, Umwelt, Hydrobiology and Attexo with relevant dates and survey methods outlined in Table A-1 and Table A-2.

Surveys have confirmed vegetation communities present within the disturbance footprint, presence, or potential presence of threatened species under EPBC Act and habitat suitability.

Further detail regarding the full extent of survey methods and effort is provided in Section 4.1 of the Borumba Pumped Hydro Energy Storage Project – Exploratory Works Preliminary Documentation (Queensland Hydro, 2024).

Table A-1: Flora surveys undertaken in disturbance footprint for Borumba PHES and Exploratory Works Projects

Method	Target MNES	Team	Survey length	Survey date	Survey effort	Total survey effort
Quaternary and secondary vegetation surveys	TECs and threatened flora	SMEC	2 days	April 2022	18 quaternary sites	578 quaternary sites 31 secondary sites
		Umwelt	2 days	21 – 22 June 2022	20 quaternary sites	
		Umwelt	1 day	18 July 2022	10 quaternary sites	
		Attexo	5 days	8-12 August 2022	31 quaternary sites	
		Attexo	4 days	13-16 September 2022	12 quaternary sites 14 secondary sites	
		SMEC	1 day	October 2022	3 quaternary sites	
		Attexo	2 days	3-4 November 2022	14 quaternary sites	
		Umwelt	5 days	7 – 11 November 2022	50 quaternary sites	
		Umwelt	4 days	5 – 8 December 2022	40 quaternary sites	
		Attexo	8 days	14 – 21 December 2022	13 quaternary sites	
		Umwelt	3 days	18 – 20 January 2023	30 quaternary sites 4 secondary sites	
		Umwelt	1 day	24 January 2023	2 secondary sites	
		Umwelt	3 days	19-21 July 2023	40 quaternary sites	
		Umwelt	3 days	21-23 November 2023	40 quaternary sites 3 secondary sites	
		Umwelt	4 days	11-14 December 2023	40 quaternary sites	
		Attexo	9 months	December 2023 – August 2024	100 quaternary sites	
		Umwelt	10 days	5-16 February 2024	80 quaternary sites 8 secondary sites	
		Umwelt	1 day	1 March 2024	3 quaternary sites	
		Umwelt	3 days	12-14 March 2024	20 quaternary sites	

Method	Target MNES	Team	Survey length	Survey date	Survey effort	Total survey effort
		EMM	5 days	29 July 2024 – 2 August 2024	14 quaternary sites	
Protected plant survey	Threatened flora	SMEC	2 days	April 2022	9 meanders	230 meanders
		SMEC	4	May 2022	6 meanders	
		SMEC	3 days	22 – 24 June 2022	5 meanders	
		Attexo	5 days	8-12 August 2022	5 meanders	
		Attexo	2 days	3-4 November 2022	5 meanders	
		Attexo	9 months	December 2023 – August 2024	200 meanders	
BioCondition survey	TEC	Umwelt	5 days	7-11 November 2022	26 Biocondition	166 Biocondition
		Attexo	9 months	December 2023 – August 2024	120 Biocondition	
		EMM	5 days	1 – 5 July 2024	5 Biocondition	
		EMM	5 days	8 – 12 July 2024	5 Biocondition	
		EMM	2 days	2 - 3 July 2025	3 Biocondition	
		EMM	2 days	7, 10 July 2025	3 Biocondition	
		EMM	2 days	14, 17 July 2025	4 Biocondition	

Table A-2: Fauna surveys undertaken in disturbance footprint for Borumba PHES and Exploratory Works Projects

Method	Target MNES	Team	Survey length	Survey date	Survey effort	Total survey effort
Habitat assessments	All MNES	Umwelt	5 days	4 – 8 May 2022	40 sites	240 sites
		Attexo	5 days	8 – 12 August 2022	9 sites	
		Attexo	2 days	3-4 November 2022	5 sites	
		Umwelt	5 days	5 - 9 December 2022	46 sites	
		Umwelt	11 days	11 - 21 December 2022	100 sites	
		SMEC	5 days	1-5 July 2024	40 sites	
Koala Spot Assessment Technique (SAT) points	Koala	Umwelt	4 days	30 May – 2 June 2022	12 sites	12 sites
Active diurnal searches	Koala Yellow-bellied glider (south-eastern) Greater glider (southern and central) Glossy black-cockatoo (south-eastern) Black-breasted button-quail Spotted-tail quoll (SE mainland population) Long-nosed potoroo (northern) Grey-headed flying-fox (*Pteropus poliocephalus)*	Umwelt	5 days	4 – 8 May 2022	41 sites (8.13 hours)	81 sites (28.13 hours)
		SMEC	5 days	1-5 July 2024	40 sites (20 hours)	
Spotlighting surveys	Koala Greater glider (southern and central)	Umwelt	3 nights	30 May – 2 June 2022	25 sites (5 hours)	91.28 hours
		Umwelt	4 nights	5 – 9 December 2022	25 sites (5 hours)	

Method	Target MNES	Team	Survey length	Survey date	Survey effort	Total survey effort
	Yellow-bellied glider (south-eastern) Long-nosed potoroo (northern) Grey-headed flying-fox Giant barred frog (*Mixophyes iteratus)*	Umwelt	4 nights	5 – 9 February 2024	25 sites (4.28 hours)	
		EMM	4 nights	1 – 4 July 2024	45 hours	
		EMM	2 nights	17 –18 July 2024	32 hours	
Call playback	Koala Yellow-bellied glider (south-eastern) Giant barred frog	Umwelt	3 nights	30 May – 2 June 2022	1 hour	4 hours
		Umwelt	4 nights	5 – 9 December 2022	1 hour	
		SMEC	4 nights	1-4 July 2024	1 hour	
		Umwelt	4 nights	5 – 9 February 2024	1 hour	
Acoustic bat call detection	Grey-headed flying-fox	Umwelt	5 days	4 – 8 May 2022	50 trap nights	133 trap nights
		Umwelt	4 days	30 May –2 June 2022	33 trap nights	
		Umwelt	11 days	11 – 21 December 2022	50 trap nights	
Bioacoustic surveys	Koala Yellow-bellied glider (south-eastern) Giant barred frog Fleay's barred frog (*Mixophyes fleayi*) Cascade tree frog (*Litoria pearsoniana*) Tusked frog (*Adelotus brevis*)	Umwelt	5 days	5 – 9 December 2022	300 trap nights	1,298 trap nights
		Umwelt	11 days	11 – 21 December 2022	563 trap nights	
		Umwelt	4 days	17 – 20 January 2023	300 trap nights	
		SMEC	1 day	18 June 2024	135 trap nights	
Targeted amphibian surveys	Giant barred frog	Umwelt	11 days	11 – 21 December 2022	7 sites	7 sites
Diurnal bird surveys	Glossy black-cockatoo (south-eastern) –	Umwelt	5 days	4- 8 May 2022	31 sites (2 hours)	6.39 hours (91 sites)

Method	Target MNES	Team	Survey length	Survey date	Survey effort	Total survey effort
	Black-breasted button-quail Australian painted-snipe (*Rostratula australis)* Squatter pigeon (*Geophaps scripta)* White-throated needletail (*Hirundapus caudacutus*) Red Goshawk (*Erythrotriorchis radiatus)* Coxen's fig-parrot (*Cyclopsitta diophthalma coxeni*)	Umwelt	11 days	11 – 21 December 2022	60 sites (4.39 hours)	
Camera trapping	Koala Greater glider (southern and central) Yellow-bellied glider (south-eastern) Long-nosed potoroo (northern) Spotted-tail quoll (SE mainland population) Black-breasted button-quail	Umwelt	4 nights	4 – 8 May 2022	503 trap nights	2,888 trap nights
		Umwelt	3 nights	30 May – 2 June 2022	450 trap nights	
		Umwelt	10 nights	11 – 21 December 2022	1100 trap nights	
		Umwelt	3 nights	17 – 20 January 2023	450 trap nights	
		SMEC	12 nights	8 -19 July 2024	360 trap nights	
		EMM	25 nights	14 July – 7 August 2025	25 nights	
Elliot trap surveys	Long-nosed potoroo (northern) Spotted-tail quoll (SE mainland population)	Umwelt	3 nights	30 May – 2 June 2022	155 trap nights	855 trap nights
		Umwelt	10 nights	11 – 21 December 2022	700 trap nights	
Pitfall trapping	Reptiles Amphibians	Umwelt	4 nights	11–15 March 2024	107 trap nights	295 trap nights
		Umwelt	4 nights	18-22 March 2024	188 trap nights	

A-2 Offset area survey effort

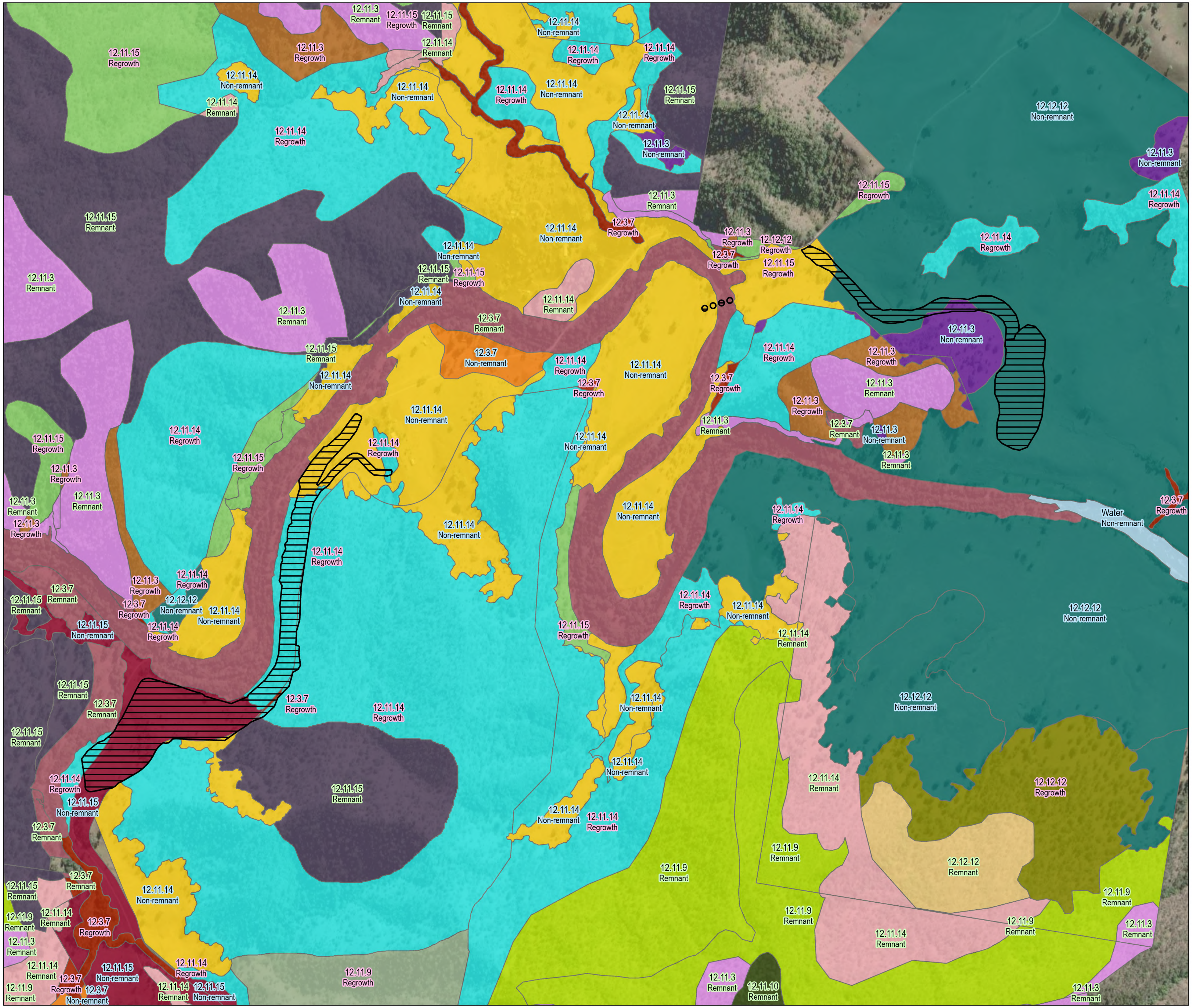
In addition to the surveys described in Section A-1 that relate to the Borumba PHES Project area, which are in close proximity to proposed offset areas, there have been additional ecology surveys carried out from February 2024 targeting potential offset areas. These surveys have been led by suitably qualified ecologists from SMEC, Attexo and EMM to assess potential offset areas and their suitability to meet the Exploratory Works MNES offset requirements.

These surveys have included confirmation of vegetation communities through quaternary flora survey sites and BioCondition transects, habitat assessments, targeted threatened flora and fauna surveys and pest animal surveys.

A broad summary of the field ecology surveys completed associated with offset areas is summarised in Table A-3.

Table A-3: Offset area survey effort summary

Survey method	Timing	Survey effort
Spotlighting (person hours) Targeting greater glider, koala, yellow-bellied glider	July and November 2024, August 2025	153 person hours
Call playback (hours) Targeting yellow-bellied glider	July and November 2024, August 2025	3 person hours
Cameras to detect pest animals on offset areas (trap nights)	June – July 2024 November – December 2024 July – August 2025	610 trap nights
Diurnal searches (hours)	October and November 2024	68
Vegetation surveys (includes BioCondition, quaternary and secondary)	February – December 2024	91 BioCondition sites (not all used in the HQ calculations) 88 Quaternary sites
Modified habitat quality assessments	June – December 2024 July 2025	42 sites for impact and 91 sites for offset areas (not all used in the HQ calculations)
Thermal drone surveys (no. of nights and hectares covered)	16 July 2024	1 night (covered 155 ha)



Queensland Hydro

GDA2020 MGA Zone 56

N

0 260 m

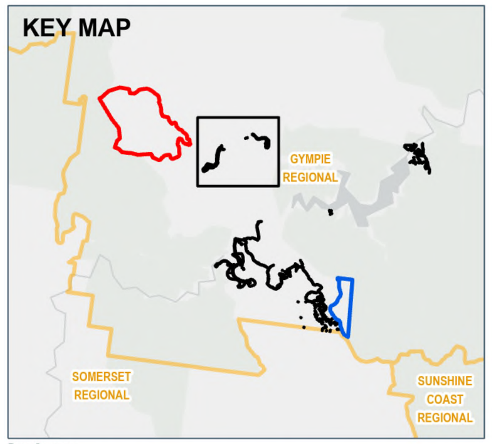
1:10,000 @ A3

LEGEND

Exploratory Works Project Footprint (EPBC Only)

Ground-truthed Vegetation

- 12.11.10,Remnant
- 12.11.14,Non-remnant
- 12.11.14,Regrowth
- 12.11.14,Remnant
- 12.11.15,Non-remnant
- 12.11.15,Regrowth
- 12.11.15,Remnant
- 12.11.3,Non-remnant
- 12.11.3,Regrowth
- 12.11.3,Remnant
- 12.11.9,Regrowth
- 12.11.9,Remnant
- 12.12.12,Non-remnant
- 12.12.12,Regrowth
- 12.12.12,Remnant
- 12.3.7,Non-remnant
- 12.3.7,Regrowth
- 12.3.7,Remnant
- Water,Non-remnant



Data Sources:
1. Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

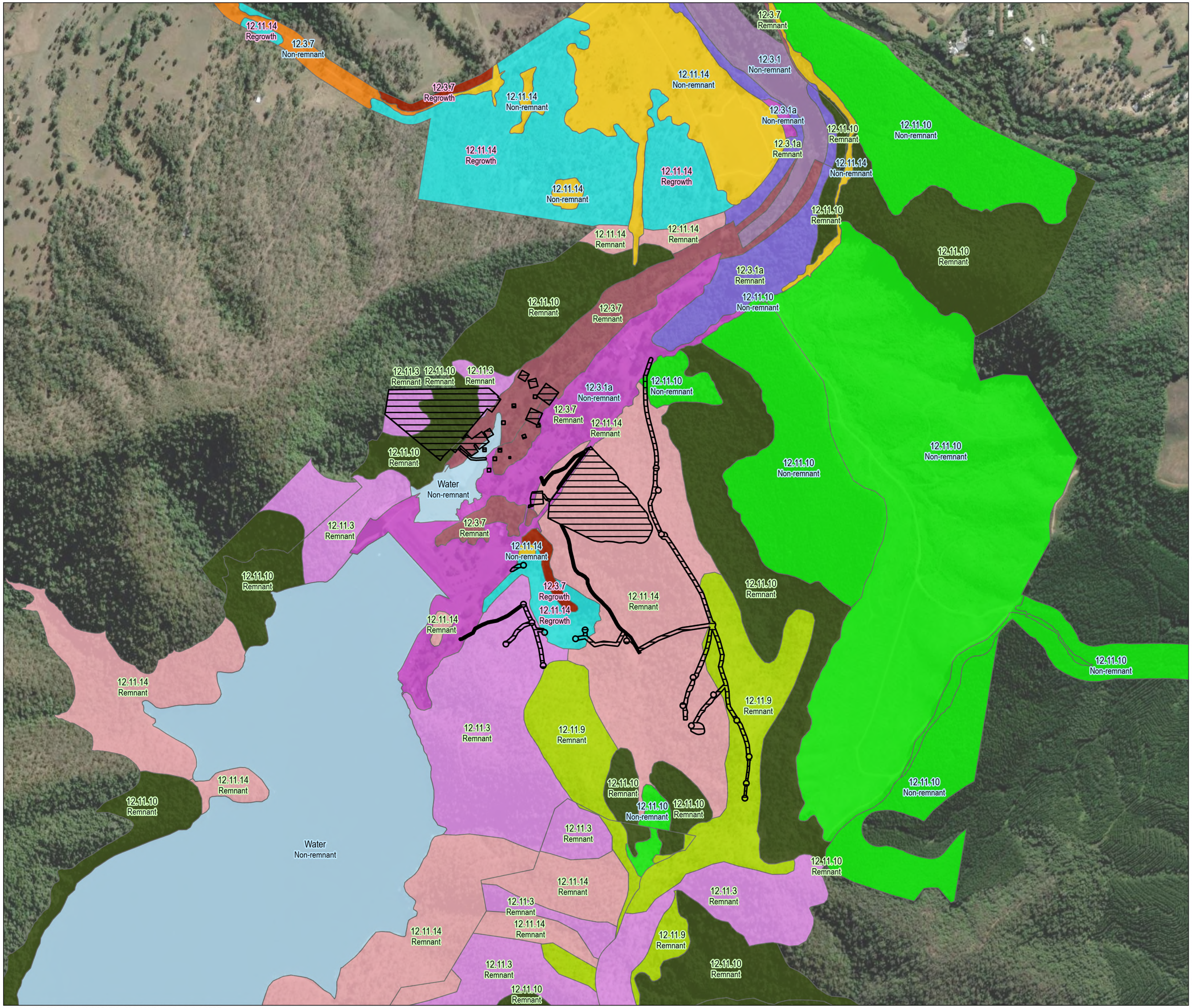
Borumba PHES Project
Offset Area Management Plan

GROUND-TRUTHED REGIONAL ECOSYSTEM WITHIN THE DISTURBANCE FOOTPRINT

PROJECT NO: 30032677
CREATED BY: NC17428
MODIFIED ON: 28/08/2025
VERSION: A
AMENDED BY: NC17428

FIGURE A-A

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\AppendixA-GTRE



Queensland Hydro

GDA2020 MGA Zone 56

N

0 260 m

1:10,000 @ A3

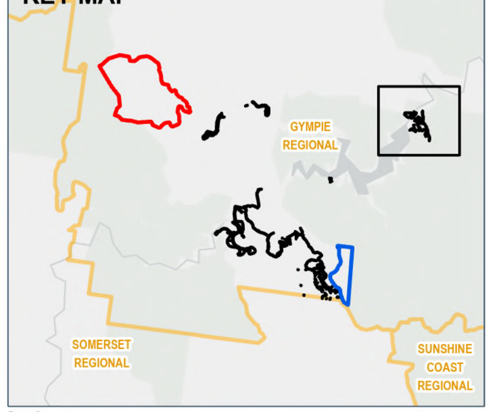
LEGEND

Exploratory Works Project Footprint (EPBC Only)

Ground-truthed Vegetation

- 12.11.10,Non-remnant
- 12.11.10,Remnant
- 12.11.14,Non-remnant
- 12.11.14,Regrowth
- 12.11.14,Remnant
- 12.11.3,Remnant
- 12.11.9,Remnant
- 12.3.1,Non-remnant
- 12.3.1a,Non-remnant
- 12.3.1a,Remnant
- 12.3.7,Non-remnant
- 12.3.7,Regrowth
- 12.3.7,Remnant
- Water,Non-remnant

KEY MAP



Data Sources:
1. Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

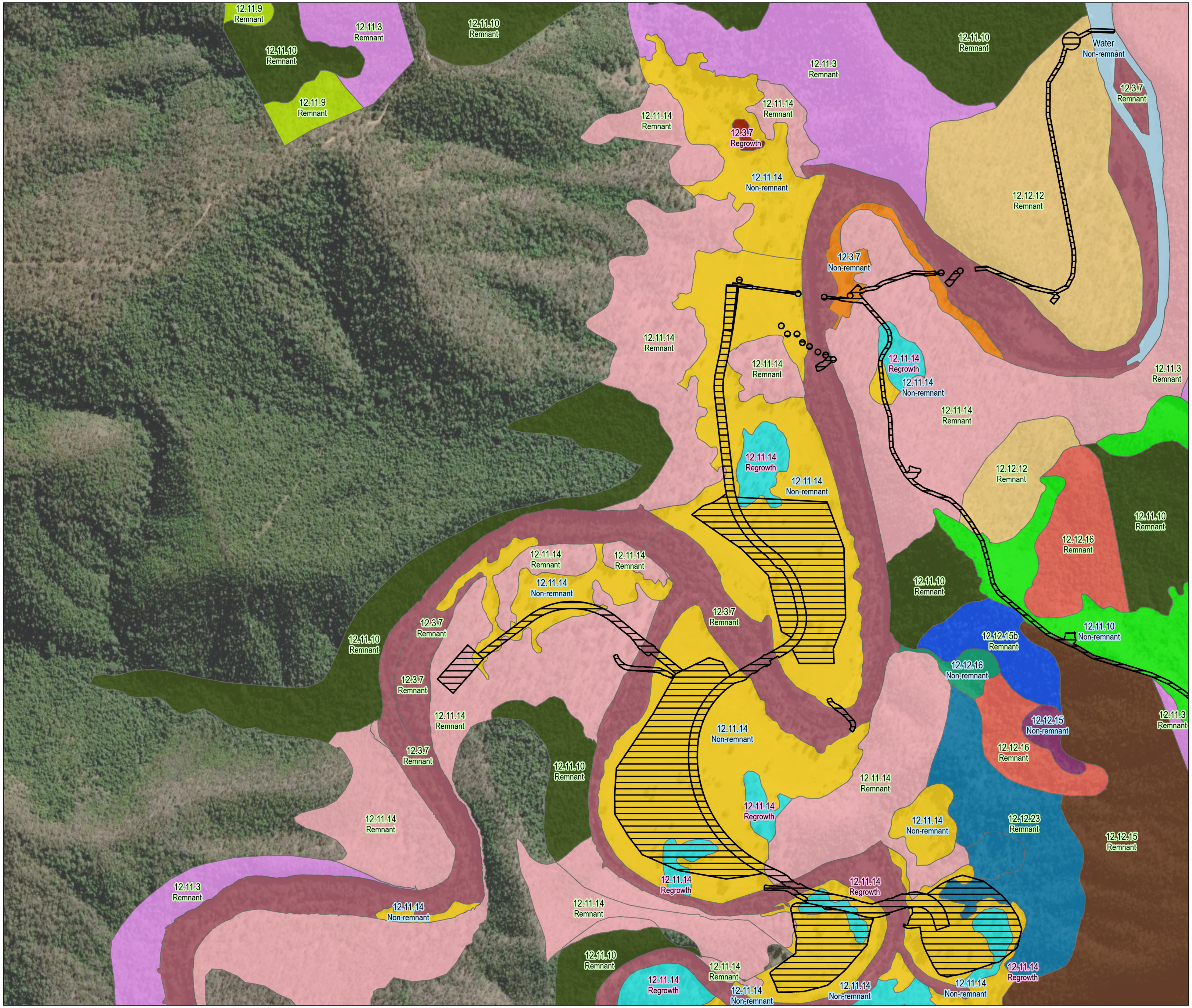
Borumba PHES Project
Offset Area Management Plan

GROUND-TRUTHED REGIONAL ECOSYSTEM WITHIN THE DISTURBANCE FOOTPRINT

PROJECT NO: 30032677
CREATED BY: NC17428
MODIFIED ON: 28/08/2025
VERSION: A
AMENDED BY: NC17428

FIGURE A-B

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\AppendixA-GTRE



Queensland Hydro

GDA2020 MGA Zone 56

N

0 260 m

1:10,000 @ A3

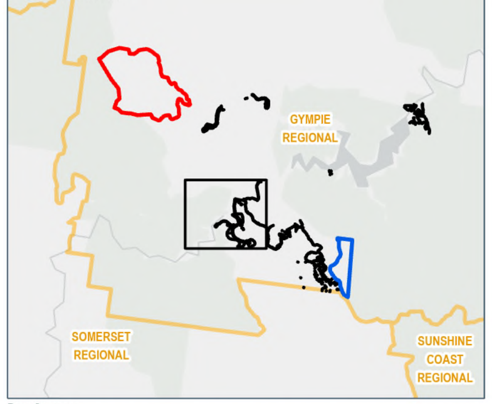
LEGEND

Exploratory Works Project Footprint (EPBC Only)

Ground-truthed Vegetation

- 12.11.10,Non-remnant
- 12.11.10,Remnant
- 12.11.14,Non-remnant
- 12.11.14,Regrowth
- 12.11.14,Remnant
- 12.11.3,Remnant
- 12.11.9,Remnant
- 12.12.12,Remnant
- 12.12.15,Non-remnant
- 12.12.15,Remnant
- 12.12.15b,Remnant
- 12.12.16,Non-remnant
- 12.12.16,Remnant
- 12.12.23,Remnant
- 12.3.7,Non-remnant
- 12.3.7,Regrowth
- 12.3.7,Remnant
- Water,Non-remnant

KEY MAP



Data Sources:
1. Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

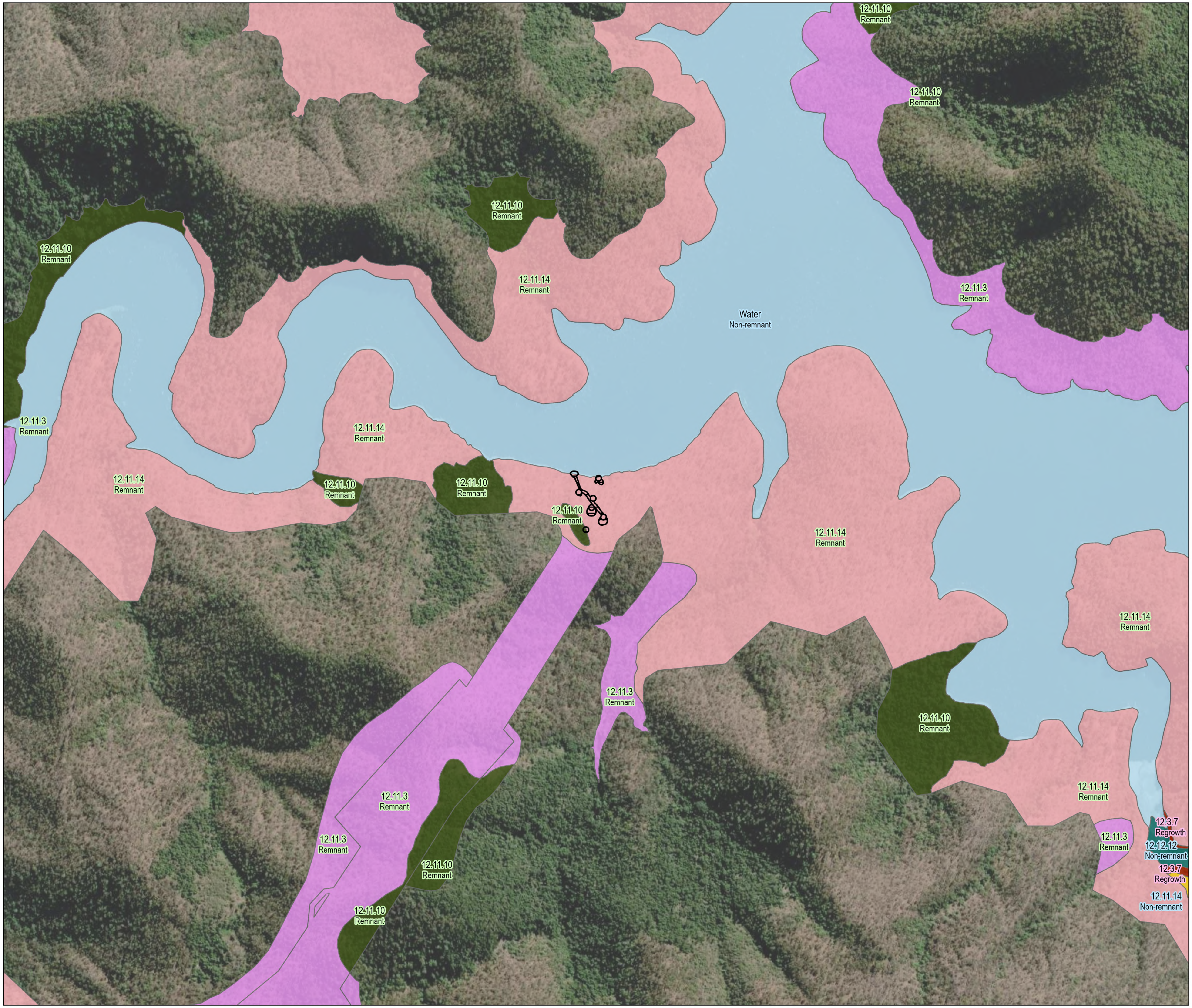
Borumba PHES Project
Offset Area Management Plan

GROUND-TRUTHED REGIONAL ECOSYSTEM WITHIN THE DISTURBANCE FOOTPRINT

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	28/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE A-C

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\AppendixA-GTRE



Queensland Hydro

GDA2020 MGA Zone 56

N

0 260 m

1:10,000 @ A3

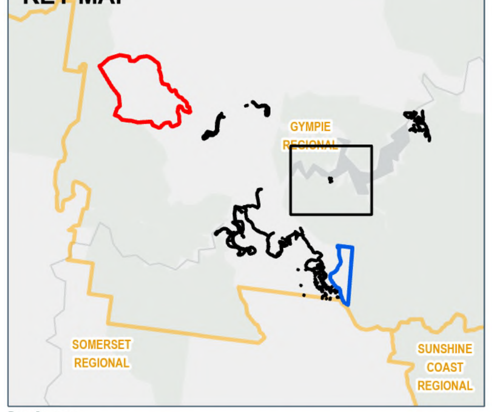
LEGEND

Exploratory Works Project Footprint (EPBC Only)

Ground-truthed Vegetation

- 12.11.10,Remnant
- 12.11.14,Non-remnant
- 12.11.14,Remnant
- 12.11.3,Remnant
- 12.12.12,Non-remnant
- 12.3.7,Regrowth
- Water,Non-remnant

KEY MAP



Data Sources:
1. Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

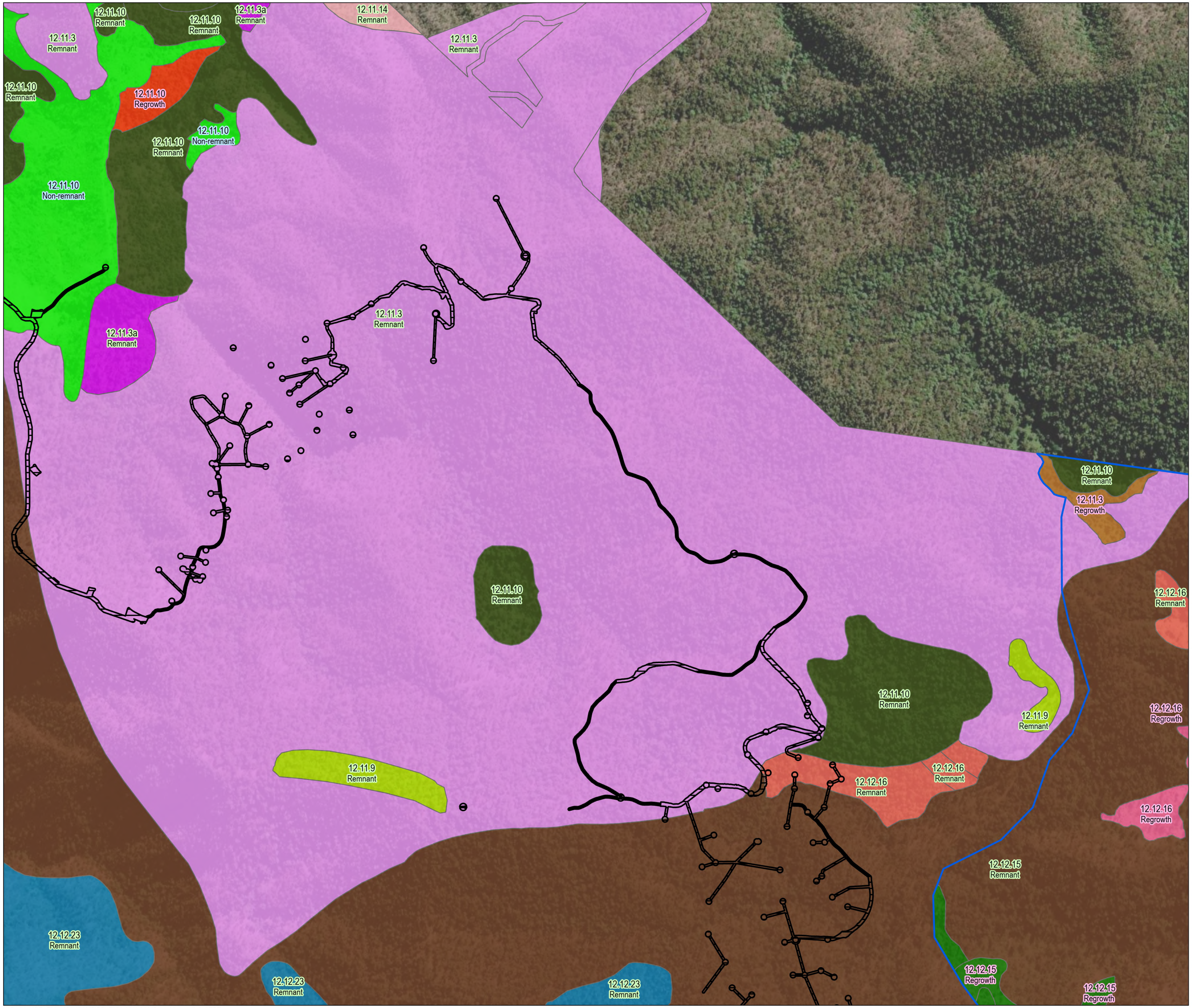
Borumba PHES Project
Offset Area Management Plan

GROUND-TRUTHED REGIONAL ECOSYSTEM WITHIN THE DISTURBANCE FOOTPRINT

PROJECT NO: 30032677
CREATED BY: NC17428
MODIFIED ON: 28/08/2025
VERSION: A
AMENDED BY: NC17428

FIGURE A-D

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\AppendixA-GTRE



V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\AppendixA-GTRE

Queensland Hydro

GDA2020 MGA Zone 56

N

0 260 m

1:10,000 @ A3

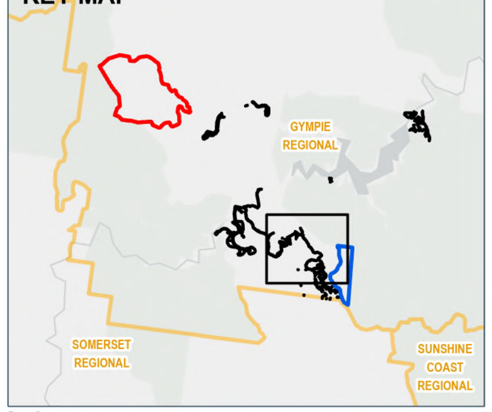
LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Offset Area A

Ground-truthed Vegetation

- 12.11.10,Non-remnant
- 12.11.10,Regrowth
- 12.11.10,Remnant
- 12.11.14,Remnant
- 12.11.3,Regrowth
- 12.11.3,Remnant
- 12.11.3a,Remnant
- 12.11.9,Remnant
- 12.12.15,Regrowth
- 12.12.15,Remnant
- 12.12.16,Regrowth
- 12.12.16,Remnant
- 12.12.23,Remnant

KEY MAP



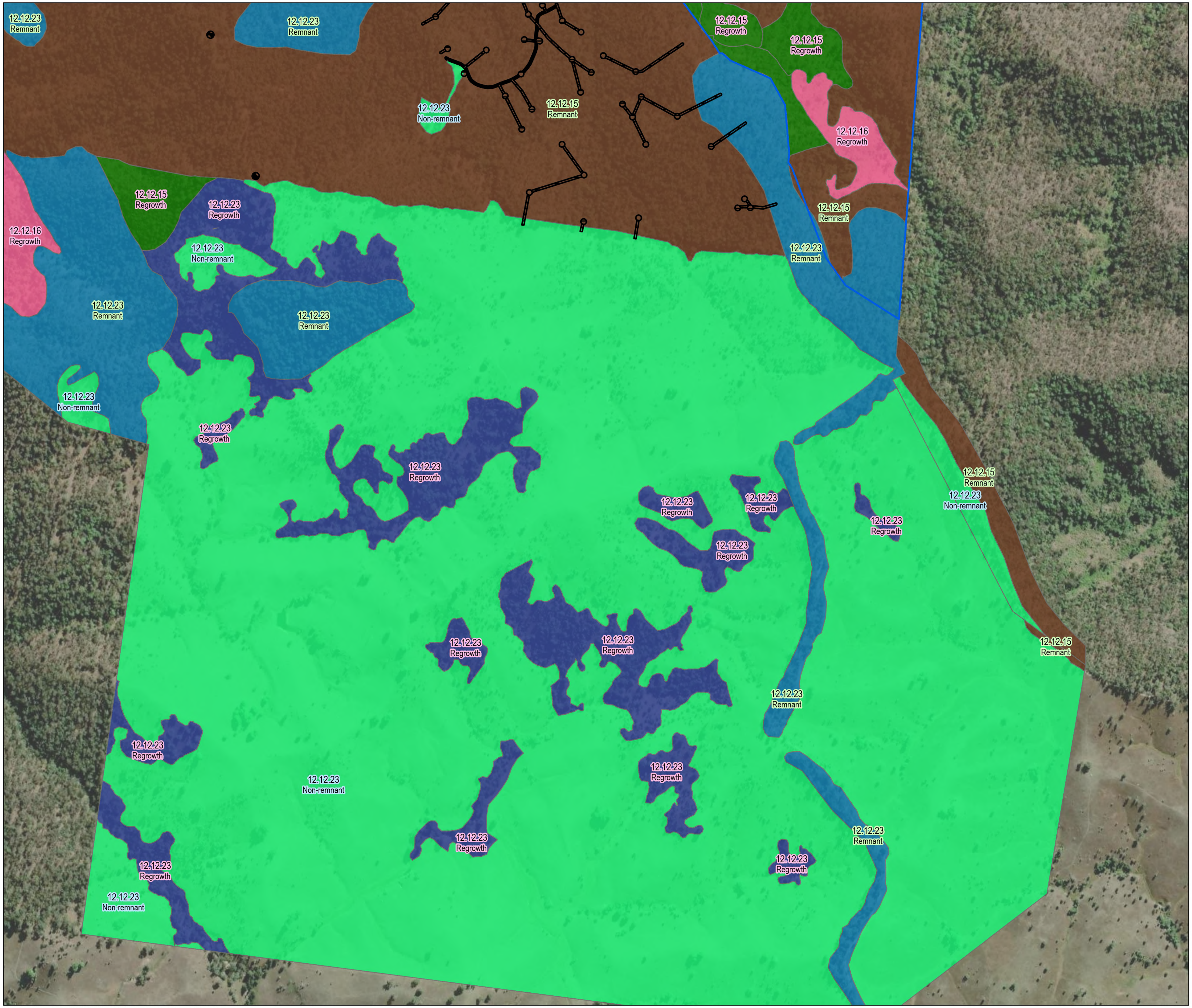
Data Sources:
1. Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

Borumba PHES Project
Offset Area Management Plan

GROUND-TRUTHED REGIONAL ECOSYSTEM WITHIN THE DISTURBANCE FOOTPRINT

PROJECT NO: 30032677
CREATED BY: NC17428
MODIFIED ON: 28/08/2025
VERSION: A
AMENDED BY: NC17428

FIGURE A-E



Queensland Hydro

GDA2020 MGA Zone 56

N

0 260 m

1:10,000 @ A3

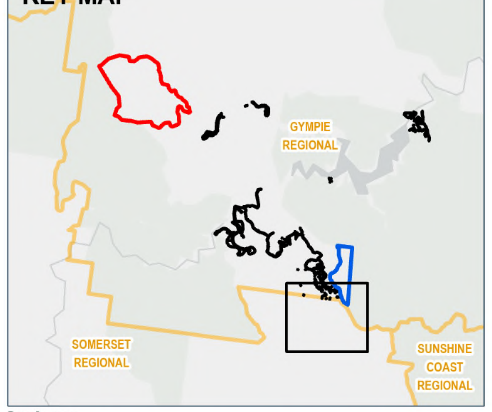
LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Offset Area A

Ground-truthed Vegetation

- 12.12.15,Regrowth
- 12.12.15,Remnant
- 12.12.16,Regrowth
- 12.12.23,Non-remnant
- 12.12.23,Regrowth
- 12.12.23,Remnant

KEY MAP



Data Sources:
1. Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar

Borumba PHES Project
Offset Area Management Plan

GROUND-TRUTHED REGIONAL ECOSYSTEM WITHIN THE DISTURBANCE FOOTPRINT

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	28/08/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE A-F

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\AppendixA-GTRE

Appendix B
Modified habitat quality assessment methodology

Queensland Hydro

Prepared for the Department of Climate Change, Energy, the Environment and Water

Borumba Pumped Hydro Energy Storage Project – Exploratory Works Modified Habitat Quality Assessment

OCTOBER 2025

qldhydro.com.au

Contents

Figures

Tables

Acknowledgement of Country

In the spirit of reconciliation, Queensland Hydro acknowledges the Traditional Custodians of Country throughout Queensland and, in particular the lands, skies and waters on which we operate. We celebrate the diversity of Aboriginal peoples and their ongoing cultures and connections to the lands, skies and waters of Queensland.

Queensland Hydro pays respect to Elders past and present honouring their continuing spiritual and cultural connections to Country.

Acronyms and abbreviations

Acronym / Abbreviation	Definition
BBBQ	Black-breasted Button-quail
BioCondition manual	BioCondition Assessment Manual (Eyre et al. 2015)
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DBH	Diameter at breast height
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
GRC	Gympie Regional Council
ha	Hectare(s)
KMB	Koala Management Bioregion
LGA	Local government area
LIKFT	Locally Important Koala Food Trees
Lowland rainforest TEC	The Lowland Rainforest of subtropical Australia Threatened Ecological Community
MHQA	Modified Habitat Quality Assessment
MNES	Matters of National Environmental Significance
MW	Megawatt
PHES	Pumped Hydro Energy Storage
SHI	Species habitat indices
SIA	Significant impact assessments
SNES	Species of National Environmental Significance
SRI	Significant residual impact
SSR	Species stocking rate
ST	Supplementary table
TEC	Threatened Ecological Community
The guide to habitat quality	Guide to determining terrestrial habitat quality v1.2 (Eyre et al. 2017)

1. Introduction

Background

Queensland Hydro is the proponent of the Borumba Pumped Hydro Energy Storage Project (Borumba PHES Project). The Project is a 2,000 megawatt (MW), 48,000-megawatt hour (MWh) hydroelectric scheme to store, generate and supply energy through a pumped hydroelectric structure linked to the existing Lake Borumba in the Gympie and Somerset Regional Council local government areas (LGA).

The Borumba PHES Project – Exploratory Works (the Exploratory Works Project) refers to the geological investigations, supporting infrastructure and activities needed to inform the development of the separate but related Borumba PHES Project – Main Works. Where key project infrastructure associated with the Main Works (e.g., powerhouse) is proposed for construction, investigation is vital, as geological uncertainty is a significant risk for the Borumba PHES Project. The Exploratory Works Project will determine if the Borumba PHES Project can proceed or if material changes to the Main Works reference design are necessary.

Exploratory Works have been designed to avoid clearing of native vegetation as much as possible, however, some impacts on native vegetation communities and fauna species habitats will be unavoidable. Significant impact assessments (SIA) have been completed for those matters of national environmental significance (MNES) known or with potential to occur in the Exploratory Works Project area, and environmental offsets will be required for those MNES found likely to experience a significant residual impact (SRI).

Environmental offsets will be assessed and delivered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) when required. This report supports the MNES environmental offset assessments and informs the Environmental Offset Area Management Plan.

Objectives

Based on the results of SIAs, several MNES are considered likely to experience an SRI due to the Exploratory Works Project. To determine the offset requirements for these MNES, accurate and repeatable impact and offset area habitat quality scoring is required. Habitat quality scoring not only measures the current ecological condition of MNES habitats on the impact site and offset site, but it also provides guidance for successful management actions to increase habitat quality in the future, and appropriate monitoring to measure those gains throughout subsequent assessment.

As per recent Commonwealth feedback, habitat quality scoring for the Exploratory Works Project will be delivered through application of the ‘Modified Habitat Quality Assessment’ (MHQA) approach, in accordance with the requirements of the EPBC Act Environmental Offsets Policy. The MHQA approach is a Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) adaptation of the existing Queensland Government *Guide to determining terrestrial habitat quality v1.2* (Eyre et al. 2017) (the guide to habitat quality) which is a benchmark derived scoring procedure.

For each MNES, the MHQA will deliver a habitat quality score for the impact area and a starting habitat quality score for the appropriate offset area. These habitat quality scores can then be entered into the EPBC Offset Assessment Guide calculator to support a determination of the total offset provision.

Although most scoring inputs associated with MHQA are prescribed in the guide, several require matter-specific derived ecological assessments to inform accurate scoring. In these circumstances, it is necessary to establish relevant scoring ‘parameters’ for a particular MNES. The primary objectives of this document are to provide the specific scoring procedures used for each relevant MNES, as well as providing sufficient justification for the selected scoring parameters, and score rankings. A description of the overall scoring procedure, along with matter-specific scoring and associated scoring parameters are provided below.

The specific matters assessed as being likely to experience a SRI and therefore requiring detailed habitat quality scoring addressed in this report include:

- Glossy Black-Cockatoo (south-eastern) (*Calyptorhynchus lathami lathami*) – Vulnerable
- Greater Glider (southern and central) (*Petauroides volans*) – Endangered
- Yellow-bellied Glider (south-eastern) (*Petaurus australis australis*) – Vulnerable
- Koala (combined populations of QLD, NSW and the ACT) (*Phascolarctos cinereus*) – Endangered

- Black-breasted Button-quail (*Turnix melanogaster*) – Vulnerable
- Long-nosed Potoroo (northern) (*Potorous tridactylus tridactylus*) - Vulnerable
- Lowland Rainforest of Subtropical Australia – Critically Endangered
- Scrub Turpentine (*Rhodamnia rubescens*) – Critically Endangered
- Brush Sophora (*Sophora fraseri*) - Vulnerable

2. Scoring methodology

The MHQA scoring method relies on detailed assessment of three indicators:

1. site condition
2. site context
3. species stocking rate (SSR).

These indicators are, in turn, comprised of multiple scoring attributes which utilise both site-specific field data and spatially derived data to determine habitat quality. In certain cases, attribute scoring will be undertaken utilising multiple matter-specific parameters. Maximum attribute scores and weightings vary according to matter type (e.g., a Threatened Ecological Community (TEC) or a threatened fauna species)) but the combined attribute scores, once finalised and appropriately weighted, all result in a final habitat quality score out of 10. The maximum possible scores are summarised according to matter group below in Table 1.

Table 1: Maximum indicator scores and weighted scores

Matter group	Site condition		Site context		Species stocking rate	
	Maximum indicator score	Maximum weighted score	Maximum indicator score	Maximum weighted score	Maximum indicator score	Maximum weighted score
Fauna species	*100*	**3**	*56*	**3**	*70*	**4**
TEC	*80*	**7**	*46*	**3**	*NA*	NA
Flora species	*80*	**3**	*46*	**3**	*105*	**4**

Where possible, scores were allocated based on relevant, site-specific data from field surveys. Other scoring methodologies (e.g., evaluation of patch size) were completed via spatial analysis. Scoring of SSR parameters was based on advice and/or mapping provided by DCCEEW, as well as literature review and expert opinion where applicable. Furthermore, additional comparisons to state vegetation community benchmarks or thresholds (Bio Condition Benchmark Database. Version 3.4 (April 2023) (Queensland Herbarium 2023)) were used for scoring where appropriate. All associated benchmarks and thresholds are provided in Appendix A.

The subsequent sections summarise the scoring procedure adopted for each indicator. The exact scoring method for each matter is repeated for both impact and offset areas.

2.1 Site Condition

All site condition scoring attributes and maximum scores are summarised in Table 2.

Table 2: Site condition scoring attributes and maximum scores

Attribute	Maximum score
Recruitment of woody perennial species in EDL	5
Native plant species richness - trees	5
Native plant species richness - shrubs	5
Native plant species richness - grasses	5
Native plant species richness - forbs	5
Tree canopy height	5
Tree canopy cover	5
Shrub canopy cover	5

Attribute	Maximum score
Native grass cover	5
Organic litter	5
Large trees	15
Coarse woody debris	5
Non-native plant cover	10
Quality and availability of food and foraging habitat*	10
Quality and availability of shelter*	10

*Applicable to fauna species only

The Site Condition indicator is primarily associated with pre-determined floristic and structural field data collection with scores derived from comparisons to Queensland Government Regional Ecosystem (vegetation community) benchmark data as per the guide to habitat quality. These data are used for all matter groups and represent the strongest field data component of the scoring method. However, the MHQA approach adds two scoring attributes to this group when assessing fauna species. These two attributes are hereafter referred to collectively as Species Habitat Indices (SHI) and include:

- Quality and availability of food and foraging habitat (max score = 10)
- Quality and availability of shelter (max score = 10)

Scoring of these attributes is derived from species-specific parameters (as many as are considered appropriate) and is informed by the ecological requirements of each species. For example, the presence of micro-habitat features for shelter, or abundance of specific food resources. The SHI scoring is a major component of the overall scoring procedure and requires in-depth background and reference material for justification. As such, the SHI scoring parameters for each relevant species, and the justification of their application are described below.

Note that site condition attributes with a prescribed scoring procedure under the guide to habitat quality have not been reproduced for context herein.

2.2 Site Context

The site context scoring attributes and maximum scores are summarised below in Table 3.

Table 3: Site context scoring attributes and maximum scores

Attribute	Maximum score
Size of patch	10
Connectedness	5
Context	5
Ecological Corridors	6
Role of site location to species overall population in the state	5
Threats to the species	15
Species mobility capacity	10

Scoring of the Site Context indicator is primarily derived from site-specific spatial data (e.g., patch size and connectivity attributes) and follows the scoring instructions of the *BioCondition Assessment Manual* (Eyre et al. 2015) (BioCondition manual) as well as the guide to habitat quality.

The following attributes also include matter-specific site context scoring:

- Role of site location to species/TEC overall population in the state (max score = 5)

- Threats to the species (max score = 15)
- Species mobility capacity (applicable to fauna only, max score = 10)

2.2.1 Role of site location

Scoring when dealing with species matters will be undertaken by utilising inputs from the SSR Supplementary Table (ST) and weighted accordingly (max score in SSR ST of 15 rather than 5). In accordance with the guide to habitat quality v1.2, this is scored taking into consideration the observed role of the site in relation to the overall populations for the species in Queensland. For TECs, this attribute will be scored and justified according to each specific community.

2.2.2 Threats to the species

Scoring will utilise elements from the guide to habitat quality (e.g., scores of 1, 7 and 15) with specific threats for each matter identified from applicable statutory documentation, predominantly Conservation Advice or Recovery Plan. Each species generally has a list of threats which are considered to contribute to the overall species decline (Table 5). Some of these threats are location specific and may not threaten the MNES present in the Project site or offset sites. Others are likely to threaten the species over the species entire range and would apply equally to both the Project site and offset sites.

The risk matrices provided in contemporary Conservation Advice apply four levels of risk for each identified threat (Table 4). Most matters have multiple threats identified, with each posing a unique threat to the species (Table 5). To incorporate this, weightings have been applied; so that those threats with an increased risk have greater influence on the final score. Once an initial 'risk score' was determined from the applicable Conservation Advice the proportion each threat contributes to the total risk is calculated. The proportion for each risk is then used to determine the weighting for each risk (e.g., 80% to bushfire and 20% to predation). The weighting was then applied to each threat score (1= high, 7 =moderate, 15 = low) as determined by the MHQA methodology. The final threat score was then calculated by summing each weighted threat score, with a final maximum score out of 15. A worked example of the threat scoring calculation is provided below.

Where risk matrixes are not provided in a Conservation Advice, initial risk is assigned based on the documented levels of each threat within statutory documentation as well as consideration for the EPBC Act status of each matter.

Table 4: DCCEEW Threat risk matrix

RISK					
Likelihood	**Consequence**				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain	1 (low)	2 (moderate)	4 (very high)	4 (very high)	4 (very high)
Likely	1 (low)	2 (moderate)	3 (high)	4 (very high)	4 (very high)
Possible	1 (low)	2 (moderate)	3 (high)	4 (very high)	4 (very high)
Unlikely	1 (low)	1 (low)	2 (moderate)	2 (high)	4 (very high)
Unknown	1 (low))	1 (low)	2 (moderate)	2 (high)	4 (very high)

Table 5: Threats and risk scores to the species impacted by Exploratory Works.

Likelihood	**Species**								
	Long-nosed Potoroo^	Black-breasted Button-quail^	Koala	Greater Glider	Yellow-bellied Glider	Glossy Black-cockatoo	Scrub Turpentine	Brush Sophora^	Lowland Rainforest TEC^
Habitat loss and fragmentation	4	4	4	4	4	4	4	4	4
Grazing	4	3				2		2	3

Likelihood	Species								
	Long-nosed Potoroo^	Black-breasted Button-quail^	Koala	Greater Glider	Yellow-bellied Glider	Glossy Black-cockatoo	Scrub Turpentine	Brush Sophora^	Lowland Rainforest TEC^
Timber harvesting	3			4	4	4		2	4
Phytophthora (and other die back)	1*								
Myrtle rust	1						4		3
Foxes	4	2		1	1				1
Cats	4	2		1	1				1
Dogs	3	2	2						1
Cane toads									1
Fire regimes	3	2	4	4	4	4		4	3
Climate change	4	3	4	4	4	4			4
Habitat degradation- weeds		3				2	4	4	4
Habitat degradation- Pig damage/trampling		3							
Habitat degradation- Deer damage					1				
Disease (chlamydia)			4*						
Drought			4			4			
Heatwaves			4			4			
Collisions with vehicles			2						
Competition with overabundant native species for fungal resources	1								
Competition with pigs	1								
Hyper predation by owls				3*					
Competition with Sulphur-crested Cockatoos				2*					
Barbed wire entanglement				1	1				
Competition for nest hollows						3*			
Psittacine Beak and Feather Disease						2*			
Toxoplasmosis	1								
Illegal egg collection						1*			
Urbanisation (rubbish dumping, firewood collection, arson, trampling)									3
Total risk score (minus threats which are only relevant to specific areas)	31	24	20	19	20	27	12	16	**32**

* Threat only relevant to specific area and the species in the Project Site is not threatened by the threat in the local area. ^ these species do not have a threat matrix in their Conservation Advice or Recovery Plan. Threats have been taken from the text and risk rating assumed from the text.

Weighted threat scores will be calculated as per the following worked example.

- **Step 1)** Determine the risk from the threat from the threat matrix table and relevant conservation advice (Table 5) (example only):
  - Threat 1- bushfire: risk = very high (4)
  - Threat 2- predation by introduced predators: risk = moderate (2)
  - Threat 3- habitat degradation: risk = high (3)
- **Step 2)** Determine weighting factor:

  For the example there are three threats and together they make up the total risk for the species. In this example the total risk is 9 (4 + 2 + 3).

  Work out the proportion each threat contributes to the total risk:

  - Threat 1- bushfire: 4 out of the total risk of 9 = 0.44 or 44%
  - Threat 2- predation: 2 out of the total risk of 9 = 0.22 or 22%
  - Threat 3- habitat degradation: 3 out of the total risk of 9 = 0.33 or 33%

  This means the bushfire risk to the species is twice that of predation or bushfire contributes to 44% of the overall threat score while predation only contributes 22%. The remaining 33% of the score would be attributed to habitat degradation

  The total overall threat score (as per the methodology) is out of 15 so the maximum score for bushfire would be 6.66 (0.44 x 15), the maximum score for predation will be 3.33 (0.22 x 15) and the maximum score for habitat degradation would be 5 (0.33 x 15). The maximum score the three threats together can achieve is 15.

- **Step 3)** Determine final threat score with applied weighting factor:
  - Threat 1- bushfire: if bushfire receives a threat score of 7 (based on fuel load levels) the threat score would be 7/15 (15 is the highest possible score for bushfire threat) = 0.46 x 6.66 (the highest score with the weighting) = 3.1.
  - Threat 2- predation: if predator abundance gets a score of 1 (two predators recorded on site) the threat score would be 1/15 (15 is the highest possible score for predation risk) = 0.2 x 3.33 (the highest possible score with the weighting) = 0.22
  - Threat 3- habitat degradation: if habitat degradations gets a score of 15 (cover by weeds is less than the benchmark) the threat score would be 15/15 (15 is the highest possible score for predation risk) = 1 x 5 (the highest possible score with the weighting) = 5
- **Overall threat score** = Threat 1 + Threat 2 + Threat 3 = 3.1 + 0.22 + 5 = 8.32 out of 15.

All species would be assessed for relevant threats at both the impact and offset sites and scored out of 15 using this methodology.

2.2.3 Feral predators

Various feral predators (namely the feral cat (*Felis catus*), Red Fox (*Vulpes vulpes*) and feral pig (*Sus scrofa*)) are described as threats in the statutory documentation for multiple species including Greater Glider, BBBQ and Long-nosed Potoroo. Due to the difficulties involved in estimating or modelling accurate feral predator density across a large project area (for discussion, see Yoccoz et al. 2001; Gilbert et al. 2020), scoring of this threat for each matter was standardised and relied on estimated relative abundance of feral predators from camera trap data. At least one camera trap was deployed in each assessment unit for a minimum of 14 camera-trap nights. A greater number of camera traps were placed within the offset areas when compared with the impact areas. This has occurred due to the challenges with the linear nature of the impact footprint and also because of the co-benefit of collecting more detailed pest data within the offset area that can be used to inform management actions during the offset delivery phase. Furthermore, all of the pest species of relevance to the MNES under consideration are highly mobile, wide-ranging and habitat generalists. Increased diversity of feral predators within an assessment unit was assumed to result in a higher level of threat to each matter (based on Woinarski et al. 2015). As such, the feral predator threat to each species within each assessment unit was scored based on the total richness of relevant feral predator species detected.

For Greater Glider, if both relevant feral predator species (i.e., feral cat and Red Fox) were detected within an assessment unit, the assessment unit would receive the highest threat level (1). If one feral predator was detected a score of (7) was assigned to the assessment unit, and if no feral predators were detected, the lowest threat level was assigned (15).

For BBBQ and Long-nosed Potoroo, if at least two relevant feral predator species (i.e., feral cat, Red Fox and feral pig) were detected within an assessment unit, the assessment unit would receive the highest threat level (1). If one feral predator was detected a score of (7) was assigned to the assessment unit, and if no feral predators were detected, the lowest threat level was assigned (15).

2.2.4 Bushfire

Bushfire is described as a threat in statutory documentation for all MNES except for the Lowland Rainforest TEC and Scrub Turpentine. Scoring of this threat for the relevant matters was standardised through the assessment of fuel loads informed by site-specific data. The fuel load assessment was stratified into three fuel types with thresholds derived from the *Overall fuel hazard assessment guide* (Hines ***et al.*** 2010) and was conducted on a site-by-site basis. To accurately measure fire risk, three fuel types were measured at each site and graded as per the following Table 6.

Table 6: Fuel load calculations

Fuel type	Score		
	1	7	15
Elevated fine fuel (shrub cover %)	>40%	10-40%	<10%
Near-surface fuel (plant cover %)	>40%	10-40%	<10%
Surface fuel (litter cover %)	>80%	60-80%	<60%

The site score was calculated as the average score of the three fuel types. The overall bushfire fuel load was then scored as follows: a high bushfire fuel load was assigned to sites with an average score between 1-6 (1), a moderate bushfire fuel load was assigned to sites with an average score between 7-14 (7), and a low bushfire fuel load was assigned to sites with an average score of 15 (15).

Table 7: Fuel load scoring

Parameter	Score		
	1	7	15
Bushfire fuel load	High bushfire fuel load	Moderate bushfire fuel load	Low bushfire fuel load

2.2.5 Climate Change

A study found that most species will be more vulnerable to climate change in areas with large changes in climate relative to historical patterns (high climate stress); in areas that are farther from the moderating influence of cool ocean currents, have minimal topographic diversity, lack perennial water sources and have poor connectivity along climatic gradients (high landscape exposure); and in areas with high levels of habitat loss and fragmentation (high adaptive constraints) (Klausmeyer, K. et al 2011).

Climate change is proposed to be scored and it is based on a sites resilience to climate change impacts. Proposed attributes to be measured are patch size, connectedness and context. The larger the patch size in the AU, the more connected that patch is to other large patches, and the higher the quality of the vegetation (the amount of remnant), the higher the resilience to impacts from drought, increasing temperatures, bushfires and storms. These intact landscapes which support a diversity of ecosystems, both terrestrial and aquatic, can become climate change refugia for species that may be impacted in more fragmented and cleared landscapes. For example, as temperatures increase if there is intact vegetation with a good canopy cover the forest will stay cooler and is more resilient to impacts as opposed to smaller and more open patches subject to edge effects that let more light and heat in. Species have a climatic coping range which is defined as the capacity of systems to accommodate variations in climatic conditions (T. Morelli et al 2020).

Climate change resilience was calculated by summing the patch size score, connectedness score and the site context score (1 km score for all species and communities) (Table 8).

Table 8: Climate change score criteria.

Parameter	Score		
	1 (high)	7 (moderate)	15 (low)
Climate Change	Sum of size of patch, connectiveness and context is 0 - 6	Sum of size of patch, connectiveness and context is >6-15	Sum of size of patch, connectiveness and context is >15-20

2.2.6 Species mobility capacity

This attribute is only required to be scored for fauna matters. Justification of selected parameters is provided in Section 3, including justification provided where scoring of this attribute was considered inappropriate. Where scoring was determined to be appropriate, the maximum mobility capacity score was 10 as per the MHQA scoring procedure, with scaling consisting of six potential scores (e.g., 0-5 or 0, 2, 4, 6, 8,10) dependant on the number of parameters selected.

2.3 Species Stocking Rate

Scoring of the Species Stocking Rate (SSR) indicator is derived exclusively from the MHQA scoring procedure and applies only to fauna and flora matters. The scoring inputs vary according to matter group (fauna or flora), but most consist of matter-specific attributes and parameters focusing primarily on species distribution, abundance, and site use. One attribute (**Role/importance of species population on site**) is derived from supplementary scoring with sub-attributes also varying according to matter group (see the SSR supplementary tables below). Any SSR-related attributes with a prescribed scoring procedure under the guide to habitat quality (where changes have not been proposed) are not provided herein.

2.3.1 Fauna SSR

The SSR scoring attributes and maximum scores for fauna are summarised below in Table 9, with the SSR supplementary table scoring provided in Table 11.

Table 9: Fauna species stocking rate attributes and maximum scores

Attribute	Maximum score
Presence detected on or adjacent to site (neighbouring property with connecting habitat)	10
Species usage of the site (habitat type and evidenced usage)	15
Role/importance of species population on site (see Supplementary Table below)	15

Although the survey effort and methods undertaken to date meet those recommended within Commonwealth survey guidelines for threatened mammals and threatened birds (DSEWPC (2011) and DEWHA (2010), respectively, the guidelines do not necessarily allow for an accurate density estimate for each species, particularly if the species has not been recorded during surveys or is cryptic. The difficulties associated with accurately estimating density of nocturnal, scarce and/or cryptic fauna species, such as those assessed in the current Project, have been described by various authors (see for example Duckworth 1998; Gilbert et al. 2020). Furthermore, the availability of published and reliable data on species density was not consistent across the MNES being assessed.

As a consequence, the **approximate density** attribute described in the MHQA has been removed from the fauna SSR scoring for both impact and offset score. To account for this, change the overall score weightings were adjusted accordingly.

Presence detected on or adjacent to site was scored for each matter based on site-specific field surveys, and the location of species records. If an assessment unit contained a record of the species, it received the maximum score. When determining the presence of a species **adjacent to site** the analysis required that there must be a record of the species within a prescribed distance of the site being assessed and connected to same by contiguous vegetation. The prescribed distance was based on the mobility of the species as summarised in Table 10.

Table 10: Prescribed distances for fauna adjacency

Scientific name	Common name	Adjacency distance
Calyptorhynchus lathami lathami	Glossy black-cockatoo (south-eastern)	10 km
Pteropus poliocephalus	Grey-headed flying-fox	10 km
Phascolarctos cinereus	Koala (Combined pop. of QLD, NSW, ACT)	10 km
Potorous tridactylus tridactylus	Long-nosed potoroo (northern)	2 km
Petauroides volans	Greater glider (southern and central)	2 km
Petaurus australis australis	Yellow-bellied glider (southern Subspecies)	2 km
Turnix melanogaster	Black-breasted button-quail	1 km

Species usage of the site (habitat type and evidenced usage) was scored for each matter according to the species-specific habitat mapping protocols approved by DCCEEW, as well as the standard MHQA procedure (i.e., dispersal (5), foraging (10), breeding (15)). Where species habitat categorisation did not match the standard procedure, a precautionary scoring approach was taken. For example, where foraging and breeding habitat were combined for a matter, the highest score of 15 would be applied.

Role/importance of species population on site was scored for each matter based on the fauna SSR ST, provided below.

Table 11: Fauna species stocking rate supplementary table attributes and maximum scores

Attribute	Maximum score
Key source population for breeding	10
Key source population for dispersal	5
Near the limit of the species range	15
Necessary for maintaining genetic diversity	15

For each matter, the statutory documentation and other available literature was reviewed to assess each of the SSR ST attributes. These attributes are strongly correlated to the presence of important populations; however, important populations are not currently defined for all species assessed below. Species with defined important populations included Koala, Greater Glider, Yellow-bellied Glider and BBBQ. Important populations were not defined for the Glossy Black-cockatoo or the Long-nosed Potoroo. However, a conservative approach to scoring the SSR ST attributes for all species was adopted.

Key source population for breeding – species with defined important populations occurring in the Project area were assigned a maximum score for this attribute. Conservatively, the populations of Glossy Black-cockatoo and Long-nosed Potoroo within the Project area were also assigned a maximum score for this attribute.

Key source population for dispersal – species with defined important populations occurring in the Project area were assigned a maximum score for this attribute. Conservatively, the populations of Glossy Black-cockatoo and Long-nosed Potoroo within the Project area were also assigned a maximum score for this attribute.

Near the limit of the species range – this attribute was scored via spatial analysis based on DCCEEW's *Species of National Environmental Significance* (SNES) distribution mapping. For a species to be considered near the limit of its range, the Project area would need to be located within 5 km of the distribution limit according to the SNES. None of the matters assessed were considered to occur near the limit of their range.

Necessary for maintaining genetic diversity – species with defined important populations occurring in the Project area were assigned a maximum score for this attribute. Conservatively, the populations of Glossy Black-cockatoo and Long-nosed Potoroo within the Project area were also assigned a maximum score for this attribute.

2.3.2 Flora SSR

The SSR scoring attributes and maximum scores for flora are summarised in Table 12, with the SSR ST scoring provided in Table 13.

Table 12: Flora species stocking rate attributes and maximum scores

Attribute	Maximum score
Presence detected on or adjacent to site (neighbouring property with connecting habitat)	10
Number of plants on site	30
Extent of population on site (ha)	30
Approximate density (per ha) over suitable habitat within project area	20
Role/importance of species population on site	15

Presence detected on or adjacent to site was scored for each matter based on site-specific field surveys, and the location of flora species records. If an assessment unit contained a record of the flora species, it received the maximum score. Adjacency was determined to be 1km for each flora species and was required to be connected to the site in questions by contiguous vegetation.

Number of plants on site was scored for each matter based on site-specific field surveys, and a direct count of each threatened plant recorded within each assessment unit or patch. For each species, score scaling was informed by the default numbers provided within the MHQA spreadsheet.

Extent of population on site (ha) was scored for each matter based on the results of site-specific field surveys. Calculations were based on polygons drawn around populations within suitable habitat at the site, as recommended in the MHQA. For each species, score scaling was informed by the default numbers provided within the MHQA spreadsheet.

Approximate density (per ha) over suitable habitat within project area was calculated for each matter using site-specific field data. Approximate average density was calculated by simply dividing the total number of plants recorded by the total area of potential habitat surveyed. The average density then informed score scaling, whereby sites with more than the average density were assigned higher scores, and vice versa.

Role/importance of species population on site was scored for each matter based on the flora SSR ST, provided below.

Table 13: Flora species stocking rate supplementary table attributes and maximum scores

Attribute	Maximum score
Key source population for germination and seed/gamete dispersal	10
Necessary for maintaining genetic diversity	15
Near the limit of the species range	15

For both matters, the statutory documentation and other available literature was reviewed to assess each of the SSR ST attributes. A conservative approach to scoring the SSR ST attributes for each species was adopted.

Key source population for germination and seed/gamete dispersal – As information on both species' populations is limited, a conservative approach was taken to scoring this parameter, and both species were assigned the maximum score.

Necessary for maintaining genetic diversity – As information on both species' genetic diversity is limited, a conservative approach was taken to scoring this parameter, and both species were assigned the maximum score.

Near the limit of the species range – This attribute was scored via spatial analysis based on DCCEEW's SNES distribution mapping. For a species to be considered near the limit of its range, the Project area would need to be located within 5 km of the distribution limit according to the SNES. Neither of the two threatened flora species assessed were considered to occur near the limit of their range.

3. Matter-specific scoring parameters

A total of nine matters across three groups have been identified to require matter-specific scoring through the utilisation of applicable parameters. The subsequent sections summarise the matter-specific criteria and applicable scoring procedures. Justification of parameter utilisation is also provided based on in-depth literature review with priority given to statutory documentation such as conservation advice and recovery plans, as well as and published peer reviewed journal articles.

3.1 Glossy Black-cockatoo (south-eastern) (*Calyptorhynchus lathami lathami*)

3.1.1 Site Condition – Species Habitat Indices

3.1.1.1 Quality and availability of food and foraging habitat

Glossy Black-cockatoos are highly dependent on the seeds of sheoaks (*Allocasuarina* spp. and *Casuarina* spp.) as a primary foraging resource, often relying on one or two regionally specific species (Higgins 1999). Within subcoastal southeast Queensland (Qld), they tend to show a preference for black sheoak (*A. littoralis*) and forest sheoak (*A. torulosa*) but may also utilise river sheoak (*C. cunninghamiana*) when other resources are limited (DCCEEW 2022a).

Due to their strong reliance on specific sheoak species, the presence and abundance of those species within areas of habitat are critical when determining the quality and availability of foraging resources and therefore foraging habitat quality. As such, areas supporting a higher abundance of preferred foraging trees are considered higher quality.

The first parameter selected, '*availability of preferred food trees*´, aims to measure the availability of food resources in an area of habitat by using the surrogate of dominance (combined absolute cover) of foraging tree species (likely correlates with potential fruit production). The average combined cover of these preferred food tree species (excluding shrub layers) across all survey sites in suitable habitat is 11%; as such, sites with 10% or more cover of these species were assigned the median score (3). The second parameter, '*foraging species richness*', measures the richness of preferred foraging species at each site, with those sites supporting higher species richness considered to provide more foraging opportunities and therefore higher quality habitat.

Table 14: Food and foraging parameters for Glossy Black-cockatoo

Parameter	Score					
	0	1	2	3	4	5
Availability of preferred food trees (Allocasuarina and Casuarina) (all tree layers)	No foraging tree species are present	<5% canopy cover of foraging tree species	5% to 9% canopy cover of foraging tree species	≥10% canopy cover of foraging tree species	≥20% canopy cover of foraging tree species	≥25% canopy cover of foraging tree species
Preferred foraging species richness (*Allocasuarina littoralis, A. torulosa* and *Casuarina cunninghamiana*)	None of the preferred species are present	Only *C. cunninghamiana* is present	One Allocasuarina sp. is present	One *Allocasuarina* spp. and *C. cunninghamiana* present	Both preferred Allocasuarina spp. are present	All three foraging species are present

3.1.1.2 Quality and availability of shelter

Glossy Black-cockatoos require large hollows for nesting, and most commonly utilise hollows in eucalypt species. Breeding habitat does not always overlap with foraging areas (sheoak occurrence is often patchy and sporadic) and therefore the species may undertake daily commutes. According to the *Conservation Advice* (DCCEEW 2022a), the movements of the Kangaroo Island subspecies (*C. l. halmaturinus*) have undergone the most investigation and have been shown to commute up to 14 km between nesting hollows and foraging areas without reducing reproductive success. However, nesting hollows are typically located within 1 km of foraging resources and in relative proximity (<200 m) to permanent water.

The first parameter selected to measure quality of sheltering habitat is '*distance to permanent water*'. Scoring is informed by the information in the *Conservation Advice* (DCCEEW 2022a); areas closer to permanent water are assigned higher scores, with areas within 200 assigned the median score. The next parameter selected is '*large eucalypt tree abundance*', used here as a proxy for the occurrence of large hollows suitable for use by the species (in accordance with benchmark thresholds see Appendix A). The final parameter is '*proximity to foraging resources*', with areas of breeding habitat occurring in proximity to known foraging resources considered to be of higher quality due to reduced energy requirements associated with daily commutes.

Table 15: Shelter parameters for Glossy Black-cockatoo

Parameter	Score					
	0	1	2	3	4	5
Distance to permanent water (includes Borumba Dam, farm dams and stream order 3 and above)	≥2 km from permanent water	≥1 km from permanent water	≥200 m from permanent water	Within 200 m of permanent water	Within 100 m of permanent water	Includes permanent water
Large eucalypt tree abundance	No large trees present	>0% of large tree benchmark	>40% of large tree benchmark	>60% of large tree benchmark	>80% of large tree benchmark	≥100% of large tree benchmark
Proximity to foraging resources	>2 km from foraging habitat	>1 km from foraging habitat	Within 1 km of foraging habitat	Within 500 m of foraging habitat	Within 100 m of foraging habitat	Directly adjacent to, or within foraging habitat

3.1.2 Site Context

3.1.2.1 Threats to the species

The species' *Conservation Advice* (DCCEEW 2022a) lists several threatening processes that are recognised threats for the Glossy Black-cockatoo (Figure 1). Table 15 lists the threats to Glossy-Black Cockatoo and the threat risk scores along with criteria used to measure the threat. Table 16 lists the threat criteria and for each threat the severity score.

Likelihood	Consequences				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain			• Habitat fragmentation	• Inappropriate fire regimes • Increased likelihood of extreme events (i.e., heatwave and drought) • Clearing of native vegetation/timber harvesting	
Likely		• Predation	• Competition for nest hollows	• Temporal or spatial shift of resource availability as a result of climate change	
Possible		• Grazing • Invasive weeds • Psittacine Beak and Feather Disease (PBFD)			
Unlikely					
Unknown		• Bird and egg collection			

Figure 1: Threat risk matrix for Glossy Black-cockatoo as per the Conservation Advice

Table 16: Threats for Glossy Black-cockatoo and their risk score and criteria used to measure them (if scored)

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
Habitat loss and fragmentation	4	Yes	Time since last logged or cleared (based on aerial imagery), patch size and connectivity
Fire regimes	4	Yes	Bushfire fuel load based on the abundance of elevated fine fuel, near surface fuel and surface fuel.

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
Timber harvesting	4	Yes	Active logging or the presence of logging rights over the land.
Climate change (including extreme heat waves and drought)	4	Yes	Size of the patch, connectedness and context of the patch. The climate change threat is a high risk to the species. Increasing temperatures resulting in increased frequency of heatwaves will significantly impact foraging tree species. Increasing frequency of hot bushfires is likely to decrease the availability of hollow bearing trees, impact the availability of foraging resources and can alter the structure of vegetation over time. Resilience of a patch from the effects of heatwaves and drought can depend on the size of the patch, its connectiveness (as an indication of likely ecosystem health) and its location in the landscape.
Grazing	2	Yes	Grazing intensity
Competition for nest hollows	3	Yes	The species is reliant on hollow bearing trees and competition for hollows in areas with a low abundance of hollows could significantly impact the population. Measuring hollow bearing tree abundance is difficult but hollows are more likely in older, larger trees so large tree abundance can be used as rough measure of the availability of hollow abundance.
Predation by foxes and cats (combined)	2	Yes	Number of predator species recorded present.
Habitat degradation- weeds	2	Yes	Abundance and species richness of weeds
Psittacine beak and feather disease	2	No	This disease is currently considered a low risk to the species but is known to extend across the species range. There is no current treatment and the Project will have no direct impact on the spread of the disease as it spread from bird to bird. This threat will not be scored.
Illegal egg collection	1	No	Illegal collection of eggs for the pet trade can impact populations. The extent of this threat is unknown and there is no published information to suggest it’s a threat in the region of the Project. If present, its likely the threat is very low and would be impossible to manage. This threat will not be scored.

Table 17: Threat parameters for Glossy Black-cockatoo

Parameter	Score		
	1 (high)	7 (moderate)	15 (low)
Habitat loss and fragmentation	Evidence of recent (<10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	Evidence of historical (>10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	No evidence of timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery
Timber harvesting	Active timber harvesting present	Rights to harvest currently granted to stakeholder, but no active harvesting	No harvesting rights allocated to AU, no active harvesting
Climate Change	Sum of size of patch, connectiveness and context is 0 - 6	Sum of size of patch, connectiveness and context is >6-15	Sum of size of patch, connectiveness and context is >15-20
Grazing	Active grazing present throughout the Assessment Unit and a grazing lease which extends more than 2 years is attached to the land.	No active grazing within the Assessment Unit but grazing occurs within the property and a grazing lease is attached to the land.	No active grazing within the Assessment Unit or within the property and no grazing leases are attached to the land.
Competition for nest hollows	0- 30% of large eucalypt abundance benchmark	31-80% of large eucalypt abundance benchmark	81-100% of large eucalypt abundance tree benchmark
Predation	At least two feral (cats and foxes) predators detected in assessment unit	At least one feral (cat or fox) predator detected in assessment unit	No feral predators detected in assessment unit
Weed abundance	High weed abundance (>50% cover)	Moderate weed abundance (50 to 21% cover)	Low weed abundance (<20% cover)
Bushfire fuel load (scoring described in methodology section)	High bushfire fuel load	Moderate bushfire fuel load	Low bushfire fuel load

3.1.2.2 Species Mobility Capacity

As a species capable of flight, the Glossy Black-cockatoo has strong mobility capacity. They can move large distances when required and may undertake daily commutes of more than 14 km between roosting or nesting sites to foraging areas (DCCEEW 2022a). Therefore, the species is not typically considered to be limited by general barrier effects. As such, **Species Mobility Capacity** was removed from the scoring procedure of this species.

3.2 Greater Glider (southern and central) (*Petauroides volans*)

3.2.1 Site Condition – Species Habitat Indices

3.2.1.1 Quality and availability of food and foraging habitat

The Greater Glider is a specialised folivore that almost exclusively feeds upon the leaves of eucalypts (the genera of *Eucalyptus*, *Corymbia*, *Angophora*, *Syncarpia* and *Lophostemon*). As such, the species is mostly associated with eucalypt dominated woodlands and forests. Regionally, they tend to prefer specific eucalypt species and most often utilise areas that support a high diversity of eucalypts. Although Greater Gliders may supplement their diets with buds and flowers, they prefer fresh eucalypt foliage and, as a result, may alter their foraging preferences seasonally based on tree species phenology (DCCEEW 2022).

Greater Gliders spend the majority of nocturnal hours foraging and, as such, tree species in which they are frequently detected are likely to be preferred foraging tree species. To identify preferred foraging trees, Eyre (2006) and Eyre et al. (2022) have been reviewed to determine which eucalypt species are most frequently correlated with Greater Glider records in southern Qld. The combined list of preferred tree species is summarised below in Table 18.

Table 18: Preferred Greater Glider Tree Species

Species	Source	Species	Source
Corymbia citriodora	Eyre (2006) and Eyre et al. (2022)	*Eucalyptus moluccana*	Eyre et al. (2022)
Corymbia intermedia	Eyre et al. (2022)	*Eucalyptus propinqua*	Eyre (2006)
Corymbia trachyphloia	Eyre et al. (2022)	*Eucalyptus saligna*	Eyre (2006)
Eucalyptus acmenoides	Eyre (2006) and Eyre et al. (2022)	*Eucalyptus siderophloia*	Eyre et al. (2022)
Eucalyptus biturbinata	Eyre (2006)	*Eucalyptus tereticornis*	Eyre (2006) and Eyre et al. (2022)
Eucalyptus crebra	Eyre et al. (2022)	*Lophostemon confertus*	Eyre (2006)
Eucalyptus grandis	Eyre (2006)	*Lophostemon suaveolens*	Eyre (2006) and Eyre et al. (2022)
Eucalyptus major	Eyre (2006)		

The two parameters selected to determine the quality of food and foraging habitat measure the diversity of eucalypts recorded at each site. The first parameter '*availability of preferred foraging trees*' measures the availability of preferred foraging resources by utilising canopy cover dominance as a proxy. The average cover of these preferred foraging tree species across all survey sites in suitable habitat is 39%; as such, sites with more than 40% cover of these species were assigned the median score (3). The second parameter selected is '*foraging tree species richness*' which measures the number of different preferred foraging tree species occurring at each site. A total of 15 identified preferred tree species occur in southern Queensland with a total of 13 represented in the Project area (based on BioCondition data). The mean number of Greater Glider preferred tree species across all sites is three (3.7), with a maximum richness of eight (one site). As such, sites with three preferred tree species received the median score (3), with scores incrementally decreasing and increasing by one point in concordance with tree richness. These parameters combined measure preferred tree species diversity at each site and reflect foraging habitat quality due to the species preference for areas supporting a high diversity of food trees. This also accounts for seasonal variation in foraging resource availability.

Table 19: Food and foraging parameters for Greater Glider

Parameter	Score					
	0	1	2	3	4	5
Availability of preferred foraging trees (T1, T2 and emergent)	0% canopy cover of preferred foraging resources.	0-20% canopy cover of preferred foraging resources.	>20% canopy cover of preferred foraging resources.	>40% canopy cover of preferred foraging resources.	>70% of canopy cover of preferred foraging resources.	>100% of canopy cover of preferred foraging resources.
Foraging tree species richness	No preferred food trees are present.	One preferred tree species recorded.	Two preferred tree species recorded.	Three preferred tree species recorded.	Four preferred tree species recorded.	Five or more preferred tree species recorded.

3.2.1.2 Quality and availability of shelter

Greater Gliders require tree hollows to allow sheltering and denning, with the availability of hollows considered the most important and limiting factor affecting Greater Glider occurrence. Greater Gliders are the largest gliding mammal in Australia and therefore require relatively large hollow entrances, with a particular preference for hollows greater than 10 cm in diameter. Hollows of this size typically only form in large, mature trees. The size of trees is important for Greater Gliders, with trees of at least 30 cm diameter at breast height (DBH) preferentially selected for foraging, and trees of at least 50 cm DBH preferentially selected for denning (Eyre et al. 2022). However, the species' *Conservation Advice* notes that trees of 30 cm DBH may also provide hollows suitable for denning. In occupied forest habitat of southern Qld, Greater Glider populations appear to require at least 1 live den tree per hectare, although they may also use stags where available (DCCEEW 2022).

Due to the relationship between tree size, tree age and hollow availability, and the known sheltering requirements of Greater Gliders, '*large eucalypt tree abundance'* was used as the lone parameter to determine sheltering habitat quality. Terrestrial hollow surveys are considered unreliable and tend to show observer-related bias, with large tree abundance shown to be a more accurate surrogate of hollow availability (Eyre et al. 2022). Community benchmarks of large eucalypt tree abundance (based on DBH thresholds), as well as field data on the abundance of trees 30cm DBH and above (informed by the *Conservation Advice*) were utilised to measure sheltering habitat quality, whereby areas supporting more large trees received higher scores. Relevant vegetation community benchmarks and large tree thresholds are provided in Appendix A.

Table 20: Shelter parameters for Greater Glider

Parameter	Score					
	0	2	4	6	8	10
Large eucalypt tree abundance	No large eucalypts (according to RE benchmarks) and no eucalypts 30cm DBH and above	>0% of large eucalypt abundance benchmark or at least one 30cm DBH tree	>40% of large eucalypt abundance benchmark	>60% of large eucalypt abundance benchmark	>80% of large eucalypt abundance benchmark	≥100% of large eucalypt abundance tree benchmark

3.2.2 Site Context

3.2.2.1 Threats to the species

The species' *Conservation Advice* (DCCEEW 2022b) lists several threatening processes related to Greater Glider (Figure 2). Table 21 lists the threats to Greater Glider and the threat risk scores along with criteria used to measure the threat. Table 22 lists the threat criteria and for each threat the severity score which will be used to calculate the overall threat score for each Assessment Unit.

Likelihood	Consequences				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain	Low risk	Moderate risk	Very high risk	Very high risk **Timber harvesting** **Increased temperatures and changes to rainfall patterns**	Very high risk **Inappropriate fire regimes** **Habitat clearing and fragmentation**
Likely	Low risk	Moderate risk **Competition from Sulphur-crested Cockatoos**	High risk	Very high	Very high risk
Possible	Low risk	Moderate risk	High risk **Hyper-predation by owls**	Very high risk	Very high risk
Unlikely	Low risk	Low risk **Predation by foxes** **Predation by feral cats** **Barbed wire fencing (entanglement)**	Moderate risk	High risk	Very high risk
Unknown	Low risk	Low risk	Moderate risk	High risk	Very high risk

Figure 2: Threat risk matrix for greater Glider (southern and central) from the Greater Glider Conservation Advice

Table 21: Threats for Greater Glider and their risk score and criteria used to measure them (if scored)

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
Habitat loss and fragmentation	4	Yes	Time since last logged or cleared (based on aerial imagery), patch size and connectivity of patch
Timber harvesting	4	Yes	Active logging occurring, or the presence of logging rights over the land.

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
Foxes	1	Yes (will be scored in combination with Feral Cats)	Number of predator species recorded as present. If both relevant feral animal species are recorded this receives higher score.
Cats	1	Yes (will be scored in combination with Foxes)	Number of predator species recorded as present. If both relevant feral animal species are recorded this receives higher score
Fire regimes	4	Yes	Bushfire fuel load based on the abundance of elevated fine fuel, near surface fuel and surface fuel.
Climate change (including extreme heat waves and drought)	4	Yes	Size of the patch, connectedness and context of the patch. The climate change threat is a high risk to the species. Increasing temperatures resulting in increased frequency of heatwaves will significantly impact foraging tree species. Increasing frequency of hot bushfires is likely to decrease the availability of hollow bearing trees, impact the availability of foraging resources and can alter the structure of vegetation over time. Resilience of a patch from the effects of heatwaves, fire and drought can depend on the size of the patch, its connectiveness (as an indication of likely ecosystem health) and its location in the landscape.
Hyper predation by owls	3	No	Hyper-predation by owls has been recorded in a small number of locations. It has occurred in areas where European Foxes competed with forest owls for prey which decreased owl abundance. When management of foxes have occurred, it is thought that owl abundance quickly increased in response to the availability of prey, and many of the owls shifted their diet to possums and gliders resulting in over-predation. There is no published information to suggest this is a problem for the Project area and owl numbers are comparable with surrounding areas where the threat has not been observed.
Competition with Sulphur-crested Cockatoos	2	No	This threat is only known to be a problem in a small part of the species range and there is no published information to suggest it is a problem within the Project area. It is therefore not proposed to be scored.
Barbed wire entanglement	1	Yes	Location and type of barbed wire fencing.

Table 22: Threat parameters for Greater Glider

Parameter	Score		
	1 (high)	7 (moderate)	15 (low)
Habitat loss and fragmentation	Evidence of recent (<10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	Evidence of historical (>10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	No evidence of timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery
Timber harvesting	Active timber harvesting present	Rights to harvest currently granted to stakeholder, but no active harvesting	No harvesting rights allocated to AU, no active harvesting
Climate Change	Sum of size of patch, connectiveness and context is 0 - 6	Sum of size of patch, connectiveness and context is >6-15	Sum of size of patch, connectiveness and context is >15-20
Predation- Cats and Foxes	At least two feral (cats and foxes) predators detected in assessment unit	At least one feral (cat or fox) predator detected in assessment unit	No feral predators detected in assessment unit
Bushfire fuel load (scoring described in methodology section)	High bushfire fuel load	Moderate bushfire fuel load	Low bushfire fuel load
Barbed wire entanglement	Barbed wire used on external and internal fencing which lies within remnant/regrowth vegetation.	Barbed wire used on external fencing only and fencing is through remnant/regrowth vegetation OR No internal fencing OR Internal fencing not barbed wire OR Internal fencing with barbed wire but only through non-remnant areas.	No barbed wire on internal or external fencing.

3.2.2.2 Species Mobility Capacity

Greater Gliders show strong site fidelity and have relatively small home ranges that vary in size across the species' distribution. Home ranges are typically from 1 to 4 ha but may be up to 19 ha in lower quality woodlands, with males tending to have larger home ranges (DCCEEW 2022). The Greater Glider is also highly volant and requires trees to facilitate gliding and avoid ground contact to limit predation risk. Their maximum tree-to-tree gliding capacity is strongly correlated with tree height (i.e., the glide distance increases with tree/launch height) with glide angles typically less than 40 degrees (Jackson 1999) and glide distances rarely exceeding 50 m (van der Ree et al. 2004). The suggested maximum gliding distance varies according to the literature, with some early long-distance claims (e.g., over 100 m) now strongly disputed. Currently, the maximum gliding distance is thought to be around 75 m which would require a launch height of 45 m (Taylor and Goldingay

2009). Increased canopy cover is also assumed to improve the species' mobility capacity; greater canopy cover percentages correlate to greater canopy connectivity, allowing the species to move within the patch in an unobstructed manner without unnecessary exposure to predators.

To measure Greater Glider mobility capacity, three parameters were selected: '*patch size*', '*canopy height*' and '*combined canopy cover percentage*'. Patch size scoring is directly informed by known home range sizes in high quality subcoastal habitats. Canopy height scoring is based on the existing benchmarks (Appendix A). For canopy cover percentage, the average combined canopy cover across all survey sites within suitable habitat is 70%, as such, sites with 70% or more cover were assigned the median score (3).

Table 23: Shelter parameters for Greater Glider

Parameter	Score					
	0	1	2	3	4	5
Patch size	<1 ha	>1 ha	>2 ha	>3 ha	>4 ha	>5 ha
Canopy height	<50% of canopy height benchmark	≥50% of canopy height benchmark	≥65% of canopy height benchmark	≥80% of canopy height benchmark	≥90% of canopy height benchmark	≥100% of canopy height benchmark
Combined canopy cover (T1, T2 and emergent)	<40% canopy cover	≥40% canopy cover	≥50% canopy cover	≥70% canopy cover	≥90% canopy cover	≥100% canopy cover

3.3 Yellow-bellied Glider (south-eastern) (*Petaurus australis australis*)

3.3.1 Site Condition – Species Habitat Indices

3.3.1.1 Quality and availability of food and foraging habitat

The Yellow-bellied Glider has a varied diet consisting of a range of food types, which may be sparse across landscapes and only available on a seasonal basis (Mitchell et al. 2023). Plant and insect exudates (sap, nectar, manna, and honeydew) generally form major components of Yellow-bellied Glider diet, but arthropods may also be regularly consumed (DAWE 2022a). The widely dispersed nature of glider dietary items, and seasonal limitations in their availability, often means that gliders traverse large distances when searching for food (Goldingay and Kavanagh 1991). Correspondingly, Yellow-bellied Gliders have large home ranges (from 25 – 85 ha) and prefer to inhabit large areas of old-growth forest that provide sufficient foraging resources for their family groups (DAWE 2022a). Although variable, sap drawn from trunk incisions form the most important component of Yellow-bellied Glider diet; as such, sap feed trees are considered a critical habitat component for the species (DAWE 2022a). In southern Qld, 13 tree species are known to be used as sap feed trees (Table 24), with the Grey Gum species *Eucalyptus longirostrata* and *E. biturbinata* being favoured (Eyre and Goldingay 2005). Yellow-bellied Gliders appear to select sap feed trees that are large, occupy dominant or co-dominant positions in the canopy, and possess large crowns (Mitchell et al. 2023).

Table 24: Known sap feed tree species used by Yellow-bellied Glider in southern Queensland, based on Eyre and Goldingay (2005)

Species	Bark type	Species	Bark type
Angophora leiocarpa	Gum	*Eucalyptus moluccana*	Gum
Corymbia citriodora	Gum	*Eucalyptus tereticornis*	Gum
Corymbia intermedia	Bloodwood	*Eucalyptus racemosa*	Gum
Eucalyptus biturbinata	Gum	*Eucalyptus resinifera*	Stringybark
Eucalyptus longirostrata	Gum	*Eucalyptus laevopinea*	Stringybark
Eucalyptus major	Gum	*Eucalyptus sphaerocarpa*	Stringybark
Eucalyptus melliodora	Gum		

The three parameters selected to determine the quality of food and foraging habitat rely on the abundance of large trees at each site and the presence of preferred foraging resources. The first parameter selected is the '*large eucalypt tree abundance* '. This uses the benchmark scores for large trees in the site's corresponding regional ecosystem as a proxy for potential sap feed tree availability, as sap feed trees preferred by the species are typically large. The second parameter, '*canopy dominance of preferred sap tree species'*, measures the availability of preferred sap feed tree species by utilising canopy cover dominance as a proxy. The average absolute cover of these preferred sap tree species across all survey sites in suitable habitat is 10%; as such, sites with more than 10% cover of these species were assigned the median score (3). The third parameter selected is '*tree species richness'*. This uses the benchmark scores for tree species richness in the sites corresponding regional ecosystem as a proxy for the availability of different dietary items (e.g., sap, nectar, arthropods, etc.). Tree species richness benchmarks are provided in Appendix A.

Table 25: Food and foraging parameters for Yellow-bellied Glider

Parameter	Score					
	0	1	2	3	4	5
Large eucalypt tree abundance (potential sap feed trees)	No large eucalypts (according to RE benchmarks)	>0% of large eucalypt abundance benchmark	>40% of large eucalypt abundance benchmark	>60% of large eucalypt abundance benchmark	>80% of large eucalypt abundance benchmark	≥100% of large eucalypt abundance tree benchmark
Canopy dominance of preferred sap tree species (T1, T2 and emergent)	No preferred sap tree species are present in canopy cover	<5% of canopy cover is comprised of preferred sap trees	5% to 10% of canopy cover comprised of preferred sap trees	>10% of canopy cover is comprised of preferred sap trees	>20% of canopy cover is comprised of preferred sap trees	>30% of canopy cover is comprised of preferred sap trees

Parameter	Score					
	0	1	2	3	4	5
Tree species richness	≤29% of tree species richness benchmark	≥30% of tree species richness benchmark	≥40% of tree species richness benchmark	≥50% of tree species richness benchmark	≥70% of tree species richness benchmark	≥80% of tree species richness benchmark

3.3.1.2 Quality and availability of shelter

The Yellow-bellied Glider is highly reliant on the availability of hollows in large, old trees (typically >1 m in diameter) for shelter and denning (DAWE 2022a). They have shown to be selective in the type of trees they use for denning, preferring live, smooth-barked eucalypts; with the species rarely utilising hollows in dead standing trees (stags) (DAWE 2022a). The availability of suitable hollows, which often only occur in trees 50 cm in diameter or more, is a critical habitat feature for the species (DAWE 2022a).

Due to the known relationship between tree size, age and hollow availability, '*large eucalypt tree abundance'* was used as the parameter to determine sheltering habitat quality. Terrestrial hollow surveys are unreliable and show strong observer-related bias, with large tree abundance recently shown to be a more accurate surrogate for hollow availability (Eyre et al. 2022). In this instance, vegetation community benchmarks of large eucalypt tree abundance have been utilised to measure habitat quality, whereby areas supporting more large trees receive higher scores (see Appendix A for benchmark data).

Table 26: Shelter parameters for Yellow-bellied Glider

Parameter	Score					
	0	2	4	6	8	10
Large eucalypt tree abundance	No large eucalypts (according to RE benchmarks)	>0% of large eucalypt abundance benchmark	>40% of large eucalypt abundance benchmark	>60% of large eucalypt abundance benchmark	>80% of large eucalypt abundance benchmark	≥100% of large eucalypt abundance tree benchmark

3.3.2 Site Context

3.3.2.1 Threats to the species

The species' *Conservation Advice* (DAWE 2022a) for Yellow-bellied Glider lists several threatening processes which have been recognised for the species (Figure 3). Table 27 lists the threats to Greater Glider and the threat risk scores along with criteria used to measure the threat.

Table 28 lists the threat criteria and for each threat and the severity score which will be used to calculate the overall threat score for each Assessment Unit.

Likelihood	Consequences				
	Not significant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	Low risk	Moderate risk	Very high risk **Prescribed burns**	Very high risk **Timber harvesting** **Extensive severe bushfires** **Habitat clearing and fragmentation**	Very high risk **Increased temperatures and changes to precipitation patterns**
Likely	Low risk **Habitat degradation from feral deer**	Moderate risk	High risk	Very high risk	Very high risk
Possible	Low risk	Moderate risk	High risk	Very high risk	Very high risk
Unlikely	Low risk	Low risk **Barbed wire fencing (entanglement)** **Predation by European red foxes** **Predation by feral cats**	Moderate risk	High risk	Very high risk
Unknown	Low risk	Low risk	Moderate risk	High risk	Very high risk

Figure 3: Threat risk matrix for Yellow-bellied Glider from the Yellow-bellied Glider Conservation Advice

Table 27: Threats for Yellow-bellied Glider and their risk score and criteria used to measure them (if scored)

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
Habitat loss and fragmentation	4	Yes	Time since last logged or cleared (based on aerial imagery), patch size and connectivity of patch
Timber harvesting	4	Yes	Active logging occurring, or the presence of logging rights over the land.
Foxes	1	Yes (will be scored in combination with Feral Cats)	Number of predator species recorded as present. If both relevant feral animal species are recorded this receives higher score.
Cats	1	Yes (will be scored in combination with Foxes)	Number of predator species recorded as present. If both relevant feral animal species are recorded this receives higher score
Fire regimes	4	Yes	Bushfire fuel load based on the abundance of elevated fine fuel, near surface fuel and surface fuel.
Climate change (including extreme heat waves and drought)	4	Yes	Size of the patch, connectedness and context of the patch. The climate change threat is a high risk to the species. Increasing temperatures resulting in increased frequency of heatwaves will significantly impact foraging tree species. Increasing frequency of hot bushfires is likely to decrease the availability of hollow bearing trees, impact the availability of foraging resources and can alter the structure of vegetation over time. Resilience of a patch from the effects of heatwaves, fire and drought can depend on the size of the patch, its connectiveness (as an indication of likely ecosystem health) and its location in the landscape.
Habitat degradation- feral deer	1	Yes	Number of trap nights with deer
Barbed wire entanglement	1	Yes	Location of barbed wire fencing.

Table 28: Threat parameters for Yellow-bellied Glider

Parameter	Score		
	1 (high)	7 (moderate)	15 (low)
Habitat loss and fragmentation	Evidence of recent (<10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	Evidence of historical (>10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	No evidence of timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery
Timber harvesting	Active timber harvesting present	Rights to harvest currently granted to stakeholder, but no active harvesting	No harvesting rights allocated to AU, no active harvesting
Climate Change	Sum of size of patch, connectiveness and context is 0 - 6	Sum of size of patch, connectiveness and context is >6-15	Sum of size of patch, connectiveness and context is >15-20
Predation- Cats and Foxes	At least two feral (cats and foxes) predators detected in assessment unit	At least one feral (cat or fox) predator detected in assessment unit	No feral predators detected in assessment unit
Bushfire fuel load (scoring described in methodology section)	High bushfire fuel load	Moderate bushfire fuel load	Low bushfire fuel load
Habitat degradation- feral deer	Deer recorded on more than 3 camera trap nights (minimum of 14 nights)	Deer recorded on 1 to 3 camera trap nights (minimum of 14 nights)	No deer recorded on cameras (minimum of 14 nights)
Barbed wire entanglement	Barbed wire used on external and internal fencing which lies within remnant/regrowth vegetation	Barbed wire used on external fencing only and fencing is through remnant/regrowth vegetation OR No internal fencing OR internal fencing not barbed wire OR internal fencing with barbed wire but only through non-remnant areas.	No barbed wire on internal or external fencing.

3.3.2.2 Species Mobility Capacity

Yellow-bellied Gliders live in small family groups of two to six individuals, though the typical group size is three to four (DAWE 2022a). Home ranges are large and may range in size from 25 ha to 85 ha; territories are defended by conspicuous vocalisations of the species (DAWE 2022a). The Yellow-bellied Glider is highly volant and requires trees to facilitate gliding and avoid ground contact due to the increased predation risk. They disperse poorly over distances beyond their maximum gliding distance, which has been estimated to be up to 140 m. The average glide distance, however, is much shorter and in low-canopy forest is approximately 25 m (DAWE 2022a). Increased canopy cover is assumed to improve the species' mobility capacity; greater canopy cover percentages correlate to greater canopy connectivity, presumably allowing the species to move within the patch in an unobstructed manner without unnecessary exposure to predators.

To measure Yellow-bellied Glider mobility capacity, three parameters were selected: '*patch size*', '*canopy height*' and '*combined canopy cover percentage*'. Patch size scoring is directly informed by known home range sizes. Canopy height scoring is based on the existing benchmarks (Appendix A). For canopy cover percentage, the average combined canopy cover across all survey sites within suitable habitat is 70%, as such, sites with 70% or more cover were assigned the median score (3).

Table 29: Species mobility capacity criteria for Yellow-bellied Glider

Parameter	Score					
	0	1	2	3	4	5
Patch size	<25 ha	26-35 ha	36-45 ha	46-65 ha	66-85 ha	>85 ha
Canopy height	<50% of canopy height benchmark	≥50% of canopy height benchmark	>65% of canopy height benchmark	>80% of canopy height benchmark	>90% of canopy height benchmark	≥100% of canopy height benchmark
Combined canopy cover (T1, T2 and emergent)	<40% canopy cover	≥40% canopy cover	≥50% canopy cover	≥70% canopy cover	≥90% canopy cover	≥100% canopy cover

3.4 Koala (combined populations of QLD, NSW and the ACT) (*Phascolarctos cinereus*)

3.4.1 Site Condition – Species Habitat Indices

3.4.1.1 Quality and availability of food and foraging habitat

Koalas are obligate folivores and feed almost exclusively on the leaves of eucalypts (the genera of *Eucalyptus*, *Corymbia*, *Angophora*, *Syncarpia* and *Lophostemon*) with strong preferences for particular species according to region. In accordance with Youngentob et al. 2021, these regionally preferred species are known as Locally Important Koala Food Trees (LIKFT) and are defined as tree species that are regularly browsed by Koalas and comprise a considerable proportion of the local populations' diet within each defined Koala Management Bioregion (KMB). In addition to LIKFTs, primary and secondary Koala habitat trees have been identified by the local Gympie Regional Council (GRC). The listed LIKFTs for the Southeast Qld KMB, as well as the primary and secondary habitat trees identified by the GRC associated within the Study area are summarised below in Table 30. These, hereafter, will be cumulatively referred to as important food tree species.

Table 30: Important Food Tree Species for the Koala

Species	Source	Species	Source
Corymbia citriodora	LIKFT, GRC[2]	*Eucalyptus microcorys*	LIKFT, GRC[1]
Corymbia intermedia	GRC[2]	*Eucalyptus moluccana*	LIKFT, GRC[2]
Eucalyptus acmenoides	LIKFT, GRC[2]	*Eucalyptus propinqua*	LIKFT, GRC[1]
Eucalyptus carnea	LIKFT	*Eucalyptus racemosa*	LIKFT, GRC[1]
Eucalyptus crebra	LIKFT, GRC[2]	*Eucalyptus resinifera*	LIKFT, GRC[2]
Eucalyptus eugenioides	LIKFT	*Eucalyptus saligna*	LIKFT
Eucalyptus grandis	LIKFT, GRC[2]	*Eucalyptus siderophloia*	LIKFT
Eucalyptus major	LIKFT, GRC[1]	*Eucalyptus tereticornis*	LIKFT, GRC[1]
Eucalyptus melanophloia	LIKFT	*Lophostemon confertus*	GRC[2]

[1]Primary Habitat Tree listed by the Gympie Regional Council, [2]Secondary Habitat Tree listed by the Gympie Regional Council

Due to the local Koala populations reliance on these important food tree species, their availability is a critical component of Koala foraging habitat quality. As such, the parameter selected to assess the quality and availability of food and foraging habitat is '*availability of important food trees*'. This is considered an appropriate proxy for preferred resource availability. The average cover of these important food tree species across all survey sites in suitable habitat (excluding rainforests) is 33%; as such, sites with more than 30% cover of these species were assigned the median score (6). Scores for this parameter increase along with canopy dominance by any identified important food tree species. Koalas do not require diverse forests if the available tree species provide sufficient quality and quantity of foraging resources (Youngentob et al. 2021), so richness of important food tree richness has been excluded from the scoring process.

Table 31: Food and foraging criteria for Koala

Parameter	Score					
	0	2	4	6	8	10
Availability of important food trees (T1, T2 and emergent)	0% of important food tree cover	0-15% canopy cover of important food tree species	>15% canopy cover of important food tree species	>30% canopy cover of important food tree species	>45% canopy cover of important food tree species	>65% absolute canopy cover of important food tree species

3.4.1.2 Quality and availability of shelter

Landscape aspects such as sheltered gullies, areas of dense vegetation (e.g., closed canopy forests) and vegetated watercourses are recognised as important Koala refuges during extreme weather events such as droughts and intense bushfires. In these important refuge areas, as well as in general habitat areas, Koalas prefer to shelter in larger trees as they provide stable structures during inclement weather such as storms, and can also assist in thermoregulation during hot weather as a result of increased transpiration rates (DCCEEW 2022). These factors have been incorporated as parameters to determine the quality and availability of sheltering habitat for Koala.

The first parameter selected is '*proximity to refuge habitats'* which assesses each sites proximity to refugia including gullies, rainforest dominated communities and riparian vegetation. Score scaling was informed by Youngentob et al. (2021); a score of 3 was assigned to sites that were a minimum of 1 km from shelter habitat. Other sites were assigned higher or lower scores with increasing or decreasing proximity to shelter habitat, respectively. The second parameter proposed is the '*number of large trees per ha*', which utilises field-based large tree data and scores each site based on benchmark comparisons; scores increase with increasing density of large trees (see Appendix A for community benchmarks and thresholds).

Table 32: Shelter criteria for Koala

Parameter	Score					
	0	1	2	3	4	5
Proximity to refuge habitats	The site is >5 km from refuge habitat	The site is <5 km from refuge habitat	The site is <3 km from refuge habitat	The site is <1 km from refuge habitat	The site is <500 m from refuge habitat	The site supports or adjoins refuge habitat
Number of large trees per ha	No large trees present	>0% of large tree benchmark	>40% of large tree benchmark	>60% of large tree benchmark	>80% of large tree benchmark	≥100% of large tree benchmark

3.4.2 Site Context

3.4.2.1 Threats to the species

The species' *Conservation Advice* (DCCEEW 2022c) lists several threats to the species (Figure 4). Table 33 lists the threats to Koala and the threat risk scores along with criteria used to measure the threat. Table 34 lists the threat criteria and for each threat and the severity score which will be used to calculate the overall threat score for each Assessment Unit.

Likelihood	Consequences				
	Not significant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	Low risk	Very high risk **Encounter mortality with vehicles and dogs**		Very high risk **Clearing of koala habitat koala retrovirus (KoRV) and Chlamydia** **Increased frequency of drought** **Increased frequency of heatwaves** **Increasing frequency of high-intensity bushfire**	Very high risk **Shrinking climate envelope resulting in habitat loss**
Likely	Low risk	Moderate risk	High risk	Very high risk	Very high risk
Possible	Low risk	Moderate risk	High risk	Very high risk	Very high risk
Unlikely	Low risk	Low risk	Moderate risk	High risk	Very high risk
Unknown	Low risk	Low risk	Moderate risk	High risk	Very high risk

Figure 4: Threat risk matrix for Koala from the Koala Conservation Advice

Table 33: Threats for Koala and their risk score and criteria used to measure them (if scored)

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
Habitat loss and fragmentation	4	Yes	Time since last logged or cleared (based on aerial imagery), patch size and connectivity of patch

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
Collisions with vehicles	2	Yes	Active logging occurring, or the presence of logging rights over the land.
Wild Dogs	2	Yes	Records of Wild Dogs on cameras.
Disease- Koala retrovirus and Chlamydia	4	No	Diseases are a serious threat to Koala populations, particularly in South-east Queensland. Strains of Chlamydia can show no symptoms and detecting disease can be invasive. Chlamydia affects Koala across the region and will occur in both the Project Area and offset areas. Because of the difficulty in detecting disease, the invasiveness of the testing and its distribution across the region, measuring disease is impossible. This criteria will not be measured.
Fire regimes	4	Yes	Bushfire fuel load based on the abundance of elevated fine fuel, near surface fuel and surface fuel.
Climate change (including extreme heat waves and drought)	4	Yes	Size of the patch, connectedness and context of the patch. The climate change threat is a high risk to the species. Increasing temperatures resulting in increased frequency of heatwaves will significantly impact foraging tree species. Increasing frequency of hot bushfires is likely to decrease the availability of hollow bearing trees, impact the availability of foraging resources and can alter the structure of vegetation over time. Resilience of a patch from the effects of heatwaves, fire and drought can depend on the size of the patch, its connectiveness (as an indication of likely ecosystem health) and its location in the landscape.

Table 34: Threat parameters for Koala

Parameter	Score		
	1 (high)	7 (moderate)	15 (low)
Habitat loss and fragmentation	Evidence of recent (<10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	Evidence of historical (>10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	No evidence of timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery

Parameter	Score		
	1 (high)	7 (moderate)	15 (low)
Climate Change	Sum of size of patch, connectiveness and context is 0 - 6	Sum of size of patch, connectiveness and context is >6-15	Sum of size of patch, connectiveness and context is >15-20
Predation- Wild Dogs	Dogs recorded on more than 3 camera trap nights (minimum of 14 nights)	Dogs recorded on 1 to 3 camera trap nights (minimum of 14 nights)	No dogs recorded on cameras (minimum of 14 nights)
Bushfire fuel load (scoring described in methodology section)	High bushfire fuel load	Moderate bushfire fuel load	Low bushfire fuel load
Vehicle strike	High risk of mortality from vehicle strike: Maintained gravel or sealed roads (proxy for regular vehicle speeds of up to 60 km/h) within the site	Moderate risk of mortality from vehicle strike: Unmaintained tracks e.g. farm tracks (proxy for regular vehicle speeds of up to 40 km/h) within the site	Low risk of mortality from vehicle strike: No vehicle formed tracks associated within the site

3.4.2.2 Species Mobility Capacity

Koalas are typically arboreal; although dispersal between patches of suitable habitat may necessitate terrestrial travel across cleared areas, they tend to prefer natural, undisturbed, and contiguous habitats. When on the ground, Koalas' movement capacity may be severely reduced by unnatural obstructions such as fences, dense weedy areas, and high-capacity roads. Moving through cleared areas also poses increased risk for the species; examples include predation from domestic dogs, vehicle strike and structure entrapment (i.e., becoming tangled in fences) (DCCEEW 2022).

As the species can disperse across most habitat types and barrier-effects can be complex, only one parameter in '*Lantana camara cover*' was selected to measure Koala mobility capacity. *Lantana camara* is widespread across the Project area and areas of high encroachment are likely to form Koala barriers and decrease overall ecosystem function. The parameter will use site-specific data to measure *Lantana camara* occurrence. Although vehicle interactions may also limit mobility, this parameter is already measured as part of the threats to the species indicator.

Table 35: Species mobility capacity criteria for Koala

Parameter	Score					
	0	2	4	6	8	10
Lantana camara cover	>80% *Lantana camara* cover	>65-80 % *Lantana camara* cover	>50-65% *Lantana camara* cover	>25-50% *Lantana camara* cover	>5-25 % *Lantana camara* cover	<5% *Lantana camara* cover

3.5 Black-breasted Button-quail (*Turnix melanogaster*)

3.5.1 Site Condition – Species Habitat Indices

3.5.1.1 Quality and availability of food and foraging habitat

The BBBQ has specific habitat requirements that, in the context of the Project, include areas of dense forest or thicket vegetation with a closed canopy, a dense midstorey, and a ground-level mosaic of both open areas with deep leaf litter and areas of ground covering vegetation (DCCEEW 2022d). BBBQ typically require a dense layer of leaf litter and/or soft friable soils to forage for the invertebrates (including beetles, ants and earwigs) that are their main source of food (DCCEEW 2022d). Smyth and Pavey (2001) found that, in a fragmented landscape, BBBQ preferentially foraged in the three largest patches of suitable habitat available (all >15 ha in size) and were not detected foraging in smaller patches of suitable habitat (all < 10 ha in size). Personal communications from Roger Jaensch to the authors of the *Recovery Plan*, however, indicate that the species may forage in areas of suboptimal habitat when influenced by seasonal conditions or local disturbance (DCCEEW 2022d). Ideal foraging habitat for BBBQ includes closed canopy forests with a dense midstorey or shrub layer that provides concealment from predators, and a relatively bare understory with deep leaf litter and/or friable soils.

Three parameters were selected to assess the quality and availability of food and foraging habitat for BBBQ. The first parameter, '*midstorey and shrub layer coverage*' measures the complexity of the midstorey layer upon which the species relies for concealment from predators while foraging. Higher percentages of midstorey cover correspond to higher scores; only native species are included in cover calculations. The second parameter, '*patch condition and proximity to other suitable habitats*', measures the size of the immediate patch and the distance to others available nearby. Larger patch sizes correspond to higher scores. Despite the species apparent dispersal ability (DCCEEW 2022d), the capacity to forage within a large patch of remnant vegetation appears to be preferred by the species (Smyth and Pavey 2001). The final parameter selected was '*organic litter cover percentage*', which directly measures the availability of preferred foraging substrates in each patch in comparison to benchmarks (see Appendix A for all benchmark data). Higher percentages of organic litter correspond to higher scores.

Table 36: Food and foraging criteria for Black-breasted Button-quail

Parameter	Score					
	0	1	2	3	4	5
Midstorey and shrub layer coverage (native species only)	Shrub and midstorey layer absent	Shrub and/or midstorey layer cover <9%	Shrub and/or midstorey layer cover >10%	Shrub and/or midstorey layer cover >40%	Shrub and/or midstorey layer cover >60%	Shrub and/or midstorey layer cover >80%
Patch condition and proximity to other suitable habitats (eg vine thickets, dry rainforest communities, other forests with dense shrub layer)	No other suitable habitat located within 1km of patch, patch <10 ha in size, no connectivity	Patch is within 1km of other suitable habitat, patch <10 ha in size, no connectivity	Patch is within 500m of other suitable habitat, patch <10 ha in size, no connectivity	Patch is <10 ha in size, but is directly connected to other suitable habitat by contiguous vegetation	Patch is suitable habitat ≥10 ha in size in non-remnant or regrowth condition	Patch is suitable habitat ≥10 ha in size in remnant condition

Parameter	Score					
	0	1	2	3	4	5
Organic litter cover percentage	No organic litter	≤10% of benchmark organic litter	11 – 39% of benchmark organic litter	40 – 59% of benchmark organic litter	60 – 79% of benchmark organic litter	>80% of benchmark organic litter

3.5.1.2 Quality and availability of shelter

BBBQ rely on a dense midstorey layer of vegetation, as well as their cryptic plumage to provide concealment from predators (DCCEEW 2022d). The species typically occurs in small family groups and is polyandrus, with females known to defend breeding territories between 2 ha and 10 ha in size (DCCEEW 2022d). In fragmented landscapes, BBBQ have been shown to avoid smaller patches of habitat, particularly those below 7 ha in size. The species prefers larger and less fragmented habitat patches with good inter-patch connectivity (Smyth and Pavey 2001). However, within a contiguous matrix of other forest types, BBBQ may occur in patches of suitable habitat as small as 0.2 ha when these are directly connected to larger patches of habitat.

Three parameters were selected to assess the quality and availability of shelter. The first parameter was '*combined canopy cover*', measured as a percentage. Higher canopy cover percentages correspond with higher scores. The second parameter was '*midstorey and shrub layer coverage*', again measured as a percentage and scored so that higher scores were assigned to higher midstorey cover percentages; only native species were assessed for this parameter. The final indicator of '*immediate patch size*' was derived from known breeding territories, with larger patches of habitat receiving higher scores.

Table 37: Shelter criteria for Black-breasted Button-quail

Parameter	Score					
	0	1	2	3	4	5
Combined canopy cover (T1, T2 and emergent)	Less than 10% canopy cover	10% - 19% canopy cover	20-39% canopy cover	40-59% canopy cover	60-79% canopy cover	>80% canopy cover
Midstorey and shrub layer coverage (native species only)	Shrub and midstorey layer absent	Shrub and/or midstorey layer cover <9%	Shrub and/or midstorey layer cover >10%	Shrub and/or midstorey layer cover >40%	Shrub and/or midstorey layer cover >60%	Shrub and/or midstorey layer cover >80%
Immediate patch size (analogous habitat)	<0.5 ha	>0.5 ha	>2 ha	>4 ha	>6 ha	>8 ha

3.5.2 Site Context

3.5.2.1 Threats to the species

The species *Recovery Plan* (DCCEEW 2022d) lists several threats for the species. Table 38 lists the threats to Black-breasted Button-quail and the threat risk scores along with criteria used to measure the threat. Table 39 lists the threat criteria and for each threat the severity score which will be used to calculate the overall threat score for each Assessment Unit.

Table 38: Threats for Black-breasted Button-quail

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
Habitat loss and fragmentation	4	Yes	Time since last logged or cleared (based on aerial imagery), patch size and connectivity
Grazing	3	Yes	Presence of grazing
Predation- foxes, Feral Cats and Wild Dogs	2	Yes (will be scored in combination)	Number of predator species recorded present.
Predation- Wild Dogs	2	Yes	Records of Wild Dogs on cameras.
Fire regimes	4	Yes	Bushfire fuel load based on the abundance of elevated fine fuel, near surface fuel and surface fuel.
Habitat degradation- pigs	3	Yes	Presence of pigs found on cameras
Climate change including increased frequency of droughts	3	Yes	Size of the patch, connectedness and context of the patch. The climate change threat is a high risk to the species. Increasing temperatures resulting in increased frequency of heatwaves and droughts which will impact the availability of foraging resources and can alter the structure of vegetation over time. Resilience of a patch from the effects of heatwaves, fire and drought can depend on the size of the patch, its connectiveness (as an indication of likely ecosystem health) and its location in the landscape.

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
Weeds	3	Yes	Weed cover percentage and occurrence of degrading weeds named in Recovery Plan (Cat’s Claw Creeper, Madeira Vine, Climbing Asparagus, Green Panic or Coral Berry).

Table 39: Scoring criteria for threats to Black-breasted Button-quail

Parameter	Score		
	1 (high)	7 (moderate)	15 (low)
Habitat loss and fragmentation	Evidence of recent (<10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	Evidence of historical (>10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	No evidence of timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery
Grazing	Active grazing present throughout the Assessment Unit and a grazing lease which extends more than 2 years is attached to the land.	No active grazing within the Assessment Unit but grazing occurs within the property and a grazing lease is attached to the land.	No active grazing within the Assessment Unit or within the property and no grazing leases are attached to the land.
Climate Change	Sum of size of patch, connectiveness and context is 0 - 6	Sum of size of patch, connectiveness and context is >6-15	Sum of size of patch, connectiveness and context is >15-20
Habitat degradation- Weed cover percentage and occurrence of degrading weeds named in Recovery Plan (Cat’s Claw Creeper, Madeira Vine, Climbing Asparagus, Green Panic or Coral Berry)	High weed cover (>75%) including at least one of the degrading weed species	Moderate weed cover (26-74% cover) including at least one degrading weed species	Low weed cover (0-25%) or no evidence of degrading weed species
Predation- Wild Dogs	Dogs recorded on more than 3 camera trap nights (minimum of 14 nights)	Dogs recorded on 1 to 3 camera trap nights (minimum of 14 nights)	No dogs recorded on cameras (minimum of 14 nights)

Parameter	Score		
	1 (high)	7 (moderate)	15 (low)
Habitat degradation- Pigs	Feral pigs recorded on more than 3 camera trap nights (minimum of 14 nights)	Feral pigs recorded on 1 to 3 camera trap nights (minimum of 14 nights)	No feral pigs recorded on cameras (minimum of 14 nights)
Bushfire fuel load (scoring described in methodology section)	High bushfire fuel load	Moderate bushfire fuel load	Low bushfire fuel load
Feral predator (Feral Cat and/or European Red Fox) presence based on a minimum of 14 camera-trap nights	At least two feral predators (Feral Cats or European Red Fox) detected in assessment unit	At least one feral predator detected in assessment unit	No feral predators detected in assessment unit

3.5.2.2 Species Mobility Capacity

The dispersal patterns of BBBQ are poorly understood, though recent work on the species indicates that the mobility capacity of the species is essentially unconstrained, and that there is a single continuous population across its range. Individuals are generally considered to be sedentary, though vagrancy and occurrence in isolated patches of habitat is now well documented, indicating a greater capacity for movement than previously understood (DCCEEW 2022d). However, the species apparently favours larger, intact tracts of habitat for both breeding and foraging (Smyth and Pavey 2001); presumably, the species would also prefer to move through larger areas of connected vegetation to limit exposure to predators. Consequently, one parameter one was selected to measure the species' mobility capacity: '*connectedness*' as per the guide to habitat quality.

Table 40: Species mobility capacity criteria for Black-breasted Button-quail

Parameter	Score			
	0	2	4	5
Connectedness score	Patch has no connectivity to woody vegetation	Patch is connected to remnant vegetation along >10% to >50% of its perimeter OR to remnant vegetation along <10% of perimeter, AND to regrowth vegetation along >25% of perimeter	Patch is connected to remnant vegetation along 50 to 75% of perimeter	Patch is connected with adjacent remnant vegetation along >75% of its perimeter OR includes > 500 ha remnant vegetation

3.6 Northern Long-nosed Potoroo (*Potorous tridactylus tridactylus*)

3.6.1 Site Condition – Species Habitat Indices

3.6.1.1 Quality and availability of food and foraging habitat

The Northern Long-nosed Potoroo occurs in a wide variety of habitats across its range. In the context of the Project, the species is likely to favour areas of wet sclerophyll forest and rainforest with a mosaic of dense understorey vegetation and open spaces to allow foraging (TSSC 2019; DAWE 2022b). Established metrics of habitat suitability for the species include proximity to extensive areas of vegetation (>2km^2), the presence of dense understorey vegetation (at least 25% area coverage) and patch size (TSSC 2019). Long-nosed Potoroos are omnivorous, with the bulk of their diet comprised of hypogeal sporocarps (the fruiting bodies of underground fungi). The species also feeds on fruits, seeds, roots, flowers and arthropods. The reliance on underground fungi means that the species requires suitable vegetation and soils to allow for persistent fungi growth; which can be reduced at certain weed infested sites.

Due to the mycorrhizal relationships between fungi and plants, it is presumed that an increase in tree and shrub richness corresponds with an increase in the availability and diversity of underground fungi (Claridge et al. 1993). Consequently, the first two parameters selected to assess the quality and availability of food and foraging habitat were the benchmark related '*tree species richness*' and '*shrub species richness*'; the species richness of trees and shrubs is considered a proxy for fungi availability (see Appendix A for benchmark data). Long-nosed Potoroos also prefer to forage in proximity to dense understorey cover, such as ferns and herbs, and as such '*native forb cover percentage*' was selected as the final parameter; the cover of introduced forbs, such as Creeping Cinderella Weed (*Calyptocarpus vialis*), were excluded as they are likely to reduce overall habitat quality.

Table 41: Food and foraging criteria for Long-nosed Potoroo

Parameter	Score					
	0	1	2	3	4	5
Tree species richness	<10% of benchmark richness	10-20% of benchmark richness	20-30% of benchmark richness	30-50% of benchmark richness	50-80% of benchmark richness	>80% of benchmark richness
Shrub species richness	<10% of benchmark richness	10-20% of benchmark richness	20-30% of benchmark richness	30-50% of benchmark richness	50-80% of benchmark richness	>80% of benchmark richness
Native forb cover percentage	<10% OR >90% forb cover	10-19% forb cover	20-39% forb cover	40-59% forb cover	60-79% forb cover	80-89% forb cover

3.6.1.2 Quality and availability of shelter

The Long-nosed Potoroo requires a mosaic of habitats to meet its specific niche requirements (Trent 2015). Probability of occurrence increases significantly with patch size, with multiple authors (reviewed in Trent (2015) and DAWE (2022b)) suggesting that forest patches must be at least 10 ha in size to support individuals, and that most occurrences of the species are in forest patches > 40 ha in size. Within patches of suitable habitat, the species appears to require at least some canopy cover, as well as a dense layer of ground cover (to provide refuge from predators) (Trent 2015; TSSC 2019). Consequently, '*patch size*', '*combined canopy cover*' and '*midstorey and shrub layer coverage*' were selected as parameters to assess the quality and availability of shelter for the species; for the latter parameter, only native species were assessed.

Table 42: Shelter criteria for Long-nosed Potoroo

Parameter	Score					
	0	1	2	3	4	5
Patch size	<10 ha	≥10 ha	>20 ha	>40 ha	>75 ha	>90 ha
Combined canopy cover (T1, T2 and emergent)	Less than 10% canopy cover	10-19% canopy cover	20-39% canopy cover	40-59% canopy cover	60-79% canopy cover	>80% canopy cover
Midstorey and shrub layer coverage (native species only)	Shrub and midstorey layer absent	Shrub and/or midstorey layer cover <9%	Shrub and/or midstorey layer cover >10%	Shrub and/or midstorey layer cover >40%	Shrub and/or midstorey layer cover >60%	Shrub and/or midstorey layer cover >80%

3.6.2 Site Context

3.6.2.1 Threats to the species

The species' *Conservation Advice* (TSSC 2019) lists several threats for the species. The Conservation Advice does not contain a threat matrix but does list habitat fragmentation as the highest threat to this species, so it has been assumed the risk is high (score 4). Table 43 lists the threats to Long-nosed Potoroo and the threat risk scores along with criteria used to measure the threat. Table 43 lists the threat criteria and for each threat the severity score which will be used to calculate the overall threat score for each Assessment Unit.

Table 43: Threats for Northen Long-nosed Potoroo

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
Habitat loss and fragmentation	4	Yes	Time since last logged or cleared (based on aerial imagery), patch size and connectivity
Grazing	4	Yes	Presence of grazing
Timber harvesting	3	Yes	Active logging occurring, or the presence of logging rights over the land.

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
Forest dieback caused by Phytophthora and Manorina melanocephala	1	No	Dieback could potentially impact the quality of Long-nosed Potoroo habitat. However, it is not known if dieback directly impacts Long-nosed Potoroo populations and worst impacts of Phytophthora are seen along the coastal fringe of south-eastern Australia (not in the Project Area). Bell Minor related dieback is a threat to the species in Northern NSW. These threats are not relevant to the Project Site.
Competition with pigs	1	Yes	Records of Wild Dogs on cameras.
Myrtle Rust	1	Yes	Present of Myrtle Rust in the Assessment Unit.
Predation- foxes, Feral Cats	4	Yes (will be scored in combination)	Number of predator species recorded present.
Habitat degradation- weeds	1	Yes	Weed cover percentage and weed richness.
Competition with overabundant native species for fungal resources	1	No	Other fungi eating animals including Brush Turkeys compete with Long-nosed Potoroo for access to fungi. Species such as Brush Turkeys which have become abundant due to human activities can outcompete Long-nosed Potoroo. The Project Area is relatively remote and there is no evidence that Brush Turkeys or other native species have become over abundant to the point where they would out compete Long-nosed Potoroo. This threat is not relevant to the Project Area.
Predation- Wild Dogs	3	Yes	Records of Wild Dogs on cameras.
Toxoplasmosis	1	No	Toxoplasmosis is known to infect marsupials including Long-nosed Potoroos but it is currently only known to impact populations in Tasmania.
Fire regimes	3	Yes	Bushfire fuel load based on the abundance of elevated fine fuel, near surface fuel and surface fuel.
Climate change including increased frequency of droughts	4	Yes	Size of the patch, connectedness and context of the patch. The climate change threat is a high risk to the species. Increasing temperatures resulting in increased frequency of heatwaves and droughts which will impact the availability of foraging resources and can alter the structure of vegetation over time. Resilience of a patch from the effects of

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
			heatwaves, fire and drought can depend on the size of the patch, its connectiveness (as an indication of likely ecosystem health) and its location in the landscape.

Table 44: Scoring criteria for threats to Long-nosed Potoroo

Parameter	Score		
	1 (high)	7 (moderate)	15 (low)
Habitat loss and fragmentation	Evidence of recent (<10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	Evidence of historical (>10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	No evidence of timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery
Timber harvesting	Active timber harvesting present	Rights to harvest currently granted to stakeholder, but no active harvesting	No harvesting rights allocated to AU, no active harvesting
Grazing	Active grazing present throughout the Assessment Unit and a grazing lease which extends more than 2 years is attached to the land.	No active grazing within the Assessment Unit but grazing occurs within the property and a grazing lease is attached to the land.	No active grazing within the Assessment Unit or within the property and no grazing leases are attached to the land.
Climate Change	Sum of size of patch, connectiveness and context is 0 - 6	Sum of size of patch, connectiveness and context is >6-15	Sum of size of patch, connectiveness and context is >15-20
Myrtle Rust	Myrtle Rust known or assumed to be present in the Assessment Unit	Myrtle Rust known or assumed to be present in an adjacent Assessment Unit	Myrtle Rust not known to be present in the Assessment Unit or in adjacent Assessment Units.
Habitat degradation- Weed cover percentage and species richness	High weed cover (>75%) including at least one of the degrading weed species	Moderate weed cover (26-74% cover) including at least one degrading weed species	Low weed cover (0-25%) or no evidence of degrading weed species
Predation- Wild Dogs	Dogs recorded on more than 3 camera trap nights (minimum of 14 nights)	Dogs recorded on 1 to 3 camera trap nights (minimum of 14 nights)	No dogs recorded on cameras (minimum of 14 nights)

Parameter	Score		
	1 (high)	7 (moderate)	15 (low)
Competition with Pigs	Feral pigs recorded on more than 3 camera trap nights (minimum of 14 nights)	Feral pigs recorded on 1 to 3 camera trap nights (minimum of 14 nights)	No feral pigs recorded on cameras (minimum of 14 nights)
Bushfire fuel load (scoring described in methodology section)	High bushfire fuel load	Moderate bushfire fuel load	Low bushfire fuel load
Feral predator (Feral Cat and/or European Red Fox) presence based on a minimum of 14 camera-trap nights	At least two feral predators (Feral Cats or European Red Fox) detected in assessment unit	At least one feral predator detected in assessment unit	No feral predators detected in assessment unit

3.6.2.2 Species mobility capacity

Long-nosed Potoroo are thought to have home ranges between 19 and 100 ha in size with a limited dispersal capacity of approximately 6-8 km through suitable habitat (DAWE 2022b). Barriers to dispersal include breaks in canopy and understory cover and roadside or trackside areas where predators may be more abundant (Bali et al. 2003). The species apparently favours larger, intact tracts of habitat; occurrence records indicate that a minimum patch size of at least 40 ha is needed to support a viable population of Long-nosed Potoroo, and in SEQ, proximity to areas of vegetation >200 ha in size is the second most important environmental variable predicting suitability of habitat for the species (Trent 2015; DAWE 2022b). Presumably, larger patches of suitable habitat allow the species to move within the patch in an unobstructed manner without unnecessary exposure to predators. Consequently, two parameters were selected to measure the species' mobility capacity: '*patch size*' and '*connectedness*'.

Table 45: Species mobility capacity for Long-nosed Potoroo

Parameter	Score					
	0	1	2	3	4	5
Patch size	<10 ha	10-40 ha	40-70 ha	70-100 ha	100-200 ha	>200 ha

	0	2	4	5
Connectedness score	Patch has no connectivity to woody vegetation	Patch is connected to remnant vegetation along >10% to >50% of its	Patch is connected to remnant vegetation along 50 to 75% of perimeter	Patch is connected with adjacent remnant vegetation along >75% of its perimeter OR includes > 500 ha remnant vegetation

Parameter	Score					
	0	1	2	3	4	5
		perimeter OR to remnant vegetation along <10% of perimeter, AND to regrowth vegetation along >25% of perimeter				

3.7 Lowland Rainforest of subtropical Australia Threatened Ecological Community

3.7.1 Site Condition and Site Context

The Lowland Rainforest of subtropical Australia Threatened Ecological Community (hereafter lowland rainforest TEC) occurs from Maryborough, Qld to Grafton, NSW below 300 m elevation and is typically a tall and diverse closed forest community. It is typified by a low abundance or complete lack of sclerophyllous taxa such as those within the genera of *Eucalyptus*, *Melaleuca* and *Casuarina* (TSSC 2011).

There are three recognised condition classes for areas of vegetation that meet the key diagnostic characteristics of the lowland rainforest TEC. These all relate to data that are either collected within BioCondition assessments to determine the **Site Condition Score** or measured via spatial analysis for the **Site Context Score**. Specifically, the data that inform conditional classification of the TEC include:

- total native vegetation cover (analogous to *non-native plant cover*)
- species richness (included in the four *native plant species richness* measurements)
- canopy cover (included in the three *canopy cover* measurements)
- ‘patch type’, which refers to the status of the vegetation (non-remnant, regrowth or remnant)
- ‘patch size’.

‘*Patch type*’ is directly related to the ecologically dominant layer cover percentage and height in comparison to the benchmarks (both measured in **Site Condition Score** and are used to assign appropriate assessment units). The ‘*patch size*’ parameter is included in the **Site Context Score.**

As these data are largely already included in the habitat quality assessment method, the use of the standardised scoring approach and weighting is considered appropriate to determine the **Site Condition Score** and **Site Context Score** for lowland rainforest TEC.

However, the condition class for each patch of lowland rainforest TEC will directly inform the scoring of the ‘*Role of site location to TEC overall population in the state*’ attribute. This includes a maximum score (15) for those sites that meet the highest quality condition threshold (Class A), a median score (10) for those that meet moderate quality condition threshold (Class B), and a low score (5) for those sites that only achieve the minimum conditional threshold (Class C), in accordance with the lowland rainforest TEC *Listing Advice* (TSSC 2011).

Table 46: Condition thresholds for Lowland Rainforest of subtropical Australia

	Score			
Role of site location to TEC overall population in the state	15	10	5	0
Patch Type **(evidence of remnant vegetation & regeneration status)**	**Class A** Natural remnant evident by the persistence of mature residual trees AND	**Class B** Some residual trees (from Appendix B) are present plus evidence of either; a) Natural regeneration AND/OR b) Regeneration with active management AND	**Class C** A non-remnant patch that has recovered through a) Natural regeneration AND/OR b) supplementary planting that has stature and quality that is reflective of the description AND	**Not TEC** **Ground-truthed as suitable RE but does not currently meet the size, cover or species richness criteria to be a TEC.**
Patch size	≥0.1ha AND	≥1ha AND	≥2ha AND	
Canopy cover	Emergent/canopy/subcanopy cover is ≥70% AND			
Species richness	Contains ≥40 native woody species (Appendix A) AND	Contains ≥30 native woody species AND		
Percent of total vegetation cover that is native	≥70% of vegetation is native	≥50% of vegetation is native		

3.7.1.1 Threats

There are several threatening processes identified in the Lowland Rainforest TEC listing advice (TSSC 2011). The document does not provide risk ratings for each threat so the ratings have been assumed from the text.

Table 47: Threats for Lowland Tropical Rainforest TEC

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
Habitat loss and fragmentation	4	Yes	Time since last logged or cleared (based on aerial imagery), patch size and connectivity
Grazing	3	Yes	Presence of grazing
Timber harvesting	4	Yes	Active logging occurring, or the presence of logging rights over the land.
Myrtle Rust	4	Yes	Present of Myrtle Rust in the Assessment Unit.
Predation- foxes, Feral Cats	1	Yes (will be scored in combination)	Number of predator species recorded present.
Cane toads	1	No	This threat is only linked indirectly to the TEC due to Cane Toad impacting species that inhabit the TEC. There is no direct link to Cane Toads impacting the TEC directly. This will not be scored.
Habitat degradation- weeds	4	Yes	Weed cover percentage and weed richness.
Predation- Wild Dogs	1	Yes	Records of Wild Dogs on cameras.
Fire regimes	3	Yes	Bushfire fuel load based on the abundance of elevated fine fuel, near surface fuel and surface fuel.
Climate change including increased frequency of droughts	4	Yes	Size of the patch, connectedness and context of the patch. The climate change threat is a high risk to the species. Increasing temperatures resulting in increased frequency of heatwaves and droughts which will impact the availability of foraging resources and can alter the structure of vegetation over time. Resilience of a patch from the effects of heatwaves, fire and drought can depend on the size of the patch, its

Threat	Risk score	Included in the scoring of threats to the species	Criteria used to measure
			connectiveness (as an indication of likely ecosystem health) and its location in the landscape.
Urbanisation (rubbish dumping, firewood collection, arson)	3	Yes	Distance to nearest residential house, road/track or infrastructure.

Table 48: Scoring criteria for threats to Lowland Rainforest TEC

Parameter	Score		
	1 (high)	7 (moderate)	15 (low)
Habitat loss and fragmentation	Evidence of recent (<10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	Evidence of historical (>10 year-old) timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery	No evidence of timber harvesting, habitat clearing or other fragmentation within assessment unit on satellite imagery
Timber harvesting	Active timber harvesting present	Rights to harvest currently granted to stakeholder, but no active harvesting	No harvesting rights allocated to AU, no active harvesting
Grazing	Active grazing present throughout the Assessment Unit and a grazing lease which extends more than 2 years is attached to the land.	No active grazing within the Assessment Unit but grazing occurs within the property and a grazing lease is attached to the land.	No active grazing within the Assessment Unit or within the property and no grazing leases are attached to the land.
Climate Change	Sum of size of patch, connectiveness and context is 0 - 6	Sum of size of patch, connectiveness and context is >6-15	Sum of size of patch, connectiveness and context is >15-20
Myrtle Rust	Myrtle Rust known or assumed to be present in the Assessment Unit	Myrtle Rust known or assumed to be present in an adjacent Assessment Unit	Myrtle Rust not known to be present in the Assessment Unit or in adjacent Assessment Units.
Habitat degradation- Detrimental weed species cover	>50% cover	25-50% cover	<25% cover

Parameter	Score		
	1 (high)	7 (moderate)	15 (low)
Predation- Wild Dogs	Dogs recorded on more than 3 camera trap nights (minimum of 14 nights)	Dogs recorded on 1 to 3 camera trap nights (minimum of 14 nights)	No dogs recorded on cameras (minimum of 14 nights)
Bushfire fuel load (scoring described in methodology section)	High bushfire fuel load	Moderate bushfire fuel load	Low bushfire fuel load
Feral predator (Feral Cat and/or European Red Fox) presence based on a minimum of 14 camera-trap nights	At least two feral predators (Feral Cats or European Red Fox) detected in assessment unit	At least one feral predator detected in assessment unit	No feral predators detected in assessment unit
Urbanisation	Distance to nearest residential dwelling, tracks/roads or other infrastructure is less than 500 m.	Distance to nearest residential dwelling, tracks/roads or other infrastructure is more between 1 km and 500 m.	Distance to nearest residential dwelling, tracks/roads or other infrastructure is more than 1 km

References

Bali, R, Lewis, B and Brown, K 2003, The status and distribution of the Cobaki Long-nosed Potoroo population, Tugun Bypass Environmental Impact Statement Technical Paper Number 12.

Cameron, M 2009, The influence of climate on Glossy Black-cockatoo reproduction, Pacific Conservation Biology, 15(1), pp. 65-71.

Claridge, AW, Tanton, MT and Cunningham, RB 1993, Hypogeal fungi in the diet of the Long-nosed Potoroo (Potorous tridactylus) in mixed-species and regrowth eucalypt forest stands in south-eastern Australia, Wildlife Research, 20, pp. 321-338.

DAWE (Department of Agriculture, Water and the Environment) 2022a, Conservation Advice for Petaurus australis australis (yellow-bellied glider (south-eastern)), Commonwealth of Australia, available online: https://www.environment.gov.au/biodiversity/threatened/species/pubs/87600-conservation-advice-02032022.pdf.

- 2022b, Conservation Advice for Potorous tridactylus tridactylus (northern long-nosed potoroo), Commonwealth of Australia, available online: https://www.environment.gov.au/biodiversity/threatened/species/pubs/66645-conservation-advice-15022022.pdf.

DCCEEW (Department of Climate Change, Energy, the Environment and Water) 2022a, Conservation Advice for Calyptorhynchus lathami lathami (South-eastern Glossy Black Cockatoo), Commonwealth of Australia, available online: http://www.environment.gov.au/biodiversity/threatened/species/pubs/67036-conservation-advice-10082022.pdf.

- 2022b, Conservation Advice for Petauroides volans (greater glider (southern and central))', Commonwealth of Australia, available online: https://www.environment.gov.au/biodiversity/threatened/species/pubs/254-conservation-advice-05072022.pdf.

- 2022c, Conservation Advice for Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory, Commonwealth of Australia, available online: https://www.environment.gov.au/biodiversity/threatened/species/pubs/85104-conservation-advice-12022022.pdf.

- 2022d, National Recovery Plan for Black-breasted Button-quail (Turnix melanogaster), Commonwealth of Australia, available online: https://www.dcceew.gov.au/sites/default/files/documents/national-recovery-plan-black-breasted-button-quail.pdf.

DEWHA (Department of the Environment, Water, Heritage and the Arts) 2008, Approved Conservation Advice for Sophora fraseri, Commonwealth of Australia, available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/8836-conservation-advice.pdf.

- 2010, Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999, Commonwealth of Australia, available from: https://www.dcceew.gov.au/sites/default/files/documents/survey-guidelines-birds-april-2017.pdf.

DSEWPC (Department of Sustainability, Environment, Water, Population and Communities) 2011, Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the EPBC Act, Commonwealth of Australia, available from: https://www.dcceew.gov.au/sites/default/files/documents/survey-guidelines-mammals.pdf.

Duckworth, JW 1998, The difficulty of estimating population densities of nocturnal forest mammals from transect counts of animals, Journal of Zoology, 246, pp. 466-468.

Eyre, T 2006, Regional habitat selection of large gliding possums at forest stand and landscape scales in southern Queensland, Australia: I. Greater glider (Petauroides volans), Forest Ecology and Management, 235, pp. 270-282.

Eyre, TJ and Goldingay, RL 2005, Characteristics of sap trees used by yellow-bellied gliders in southern Queensland, Wildlife Research, 32, pp. 23-35.

Eyre, TJ, Smith, GC, Venz, MF, Mathieson, MT, Hogan, LD, Starr, C, Winter, J and McDonald, K 2022, Guide to greater glider habitat in Queensland, report prepared for the Department of Agriculture, Water and the Environment, Canberra by the Department of Environment and Science, Queensland Government, Brisbane, available online: https://www.agriculture.gov.au/sites/default/files/documents/guide-greater-glider-habitat-qld.pdf.

Gilbert, NA, Clare, JDJ, Stenglein, JL, and Zuckerberg, B 2020, Abundance estimation of unmarked animals based on camera-trap data, Conservation Biology, 35(1), pp. 88-100.

Goldingay, RL and Kavanagh, RP 1991, The yellow-bellied glider: a review of its ecology, and management considerations, Conservation of Australia's forest fauna 1, pp. 365-375.

Higgins PJ (Ed.) 1999, Handbook of Australian, New Zealand and Antarctic birds, Vol. 4, Oxford University Press, Melbourne.

Hines, F, Tolhurst, KG, Wilson, AAG and McCarthy, GJ 2010, Overall fuel hazard assessment guide, Department of Sustainability and Environment, Victorian Government, available online: https://www.ffm.vic.gov.au/__data/assets/pdf_file/0005/21110/Report-82-overall-fuel-assess-guide-4th-ed.pdf.

IUCN Standards and Petitions Committee, 2024, Guidelines for using the IUCN Red List categories and criteria: Version 16, prepared by the Standards and Petitions Committee, available from: https://www.iucnredlist.org/documents/RedListGuidelines.pdf.

Jackson, SM 1999, Glide angle in the genus Petaurus and a review of gliding in mammals, Mammal Review, 30, pp. 9-30.

Mitchell, MK, Rendall, AR, Lefoe, MJ and Whisson, DA 2023, Food tree selection by an arboreal marsupial: Implications for timber harvest, Forest Ecology and Management, 544, p. 121218.

Queensland Herbarium, 2023, BioCondition Benchmark Database. Version 3.4 (April 2023) Department of Environment, Science and Innovation (DESI), available online: https://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks

Smyth, AK and Pavey, CR 2001, Foraging by the endangered black-breasted button-quail (Turnix melanogaster) within fragmented rainforest of an agricultural landscape, Biological Conservation, 98(2), pp. 149-157.

Taylor, BD and Goldingay, RL 2009, Can Road-Crossing Structures Improve Population Viability of an Urban Gliding Mammal?, Ecology and Society, 14(2), p. 13.

Threatened Species Scientific Committee (TSSC) 2011, Commonwealth Listing Advice on Lowland Rainforest of Subtropical Australia, Department of Sustainability, Environment, Water, Population and Communities, available online: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/101-listing-advice.pdf.

- 2019, Conservation Advice *Potorous tridactylus tridactylus* Long-nosed Potoroo (SE Mainland), Commonwealth of Australia, available online: https://www.environment.gov.au/biodiversity/threatened/species/pubs/66645-conservation-advice-31102019.pdf.

- 2020, Conservation Advice *Rhodamnia rubescens* Scrub Turpentine, Department of Agriculture, Water and the Environment, available online: http://www.environment.gov.au/biodiversity/threatened/species/pubs/15763-conservation-advice-11122020.pdf.

Trent, SW 2015, Assessment of Habitat Factors and Development of a Species Distribution Model for the Long Nosed Potoroo (Potorous tridactylus tridactylus) in SEQ, Masters Thesis, University of Southern Queensland, available online: https://sear.unisq.edu.au/37623/1/StephenTRENT-2015.pdf.

van der Ree, R, Ward, SJ, and Handasyde, K 2004, Possums and gliders in Victoria, pages 91-110 in RL Goldingay and S Jackson (editors), The biology of Australian possums and gliders, Surrey Beatty and Sons PTY, Chipping Norton, Australia.

Vinson, SG, Johnson, AP and Mikac, KM 2021, Current estimates and vegetation preferences of an endangered population of the vulnerable greater glider at Seven Mile Beach National Park, Austral Ecology, 46, pp. 303-314.

Woinarski, JCZ, Burbidge, AA and Harrison PL 2015, Ongoing unravelling of a continental fauna: Decline and extinction of Australian mammals since European settlement, Proceedings of the National Academy of Sciences, 112(15), pp. 4531-4540.

Youngentob, KN, Marsh, KF and Skewes, J 2021, A review of koala habitat assessment criteria and methods, report prepared for the Department of Agriculture, Water and the Environment, Canberra.

Appendix A - Vegetation community benchmarks and large tree thresholds

Regional Ecosystem	Benchmark attribute					
	Large eucalypt tree abundance (per ha)	Tree canopy height (m)	Tree species richness	Large tree abundance (per ha) (eucalypt + non eucalypt)	Organic litter ground cover percentage (%)	Shrub species richness
12.3.1a	5	28	11	150	30	17
12.3.2	50	30	14	84	56	21
12.3.7	20	22	6	60	27	8
12.3.11	22	23	7	30	37	7
12.8.16	33	20	7	33	21	7
12.11.3	67	25	6	67	76	12
12.11.3a	41	26	11	41	54	13
12.11.9[1]	34	25	7	36	27	12
12.11.10	na	22	25	88	54	23
12.11.11	na	17	44	80	72	37
12.11.14	33	25	6	36	30	7
12.11.15[2]	33	25	6	36	30	7
12.12.12	60	22	4	60	35	3
12.12.15	47	24	8	57	65	6
12.12.12	54	28	12	59	57	17
12.12.15	na	28	45	73	51	38
12.12.15b	34	25	7	36	27	12
12.12.16	5	28	11	150	30	17
12.12.23	50	30	14	84	56	21

[1] Surrogate benchmark data used from RE12.12.23,

[2] Surrogate benchmark data used from RE12.11.14

Regional Ecosystem	Threshold attribute	
	Large eucalypt DBH (cm)	Large non-eucalypt DBH (cm)
12.3.1a	72	36
12.3.2	55	29
12.3.7	51	36
12.3.11	49	36
12.8.16	42	NA
12.11.3	45	NA
12.11.3a	46	NA
12.11.9[1]	41	25
12.11.10	NA	33
12.11.11	NA	29
12.11.14	41	25
12.11.15[2]	52	26
12.12.12	45	NA
12.12.15	47	26
12.12.12	47	27
12.12.15	NA	38
12.12.15b	52	26
12.12.16	72	36
12.12.23	55	29

[1] Surrogate benchmark data used from RE12.12.23,

[2] Surrogate benchmark data used from RE12.11.14

ABN 81 661 444 515

Get in touch

1800 433 939

239 George Street,
Brisbane City QLD 4000

info@qldhydro.com.au

qldhydro.com.au

Appendix C
MHQA scores

Greater glider

Table C-1: Greater glider habitat quality score summary – Impact Area

Final habitat quality score (weighted)	AU4	AU5	AU9	AU10	AU12	AU14	AU17	AU19	Average/Final
Site Condition Score (out of 3)	1.39	1.96	2.02	1.93	1.80	2.12	1.95	1.50	**1.83**
Site Context Score (out of 3)	1.77	2.26	2.00	2.19	1.93	2.05	2.22	2.08	**2.06**
Species Stocking Rate (out of 4)	3.17	3.07	3.50	2.50	3.50	3.50	3.50	3.50	**3.28**
Habitat Quality score (out of 10)	6.32	7.29	7.52	6.62	7.23	7.67	7.67	7.08	**7.17**
Assessment Unit area (ha)	7.30	9.10	8.80	0.65	1.31	4.60	1.13	2.32	**35.2**
Total impact area (ha) for this MNES	35.2	35.2	35.2	35.2	35.2	35.2	35.2	35.2	**35.2**
Size Weighting	0.21	0.26	0.25	0.02	0.04	0.13	0.03	0.07	**1.00**
Weighted Habitat Quality Score	**1.31**	**1.88**	**1.88**	**0.12**	**0.27**	**1.00**	**0.25**	**0.47**	7.2

Table C-2: Greater glider habitat quality score summary – Offset Area A

Final habitat quality score (weighted)	AU10	AU11	AU12	AU13	AU16	Average/Final
Site Condition Score (out of 3)	1.52	1.97	0.76	1.63	1.94	**1.57**
Site Context Score (out of 3)	2.43	2.67	2.42	2.51	2.40	**2.49**
Species Stocking Rate (out of 4)	3.50	3.50	3.50	3.50	3.50	**3.50**
Habitat Quality score (out of 10)	7.46	8.15	6.68	7.64	7.84	**7.55**
Assessment Unit area (ha)	2.15	5.57	10.86	85.01	4.11	**107.70**
Total offset area (ha) for this MNES	107.70	107.70	107.70	107.70	107.70	**107.70**
Size Weighting	0.02	0.05	0.10	0.79	0.04	**1.00**
Weighted Habitat Quality Score	**0.15**	**0.42**	**0.67**	**6.03**	**0.30**	7.6

Table C-3: Greater glider habitat quality score summary – Offset Area B

Final habitat quality score (weighted)	AU5	AU6	AU7	AU8	AU9	AU11	AU13	AU18	AU19	AU20	AU21	AU22	AU23	Average / Final
Site Condition Score (out of 3)	1.78	2.07	0.63	1.94	1.82	2.16	2.12	1.00	1.58	1.58	2.17	2.17	0.46	**1.65**
Site Context Score (out of 3)	2.37	2.65	1.55	1.81	2.41	2.57	2.69	1.57	2.17	2.26	2.74	2.68	1.06	**2.19**
Species Stocking Rate (out of 4)	3.50	3.00	2.00	3.30	3.50	3.00	3.50	3.00	3.50	3.33	2.50	2.50	3.50	**3.09**
Habitat Quality score (out of 10)	7.65	7.72	4.18	7.05	7.73	7.72	8.30	5.57	7.25	7.17	7.41	7.35	5.01	**6.93**
Assessment Unit area (ha)	*60.15*	*38.82*	*75.739*	*91.95*	*160.41*	*66.66*	*1.12*	*0.49*	*0.90*	*45.03*	*39.45*	*8.70*	*12.83*	**602.2**
Total offset area (ha) for this MNES	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	**602.2**
Size Weighting	0.10	0.06	0.13	0.15	0.27	0.11	0.00	0.00	0.00	0.07	0.07	0.01	0.02	**1.00**
Weighted Habitat Quality Score	**0.76**	**0.50**	**0.53**	**1.08**	**2.06**	**0.85**	**0.02**	**0.00**	**0.01**	**0.54**	**0.49**	**0.11**	**0.11**	**7.0**

Koala –Foraging/breeding

Table C-4: Koala habitat quality score summary (foraging/breeding/) – Impact Area

Final habitat quality score (weighted)	AU4	AU5	AU9	AU10	AU12	AU14	AU17	AU19	Average / Final
Site Condition Score (out of 3)	1.50	2.10	2.16	2.15	2.04	2.25	2.04	1.65	**1.99**
Site Context Score (out of 3)	2.06	2.47	2.27	2.54	2.11	2.22	2.41	2.30	**2.30**
Species Stocking Rate (out of 4)	2.83	3.50	3.50	3.50	3.50	3.50	3.50	3.50	**3.42**
Habitat Quality score (out of 10)	*6.39*	*8.06*	*7.94*	*8.19*	*7.65*	*7.97*	*7.95*	*7.45*	**7.70**
Assessment Unit area (ha) in disturbance footprint	7.33	9.19	8.78	0.65	1.31	4.60	1.13	2.31	**35.30**
Total impact area (ha) for this MNES	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	**35.30**
Size Weighting	0.21	0.26	0.25	0.02	0.04	0.13	0.03	0.07	**1.00**
Weighted Habitat Quality Score	1.33	2.10	1.98	0.15	0.28	1.04	0.25	0.49	7.6

Table C-5: Koala habitat quality score summary (foraging/breeding) – Offset Area A

Final habitat quality score (weighted)	AU10	AU11	AU12	AU13	AU16	Average/Final
Site Condition Score (out of 3)	1.67	2.03	0.80	1.70	2.08	**1.66**
Site Context Score (out of 3)	2.21	2.59	2.33	2.49	2.64	**2.45**
Species Stocking Rate (out of 4)	3.50	3.50	3.50	3.50	3.50	**3.50**
Habitat Quality score (out of 10)	7.39	8.12	6.63	7.69	8.22	**7.61**
Assessment Unit area (ha)	2.15	5.57	10.86	85.01	4.11	**107.7**
Total offset area (ha) for this MNES	107.7	107.7	107.7	107.7	107.7	**107.7**
Size Weighting	0.02	0.05	0.10	0.79	0.04	**1.00**
Weighted Habitat Quality Score	0.15	0.42	0.67	6.07	0.31	7.6

Table C-6: Koala habitat quality score summary (foraging/breeding) – Offset Area B

Final habitat quality score (weighted)	AU5	AU6	AU8	AU9	AU11	AU13	AU19	AU20	AU21	AU22	Average/ Final
Site Condition Score (out of 3)	1.85	2.08	2.08	1.91	2.28	2.25	1.63	1.77	2.21	2.21	**2.03**
Site Context Score (out of 3)	2.49	2.67	1.95	2.54	2.62	2.52	2.33	2.21	2.66	2.75	**2.47**
Species Stocking Rate (out of 4)	3.50	3.00	3.50	3.50	3.00	3.00	2.50	3.50	2.50	2.50	**3.05**
Habitat Quality score (out of 10)	7.85	7.75	7.52	7.95	7.90	7.77	6.46	7.49	7.37	7.46	**7.55**
Assessment Unit area (ha)	60.15	38.82	91.95	160.41	66.66	1.12	0.90	45.03	39.45	8.70	**513.1**
Total offset area (ha) for this MNES	513.1	513.1	513.1	513.1	513.1	513.1	513.1	513.1	513.1	513.1	**513.1**
Size Weighting	0.12	0.08	0.18	0.31	0.13	0.00	0.00	0.09	0.08	0.02	**1.00**
Weighted Habitat Quality Score	**0.92**	**0.59**	**1.35**	**2.49**	**1.03**	**0.02**	**0.01**	**0.66**	**0.57**	**0.13**	**7.7**

Koala – Dispersal/refuge

Table C-7: Koala habitat quality score summary (dispersal/refuge) – Impact Area

Final habitat quality score (weighted)	AU1	AU3	AU6	AU9	AU11	AU16	AU19	Average/Final
Site Condition Score (out of 3)	1.91	2.06	1.23	2.27	2.22	2.29	2.30	**2.04**
Site Context Score (out of 3)	0.80	0.39	0.96	2.16	0.59	0.81	1.65	**1.05**
Species Stocking Rate (out of 4)	1.50	1.50	3.50	3.50	1.50	1.50	3.50	**2.36**
Habitat Quality score (out of 10)	*4.21*	*3.95*	*5.69*	*7.94*	*4.31*	*4.60*	*7.45*	**5.45**
Assessment Unit area (ha)	1.10	37.88	6.90	0.30	5.90	0.05	0.22	**52.3**
Total impact area (ha) for this MNES	52.3	52.3	52.3	52.3	52.3	52.3	52.3	**52.3**
Size Weighting	0.02	0.72	0.13	0.01	0.11	0.00	0.00	**1.00**
Weighted Habitat Quality Score	**0.09**	**2.86**	**0.75**	**0.05**	**0.49**	**0.00**	**0.03**	**4.3**

Table C-8: Koala habitat quality score summary (dispersal/refuge) – Offset Area A

Final habitat quality score (weighted)	AU2	AU14	AU15	Average / Final
Site Condition Score (out of 3)	1.19	1.00	1.05	**1.08**
Site Context Score (out of 3)	2.43	2.31	2.11	**2.28**
Species Stocking Rate (out of 4)	2.50	2.50	2.50	**2.50**
Habitat Quality score (out of 10)	*6.12*	*5.80*	*5.66*	**5.86**
Assessment Unit area (ha)	*2.04*	*9.65*	*3.10*	***14.8***
Total offset area (ha) for this MNES	14.8	14.8	14.8	**14.8**
Size Weighting	0.14	0.65	0.21	**1.00**
Weighted Habitat Quality Score	**0.84**	**3.79**	**1.19**	**5.8**

Table C-9: Koala habitat quality score summary (dispersal/refuge) – Offset Area B

Final habitat quality score (weighted)	AU1	AU2	AU3	AU4	AU7	AU15	AU18	AU23	Average / Final
Site Condition Score (out of 3)	1.51	1.68	1.61	1.94	0.73	1.73	1.04	0.58	**1.35**
Site Context Score (out of 3)	2.62	2.53	2.70	2.64	1.92	2.66	1.83	1.50	**2.30**
Species Stocking Rate (out of 4)	2.50	2.10	2.50	2.50	1.67	1.50	1.50	2.50	**2.10**
Habitat Quality score (out of 10)	*6.64*	*6.31*	*6.80*	*7.08*	*4.31*	5.88	*4.37*	*4.58*	**5.75**
Assessment Unit area (ha)	*8.30*	*28.77*	*2.55*	*11.41*	*75.74*	*4.67*	*0.49*	*12.83*	***144.7***
Total offset area (ha) for this MNES	144.7	144.7	144.7	144.7	144.7	144.7	144.7	144.7	**144.7**
Size Weighting	0.06	0.20	0.02	0.08	0.52	0.03	0.00	0.09	**1.00**
Weighted Habitat Quality Score	**0.38**	**1.25**	**0.12**	**0.56**	**2.26**	**0.19**	**0.01**	**0.41**	**5.2**

Black-breasted button-quail

Table C-10: Black-breasted button-quail habitat quality score summary – Impact Area

Final habitat quality score (weighted)	AU15	Average / Final
Site Condition Score (out of 3)	1.76	**1.95**
Site Context Score (out of 3)	1.85	**2.02**
Species Stocking Rate (out of 4)	2.50	**2.67**
Habitat Quality score (out of 10)	6.11	**6.63**
Assessment Unit area (ha)	0.20	**0.2**
Total impact area (ha) for this MNES	0.20	**0.20**
Size Weighting	1.00	**1.00**
Weighted Habitat Quality Score	**6.11**	**6.1**

Table C-11: Black-breasted button-quail habitat quality score summary – Offset Area A

Final habitat quality score (weighted)	AU2	AU14	AU15	Average / Final
Site Condition Score (out of 3)	1.38	1.03	1.30	**1.23**
Site Context Score (out of 3)	2.64	2.46	2.50	**2.54**
Species Stocking Rate (out of 4)	2.50	2.50	2.50	**2.50**
Habitat Quality score (out of 10)	*6.52*	*5.99*	*6.30*	**6.27**
Assessment Unit area (ha)	*2.04*	*9.65*	*3.10*	**14.8**
Total offset area (ha) for this MNES	14.8	14.8	14.8	**14.8**
Size Weighting	0.14	0.65	0.21	**1.00**
Weighted Habitat Quality Score	**0.90**	**3.91**	**1.32**	**6.1**

Table C-12: Black-breasted button-quail habitat quality score summary – Offset Area B

Final habitat quality score (weighted)	AU1	AU2	AU3	AU4	AU15	Average / Final
Site Condition Score (out of 3)	1.75	1.92	1.80	2.20	2.01	**1.93**
Site Context Score (out of 3)	2.58	2.55	2.62	2.50	2.61	**2.57**
Species Stocking Rate (out of 4)	2.50	2.50	2.50	2.50	2.50	**2.50**
Habitat Quality score (out of 10)	*6.84*	6.97	*6.91*	*7.19*	*7.11*	**7.01**
Assessment Unit area (ha)	*8.30*	*28.77*	*2.55*	*11.41*	*4.67*	**55.7**
Total offset area (ha) for this MNES	55.7	55.7	55.7	55.7	55.7	**55.7**
Size Weighting	0.15	0.52	0.05	0.20	0.08	**1.00**
Weighted Habitat Quality Score	**1.02**	**3.60**	**0.32**	**1.47**	**0.60**	***7.0***

Glossy black-cockatoo

Table C-13: Glossy black-cockatoo habitat quality score summary – Impact Area

Final habitat quality score (weighted)	AU4	AU5	AU9	AU10	AU12	AU14	AU15	AU17	AU19	Average / Final
Site Condition Score (out of 3)	1.35	1.82	2.05	1.86	1.73	2.10	1.55	1.93	1.75	**1.79**
Site Context Score (out of 3)	2.03	2.43	2.16	2.43	2.10	2.23	2.38	2.45	2.28	**2.28**
Species Stocking Rate (out of 4)	3.17	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	**3.46**
Habitat Quality score (out of 10)	6.55	7.74	7.70	7.80	7.33	7.83	7.42	7.88	7.53	**7.53**
Assessment Unit area (ha)	0.06	9.06	8.70	0.65	1.30	4.50	0.20	1.13	2.30	**27.9**
Total impact area (ha) for this MNES	27.9	27.9	27.9	27.9	27.9	27.9	27.9	27.9	27.9	**27.9**
Size Weighting	0.00	0.32	0.31	0.02	0.05	0.16	0.01	0.04	0.08	**1.00**
Weighted Habitat Quality Score	**0.01**	**2.51**	**2.40**	**0.18**	**0.34**	**1.26**	**0.05**	**0.32**	**0.62**	**7.7**

Table C-14: Glossy black-cockatoo habitat quality score summary – Offset Area A

Final habitat quality score (weighted)	AU10	AU11	AU12	AU13	AU16	Average / Final
Site Condition Score (out of 3)	1.52	1.78	0.77	1.59	1.79	**1.49**
Site Context Score (out of 3)	2.51	2.53	2.51	2.50	2.42	**2.49**
Species Stocking Rate (out of 4)	3.50	3.50	3.50	3.50	3.50	**3.50**
Habitat Quality score (out of 10)	*7.53*	*7.81*	*6.78*	*7.59*	*7.72*	**7.48**
Assessment Unit area (ha)	*2.15*	*5.57*	*10.86*	*85.01*	*4.11*	**107.7**
Total offset area (ha) for this MNES	107.7	107.7	107.7	107.7	107.7	**107.7**
Size Weighting	0.02	0.05	0.10	0.79	0.04	**1.00**
Weighted Habitat Quality Score	**0.15**	**0.40**	**0.68**	**5.99**	**0.29**	**7.5**

Table C-15: Glossy black-cockatoo habitat quality score summary – Offset Area B

Final habitat quality score (weighted)	AU5	AU6	AU7	AU8	AU9	AU11	AU13	AU18	AU19	AU20	AU21	AU22	AU23	Average / Final
Site Condition Score (out of 3)	1.69	1.95	0.72	1.87	1.72	1.97	2.05	1.03	1.48	1.80	2.03	1.90	0.61	1.60
Site Context Score (out of 3)	2.39	2.52	1.77	1.70	2.37	2.44	2.43	1.72	2.25	2.10	2.53	2.64	1.22	2.16
Species Stocking Rate (out of 4)	3.50	3.00	2.33	3.50	3.50	3.00	3.50	3.50	3.50	3.50	2.50	2.50	3.50	3.18
Habitat Quality score (out of 10)	7.58	7.47	4.82	7.06	7.59	7.42	7.98	6.25	7.23	7.41	7.06	7.04	5.33	6.94
Assessment Unit area (ha)	60.15	38.82	75.74	91.95	160.41	66.66	1.12	0.49	0.90	45.03	39.45	8.70	12.83	602.2
Total offset area (ha) for this MNES	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2
Size Weighting	0.10	0.06	0.13	0.15	0.27	0.11	0.00	0.00	0.00	0.07	0.07	0.01	0.02	1.00
Weighted Habitat Quality Score	0.76	0.48	0.61	1.08	2.02	0.82	0.01	0.01	0.01	0.55	0.46	0.10	0.11	*7.0*

Yellow-bellied glider

Table C-16: Yellow-bellied glider habitat quality score summary – Impact Area

Final habitat quality score (weighted)	AU4	AU5	AU9	AU10	AU12	AU14	AU17	AU19	Average / Final
Site Condition Score (out of 3)	1.44	1.94	2.02	1.89	1.91	2.03	1.97	1.60	**1.85**
Site Context Score (out of 3)	1.78	2.41	2.26	2.39	2.09	2.20	2.27	2.28	**2.21**
Species Stocking Rate (out of 4)	2.50	2.50	3.39	2.50	2.50	3.50	3.50	2.50	**2.86**
Habitat Quality score (out of 10)	5.72	6.85	7.67	6.79	6.50	7.73	7.74	6.38	**6.92**
Assessment Unit area (ha)	7.33	9.19	8.78	0.65	1.31	4.60	1.13	2.31	**35.3**
Total impact area (ha) for this MNES	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	**35.3**
Size Weighting	0.21	0.26	0.25	0.02	0.04	0.13	0.03	0.07	**1.00**
Weighted Habitat Quality Score	**1.19**	**1.78**	**1.91**	**0.12**	**0.24**	**1.01**	**0.25**	**0.42**	**6.9**

Table C-17: Yellow-bellied glider habitat quality score summary – Offset Area A

Final habitat quality score (weighted)	AU10	AU11	AU12	AU13	AU16	Average / Final
Site Condition Score (out of 3)	1.62	1.93	0.79	1.60	1.94	**1.58**
Site Context Score (out of 3)	2.37	2.66	2.21	2.46	2.21	**2.38**
Species Stocking Rate (out of 4)	3.00	3.50	3.50	3.50	3.50	**3.40**
Habitat Quality score (out of 10)	*7.00*	*8.09*	*6.50*	*7.56*	*7.65*	**7.36**
Assessment Unit area (ha)	*2.15*	*5.57*	*10.86*	*85.01*	*4.11*	**107.7**
Total offset area (ha) for this MNES	107.7	107.7	107.7	107.7	107.7	**107.7**
Size Weighting	0.02	0.05	0.10	0.79	0.04	**1.00**
Weighted Habitat Quality Score	**0.14**	**0.42**	**0.66**	**5.96**	**0.29**	**7.47**

Table C-18: Yellow-bellied glider habitat quality score summary – Offset Area B

Final habitat quality score (weighted)	AU5	AU6	AU7	AU8	AU9	AU11	AU13	AU18	AU19	AU20	AU21	AU22	AU23	Average/ Final
Site Condition Score (out of 3)	1.80	2.01	0.68	1.95	1.85	2.09	2.04	1.07	1.58	1.71	2.17	2.06	0.50	**1.65**
Site Context Score (out of 3)	2.31	2.49	1.55	1.73	2.35	2.48	2.70	1.54	2.14	2.19	2.62	2.50	1.03	**2.13**
Species Stocking Rate (out of 4)	2.50	2.50	2.17	2.50	2.50	2.50	2.50	1.50	2.50	2.50	2.50	2.50	1.50	**2.32**
Habitat Quality score (out of 10)	6.61	7.00	4.39	6.19	6.69	7.07	7.24	4.11	6.22	6.41	7.29	7.06	3.03	**6.10**
Assessment Unit area (ha)	60.15	38.82	75.74	91.95	160.41	66.66	1.12	0.49	0.90	45.03	39.45	8.70	12.83	602.2
Total offset area (ha) for this MNES	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	602.2	**602.2**
Size Weighting	0.10	0.06	0.13	0.15	0.27	0.11	0.002	0.001	0.00	0.07	0.07	0.01	0.02	**1.00**
Weighted Habitat Quality Score	**0.66**	**0.45**	**0.55**	**0.94**	**1.78**	**0.78**	**0.01**	**0.00**	**0.01**	**0.48**	**0.48**	**0.10**	**0.06**	**6.3**

Long-nosed potoroo

Table C-19: Long-nosed potoroo habitat quality score summary – Impact Area

Final habitat quality score (weighted)	AU2	AU4	AU5	AU9	AU10	AU12	AU14	AU15	AU17	AU19	Average/Final
Site Condition Score (out of 3)	2.07	1.54	2.02	2.15	2.07	1.91	2.21	1.77	2.01	1.76	**1.95**
Site Context Score (out of 3)	2.13	1.95	2.42	2.16	2.56	1.87	2.16	2.09	2.35	2.20	**2.19**
Species Stocking Rate (out of 4)	3.50	3.17	3.07	3.50	2.50	3.50	3.50	3.50	3.50	3.50	**3.32**
Habitat Quality score (out of 10)	*7.70*	*6.65*	*7.51*	*7.81*	*7.13*	*7.28*	*7.87*	*7.36*	*7.86*	*7.46*	**7.46**
Assessment Unit area (ha)	2.50	7.33	9.18	8.80	0.65	1.31	4.60	0.21	1.13	2.31	***38.0***
Total impact area (ha) for this MNES	38.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0	**38.0**
Size Weighting	0.07	0.19	0.24	0.23	0.02	0.03	0.12	0.01	0.03	0.06	**1.00**
Weighted Habitat Quality Score	**0.51**	**1.28**	**1.81**	**1.81**	**0.12**	**0.25**	**0.95**	**0.04**	**0.23**	**0.45**	7.46

Table C-20: Long-nosed potoroo habitat quality score summary – Offset Area A

Final habitat quality score (weighted)	AU2	AU10	AU11	AU12	AU13	AU14	AU15	Average / Final
Site Condition Score (out of 3)	1.29	1.74	2.10	0.88	1.68	0.93	1.14	**1.39**
Site Context Score (out of 3)	2.37	2.43	2.69	2.38	2.48	2.18	2.20	**2.39**
Species Stocking Rate (out of 4)	3.50	3.50	3.50	3.50	3.50	3.50	3.50	**3.50**
Habitat Quality score (out of 10)	7.15	7.68	8.29	6.76	7.67	6.60	6.84	**7.28**
Assessment Unit area (ha)	2.04	2.15	5.57	10.86	85.01	9.65	3.10	**118.4**
Total offset area (ha) for this MNES	118.4	118.4	118.4	118.4	118.4	118.4	118.4	**118.4**
Size Weighting	0.02	0.02	0.05	0.09	0.72	0.08	0.03	**1.00**
Weighted Habitat Quality Score	**0.12**	**0.14**	**0.39**	**0.62**	**5.51**	**0.54**	**0.18**	7.49

Table C-21: Long-nosed potoroo habitat quality score summary – Offset Area B

Final habitat quality score (weighted)	AU1	AU2	AU3	AU4	AU11	AU13	AU15	AU18	AU19	AU20	AU21	AU22	Average / Final
Site Condition Score (out of 3)	1.64	1.88	1.64	2.00	2.23	2.21	1.79	1.03	1.64	1.91	2.23	2.03	**1.85**
Site Context Score (out of 3)	2.33	2.31	2.40	2.37	2.40	2.39	2.33	1.71	2.01	2.02	2.45	2.45	**2.26**
Species Stocking Rate (out of 4)	2.00	2.90	3.50	3.50	3.00	3.50	2.50	2.00	3.50	3.33	2.50	2.50	**2.89**
Habitat Quality score (out of 10)	5.98	7.09	7.53	7.87	7.63	8.10	6.61	4.75	7.15	7.26	7.17	6.98	**7.01**
Assessment Unit area (ha)	8.30	28.77	2.55	11.41	66.66	1.12	4.67	0.49	0.90	45.03	39.45	8.70	**218.0**
Total offset area (ha) for this MNES	218.0	218.0	218.0	218.0	218.0	218.0	218.0	218.0	218.0	218.0	218.0	218.0	**218.0**
Size Weighting	0.04	0.13	0.01	0.05	0.31	0.01	0.02	0.00	0.00	0.21	0.18	0.04	**1.00**
Weighted Habitat Quality Score	**0.23**	**0.94**	**0.09**	**0.41**	**2.33**	**0.04**	**0.14**	**0.01**	**0.03**	**1.50**	**1.30**	**0.28**	***7.3***

Brush sophora

Table C-22: Brush sophora habitat quality score summary – Impact Area

Final habitat quality score (weighted)	AU1	AU9	AU14	Average / Final
Site Condition Score (out of 3)	0.81	2.20	2.26	**1.76**
Site Context Score (out of 3)	1.84	2.20	2.23	**2.09**
Species Stocking Rate (out of 4)	4.13	2.38	4.03	**3.51**
Habitat Quality score (out of 10)	*6.78*	*6.79*	*8.52*	**7.36**
Assessment Unit area (ha)	0.03	0.20	0.07	**0.3**
Total impact area (ha) for this MNES	0.3	0.3	0.3	**0.3**
Size Weighting	0.10	0.67	0.23	**1.00**
Weighted Habitat Quality Score	0.68	4.52	1.99	7.2

Table C-13: Brush sophora habitat quality score summary – Offset Area A

Final habitat quality score (weighted)	AU2	AU10	AU11	AU12	AU13	AU14	AU15	AU16	Average / Final
Site Condition Score (out of 3)	1.32	1.72	2.03	0.79	1.71	0.96	1.16	2.09	**1.47**
Site Context Score (out of 3)	2.52	2.41	2.52	2.33	2.45	2.22	2.49	2.33	**2.41**
Species Stocking Rate (out of 4)	0.19	1.33	1.33	0.19	0.19	0.19	0.19	0.19	**0.48**
Habitat Quality score (out of 10)	*4.03*	*5.46*	*5.89*	*3.30*	*4.34*	*3.36*	*3.84*	*4.61*	**4.35**
Assessment Unit area (ha)	*2.04*	*2.15*	*5.57*	*10.86*	*85.01*	*9.65*	*3.10*	*4.11*	***122.5***
Total offset area (ha) for this MNES	122.5	122.5	122.5	122.5	122.5	122.5	122.5	122.5	**122.5**
Size Weighting	0.02	0.02	0.05	0.09	0.69	0.08	0.03	0.03	**1.00**
Weighted Habitat Quality Score	0.07	0.10	0.27	0.29	3.01	0.26	0.10	0.15	4.3

Lowland Rainforest TEC

Table C-24: Lowland Rainforest TEC habitat quality score summary – Impact Area

Final habitat quality score (weighted)	AU2	Average / Final
Site Condition Score (out of 7)	4.96	4.96
Site Context Score (out of 3)	2.43	2.43
Habitat Quality score (out of 10)	7.39	7.39
Assessment Unit area (ha)	2.5	2.5
Total impact area (ha) for this MNES	2.5	2.5
Size Weighting	1.00	1.00
Weighted Habitat Quality Score	7.39	**7.4**

Table C-25: Lowland Rainforest TEC habitat quality score summary – Offset Area A

Final habitat quality score (weighted)	AU2	AU14	AU15	Average / Final
Site Condition Score (out of 3)	3.08	2.23	2.71	**2.68**
Site Context Score (out of 3)	2.48	2.25	2.22	**2.31**
Habitat Quality score (out of 10)	5.57	4.48	4.93	**4.99**
Assessment Unit area (ha)	*2.04*	*9.65*	*3.10*	**14.8**
Total offset area (ha) for this MNES	14.8	14.8	14.8	**14.8**
Size Weighting	0.14	0.65	0.21	**1.00**
Weighted Habitat Quality Score	**0.77**	**2.92**	**1.03**	**4.7**

Table C-26: Lowland Rainforest TEC habitat quality score summary – Offset Area B

Final habitat quality score (weighted)	AU1	AU2	AU15	Average / Final
Site Condition Score (out of 3)	3.97	4.52	4.42	**4.31**
Site Context Score (out of 3)	2.53	2.56	2.62	**2.57**
Habitat Quality score (out of 10)	6.50	7.09	7.04	**6.88**
Assessment Unit area (ha)	*8.30*	*28.77*	*4.67*	**41.7**
Total offset area (ha) for this MNES	41.7	41.7	41.7	**41.7**
Size Weighting	0.20	0.69	0.11	**1.00**
Weighted Habitat Quality Score	**1.29**	**4.89**	**0.79**	**6.9**

Appendix D
EPBC offset calculators

Greater glider

Table D-1: Offset Assessment Guide inputs for greater glider

Calculator input	Offset Area A	Offset Area B
Impact Area	**35.2 ha**	
Impact Area Score	**7 (Refer to Appendix C)**	
EPBC Act Status	**Endangered**	
Time over which loss is averted	20 years (Refer to Table 12 for the justification for this value)	
Time until ecological benefit	20 years (Refer to Table 12 for the justification for this value)	
Start area (ha)	107.7	602.2
Starting quality	8 Justification provided in Appendix C	7 Justification provided in Appendix C
Risk of loss (%) without offset	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality without offset	8 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.	7 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.
Risk of loss (%) with an offset:	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality with offset:	9 • It is proposed the offset will increase by one habitat quality point over 20 years. • Offset Area A contains areas of regrowth and cleared lands that are dominated by weeds. • There is a high potential to increase the abundance of large trees, increase canopy cover and reduce weed extent. • An MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.	8 • It is proposed the offset will increase by one habitat quality point over 20 years. This is considered conservative due to the areas of regrowth and non-remnant cleared land that will be actively managed for natural regeneration and revegetation of greater glider habitat. • There is a lack of large trees across the offset area which will be improved over the 20 years. Recruitment, species richness, canopy height and cover will be increased. Weed cover and pest animals will be reduced all resulting in improved habitat quality. • An MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.
Confidence in result (%) **Risk of loss**	90% • (Refer to Table 26)	90% • (Refer to Table 26)

Calculator input	Offset Area A	Offset Area B
Confidence in result (%) **Habitat gains**	• 85% • There is a high degree of confidence the future habitat quality score can be achieved using proven land management and restoration techniques. There is strong evidence of existing threats occurring in the offset area that can be actively managed and reduced including weeds, pest animals and inappropriate fire regimes. Use of experienced and qualified contractors to undertake the management and monitoring and review the offsets progress also increases the confidence in completion criteria being achieved. • Management actions including weed control and pest animal control are known to be effective in reducing weed cover, reducing browsing on regenerating trees or outcompeting new growth and reducing predation of pest animals on MNES. • Annual management, monitoring and reporting measures proposed provide increased confidence that the offset areas will improve in habitat quality. Any issues will be identified early and corrective actions implemented.	• 85% • Same justification for Area A

Koala

Table D-2: Offset Assessment Guide inputs for koala (foraging and breeding)

Calculator input	Offset Area A	Offset Area B
Impact Area	**35.3ha**	
Impact Area Score	**8 (Refer to Appendix C)**	
EPBC Act Status	**Endangered**	
Time over which loss is averted	20 years (Refer to Table 12 for the justification for this value)	
Time until ecological benefit	20 years (Refer to Table 12 for the justification for this value)	
Start area (ha)	107.7	513.2
Starting quality	8 Justification provided in Appendix C	8 Justification provided in Appendix C
Risk of loss (%) without offset	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality without offset	8 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.	8 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.
Risk of loss (%) with an offset:	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality with offset:	9 • It is proposed the offset will increase by one habitat quality point over 20 years. • Offset Area A contains areas of regrowth and cleared lands that are dominated by weeds. • There is a high potential to increase the abundance of large trees, increase canopy cover and reduce weed extent. • A MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.	9 • It is proposed the offset will increase by one habitat quality point over 20 years. This is considered conservative due to the areas of regrowth and non-remnant cleared land that will be actively managed for natural regeneration and revegetation of koala habitat. • There is a lack of large trees across the offset area which will be improved over the 20 years. Recruitment, species richness, canopy height and cover will be increased. Weed cover and pest animals will be reduced all resulting in improved habitat quality. • A MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.
Confidence in result (%) **Risk of loss**	90% (Refer to Table 26)	90% (Refer to Table 26)
Confidence in result (%) **Habitat gains**	85% • There is a high degree of confidence the future habitat quality score can be achieved using proven land management and restoration	85% • Same justification for Area A

Calculator input	Offset Area A	Offset Area B
	techniques. There is strong evidence of existing threats occurring in the offset area that can be actively managed and reduced including weeds, pest animals and inappropriate fire regimes. Use of experienced and qualified contractors to undertake the management and monitoring and review the offsets progress also increases the confidence in completion criteria being achieved. • Management actions including weed control and pest animal control are known to be effective in reducing weed cover, reducing browsing on regenerating trees or outcompeting new growth and reducing predation of pest animals on MNES. • Annual management, monitoring and reporting measures proposed provide increased confidence that the offset areas will improve in habitat quality. Any issues will be identified early and corrective actions implemented.	

Table D-3: Offset Assessment Guide inputs for koala (dispersal and refuge)

Calculator input	Offset Area A	Offset Area B
Impact Area	**52.3 ha**	
Impact Area Score	**4 (Refer to Appendix C)**	
EPBC Act Status	**Endangered**	
Time over which loss is averted	20 years (Refer to Table 12 for the justification for this value)	
Time until ecological benefit	20 years (Refer to Table 12 for the justification for this value)	
Start area (ha)	14.8	144.7
Starting quality	6 Justification provided in Appendix C	5 Justification provided in Appendix C
Risk of loss (%) without offset	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality without offset	6 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.	5 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.
Risk of loss (%) with an offset:	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality with offset:	8 • It is proposed the offset will increase by one habitat quality point over 20 years. • Offset Area A contains areas of regrowth and cleared lands that are dominated by weeds. • There is a high potential to increase the abundance of large trees, increase canopy cover and reduce weed extent. • A MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.	7 • It is proposed the offset will increase by two habitat quality points over 20 years. This is considered conservative due to the areas of regrowth and non-remnant cleared land that will be actively managed for natural regeneration and revegetation of koala habitat. • There is a lack of large trees across the offset area which will be improved over the 20 years. Recruitment, species richness, canopy height and cover will be increased. Weed cover and pest animals will be reduced all resulting in improved habitat quality. • A MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.
Confidence in result (%) **Risk of loss**	90% (Refer to Table 26)	90% (Refer to Table 26)
Confidence in result (%) **Habitat gains**	80% • There is a high degree of confidence the future habitat quality score can be achieved using proven land management and restoration techniques. There is strong evidence of existing threats occurring in the offset	80% • Same justification for Area A

Calculator input	Offset Area A	Offset Area B
	area that can be actively managed and reduced including weeds, pest animals and inappropriate fire regimes. Use of experienced and qualified contractors to undertake the management and monitoring and review the offsets progress also increases the confidence in completion criteria being achieved. • Management actions including weed control and pest animal control are known to be effective in reducing weed cover, reducing browsing on regenerating trees or outcompeting new growth and reducing predation of pest animals on MNES. • Annual management, monitoring and reporting measures proposed provide increased confidence that the offset areas will improve in habitat quality. Any issues will be identified early and corrective actions implemented.	

Black-breasted button-quail

Table D-4: Offset Assessment Guide inputs for Black-breasted button quail

Calculator input	Offset Area A	Offset Area B
Impact Area	**0.2 ha**	
Impact Area Score	**6 (Refer to Appendix C)**	
EPBC Act Status	**Vulnerable**	
Time over which loss is averted	20 years (Refer to Table 12 for the justification for this value)	
Time until ecological benefit	20 years (Refer to Table 12 for the justification for this value)	
Start area (ha)	14.8	55.7
Starting quality	6 Justification provided in Appendix C	7 Justification provided in Appendix C
Risk of loss (%) without offset	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality without offset	6 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.	7 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.
Risk of loss (%) with an offset:	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality with offset:	7 • It is proposed the offset will increase by one habitat quality point over 20 years. • Offset Area A contains areas of regrowth and cleared lands that are dominated by weeds. • There is a high potential to restore these areas through weed control, fire management and allowing natural regeneration. • There is predicted to be increases to canopy cover, canopy height, shrub cover, species richness and leaf litter. • A MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.	8 • It is proposed the offset will increase by one habitat quality point over 20 years. • There is a lack of large trees across the offset area which will be improved over the 20 years. Recruitment, species richness, canopy height and cover will be increased. Weed cover and pest animals will be reduced all resulting in improved habitat quality. • A MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.
Confidence in result (%) **Risk of loss**	90% (Refer to Table 26)	90% (Refer to Table 26)
Confidence in result (%) **Habitat gains**	85% • There is a high degree of confidence the future habitat quality score can be achieved using proven land management and restoration techniques. There is strong evidence of	85% • Same justification for Area A

Calculator input	Offset Area A	Offset Area B
	existing threats occurring in the offset area that can be actively managed and reduced including weeds, pest animals and inappropriate fire regimes. Use of experienced and qualified contractors to undertake the management and monitoring and review the offsets progress also increases the confidence in completion criteria being achieved. • Management actions including weed control and pest animal control are known to be effective in reducing weed cover, reducing browsing on regenerating trees or outcompeting new growth and reducing predation of pest animals on MNES. • Annual management, monitoring and reporting measures proposed provide increased confidence that the offset areas will improve in habitat quality. Any issues will be identified early and corrective actions implemented.	

Glossy black-cockatoo

Table D-5: Offset Assessment Guide inputs for Glossy black-cockatoo

Calculator input	Offset Area A	Offset Area B
Impact Area	**27.9 ha**	
Impact Area Score	**8 (Refer to Appendix C)**	
EPBC Act Status	**Vulnerable**	
Time over which loss is averted	20 years (Refer to Table 12 for the justification for this value)	
Time until ecological benefit	20 years (Refer to Table 12 for the justification for this value)	
Start area (ha)	107.7	602.2
Starting quality	8 Justification provided in Appendix C	7 Justification provided in Appendix C
Risk of loss (%) without offset	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality without offset	8 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.	7 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.
Risk of loss (%) with an offset:	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality with offset:	9 • It is proposed the offset will increase by one habitat quality point over 20 years. • Offset Area A contains areas of regrowth and cleared lands that are dominated by weeds. • There is a high potential to increase the abundance of large trees, increase canopy cover and reduce weed extent. • A MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.	8 • It is proposed the offset will increase by one habitat quality point over 20 years. This is considered conservative due to the areas of regrowth and non-remnant cleared land that will be actively managed for natural regeneration and revegetation of eucalypt woodland habitat. • There is a lack of large trees across the offset area which will be improved over the 20 years. Recruitment, species richness, canopy height and cover will be increased. Weed cover and pest animals will be reduced all resulting in improved habitat quality. • A MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.
Confidence in result (%) **Risk of loss**	90% (Refer to Table 26)	90% (Refer to Table 26)
Confidence in result (%) **Habitat gains**	85% • There is a high degree of confidence the future habitat quality score can be achieved using proven land	85% • Same justification for Area A

Calculator input	Offset Area A	Offset Area B
	management and restoration techniques. There is strong evidence of existing threats occurring in the offset area that can be actively managed and reduced including weeds, pest animals and inappropriate fire regimes. Use of experienced and qualified contractors to undertake the management and monitoring and review the offsets progress also increases the confidence in completion criteria being achieved. • Management actions including weed control and pest animal control are known to be effective in reducing weed cover, reducing browsing on regenerating trees or outcompeting new growth and reducing predation of pest animals on MNES. • Annual management, monitoring and reporting measures proposed provide increased confidence that the offset areas will improve in habitat quality. Any issues will be identified early and corrective actions implemented.	

Yellow-bellied glider

Table D-6: Offset Assessment Guide inputs for yellow-bellied glider

Calculator input	Offset Area A	Offset Area B
Impact Area -	**35.3 ha**	
Impact Area Score	**7 (Refer to Appendix C)**	
EPBC Act Status	**Vulnerable**	
Time over which loss is averted	20 years (Refer to Table 12 for the justification for this value)	
Time until ecological benefit	20 years (Refer to Table 12 for the justification for this value)	
Start area (ha)	107.7	602.2
Starting quality	7 Justification provided in Appendix C	6 Justification provided in Appendix C
Risk of loss (%) without offset	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality without offset	7 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.	6 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.
Risk of loss (%) with an offset:	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality with offset:	8 • It is proposed the offset will increase by one habitat quality point over 20 years. • Offset Area A contains areas of regrowth and cleared lands that are dominated by weeds. • There is a high potential to increase the abundance of large trees, increase canopy cover and reduce weed extent. • A MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.	7 • It is proposed the offset will increase by one habitat quality point over 20 years. This is considered conservative due to the areas of regrowth and non-remnant cleared land that will be actively managed for natural regeneration and revegetation of greater glider habitat. • There is a lack of large trees across the offset area which will be improved over the 20 years. Recruitment, species richness, canopy height and cover will be increased. Weed cover and pest animals will be reduced all resulting in improved habitat quality. • A MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.
Confidence in result (%) **Risk of loss**	90% (Refer to Table 26)	90% (Refer to Table 26)
Confidence in result (%) **Habitat gains**	85% • There is a high degree of confidence the future habitat quality score can	85% • Same justification for Area A

Calculator input	Offset Area A	Offset Area B
	be achieved using proven land management and restoration techniques. There is strong evidence of existing threats occurring in the offset area that can be actively managed and reduced including weeds, pest animals and inappropriate fire regimes. Use of experienced and qualified contractors to undertake the management and monitoring and review the offsets progress also increases the confidence in completion criteria being achieved. • Management actions including weed control and pest animal control are known to be effective in reducing weed cover, reducing browsing on regenerating trees or outcompeting new growth and reducing predation of pest animals on MNES. • Annual management, monitoring and reporting measures proposed provide increased confidence that the offset areas will improve in habitat quality. Any issues will be identified early and corrective actions implemented.	

Long-nosed potoroo

Table D-7: Offset Assessment Guide inputs for long-nosed potoroo

Calculator input	Offset Area A	Offset Area B
Impact Area	**38 ha**	
Impact Area Score	**7 (Refer to Appendix C)**	
EPBC Act Status	**Vulnerable**	
Time over which loss is averted	20 years (Refer to Table 12 for the justification for this value)	
Time until ecological benefit	20 years (Refer to Table 12 for the justification for this value)	
Start area (ha)	118.4	218.0
Starting quality	7 Justification provided in Appendix C	7 Justification provided in Appendix C
Risk of loss (%) without offset	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality without offset	7 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.	7 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.
Risk of loss (%) with an offset:	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality with offset:	8 • It is proposed the offset will increase by one habitat quality point over 20 years. • Offset Area A contains areas of regrowth and cleared lands that are dominated by weeds. • There is a high potential to increase the abundance of large trees, increase canopy cover and reduce weed extent. • A MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.	8 • It is proposed the offset will increase by one habitat quality point over 20 years. This is considered conservative due to the areas of regrowth and non-remnant cleared land that will be actively managed for natural regeneration and revegetation of greater glider habitat. • There is a lack of large trees across the offset area which will be improved over the 20 years. Recruitment, species richness, canopy height and cover will be increased. Weed cover and pest animals will be reduced all resulting in improved habitat quality. • A MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved.
Confidence in result (%) **Risk of loss**	90% (Refer to Table 26)	90% (Refer to Table 26)

Calculator input	Offset Area A	Offset Area B
Confidence in result (%) **Habitat gains**	85% • There is a high degree of confidence the future habitat quality score can be achieved using proven land management and restoration techniques. There is strong evidence of existing threats occurring in the offset area that can be actively managed and reduced including weeds, pest animals and inappropriate fire regimes. Use of experienced and qualified contractors to undertake the management and monitoring and review the offsets progress also increases the confidence in completion criteria being achieved. • Management actions including weed control and pest animal control are known to be effective in reducing weed cover, reducing browsing on regenerating trees or outcompeting new growth and reducing predation of pest animals on MNES. • Annual management, monitoring and reporting measures proposed provide increased confidence that the offset areas will improve in habitat quality. Any issues will be identified early and corrective actions implemented.	85% • Same justification for Area A

Brush sophora

Table D-8: Offset Assessment Guide inputs for brush sophora

Calculator input	Offset Area A	Offset Area B
Impact Area	**0.3 ha**	
Impact Area Score	**7 (Refer to Appendix C)**	
EPBC Act Status	**Vulnerable**	
Time over which loss is averted	20 years (Refer to Table 26 for the justification for this value)	
Time until ecological benefit	20 years (Refer to Table 26 for the justification for this value)	
Start area (ha)	122.5	n/a
Starting quality	4 Justification provided in Appendix C	n/a
Risk of loss (%) without offset	0% (Refer to Table 26)	n/a
Future quality without offset	4 No reduction in future quality proposed. Starting quality score is maintained. Further justification provided in Section 4.6.	n/a
Risk of loss (%) with an offset:	0% (Refer to Table 26)	n/a
Future quality with offset:	6 • It is proposed the offset will increase by two habitat quality points over 20 years. • Offset Area A contains remnant vegetation that is highly disturbed with weeds. Through a reduction in weed cover this will result in improvements to recruitment, species richness and canopy cover. The listed species is also likely to be outcompeted with weeds at this time so through active management its habitat will improve and be more likely to be able to regenerate and increase in population size. • A MHQA spreadsheet has been prepared to demonstrate where the gains can be achieved	n/a
Confidence in result (%) **Risk of loss**	90% (Refer to Table 26)	n/a
Confidence in result (%) **Habitat gains**	80% • There is a high degree of confidence the future habitat quality score can be achieved using proven land	n/a

Calculator input	Offset Area A	Offset Area B
	management and restoration techniques. There is strong evidence of existing threats occurring in the offset area that can be actively managed and reduced including weeds, pest animals and inappropriate fire regimes. Use of experienced and qualified contractors to undertake the management and monitoring and review the offsets progress also increases the confidence in completion criteria being achieved. • Management actions including weed control and pest animal control are known to be effective in reducing weed cover, reducing browsing on regenerating trees or outcompeting new growth and reducing predation of pest animals on MNES. • Annual management, monitoring and reporting measures proposed provide increased confidence that the offset areas will improve in habitat quality. Any issues will be identified early and corrective actions implemented.	

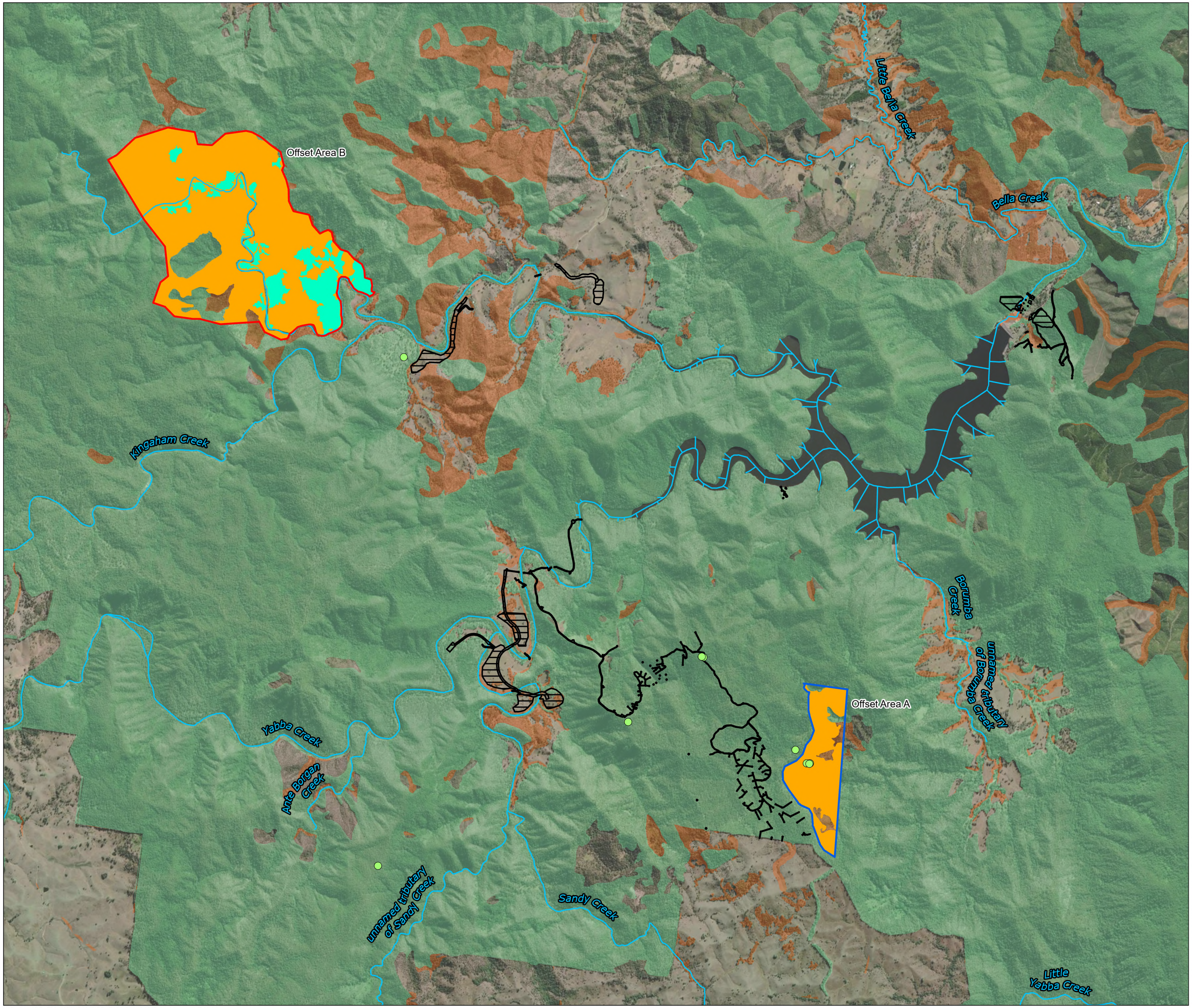
Lowland Rainforest TEC

Table D-9: Offset Assessment Guide inputs for Lowland Rainforest TEC

Calculator input	Offset Area A	Offset Area B
Impact Area	**2.5 ha**	
Impact Area Score	**7 (Refer to Appendix C)**	
EPBC Act Status	**Critically Endangered**	
Time over which loss is averted	20 years (Refer to Table 26 for the justification for this value)	
Time until ecological benefit	20 years (Refer to Table 26 for the justification for this value)	
Start area (ha)	14.8	41.7
Starting quality	5 Justification provided in Appendix C	7 Justification provided in Appendix C
Risk of loss (%) without offset	0% (Refer to Table 26)	0% (Refer to Table 12)
Future quality without offset	5 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.	7 • No reduction in future quality proposed. Starting quality score is maintained. • Further justification provided in Section 4.6.
Risk of loss (%) with an offset:	0% (Refer to Table 26)	0% (Refer to Table 26)
Future quality with offset:	7 • It is proposed the offset will increase by two habitat quality points over 20 years. • Offset Area A contains areas of regrowth and cleared lands that are dominated by weeds. • A number of MHQA sites do not meet the threshold level required for the Lowland Rainforest TEC therefore through active management and restoration these criteria are expected to meet Condition Class A. • Other habitat gains are expected to be increase the abundance of large trees, increase canopy cover, increase in shrub cover and reduce weed extent. • A MHQA spreadsheet has been prepared to demonstrate where the two point gains can be achieved.	9 • It is proposed the offset will increase by two habitat quality points over 20 years. • Recruitment, species richness, canopy height and cover will be increased. • Weed cover and pest animals will be reduced all resulting in improved habitat quality. • A MHQA spreadsheet has been prepared to demonstrate where the two point gains can be achieved.
Confidence in result (%) **Risk of loss**	90% (Refer to Table 26)	90% (Refer to Table 26)
Confidence in result (%)	80%	80% • Same justification for Area A

Calculator input	Offset Area A	Offset Area B
Habitat gains	• There is a high degree of confidence the future habitat quality score can be achieved using proven land management and restoration techniques. There is strong evidence of existing threats occurring in the offset area that can be actively managed and reduced including weeds, pest animals and inappropriate fire regimes. Use of experienced and qualified contractors to undertake the management and monitoring and review the offsets progress also increases the confidence in completion criteria being achieved. • Management actions including weed control and pest animal control are known to be effective in reducing weed cover, reducing browsing on regenerating trees or outcompeting new growth and reducing predation of pest animals on MNES. • Annual management, monitoring and reporting measures proposed provide increased confidence that the offset areas will improve in habitat quality. Any issues will be identified early and corrective actions implemented.	

Appendix E
MNES offset area figures



Queensland Hydro

GDA2020 MGA Zone 56

N

0 1300 m

1:50,000 @ A3

LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Offset Area A
- Offset Area B
- Watercourse [defined by Water Act 2000]

Field Survey Records

- Greater glider

Habitat within Offset Area

- Greater glider foraging and denning habitat
- Greater glider future habitat

Vegetation Management Status

- Remnant
- Regrowth

Data Sources:
1. Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019
World Imagery: Maxar

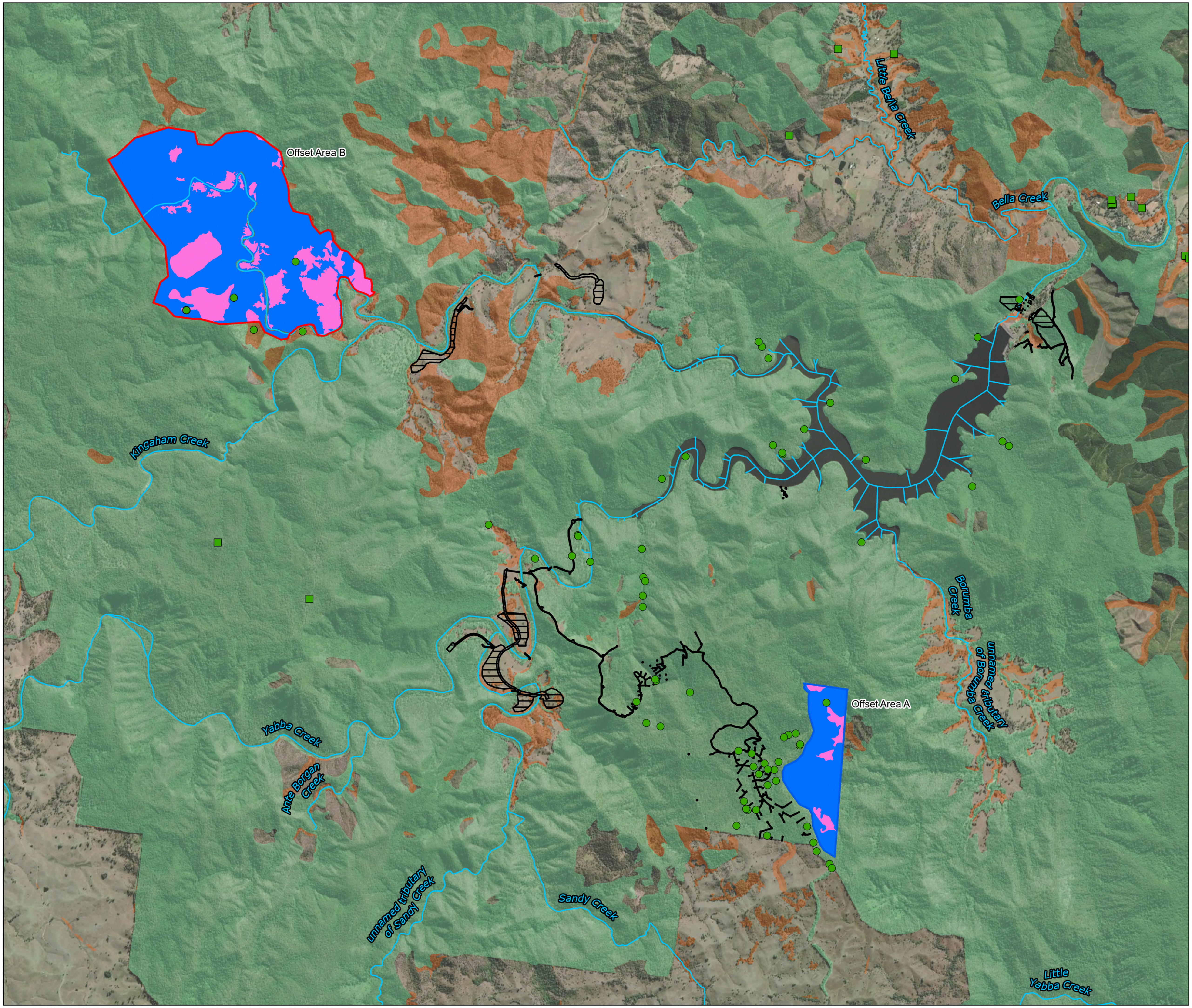
Borumba PHES Project
Offset Area Management Plan

GREATER GLIDER HABITAT WITHIN THE OFFSET AREAS

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	1/09/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE E1

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\AppendixE-Habitat



Queensland Hydro

GDA2020 MGA Zone 56

N

0 1300 m

1:50,000 @ A3

LEGEND

Exploratory Works Project Footprint (EPBC Only)
Offset Area A
Offset Area B
Watercourse [defined by Water Act 2000]

Desktop Threatened Species Records

Koala

Field Survey Records

Koala

Habitat within Offset Area

Koala dispersal habitat
Koala foraging and breeding habitat

Vegetation Management Status

Remnant
Regrowth

Data Sources:
1. Basemap © Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019
World Imagery: Maxar

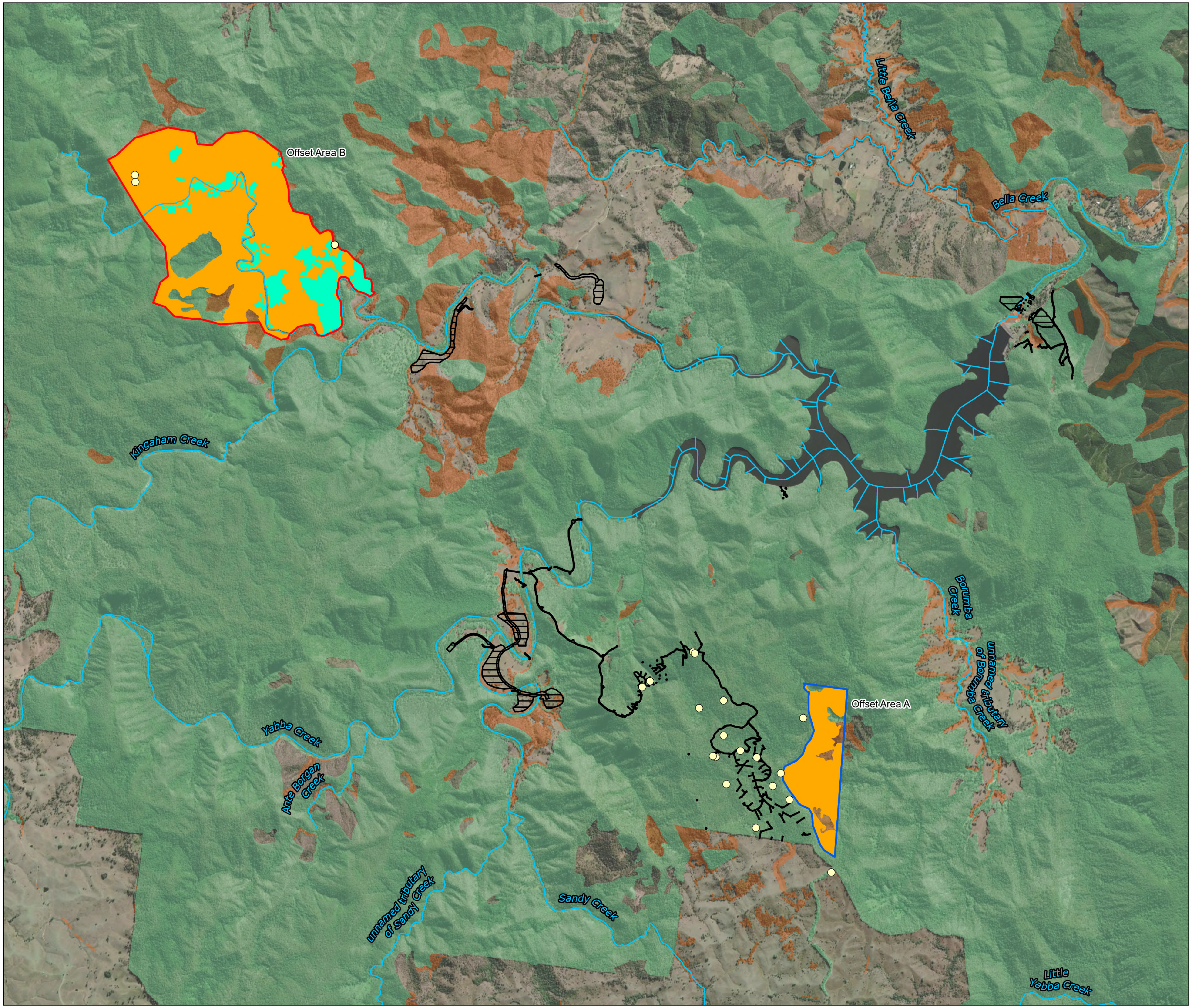
Borumba PHES Project
Offset Area Management Plan

KOALA
HABITAT WITHIN THE OFFSET AREAS

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	1/09/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE E2

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\AppendixE-Habitat



Queensland Hydro

GDA2020 MGA Zone 56

N

0 1300 m

1:50,000 @ A3

LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Offset Area A
- Offset Area B
- Watercourse [defined by Water Act 2000]

Field Survey Records

- Glossy black-cockatoo

Habitat within Offset Area

- Glossy black-cockatoo foraging and denning habitat
- Glossy black-cockatoo future habitat

Vegetation Management Status

- Remnant
- Regrowth

Data Sources:
1. Basemap © World Imagery: Earthstar Geographics
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019

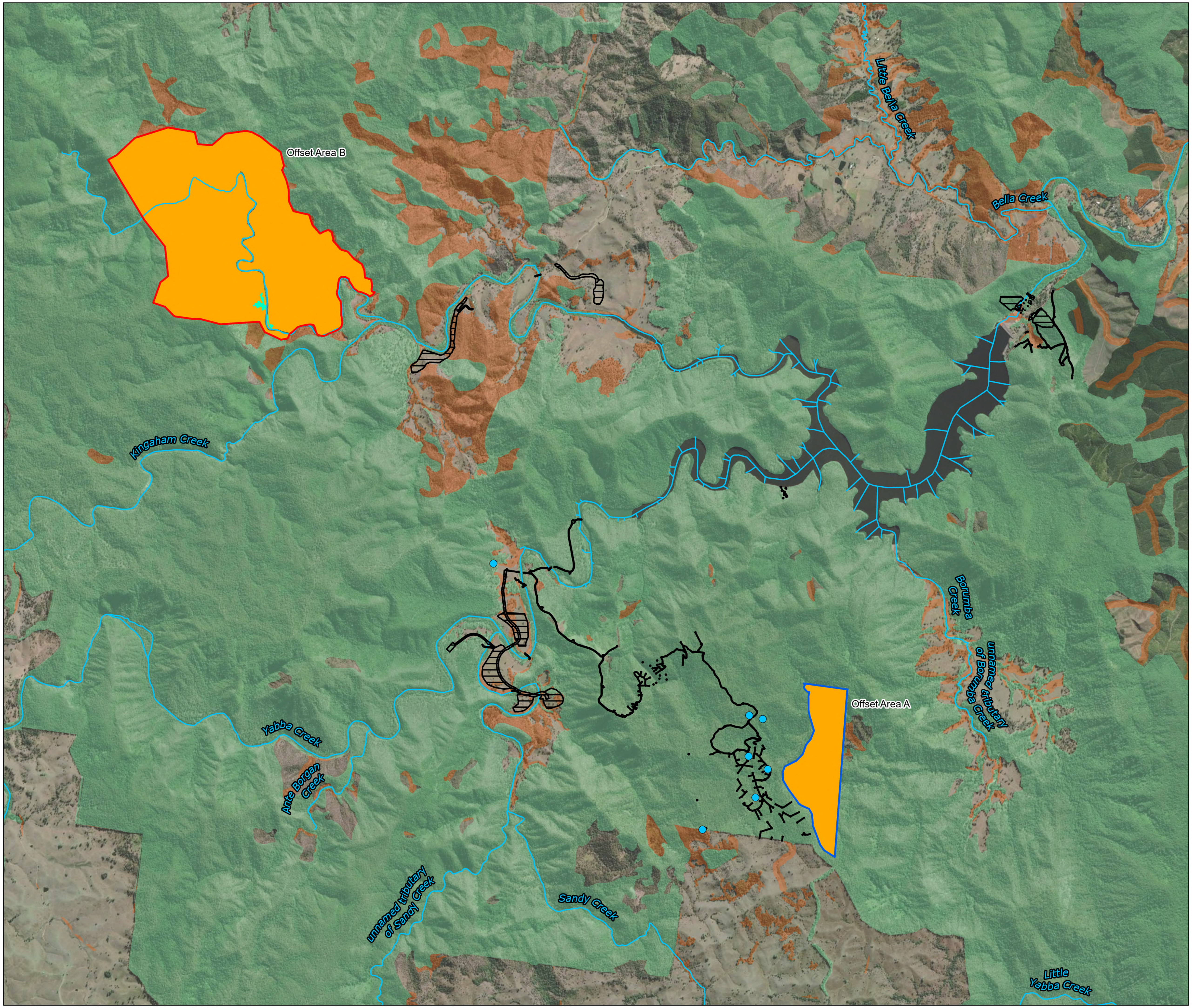
Borumba PHES Project
Offset Area Management Plan

GLOSSY BLACK-COCKATOO HABITAT WITHIN THE OFFSET AREAS

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	1/09/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE E3

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\AppendixE-Habitat



Queensland Hydro

GDA2020 MGA Zone 56

N

0 1300 m

1:50,000 @ A3

LEGEND

Exploratory Works Project Footprint (EPBC Only)

Offset Area A

Offset Area B

Watercourse [defined by Water Act 2000]

Field Survey Records

Long-nosed potoroo

Habitat within Offset Area

Long-nosed potoroo foraging habitat

Long-nosed potoroo future habitat

Vegetation Management Status

Remnant

Regrowth

Data Sources:
1. Basemap © World Imagery: Earthstar Geographics
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019

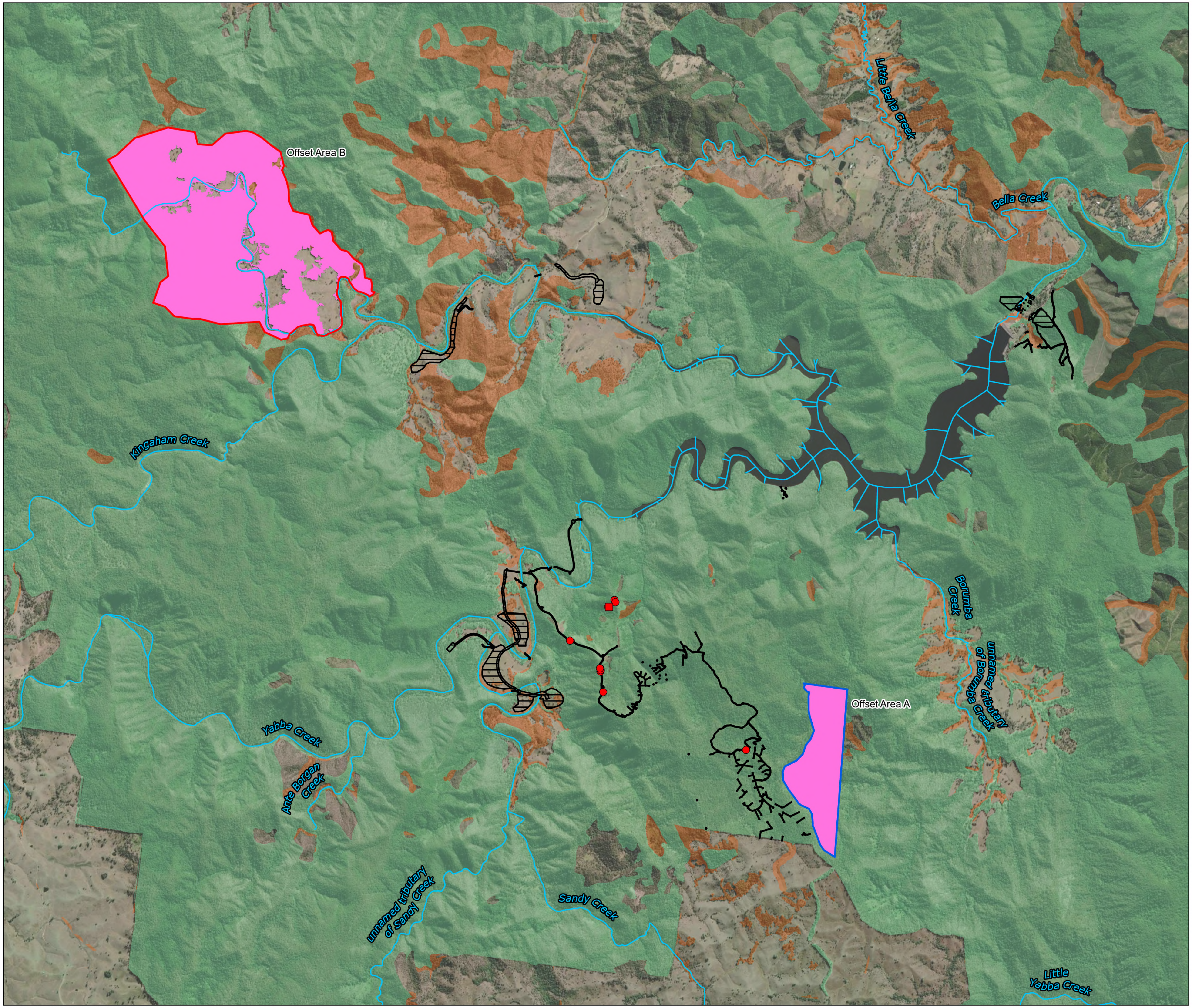
Borumba PHES Project
Offset Area Management Plan

LONG-NOSED POTOROO HABITAT WITHIN THE OFFSET AREAS

PROJECT NO: 30032677
CREATED BY: NC17428
MODIFIED ON: 1/09/2025
VERSION: A
AMENDED BY: NC17428

FIGURE E4

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\AppendixE-Habitat



Queensland Hydro

GDA2020 MGA Zone 56

N

0 1300 m

1:50,000 @ A3

LEGEND

Exploratory Works Project Footprint (EPBC Only)
Offset Area A
Offset Area B
Watercourse [defined by Water Act 2000]

Desktop Threatened Species Records

Brush sophora

Field Survey Records

Brush sophora

Habitat within Offset Area

Brush sophora potential habitat

Vegetation Management Status

Remnant
Regrowth

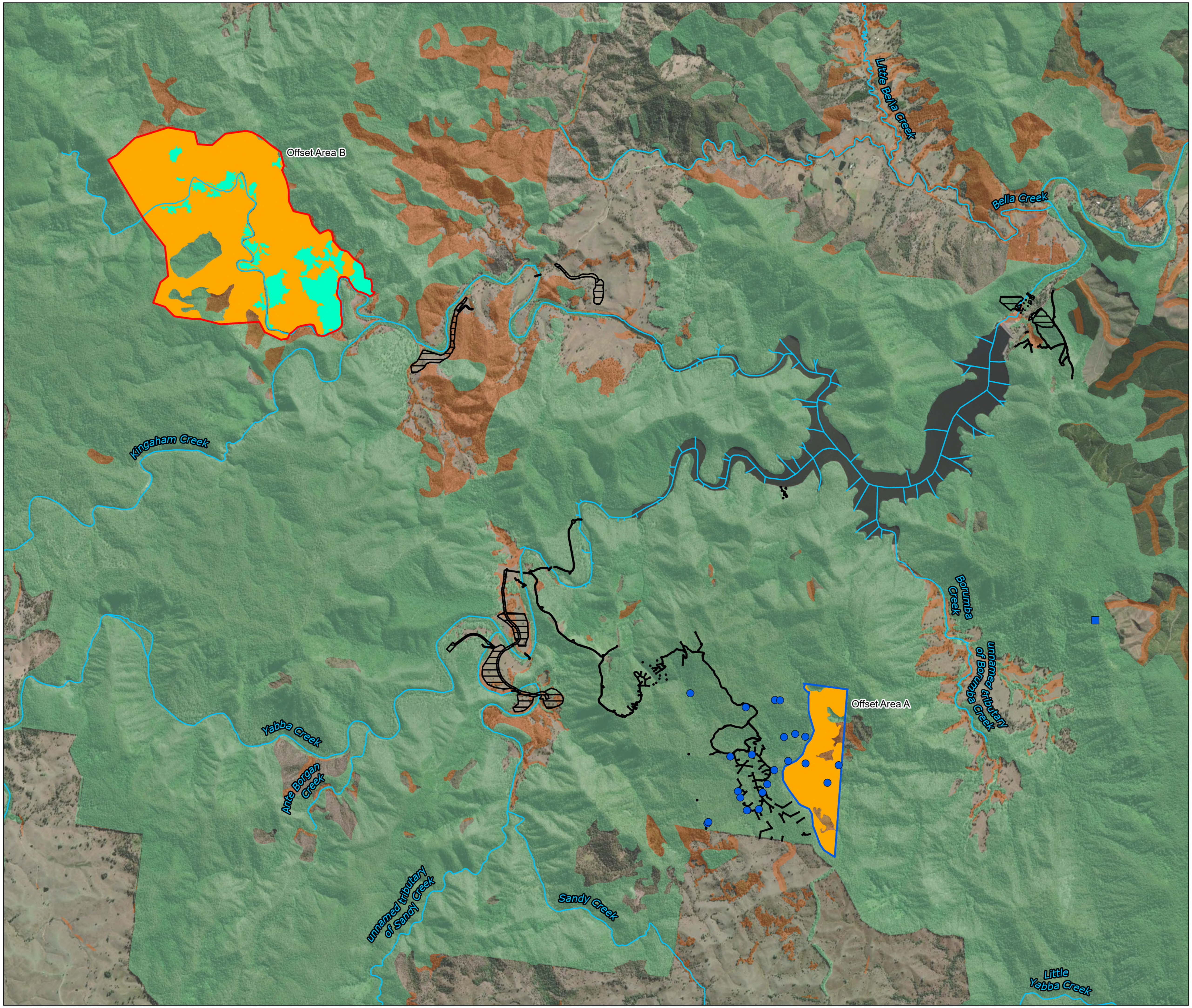
Data Sources:
1. Basemap © World Imagery: Earthstar Geographics
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019

Borumba PHES Project
Offset Area Management Plan

BRUSH SOPHORA
HABITAT WITHIN THE OFFSET AREAS

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	1/09/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE E5



Queensland Hydro

GDA2020 MGA Zone 56

N

0 1300 m

1:50,000 @ A3

LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Offset Area A
- Offset Area B
- Watercourse [defined by Water Act 2000]

Desktop Threatened Species Records

- Yellow-bellied glider

Field Survey Records

- Yellow-bellied glider

Habitat within Offset Area

- Yellow-bellied glider foraging and denning habitat
- Yellow-bellied glider future habitat

Vegetation Management Status

- Remnant
- Regrowth

Data Sources:
1. Basemap © World Imagery: Earthstar Geographics
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019

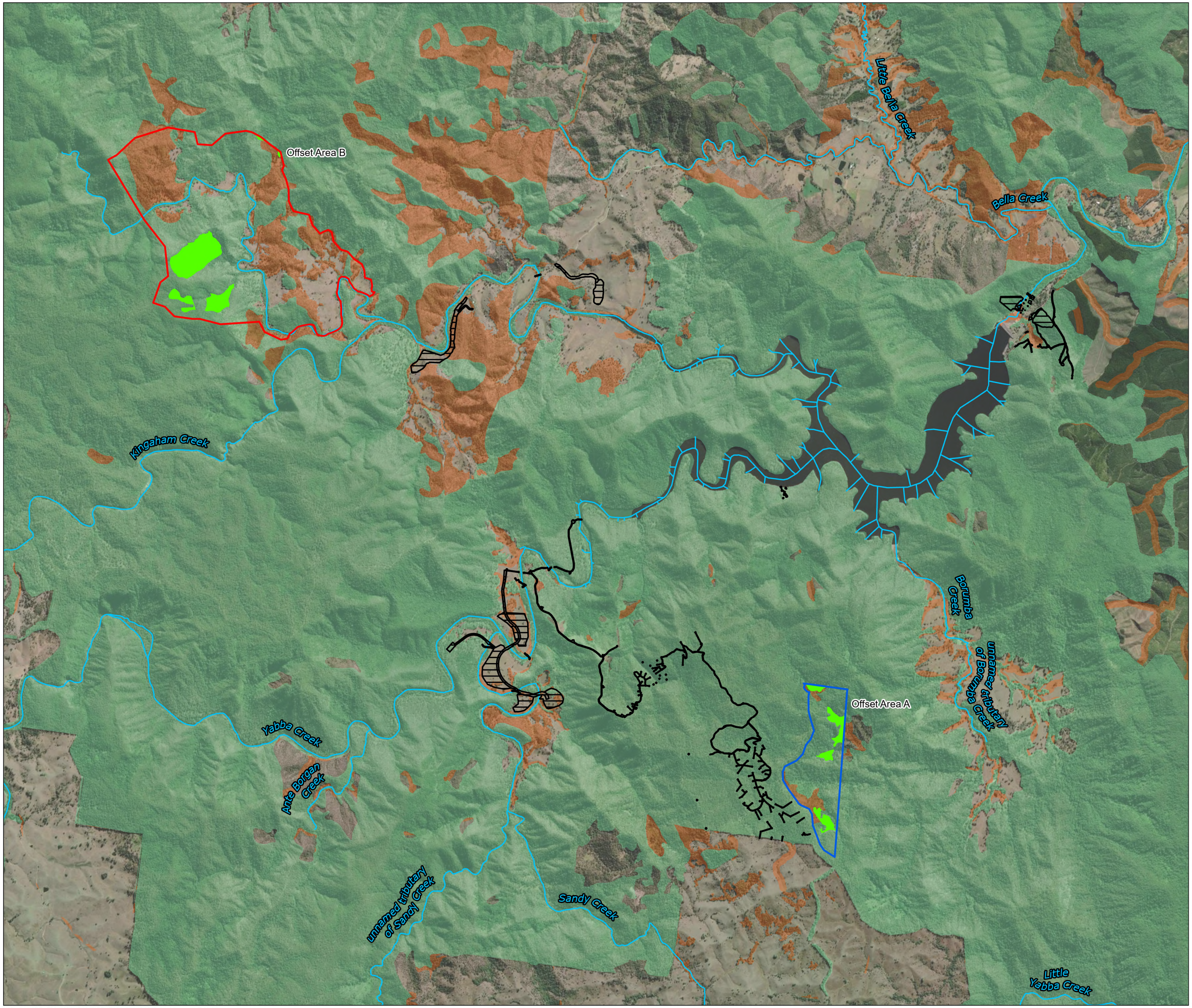
Borumba PHES Project
Offset Area Management Plan

YELLOW-BELLIED GLIDER HABITAT WITHIN THE OFFSET AREAS

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	1/09/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE E6

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\AppendixE-Habitat



Queensland Hydro

GDA2020 MGA Zone 56

N

0 1300 m

1:50,000 @ A3

LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Offset Area A
- Offset Area B
- Watercourse [defined by Water Act 2000]

Habitat within Offset Area

- Lowland Rainforest TEC

Vegetation Management Status

- Remnant
- Regrowth

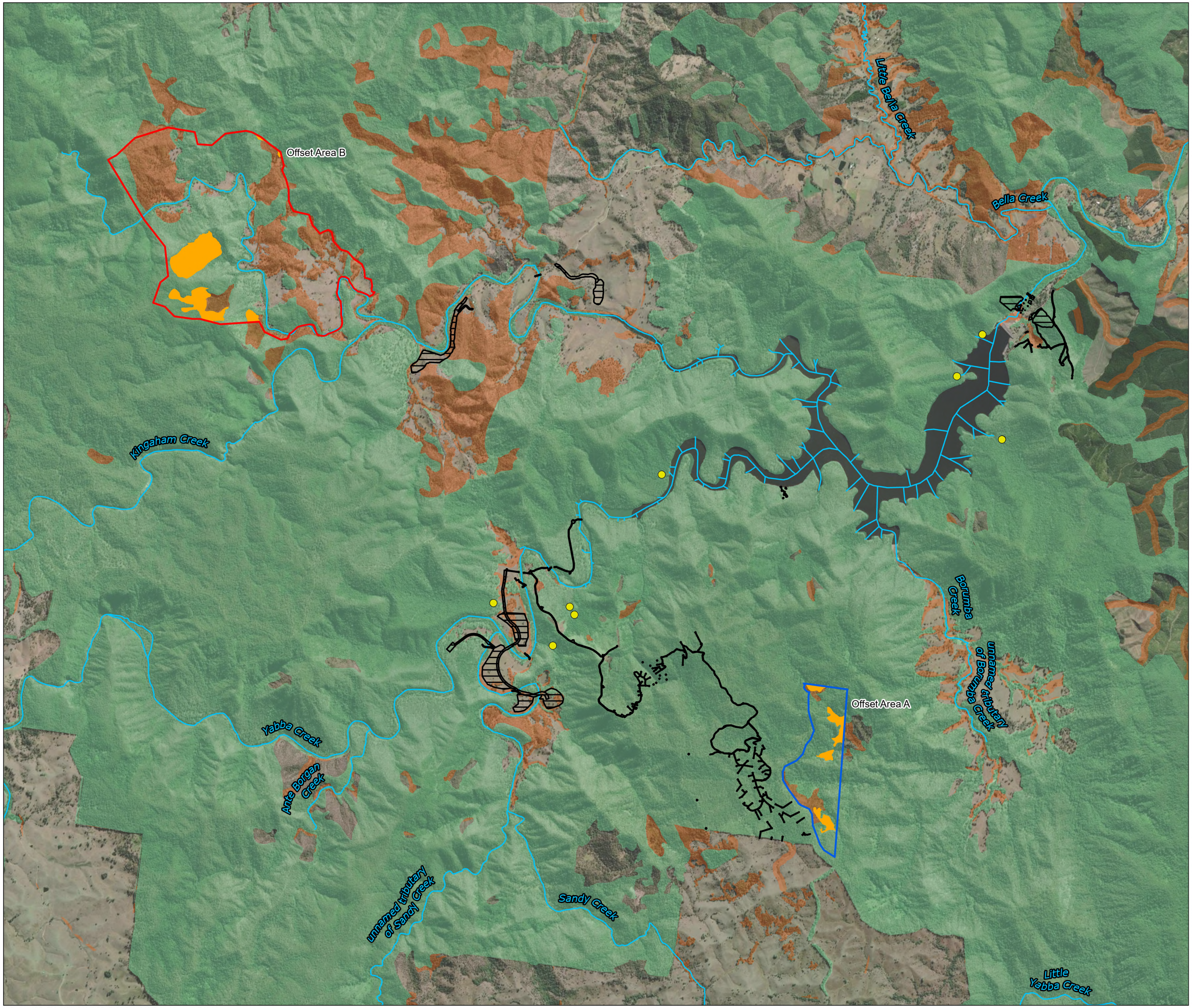
Data Sources:
1. Basemap © World Imagery: Earthstar Geographics
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019

Borumba PHES Project
Offset Area Management Plan

LOWLAND RAINFOREST TEC HABITAT WITHIN THE OFFSET AREAS

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	1/09/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE E7



Queensland Hydro

GDA2020 MGA Zone 56

N

0 1300 m

1:50,000 @ A3

LEGEND

- Exploratory Works Project Footprint (EPBC Only)
- Offset Area A
- Offset Area B
- Watercourse [defined by Water Act 2000]

Field Survey Records

- Black-breasted button-quail

Habitat within Offset Area

- Black-breasted button-quail foraging and breeding habitat

Vegetation Management Status

- Remnant
- Regrowth

Data Sources:
1. Basemap © World Imagery: Earthstar Geographics
Light Gray Base: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Watercourse [defined by Water Act 2000]: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019

Borumba PHES Project
Offset Area Management Plan

BLACK-BREASTED BUTTON-QUAIL HABITAT WITHIN THE OFFSET AREAS

PROJECT NO:	30032677
CREATED BY:	NC17428
MODIFIED ON:	1/09/2025
VERSION:	A
AMENDED BY:	NC17428

FIGURE E8

V:\Projects\BR_ENV_031_OAMP\BR_ENV_031_OAMP.aprx\AppendixE-Habitat

Appendix F
Scrub turpentine indirect offset plan

Scrub turpentine (*Rhodamnia rubescens*) was listed as Critically Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in December 2020 and is also Critically Endangered under the Queensland *Nature Conservation Act 1992* (NC Act). The species has a wide distribution known to occur from north of Batemans Bay in NSW to Bundaberg in Queensland along coastal districts and inland onto warmer rainforest and rainforest margins up to 600 metres above sea level (asl) in areas with rainfall between 1,000-1,600 mm (TSSC, 2020). The number of distinct populations of scrub turpentine is unknown but is expected to be large given the wide distribution of the species. Occurrences of scrub turpentine are contiguous along the entire range of the species with no significant disjunctions (TSSC, 2020).

Given the extensive geographic range of scrub turpentine it is reasonable to suspect that the number of mature individuals may be large (i.e., not < 10,000, the IUCN threshold for Vulnerable). However, there is substantial evidence of scrub turpentine mortality and a lack of successful seedling recruitment due to infection by *Austropuccinia psidii* (myrtle rust) at multiple sites throughout the species' range. Additionally, no formal estimates of the species' total abundance or extinction-risk status prior to 2010 have been published (TSSC, 2020). This gap in data is significant, as myrtle rust, a major threat to the species, was first detected in Australia in 2010.

Species threats

Myrtle rust threatens trees and shrubs in the Myrtaceae family of plants. Myrtaceae is the largest plant family in Australia and includes native plants such as tea tree (*Melaleuca* spp.) and eucalypts (*Eucalyptus* spp., *Angophora* spp., and *Corymbia* spp.) (DCCEEW, 2024). scrub turpentine is a known host of myrtle rust and is 'Highly to Extremely Susceptible' to infection (Pegg et al., 2014). Myrtle rust is causing tree mortality with large reductions in population size documented over a short period of time. Once infected the pathogen affects a tree's ability to reproduce, with infected fruit not surviving to maturity (TSSC, 2020).

Studies of 43 scrub turpentine populations from Murramarang National Park, near Batemans Bay, NSW to Traveston Crossing, near Gympie Qld, from 2011 to 2014 showed approximately 12% mortality from myrtle rust across the 669 tree study population (Carnegie et al., 2016). Ongoing observations in 2016 of a sub-sample of populations from Carnegie et al. (2016) showed mortality had increased to over 50%. These observations showed no evidence of successful regeneration within the populations. Therefore, the species long term viability in the wild is at significant risk.

Disease assessments on populations across eastern Australia have identified at least 20 species, including scrub turpentine, that are severely affected by myrtle rust. scrub turpentine exhibits extensive branch damage, infected flowers and fruit, no seedling regeneration with little or no resistant sub-populations recorded. This evidence suggests that scrub turpentine faces an imminent risk of extinction within a generation (F. Giblin, personal communication, May 16, 2024).

There is no effective control of myrtle rust that can protect scrub turpentine from infection. Carnegie et al. (2016) found during controlled trials that ongoing monthly fungicide treatments were effective however, less frequent applications proved ineffective in controlling myrtle rust. Therefore, for fungicide application to be an effective control it would have to occur monthly on an indefinite basis. Additionally, it is not possible to effectively treat the canopy of tall trees. The fungus produces millions of spores which are easily dispersed in the wind and can be transmitted through direct contact with people and fauna (including insects), and through movement of infected plant material (F. Giblin, personal communication, May 16, 2024). This makes myrtle rust extremely difficult to control and eradicate.

The Myrtle Rust National Action Plan (Mackinson et al., 2020) sets out recommendations for responding to and managing myrtle rust in Australia as well as setting out actions for recovery. Priority actions include:

1. Establish momentum, funding, and leadership for a coordinated national environmental response to myrtle rust.
   - Enabling the response
   - Awareness and engagement
5. Adopt a coordinated and long-term national environmental response to myrtle rust

- Impact assessment
- Towards recovery
- Biosecurity

A high priority action includes germplasm collection. Decline of the species means loss of genetic variation, including distinct genotypes that may be significant for ecological reasons or as future genetic resources. Preservation of genetic variation is a conservation goal; where this cannot be done in the wild, it can be approximated by germplasm capture. For some species in severe and uniform decline due to myrtle rust, germplasm capture is now the only option to avoid the likelihood of complete extinction. scrub turpentine is a priority species as it is undergoing strong declines and recommended for emergency level action to secure germplasm (Mackinson et al., 2020).

Photo F-1: Myrtle rust damage on leaves of scrub turpentine (Wills, 2024)

Photo F-2: Myrtle rust spores on leaf of scrub turpentine (Giblin, 2024)

EPBC Act Environmental Offsets Policy

The EPBC Act Environmental Offsets Policy includes an offset principle that offsets will be built around direct offsets but may include other compensatory measures. The policy specifies a minimum of 90 per cent direct offsets are required when offsetting a significant, residual impact on MNES. As per Section 4.2.1 (page 8) deviation from the 90 per cent direct offset requirement will only be considered where:

- it can be demonstrated that a greater benefit to the protected matter is likely to be achieved through increasing the proportion of other compensatory measures in an offsets package or;
- scientific uncertainty is so high that it isn't possible to determine a direct offset that is likely to benefit the protected matter.

In assessing the suitability of an offset the government decision-making will be informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty (DSEWPC, 2012). Offsets should align with conservation priorities for the impacted protected matter.

Land-based offsets

The option of delivering a land-based offset for the species is available. One of the considerations when assessing land-based offset areas is infection of the species with myrtle rust. Within proposed offset areas for Exploratory Works there are confirmed individuals of scrub turpentine which are showing signs of infection by myrtle rust. There are risks that myrtle rust will compromise the long-term survival of any populations within the offset area. Additionally, if a land-based offset was to be implemented, monthly spraying would be necessary throughout the plants' lifespan to manage infections effectively. This method is less effective on larger trees, as their canopies cannot be adequately treated. Therefore, consistent monthly spraying for the entire duration of the plants' life cannot be guaranteed.

Delivery of a land-based offset for scrub turpentine could secure and manage suitable habitat for this species and improve its habitat quality. The offset would also be able to support existing populations of the species. However, there isn't certainty as to whether those populations would survive in the mid to long term or be able to regenerate if the myrtle rust issue isn't addressed.

Compensatory measures

Section 4.2.2 of the EPBC Act Environmental Offsets Policy identifies that "other compensatory measures are those actions that do not directly offset the impacts on the protected matter but are anticipated to lead to benefits for the impacted protected matter". For example, research into effective re-vegetation techniques for a particular ecological community may be an appropriate component of an offsets package for an action that involves clearing of that ecological community.

Further guidance on other compensatory measures is outlined in Appendix A of the policy.

Recently the NSW Government has amended its environmental offset policy position and been advising offset areas owners that they cannot use land based offset credits for certain threatened species including scrub turpentine. Proponents in NSW are being advised by government agencies to investigate alternative conservation measures such as investment in targeted research or propagation trials that may be a more appropriate offset than managing the species within land based offset areas (Ward, 2024).

Research-based compensatory measures are presented in the NSW SoS Strategy and critical actions for scrub turpentine include monitoring programs, genetic conservation through ex-situ collection and ultimately translocation-based recovery programs (DPE, 2024).

A working group headed by the Botanic Gardens of Sydney and funded by the NSW Government have been exploring ways to improve resistance of scrub turpentine to myrtle rust. Since the project began in September 2023, there have been promising results in the development of a trial breeding program of myrtle rust resistant scrub turpentine plants. Seemingly resistant or tolerant plants were collected ex-situ and inoculated with around 20% of the plants resisting infection. Seedlings from these plants were established and approximately 350 individuals displayed resistance (Doyle, 2023). There is currently $750,000 allocated to the project for two years. This project is recognised by myrtle rust experts as a leading pilot program that can be applied to other Myrtaceae species that are susceptible to myrtle rust (G. Pegg, personal communication, August 13 2024).

At present there is a lack of funding to undertake research and conservation actions to protect all species affected by myrtle rust. Experts from the Queensland DPI: Fiona Giblin, Tracey Menzies, and Geoff Pegg, are currently undertaking research to understand the genetic diversity and presence (or absence) of resistance/tolerance across Queensland populations of scrub turpentine (as well as *Rhodomyrtus psidioides*, and other at-risk Myrtaceae species) to guide strategies to save species from extinction and the potential to rehabilitate populations. They also are trying to identify a number of scrub turpentine populations in Queensland and collect germplasm.

DPI's research is linking multiple national projects including the project run by the Royal Botanic Gardens in Sydney, builds on previous DPI studies and is in collaboration with NSW government agencies, the Australian Network for Plant Conservation and the National Myrtle Rust Working Group. The data collected in this study will be shared with the Queensland Department of Tourism Sustainability and Innovation (DETSI) and the central myrtle rust database of Plant Health Australia. There are also important project links to Indigenous Ranger teams working on forest health and biosecurity (G. Pegg, personal communication, August 13, 2024).

Currently the DPI program is funded until 2026, with just $165,000 in funding to cover all aspects of the program. However, there are still substantial works required that there is no guaranteed funding for.

Proposed compensatory measures

The Borumba Exploratory Works Project will lead to the loss of 0.7 ha of known habitat for this species. The primary threat to scrub turpentine is myrtle rust, not habitat loss. The continued decline of mature plants and lack of successful regeneration threaten the long-term viability of scrub turpentine in the wild (Carnegie et al., 2016). Therefore, we believe that a compensatory offset will offer more suitable measures for protecting scrub turpentine populations in the future. It is proposed the Exploratory Works offset package be 100% compensatory measures due to the threats posed by myrtle rust.

The proposed compensatory measures that could be applied for the Borumba Exploratory Works is to deliver funding for further research, with aims to deliver meaningful outputs for the ongoing survival of the species and build on the body of research currently being undertaken by DPI.

Consultation

Queensland Hydro have consulted with Dr Fiona Giblin who is a Principal Plant Pathologist, Dr Geoff Pegg who is a Project Leader in Forest Production with the Queensland DPI and Bob Makinson, a plant taxonomist and committee member of the Australian Network for Plant Conservation who have all been working on the conservation of species at risk of decline due to myrtle rust. These experts agree that the most urgent action in the conservation of scrub turpentine is the collection of germplasm to initiate conservation collections and provide plant material for future research and resistance breeding programs (F. Giblin, personal communication, July 16, 2024; G. Pegg, personal communication, August 13, 2024).

Consistent with the Myrtle Rust National Action Plan and NSW SoS Operational Plan for Myrtle Rust, future conservation strategies of the species that require additional funding suggested by these experts include:

- collecting germplasm and cuttings from healthy individuals for propagation
- propagating plants and creating seed orchards then managing myrtle rust within these orchards and maintaining a healthy population to reproductive stage
- using the seed orchards to conduct various research strategies including:
- fungicide trials
- RNA trials
- conducting resistance breeding programs
- planting the species into conservation areas that can be managed long term with the eventual goal to replant wild populations with resistance to myrtle rust.

An Indirect Offsets Plan proposal from the Queensland DPI has been received, which outlines the proposed scope of work including costs, methodology and timing. The results of this proposal, including completion criteria and corrective actions are discussed in the sections below.

Legal certainty

A contract will be prepared between Qld Hydro and the DPI. The contract between the two parties would also include:

- scope of work with actions and deliverables set out
- roles and responsibilities
- quarterly reporting of results back to Qld Hydro and annual reporting to DCCEEW as a minimum
- milestone invoicing
- proposed linkages to the main Project offset strategy including future tasks that could be built on.

Proposed compensatory project

Project context

This project will contribute to a coordinated state response to the conservation of Myrtaceae species at significant risk of extinction due to the impacts of myrtle rust across their entire range within Queensland (and Australia). The project will build on the work Queensland DPI have managed to achieve in recent years.

Scope of work

A compensatory package for research will facilitate the following goals over 12 months from formal engagement:

- Collation of survey information on all *Rhodamnia rubescens* identified at the Borumba PHES project site including their health status, age and location. This will include all individuals both within the proposed impact areas and adjacent lands.

- Consideration of population locations, life stages of plants (e.g. suckers, saplings, mature), and assessment of current and future health of plants.
- Strategic collection of additional germplasm for conservation collections and genetic studies, including methods to improve propagation rates for *Rhodamnia rubescens* which has proven difficult to propagate.
- Continued monitoring of the impacts of disease in the field for ongoing analysis of the epidemiology of the fungus in the Australian environment. Monitoring will be conducted across Borumba region, including the exploratory areas, potentially affected areas, along with any neighbouring areas containing *Rhodamnia rubescens* and which might provide additional important knowledge.
- Preparation of plants in the glasshouse for assessment of resistance in controlled pathogen inoculation experiments. Develop improved propagation techniques.
- Increased engagement with stakeholders, such as community groups, landowners, local government and Traditional Owners, for ongoing knowledge exchange and environmental biosecurity awareness.

Proposed fee

Table F.1 – Proposed fee for compensatory measures proposed for scrub turpentine

Task	Description	Fee
Project activities	Field work, sample collection, training, workshops, labour, travel, vehicle lease, etc.	$58,837
Equipment, facilities, supplies, maintenance etc	Lab consumables, glasshouses ESP and Gympie operating costs, field site Gympie, Environment Controlled Rooms ESP, sample analysis	$26,800
Administrative support	Project administration and overheads	$5,034
Total project budget		**$90,671**

Project team

The project team will consist of members of the National Myrtle Rust Working Group which is a Commonwealth advisory and coordinating group. These include:

- Principal Plant Pathologist: Dr Fiona Giblin
- Senior Principal Forest Pathologist: Dr Geoff Pegg
- Forest Research Technician: Ms Tracey Menzies

The project team will also collaborate with and have access to leading Australian myrtle rust researchers within Qld Department of Primary Industries (DPI), NSW DCCEEW, Research Centre for Ecosystem Resilience (ReCER) and Australian Network for Plant Conservation (ANPC). Collaboration will also occur with the Threatened Species officers within the Qld DETSI.

Benefits to the species

A greater conservation benefit can be achieved for the species through financial contributions to expand on these research projects and conservation actions being done in collaboration between Qld DPI, NSW government agencies, Royal Botanic Gardens in Sydney and the National Myrtle Rust Working Group. The research program will benefit scrub turpentine by:

- Targeting research priorities for the species including genetic and physiological research into myrtle rust resistance and susceptibility and investigations into options for live collections of scrub turpentine.
- Improving propagation rates for the species.
- Collaborating with a government department that has specialist teams working on this topic that are highly experienced and appropriately trained to complete the work.
- Producing timely results by building on a pre-existing research program.
- Allow for research to be transparent, published in peer-reviewed papers, and more widely distributed to other research organisations by working with a government department.

- Increasing awareness and education of this threatened flora species and myrtle rust threats with local communities, local governments and conservation groups will help to gather more data on the distribution of populations and extent of infection from myrtle rust as well as identify any new healthy populations, which may be important sources of resistance to disease.
- Fostering long-term biosecurity awareness, including the need to remain vigilant for the potential incursion of new strains of the fungus into Australia.

These research priorities comply with the conditions of the offset policy as per Table F-3 and Table F-4.

SMART completion criteria

Completion criteria as they pertain to the scope of work can be found in Table F2. Completion criteria should be specific and auditable with measurable outcomes and clear timeframes.

Table F-2 SMART completion criteria for scrub turpentine

Goal	Purpose	Method	Triggers for adaptive management	Adaptive management
Collation of survey information on all *Rhodamnia rubescens* identified at the Borumba PHES project site.	Will enable a central database of survey information. Data exists across various consultancies and contractors. This should be collated into a central database so DPI can analyse the information on populations and their health status. This information will be used to understand populations, their health condition and prioritise individuals for genetic sampling.	Data to be provided by Qld Hydro to DPI within two months of formal engagement. Data will then be provided on an ongoing basis as further data is collected. Central database to be completed by DPI within 4 months of formal engagement. The database should include: All records of *Rhodamnia rubescens* individuals Individual health assessments Age class information Habitat mapping	A central database has not been completed with all relevant survey information as listed within the 3-month period. OR Data collected within the 12-month period has not been included in the central database within 1 month of collection and QA checks.	Initial investigation why the action hasn't been completed. Address results of the initial investigation within 2 weeks of investigation. If results of investigation cannot be addressed within 2 weeks, notify DPI.
Collection of germplasm to initiate conservation collections and provide plant material for future research and resistance breeding programs. Preservation of genetic variation of this species.	To improve propagation rates for *Rhodamnia rubescens* which has historically been difficult to propagate. Germplasm capture from populations in Borumba region including Project area.	Conduct field work within the Project area and surrounding Borumba region during the appropriate season to collect germplasm and take cuttings. Germplasm collection surveys should occur at least 3 times over the 12 months.	Collection of germplasm has not been conducted. Propagation trials are unsuccessful.	Initial investigation why germplasm hasn't been collected (i.e. weather, resources). Address results of the initial investigation within 2 weeks of investigation. If results of investigation cannot be addressed within

Goal	Purpose	Method	Triggers for adaptive management	Adaptive management
Improve propagation rates for species.	Investigate salvage of individuals from Project footprint.			2 weeks, notify DCCEEW.
Continued monitoring of the impacts of disease in the field.	For ongoing analysis of the epidemiology of the fungus in the Australian environment	Selection of representative populations for monitoring. Implement four monitoring events over 18-month period.	Monitoring does not occur in timeframe allocated.	Investigate reason for monitoring being delayed. Complete monitoring within 1 month of the delay. If this cannot be achieved notify DCCEEW and agree on an amended timeline.
Increased engagement with stakeholders, such as community groups, landowners, local government and Traditional Owners	For ongoing education within the community, knowledge exchange and environmental biosecurity awareness, management of myrtle rust affected species in the field and in propagation.	Conduct a minimum of three information sessions within the 12-month period.	Two information sessions have not been conducted within 12 months.	Review resourcing and reasons for delay in stakeholder engagement. Explore alternative solutions for community education and awareness. Can online sessions be carried out? Investigate engagement being conducted by approved third party if DPI resourcing is constrained.
Preparation for establishment of a field orchard at the DPI research land near Traveston (and potentially at other suitable locations)	For ongoing monitoring and future research.	Location of field orchard should be confirmed within 12 months of engagement. A preparation plan should be written with clear objectives, schedules and roles and responsibilities. Can include measures (if applicable) such as: • weed control • pathogen control • fencing	Location has not been confirmed OR Preparation plan has not been written within 12 months of engagement.	Initial investigation why delays have occurred. Address results of the initial investigation within 2 months of investigation. If results of investigation cannot be addressed within 2 months, notify DCCEEW and identify new timeline.

Table F-2: Justification for deviation from direct offset requirements

EPBC Condition	Justification
Deviation from 90% will be considered where:	
it can be demonstrated that a greater benefit to the protected matter is likely to be achieved through increasing the proportion of other compensatory measures in an offsets package **or**	Scrub turpentine is facing an extremely high risk of extinction in Australia in the immediate future (TSSC, 2020). According to experts currently researching the impacts of myrtle rust on the species such as Dr Fiona Giblin (personal communication, 16 July 2024), the protection of Scrub turpentine in land-based offsets is not likely to result in conservation gains. Even plants in remote areas are showing symptoms of infection and it is not possible to treat wild populations with fungicide long term. Additionally, due to the effects of myrtle rust there are very low levels of reproduction occurring in wild populations. The priorities for this species right now based on expert advice is to be collecting germplasm and establishing plant and seed orchards of the species with a higher tolerance to myrtle rust so they can eventually be replanted into conservation areas (refer Section 4.1).
scientific uncertainty is so high that it isn't possible to determine a direct offset that is likely to benefit the protected matter.	Scientific uncertainty with land-based offsets will be higher due to: • Existing populations are mostly heavily infected with myrtle rust and are not effectively regenerating. • Lack of available reproductive material due to myrtle rust will affect the ability to source plants for revegetation programs. All current germplasm collection is being reserved for research and future security of the species. • No known control for myrtle rust means that plants protected in land-based offsets will already be infected or become infected over time and there aren't effective treatments other than monthly spraying. • Use of fungicide is an unviable maintenance method in a wild environment due to the need to treat at least monthly and the inability to treat the canopy of larger individuals.

Table F-3: Justification for how the proposed compensatory measures comply with the offsets policy

Offset Policy Condition	Justification
Research programs will	
Endeavour to improve the viability of the impacted protected matter	The suggested research priorities will aim to prevent the extinction of the species, which is predicted based on current losses.
Be targeted toward key research/ education activities as identified in the relevant Commonwealth approved recovery plan, threat abatement plan, conservation advice, ecological character description, management plan or listing document.	The TSSC conservation advice states the following research priorities: • Seek resources for genetic and physiological research into the resistance and susceptibility of Scrub turpentine to myrtle rust. • Understand the best techniques for long term seed and tissue storage. Investigate and implement options for tissue culture and/or inter-situ live collections (in sites amenable to fungicidal management), as alternatives to seed banking if the species proves storage intolerant, and/or as resources for seed production and resistance studies. The compensatory measures outlined cover both research priorities.
Be undertaken in a transparent, scientifically robust and timely manner	It is suggested the compensatory measures be undertaken by the Queensland Government DPI. They have a specialist team that are highly experienced and qualified to implement the work, and it would build on conservation actions already occurring in collaboration with the Royal Botanic Gardens Sydney in NSW, leading myrtle rust researchers within the NSW Department of

Offset Policy Condition	Justification
	Primary Industries and the Australian Network for Plant Conservation (ANPC). By working with DPI it would also ensure actions could occur in a timely manner. The use of a government organisation ensures that processes will be transparent and scientifically robust as the staff are appropriately trained and experienced to be conducting this work.
Be undertaken by a suitably qualified individual or organisation in a manner approved by the department	As above, the researchers working on myrtle rust at DPI are all post-doctoral researchers and are already conducting research that uses best practice, is peer reviewed and are all published authors in peer reviewed scientific journals. Additionally, research conducted by a government department can be made available to the public on their website, published in peer-reviewed papers, and more widely distributed to other research organisations etc.
Consider best practice research approaches	
Be tailored to at least a postgraduate education level	
Present findings that can be peer-reviewed	
Publish findings in an internationally recognised peer-reviewed scientific journal or be of a standard that would be acceptable for publication in such a journal. Publications should be submitted to free open access journals. Data and information collected should have creative commons licensing and be free and accessible	
Research outputs should inform future management decisions on the protected matter and, where possible, be readily applicable to other similar matters (species groupings etc).	The findings of the conservation actions will inform future management decisions and are expected to be applicable to all Australian species threatened by myrtle rust, leading to broader ecological gains.
The proponent is required to	
Select an institutional or individual host (for the purpose of executing the program) through an internationally available open tender process or provide evidence that the program can be successfully undertaken in-house.	QH will work with DPI to build on the existing programs, data and working relationships with the Royal Botanic Gardens Sydney and Domain in NSW, leading myrtle rust researchers within the NSW Department of Primary Industries and the ANPC, as well as threatened species officers within the Queensland DESI.
Provide updates on progress and key findings to the department through periodic reporting	The findings from DPI would be reported quarterly back to Qld Hydro and the results would be summarised into an annual report for DCCEEW (as a minimum).
Ensure that funds are managed appropriately and that auditable financial records are kept and maintained	Contractual arrangements would be set up between Qld Hydro and DPI in relation to expenditure of funds and reporting on expenditure of funds.
Apply a ‘no-surprises’ policy to the publication, whereby research publications and outputs are provided to the department at least 5 working days before release.	Research will be presented by Qld Hydro to the DCCEEW at least 5 working days before release.

Appendix G
Species information

Lowland Rainforest of Subtropical Australia TEC

Status

EPBC listed as Critically Endangered.

Description

The Lowland Rainforest of Subtropical Australia is a threatened ecological community consisting of a moderately tall (>20 m) to tall (>30 m) closed forest (DSEWPC, 2011). This TEC has the most diverse tree flora of any vegetation type in NSW (Floyd, Australian Rainforests in New South Wales, 1990) with the species composition of the canopy varying between local stands and regions (Keith D. A., 2004). Its canopy is often multilayered with a discontinuous upper layer of emergents from 40-50 m tall, over the main canopy and subcanopy (DSEWPC, 2011). Araucaria cunninghamii, Ficus spp., Lophostemon confertus and Eucalyptus spp. are characteristic of the upper layer (DSEWPC, 2011). Sparse shrubs and seedlings make up the understorey including a variety of vines and ferns (DSEWPC, 2011). Fauna within this TEC is characterised by a high proportion of frugivorous birds, micro- and mega-chiropteran bats, epiphyte and litter foraging vertebrates and a range of invertebrate groups including snails and insects (DSEWPC, 2011).

Distribution

Lowland Rainforest of Subtropical Australia occurring from Maryborough in Queensland to Clarence River in New South Wales with isolated areas between Clarence River and the Hunter River (DSEWPC, 2011). Occurring in the South Eastern Queensland and NSW North Coast Bioregions, patches of this TEC are typically less then 10ha in size and scattered (DSEWPC, 2011).

Habitat

This TEC prefers highly fertile basaltic and alluvial solid of which many of these areas have already been heavily cleared due to their high suitability for agricultural use (DSEWPC, 2011). This includes sand and old/elevated alluvial soils as well as floodplain alluvia (DSEWPC, 2011). It predominantly occurs in high annual rainfall (>1300 mm) areas in areas <300 m above sea level (DSEWPC, 2011). Although occurring in relatively small, scattered patches, the community offers habitat for a large number of fauna, frugivorous birds and threatened species (DSEWPC, 2011).

Threats to the TEC

The main threats to this TEC are vegetation clearing, exotic weeds and the impacts associated with fragmentation of remnants (DSEWPC, 2011). Due to the characteristics of the soils this community occurs on, the relatively fertile, flat soils occupied by this community are highly suitable for agricultural purposes (DSEWPC, 2011). The TEC has therefore, suffered extensive clearing dramatically decreasing its extent, resulting in the fragmentation that has made this community vulnerable to weed invasion (DSEWPC, 2011).

Brush sophora (*Sophora fraseri*)

Species status

EPBC Act and Nature Conservation Act listed as Vulnerable.

Description

As part of the Fabaceae family, this species is a softly pubescent, sparsely branched leguminous shrub reaching 1-2 m in height (DEWHA, 2008). The leaves of this shrub are pinnate, 6-15 cm in length with a 10-20 mm stalk (DEWHA, 2008). They have between 21 and 35 oblong to ovate leaflets that are 5-25 mm in length and 3-10 mm wide, with smooth margins and stalks 1-2 mm long (DEWHA, 2008). Flowers occur during spring in racemes roughly 10 mm long on stalks around 10 mm long (DEWHA, 2008). The petals are pale yellow and roughly 10 mm long with 5 mm sepals (DEWHA, 2008). Fruits are irregularly restricted between seeds and do not open at maturity (DEWHA, 2008).

Distribution

Sophora fraseri rarely occurs in northern NSW and is more widespread (not common) across south-east Queensland where it is conserved in Mount Mistake National Park and Lamington National Park (DEWHA, 2008). The distribution of this shrub overlaps with three EPBC Act-listed TEC's; Brigalow (*Acacia harpophylla* dominant and co-dominant), Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (DEWHA, 2008). *Sophora fraseri* can be found in the NSW Northern Rivers, Burnett Mary, Condamine and South East Queensland Natural Resource Management Regions (DEWHA, 2008).

Habitat

This species prefers moist habitats in hilly terrain at altitudes between 60 and 660 m. It occurs in wet sclerophyll forest and along rainforest margins on shallow stony to shaly soils in eucalypt forests or in the large canopy gaps in closed forest communities (DEWHA, 2008). Associated species of *Sophora fraseri* include *Corymbia citriodora, Eucalyptus carnea, E. microcorys, E. acmenoides, E. propinqua* and *Lophostemon confertus* (Queensland Government, 2024).

Threats

The main threats to *Sophora fraseri* that have been identified are habitat loss through the clearing for development and agriculture, weed infestation (including lantana camara), livestock grazing, timber harvesting activities, the localised extinction of small populations and inappropriate fire regimes causing the depletion of soil seed banks (DECC, 2005).

Scrub turpentine (*Rhodamnia rubescens*)

Species status

EBPC Act and Nature Conservation Act listed as Critically Endangered.

Description

Rhodamnia rubescens is a shrub to small tree to 25 m high characterised as a common understorey tree (TSSC, 2020). It possesses reddish brown, fissured bark and young stems that are densely tomentose (PlantNET, 2024). The species is in flower from late winter right through spring, peaking in October and fruiting in December in the Sydney region (TSSC, 2020). It also has the ability to resprout from rootstock post fire to then produce suckers (Benson & McDougall, 1998)

Distribution

Rhodamnia rubescens occurs from the coastal districts of NSW from north of Batemans Bay to Bundaberg in Queensland. This distribution occasionally extends further inland onto the escarpment up to 600 m above sea level in certain areas with rainfall of 1000-1600 mm (Benson & McDougall, 1998). While the exact number of distinct populations is unknown, it is expected to be large given the wide distribution of the species and occurrences are contiguous along its entire range with no major disjunctions (TSSC, 2020).

Habitat

This species commonly inhabits all rainforest subforms with the exception of cool temperate rainforest (TSSC, 2020). In these environments it is a common pioneer species in eucalypt forests, occurring on a range of volcanically derived and sedimentary soils (TSSC2020; Floyd, 1990). Populations and individuals of the species often occur in wet sclerophyll associations in the transition zones of rainforests (including in the open forest of *Eucalyptus tereticornis* and *bosistoana* of the Sydney region) and Creekside riparian associations (Benson & McDougall, 1998; TSSC, 2020).

There are several important vegetation classes that are suitable habitat for *Rhodamnia rubescens*. These include Northern Warm Temperate Rainforests, North Coast Wet Sclerophyll Forests, Subtropical Rainforests, Littoral Rainforest, Northern Escarpment WSF, Northern Hinterland WSF, Southern Lowland WSF and most likely the northern patches of Southern Escarpment WSF and South Coast WSF. There is also a possibility the easterly patches of Northern Tableland WSF, and some adjacent areas of dry sclerophyll and grassy woodland associations offer suitable species habitat (TSSC, 2020).

In NSW under the BC Act, *Rhodamnia rubescens* is listed as a characteristic species in the Final Determination for the Endangered Ecological Community (EEC) Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Comer Bioregions (TSSC, 2020). There are a number of other EECs listed under the BC Act that the species is highly likely to occur in however, it is not listed as a characteristic species (TSSC, 2020).

Threats

The major threat to *Rhodamnia rubescens* is mortality caused by the infection of *Austropuccinia psidii*. There is solid documentation that infection by *Austropuccinia psidii* causes mortality and unsuccessful seedling recruitment (Carnegie, et al., 2016; Pegg, et al., 2014). Other threats are likely to have contributed to population declines in the past including land clearing and rainforest clearing efforts in northern NSW to facilitate agricultural practices, population fragmentation and weed invasion (TSSC, 2020).

Black-breasted button quail (*Turnix melanogaster*)

Species status

EPBC Act and Nature Conservation Act listed as Vulnerable

Description

Turnix melanogaster is a large, plump, pale-eyed Australian quail species (TSSC, 2015; Marchant & Higgins, 1993). Females of this species tend to be larger than males and have a black head and breast with white half-moon markings across the upper-breast (Pizzey & Knight, 1997). Females also have a chestnut marbled upper that is covered in black ladder markings and white streaks (Pizzey & Knight, 1997). In comparison, males possess white markings on the face, fine black dots around the neck and a mottled chestnut and black upper-breast (Pizzey & Knight, 1997). Similarly, both sexes have white-cream eyes, grey bills and yellowish legs (Pizzey & Knight, 1997). Males and juveniles can also often be confused with Turnix varia (TSSC, 2015). Calls differ between sexes of *Turnix melanogaster*, females make low ‘oo-oom’ noises, low, tremulous drumming sounds or deep chucks, whereas males make soft clucks (Pizzey & Knight, 1997).

Distribution

Turnix melanogaster are distributed throughout south-eastern Queensland, ranging from Byfield in the north to the Border Ranges rainforest further south typically east of the Great Dividing Range (TSSC, 2015). The species has also been recorded further inland at Barakula State Forest in Queensland and Palmgrove National Park (Mathieson & Smith, 2009; TSSC, 2015). The density of the species in Queensland and largely reduced in many areas across the state, particularly in the Dawson and Fitzroy catchments (Bennett., 1985; Hamley, Flower, & Smith, 1997).

Habitat

In south-east Queensland *Turnix melanogaster* are predominantly recorded in vine thicket forests with a closed canopy, deep litter layer in areas with annual average rainfall of between 800-1200 m (Garnett, Szabo, & Dutson, 2011). The quail has a preference for softwood scrubs in the Brigalow belt, mature hoop pine plantations (especially with lantana camara present), vine scrub regrowth, dry sclerophyll forest adjacent to rainforest and Acacia and Austromyrtus scrubs on sandy coastal soils (TSSC, 2015; Marchant & Higgins, 1993; Hamley, Flower, & Smith, 1997; DCCEEW, 2022; Mathieson & Smith, 2009). For breeding purposes, an abundance of *Pteridium esculentum, Doodia aspera* and *Lantana camara* are required for ground nesting in the breeding season from September to May (Garnett, Szabo, & Dutson, 2011; Mathieson & Smith, 2009; DCCEEW, 2022).

Threats

Habitat loss or degradation from changing fire regimes, domestic livestock, feral pigs and feral animal predation (cats and foxes) are the leading threats to the quail (TSSC, 2015; Mathieson & Smith, 2009). By the 1960s, at least 90% of *Turnix melanogaster* habitat had been cleared and reduced to a mere few thousand hectares for agriculture and hoop pine plantations (Hamley, Flower, & Smith, 1997). There is still possibility that domestic livestock grazing is still impacting habitat across parts of the species range (TSSC, 2015).

Glossy black-cockatoo (*Calyptorhynchus lathami lathami*)

Species status

EPBC Act and Nature Conservation Act listed as Vulnerable.

Description

As the smallest of the black cockatoos, *Calyptorhynchus lathami lathami* has mostly dull black plumage, an inconspicuous crest, a blackish-brown head and a broad bulbous bill (DCCEEW, 2022). The adult females of this species have variable yellow patches in their tail and yellowish-red panels in the tail, while adult males have bright red panels in the tail (Higgins, 1999; Menkhorst, et al., 2017). There are three subspecies (*C. l. lathami, C. L. halmaturinus* and *C. L. erebus*) which have identical plumage and differ predominantly in their size and shape of the bill (Higgins, 1999; Schodde, Mason, & Wood, 1993).

Distribution

Calyptorhynchus lathami lathami is widespread but uncommon and are found from Mitchell in Queensland right through eastern New South Wales as far as East Gippsland in Victoria (DCCEEW, 2022). Their distribution is continuous throughout the forested areas of the Great Dividing Range, becoming more scattered further inland extending as far west as the NSW Riverina (Higgins, 1999; Garnett, Szabo, & Dutson, 2011). It was once thought that birds in the Riverina were rather isolated from the main population but have since been regarded as connected to the main population further east (Garnett, Szabo, & Dutson, 2011; Cameron, Castley, Teixiera, Menkhorst, & Garnett, 2021).

Habitat

Calyptorhynchus lathami lathami feed almost exclusively on the seeds of sheoak trees (*Allocasuarina* spp. and *Casuarina* spp.), typically relying on one or two species within any given region (Higgins, 1999). This species possesses a strong preference to individual feed trees and are known, choosing not to feed on many other proximate trees of the same tree species (DCCEEW, 2022). Feeding reward in the form of cone size, number and weights of seeds in the cones and their nutritional content drives this strong preference (Clout, 1989; Crowley & Garnett, 2001; Cameron & Cunningham, 2006; North, Lamont, Ogbourne, & Conroy, 2020). The presence of sheoak trees is critical for this species as they can spend anywhere up to 88% of their day feeding and foraging (Clout, 1989). They show a preference for black sheoak (*A. littoralis*) and forest sheoak (*A. torulosa*) in south-east Queensland and north-east New south Wales (Glossy Black Conservancy, 2010). There are also records of the species feeding on stringybark sheoak (*A. inophloia*), coastal sheoak (*C. equisetifolia*) and occasionally river sheoak (*C. cunninghamiana*) and swamp sheoak (*C. glauca*). Drooping sheoak *(A. verticillata*), broombush sheoak (*A. diminuta*), mallee sheoak (*A. gymnanathera*), belah (*C. cristata*) are important food species in inland NSW (Department of Environment and Conservation, 2004; Chapman, 2007).

The presence of very mature eucalyptus trees (both dead and alive) also a critical habitat feature for *Calyptorhynchus lathami lathami*, being hollow nesters (Higgins, 1999). Key species utilised for nesting hollows are narrow-leaved ironbark (*Eucalyptus crebra*), blue-leaved ironbark (*E. nubila*), Blakely's red gum (*E. blakelyi*) and River red gums (*E. camaldulensis*) (Cameron & Cunningham, 2006). *Calyptorhynchus lathami lathami* require large tree hollows that take centuries to form and are ideally within proximity to foraging habitat and feed tree species.

Threats

Due to their highly specialised diet, preference for individual feed trees and specific nesting requirements, the main threat to the black cockatoo is habitat loss, degradation and fragmentation (DCCEEW, 2022). Historic clearance has previously been the main cause of decline destroying breeding and feeding habitats. Wildfires additionally cause habitat degradation and loss, in conjunction with inappropriate fire regimes with too frequent or intense burning resulting in feeding habitat being deemed unsuitable for up to 10 years or more (Garnett, Szabo, & Dutson, 2011). Limited hollow availability also has potential to amplify otherwise minor threats like nest predation and the transmission of diseases when competition for hollows increases (DCCEEW, 2022). Climate change will also in future impact food availability due to its correlation with rainfall (Cameron & Cunningham, 2006). Rainfall has further been found to correlate with breeding success of the species (Cameron, 2009). Other minor threats to habitat include grazing and invasive weeds (Cameron, Castley, Teixiera, Menkhorst, & Garnett, 2021).

Greater glider (*Petauroides volans*)

Species status

EPBC Act listed as Endangered and Nature Conservation Act listed as Vulnerable.

Description

Petauroides volans is an arboreal nocturnal marsupial and the largest of the gliding possums in eastern Australia reaching a weight range of 900-1700g (DCCEEW, 2022). IT has thick fur that increases its apparent size however, male tend to be smaller than females (McKay, 1989; McKay, 2008). The fur is white or cream in colour on the underside, varying from dark grey, dusky brown right through to a light mottled cream and grey on the back (DCCEEW, 2022). The glider has large furry ears, a short snout and a long fury tail. The gliding membrane extends from the forearm to the tibia and the tail is not prehensile (McKay, 1989; McKay, 2008).

Distribution

This species occurs throughout eastern Australia with a broad distribution from QLD, south through NSW, the ACT and into central VIC (McGregor, et al., 2020; DCCEEW, 2022). It occurs across an elevation range of 0-1200 m above sea level (Kavanagh, Distribution and conservation status of possums and gliders in New South Wales, 2004) and the species' distribution also overlaps with the Gondwana Rainforests of Australia and the Blue Mountains World Heritage Areas (DCCEEW, 2022). *Petauroides volans* is also present on some Commonwealth lands including the Shoalwater Bat Training Area near Rockhampton (Queensland Herbarium, 2018).

Habitat

Petauroides volans is a largely solitary species and mainly restricted to the eucalypt woodlands and forest of eastern Australia (DCCEEW, 2022). The highest abundance of this species is most commonly sound in tall, mountain, moist eucalypt forests on fertile soils with an abundance of hollow and relatively old trees (DCCEEW, 2022). *Petauroides volans* has also been found in drier habitats in south eastern QLD (Eyre, 2004) and distribution has been known to be patchy even in continuous habitat (Kavanagh, 2000). It is likely this is due to only a portion of potential habitat being suitable for the species and variability of forest overstorey and forage quality across the landscape (Eyre, 2002; Youngentob, et al., 2011).

There are several factors within the same forest type that are positively correlated with species occurrence. These include canopy productivity, the amount of foliage within the forest, stand age, overstorey basal areas, tree hollow abundance, patch size, levels of foliar nutrients and connectivity (DCCEEW, 2022). Large contiguous areas of eucalypt forest are critical for the glider and must have mature follow-bearing trees with a diverse range of preferred food species in the particular region (DCCEEW, 2022). The *Petauroides volans* diet is mainly folivorous and is largely made up of eucalyptus leaves, buds and flowers (Kehl & Borsboom, 1984; Kavanagh & Lambert, 1990). Habitat connectivity is very important for *Petauroides volans*. Smaller or fragmented patches of habitat must be connected to larger patches that can facilitate species dispersal and or enable recolonisation (DCCEEW, 2022).

Areas of cool microclimates are important for this species and include sheltered high elevation areas, coastal lowland areas, southern slopes and protected gullies (DCCEEW, 2022). Unburnt habitat within or adjacent to recently burnt areas are important short-term and or long-term post-fire refuges, allowing for the glider the recover, persists and repopulate burnt areas (DCCEEW, 2022).

Threats

The main threats to the greater glider include and stem from intense and frequent bushfires, climate change, inappropriate prescribed burning, land clearing and timber harvesting (DCCEEW, 2022). *Petauroides volans* is very sensitive to these impacts and although it is unlikely the extend of occurrence of *Petauroides volans* has changed substantially since European settlement (Eyre, Distribution and conservation status of the possums and gliders of southern Queensland, 2004; Kavanagh, Distribution and conservation status of possums and gliders in New South Wales, 2004; van der Ree, Ward, & Handasyde, 2004), the area of occupancy has declined dramatically due to land clearing. Additional clearing, bushfires, edge effects, fragmentation impacts, some forestry activities and climate change continue to aid this decline (Eyre, Distribution and conservation status of the possums and gliders of southern Queensland, 2004; Lindenmayer, et al., 2011; DCCEEW, 2022).

Yellow-bellied glider (*Petaurus australis australis*)

Species status

EPBC Act and Nature Conservation Act listed as Vulnerable.

Description

Petaurus australis australis is a medium sized, nocturnal arboreal marsupial and the second largest Australian glider (DAWE, Conservation Advice for *Petaurus australis australis* (yellow-bellied glider (south-eastern)), 2022). The head and body length of this species ranges from 240-310 m and the tail ranges from 380-470 m. The fur is greyish-brown in colour and has a black stripe running down the back to the tail which is predominantly black with grey edging at the base (DAWE, Conservation Advice for *Petaurus australis australis* (yellow-bellied glider (south-eastern)), 2022). Females have longer tails; however, both males and females have similar markings. The belly is notable white to yellow in colour, becoming more yellow with age. This glider species has black markings on the feet, along the edge of the gliding membrane and a stripe down each thigh. The ears are a prominent feature, more pale in colour and bare (Goldingay, yellow-bellied glider *Petaurus australis*, 2008). There are two subspecies of yellow-bellied glider with the wet tropics glider being smaller, darker in colour on the back and less distinctively yellow on the belly compared to the south-eastern subspecies (Goldingay & Kavanagh, 1991; Brown, Cooksley, Carthrew, & Cooper, 2006).

Distribution

The distribution of *Petaurus australis australis* is widespread but patchy from south-eastern Queensland to far south-eastern South Australia closer to the SA-VIC border (DAWE, Conservation Advice for *Petaurus australis australis* (yellow-bellied glider (south-eastern)), 2022). The glider is commonly found at altitudes from sea level to 1400 m above sea level (DAWE, Conservation Advice for *Petaurus australis australis* (yellow-bellied glider (south-eastern)), 2022). In NSW it is found in forests throughout the eastern coast, extending from the NSW-QLD border right down to the NSW-VIC border (Van der Ree, Ward, & Handasyde, 2004). Its distribution also encompasses forests further inland to the western slopes of the Great Dividing Range in section of both NSW and QLD (Van der Ree, Ward, & Handasyde, 2004). Its distribution also overlaps with the Gondwana Rainforests of Australia World Heritage Area (DAWE, Conservation Advice for *Petaurus australis australis* (yellow-bellied glider (south-eastern)), 2022).

Subspecies' distribution is very disjunct over the entire range, this can be attributed to a combination of detrimental land clearing and biogeographic processes (van der Ree, Ward, & Handasyde, 2004; Carthew, 2004; Rees, Paull, & Carthew, 2007).

Habitat

yellow-bellied gliders are found in eucalyptus-dominant forests and woodland. This includes wet and dry sclerophyll forests, with abundance largely dependent on the suitability of habitat determined by the floristics and forest age of the area (Kavanagh, Debus, Tweedie, & Webster, 1995; Rees, Paull, & Carthew, 2007; Woinarski, Burbidge, & Harrison, 2014). Living hollow bearing trees are a major preference for denning and large areas of forest are essential for the maintenance of population viability, as groups live in large exclusive home ranges. The persistence of large contiguous areas of floristically diverse eucalyptus forest is essential. They must be dominated by winter-flowering and smooth-barked eucalypt species and include living mature hollow-bearing trees for denning and sap trees for food (Milledge, Palmer, & Nelson, 1991; Eyre & Smith, 1997; Incoll, Loyn, Ward, Cunningham, & Donnelly, 2001; van der Ree, Ward, & Handasyde, 2004; Kavanagh, Mclean, & Stanton, 2021). Habitat corridors are also critical habitat offerings pathways and facilitating dispersal between habitat patches, enable recolonisation and avoidance from threats. These specific habitat requirements of the glider have the potential to cause disjunct populations despite the continuation between section of forest (Eyre, 2004; DAWE, Conservation Advice for *Petaurus australis australis* (yellow-bellied glider (south-eastern)), 2022).

Threats

Threats to the yellow-bellied glider are predominantly clearing, altered fire regimes, climate change, fragmentation, and timber harvesting (DAWE, Conservation Advice for *Petaurus australis australis* (yellow-bellied glider (south-eastern)), 2022). A less dominant impact is predation by invasive species however, it has not been determined whether this is a population-level threat. Mortality caused by barbed wire fencing and habitat degradation from feral deer also come under this category. *Phytophthora cinnamomi* is a plant pathogen in the form of a fungus causing dieback that may be contributing to habitat degradation however, more investigation is again required to determine if it is a population level threat (DAWE, Conservation Advice for *Petaurus australis australis* (yellow-bellied glider (south-eastern)), 2022).

Koala (*Phascolarctos cinereus*)

Species status

EPBC Act and Nature Conservation Act listed as Endangered.

Description

The koala is a medium-sized marsupial, characterised by a stocky body, sharp claws, large, rounded ears, and grey fur. Although males are generally larger than females, there are gradual changes in morphological appearance across its range with larger individuals located in the south and smaller individuals in the north. Individuals in the southern end of the species range tend to have thicker, longer fur that is grey-brown in colour. Fur in the northern regions tends to be shorter and more silver-grey in colour (Martin & Handasyde, 1999; DAWE, 2022).

Distribution

Koalas have an extremely wide range occurring in eastern forests and woodlands dominated by Eucalyptus species. Although its distribution is not continuous, it includes NSW, QLD, VIC, ACT and SA. With such a large range, cleared land and unsuitable habitat separate the several subpopulations across the states (Martin & Handasyde, 1999). The listed koala population is wide and patchy spanning the inland and coastal areas of Queensland north to the Herberton area, further west into hotter, dryer semi-arid climates of central Queensland, NSW and the ACT (DAWE, 2022). Other populations not listed under the EPBC Act occur further south in VIC and SA where koalas are widespread throughout lowlands and foothill eucalypt forests and woodlands (DAWE, 2022).

Habitat

The range of the koala is determined by their specialist habitat, food, and environmental requirements. koalas are primarily tree-dwelling leaf-eaters with a highly specialised diet defined by the palatability and availability of a limited variety of Eucalyptus, Corymbia and Angophora species (DAWE, 2022). The primary food species differ between habitats and can be as few as two in one particular locations (Melzer, Carrick, Menkhorst, Lunney, & John, 2000; Tucker, Melzer, & Ellis, 2008). koalas are nocturnal, spending a large portion of their time moving across the ground between shelter and food trees, with movement increasing during the breeding season (September-February) (DAWE, 2022).

koalas are known to utilise over 400 tree species for food and habitat requirements with species differing in habitat type and location throughout their range. The wide-ranging distribution has, therefore, cause a high diversity of habitat associations across bioregions. Woodland and forest patches and corridors with a sufficient amount of food and shelter resources are essential. The key habitat attributes for the koala are rooted in the availability of resources for foraging, survival, growth, movement, and reproduction (DAWE, 2022).

Threats

koalas are heavily impacted by wide-scale climate change drives, particularly increased intensity and frequency of high temperatures, drought and weather conditions promoting bushfires and a shrinking climatically suitable area (McAlpine, et al., 2015; Adams-Hosking, Grantham, Rhodes, McApline, & Moss, 2011; Runge, Rhodes, & Latch, 2021a). There is now a large overlap of the koala's national distribution and human-modified landscapes (DAWE, 2022). koala retrovirus, Chlamydia, clearance of vegetation due to urbanisation, agriculture, mining, livestock grazing, vehicle and dog mortality have also dramatically reduced the species distribution (McAlpine, et al., 2015).

Long-nosed potoroo (*Potorous tridactylus tridactylus*)

Species status

EPBC Act and Nature Conservation Act listed as Vulnerable.

Description

Potorous tridactylus tridactylus is a medium-sized, compact marsupial with a weight range of 660-1640g (DAWE, 2022; Johnston, 2008). The hind limbs of this species are well developed to enable the potoroo to hop at great speeds, while the forearms are much shorter and muscular with claws for digging (DAWE, 2022). The marsupial has small, rounded ears and large eyes, with two layers of fur, short dark grey fur over the back and coarser hair protruding through it. Coarse white fur with a grey base layer covers the underside, where females have a pouch containing four mammae (Johnston, 2008). All potoroos are omnivorous with a diet of fruits, seeds, leaves, flowers, roots and invertebrates (Bennett & Baxter, 1989). They are nocturnal feeders relying on the fruit bodies of underground fungi for up to 90% of their diet which can vary between seasons (Claridge, Tanton, & Cunningham, 1993; Claridge & Cork, 1994). This consumption of underground fungi assists in fungal spore dispersion, improving soil condition and moisture penetration, making them and intricate part of the forest ecology and food webs of their habitats (Claridge, Tanton, & Cunningham, 1993; DAWE, 2022).

Distribution

Potorous tridactylus tridactylus has a broad and fragmented distribution, generally occurring between sea level and up to 800 m above sea level, restricted to habitats with annual rainfall above 760 mm (Johnston, 2008). However, recent sightings suggest they can occur up to 1000 m above sea level (DAWE, 2022). The northern long-nosed potoroo is distributed through two major bioregions, occurring between Many Peaks Range to the northern most boundaries of the Sydney Basin (DAWE, 2022). Few populations persist in lowland heath and coastal habitats throughout Queensland, while most other known populations are further inland at higher altitudes in forested ranged. The NSW populations of the northern long-nosed potoroo are located from Cobaki Lake near the Queensland border to the northern boundary of the Sydney basin (DAWE, 2022).

Habitat

Potorous tridactylus tridactylus is known to occur in a range of vegetation types from coastal scrub and heathy woodland to wet sclerophyll forest and rainforest (Norton, French, & Claridge, 2010; Andren, Milledge, Scotts, & Smith, 2013; DAWE, 2022). They are also often found near creeks or gullies, providing refuge during drought and fire (Andren, Milledge, Scotts, & Smith, 2013; Martin & Temple-Smith, 2012). As generally solitary animals, the long-nosed potoroo has limited dispersal capabilities, high site fidelity and a small home range (Frankham, Reed, Fletcher, & Handasyde, 2011).

This species is matrix-sensitive, making its ideal habitat wooded environments with a dense understorey layer offering cover and sufficient open space beneath the sub-canopy to allow for foraging (Norton, French, & Claridge, 2010; Andren, Milledge, Scotts, & Smith, 2013). These forested habitats need to ideally be remnant vegetation patches larger than 0.1 km^2 (Martin & Temple-Smith, 2012; DAWE, 2022).

In lower altitude coastal habitats, *Potorous tridactylus tridactylus* is found in scribbly gum (*Eucalyptus signata*) woodlands that have a heathy understorey (Andren, Milledge, Scotts, & Smith, 2013). Wallum banksia (*Banksia aemula*), coastal blackbutt (*Eucalyptus pilularis*), coast cypress pine (*Callitris columellaris*), heath-leaved banksia (*Banksia ericifolia*) and broadleaved paperbark (*Melaleuca quinquenervia*) are common species of these habitats with dense coverage of grass trees, forbs, sedges, ferns, and other heath species (Trent, 2015). Key environmental variables of potoroo habitat include nearby areas of vegetative cover, dense undergrowth cover, average annual temperature, and average annual rainfall (Trent, 2015). In Queensland, REs considered as essential habitat for this species in the south-east Queensland bioregion include: 12.11.1, 12.11.10, 12.11.2, 12.11.3, 12.12.1, 12.12.15, 12.12.16, 12.12.2, 12.2.15, 12.2.6, 12.2.8, 12.3.18, 12.3.19, 12.3.2, 12.3.3, 12.3.7, 12.5.3, 12.5.6, 12.8.14, 12.8.16, 12.8.17, 12.8.3, 12.8.4, 12.8.5, 12.8.8, 12.8.9, 12.9-10.25, 12.9-10.26, 12.9-10.4 and 12.9-10.5.

Threats

As a group, Potoroids have the highest percentage of extinct and threatened species of any mammal family in Australia at 61.9% (Woinarski, Burbidge, & Harrison, 2014). *Potorous tridactylus tridactylus* is most severely threatened by habitat loss and fragmentation, inappropriate fire regimes, predation by invasive species (specifically European red foxes and feral cats) and habitat degradation (DAWE, 2022). Having such specific dietary requirements, the potoroo is at risk of drought, consumption by other species and forest dieback resulting in the loss of refugial habitats (DAWE, 2022). Other threats to the species include competition with other herbivores, invasive weeds, changing weather patterns, timber harvesting, disease and increased bushfire frequency and intensity (DAWE, 2022).

Queensland Hydro

ABN 81 661 444 515

Get in touch

1800 433 939

239 George Street,
Brisbane City QLD 4000

info@qldhydro.com.au

qldhydro.com.au