Ecological Assessment Report

Birkdale Community Precinct

Raptor ENVIRONMENTAL

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Executive Summary

Raptor Environmental was commissioned by Jacobs on behalf of Redland City Council (RCC) to conduct a detailed ecological assessment and prepare an Ecological Assessment Report (EAR) for the proposed Birkdale Community Precinct. There have been a number of ecological studies associated with the Project. This EAR builds on these studies, provides contemporary site-based assessments, identifies ecological values, quantifies the Project's benefits and impacts, and identifies environmental approval requirements, where they relate to ecology. This EAR will support the Local Government Infrastructure Designation (LGID) application, Operational works applications and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Significant Impact Assessment (SIA) and inform the finalisation of the Commonwealth Conservation Agreement, as well as other potential legislative requirements.

The proposed Project is located at 362-388 Old Cleveland Road East, Birkdale. The Project will provide a central community hub for the RCC Local Government Area (LGA). The Project includes the delivery of separate Project components (e.g. White water rafting facility, internal roads, carparks etc).

This EAR identified several matters of national environmental significance (MNES) and matters of state environmental significance (MSES) within the Project Area. The table below provides a summary of ecological values, known and potential impacts and how these elements are considered throughout the design process and will be further considered in the detailed design.

	Value	Considered Impacts	Benefits and Response
MNES	Koala habitat	Minor area of habitat will be cleared.	• The design retains the Conservation Area including 39 ha of habitat that will be managed and restored.
		Potential impact on movement path.	• Internal traffic will be limited to 30km/hr. • Patches of koala habitat and koala habitat trees will be retained to maintain movement and foraging opportunities within the Development Footprint.
		Increase in traffic, noise and light within the Project Area.	• The Redland Coast Koala Conservation Plan 2022-2027 includes initiatives relevant to the project including: o Koala population monitoring and disease management; o Smart signs and driver awareness; and o Community engagement.

	Value	Considered Impacts	Benefits and Response
	TEC	Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales South East Queensland TEC, Subtropical Eucalypt Forest on the floodplains TEC and Subtropical and Temperate Coastal Saltmarsh; entirely avoided from direct impacts.	0.94 ha of a vegetation community that does not presently meet the condition thresholds for the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland TEC will be retained and restored such that it does.
		Potential for indirect impacts to occur during detailed design by altering hydrology.	The Stormwater management plan demonstrates a minimal change to the existing hydrological regime of the tidal waterway downsteam of the outlet from the wetland area.
MSES	Protected Plants	Protected Plants are unlikely to occur within the Project Area.	Areas of the Development Footprint area mapped within the High-risk area for Protected Plants. A Protected Plant Survey and Report will be required.
	Wildlife habitat	Several breeding places for Special Least Concern, Least Concern colonial breeders and Least Concern species will be impacted.	• The design avoids the majority of habitat features within the Development Footprint. • A Species Management Program – High Risk of Impacts will be required to be prepared and submitted to the Department of Environment and Science which details impact mitigation measures for impacts to several breeding places. • The design incorporates ecologically sensitive lighting throughout the proposed infrastructure within the Development Footprint.
	Koala habitat	Minor areas of habitat will be cleared in Koala District A.	• The design retains the Conservation Area which will be retained and restored. • The design retains patches and individual Non-juvenile Koala habitat trees within the Development Footprint. • Clearing will be staged and will occur sequentially under the supervision of a Koala spotter.

	Value	Considered Impacts	Benefits and Response
	Regulated Vegetation	Minor area or regrowth vegetation will be cleared.	• The Conservation Area will be protected through a Property Map of Assessable Vegetation (PMAV) application to amend the vegetation mapping to Category A area (i.e. declared offset area). • Infrastructure is not proposed in the Conservation Area and the Regulated Vegetation within the Conservation Area will be retained. • The design avoids and minimises clearing of Regulated Vegetation by consolidating infrastructure in the cleared areas of the Development Footprint.
	Marine plants	Minor area of Marine Plants will be disturbed.	• The design of the proposed Kayak and canoe launch facility is located in a cleared and eroding section of Tingalpa Creek which will be stabilised and restored. • The minor disturbance to Marine Plants will be assessed under State Development Assessment Provisions (SDAP) Code 11: Removal, destruction or damage of marine plants supported by a marine plant disturbance plan.
	Tidal waterway	Potential for the Kayak and canoe launch facility to impact flows of Tingalpa Creek.	• The detailed design will ensure tidal flows of Tingalpa Creek are maintained and fish movement will be uninhibited.

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Glossary of Acronyms and Abbreviations

ALA	Atlas of Living Australia
AS	Australian Standard
C	Least Concern
CEEVNT	Critically Endangered, Endangered, Vulnerable, Near Threatened
CR	Critically Endangered
DAMS	Development Assessment Mapping System
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DES	Department of Environment and Science
DoR	Department of Resources
E	Endangered
EAR	Ecological Assessment Report
CEMP	Construction Environment Management Plan
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESD	Ecologically Sustainable Development
ha	hectares
HAT	Highest Astronomical Tide
HES	High ecological significance
km	kilometre
LGA	Local Government Area
LGID	Local Government Infrastructure Designation
LIKT	Locally important koala tree
m	metre
Ma	Marine
Mi	Migratory
MLES	Matters of Local Environmental Significance
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
NC Act	*Nature Conservation Act 1992*
NJKHT	Non-juvenile koala habitat tree
OEMP	Operational Management Plan
PMST	Protected Matters Search Tool
RCC	Redlands City Council
RE	Regional Ecosystem
SARA	State Assessment and Referral Agency
SDAP	State Development Assessment Provision
SL	Special Least Concern
SMP	Species Management Programs
SPP	State Planning Policy
SUR	Scientific Users permit
TEC	Threatened Ecological Community
V	Vulnerable
VMA	*Vegetation Management Act 1999*

1 Introduction

Raptor Environmental was commissioned by Jacobs on behalf of Redland City Council (RCC) to conduct a detailed ecological assessment and prepare an Ecological Assessment Report (EAR) for the proposed Birkdale Community Precinct. To date, there have been several ecological studies associated with the Project. The current EAR builds on these studies, provides contemporary site-based field assessments, identified ecological values, quantifies benefits and impacts of the Project, and identifies environmental approval requirements (where they relate to ecological matters).

The Project is located at 362-388 Old Cleveland Road East, Birkdale (**Figure 1**). The locations of the Project Area and Birkdale Community Precinct Master Plan are shown in detail the Draft Birkdale Community Precinct Master Plan, provided as **Plate 1**.

Specifically, the Project Area incorporates 62 hectares (ha) is described as the following land parcels:

- Lot 1 on RP14143,
- Lot 2 on RP14144,
- Lot 2 on SP146445, and
- Lot 2 on RP211270.

Pursuant to the *Redland City Plan 2018* (Version 7), the land parcels within the Project Area are zoned as follows:

- Lot 1 on RP14143 and Lot 2 on RP14144 – 'Community Facilities' and 'Conservation' zones;
- Lot 1 on SP146445 – 'Community Facilities' zone; and
- Lot 2 on RP211270 – 'Low Density Residential' zone.

The Project Area is also zoned with the Regional Landscape and Rural Production Area pursuant to the *Southeast Queensland Regional Plan 2017.*

1.1 Definitions

Definitions for terminology used to describe the Project components include:

Project – all aspects of the Birkdale Community Precinct.

Project Area – the total area comprising Lot 1 on RP14143, Lot 2 on RP14144, Lot 2 on SP146445 and Lot 2 on RP211270 (i.e. 62 ha encompassing the Development Footprint and Conservation Area as shown in **Figure 1**).

Development Footprint – comprises 23 ha as shown in **Plate 1** and **Figure 1** illustrating the proposed project elements that are described in **Section 1.2**.

Conservation Area – comprises 39 ha and is shown in **Figure 1** and will be retained and protected.

1.2 Project Description and Components

The Project will provide a central community hub for the RCC Local Government Area (LGA). The proposed Redlands Whitewater Centre will be a host venue for the Brisbane 2023 Olympics and Paralympics Games. The Draft Birkdale Community Precinct Master Plan (Redland City Council, 2022) states that, "*its collective wealth is measured by its dedicated conservation and celebration habitat, culture and heritage, by its enhancement of today's social values, and the strong legacy outcomes of it being a home for active and passive recreation, education and technology diversity*."

The Project will result in the creation of seven 'hubs' within the Development Footprint, including:

- Cultural hub;
- Willards Farm (food) hub;
- Innovation hub;
- Entertainment hub;
- Communications hub;
- Recreation and adventure sports hub and;
- Conservation hub.

The locations of the separate hubs for the Project are shown on the Pre- 2023 Master Plan in **Plate 1**, below.

1.3 Background

The Project Area is located in the suburb of Birkdale, Queensland. It is situated to the northeast of Tingalpa Creek (a tidal waterway) and encompasses an area of 62 ha. The Project Area (excluding Lot 2 on RP211270) was purchased by RCC from the Commonwealth in 2019. As part of the conditions of sale, the Commonwealth entered into a Conservation Agreement with RCC for the land described as Lot 1 on RP14143, Lot 2 on RP14144 and Lot 2 on SP146445.

The Development Footprint encompasses approximately 23 ha in the centre of the Project Area. The remaining areas form the Conservation Area that is the subject of the Conservation Agreement with the Commonwealth. While the Conservation Area supports an expanse of remnant and regrowth vegetation, the Development Footprint has been historically modified and primarily supports exotic grassland and scattered juvenile trees. The Project Area supports heritage assets including the former World War 2 radio receiving station and Willard's Farm (Redland City Council, 2022).

The Conservation Agreement specifies clauses requiring the protection and conservation of species and threatened ecological communities (TECs) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) within the Conservation Area.

The objectives of the Conservation Agreement are for the long-term protection and conservation of protected matters found on the land, including:

1. Koala and Koala habitat present in the Conservation Area, to improve and maintain the viability of the Koala in the local area and promote and enhance the survival and conservation status of the species;

2. Subtropical and Temperate Coastal Saltmarsh ecological community in the Conservation Area, to improve and maintain the viability of the ecological community; and

3. Other ecological values within the Conservation Area, including ecological communities or habitat for other EPBC Act listed species as identified and may be identified in the future.

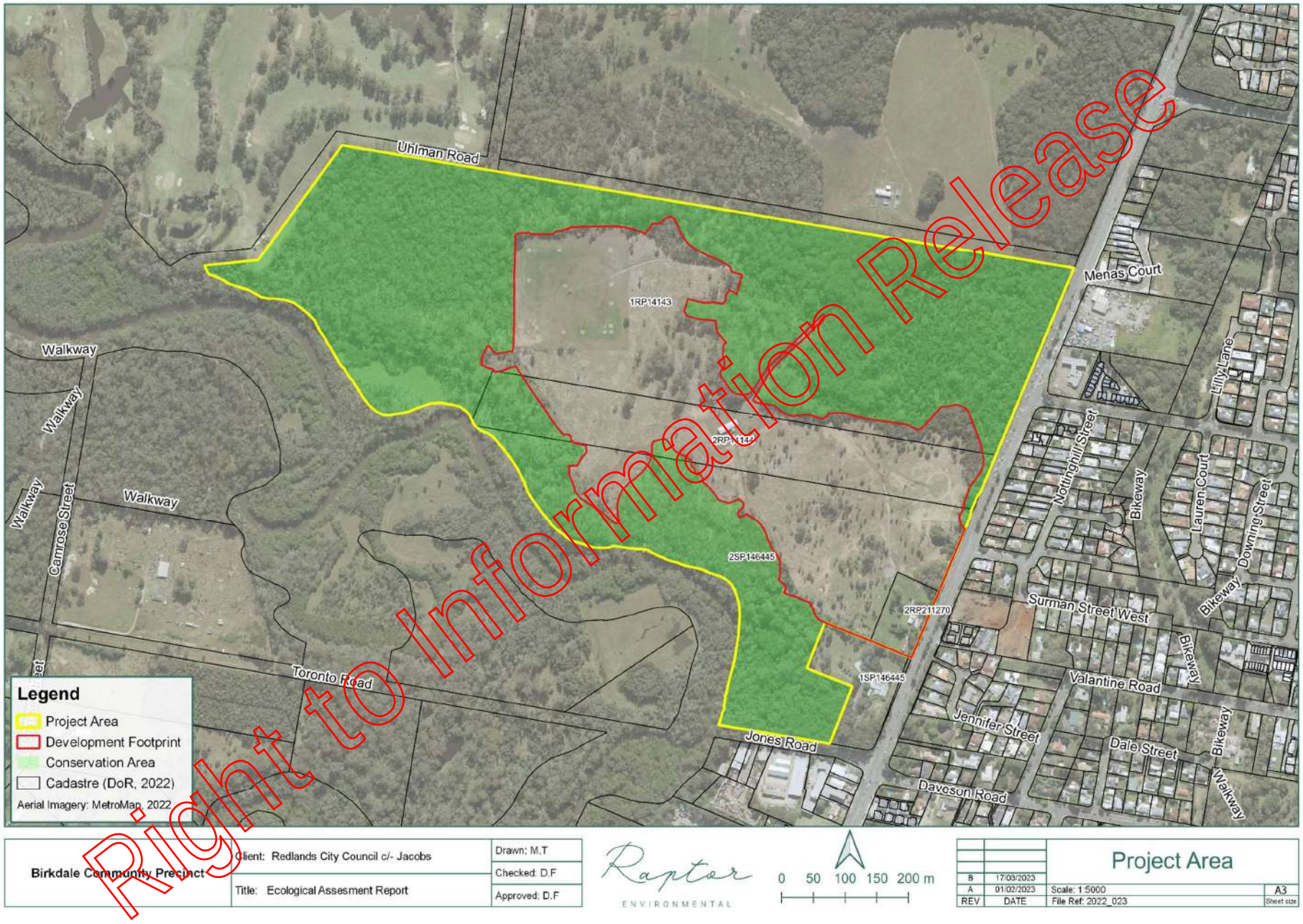

Figure 1. The Project Area.

Plate 1. Birkdale Community Precinct Master Plan (Pre-2032).

1.4 Previous Studies

Four phases of ecological and environmental assessments have been completed for the Project, as follows:

- Phase 1 - Initial pre-purchase land investigation:
  - Environmental Investigation - Land in Birkdale, Capalaba prepared by ERM (dated 2018).
- Phase 2 - Ecological assessments, management plans and Koala studies to ensure compliance with the Conservation Agreement:
  - Ecological Assessment Report and Environmental Management Plan prepared by Cardno (dated 18 June, 2020).
  - Regional Ecosystem Review prepared by Cardno (dated 23 September 2021).
  - Environmental Early Works and Social Land Management Plan prepared by Cardno (dated 23 November 2021).
  - Koala Habitat Assessment and Recommendations prepared by Biolink (dated October, 2021).
  - Koala Survey Report prepared by the University of the Sunshine Coast (dated June, 2021).
- Phase 3 – Review of Environmental Approvals, Conservation Agreement and MNES:
  - Environmental and Approvals Considerations, Birkdale Community Precinct Master Plan prepared by ERM (June, 2022).
  - Draft Conservation Agreement Review prepared by ERM (dated 2 August 2022).
  - Draft Threatened Species and Threatened Ecological Communities Review prepared by ERM (dated 2 August 2022).
- Phase 4 – Supporting documentation for the LGID and finalization of the Conservation Agreement including:
  - EAR (this report) prepared by Raptor Environmental (dated 20 March 2023) to support and inform environmental approvals and refine the detailed design at a fine scale.
  - EPBC Act Significant Impact Assessment prepared by Raptor Environmental (dated 20 March 2023).
  - Marine Plant Disturbance Plan prepared by Raptor Environmental (dated 28 February 2023).
  - Wildlife Habitat Management Plan prepared by Raptor Environmental (dated 22 March 2023).

1.5 Scope of this Report

This EAR incorporates a contemporary assessment of ecological values within the Development Footprint, as well as the outcomes of targeted studies in accordance with the recommendations made in previous reports (listed above). This EAR focuses in detail on the Development Footprint, although parts of the study also incorporate areas within the Conservation Area.

Specifically, the scope of this EAR includes the following items.

- The methodologies and outcomes of a detailed fauna assessment;
- Assessment of general ecological values in the open grassland area (i.e. the Development Footprint);
- Collection of information to support a Vegetation Management Plan;
- Evaluation of Koala habitat connectivity within the Project Area;
- Consideration of MNES pursuant to the EPBC Act (including recent listing changes), including:
    - The Endangered Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*).
    - The Endangered Greater glider - southern and central (*Petauroides volans*).
    - The Endangered Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland TEC.
    - The Endangered Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland Bioregion TEC.
    - The Vulnerable Subtropical and Temperate Coastal Saltmarsh TEC.
    - The Vulnerable South-eastern glossy black cockatoo (*Calyptorhynchus lathami lathami*).
    - The Vulnerable, Marine and Migratory White-throated needletail (*Hirundapus caudacutus*).
    - The Vulnerable Grey-headed flying-fox (*Pteropus poliocephalus*).
    - The Marine and Migratory Rufous fantail (*Rhipidura rufifrons*).
    - The Marine and Migratory Satin flycatcher (*Myiagra cyanoleuca*).
- Consideration of updated listings of MSES, including:
    - Updates to the listings of the Koala and Greater glider (Southern and central) pursuant to the *Nature Conservation (Animals) Regulation 2020.*
    - Updates to the *Vegetation Management Act 1999* Vegetation Management Map, which now incorporates Category C – High Value Regrowth vegetation.

- Consideration of MLES, including *Redland City Council Planning Scheme Environmental Significance Planning Scheme Policy* list of Locally significant species.

This EAR will support the Local Government Infrastructure Designation (LGID) application under the *Planning Act 2016.* As such, assessment of Matters of State Environmental Significance (MSES) will likely be relevant to this designation.

1.5.1 Caveats

The scope of this EAR does not extend to the provision of a Vegetation Management Plan (although this EAR will identify restoration principles and approaches that may be integrated into a broader Vegetation Management Plan for the Project). This EAR also does not incorporate the results of a Protected Flora Survey conducted in accordance with the Flora Survey Guidelines (2020) pursuant to the *Nature Conservation (Plants) Regulation 2020*, given the time-frame requirements for such a survey (i.e. the survey must be conducted 12 months before the commencement of clearing activities).

2 Methodology

2.1 Desktop Review

2.1.1 Reports and databases

To inform the requirements of the field survey, a desktop assessment was undertaken to review contemporary and relevant database and mapping resources relating to flora and fauna, ecological communities, waterways and other MNES, MSES and Matters of Local Environmental Significance (MLES) likely to occur within and in proximity to the Project Area. The outcomes sought by the desktop assessment were to:

- review amendments to legislation since the preparation of the previous Ecological Assessment Report (Cardno, 2020);
- refine a list of threatened species to be targeted by the fauna and flora survey;
- guide the level of detail required during the field assessment.

In addition to review of current aerial photography, the following key Commonwealth, State and Local government desktop databases and mapping resources reviewed are listed below. Applicable outputs from these searches have been presented in **Appendix A**.

- MNES
  - Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW's) EPBC Act Protected Matters Search Tool (PMST);
  - Atlas of Living Australia (insofar as MNES species are concerned); and
  - National flying-fox monitoring map prepared by DCCEEW.
- MSES
  - MSES mapping as shown on the Development Assessment Mapping System (DAMS) and the State Planning Policy (SPP) interactive mapping system;
  - Regulated Vegetation Management Map prepared by the Department of Resources (DoR) and pursuant to the *Vegetation Management Act 1999*;
  - Koala Habitat Map prepared by the Department of Environment and Science (DES);
  - Protected Plants Flora Survey Trigger Map prepared by DES;
  - Wildlife online database prepared by DES;
  - Atlas of Living Australia (insofar as MSES species are concerned); and
  - The Queensland Wetland Environmental Values Map under the Environmental Protection (Wetland and Water Biodiversity) Policy 2019.
- MLES
  - *Redland City Plan 2018* online mapping tool and relevant overlays.

Mapping searches were centred on coordinates that represented the centre of the Project Area (-27.5097, 153.2014), or a centrally located Lot/Plan (i.e. Lot 1 on RP14143) as relevant. A three-kilometre buffer was applied for each desktop search where relevant.

2.1.2 Desktop mapping

2.1.2.1 Koala Habitat Characterisation

The Commonwealth provides guidance on the assessment of Koala habitat (Department of Climate Change, Energy, the Environment and Water, 2022) and Raptor Environmental has adopted the methodology described in the recent publication by the Australian National University (Youngentob, 2021) including:

- Summary of Koala presence and abundance within the Project Area and broader Birkdale area.
    - A summary of Koala presence in the Project Area was collated based on the existing information provided in previous studies (Cardno, 2020; BioLink, 2021; University of the Sunshine Coast, 2021).
- An overview of habitat extent and connectivity.
- Koala habitat characterisation in accordance with **Table 1**, which indicates that the following attributes are valuable when identifying Koala habitat:
    - Locally important koala tree (LIKT);
    - Ancillary habitat trees; and
    - Open ground.

Using combinations of these attributes, Koala habitat within the Project Area was assigned to three separate Koala habitat categories as per **Table 2**. While delineation of areas was a desktop exercise, it was also supported by field data.

The assessment of Koala habitat included mapping individual and patches of non-juvenile koala habitat trees (NJKHTs) as defined under the Queensland *Environmental Offsets Regulation 2014*. Mapping of Koala habitat categories within the Project Area relied, in part, upon the ground-truthed Regional Ecosystem mapping presented in the Regional Ecosystem Review (Cardno, 2021) (**Appendix B**). This information was supplemented by transects completed by Raptor Environmental in 2022 in remnant and regrowth regional ecosystems (REs) supporting Koala habitat to aid in quantifying NJKHTs in each regional ecosystem. Transects utilised a 50 x 20 m plot and to quantify density of NJKHTs (refer to **Figure 2**).

Table 1. Summary of Koala habitat assessment criteria (Youngentob, 2021).

Section of report	Habitat assessment criteria	Applicable attributes
3.2	Locally important Koala tree The document states "*The combination of koala occurrence and LIKT provides a strong indication that an area is koala habitat. However, it is important to recognise that the absence of koalas does not mean that an area with LIKT is not potential koala habitat*."	Applicable in assessing koala habitat
3.2	Ancillary habitat The document states "*In some areas, the availability of certain tree species and other vegetation types not commonly recognised as important food may still be essential for koala survival due to the shelter or other resources they provide*"	Applicable in assessing koala habitat
7.1	Soil fertility The document states "…as a general rule, soil fertility should not be used as an indicator of koala habitat or koala habitat quality"	Not applicable
7.2	Tree size and age class The document states "*The published literature does not include data that can be used to identify specific tree size thresholds that would be consistent across the range of the koala*"	Not applicable
7.3	Primary and secondary food tree species The document states "*Methods of habitat assessment that rank the importance of particular eucalypt tree species as 'primary' or 'secondary' should be used with caution and awareness of limitations*"	Not applicable
7.4	Proportion of preferred food trees in a landscape (primary and secondary habitat) The document states "*If secondary habitat can support a koala population, even at a lower density, it should not automatically receive lower priority for conservation than an area of primary habitat*"	Not applicable
7.5	Tree species diversity The document states "*Tree species diversity should not be considered a requirement for koala habitat unless it has been robustly demonstrated that it is important for koala populations in a specific area*"	Not applicable
7.6	Remnant vegetation and non-remnant vegetation The document states "*Non-remnant vegetation should be given the same consideration as remnant vegetation when determining whether it is koala habitat and its potential utility to koalas should not be downgraded simply on the basis of whether the vegetation has regrown or has never been disturbed*."	Not applicable
4	Open ground	Applicable in assessing koala habitat

Section of report	Habitat assessment criteria	Applicable attributes
	The document states "…*the ground itself forms an essential component of koala habitat*"	

Table 2. Koala habitat value score.

Habitat Category	Based on ANU Report (Youngentob et al., 2021)	
	Locally important koala tree (LIKT)	Ancillary koala habitat tree
A	LIKT trees dominate the vegetation community	Ancillary koala habitat trees in scattered in the vegetation community
B	LIKT scattered	Ancillary koala habitat trees dominate the vegetation community
C	Areas cleared, do not support LIKT or ancillary trees OR support isolated LIKT or ancillary trees	

2.1.2.2 Threatened Ecological Communities and Regional Ecosystems

Previous ecological assessments for the project included a Regional Ecosystem Review (Cardno, 2021). The review refined land zone boundaries and identified additional regional ecosystems (REs) not currently mapped. Underlying land zones and vegetation assemblages are used to identify REs and assist in identifying potential TECs. This study assisted the desktop identification of potential TECs which correspond with alluvial river and creek flats (i.e. landzone 3).

The vegetation community assessment sought to build upon the refined Regional Ecosystem (RE) mapping undertaken by Cardno (2021). In addition, high-resolution contemporary aerial imagery was also reviewed to take recent vegetation changes within the Development Footprint into account (i.e. removal of weeds). Where deviations from the refined RE mapping were identified during the field assessment, updated RE and TEC boundaries were mapped.

2.1.2.3 Habitat Connectivity

Habitat connectivity across the landscape incorporating factors such as barriers to local dispersal, land use and effective connection elements in the environment were reviewed. Mapping of existing fauna movement barriers, including fencing, surrounding roads was completed to gain insight into the current fauna movement opportunities and limitations within the broader landscape.

2.1.3 Likelihood of Occurrence Assessment

Following review of relevant desktop resources, a likelihood of occurrence assessment was undertaken for species listed under the *Nature Conservation Act 1992* (NC Act) and EPBC Act that:

- Have verified occurrence records within 3km of the Project Area according to the Queensland Wildnet online database;
- Are considered 'known' to occur within 3km of the Project Area according to the EPBC Act PMST.

To assess the likelihood of occurrence for these species, the habitat requirements for each species was reviewed and compared against the habitat types present within the Project Area. The likelihood of occurrence status for each species was determined as follows:

- Species which have not been previously recorded and have strict habitat requirements that are not met by the habitat types within the Project Area were classified as '**unlikely'**.
- Species which have not previously been recorded within the Project Area or immediate surrounds (but have been recorded within at least 3km of the Project Area) and have habitat requirements that are broadly similar with the habitat types present within the Project Area were classified as '**possible**'.
- Species which have previously been recorded within the Project Area or immediate surrounds and have habitat requirements consistent with the habitat types present within the Project Area were classified as '**likely**'.
- Species which have previously been recorded within the Project Area or immediate surrounds within recent years (i.e. within the last 30 years) were classified as '**known**'.

The results of the likelihood of occurrence assessment are provided in **Appendix C**.

2.2 Field Assessment

The field assessment component undertaken for this EAR sought to build upon previous assessments (i.e. Cardno, 2020; BioLink, 2021; University of the Sunshine Coast, 2021) which surveyed the entire Conservation Area or focused on a particular species within the Project Area (i.e. Koala). As such, the field assessments undertaken for this EAR focused on accumulating finer-scale information for all matters of environmental significance and associated habitat that may occur within the Development Footprint and immediate surrounds (within the Conservation Area).

The field assessment involved seven days of survey conducted from the 8th of September to the 12th of September 2022, 3rd March and 24th March 2023. All assessments were undertaken in accordance with a current Animal Ethics permit (license number: CA 2022/01/1581) and Scientific Users permit (registration number: SUR001662).

The field assessment involved nocturnal and diurnal survey methodologies. Surveys were undertaken in accordance with the following guidelines.

- *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre *et al*., 2022a).
- *Survey Guidelines for Australia's Threatened Mammals (Department of Sustainability, Environment, Water, Population and Communities, 2011).*
- *Biocondition Assessment Manual* (Eyre *et al., 2015).*
- *A review of koala habitat assessment criteria and methods* (Youngentob, 2021).
- *Guide to greater glider habitat in Queensland* (Eyre *et al.,* 2022b).
- *Redland City Plan Planning Scheme Policy 1 – Environmental Significance.*

Locations where various survey methods were undertaken are shown in the following figures:

- **Figure 2** – Transects, plots and observation points
- **Figure 3** – Traps and detectors.
- **Figure 4** – Vegetation assessment and mapping.

Detailed descriptions of the survey methodologies undertaken are provided in **Table 3**.

Table 3. Description of survey methods

Survey Technique	Field assessment
Flora and Threatened Ecological Communities	
Vegetation communities	Mapping of broad vegetation communities and Koala habitat characterisation within the Project Area. This mapping was supplemented with Koala habitat tree transects completed in remnant and regrowth regional ecosystems (REs) supporting Koala habitat..
Threatened Ecological Communities	Potential TECs were assessed in accordance with the Queensland Government's *BioCondition Assessment Manual* (Eyre et al., 2015). BioCondition is a condition assessment framework for Queensland that provides a measure of how well a terrestrial ecosystem is functioning for biodiversity values and includes the quantification of native understorey. This approach was used to assist in determining TECs as per the Conservation Advices for the following TECs: • Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland bioregions (Department of Climate Change, Energy, the Environment and Water (2022c) • Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland (Department of the Environment and Energy, 2018). BioCondition assessments are repeatable and quantifiable method of assessing non-native vegetation cover in the understorey and large trees. The location of the BioCondition plots assessed for the Project are shown on **Figure 2** and is presented in **Appendix D**.
Flora inventory	A list of the native flora species encountered was compiled during random meanders undertaken within the Development Footprint; however it should be noted that the survey methodology adopted for this study was not on accordance with the Flora Survey Guidelines (2020) pursuant to the *Nature Conservation (Plants) Regulation 2020*, given the

Survey Technique	Field assessment
	time-frame requirements for such a survey and proposed project staging (i.e. the survey must be conducted 12 months before the commencement of clearing activities).
Marine Plant Survey	A marine plant survey was undertaken of the proposed Kayak and canoe launch facility. The survey assessed areas on tidal land (i.e. ≤ Highest Astronomical Tide (HAT)) and areas supporting marine plants as defined under the *Fisheries Act 1994* and the Fish Habitat and Management Operational Policy (FHMOP 001) (Department of Primary Industries and Fisheries, 2007).
Weeds	A list of the exotic and/or invasive flora species encountered was compiled during random meanders undertaken within the Development Footprint. This included mapping the broad locations of restricted weeds listed under the *Biosecurity Act 2014*.
Fauna	
Site selection	Surveys were undertaken at multiple sites within the Development Footprint and immediate surrounds during the Spring survey period. The locations of the survey sites were determined following consideration of areas which were representative of vegetation communities potentially directly impacted by the Project and/or occurring at the direct interface of the Development Footprint and Conservation's Area including: 1. Dry sclerophyll forest in regrowth vegetation on land zone 3; 2. Dry sclerophyll forest at the junction of the secondary access roads in advanced regrowth vegetation on land zone 5; and 3. Exotic grassland with scattered native trees and fringing young regrowth vegetation. The location of the fauna survey sites has been illustrated in **Figure 3**.
Active diurnal searches	Active diurnal searches were undertaken in accordance with Section 8.3 of the *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre et al., 2022a). Four active diurnal searches were completed throughout the survey period (i.e. one per day). Each diurnal search was undertaken by two ecologists for a 30-minute period (i.e. 60 person-minutes for four days) during mid and early morning. Searches were undertaken over a 50 x 50 m plot area within the three survey sites. The diurnal searches targeted identification of bird and herpetofauna species. Search techniques for herpetofauna included turning over of woody debris, rocks and leaf litter beneath trees, as well as looking beneath peeling bark for reptiles.
Small mammal trapping	Small mammal trapping was undertaken in accordance with Section 8.4 of the *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre et al., 2022). The survey methodology utilised for this project involved the designation of three separate 'survey sites' (i.e. survey site 1, survey site 2 and survey site 3). Survey sites 1 and 2 were located to the south and north of the Development Footprint, respectively and survey site 3 was located centrally within the Development Footprint. A total of 20 Elliot traps were deployed at each survey site for four nights (i.e. a total of 240 trap-nights). The locations of Elliot traps are shown on **Figure 3**. Traps were baited with universal bait mixture (i.e. a combination of rolled oats, peanut butter, honey and vanilla essence). Traps were positioned and covered to reduce possibility of exposure of trapped animals. Traps were opened before dusk and checked each morning shortly after dawn (**Plate 2**) after which they were closed for the day. Two traps at Site 3 (Elliot traps I and M) were installed on the trunk of mature trees with the aim of trapping small arboreal mammals including gliders (**Plate 3**).

Survey Technique	Field assessment
Pitfall trapping	Pitfall traps were installed at survey sites 1 and 2 as per Section 8.1 of the *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre et al., 2022) (**Figure 3**). Pitfall traps were not installed at survey site 3, due to the lack of understorey habitat owing to regular slashing of the Development Footprint. Pitfall traps target small, ground dwelling mammals, reptiles and amphibians. The technique utilised four 20 litre buckets connected by a drift fence using a 'T' configuration (refer to **Plates 4 and 5** below). Each bucket was furnished with a dampened sponge, floatable material (i.e. a cork) and leaf litter. Traps were checked at dawn, before midday, at dusk and opportunistically throughout the day. Buckets were closed for one day owing to excessive rain.
Spotlight searches and stag watching	Spotlight searches were undertaken in accordance with Section 8.10 of the *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre et al., 2022a) and the *Survey Guidelines for Australia's Threatened Mammals* (Department of Sustainability, Environment, Water, Population and Communities (2011). Spotlight searches were taken in proximity to survey sites 1 and 2 (in areas supporting high-quality arboreal mammal habitat including habitat suitable for *Petauroides volans* (Greater glider (Southern and central)), as well as throughout the balance of the Development Footprint. Spotlighting searches were undertaken over four nights by two ecologists for a 2 – 3 hr period (i.e. average 4 person hours for four nights). It is noted that the *Survey Guidelines for Australia's Threatened Mammals* (Department of Sustainability, Environment, Water, Population and Communities (2011) recommends a method of 2 x 200m transects per 5 ha, however the Spotlight searches completed were covered a greater distance and longer time-frame than the guidelines survey method. Each spotlight survey involved the observers meandering slowly through each survey site (including the extent of the Development Footprint) following call-playback activities. Spotlight searches were focused in a mixture of sparsely and densely vegetated areas (**Appendix E**). Prior to spotlighting searches at dusk, two stag watching searches were completed (i.e. 9 and 10 September 2022) at the locations shown in **Figure 2**. Stag watching involved direct observation of nocturnal wildlife emerging from tree hollows at dusk. This technique is effective for the detection of possums and gliders and significant habitat trees containing hollow-bearing limbs were targeted for stag watching. The areas surveyed during spotlight searches are shown on **Figure 2**.
Call playback	Call playback was undertaken in accordance with Section 8.9 of the *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre et al., 2022a) using a megaphone to amplify calls. Call playback was completed over four nights, in five key habitat locations (including survey sites 1 and 2) as well as at the centre of the Development Footprint. Call playback surveys targeted multiple fauna groups, including birds, amphibians and mammals, with particular emphases on this species deemed 'likely' to occur by the Project's likelihood of occurrence assessment. Specific species targeted were: • Koala (*Phascolarctos cinereus*); • Sugar glider (*Petaurus breviceps*) • Squirrel glider (*Petaurus norfolcensis*); • Powerful owl (*Ninox strenua*) and • Wallum sedge frog (*Litoria olongburensis*). The locations where call playback was undertaken are shown on **Figure 2**.
Camera trapping	Camera trapping was undertaken in accordance with Section 9.13 of the *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre et al., 2022a). Three passive infrared sensor camera traps were left deployed for a period of one week (refer to specifications below and **Plate 6**). Camera traps were positioned at survey sites 1, 2 and 3. Camera traps were baited with a meat (i.e. sardines). The locations of camera traps are shown on **Figure 3**.

<table>
<tr><th>Survey Technique</th><th>Field assessment</th></tr>
<tr><td></td><td>Three camera traps were deployed for a period of one week. Two camera traps were positioned along the northern and southern boundaries of the Development Footprint, while a third was placed centrally within the Development Footprint within survey sites 1, 2 and 3.

Camera trap specifications are detailed below.
<table>
<tr><th>Camera trap</th><th>Make</th><th>Model</th><th>Installation</th><th>Aspect (facing)</th></tr>
<tr><td>1</td><td>Reconyx HF2X</td><td>Hyperfire 2</td><td>Installed on a tree at 0.6 m</td><td>North</td></tr>
<tr><td>2</td><td>Browning Patriot</td><td>BTC-PATRIOT-FHD</td><td>Installed on a tree at 0.6 m</td><td>South</td></tr>
<tr><td>3</td><td>Swan</td><td>Outback-Cam-5MP</td><td>Installed on a tree at 0.6 m</td><td>Southwest</td></tr>
</table></td></tr>
<tr><td>Microbat Echolocation Call Detection</td><td>Microbat Echolocation call detection was undertaken in accordance with Section 8.11 of the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al., 2022a). The methodology recommends setting of one bat detector on the centre of the generic survey site to record continuously for a minimum of three nights (dusk until dawn) during each survey period. One Chorus wildlife recorder was deployed for four nights to the north of the Development Footprint, areas along the proposed secondary access road which is a narrow corridor overtopped by canopy trees.

Additionally, analysis of bat activity was completed over a single night using a handheld Echo meter Touch Pro 2 within the Development Footprint. Additional microbat survey methodologies were not utilised as there were no threatened microbat species that were considered ‘likely’ to occur within the Project Area by the likelihood of occurrence assessment (noting that some threatened microbat species’ calls cannot be distinguished using echolocation call detection, such as Nyctophilus spp.). The location where the Chorus wildlife recorder was deployed is shown on Figure 3.</td></tr>
<tr><td>Habitat assessment</td><td>A detailed habitat assessment was completed within the Development Footprint (Appendix F). The habitat assessment involved mapping of habitat features, such as hollow-bearing trees, termitaria, nests, burrows and fallen logs. The habitat assessment included identification and mapping of hollows suitable for:

• Calyptorhynchus lathami lathami (South-eastern glossy black cockatoo) as per the Conservation Advice Department of Climate Change, Energy, the Environment and Water (2022a):
o >8 m above ground;
o Located in branches >30 cm in diameter;
o Branch or stem no more than 45° from vertical; and
o Minimum entrance diameter of >15 cm.
• Petauroides volans (Greater glider (Southern and central)) as per the Conservation Advice (Department of Climate Change, Energy, the Environment and Water (2022b):
o Hollows ≥10cm diameter in large old trees.

Additionally, assessments of Koala habitat were completed in accordance with the methodology described in Section 2.1.2. For the purposes of this assessment, characterisation of Koala habitat within the Project Area included mapping of Koala habitat</td></tr>
</table>

Survey Technique	Field assessment
	trees. To aid in delineating koala habitat trees, the definition of a non-juvenile koala habitat trees (NJKHTs) was adopted. A general habitat assessment was completed at each of the survey sites and included the following information: • coarse woody debris; • percentage native understory ; • hollows; • organic litter; • distance to water; • weed cover; • species richness; and • tree canopy cover.
Opportunistic searches	Opportunistic searches included surveys for scats and animal tracks over a diurnal and nocturnal survey. Additionally, opportunistic observation for signs of wildlife were completed during all survey days (i.e. any bird species observed during vegetation assessments were recorded).
Options review of design and TECs	
Development Footprint	The field assessment included ground-truthing TECs in relation to the proposed Development Footprint in order to provide design recommendations and adjustments to the proposed Conservation Area boundary to avoid directly impacting TECs. Mapped TECs and additional vegetation communities were ground-truthed to confirm presence/absence and extent as per the methodology described in above.
Tingalpa Creek Kayak and canoe launch facility	A review of suitable locations for the proposed Kayak and canoe launch facility, pathway and pontoon was completed to avoid and minimise impacts to ecological values along of Tingalpa Creek. This included an assessment of Tingalpa Creek to review the presence and extent of ecological values including TECs, marine plants, remnant vegetation and habitat features to determine an appropriate siting.
Wetland design	A review of the location of the proposed wetland area within the Development Footprint was completed in order to minimise impacts to ecological values and the hydrological regime. This included a mapping aquatic habitat within proximity to the area and a review of upstream and downstream aquatic habitat and the extent of tidal influence (i.e. marine plants).

Plate 2: Elliott trap.

Plate 3: Arboreal deployment of Elliott trap.

Plate 4: Pitfall trap and 'T' configuration drift net in survey site 2.

Plate 5: Installation of drift fence in survey site 1.

Plate 6: Camera trap and bait tube installed at survey site 2.

2.3 Limitations and Climatic Conditions

Limitations associated with the above-listed methodologies are listed below.

- The field assessment was undertaken over five days in spring 2022 with an additional two days in Autumn 2023. This is outside of the optimal timing for the detectability of some cryptic flora species including Winter and Summer flowering species, however the majority of the Development Footprint was regularly slashed which reduced the likelihood of recruitment of cryptic flora species.
- The field assessment did not include the seasonal replication required to detect certain migratory fauna species, however the highly modified Development Footprint provides limited habitat suitable for migratory fauna species.
- The Conservation Area and portions of the Development Footprint are mapped within the High-risk Area for Protected Plants. A Protected Plants Survey and associated report will be required. Due to the statutory time-frames regarding the validity of the flora survey, it is recommended that a Protected Plant Flora Survey is completed once construction time-frames are confirmed. As such, a Protected Plant Flora Survey is excluded from this ecological assessment.
- During the field assessment, 12 of the 20 Elliott traps located with survey site 3 were compromised on the fourth morning of the survey (i.e. 11 September 2022). Torresian crows (*Corvus orru*) were observed disassembling Elliott traps. Traps were subsequently secured in a manner that reduced the risk of disassembly.
- Due to the completion of extensive surveys for Koala previously of the Project Area which provide presence and population density estimates (USC, 2021, Biolink, 2021 and Cardno, 2020), the contemporary fauna survey did not include additional Koala survey.
- Pitfall traps were closed for one day on September 9 due to rainfall. The weather and moonlight conditions present at the time of spotlighting surveys are provided in **Table 4**.

Table 4. Weather conditions during the field survey component of the study.

Date	Temperature °C (max)*	Rainfall (mm)*	Wind speed (km/hr) and direction	Moon-phase
September 8, 2022	20.0	0	31 NE	Waxing Gibbous
September 9, 2022	20.1	10.8	30 N	Waxing Gibbous
September 10, 2022	20.2	4.8	37 W	Full moon
September 11, 2022	23.2	0	24 NE	Waning Gibbous
September 12, 2022	21.6	0	22 N	Waning Gibbous

* Observations were drawn from Redland (Alexandra Hills) {station 140007} (Bureau of Meteorology, 2022).

Notwithstanding the above limitations, the survey methods and effort used during the survey, and the application are considered adequate to assess impacts from the Project to those communities and species identified by the desktop assessment as 'known' or 'likely' to occur within the Project Area.

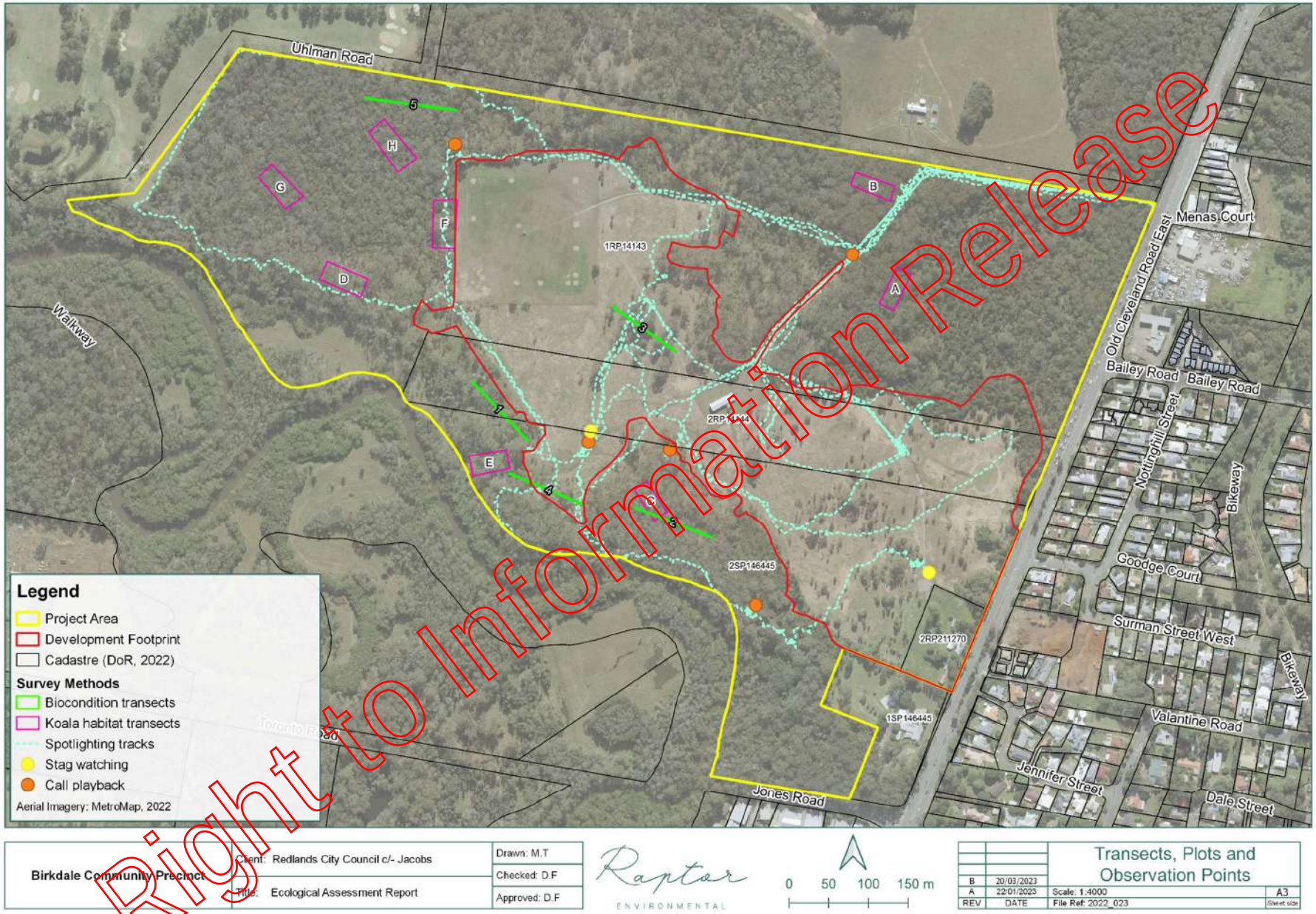

Figure 2. Survey methods – transects, plots and observation points

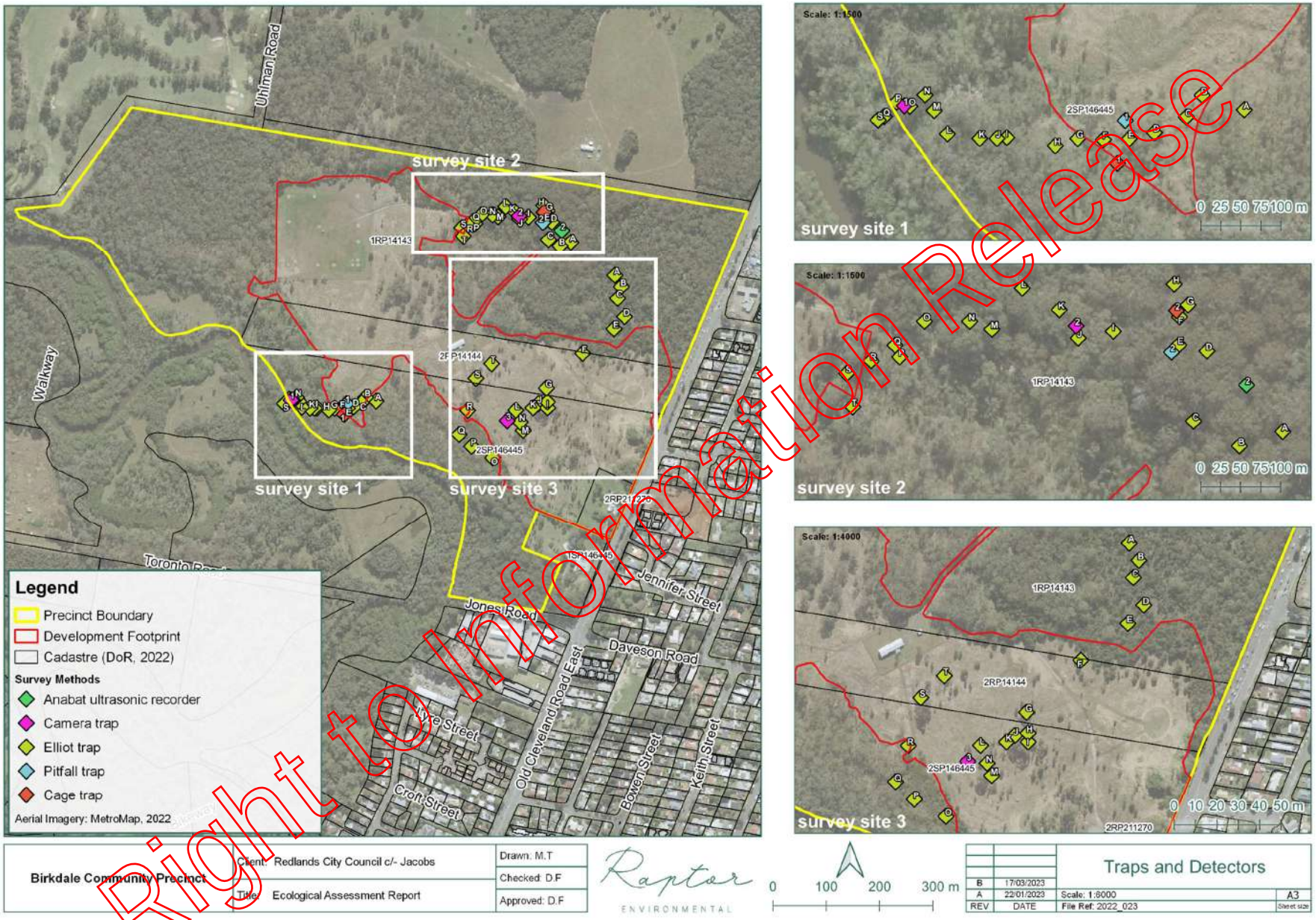

Figure 3. Survey methods – traps and recording devices.

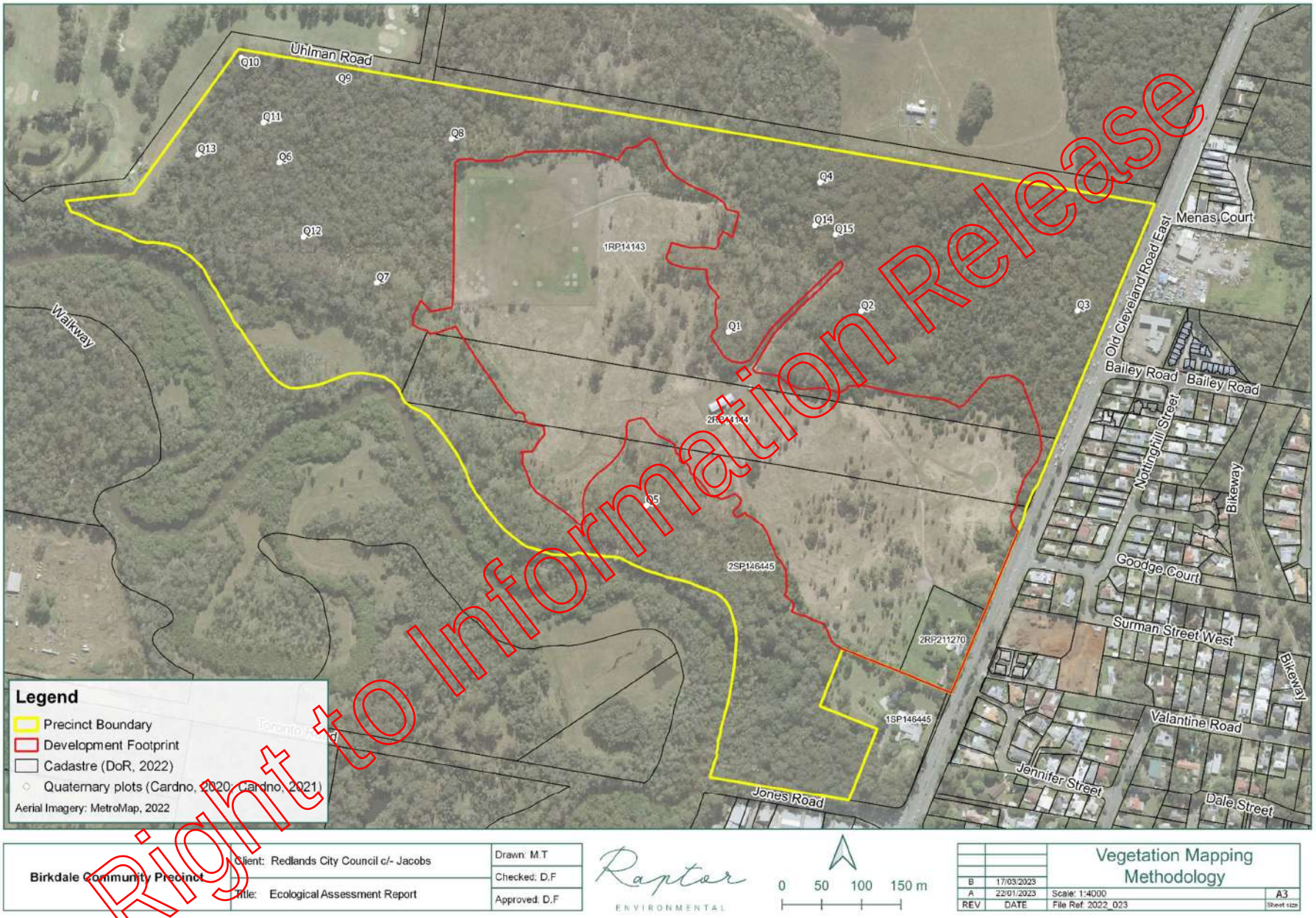

Figure 4. Survey methods – vegetation assessment and mapping.

3 Results

3.1 Matters of National Environmental Significance

The EPBC Act provides a legislative framework to protect and manage nationally and internationally significant flora, fauna, ecological communities, and heritage places. The EPBC Act defines these as MNES. The *EPBC Act Policy Statement 1.1, the 'Significant Impact Guidelines'* further lists a set of 'significant impact criteria' for each of the nine listed matters of national environmental significance. The MNES which may apply to the proposed works include the potential to impact upon:

- listed threatened and TECs.
- migratory species.

The EPBC Act PMST indicates that there are 83 threatened species with habitat that is 'known' or 'likely' to occur within a three-kilometre radius of the Project Area. The desktop likelihood of occurrence assessment identified seven threatened fauna species listed under the EPBC Act which are 'known' or 'likely' to occur within the Project Area. The Project Area is 'known' or 'likely' to support habitat for nine MNES, listed below.

- Endangered Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*).
- Endangered Greater glider (Southern and central) (*Petauroides volans*).
- Endangered Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community.
- Endangered Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland bioregion.
- Vulnerable Subtropical and Temperate Coastal Saltmarsh.
- Vulnerable South-eastern glossy black cockatoo (*Calyptorhynchus lathami lathami*).
- Vulnerable, Marine and Migratory White-throated needletail (*Hirundapus caudacutus*).
- Vulnerable Grey-headed flying-fox (*Pteropus poliocephalus*).
- Marine and Migratory Rufous fantail (*Rhipidura rufifrons*).
- Marine and Migratory Satin flycatcher (*Myiagra cyanoleuca*).

3.1.1 Threatened Fauna and Migratory Species

The likelihood of occurrence assessment completed for threatened fauna in accordance with the methodology outlined in **Section 2.1.3** is provided as **Appendix C**. The results of the likelihood of occurrence assessment for threatened fauna indicates that seven species listed under the EPBC Act are 'known' or 'likely' to occur within the Project Area. Species that have previously been recorded within the Project Area include:

- *Phascolarctos cinereus* (Koala);
- *Myiagra cyanoleuca* (Satin flycatcher);and
- *Rhipidura rufifrons* (Rufous fantail).

Species considered 'likely' to occur within the Project Area include:

- *Hirundapus caudacutus (*White-throated needletail);
- *Calyptorhynchus lathami lathami* (South-eastern glossy black cockatoo);
- *Petauroides volans* (Greater glider (Southern and central)); and
- *Pteropus poliocephalus* (Grey-headed flying-fox).

The Project Area does not support a known Grey-headed flying fox roost; however, several roosts that house the Grey-headed flying fox are located within 5 km of the Project Area (**Appendix A**). As the species is known to travel considerable distances to feed, it is considered 'likely' to occur for foraging purposes only.

Table 5, below, provides the summarised results of the likelihood of occurrence assessment for EPBC-listed species, as well as the years of identification for this species 'known' to occur within the Project Area.

Table 5. EPBC-listed fauna species – summarised likelihood of occurrence assessment results for species 'likely' or 'known' to occur.

Scientific Name	Common Name	Status*		Likelihood of Occurrence	Observed in Survey Year	
		NC Act	EPBC Act		2022	2020
Mammals						
Petauroides volans	Greater glider (Southern and central)	E	E	Likely	-	-
Phascolarctos cinereus	Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)	E	E	Known	Y	Y
Pteropus poliocephalus	Grey-headed flying-fox	C	V	Likely	-	-
Aves						
Hirundapus caudacutus	White-throated needletail	V	V, Mi	Likely	-	-
Calyptorhynchus lathami lathami	South-eastern glossy black-cockatoo	V	V	Likely	-	--
Myiagra cyanoleuca	Satin flycatcher	SL	Mi	Known	Y	-

Scientific Name	Common Name	Status*		Likelihood of Occurrence	Observed in Survey Year	
		NC Act	EPBC Act		2022	2020
Rhipidura rufifrons	Rufous fantail	SL	Mi	Known	Y	-

The results of the desktop and field assessment for the species which are considered 'known' or 'likely' to occur in the Project Area have been detailed below.

3.1.1.1 Greater glider (Southern and central)

The likelihood of occurrence assessment for Greater glider resulted in the species being classified as 'likely' to occur as suitable habitat is present within the Conservation Area, however the Development footprint lacks suitable habitat attributes as defined by the Guide to Greater Glider Habitat in Queensland (Eyre *et al*, 2022b). The targeted field surveys did not record Greater glider within the Project Area.

In accordance with the species' Conservation Advice, the Greater glider's diet consists primarily of restricted species of eucalyptus leaves supplemented by buds and flowers (DCCEEW, 2022b). The Greater glider shelters in tree hollows during the day and prefer large hollows (diameter >10cm) in large old trees. The Conservation Advice states, "*The probability of occurrence of the species is positively correlated with the availability of tree hollows, which is a key limiting resource*." In southern Queensland, Greater gliders require a minimum of 2-4 live den trees within each 2 ha of suitable habitat.

The field assessment included a review of suitable den trees. The Development Footprint contains two trees with hollow-bearing limbs of greater than 10cm diameter (DCCEEW, 2022b). The proposed design will impact a single hollow-bearing tree containing potential denning habitat. The Conservation Advice defines 'habitat critical to the survival' of the Greater glider as containing the characteristics described in **Table 6** (noting that critical habitat critical is defined by forest type on a regional basis). Further, the *Guide to greater glider habitat in Queensland* (Eyre *et al.,* 2022b) was considered concerning habitat for Greater glider within the Project Area. This guide provides an update on quantitative and qualitative information about Greater glider habitat. **Table 6** below details the definition of habitat in the Conservation Advice (DCCEEW, 2022b) and *Guide to greater glider habitat in Queensland* and its applicability to the Project Area.

Table 6. Review of habitat availability for the Greater glider.

Habitat	Applicability to the Project Area
Habitat critical to the survival of the Greater glider (Conservation Advice)	
Large contiguous areas of eucalypt forest, which contain mature hollow-bearing trees[1] and a diverse range of the species' preferred food species in a particular region; and	The Conservation Area contains large areas of contiguous eucalypt forest containing mature hollow-bearing trees. The Development Footprint has been historically cleared and supports a low diversity of the

[1] Tree hollows can be difficult to detect in ground-based surveys. The presence of trees with basal diameter > 30 cm can be used as a proxy measure for tree hollows used by greater gliders in Queensland (Eyre et al. 2021).

Habitat	Applicability to the Project Area
	species' preferred food species and supports two isolated hollow-bearing trees located 80m and 130 m from surrounding continuous habitat areas.
Smaller or fragmented habitat patches connected to larger patches of habitat, that can facilitate dispersal of the species and/or that enable recolonization; and	The Conservation Area supports habitat for Greater glider that are connected to larger patches of contiguous habitat. These areas would assist in facilitating dispersal of the species. However, the Development Footprint is largely unvegetated and would not facilitate dispersal.
Cool microclimate forest/woodland areas (e.g. protected gullies, sheltered high elevation areas, coastal lowland areas, southern slopes); and	The Conservation Area provides forested areas including sheltered gullies which provide a cool microclimate for refuge. The Development Footprint has been historically cleared and does not contain cool microclimate forest/woodland areas.
Areas identified as refuges under future climate changes scenarios; and	The Conservation Area provides a refuge for future climate change scenarios, however the Development Footprint is not identified as a suitable refuge for Greater gliders in future climate change scenarios.
Short-term or long-term post-fire refuges (i.e. unburnt habitat within or adjacent to recently burnt landscapes) that allow the species to persist, recover and recolonize burnt areas.	The Conservation Area provides short-term and long-term post-fire refuge that allow the species to persist, recover and recolonize burnt areas. The Development Footprint lacks the vegetation to provide a refuge (either short-term or long-term) following fires; however, it may provide a natural firebreak within the landscape. It is unlikely that Greater gliders would be able to use the Development Footprint in such a scenario given the lack of vegetation present within the Development Footprint as ground-level travel would be required.
Habitat (Guide to greater glider habitat in Queensland)	
<u>Habitat</u> Regional ecosystems with confirmed greater glider records. Contains habitat attributes (but not necessarily all attributes), such as live and dead hollow-bearing trees for denning, feed trees, large trees, habitat connectivity across the landscape.	In southern Queensland, Greater gliders require a minimum of 2-4 live den trees within each 2 ha of suitable habitat. The remnant REs within the Conservation Area contain live den trees which provide suitable habitat for the Greater glider. The field assessment included a review of suitable den trees. The Development Footprint contains two trees with hollow-bearing limbs of greater than 10cm diameter (DCCEEW, 2022b) The Development Footprint doesn't contain the minimum amount of live den trees to be considered suitable habitat. The proposed design will impact a single hollow-bearing tree containing potential denning habitat; however, this tree is isolated from continuous habitat by a cleared expanse (i.e. 80m distance). The Development Footprint does not contain remnant REs, as such, it is not considered 'habitat' or 'potential habitat' for Greater glider.
<u>Potential habitat</u> Regional ecosystems that do not have confirmed greater glider records but are identified by experts as potential greater glider habitat Contains habitat attributes (but not necessarily all attributes), such as live and dead hollow-bearing trees for denning, feed trees, large trees, habitat connectivity across the landscape	

Habitat	Applicability to the Project Area
Not habitat Regional ecosystems with no confirmed records of greater gliders, and identified by experts as non-habitat. Does not contain habitat attributes such as live and dead hollow-bearing trees for denning, feed trees, large trees, habitat connectivity across the landscape.	The Project Area and surrounds are not known to contain a Greater glider population (ALA, 2023). The nearest records of a live specimen are located within Greater Glider Reserve, approximately 3km to the south-east of the Project Area. Greater Glider Reserve is mapped as containing RE 12.5.3 and RE 12.3.6. The Conservation Area areas ground-truthed as RE12.5.3 (refer to **Section 3.2.2**). The Project Area and surrounds are not known to contain a Greater glider population and the species was not recorded during the field assessments (Cardno, 2020 and Raptor Environmental, 2023). The Conservation Area contains habitat attributes suitable for use by the species. The Development Footprint lacks areas of contiguous canopy cover that would limit the capability of the Greater glider to move through the area. As such, the Development Footprint is not considered habitat for the Greater glider due to the lack of habitat connectivity across the landscape and lack of mature vegetation that would provide the requisite number of den trees for a population were it to reside in the area.

3.1.1.2 Koala

It is well established that Koala are present within and surrounding the Project Area (Cardno, 2020; USC, 2021 and Biolink, 2021). Further, opportunistic searches completed recorded Koala scats (Raptor Environmental, 2022).

A total of 165 individual NJKHTs were located within the Development Footprint by way of handheld GPS in open areas of the site along with three patches of vegetation dominated by NJKHTs (**Figure 5**, **Appendix G**).

Of the NJKHTs, three species, Forest Red Gum (*Eucalyptus tereticornis*), Tallowwood (*Eucalyptus microcorys*), and Northern Grey Ironbark (*Eucalyptus siderophloia*) are considered to be LIKT as per the Australian National University (Youngentob, 2021).

The results of the Koala habitat characterisation exercise are shown on **Figure 6**. Pre-and post-construction estimates of Koala habitat availability are provided in **Table 7**.

Table 7. Estimate of impacts on Koala habitat.

Habitat Category	Pre-construction (ha)	Estimated Post-construction (ha)	Reduction of habitat type (ha)
A (Plate 7)	34.43	32.4	~1.8
B (Plate 8 and 9)	4.8	1.96	~2.9
C (Plate 10)	22.8	4.3	~18.5

Plate 7: Patch of Category A Koala habitat dominated by LIKT in the Development Footprint.

Plate 8: Patch of Category B Koala habitat with scattered LIKT.

Plate 9: Patch of Category B koala habitat dominated by ancillary habitat trees.

Plate 10: Areas of Category C Koala habitat characterised by a cleared area.

3.1.1.3 Grey-headed Flying-fox

The Project Area does not contain a known roost site for the Grey-headed flying-fox. The closest recorded roost site that hosts Grey-headed flying-foxes is located 2.5 km from the Project Area. The broader Project Area contains vegetation that would be highly suitable for foraging by the Grey-headed flying fox. The Development Footprint only contains small patches and scattered trees from the species' favoured feeding genera (i.e. Eucalyptus, Corymbia or Angophora), and it is likely that the species would also undertake occasional or regular foraging within the Development Footprint (Eby & Law, 2008).

While flying foxes were heard foraging during spotlighting and seen flying high overhead, no Grey-headed flying foxes were directly observed. A single Black-headed flying fox was observed during diurnal surveys.

3.1.1.4 White-throated Needletail

The White-throated needletail is a non-breeding migrant to Australia. As such, the species' habitat in Australia consists of non-breeding habitat only. The species is typically found over

wooded areas, where it is almost exclusively aerial. They will roost in hollows in tall trees on ridge-tops, on bark or rock faces (Commonwealth of Australia, 2015). Such habitat is present along the northern, western and southern extents of the Project Area; however, the Development Footprint largely avoids areas of intact vegetation. The Development Footprint does, however, contain hollow-bearing trees that could be used by the species for roosting purposes. The species was not observed during site surveys.

3.1.1.5 South-eastern glossy black cockatoo

South-eastern glossy black cockatoos rely on nine species of she-oaks (*Allocasuarina spp*. and *Casuarina spp.*) for feeding, with species used varying depending on the region. Birds often only feed on one or two species in one region (DCCEEW, 2022a). In south-east Queensland and north-east New South Wales, they show preference for:

- Black sheoak (*A. littoralis*), and
- Forest sheoak (*A. torulosa*).

There are also records of the species feeding on Swamp sheoak (*C. glauca*).

While the Project Area contains Swamp she-oak, the Development Footprint contains only scattered juvenile Black sheoak. The South-eastern glossy black cockatoo is a nomadic species, which often returns to the same food trees year to year. Searches for orts were undertaken where preferred food species were present, however, none were encountered.

The species has previously been recorded in Atlas of Living Australia, records collected from citizen-science databases are subject to some degree of uncertainty. Upon scrutiny of the record of a Glossy Black Cockatoo within the Development, the record has been denatured to protect the taxon (coordinate uncertainty increased by ~30,000m). Additionally, Atlas of Living Australia records for the species collected within the vicinity of the Project include five individuals along Tingalpa Creek, approximately 1.75 km northwest of the Project Area (ALA, 2022).

While orts were not identified as part of this study, the South-eastern glossy black cockatoo could potentially use the Project Area as an intermittent feeding resource. It is likely that South-eastern glossy black cockatoo occur in the wider landscape and despite the lack of evidence within the Project Area may utilise the resources within the Project Area on occasion.

There are also three hollow-bearing trees within the Development Footprint that could be suitable for use by the species for sheltering or breeding purposes.

3.1.1.6 Satin flycatcher

The Satin flycatcher's preferred habitat consists of "*eucalypt forest and woodlands, at high elevations when breeding. They are particularly common in tall wet sclerophyll forest, often in gullies or along water courses. In woodlands they prefer open, grassy woodland types. During migration, habitat preferences expand, with the species recorded in most wooded habitats except rainforests. Wintering birds in northern Qld will use rainforest - gallery forests interfaces, and birds have been recorded wintering in mangroves and paperbark swamps*." (Commonwealth of Australia, 2015). Such habitat is present along the western and southern extents of the Project Area and within vegetated parts of the Development Footprint. As

such, the species would readily inhabit any vegetated area within the Development Footprint. The species was observed throughout the wooded portions of the Project Area during site surveys.

3.1.1.7 Rufous fantail

The Rufous fantail favours "*moist, dense habitats, including mangroves, rainforest, riparian forests and thickets, and wet eucalypt forests with a dense understorey. When on passage a wider range of habitats are used including dry eucalypt forests and woodlands and Brigalow shrublands*" (Commonwealth of Australia, 2015). Habitat for the Rufous fantail is present along the western and southern extents of the Project Area adjoining the Development Footprint. Rufous Fantail are also known to regularly occur along fragmented habitat edges. A Rufous fantail was recorded along the edge of the Development Footprint during the field assessment.

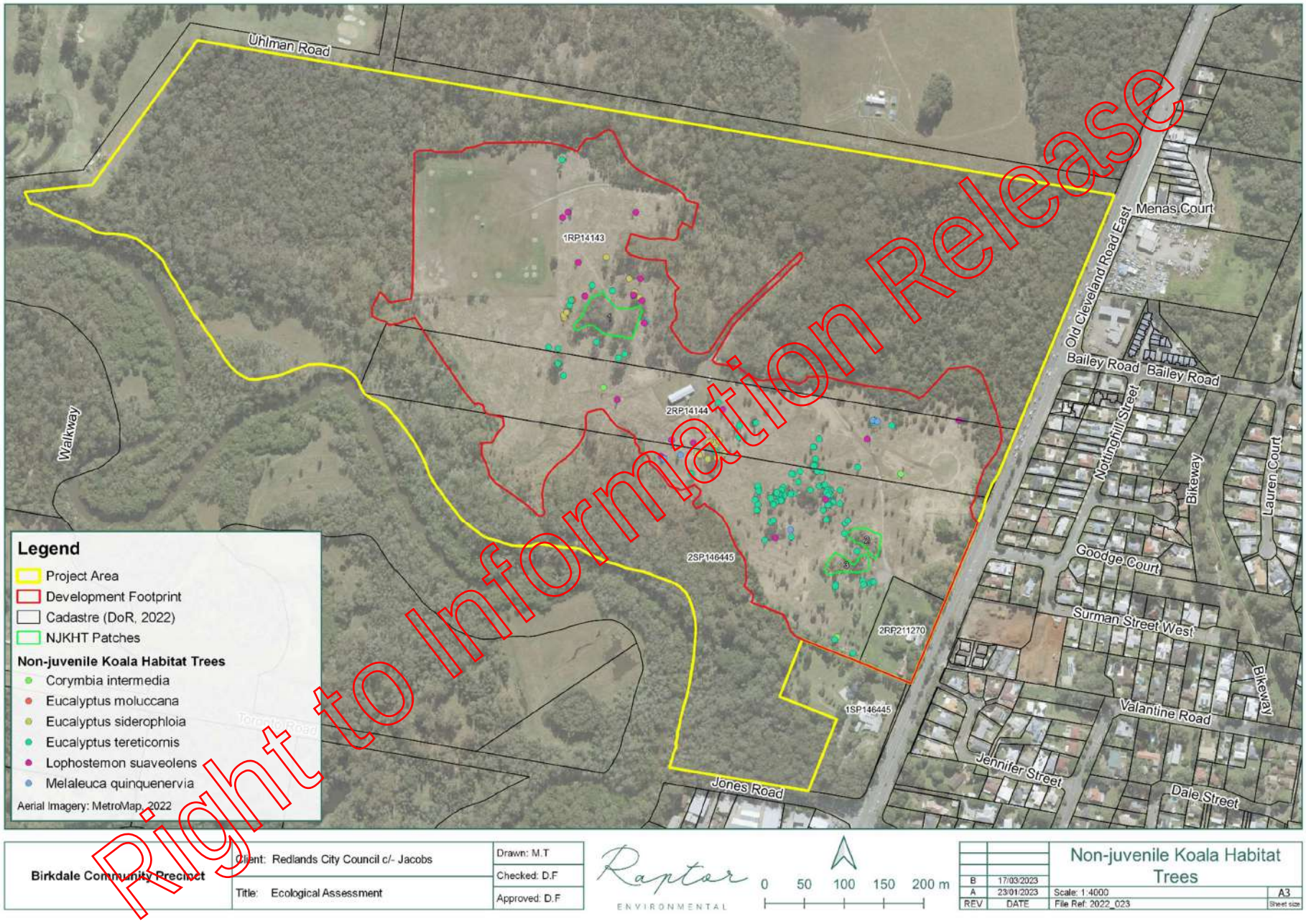

Figure 5. Non-juvenile Koala habitat trees within the Development Footprint.

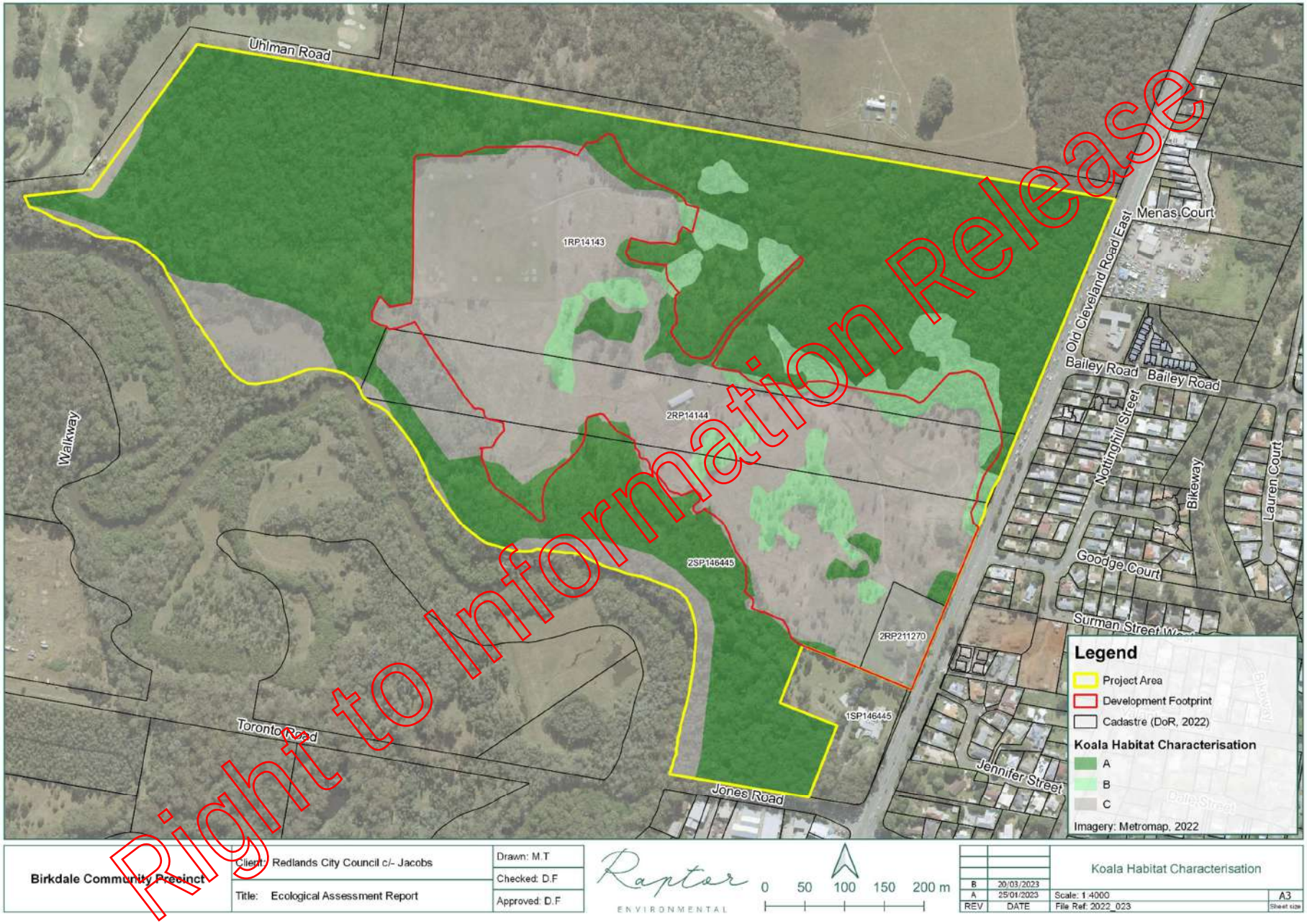

Figure 6. Koala habitat characterisation within the Project Area.

3.1.2 Threatened Flora Species

The likelihood of occurrence assessment completed for threatened flora in accordance with the methodology outlined in **Section 2.1.3** is provided as **Appendix C**. The results of the likelihood of occurrence assessment for threatened flora indicates that no species listed under the EPBC Act are 'known' or 'likely' to occur within the Project Area.

3.1.3 Threatened Ecological Communities

The EPBC Act PMST indicates that four TECs are 'likely' to occur within the Project Area. These include:

- Subtropical and Temperate Coastal Saltmarsh;
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (Coastal Swamp Oak Forest);
- Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland; and
- Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregion TEC.

Additionally, a TEC 'may' occur within the Project Area, Lowland Rainforest of Subtropical Australia. A review of the Regulated Vegetation Management Map, the Review of Regional Ecosystems Report (Cardno , 2021) and amendments to the RE mapping as part of the field assessment (Raptor Environmental, 2023) indicates REs mapped within the Project Area which directly correspond with TECs as details in **Table 8**.

Table 8. Regional Ecosystems mapped within the Project Area that correspond with TECs.

TEC	TEC Status	Equivalent RE Code	Equivalent RE Description
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland (DoEE, 2018)	Endangered	12.1.1	*Casuarina glauca woodland on margins of marine clay plains*
		12.3.20	*Melaleuca quinquenervia, Casuarina glauca +/- Eucalyptus tereticornis, E. siderophloia, M. styphelioides open forest on low coastal alluvial plains*
Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregion TEC (DCCEEW, 2022c)	Endangered	12.3.11	*Eucalyptus tereticornis +/- Eucalyptus siderophloia, Corymbia intermedia open forest on alluvial plains usually near coast*
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland	Endangered	12.3.6	*Melaleuca quinquenervia +/- Eucalyptus tereticornis, Lophostemon suaveolens, Corymbia intermedia open forest on coastal alluvial plains*

TEC	TEC Status	Equivalent RE Code	Equivalent RE Description
Subtropical and Temperate Coastal Saltmarsh (DSEWPC, 2013)	Vulnerable	12.1.2	*Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains.*

The extent of current TECs were ground-truthed within the Project Area as shown in **Figure 7**. The results of this assessment were that:

- The extent of Subtropical and Temperate Coastal Saltmarsh reflects the findings of Cardno, 2020 (**Plate 11**).
- The extent of Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and Queensland previously identified in Cardno, 2020 was verified. In addition:
    - An additional potential patch of the TEC was identified and assessed using the BioCondition assessment framework to ascertain if the patch met the key characteristics and condition thresholds to be considered the TEC (**Plate 12**).
    - The results of the BioCondition Assessment indicate that the understorey was dominated by exotic species. As such, the patch did meet the condition thresholds to be considered the TEC (refer to patch of regrowth RE12.3.20 shown in **Figure 9** and BioCondition Assessment 1 in **Appendix D**).
- Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland was not identified within the Project Area. While the Project Area contains mixed polygons of RE 12.3.6 (and surrounding areas contain RE 12.3.11), these patches of RE did not meet the key diagnostic characteristics to be considered the Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland TEC. This is because where *Melaleuca quinquenervia* occurs, it is either:
    - in abundance and located on land zone 5 (i.e. not on a substrate subject to inundation), or
    - where it occurred on appropriate substrate, it was a relatively minor element of the vegetation community.
- Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland Bioregion TEC corresponds with RE12.3.11 mapped within the Project Area. Four vegetated areas were identified as containing potential Subtropical Eucalypt Floodplain Forest TEC. BioCondition Assessments indicate that two of the vegetation communities meet the key diagnostic characteristics and condition thresholds to be the TEC and are categorised as Class A2 – Good Condition as per the Conservation Advice (Department of Climate Change, Energy, the Environment and Water (2022c) (**Appendix D, Plate 13**). The remaining two areas did not meet the key diagnostic characteristics (i.e. patch size <0.5 ha or canopy cover < 20%) to be considered the TEC (**Plate 14**).

Plate 11: Patch of Subtropical and Temperate Coastal Saltmarsh adjoining Tingalpa Creek.

Plate 12: Patch of regrowth 12.3.20 lacking the structure to be considered the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and Queensland. If managed it may reach this status.

Plate 13: Mapped RE12.3.11 which corresponds with Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland Bioregion

Plate 14: Patch of vegetation within the Development Footprint which doesn't meet the size criteria to be considered Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland Bioregion

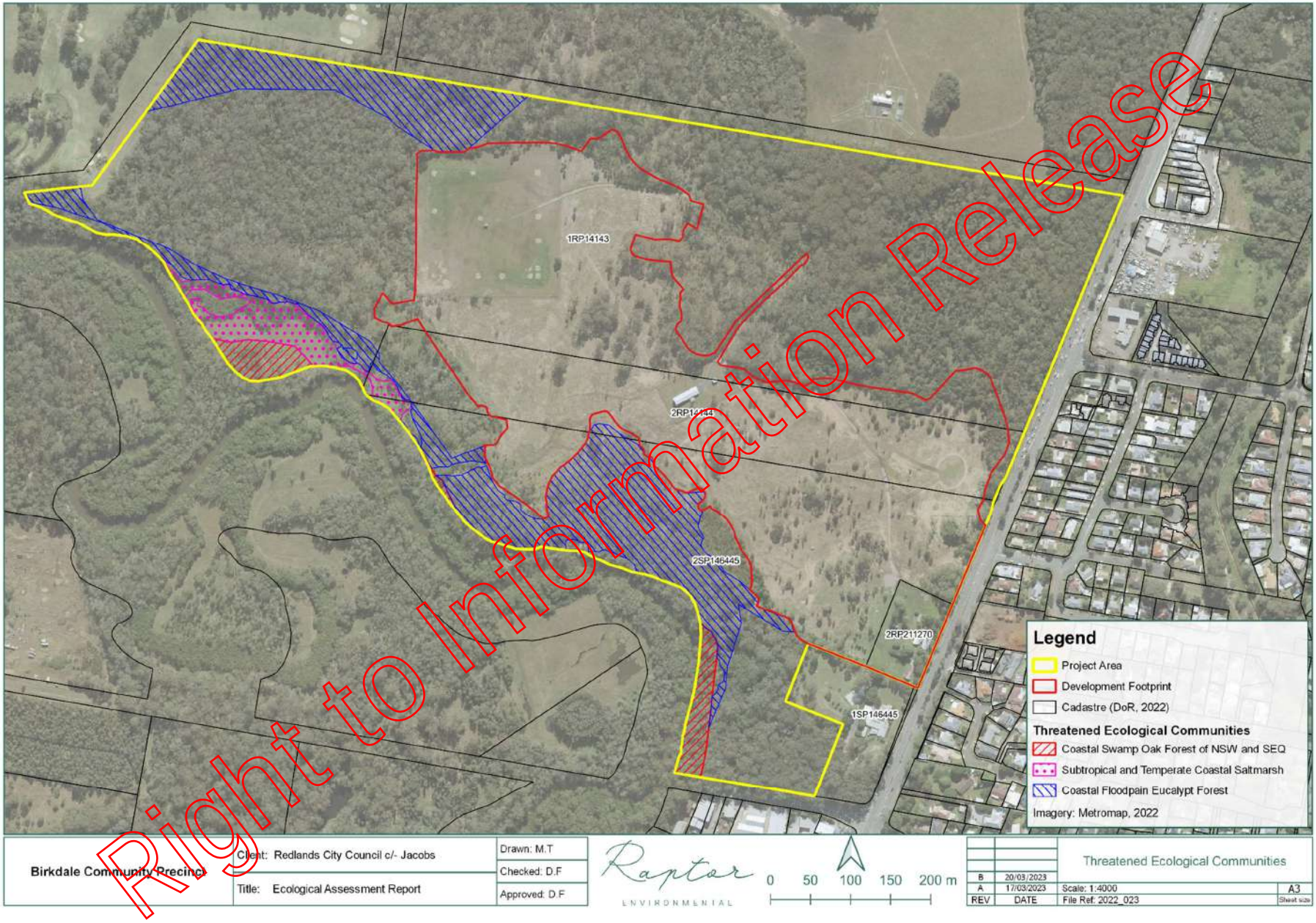

Figure 7. Threatened Ecological Communities within the Project Area.

Site-based considerations relevant to the EPBC Act, including a summary of the findings of the Significant Impact Assessment, are provided in **Table 9.** The Significant Impact Assessment completed for the Project is provided as **Appendix H**.

MNES are addressed for the Project Area by way of a Conservation Agreement entered into with the Commonwealth. The terms of the agreement are, at the time of preparing this EAR, subject to ongoing refinement.

Table 9. Summary of EPBC Act Significant Impact Assessment.

<table>
<tr><th>MNES</th><th>Summary</th><th>Significant Impact</th></tr>
<tr><td colspan="3">Endangered Species and Ecological Communities</td></tr>
<tr><td>Koala (Phascolarctos cinereus)</td><td>The table below includes a comparison of Koala habitat types estimated based on pre-construction and post-construction areas.
<table>
<tr><th>Habitat Category</th><th>Pre-construction (ha)</th><th>Post-construction (ha)</th><th>Reduction of habitat type (ha)</th></tr>
<tr><td>A</td><td>34.43</td><td>32.4</td><td>~1.8</td></tr>
<tr><td>B</td><td>4.8</td><td>1.96</td><td>~2.9</td></tr>
<tr><td>C</td><td>22.8</td><td>4.3</td><td>~18.5</td></tr>
</table>
Koala habitat is protected and retained within the Conservation Area. The Development Footprint impacts 0.2% of the southeast Queensland bioregion population. An overall reduction in the area of occupancy of the Koala is not anticipated as the Project provides opportunities to improve the condition of remaining Category B areas and restore some portions of Category C areas with the long-term aim to enhance these to Category A condition. The Project will also adopt avoidance measures to minimise clearing to the furthest extent practicable. The Project is unlikely to fragment an existing population considering that the southern portion of the Site adjoining the Tingalpa Creek corridor (along the boundary of the Conservation Area) will be retained and enhanced by the Project, and connectivity will be maintained across the Development Footprint during the operational phase.</td><td>Unlikely</td></tr>
<tr><td>Greater glider - southern and central (Petauroides volans)</td><td>The Conservation Area contains habitat attributes suitable for use by the species, such as live and dead hollow-bearing trees for denning, feed trees, large trees and habitat connectivity across the landscape. However, the Development Footprint itself lacks areas of contiguous canopy cover that would limit the capability of the Greater glider to move through the area. As such, the Project is considered unlikely to result in a significant impact on a Greater glider population.</td><td>Unlikely</td></tr>
</table>

MNES	Summary	Significant Impact
Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland Bioregion	The Project does not result in a direct impact to the Subtropical Eucalypt Floodplain Forest TEC which will be protected and retained within the Conservation Area. Potential indirect impacts associated with changes in hydrological regime are managed through the measures outlined in the Stormwater Management Plan including bioretention basins, diversion and treatment swales and a water reuse system and expansive irrigation area. Additional potential indirect impacts such as weed invasion and altered fire regimes are managed through the outcomes of the Conservation Agreement, routine controls, Council's invasive species management program and Council's Parks and Conservation Planned Burn Program, Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP).	Unlikely
Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland	The Project does not result in a direct impact to the Coastal Swamp Oak TEC which will be protected and retained within the Conservation Area. While the Project has the potential to have an indirect impact on the TEC as a result of changes to surrounding hydrology, weeds and fire regime, indirect impacts will be addressed in the outcomes of the Stormwater Management Plan, Conservation Agreement, routine controls, Council's invasive species management program and Council's Parks and Conservation Planned Burn Program, CEMP and OEMP.	Unlikely
Vulnerable Species and Ecological Communities		
South-eastern glossy black cockatoo (*Calyptorhynchus lathami lathami*)	Areas within and surrounding the Project Area are suitable intermittent foraging habitat for the South-eastern glossy black cockatoo. The Development Footprint will require the removal of scattered juvenile Black sheoak; however, the majority of such trees in the Project Area will be protected and retained within the Conservation Area. The Project results in the protection of the Conservation Area and restoration of an area which includes a patch of vegetation dominated by *Casuarina glauca*, restoration of these areas will improve the condition of potential foraging resources for South-eastern glossy black cockatoo. As such, the Project will not reduce the availability of foraging habitat for the species. The Development Footprint contains two hollows with characteristics consistent of those preferred by the South-eastern glossy black-cockatoo. One of the significant hollow-bearing trees will be retained and one will be removed as it was assessed as structurally unsafe to retain within the Development Footprint.	Unlikely
Grey-headed flying-fox (*Pteropus poliocephalus*)	The Conservation Area will be protected and retained for the Project and supports suitable foraging habitat for the Grey-headed flying fox. The Development Footprint supports limited foraging habitat and directly impacts juvenile live foraging trees including scattered winter and	Unlikely

MNES	Summary	Significant Impact
	spring species. The vegetation community in the Development Footprint which will be directly impacted is limited to scattered retained individual trees which are unlikely to represent critical habitat for the Grey-headed flying fox. In addition, two patches of semi-mature and mature eucalypt trees will be retained as part of the design.	
White-throated needletail (*Hirundapus caudacutus*)	Densely wooded habitat within the Conservation Area fill be protected and retained for the Project. The Development Footprint does not contain densely wooded areas that would be considered critical habitat for the species (noting that appropriate habitat is present in the Conservation Area). The species' habitat in Australia consists of non-breeding habitat only. The Development Footprint avoids areas that would be considered 'important habitat' for the species.	Unlikely
Migratory Species		
Rufous fantail (*Rhipidura rufifrons*)	Habitat within the Conservation Area will be protected and retained for the Project. The Project will retain existing vegetation along the northern, western and southern fringes of the Development Footprint and require the removal of scattered trees within an historically cleared area. As such, it will not substantially modify, destroy or isolate an area of habitat for the Rufous fantail (noting that the Development Footprint has been subject to previous modification and therefore does not support what is considered 'important habitat' for the species).	Unlikely
Satin flycatcher (*Myiagra cyanoleuca*)	The species' preferred habitat consists of "*eucalypt forest and woodlands, at high elevations when breeding. They are particularly common in tall wet sclerophyll forest, often in gullies or along water courses. In woodlands they prefer open, grassy woodland types. During migration, habitat preferences expand, with the species recorded in most wooded habitats except rainforests. Wintering birds in northern Queensland will use rainforest - gallery forests interfaces, and birds have been recorded wintering in mangroves and paperbark swamps.*" Such habitat is present along the western and southern extents of the Conservation Area which will be protected and retained for the Project. The Development Footprint avoids areas that would be considered 'important habitat' for the species.	Unlikely

The summary of findings of the Significant Impact Assessment indicate a significant impact on a MNES threatened and migratory species and TEC is unlikely to occur as a result of the Project.

3.2 Matters of State Environmental Significance

Matters of State Environmental Significance (MSES) are an element of the biodiversity state interest defined under the State Planning Policy 2017 (SPP). The following MSES as defined in the SPP are relevant to the Project:

- Threatened wildlife under the *Nature Conservation Act 1992* and special least concern animals under the *Nature Conservation (Animals) Regulation 2020*.
- High risk area on the flora survey trigger as described by the *Environmental Offsets Regulation 2014*.
- Regulated vegetation under the *Vegetation Management Act 1999* that is:
    - category B areas on the regulated vegetation management map, that are 'endangered' and 'of concern' regional ecosystems.
- Marine plants under the *Fisheries Act 1994*.
- Wetlands in a wetland protection area or wetlands of high ecological significance shown on the map of Queensland wetland environmental values under the *Environmental Protection Regulation 2019*.

3.2.1 Threatened Wildlife

3.2.1.1 Fauna

The likelihood of occurrence assessment completed for threatened fauna in accordance with the methodology outlined in **Section 2.1.3** is provided as **Appendix C**.

The results of the likelihood of occurrence assessment for threatened fauna indicates that six species listed under the *Nature Conservation (Animals) Regulation 2020* are 'known' or 'likely' to occur within the Project Area (**Table 10**). Additionally, the Project Area is known to contain the Special Least Concern *Tachyglossus aculeatus* (Short-beaked echidna), which was recorded within the Project Area in the 2020 Cardno study.

Table 10. NC Act-listed fauna species – summarized likelihood of occurrence assessment results.

Scientific Name	Common Name	Status*		Likelihood of Occurrence	Survey Year	
		NC Act	EPBC Act		2022	2020
Aves						
Hirundapus caudacutus	White-throated needletail	V	V, Mi	Likely	-	-
Calyptorhynchus lathami lathami	South-eastern glossy black-cockatoo	V	V	Likely	-	--
Myiagra cyanoleuca	Satin flycatcher	SL	Mi	**Known**	**Y**	**-**

Scientific Name	Common Name	Status*		Likelihood of Occurrence	Survey Year	
		NC Act	EPBC Act		2022	2020
Rhipidura rufifrons	Rufous fantail	SL	Mi	**Known**	**Y**	-
Mammals						
Phascolarctos cinereus	Koala	E	E	**Known**	**Y**	**Y**
Tachyglossus aculeatus	Short-beaked echidna	SL	-	**Known**	-	**Y**

Under the *Nature Conservation (Koala) Conservation Plan 2017* (Koala Plan), the Koala Conservation Plan Map shows Koala Priority Areas and Koala Habitat Areas. The main purpose of Koala Priority Areas is to strategically focus long-term management and monitoring efforts on areas that have the highest likelihood of achieving conservation outcomes for Koalas. In addition, the purpose of Koala habitat areas is to avoid impacts on Koala habitat to ensure the long-term persistence of koala populations in the wild.

The entirety of the Project Area is mapped within a Koala Priority Area. Areas within the Project Area that contain Regulated Vegetation are also mapped as 'Core Koala Habitat' (**Appendix C**). This also includes small sections of vegetation within the Development Footprint.

A total of 77 fauna species were recorded during the contemporary fauna survey including:

- 4 amphibians
- 53 birds
- 14 mammals
- 6 Reptiles

A full list of the fauna species (91 in total) identified within the Project Area in 2020 and 2022 is provided as **Appendix I**. The list includes those species previously identified in Cardno, 2020.

The contemporary fauna survey resulted in the following:

- Two reptiles recorded within pitfall traps including Least Concern *Lampropholis guichenoti* (Garden skink) (**Plate 15**) and Least Concern *Calyptotis scutirostrum* (Scute-snouted calyptotis) (**Plate 16**).
- Elliott trapping resulted in captures of the pest species *Rattus rattus* (Black rat) within survey site 1.
- Spotlighting surveys recorded seven species including Least Concern *Podargus strigoides* (Tawny frogmouth) (**Plate 17**) and Least Concern *Pteropus alecto* (Black flying fox).
- Anabat records identified four species of Least Concern microbats.

- The diurnal searches resulted in a diversity of Least Concern avifauna including grassland, urban specialists, open forest (**Plate 18**), water birds, marine and migratory birds (**Plate 19, Plate 20** and **Plate 21**).
- Opportunistic searches recorded scats of the Endangered *Phascolarctos cinereus* (Koala) (**Plate 22**).

The Project Area also supports a wide diversity of uncommon Least Concern bird species, such as the *Aviceda subcristata* (Pacific baza), *Todiramphus macleayii* (Forest kingfisher) and the *Turnix maculosus* (Red-backed button quail).

Plate 15: Garden skink recorded from pitfall trapping.

Plate 16: Scute-snouted calyptotis recorded from pitfall trapping.

Plate 17: Tawny frogmouth perching during spotlighting survey.

Plate 18: Red backed fairy wren utilising grassland habitat within the Development Footprint.

Plate 19: Satin flycatcher catcher recorded within woodland.

Plate 20: Rainbow bee-eater.

Plate 21: Rufous fantail.

Plate 22: Koala scats recorded in survey site 1.

3.2.1.2 Fauna Habitat

The habitat assessment identified 39 habitat features within the Development Footprint and vehicle access roads, including:

- ten hollow-bearing trees (three of which are significant habitat trees) (**Plate 23 and Plate 24**);
- 14 arboreal termitaria;
- two burrows;
- two hollow logs (fallen);
- five nests;
- one drey; and
- one stag.

The locations of discrete habitat features are shown on **Figure 8**. General habitat assessments were completed at the survey sites (**Figure 3**). Detailed information collected during the habitat feature survey is provided in **Appendix F**.

A gully is located within the southern portion of the Development Footprint, which includes marine plants 4 m to the west of the Development Footprint. The gully, above areas of tidal influence, provides suitable habitat for Least Concern frog species, such as the Eastern sedge frog (*Litoria fallax*), Peron's tree frog (*Litoria peronii*) and Striped marsh frog (*Limnodynastes peronii*), all of which were heard calling from this area during nocturnal surveys (**Plate 25**). A historic weir was noted along the gully however the weir allows tidal water upstream and no longer serves the function of a significant tidal barrier (**Plate 26**).

Plate 23: Significant habitat tree bearing multiple large hollows is located to the east of the proposed wetland area.

Plate 24: Hollow-bearing tree within the Development Area.

Plate 25: The northern extent of the gully within the Development Footprint includes minor ponding enhanced in some areas within vehicle tracks.

Plate 26: Historic tidal weir located within the tidal extent of the gully.

The Project Area contains one Endangered species, the Koala, listed under the *Nature Conservation Act 1992* and subordinate *Nature Conservation (Animals) Regulation 2020.* It also provides habitat for the Special Least Concern species or Least Concern Colonial Breeding Species including:

- Special Least Concern - Short-beaked echidna.
- Special Least Concern - Rufous fantail.
- Special Least Concern - Satin flycatcher.
- Colonial Breeder - Little bent-wing bat (*Miniopterus australis*).
- Colonial Breeder - White-striped freetail bat (*Austronomus australis*).

With respect to fauna, the DES Information sheet: Species Management Program Requirements for tampering with a protected animal breeding place in Queensland provides additional guidance relating to Species Management Programs (SMP). An SMP – Low Risk of Impacts is required for tampering with the breeding spaces of Least Concern species. An SMP – High Risk of Impacts is required for any proposed activity that will impact on breeding places of protected animals that are classified as Critically Endangered, Endangered, Vulnerable, Near Threatened (CEEVNT), Special Least Concern, or as a Least Concern Colonial Breeding species.

Given the known presence of Endangered, Special Least Concern and Least Concern colonial breeding species within the Project Area, an SMP – High Risk of Impacts will be required for the abovementioned species.

The *Planning Regulation 2017* provides the regulatory framework for the management of Koala Habitat as described in the *Nature Conservation (Koala) Plan 2017.* Schedule 10, Part 10, Division 2, sub-part 16A of the *Planning Regulation 2017* states that:

(1) "Development is prohibited development to the extent the development involves interfering with koala habitat in an area that is both—
- *a koala priority area; and*
- *a koala habitat area."*

(2) However, subsection (1) does not apply to the extent the development—
- *(a) is exempted development; or*
- *(b) is assessable development under section 16C; or*
- *(c) is in an identified koala broad-hectare area and is—*
  - *(i) accepted development, or assessable development, under a local categorising instrument, other than development that is for an extractive industry and is not assessable development under section 16C; or*
  - *(ii) development under part 14, division 1, section 21; Vegetation management Act 1999.*

According to Schedule 24 of the *Planning Regulation 2017*, the definition of 'exempted development' includes: "*development for infrastructure stated in schedule 5, if the development is carried out by or for the State or a public sector entity*."

The Project will be carried out by a public sector entity (RCC) and will proceed under a Local Government Infrastructure Designation (LGID) application. As part of this process, RCC would designate the Project as a type of infrastructure listed in Schedule 5 of the *Planning Regulation 2017* (i.e. community and cultural facilities, including community centres, galleries, libraries and meeting halls – or – facilities for parks and recreation). If the LGID is successful, the Project would be considered exempt from the requirements listed in

Schedule 10 of the *Planning Regulation 2017*. If this does not occur, the Project would be considered prohibited development.

Irrespective of the above, the Project is located within a Koala District A Area. As such, the Project must comply with the Koala-spotter requirements and sequential clearing conditions specified in the *Nature Conservation (Koala) Plan 2017*.

The sequential clearing conditions are listed in Part 3, sub-part 10 of the Koala Plan as stated below:

a) *clearing of the koala habitat trees is carried out in a way that ensures koalas on the area being cleared (the clearing site) have enough time to move out of the clearing site without human intervention, including, in particular, for clearing sites with an area of more than 3ha, by—*

   i. *carrying out the clearing in stages; and*

   ii. *ensuring not more than the following is cleared in any 1 stage—*

      (A) for a clearing site with an area of 6ha or less—50% of the site's area;

      (B) for a clearing site with an area of more than 6ha—3ha or 3% of the site's area, whichever is the greater; and

   iii. *ensuring that between each stage and the next there is at least 1 period of 12 hours starting at 6p.m. on a day and ending at 6a.m. on the following day during which no trees are cleared on the site;*

b) *clearing of the koala habitat trees is carried out in a way that ensures, while the clearing is carried out, appropriate habitat links are maintained within the clearing site and between the site and its adjacent area, to allow koalas living on the site to move out of the site;*

c) *no koala habitat tree in which a koala is present, and no koala habitat tree with a crown overlapping a tree in which a koala is present, is cleared.*

The Koala spotter requirements are provided in Part 3, sub-part 11 of the Koala Plan. These requirements apply *"to a person clearing, in a koala habitat area, koala habitat trees having a trunk of a diameter of more than 10cm at 1.3m above the ground."* A Koala spotter is defined as, "*a person who has qualifications and experience, or demonstrated skills and knowledge, in locating koalas in koala habitats; or conducting arboreal fauna surveys.*" The person clearing must ensure the clearing is carried out in the presence of a Koala spotter who has the primary role of locating Koalas in the trees for the person (i.e. in addition to a fauna spotter). The Wildlife Habitat Management Plan details the mitigation measures for fauna during the project phases (refer to **Appendix J**).

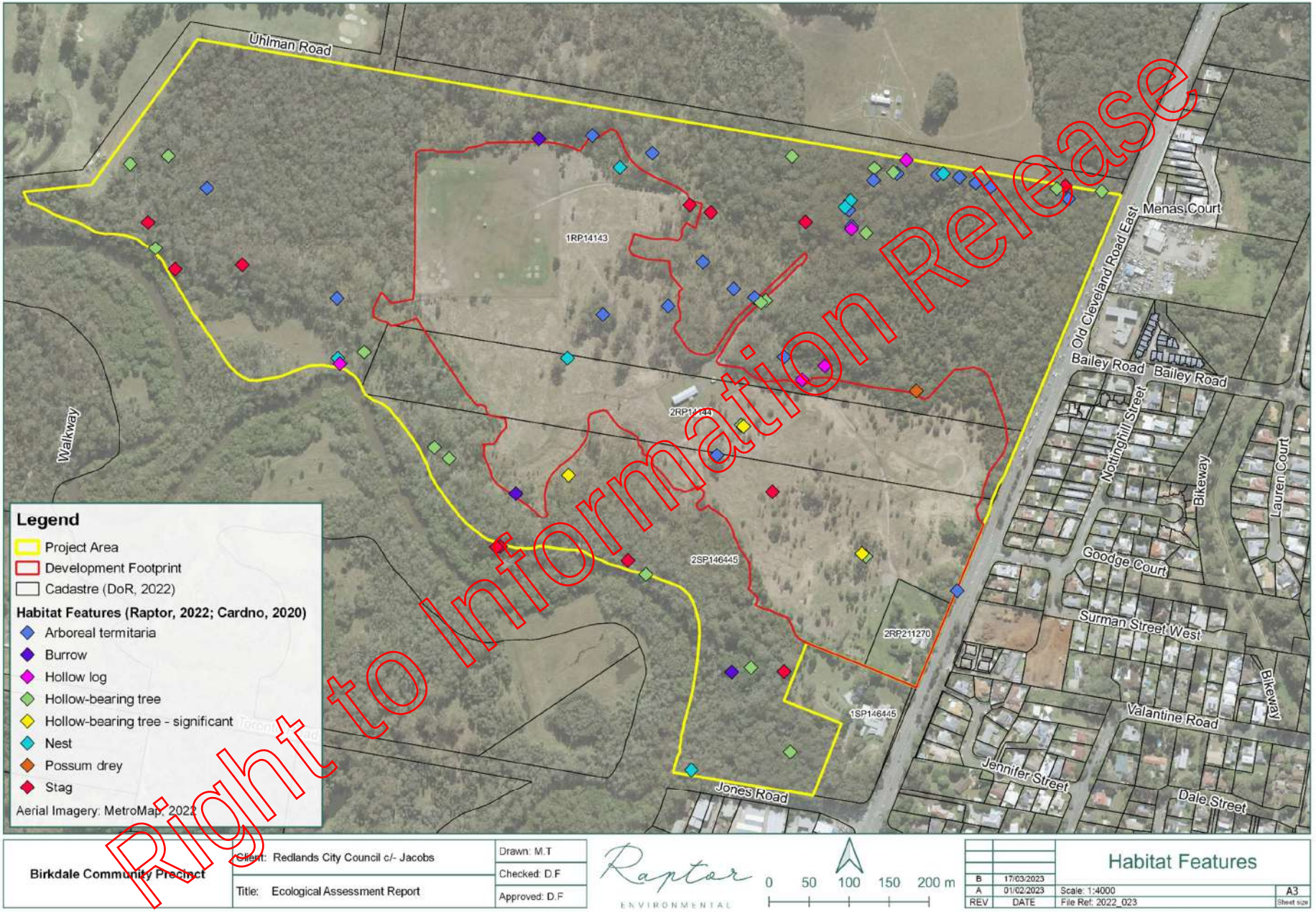

Figure 8. Habitat Features.

3.2.1.3 Flora

The likelihood of occurrence assessment completed for threatened flora in accordance with the methodology outlined in **Section 2.1.3** is provided as **Appendix C**.

The results of the likelihood of occurrence assessment for threatened flora indicates that no species are 'known' or 'likely' to occur within the Project Area. The Wildlife Online database returned two threatened flora species listed under the *Nature Conservation (Plants) Regulation 2020* that have previously been recorded within 3km of the Project Area, the Endangered *Melaleuca irbyana* and Special Least Concern *Najas tenuifolia* (Water Nymph) (**Table 11**). These species are considered unlikely to occur within the Project Area because:

- Reliable *Melaleuca irbyana* records have been made approximately 1.5km upstream from the Project on the southern bank on Tingalpa Creek. Despite previous search efforts (i.e. Cardno, 2020), in addition to the present study, the species was not found to occur within the Development Footprint and is considered highly unlikely to occur within the Conservation Area.
- A reliable *Najas tenuifolia* record has been made approximately 2.5km to the northeast of the Project. Searches of ephemeral water bodies on the southern edge of the Development Footprint did not reveal the Water nymph to be present.

Table 11. Flora species – summarized likelihood of occurrence assessment results.

Scientific Name	Common Name	Status*		Likelihood of Occurrence
		NC Act	EPBC Act	
Melaleuca irbyana	Swamp tea-tree	E	-	Unlikely
Najas tenuifolia	Water nymph	SL	-	Unlikely

*Nature Conservation Act 1992: CR; Critically Endangered; E = Endangered; V = Vulnerable; SL = Special Least Concern; C = Least Concern.

Environment Protection and Biodiversity Conservation Act 1999: CE = Critically Endangered; E = Endangered; V = Vulnerable.

The flora inventory conducted within the Development Footprint identified 104 flora species, including 28 exotic species. None of the species recorded are listed as threatened flora species listed under the *Nature Conservation Act 1992* and subordinate *Nature Conservation (Plants) Regulation 2020* were identified during the ecological surveys conducted in 2020 and 2022 (Cardno, 2020 and the present study).

Portions of the Development Footprint are mapped within the High-risk area on DES's Protected Plants Trigger Map. No threatened flora species listed under the *Nature Conservation Act 1992* and subordinate *Nature Conservation (Plants) Regulation 2020* were identified during the ecological surveys conducted in 2020 and 2022 (Cardno, 2020 and the present study). Portions of the Development Footprint are mapped within the High-risk area on DES's Protected Plants Trigger Map.

Pursuant to Section 141 of the *Nature Conservation (Plants) Regulation 2020*, "*the person must give a flora survey report to the chief executive before the person starts clearing; and (b) no later than 12 months after the flora survey undertaken for the report was completed*." Given that a portion of the Development Footprint is located within a High-risk area, a

protected flora survey must be completed for the Project. The survey must be undertaken no more than 12 months prior to the commencement of clearing activities. If protected flora species are identified within the Project Area (and associated 100 m buffer), the Project will require preparation of an Impact Management Plan an application for a Protected Plants Clearing Permit. If no protected flora species are identified during the survey, the Project must submit an Exempt Clearing Notification.

3.2.1.4 Landscape Context and Ecological Corridors

In a regional context, the Project Area forms part of the South-east Queensland Regional Biodiversity Corridor under ShapingSEQ (Department of Infrastructure, Local Government and Planning, 2017). The regional corridor links with the mouth of the Lagoon River to the south and extends north through Mt Cotton (including Venman Bushland National Park), Tingalpa Reservoir and to the outfall of Tingalpa Creek into Moreton Bay. Under Shaping SEQ the Project Area and surrounds to the west are within the Regional Landscape and Rural Production Area and the area to the west is within the Urban Footprint Land-use category (**Figure 9**).

At a local catchment level the Lower Tingalpa and Coolnwynpin Creek Catchment is approximately 34.4km^2 and starts to the south of Mt Cotton Road and transverses through Mt Cotton, Capalaba, Alexandra Hills, Birkdale and Thorneside before out falling into Moreton Bay at Waterloo Bay (Redland City Council, 2023).

Under RCC's Koala Conservation Program 2022-2027, Koala Safe Neighbourhoods are established as a collaboration between RCC and the local community to reduce the threats to Koalas (Redland City Council, 2021). The criteria for establishing a Koala Safe Neighbourhood includes a known koala population, evidence of koala strike on roads and habitat that can support koalas. The Birkdale koala safe neighbourhood is located 700 m north-east of the Project Area (**Figure 9**). Similar to the Koala Safe Neighbourhood actions, the design has integrated signage as well as reduced speed limits to minimise the risk of vehicle strike (refer to **Section 4.2.1**).

The Project Area is located along Tingalpa Creek and plays a significant role in the Regional Biodiversity Corridor and local creek ecological corridor. A review of historical imagery indicates the balance of the Project Area including the Development Footprint was cleared (as shown in the 1946 aerial imagery (**Appendix A**)), however clearing likely occurred earlier to accommodate the historical use of the property as a World War 2 radio receiving station. Prior to historical disturbance, the entire Project Area would have supported well vegetated areas providing high quality habitat for local fauna. Historical clearing and land use within the Development Footprint has reduced vegetation cover, habitat quality and connectivity value.

The Project Area contains existing barriers/impediments to fauna movement including existing barbed wire-fencing (eastern and northern boundaries) and fauna barrier fencing (northern and western boundaries). Koala exclusion is located to the south and along a portion of the eastern extent of the Project Area. Old Cleveland Road East adjoins the eastern boundary of the Project Area and in a four-lane carriage arterial road (**Figure 9**). The design has integrated fauna-friendly and exclusion fencing as outlined in **Section 4.2.1**.

The vegetation within the Conservation Area supports the significant ecological corridor and habitat and foraging resources for native species including threatened species (i.e. Koala). The Development Footprint is predominately cleared and contains scattered patches of retained canopy trees and scattered juvenile native canopy trees. The Development

Footprint supports movement opportunities for native species including Koala and limited habitat and foraging resources.

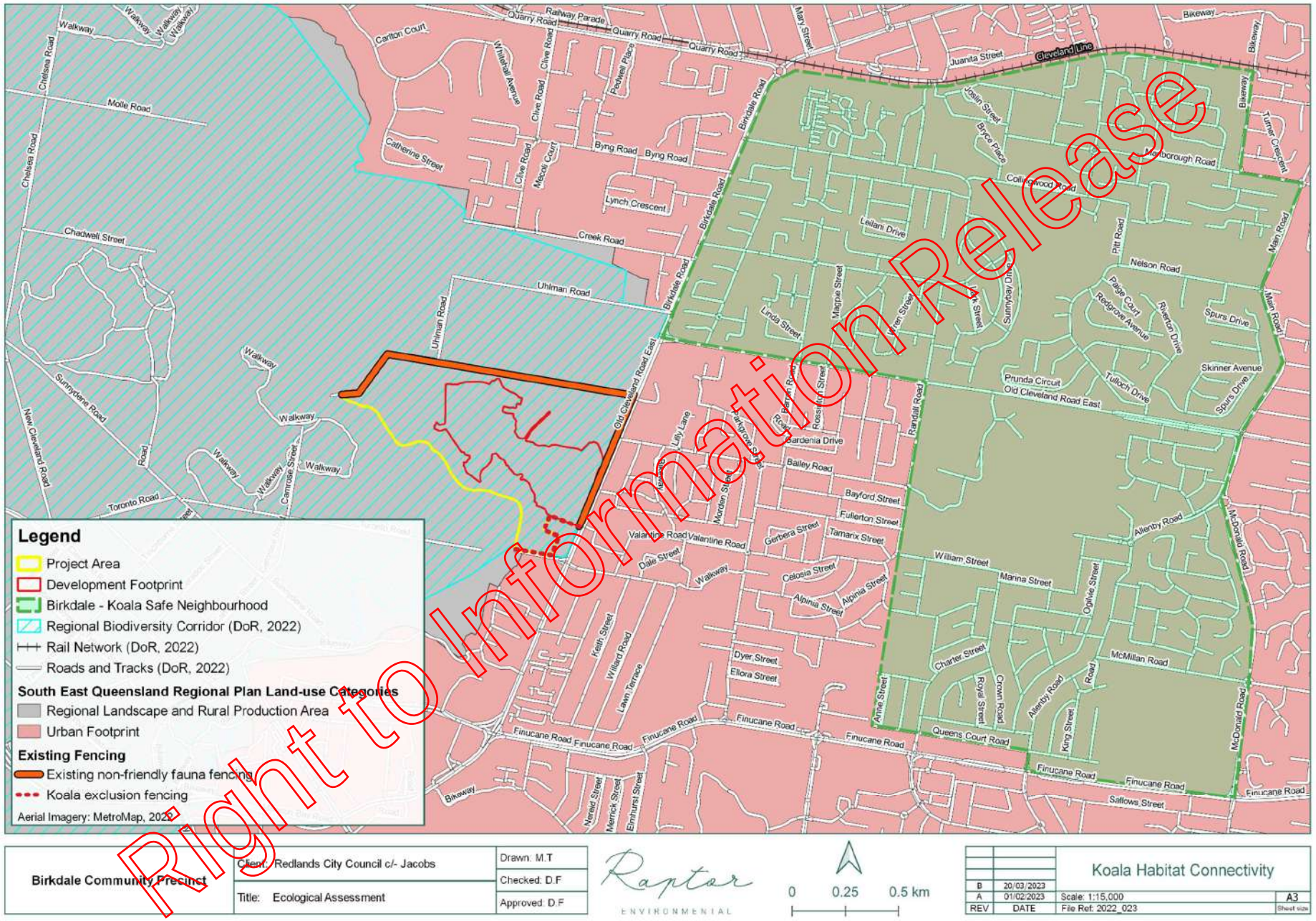

Figure 9. Landscape Context.

3.2.2 Regulated Vegetation

Queensland's DoR Vegetation Management Property Report and Regulated Vegetation Map identifies the Project Area as supporting Category C (High-value Regrowth) and Category X (non-remnant vegetation), as illustrated in **Appendix A** and **Figure 10**. According to the Regulated Vegetation Map, the Development Footprint supports the following areas of mixed-RE patches, including:

- 1.381 ha of Category C (of Concern) RE 12.3.11/12.3.6
- 0.009 ha of Category C (Endangered) RE 12.5.3/12.5.2a.
- 0.068 ha of Category C (Endangered) RE 12.5.2a/12.5.3/12.3.6.

A description of these REs from the Regional Ecosystem Description Database (REDD, 2021), is provided in **Table 12,** below.

Table 12. Regional Ecosystem descriptions as provided in the REDD.

RE Code	VMA Class	Description	Structure Category
12.3.11	Of Concern	*Eucalyptus tereticornis +/- Eucalyptus siderophloia, Corymbia intermedia open forest on alluvial plains usually near coast*	Mid-dense
12.3.6	Least Concern	*Melaleuca quinquenervia +/- Eucalyptus tereticornis, Lophostemon suaveolens, Corymbia intermedia open forest on coastal alluvial plains*	Mid-dense
12.5.3	Endangered	*Eucalyptus racemosa subsp. racemosa woodland on remnant Tertiary surfaces*	Sparse
12.5.2a	Endangered	*Corymbia intermedia, Eucalyptus tereticornis woodland. Other species can include Lophostemon suaveolens, Angophora leiocarpa, Eucalyptus acmenoides or E. portuensis, E. siderophloia or E. crebra, Corymbia tessellaris and Melaleuca quinquenervia (lower slopes).*	Mid-dense

The Regional Ecosystem Review undertaken by Cardno in 2021 provided a refined regional ecosystem map that included the boundaries of ground-truthed remnant and regrowth REs within the Project Area (**Figure 11** and **Appendix B**). The current study relied on the information provided in the Regional Ecosystem Review (Cardno, 2021) and refined this mapping to include the patch of regrowth RE 12.3.20 located adjacent to the Development Footprint. According to the refined RE mapping, the Development Footprint would involve the removal of the following areas of regrowth RE:

- 12.3.11 (0.511 ha);
- 12.5.3 (0.828 ha); and
- 12.5.7 (0.026 ha).

The *Vegetation Management Act 1999* provides a framework for the description, identification and mapping of Regulated Vegetation. It aims to prevent land degradation, maintain biodiversity, preserve ecological processes, and promote Ecologically Sustainable

Development (ESD) through various mechanisms including through the State Assessment and Referral Agency (SARA) Development Assessment process.

Schedule 21, Part 1 of the *Planning Regulation 2017* outlines the exemptions for clearing of Regulated Vegetation. Subpart 1 provides the exemptions for clearing of vegetation on land, which includes clearing that is:

> (14) "***Clearing vegetation for the construction or maintenance of infrastructure stated in schedule 5, if—***
> *(a)* ***the clearing is on designated premises****; or*
> (b) *the infrastructure is government supported transport infrastructure.*"

The Project is currently undergoing a LGID. As part of this process, RCC would designate the Project as a type of infrastructure listed in Schedule 5 of the *Planning Regulation 2017*. If the LGID is successful, the Project would be considered exempt clearing work.

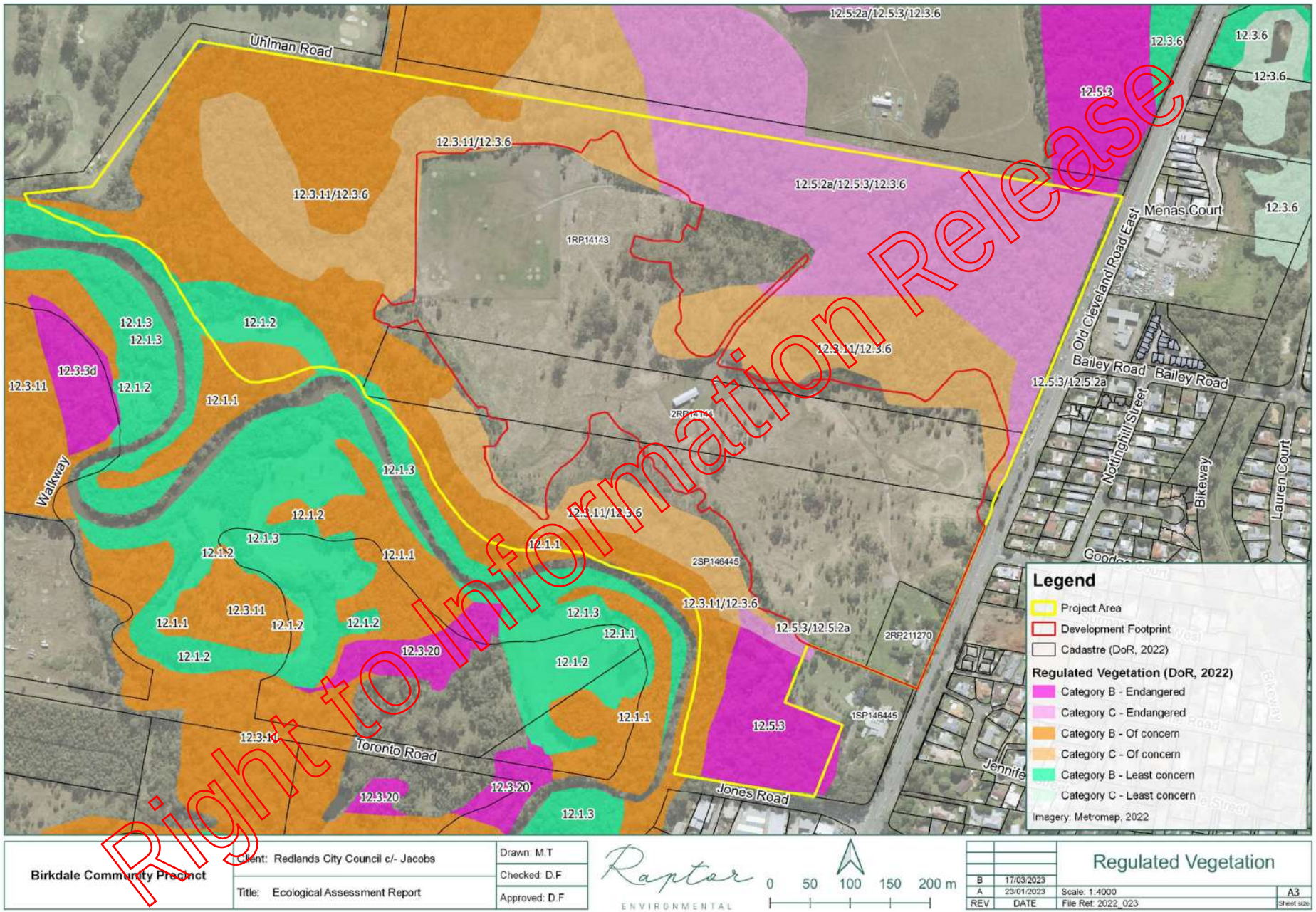

Figure 10. Regulated Vegetation within and surrounding the Project Area.

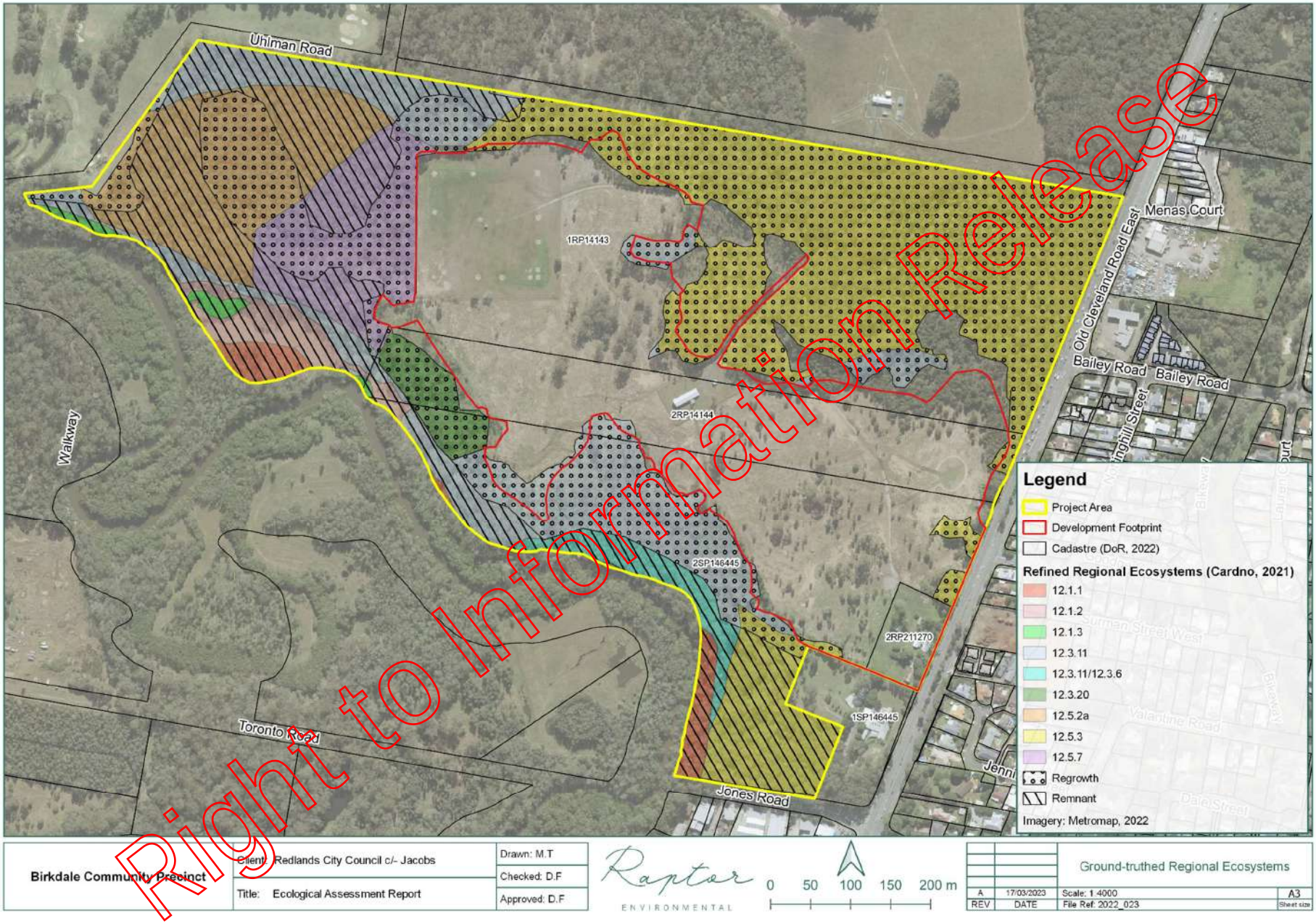

Figure 11. Ground-truthed Regional Ecosystems within the Project Area.

3.2.3 Marine Plants

The proposed kayak launch and pontoon is located to the south of the Project Area within Tingalpa Creek which is mapped as a Tidal Waterway and under Highest Astronomical Tide (HAT).

The proposed Kayak and canoe launch facility and pontoon is located within a mapped Tidal Waterway; however, a pontoon is not considered waterway barrier works. The proposed Kayak and canoe launch facility and pontoon location was confirmed during the field assessment to ensure impacts are minimised. As a result, the proposed Kayak and canoe launch facility is located in a cleared area on an eroding riparian bank. Legislative Considerations

The purpose of the *Fisheries Act 1994* is to provide for the use, conservation and enhancement of the community's fisheries resources and fish habitats in a way that seeks to apply and balance the principles of ecologically sustainable development and promote ecologically sustainable development. The *Fisheries Act 1994* regulates development considered Waterway Barrier Works and disturbance to Marine Plants.

The Kayak and canoe launch facility will impact marine plants and a response to State Development Assessment Provisions (SDAP) Code 11: Removal, destruction or damage of marine plants supported by a marine plant disturbance plan will be required. A Marine Plant Disturbance Plan was prepared to support the SDAP Code 11 (**Appendix K**).

3.2.4 Wetlands

The Project Area is located adjacent to an 'MSES high ecological significance (HES) wetland', analogous with Tingalpa Creek and the proposed Kayak and canoe launch facility is within the HES wetland (**Appendix A**). High ecological significance wetlands are identified as MSES under the Planning and Environmental Offsets legislation. Works within an HES wetland within a designated Wetland Protection Area may trigger development assessment.

The objective of the *Environmental Protection Act 1994* and subordinate *Environmental Protection Regulation 2008* is to protect Queensland's environment while allowing for development that improves the total quality of life in a way that maintains ecological processes.

As the Project Area is located outside of a Wetland Protection Area, development assessment is not triggered for the Project. With the exception of the Kayak and canoe launch facility, the current iteration of the Development Footprint avoids the mapped HES wetland located adjacent to the Project Area. However, the Kayak and canoe launch facility is strategically located within a cleared and eroding section of Tingalpa Creek.

The proposed infrastructure associated with the Kayak and canoe launch facility will include measures to stabilise and rehabilitate the eroding bank. General erosion and sediment control will also be managed through the Project's Erosion and Sediment Control Plan.

3.2.5 Pests and Weeds

The contemporary weed survey mapped 37 occurrences of weeds including eight restricted weed species listed under the *Biosecurity Act 2014*. Restricted weed species identified include:

- Aspargus fern (*Asparagus aethiopicus*)
- Camphor laurel (*Cinnamomum camphora*)
- Creeping lantana (*Lantana montevidensis*)
- Fireweed (*Senecio madagascariensis*)
- Giant Paramatta grass (*Sporobolus fertilis*)
- Lantana (*Lantana camara*)
- Mother-of-millions (*Bryophyllum delagoense*)
- Broad-leaved pepper tree (*Schinus terebinthifolius*)
- Prickly pear (*Opuntia stricta*)

The locations where weed species listed under the *Biosecurity Act 2014* are present relatively abundant are shown on **Figure 12**. The results of the weed survey, including estimated densities of infestations are provided as **Appendix L**.

A single declared pest fauna species *Vulpes vulpes* (European red fox) (**Plate 27**) was detected within the Development Footprint as evidenced through camera trap data. Foxes were also detected in the previous ecological assessment (Cardno, 2020).

Plate 27: European red fox recorded within proximity to survey site 2 through camera trap data.

The *Biosecurity Act 2014* imposes a general biosecurity obligation on persons dealing with biosecurity matters to prevent and/or minimise the impact of biosecurity risks on human health, social amenity, the economy and the environment. A general biosecurity obligation requires that all reasonable and practical measures are taken to prevent or minimise biosecurity risk and that actions are taken to prevent exacerbation of the adverse effects of biosecurity matter. With respect to these points, the *Biosecurity Act 2014* specifically notes that the requirement to manage the impact of invasive plants and animals on a person's land.

Whilst a comprehensive weed and pest survey was not completed within the Project Area, the below-listed restricted weed and animal species under the *Biosecurity Act 2014* were identified within the Development Footprint (Raptor Environmental, 2023 and Cardno, 2020):

- Asparagus fern (*Asparagis aethiopicus*).
- Camphor laurel (*Cinnamomum camphora*).
- Creeping lantana (*Lantana montevidensis*).
- Fireweed (*Senecio madagascariensis*).
- Giant Paramatta grass (*Sporobolus fertilis*).
- Lantana (*Lantana camara*).
- Mother-of-millions (*Bryophyllum delagoense*).
- Broad-leaved pepper tree (*Schinus terebinthifolius*).
- Prickly pear (*Opuntia stricta*).
- European red fox (*Vulpes vulpes*).

The Project must undertake all reasonable and practical measures to prevent or minimise biosecurity risk, including the spread of weed and pest animal species. Management and mitigation measures for weeds and pests are to be included in the CEMP.

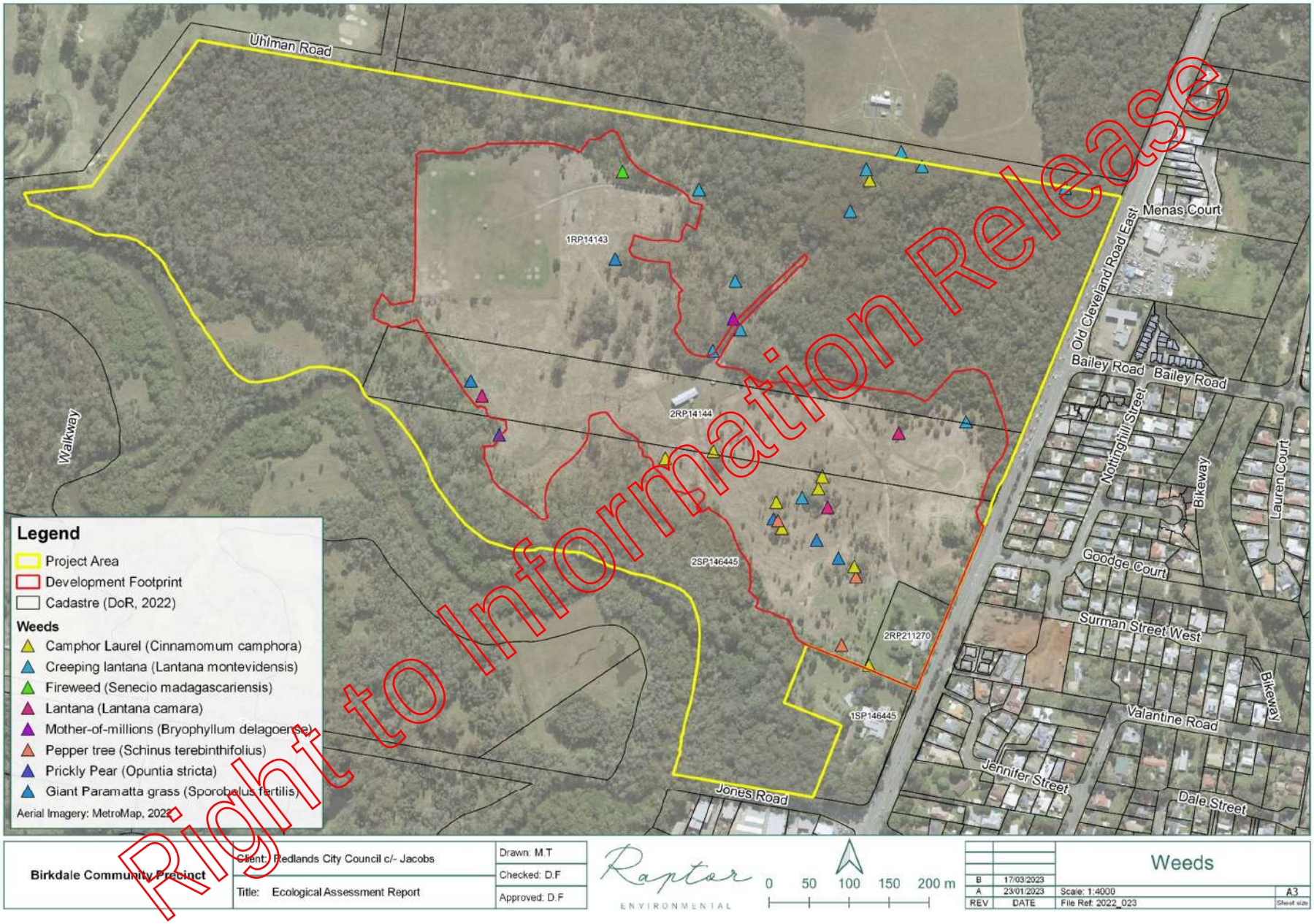

Figure 12. Weeds recorded within the Development Footprint.

3.3 Matters of Local Environmental Significance

Redland City Council Planning Scheme Environmental Significance Planning Scheme Policy describes MLES generally as habitat for particular species (i.e. Locally significant species (listed in Appendix 1 of the Policy)). Relevant to the Project is the South-eastern glossy black cockatoo which is listed as a locally significant fauna species considered 'likely' to occur within the Project Area. Habitat suitability for the South-eastern glossy black cockatoo is discussed in Section **3.1.1.2** above.

The flora and fauna species recorded as part of the surveys (Raptor Environmental, 2022 and Cardno, 2020) are not listed as Locally significant species under the *Environmental Significance Planning Scheme Policy.* MLES species and/or suitable supporting habitat are not present within the Development Footprint (refer to **Section 3.3**).

Pursuant to the *Redland City Plan 2018* (Version 7), the land parcels within the Project Area are zoned as follows:

- Lot 1 on RP14143 and Lot 2 on RP14144 - Community Facilities and Conservation.
- Lot 1 on SP146445 – Community Facilities.
- Lot 2 on RP211270) - Low Density Residential.

The Project Area also falls within various planning overlays. Relevant environmental overlays that are present within all, or part, of the Project Area include:

- Redland City Council (RCC) Koala Habitat, including the following sub-categories:
    - RE Remnant Koala Habitat
    - RE Regrowth Koala Habitat
    - Urban Non Koala Habitat
- RCC Regional Ecosystems, including the following sub-categories:
    - Endangered
    - Of Concern
- RCC Non Regional Ecosystem Habitat, including the following sub-category:
    - Urban Trees
- Bushfire Hazard Overlay, including the following sub-categories:
    - High Potential Bushfire Intensity
    - Medium Potential Bushfire Intensity
    - Potential Impact Buffer
- Coastal Protection Overlay, including the following sub-categories:
    - Erosion Prone Area
    - Coastal Management District

- Environmental Significant Overlay, including the following sub-categories:
    - MSES
    - MLES
- Flood and Storm Tide Hazard Overlay, including the following sub-categories:
    - 2016 Storm Tide Inundation Area
    - 2100 Storm Tide Inundation Area
    - Flood Prone Area
- Landslide Hazard Overlay, including the following sub-categories:
    - Medium
    - Low
- Waterway Corridors and Wetlands Overlay

Council will process under a LGID application and, if approved by the minister, will be incorporated into the local planning scheme. Chapter 8 of the Minister's Guidelines and Rules (Queensland Government, 2020) details the process for making a LGID which includes providing an acknowledgment of relevant planning instruments and how they relate to the proposal. The LGID will provide a response to relevant overlay codes using the information within this EAR.

4 Ecological Impact Assessment

4.1 Potentially Degrading Impacts

Potentially degrading impacts associated with the Project are listed in **Table 13**, below.

Table 13. Potentially degrading impacts associated with the Project.

Project Phase	Potentially Degrading Impact	Relevant Matters	Recommended Mitigations
Planning	Failure to integrate retention of LIKT into the design, resulting in increased fragmentation of the local Koala population.	MNES – Threatened Species (Koala) MSES – Threatened Species (Koala) and habitat	Refer **Table 14**, item 1
	Failure to consider fauna movement patterns into the design, resulting in decreased movement through the landscape for resident fauna populations.	MNES – Threatened and Migratory Species MSES – Threatened Species	Refer **Table 14**, item 2
	Loss of areas that could be restored to support TECs found elsewhere in the Project Area.	MNES – Threatened Ecological Communities	Refer **Table 14**, item 3
	Loss of significant habitat trees, resulting in a loss of breeding and sheltering habitat for fauna.	MSES – Threatened Species	Refer **Table 14**, item 4
Clearing and Construction	Likely impacts to habitat for an MNES and MSES species, the Endangered Koala. This includes the loss of: • Koala habitat type A ~ 1.8 ha; • Koala habitat type B ~ 2.9 ha; and • Koala habitat type C ~ 18.5 ha.	MNES – Threatened Species (Koala) MSES – Threatened Species (Koala) and habitat	Refer **Table 15**, item 1
	Possible mortality of fauna during clearing activities.	MNES – Threatened Species MSES – Threatened Species	Refer **Table 15**, item 1
	Adoption of improper erosion and sediment control measures, resulting in indirect impacts TECs.	MNES – Threatened Ecological Communities	Refer **Table 15**, item 1

Project Phase	Potentially Degrading Impact	Relevant Matters	Recommended Mitigations
	Removal of areas of regulated vegetation pursuant to the *Vegetation Management Act 1999*, including: • 1.381 ha of Category C (of Concern) RE 12.3.11/12.3.6 • 0.009 ha of Category C (Endangered) RE 12.5.3/12.5.2a. • 0.068 ha of Category C (Endangered) RE 12.5.2a/12.5.3/12.3.6.	MSES – Regulated Vegetation	Refer **Table 15**, item 1
	Possible unlawful removal of marine plant vegetation.	MSES – Marine Plants	Refer **Table 15**, items 1, 9 and 10
	Possible loss of animal breeding spaces (i.e. hollow-bearing trees).	MSES – Threatened Species	Refer **Table 15**, item 1
	Elevated noise and light levels within the Project Area, resulting in a temporary decrease in habitat quality.	MNES – Threatened Species MSES – Threatened Species	Refer **Table 15**, Items 7 and 8
	Elevated noise and light levels, leading to disruptions to the breeding cycles of resident fauna, resulting in reduced breeding success.	MNES – Threatened Species MSES – Threatened Species	Refer **Table 15**, Items 7 and 8
Operational	Changed hydrological regime for the area, resulting in indirect impacts to the Swamp Oak TEC.	MNES – Threatened Ecological Communities	Refer **Table 14,** item 3 and **Table 15**, items 9 and 10
	An increase in land-use intensity for the area, resulting in the potential introduction of weeds, pest animals and other threatening processes.	MSES – Restricted Weeds	Refer **Table 15**, items 9 and 10
	Changed lighting regime for the area, resulting in a decrease in habitat quality for resident fauna.	MNES – Threatened Species MSES – Threatened Species	Refer **Table 15**, Items 7 and 8

4.2 Impact Mitigation Measures

4.2.1 Design Phase Recommendations

Design-phase recommendations were provided in the early design phase for the Project. The design recommendations integrated into the Master Plan and are summarised in **Table 14**, below.

Table 14. Incorporated design-phase recommendations for the Project.

Number	Element	Integration in design
1	Koala habitat	The design retains Koala habitat Categories A and B (see **Figure 6**) area where possible within the Development Footprint. The Landscape Plan includes revegetation areas adjoining and buffering the Conservation Area as well as additional planting within open space areas within the Development Footprint. The planting palette incorporates locally important koala trees.
2	Fauna movement	Fauna movement infrastructure is included in the design. Proposed infrastructure includes rope bridges, signage, pavement stenciling, fauna friendly fencing and Koala exclusion fencing. Permeability of the Development Footprint is important by way of eliminating barriers in the design. It is understood that speed will be limited to 30km/hr within the Project and the facility will be inaccessible to vehicles after hours. The landscape plan includes koala food trees and locally endemic native species to maintain fauna movement opportunities within the Development Footprint.
3	Threatened Ecological Communities	The Development Footprint avoids directly impacting TECs within the Project Area. The design retains the patch of Swamp oak that has the potential to be future TEC following restoration (refer to regrowth RE 12.3.20 shown in **Figure 7**). This patch of vegetation will be restored with of the aim of restoring this patch to meet the TEC threshold. A Stormwater Management Plan has been prepared to ensure the changes to hydrological regime within proximity to TEC is minimal.
4	Significant habitat trees	Two significant habitat trees (see **Figure 11**) will be retained as part of the Project. One is located within the Development Footprint and one is located within the Conservation Area. If significant habitat trees will be impacted by the design, it is recommended that the significant habitat trees are salvaged and reinstalled as vertical habitat feature within landscaping.
5	Wetland area	The wetland area is designed to retain, TECS, vegetation within the Conservation Area, Marine Plants and a significant habitat tree (see **Figure 8**).
6	Protection of retained vegetation.	RCC propose a to submit a Property Map of Assessable Vegetation (PMAV) application to amend the vegetation mapping within the Conservation Area to Category A area (i.e. declared offset area).
7	Kayak and canoe launch facility	The proposed Kayak and canoe launch facility is located in the existing cleared area along Tingalpa Creek to minimise impacts to marine plants and remnant vegetation and TEC. The proposed

Number	Element	Integration in design
		walking track to the Kayak and canoe launch facility is an existing informal walking track and the path alignment will formalise this existing track through low-impact pathway construction.

8	Lighting	The concept design includes measures to minimise lighting minimise impacts to fauna during the operational phase of the Project. To minimise potential impacts of light spill, proper light management are incorporated into the design of the lighting:
		• The design of the proposed pathway streetlights complies with AS1158.3.1:2020 and the floodlights comply with AS4282: 2019.
		• The design incorporates a 'tilt-adaptor' to be installed (which will reduce the upward throw of light) and a warmer 3,000K colour temperature LED light engine (rather than 4,000k) be installed in the luminaires.
		• Buffer plantings are included in the Project landscaping to minimise light spill into the Conservation Area.
		• The concept design ensures floodlights face away from the Conservation Area to minimise reflection and light spill.
		• In accordance with the best practice lighting design available detailed in the National Light Pollution Guidelines for Widlife[2] (Department of the Environment and Energy, 2020) the design has incorporated the following principals:
		  • Lighting is to be installed as close as possible to the ground;
		  • Consider adaptive light controls to manage light timing, intensity and colour;
		  • Use the lowest intensity lighting appropriate for the task;
		  • Use non-reflective, dark-coloured surfaces (where possible); and
		  • Use lights with reduced or filtered blue, violet and ultra-violet wavelengths.

4.2.2 Clearing, Construction and Operational Phase Recommendations

Recommendations to be adopted throughout the clearing, construction and operational phases of the Project are detailed in **Table 15**, below.

[2] It is noted that the National Light Pollution Guidelines for Wildlife (Department of the Environment and Energy, 2020) have been developed for marine turtles, seabirds and migratory shorebirds, however in the absence of guidelines for light pollution and terrestrial vertebrates this guideline has been referenced.

Table 15. Construction and operation-phase recommendations for the Project.

Number	Element	Recommendation
1	Construction Management	Preparation of a detailed Construction Environment Management Plan, including the following sub-plans: • Koala Management Plan • Wildlife Habitat Management Plan (**Appendix J**) • Vegetation Management Plan • Rehabilitation Management Plan • Biosecurity Management Plan • Erosion and Sediment Control Plan • Noise and Vibration Management Plan • Stormwater Management Plan
2	Koala	Adherence to the Koala-spotter requirements and staged and sequential clearing conditions as specified in the *Nature Conservation (Koala) Plan 2017*.
3	Koala	Ensure Koala exclusion fencing is installed around all construction and works areas in accordance with the Queensland Government's *Koala Sensitive Design Guidelines*.
4	Koala	Provision of on-ground restoration to offset the loss of Koala habitat in accordance with the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*.
5	Koala	Conduct all clearing activities outside of the Koala breeding and dispersal season, so far as practicable.
6	Fauna mortality	Ensure a fauna-spotter catcher is present for all vegetation clearing activities.
7	Fauna habitat	Ensure the successful establishment of the lighting buffer planting to minimise light spill into the Conservation Area.
8	Fauna habitat	Ensure lighting fixtures are regularly maintained to ensure the direction of light spill does not unfavourably alter towards the Conservation Area. This includes maintenance checks after significant weather events (i.e. storms) which may damage the pole or fixtures. Ensure lighting operating hours are included in the Operational Management Plan including switching off floodlights outside of operational hours stated in the lighting plans (i.e. 10 pm).
9	Vegetation protection	Adoption of a Rehabilitation Program to be implemented around the edges of the Development Footprint to insulate retained areas of the Conservation Area from edge effects.
10	Vegetation protection	Ensure tree protection measures are adopted in accordance with *Australian Standard* (AS) *4970-2009 Protection of Trees on Development Sites.*

Number	Element	Recommendation
11	Enhancement	Implement restoration and management of the Conservation Area with particular attention paid to: • Restoration of koala habitat • Restoration of Glossy black habitat • Restoration of the Swamp Oak TEC

5 Net Gain

Net environmental benefits or gains are the increase in value of environmental or ecological services achieved by mitigation measures less the impacts of a project or action. In lieu of an existing framework for the assessment of net gain, the following is a high-level review of net benefits as they relate to the Project.

Table 16. Ecological values and project benefits

	Value	Benefits
MNES	Koala habitat	The design retains the Conservation Area including 39 ha of habitat that will be managed and restored. The Conservation Area supports koala habitat and retains and enhances a regional biodiversity corridor which supports Koala movement opportunities within the Lower Tingalpa and Coolnwynpin catchment.
		The Conservation Agreement with the Commonwealth ensures the long-term protection and conservation of MNES within the Conservation Area.
		RCC is operating under an Environmental Early Works and Social Land Management Plan to ensure MNES are protected, managed and improved over time (Cardno, 2021). The Early Works Management Plan incorporates the mandatory outcomes of the Draft Conservation Agreement including management plans for: • Weeds and pests; • Ecological values and restoration; • Bushfire management; and • Restricted access and barriers.
		Patches of koala habitat and koala habitat trees will be retained to maintain movement and foraging opportunities within the Development Footprint.
		The Landscape Plan includes revegetation areas adjoining and buffering the Conservation Area as well as additional planting within open space areas within the Development Footprint. The planting palette incorporates Locally important koala trees to maintain connectivity for Koalas through the Development Footprint.
		The design has integrated fauna-friendly fencing and exclusion fencing to ensure permeability through the Project Area and to minimise the risk of Koalas entering the transport network.
		Council's Redland Coast Koala Conservation Plan 2022-2027 details initiatives across the local government area (Redland City Council, 2022). The Redland Coast Koala Conservation Plan 2022-2027 includes initiatives relevant to the project including: • Koala population monitoring ○ Annual koala population and health monitoring will be completed within the Project Area.

	Value	Benefits
		○ Tagged koalas in the region will include individuals recorded within the population monitoring program of the Project Area. Tagging will include a minimum period of three years to monitor population and health data over a medium-term period. ○ The koala watch program will be included in community engagement activities and events to promote program uptake. ○ The Project Area is included in the list of identified sentinel sites to be included in DNA collection and health checks. ○ The disease management program will include the Project Area. • Smart signs and driver awareness ○ The internal roads will be included in the smart driver response signage project. Signs will include both passive and vehicle-activated messaging signage. ○ The design has integrated signage and internal traffic will be limited to 30km/hr. • Community engagement ○ The Project will be showcased as a koala watch focus area for community support and engagement. ○ The Project will be included in RCC's community engagement communications plan.
	TECs	0.94 ha of a vegetation community that does not presently meet the condition thresholds for the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland TEC will be retained and restored such that it does.
		Weed and pest management measures and the integration of restricted access into the design will enhance the TECs within the Conservation Area.
MSES	Wildlife habitat	The design avoids the majority of habitat features within the Development Footprint.
		The design incorporates ecologically sensitive lighting throughout the proposed infrastructure within the Development Footprint.
		The design incorporates several fauna rope bridges to ensure fauna movement through the Development Footprint is maintained. Fauna rope bridges provide safe passage for arboreal mammals including possums and gliders.
	Koala habitat	The design retains the Conservation Area including 39 ha of habitat that will be managed and restored. The Conservation Area supports koala habitat and retains and enhances a regional biodiversity corridor which supports Koala movement opportunities.
		The design retains patches and individual Non-juvenile Koala habitat trees within the Development Footprint to maintain permeability.
		Clearing will be staged and will occur sequentially under the supervision of a Koala spotter.
		Net benefits for Koala and koala habitat include those detailed in the MNES section above.

	Value	Benefits
	Regulated Vegetation	The design avoids and minimises clearing of Regulated Vegetation by consolidating infrastructure in the cleared areas of the Development Footprint.
		The Conservation Area will be protected under the *Vegetation Management Act 1999* through a PMAV application to amend the vegetation mapping to Category A area (i.e. declared offset area) to ensure the long-term protection and conservation of the Conservation Area.
	Marine Plants	The design of the proposed Kayak and canoe launch facility is located in a cleared and eroding section of Tingalpa Creek. The facility will include the stabilisation and restoration of the actively eroding section of Tingalpa Creek. The design will provide for the long-term protection marine plants along Tingalpa Creek.
	Tidal waterway	The detailed design will ensure tidal flows of Tingalpa Creek are maintained and fish movement will be uninhibited by the proposed Kayak and canoe launch facility.

6 Literature Cited

Atlas of Living Australia (2022) South-eastern glossy black cockatoo records for the Redland City Council Local Government Area.

Biolink (2021). Birkdale Community Precinct: Koala Habitat Assessment and Recommendations.

Byrnes, N.B. (1984). A revision of Melaleuca L. (Myrtaceae) in northern and eastern Australia, 1. Austrobaileya 2(1): 72.

Cardno (2021) Environmental Early Works and Social Land Management Plan prepared by Cardno (dated 23 November 2021).

Cardno (2021) Review of Regional Ecosystems – Birkdale Community Precinct.

Cardno (2020). Ecological Assessment Report – Birkdale Land Survey.

Commonwealth of Australia (2015). Draft referral guideline for 14 birds listed as migratory species under the EPBC Act.

Department of the Environment and Energy (2020). National Light Pollution Guidelines for Wildlife. Canberra: Department of the Environment and Energy. Available https://www.agriculture.gov.au/sites/default/files/documents/national-light-pollution-guidelines-wildlife.pdf

Department of the Environment and Energy (2018). Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community. Canberra: Department of the Environment and Energy. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/141-conservation-advice.pdf. In effect under the EPBC Act from 20-Mar-2018.

Department of Climate Change, Energy, the Environment and Water (2022) Referral guidance for the endangered koala, (online) https://www.dcceew.gov.au/environment/biodiversity/threatened/publications/referral-guidelines-endangered-koala, Department of Climate Change, Energy and the Environment and Water, Canberra.

Department of Climate Change, Energy, the Environment and Water (2022a). Conservation advice for Calyptorhynchus lathami lathami (south-eastern glossy black cockatoo), Department of Climate Change, Energy, the Environment and Water Canberra.

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

Department of Climate Change, Energy, the Environment and Water (2022c). Approved Conservation Advice for the Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions. Canberra: Department of Climate Change, Energy, the Environment and Water.

Department of Infrastructure, Local Government and Planning (2017) ShapingSEQ - South East Queensland Regional Plan 2017. Queensland Government, Brisbane.

Department of Primary Industries and Fisheries (2007) Fish Habitat and Management Operational Policy (FHMOP 001) Brisbane. Queensland Government.

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 Environment Protection and Biodiversity Conservation Act 1999.Canberra. Department of Sustainability, Environment, Water, Population and Communities

Eby, P., & Law, B. (2008). Ranking the feeding habitat of grey-headed flying foxes for conservation management. c: Department of Environment, Heritage, Water and the Arts.

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

Eyre TJ, Smith GC, Venz MF, Mathieson MT, Hogan LD, Starr, C, Winter, J and McDonald, K (2022b), Guide to greater glider habitat in Queensland, report prepared for the Department of Agriculture, Water and the Environment, Canberra. Department of Environment and Science, Queensland Government, Brisbane. CC BY 4.0.

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F, Richter, D., Addicott, E.P. and Appelman, C.N. (2022) Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 6.0. Updated April 2022. Queensland Herbarium, Queensland Department of Environment and Science, Brisbane.

Queensland Government (2020). Minister's Guidelines and Rules. Queensland Treasury June 2020.

Redland City Council (2023) Lower Tingalpa and Coolnwynpin Catchment (online) https://www.redland.qld.gov.au/info/20261/waterways_coasts_and_catchments/657/catchment_areas_of_the_redlands. Redland City Council, Cleveland

Redland City Council (2022) Draft Birkdale Community Precinct Master Plan, Redland City Council, Cleveland.

Redland City Council (2021) Koala Conservation Action Plan 2022-2027, Redland City Council, Cleveland.

University of the Sunshine Coast, Detection Dogs for Conservation (2021). Birkdale Community Precinct Project Koala survey report.

Youngentob, K.N, Marsh, K.F., Skewes, J., A review of koala habitat assessment criteria and methods, report prepared for the Department of Agriculture, Water and the Environment, Canberra, November. CC BY 4.0.

Appendix A Desktop Searches

Appendix B Refined Regional Ecosystem Mapping (Cardno, 2021)

Appendix C Likelihood of Occurrence

Appendix D Biocondition Assessment

Appendix E Spotlighting Survey Notes

Appendix F Habitat Assessments

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Birkdale Community Precinct: Koala Habitat Assessment and Recommendations

Report to Redlands City Council

October 2021

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Abbreviations

Abbreviation	Description
DBH	Diameter at Breast Height
EPBC	Environmental Protection and Biodiversity Conservation
GPS	Global Positioning System
LGA	Local Government Area
PKFT	Preferred Koala Food Tree
PKH	Preferred Koala Habitat
RCC	Redlands City Council
RE	Regional Ecosystem
SAT	Spot Assessment Technique
UTM	Universal Transverse Mercator

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Executive Summary

The site of the proposed Birkdale Community Precinct at 302 and 362-388 Old Cleveland Road East, Birkdale, was purchased by Redlands City Council (RCC) in 2016. Subsequently, a Conservation Agreement was entered into between RCC and the Commonwealth regarding the protection and conservation of koalas and koala habitat on the site, among other matters. This project assesses koala habitat and quantifies current koala activity levels across the 61.2 ha Birkdale Community Precinct and makes recommendations for future management.

Spot Assessment Technique (SAT) assessments were undertaken at 13 sites across the study area, 11 of which detected the presence of koalas in the form of diagnostic faecal pellets. Koala activity levels were interpreted in the context of two koala carrying capacity landscapes owing to variations in soil fertility. Eight of the sites at which koala presence was confirmed returned significant koala activity levels. Analysis of koala activity levels using a splining process performed with the spatial analyst extension in ArcGIS 10.5 produced an activity contour model delineating areas occupied by resident koalas, living in overlapping home ranges which extend beyond the boundaries of the site itself. The maintenance of connectivity across these boundaries, and across the site itself, is important for the continued viability of the local koala population.

A stadia-metric survey of Preferred Koala Food Trees (PKFTs) mapped and measured 1,774 PKFTs ≥ 100 mm Diameter at Breast Height (DBH), comprising four species; *Eucalyptus tereticornis*, *E. moluccana, E. microcorys* and *E. resinifera*. The widespread occurrence of *E. tereticornis* across the site is in broad agreement with current Regional Ecosystem (RE) mapping. However, minor adjustments to linework are recommended in some areas, while landscape considerations and floristics imply the presence of other, currently unmapped plant communities on the site. The density and size of mapped canopy trees suggests that some areas which are currently mapped as regrowth may also require recognition as remnant stands.

A notional koala carrying capacity for the site was calculated with reference to koala habitat type classifications. Mapped remnant vegetation on the site is currently estimated as likely ≤ 6 koalas, however if mapped regrowth vegetation reaches remnant status the total number that the study area could support increases to ~ 20 koalas. In this context, the carrying capacity of the site as a whole could be enhanced by increasing the density of PKFTs within existing habitat. This report recommends that a program of PKFT planting focus on areas in which overall native tree density is low, including areas that are currently dominated by introduced species such as *Pinus elliottii*, and areas that have widely spaced, typically large PKFTs but otherwise exhibit current lack of recruitment. Further

recommendations pertaining to the on-going management of the proposed Birkdale Community Precinct site include fencing to reduce a known vehicle strike blackspot on Old Cleveland Road East, securing the site against access by domestic dogs, and implementing koala-sensitive design principles in the case of future development of the site.

1. Introduction

In March of 2016 Redland City Council (RCC) purchased Willards Farm, a 61.2 ha property located at 302 and 362-388 Old Cleveland Road East, Birkdale, with the intent of establishing a Birkdale Community Precinct. The site includes areas of identified environmental, cultural and historical significance, including being in a mapped area of koala Generational Persistence, meaning that koala records have re-occurred across this localised area over periods that extend beyond the life-span of a single koala, inferring the presence of a resident population (Biolink 2019). Previous mapping of Preferred Koala Habitat (PKH) across the Redlands Local Government Area (LGA) has also identified the presence of suitable habitat for koalas on the site, by merit of the presence of Preferred Koala Feed Trees (PKFTs) within the mapped Regional Ecosystems (REs) (Biolink 2019). For the Redlands Coast, PKFTs comprise the following species (Biolink 2019):

- *Eucalyptus robusta* (swamp mahogany) *
- *E. resinifera* (red mahogany),
- *E. tereticornis* (blue (Forest red) gum),
- *E. microcorys* (tallowwood),
- *E. moluccana* (grey box), and
- *E. propinqua* and/or *E. major (*grey gums) including affiliated species such as *E. biturbinata* and/or *E. longirostrata*.

* Includes the naturally occurring *E. robusta* x *E. tereticornis* hybrid, often referred to *E. patentinervis*.

The dominance of PKFTS in the landscape are generally determined with reference to mapped REs, the descriptions of which broadly allow the determination of PKH categories as outlined in **Table 1**.

Table 1. Four-tiered koala habitat classification hierarchy criteria as applied to REs mapped within the Redlands Coast.

Koala habitat type	Classification criteria
Primary koala habitat	Forest and/or woodland REs occurring on soils of medium to high nutrient value whereupon primary PKFTs are dominant or co-dominant components of the tallest stratum.
Secondary (Class A) koala habitat	Forest and/or woodland REs occurring on soils of medium to high nutrient value whereupon primary PKFTs are sub-dominant components of the tallest stratum.

Secondary (Class B) koala habitat	Forest and/or woodland REs occurring on soils of low to medium nutrient value whereupon primary PKFTs are absent, the tallest stratum instead dominated or co-dominated by secondary food tree species only.
Secondary (Class C) / marginal koala habitat	Forest and/or woodland REs occurring on soils of low to medium nutrient value whereupon primary food tree species are absent and secondary food tree species are sub-dominant components of the tallest stratum.

Note: The terms "Primary" and "Secondary" koala food tree species[1] as used in the classifications outlined in Table 1 are based on the simplified logit models of PKFT utilisation described by Phillips (2000b).

Each of the classifications in the Table above reflects differing koala carrying capacities of the associated vegetation communities, areas of 'Primary' Koala Habitat capable of sustaining high density populations (*i.e.*, > 0.5 koalas ha^{-1}), whereas Secondary (Class C) / Marginal Koala Habitat can only sustain low density populations (*i.e.*, < 0.1 koalas ha^{-1}). Applying this understanding of the relationship between the presence of specific Eucalypt species and the ability of a landscape to support resident koalas, provides the basis for an effective and scientifically robust koala habitat assessment.

1.1. Objective

Redlands City Council requires a detailed koala habitat assessment on the site of the 61.2 ha Birkdale Community Precinct, to inform recommendations on how to maintain and/or increase the koala carrying capacity of the site, among other matters. Specifically, this requires a detailed, landscape-scale assessment of koala habitat and activity levels, to be achieved by;

- Interrogating and field-testing vegetation communities to confirm Regional Ecosystem (RE) mapping and Preferred Koala Habitat (PKH) categorisation (*e.g.* Primary, Secondary, Other).
- Mapping of individual Preferred Koala Food Trees (PFKT), species-specific to the Redlands LGA.
- Delineating areas of significant koala activity.
- Assessing koala habitat connectivity / potential movement corridors within and adjoining the site.
- Informing recommendations for management, including enhancement and expansion of koala habitat in the future.

[1] Primary Food Tree requires preferential use by koalas to be significantly higher than other congeners with utilisation that is independent of size class (Phillips *et al*. (2000) refers) whereas a Secondary Food Tree also requires a level of use that is significantly higher than other congeners but with a utilisation model that is typically size-class dependent (Phillips and Callaghan (2000) refers).

2. Methodology

2.1. Study Area

There are three lots which Birkdale Community Precinct includes, namely 1/RP14143, 2/RP141444 and 2/SP146445, hereafter referred to as the study area (**Figure 1**). Within the 61.2 ha study area, 44 ha has been identified as an intended conservation area (Cardno 2020), inclusive of most vegetated parts of the study area, but notionally excluding a centrally located expanse of mostly cleared land.

2.2. Field Survey

2.2.1 Determining Koala Activity: Spot Assessment Technique (SAT)

Within the study area, potential survey sites were spaced on a randomly designated grid at 250 m intervals. Universal Transverse Mercator (UTM) coordinates were determined for each corresponding point and uploaded into hand-held Global Positioning System (GPS) to enable location in the field. Koala activity at each field site was assessed using the Spot Assessment Technique (SAT) of Phillips & Callaghan (2011).

Interrogation of coarse underlying soil landscape mapping (CSIRO 1985) alluded to a mix of greyed podzolic soils with alluvial soils and humic greys along the banks of Tingalpa Creek, with medium to high nutrient krasnozem soils across the rest of the site. This information, in combination with mapped REs, implies the presence of two distinct koala carrying capacity landscapes across the study area, referred to as East Coast (med-high) and East Coast (low) respectively. These levels of koala utilisation are defined by Phillips and Callaghan (2011) and **Table 2** details the koala activity threshold parameters that are applicable to these areas, with medium (normal) use and high use sites indicative of the presence of resident animals, with low use sites being indicative of more transient utilisation.

Table 2. Categorisations of koala activity based on use of mean activity level ± 99% confidence intervals. Activity levels in the medium (normal) and high use range for East Coast (low) activity categories indicates occupancy levels by resident koala populations (Source: modified from Table 2 in Phillips and Callaghan 2011).

Activity category	Low use	Medium (normal) use	High use
East Coast (low)[1]	< 9.97%	≥ 9.97% but ≤ 12.59%	> 12.59%
East Coast (med-high)	< 22.52%	≥ 22.52% but ≤ 32.84%	> 32.84%

[1] Koala activity (%) is determined based on the number of trees with faecal pellets and the number of trees sampled at each site. For example, three positive trees of 30 trees would yield a 10% activity level.

Data analysis

Using the satellite imagery from ESRI Basemap World Imagery (2020) null (zero activity) sites were designated at 125 m intervals along perceived barriers to koala movement, such as Old Cleveland Road East. Null sites and koala activity data from all sampled field sites were then interpolated using regularised, thin-plate splining techniques using the spatial analyst extension in ArcGIS 10.5. Output from the splining process was utilised to produce an activity contour model to delineate areas occupied by resident koala populations by identifying contours with the 9.97%, 12.59%, 22.52% and 32.84% significant activity thresholds of Phillips & Callaghan (2011) as previously detailed in **Table 2**. This process produces a meta-population model (or contour map) that delineates important 'source' areas supporting resident koala populations. Lower activity contours were included in the activity model to assist with interpretation of connectivity.

2.2.2 Stadia-metric survey of Preferred Koala Food Trees (PKFTs)

The location of all Preferred Koala Food Trees (PKFTs), with a Diameter at Breast Height (DBH) greater than 100 mm were recorded within the defined study area using a hand-held GPS. Each PKFT was identified to species and measured. PKFTs were grouped into DBH size increments of 200 mm to determine their size-class distribution. Corrections for multi-stemmed trees were made by summing DBH for each stem.

2.2.3 Ground-truthing Regional Ecosystems (REs)

The boundaries of mapped REs were traversed guided by a handheld GPS and concordance with current descriptions of floristics was assessed while walking both the boundaries and internal sections of each mapped RE. The tree composition within each SAT site was also compared to that predicted by underlying mapped REs.

2.3 Desktop Assessment

2.3.1 Carrying Capacity

The carrying capacity of the study area was calculated by coding the habitat within "Queensland Remnant Ecosystems 2019 v 12" spatial layer and the Environmental Protection Act 1994 – High Value Regrowth 2020 (AKA "DP_QLD_EP_MATUREGROWTH_DCDB_A" spatial layer) using the criteria provided in Biolink (2019), as outlined in **Table 1**. An important distinction between the koala habitat

categories which relate to each RE described in Biolink (2019) and habitat categories of the current study, is that RE 12.3.11 / 12.3.6 is considered as Primary / Secondary A habitat in the current study because ground-truthing reveals that the dominant canopy tree, *E. tereticornis*, is not homogeneously distributed therein. Upper and lower estimates for carrying capacity were calculated by using the upper and lower bounds of each PKH category (*e.g.* Secondary A koala habitat can support 0.1 – 0.5 koalas per ha), with reference to the amount of this habitat type mapped within the study area.

3. Results

3.1 Study Area

The study area was 61.2 ha in size, consisting of three lots 1/RP14143, 2/RP14144 and 2/SP146445 located at 302 and 362-388 Old Cleveland Road East, Birkdale, QLD. The site is less than 100 m from the boundary of Redlands / Brisbane LGA (to the west) and adjoins Howeston Golf Course in the north-western corner. According to the "Remnant Ecosystems of Queensland 2019 v 12" spatial layer, 14.23 ha (23.33%) of the study area is mapped as remnant vegetation and comprises four REs and a single combination RE, these being:

- 12.1.1 - *Casuarina glauca* woodland on margins of marine clay plains (1.52 ha)
- 12.1.2 - Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains (0.89 ha)
- 12.1.3 - Mangrove shrubland to low closed forest on marine clay plains and estuaries (0.32 ha)
- 12.5.3 - *E. racemosa* subsp. *racemosa* woodland on remnant Tertiary surfaces (2.23 ha)
- 12.3.11 / 12.3.6 - *E. tereticornis* +/- *E. siderophloia, C. intermedia* open forest on alluvial plains usually near coast / *M. quinquenervia* +/- *E. tereticornis, L. suaveolens, C. intermedia* open forest on coastal alluvial plains (9.27 ha)

  (**Figure 1**).

Only one of these (12.3.11 / 12.3.6) contains PKFT species in its description, thus qualifying it as koala habitat. On occasion, REs without PKFT species in their description will qualify as PKH, for example RE 12.1.1 – *Casuarina glauca* woodland, commonly occurs as a monoculture without PKFTs and hence the appropriate habitat categorisation from a koala habitat perspective would be "Other". However, in some areas and for a variety of reasons, RE 12.1.1 may contain PKFTs such as Blue (Forest red) gum and/or swamp mahogany as localised or occasional components of the overstorey. To recognise this possibility, such REs may be categorised as "Other / Secondary A" or other combinations as appropriate, recognising the most commonly occurring form of the habitat from a koala's perspective,

while also acknowledging that within this there will be localised habitat areas wherein PKFTs may be present (Biolink 2019).

In addition to the 14.23 ha of mapped remnant vegetation, a further 28.88 ha of high value regrowth is mapped across the study area according to the *Environmental Protection Act 1994* – High Value Regrowth (DP_QLD_EP_MATUREGROWTH_DCDB_A (5/6/20 – Queensland Spatial). This high value regrowth includes three RE combinations, these being:

- 12.5.3 / 12.5.2 - *E. racemosa* subsp. *racemosa* woodland on remnant Tertiary surfaces / *C. intermedia, E. tereticornis* open forest on remnant Tertiary surfaces, usually near coast and on deep red soils (0.66 ha)
- 12.5.2 / 12.5.3 / 12.3.6 - *C. intermedia, E. tereticornis* open forest on remnant Tertiary surfaces, usually near coast and on deep red soils / *E. racemosa* subsp. *racemosa* woodland on remnant Tertiary surfaces / *M. quinquenervia* +/- *E. tereticornis, L. suaveolens, C. intermedia* open forest on coastal alluvial plains (9.61 ha)
- 12.3.11 / 12.3.6 - *E. tereticornis* +/- *E. siderophloia, C. intermedia* open forest on alluvial plains usually near coast / *M. quinquenervia* +/- *E. tereticornis, L. suaveolens, C. intermedia* open forest on coastal alluvial plains (18.61 ha)

Figure 1. The 61.2 ha study area (thin grey line), inclusive of four mapped remnant REs, plus one combination remnant RE, on the site. Three more REs occur in the immediate vicinity. Four combination REs are mapped as high value regrowth on the site, not having officially met remnant status. For description of REs refer to Section 3.1.

3.2 Field Survey

3.2.1 Determining Koala Activity: Spot Assessment Technique (SAT)

Spot Assessment Technique (SAT) assessments were undertaken on the 26th – 27th May 2021, during which time nine SAT sites were assessed (Birk_01 – Birk_10), with an additional four supplementary sites (Birk A – Birk_D) assessed to assist refinement of the boundaries of the activity contours. One of the sites selected by the 250 m grid was not assessed due to a lack of trees at the proposed location. The distribution of these sites is illustrated in **Figure 2**, with a summary of associated data supplied in **Appendix A**. Evidence of koalas in the form of diagnostic faecal pellets was recorded at eight of the nine sampled primary sites field sites resulting in a habitat utilisation estimate of approximately 88.89% of the otherwise available habitat. Of the eight active primary sites, six returned significant activity levels of medium to high, and two returned low activity levels. Three of the four supplementary sites were also active, with two of these sites returning significant activity levels of medium to high and one site returning low activity levels. Activity contour analysis reveals that the majority of the study area currently supports s significant koala activity indicative of resident animal/s. The depression in activity contours near the central-northern boundary of the site is an artefact of the splining process and in order to determine the accuracy of this aspect of the model, additional sites would need to be surveyed on adjoining lands.

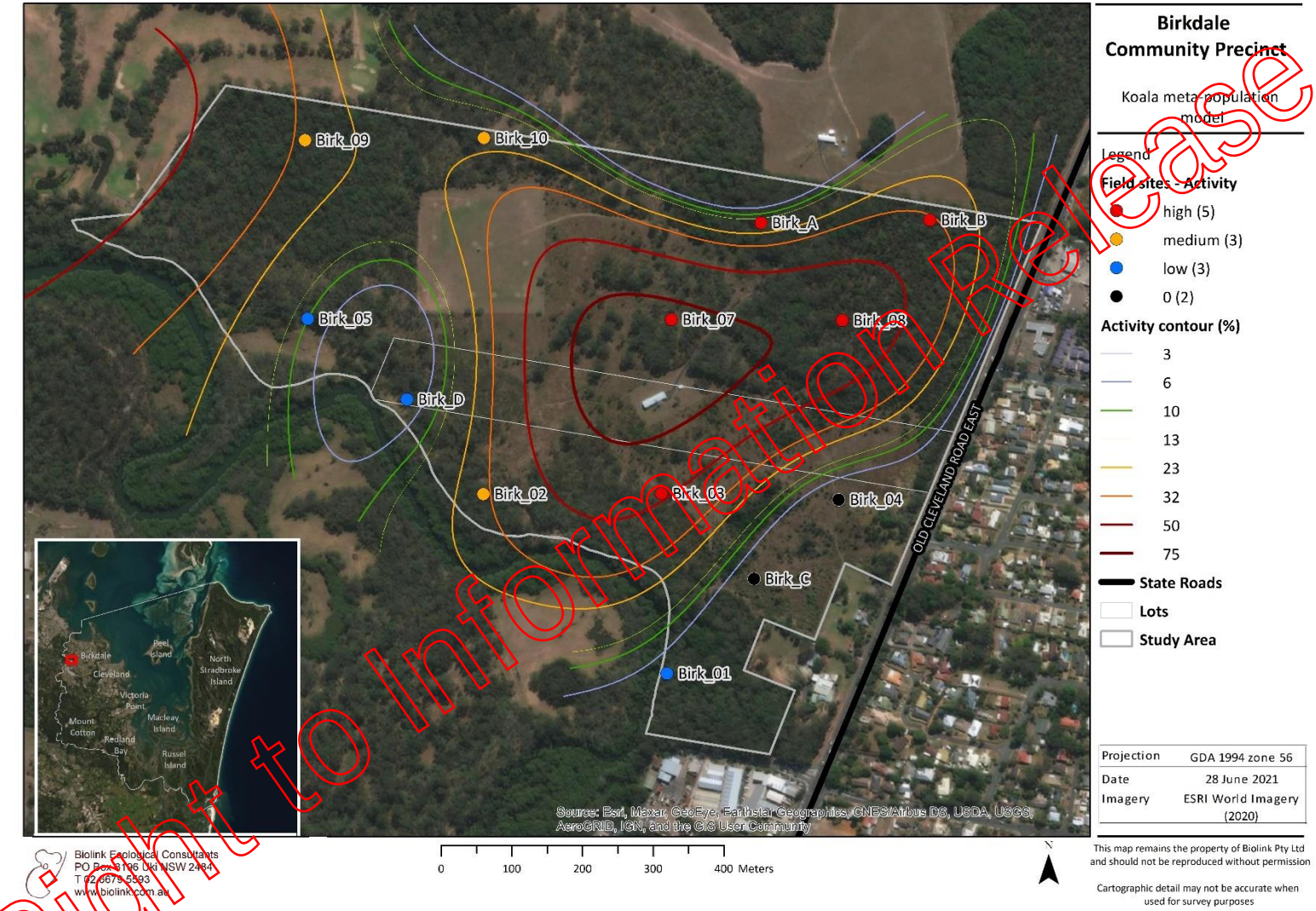


Figure 2. Koala activity model showing 13 SAT sites, comprising two sites with no koala activity (black), three low activity sites (blue), three medium activity site (orange) and four high activity sites (red).

3.2.2 Stadia-metric survey of Preferred Koala Food Trees (PKFTs)

The stadia-metric survey of PKFTs was undertaken 28th May – 2ne June 2021, during which time 1,774 PKFTs were measured and mapped (**Figure 3**). Four PKFT species were identified, namely; *E. tereticornis* (*n* = 1,543), *E. moluccana* (*n* = 217), *E. microcorys* (n = 12) and *E. resinifera* (*n* = 2) (see **Appendix B** for locational data and DBH). *Eucalyptus tereticornis* was widely distributed throughout the study area and occurred in vegetation mapped as remnant and non-remnant, across all REs except 12.1.2 (**Figure 4**). The area supporting the highest density of E. *tereticornis* was the central-south and the lowest density, other than cleared expanses, was the north-eastern portion of the study area which supports a mix of *Allocasuarina littoralis, Melaleuca quinquenervia* and non-PKFT eucalypts. *Eucalyptus moluccana* occurred predominantly in areas mapped as remnant and non-remnant RE 12.3.11 / 12.3.6 and was largely restricted to two localised patches, one along the northern boundary of the study area and the other near the south-western boundary where RE 12.3.11 / 12.3.6 meets RE 12.1.2 (**Figure 5**). There were relatively few *E. microcorys and E. resinifera* which were both restricted to a localised area in the north-west of the study area (**Figure 6**).

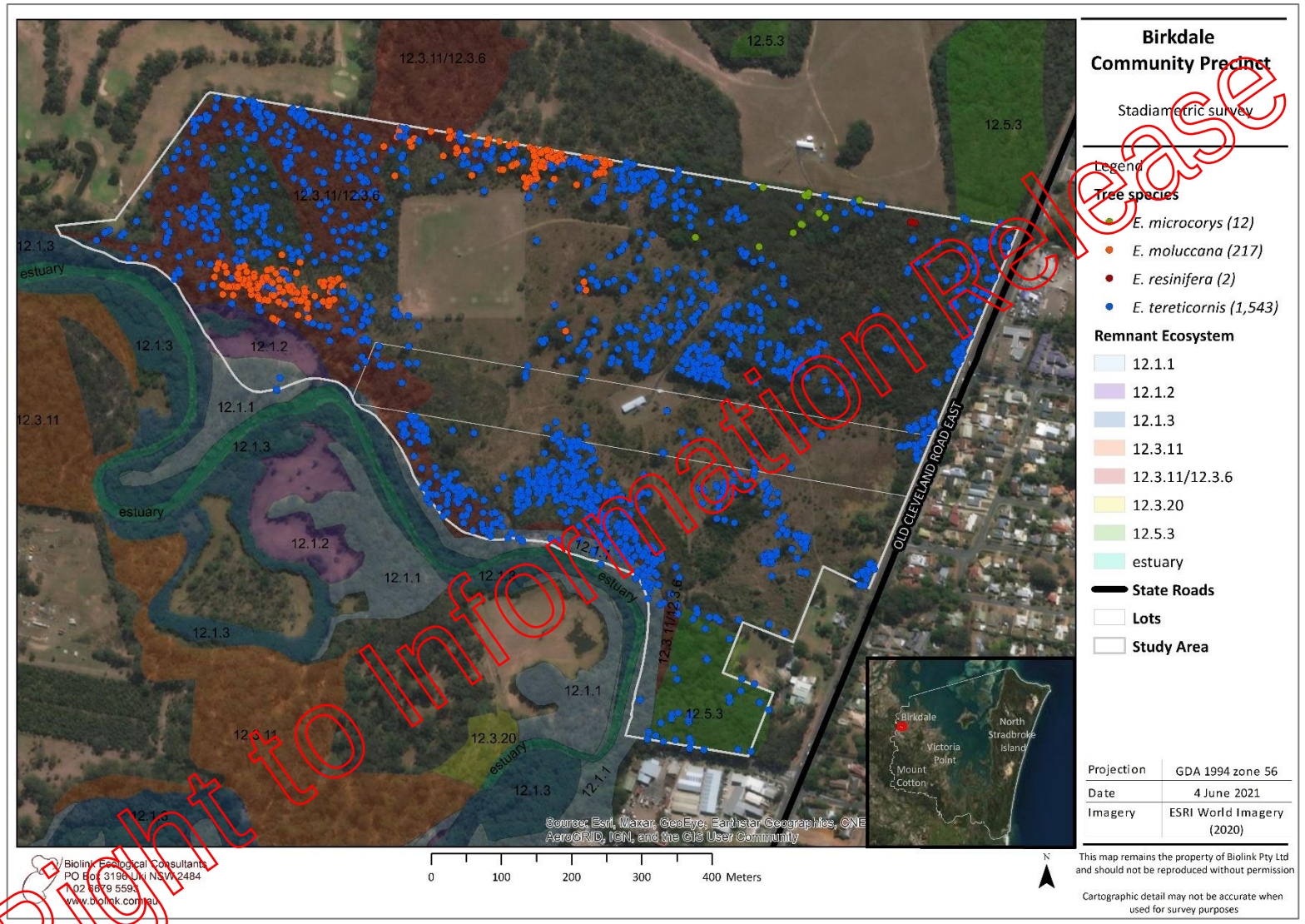


Figure 3. Distribution of 1,774 Preferred Koala Food Trees across the study area, comprising *E. tereticornis* (blue circles) (*n*=1,543), *E. moluccana* (orange circles) (*n*=217), *E. microcorys* (green circles) (*n*=12) and *E. resinifera* (red circles) (*n*=2). REs are indicated by coloured polygons.

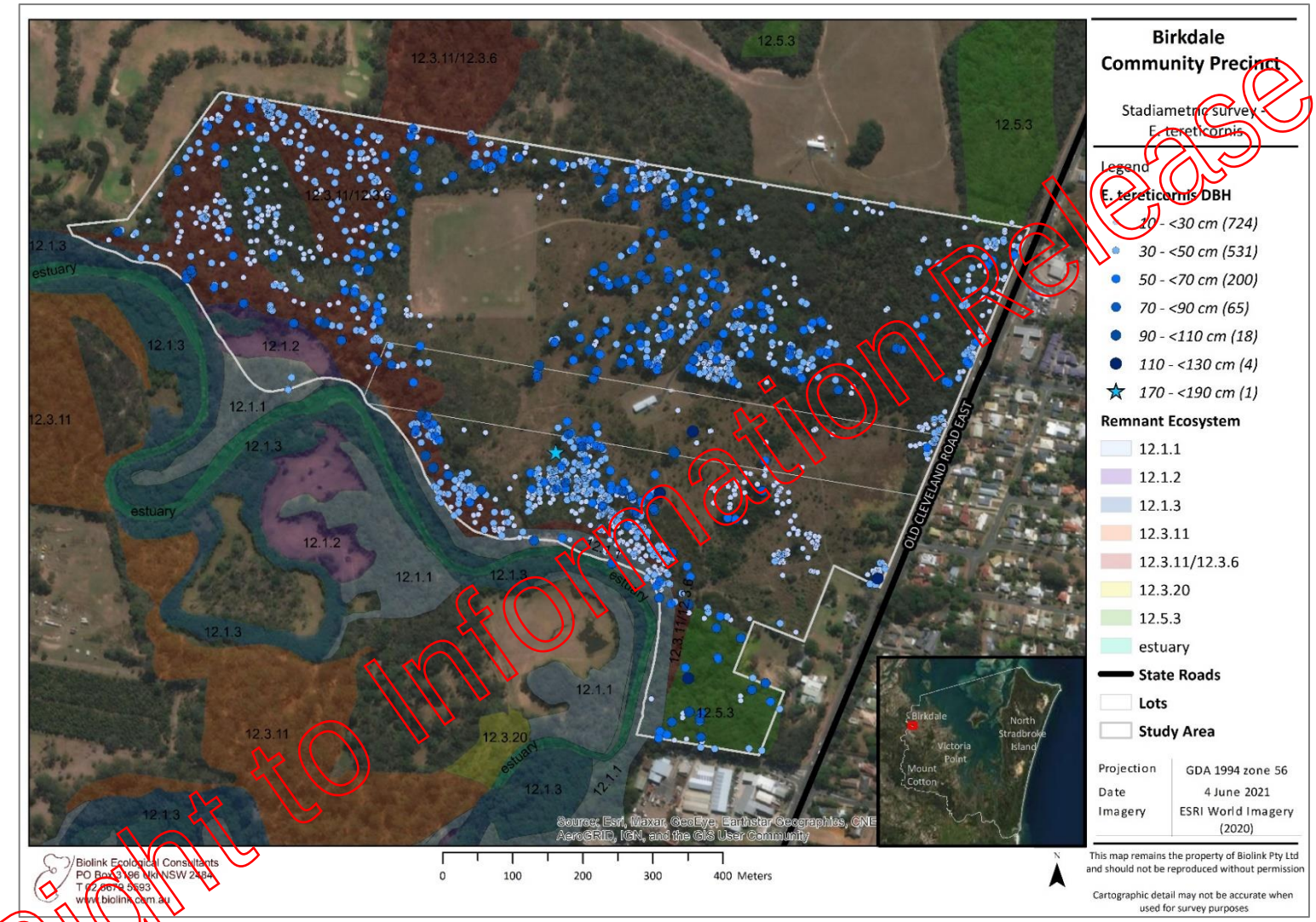


Figure 4. The distribution of 1, 543 *E. tereticornis* across the study area with individual trees displayed according to their DBH size class. Size classes are in 200 mm size increments starting at 100 - <300 mm (small, light blue circles) up to 1,100 - <1,300 mm (large, dark blue circles), and a single tree in the size class 170 - <190 cm (blue star).

Figure 5. The distribution of 217 *E. moluccana* across the study area with individual trees displayed according to their DBH size class. Size classes are in 200 mm size increments starting at 100 - <300 mm (small, light orange circles), up to 900 - <1,100 mm (large, dark orange circles).

Figure 6. The distribution of 12 *E. microcorys* across the study area with individual trees displayed according to their DBH size class. Size classes are in 200 mm increments comprising 100 - <300 mm (small, light green circles), 300 - <500 mm (medium, mid green circles) and 700 - <800 mm (large, dark green circles). The distribution of two *E. resinifera* across the study area are similarly displayed in two size classes of 100 - <300 mm (small, pink circles) and 300 - <500 mm (large, red circles).

The collective size class distribution of all PKFTs ≥ 100 mm DBH are displayed in **Figure 7**. Just under half of all mapped trees (46.89%, *n* = 832) had a DBH of less than 300 mm, with a greater proportion of these trees in the 200 - <250 mm and 250 - <300 mm size classes relative to the smaller 100 - <150 mm and 150 - <200 mm size classes.

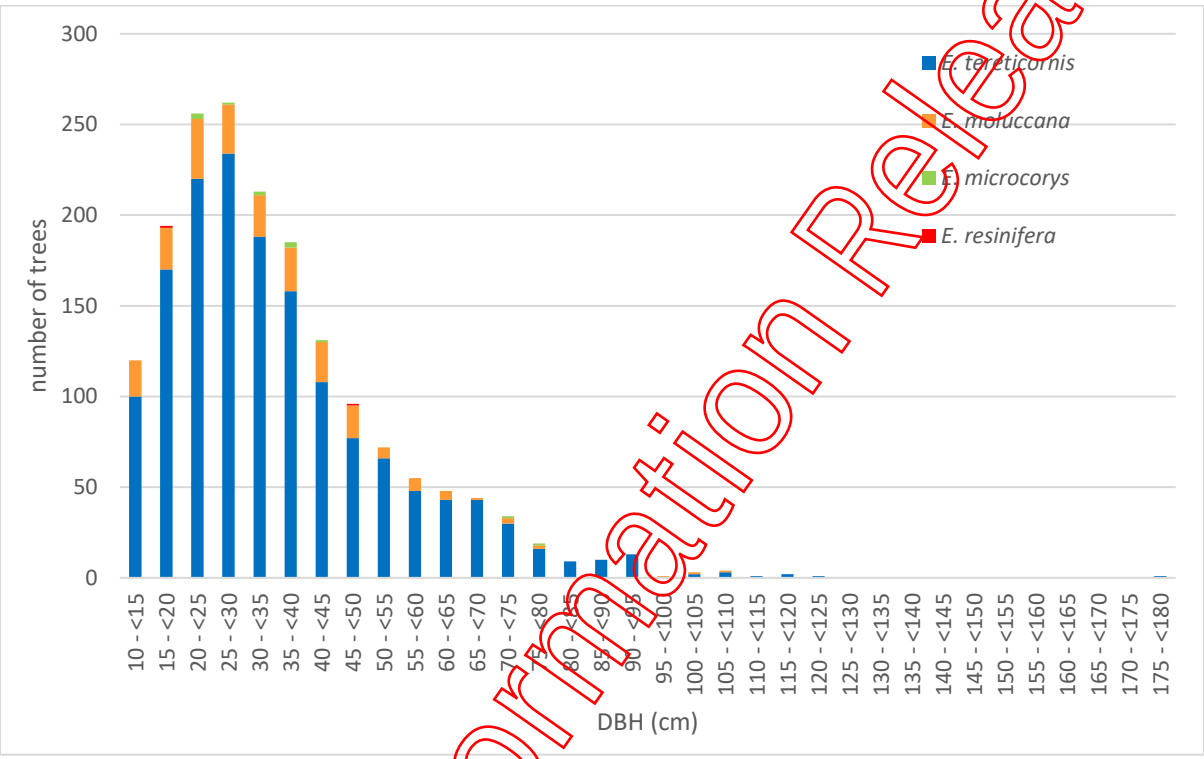


Figure 7. Histogram showing the distribution of PKFTs in 50 cm DBH intervals, with *E. tereticornis* in blue, *E. moluccana* in orange, *E. microcorys* in green and *E. resinifera* in red.

3.2.3 Ground-truthing-Regional Ecosystems (REs)

Floristic concordance

The botanical composition and boundaries of mapped RE 12.1.2 are generally consistent with the description of saltpan vegetation including grassland, herbland and sedgeland on marine clay pans, comprising as it does, a brackish grassland of *Sporobolus virginicus* with some emergent *C. glauca* and *M. quinquenervia*. RE 12.1.1, *Casuarina glauca* woodland on margins of marine clay pans, is mapped in a thin strip along much of the south-western boundary of the site adjacent to Tingalpa Creek, with a larger consolidated patch in the west. For much of this mapped RE, the species composition is largely congruous with the RE description, consisting of mangrove shrublands and *C. glauca*, with a smaller

number of emergent *L. suaveolens* and *M. quinquenervia*, and a grassy ground cover which is partially tidally inundated. Along the northern portion of 12.1.1, this RE is likely to extend in an easterly direction into adjacent mapped RE 12.3.11 / 12.3.6, in the vicinity of SAT site Birk_D (discussed below). In the more consolidated western section, the botanical composition of the site is again largely congruous with RE descriptions, including mangrove shrublands and *C. glauca*, with some emergent *E. tereticornis* and *E. siderophloia*. This RE is mapped in the far southern corner of the study area where *C. glauca* are sparser, giving way to a greater number of *L. suaveolens* and *M. quinquenervia*. At this locality the floristics are more akin to 12.3.6 and our notes imply that the boundary of the adjacent 12.3.11 / 12.3.6 extends further to the west and into 12.1.1.

The description of RE 12.3.11 / 12.3.6 is representative of the botanic composition of this mapped RE. An exception to this is in the north-west of the study area where *C. glauca* is co-dominant in the canopy, though it is not present in the RE description. The presence of *C. glauca* in this RE may be indicative of a history of fire / disturbance. Portions of the RE supporting high densities of *E. molucanna* (see **Figure 5**) are also likely to have been mistyped, particularly in the case that the land zone is better described as land zone 5 (RE 12.5.7 may be more appropriate here).

The far south-east of the study area is mapped as RE 12.5.3 and the dominance of *E. racemosa* and *C. intermedia* in the canopy is in accord with this RE description, as are the lower densities of *E. siderophloia*, *E. pilularis, A. leiocarpa, M. quinquenervia, Grevillia robusta* and *Livistona australis*. The boundaries of this RE appear to be consistent with existing mapping, though a preponderance of weeds along the mapped boundary, particularly *C. camphora* and *Syagrus romanzoffiana*, is complicating.

The north-east of the study area is mapped as high value regrowth of two combination RE descriptions, namely; 12.3.6 / 12.3.11 and 12.5.2 / 12.5.3 / 12.3.6. In areas mapped 12.3.6 / 12.3.11 the floristics are most consistent with 12.3.11, along with the additional presence of *Allocasuarina littoralis*. In areas mapped as 12.5.2 / 12.5.3 / 12.3.6, the floristics reflect 12.5.3, including the presence of some *E. microcorys* and *E. resinifera* in addition to the dominant *E. racemose*, though again with the addition of *A. littoralis*.

Canopy composition at SAT sites

Of the 13 SAT sites which were assessed, six were located within the boundaries of mapped REs with the remainder falling in unmapped vegetation or mapped high value regrowth. The majority of the sites in mapped REs (five), occurred in the combined RE 12.3.11 / 12.3.6, with the final site located in RE 12.1.1. Of the seven sites that do not fall within mapped REs, two occur in non-habitat comprised

of *Pinus elliottii* (Birk_04 and Birk_C), three sites (Birk_03, Birk_07, Birk_08) are situated in mapped high value regrowth RE 12.3.11 / 12.3.6. and the remaining two sites (Birk_A, Birk_B) are located in mapped high value regrowth corresponding to RE 12.5.2 / 12.5.3 / 12.3.6. The canopy compositions at SAT sites are broadly consistent with that described above and are presented in detail in **Appendix C**.

3.3 Desktop Assessment

3.3.1 Carrying capacity

There were four REs and a single combination RE located within the study area, totalling 14.23 ha of mapped remnant vegetation. According to PKH categorisation for Redlands LGA (Biolink 2019) two REs, 12.1.2 (0.89 ha) and 12.1.3 (0.32 ha), qualify as 'Other' koala habitat, meaning that they do not support koalas, a categorisation which is consistent with PKFT mapping (**Figure 3**). RE 12.5.3 (2.23 ha) is considered Secondary C koala habitat supporting < 0.1 koalas per ha, again consistent with PKFT mapping. The remaining RE and RE combination of 12.1.1 (1.51 ha) and 12.3.11 / 12.3.6 (9.27 ha) are considered Secondary A koala habitat supporting 0.1 – 0.5 koalas per ha, according to Biolink (2019). Ground truthing via tree mapping, in conjunction knowledge of the underlying soil landscapes, suggests that 12.3.11 / 12.3.6 is more accurately described as Secondary A / Primary koala habitat in the context of the Birkdale site. Based on these categorisations, the mapped remnant vegetation across the study area has a carrying capacity of 1.08 – 6.27 koalas.

There is an additional 28.88 ha of high value regrowth mapped across the study area. This includes three RE combinations, two of which, 12.5.3 / 12.5.2 (0.66 ha) and 12.5.2 / 12.5.3 / 12.3.6 (9.61 ha) are categorised as Secondary C / Secondary A. The remaining RE combination, 12.3.11 / 12.3.6 (18.61 ha) is considered Secondary A / Primary habitat (see above). If these REs were to reach remnant status, they could collectively support 2.27 – 13.59 koalas, increasing the total number that the study area could support to 3.35 – 19.85, better described as ~3 – 20 koalas.

4. Discussion

The outcomes of PKFT mapping and SAT survey confirm the widespread presence of koala habitat and koala activity across the Birkdale Community Precinct site with a stadia-metric survey identifying 1,774 PKFTs ≥ 100 mm DBH. This is congruous with previous mapping of PKH on the site by Biolink (2019), with the exception that areas mapped as 12.3.11 / 12.3.6 qualify as Secondary A / Primary habitat, rather than Secondary A, by virtue of *E. tereticornis* functioning as a primary food tree on medium to high nutrient soils. The study area therefore supports a mix of Primary, Secondary A, Secondary C and

Other koala habitat. Current RE mapping is in broad agreement with the floristic composition, with some minor alterations to linework and typing recommended for the boundary of 12.1.1 and 12.3.11 / 12.3.6 and other localities. Canopy cover in areas which are currently mapped as high value regrowth, particularly in the west, is likely to reach benchmarks for remnant status as is reflected by the size and density of the mapped PKFTs.

The size class distributions of *E. tereticornis* and *E. moluccana* reveal that there are fewer small trees (100 – 200 mm DBH) than is ideal for a stable population. This distribution should ideally approximate a smooth 'inverse j-shaped' pattern, akin to the log normal function, such that younger trees are plentiful enough to exceed the mortality of older trees (Smith *et al*, 1997). This should be considered during the drafting of any Vegetation Management Plan, as recruitment must keep pace with mortality for populations to persist.

Evidence of koalas in the form of diagnostic faecal pellets was recorded at eight of the nine sampled primary sites field (SAT) sites, resulting in a habitat utilisation estimate of approximately 88.89% of the otherwise available habitat. Three of the four supplementary sites were also positive for koala activity indicating that koalas are utilising the bulk of the site, including both remnant and non-remnant vegetation. Of the eleven positive sites, eight returned significant medium to high koala activity levels, with the resulting activity contours indicating the presence of resident animal/s across much of the study area with the highest activity in the central – east. SAT survey results are broadly aligned with a report by Cardno (2020) where six transects within the study area were traversed for koala faecal pellets. The primary discrepancy in the outcomes of this report compared to that of Cardo (2020) is that we report high koala activity in the north-eastern corner of the site, whereas Cardno (2020) recorded absence in this area.

The maximum notional koala carrying capacity of the site in the order of 20 koalas, based on calculations relying on the abundance of PKFTs within vegetation classified as either Primary, Secondary A or Secondary C habitat across the study area. This estimate assumes that areas mapped as high value regrowth have the same capacity to sustain koalas as mapped remnant vegetation - an assumption we consider reasonable given that all three SAT sites in high value regrowth returned significant high activity levels (Birk_03: 53.33%; Birk_07: 83.33%; Birk_08: 66.67%).

4.1 Connectivity Considerations

The proposed Birkdale Community Precinct is situated in the broader context of interconnected koala habitat throughout Redlands LGA, with other suitable habitat located on immediately adjacent lands to the north, west and south of the site (Biolink 2019). Modelled activity contours suggest that resident

koalas are likely to traverse these site boundaries, with no obvious barriers to koala movement in these locations, consisting as they do of mostly contiguous habitat. Tingalpa Creek, which bounds the study area to the south and west, is unlikely to seriously impede koala dispersal by virtue of the fact that the canopy is continuous across the creek in some sections and the width of the creek is < 5 m along several stretches. This applies predominantly to the south of Tingalpa Creek near the metal recycling plant (Jones Road) and Willards Farm Homestead. The maintenance of connectivity across these boundaries, and across the site itself, is important for the continued viability of the local koala population.

5. Recommendations

5.1 Future Development

Any future development of the Birkdale Community Precinct site should ideally avoid areas of significant koala activity, more so if removal of PKFTs is required. An exception to this is the cleared expanse in the middle of the site and weedy adjacent area dominated by *P. elliottii* and *Psidium guajava*. The 44-ha conservation area proposed by Cardo (2020) is a reasonable proxy for the areas to avoid in any possible future development of recreational infrastructure. Conversely, there are some large PKFTs located outside the proposed conservation area that require consideration. In the absence of extending the conservation area to incorporate all PKFTs ≥ 300 mm DBH, we recommend that these biodiversity assets are integrated into any development plan such that their removal is avoided and that Australian standards for Tree Protection Zones are followed. Retaining all large PKFTs will prevent placing nutritional stress on resident koalas and will serve a protective function by ensuring that areas of consolidated habitat do not become disconnected by any future development, by allowing animals to move in a 'stepping stone' fashion across non-habitat if required.

We recommend measures that will result in the exclusion of all domestic dogs from the site.

5.2 Fencing

Informed by the location of a koala vehicle-strike blackspot on Old Cleveland Road East along the eastern border of the site (Biolink 2019), koala-exclusion fencing should be installed along the length of this boundary (**Figure 8**). A variety of exclusion fencing is available and there is evidence that regardless of the type, fencing *per se* successfully deters the movement of koalas and so the potential for koala vehicle collisions (Phillips and Fitzgerald 2014). Current best practice fencing standard would imply the use of 1.5 m – 1.8 m high chain mesh wire in 3 – 5 m panels. In any wildlife exclusion fencing program and in the absence of koala-grids (see **Figure 9**) at each end of the fence line, there is the

potential for so-called 'fence-end issues', *i.e.* displacing vehicle-strikes from their current location to the ends of the fence line (van der Ree *et al.* 2015). This is best addressed by continuing the fence to a natural barrier or following the tree line away from the black spot. We suggest that at the southern boundary of the site, the fence line turns westward along Jones Road, adjacent to the recycling plant, ending at Tingalpa Creek. To the north, exclusion fencing should extend past the federally held lands directly to the north, and Birkdale Fodder Forest (near Creek Road), where fencing would turn westward and follow the tree line to meet residential fencing. To avoid trapping animals in the road corridor, this exclusion fencing should include one-way structures which would allow koalas to enter the site from the east (**Appendix D**).

Other than protecting koalas from a known vehicle-strike blackspot, fencing can also be used to great effect in excluding domestic dogs. We recommend fencing the northern boundary of the site with exclusion fencing, with the addition of two-way koala bridges at regular intervals, in order to support the continued dispersal of animals into and out of adjacent habitat (**Figure 8**, **Appendix D**). Such fencing already exists along the boundary with Howeston Golf Course, which should be modified with the addition of two-way koala bridges. Other existing fencing along the northern boundary of the site is barbed wire and would not enforce an exclusion principal.

Figure 8. Location and type of fencing to protect resident koalas from a vehicle-strike blackspot on Old Cleveland Road East (red), and prevent entry of domestic dogs to the site while supporting continued connectivity (blue). The location of a koala-grid at the entrance to the site is marked with a yellow star.

While exclusion fencing is an effective impediment to koala movement and has been shown to ameliorate vehicle mortality when correctly installed, there is a positive correlation between vehicle-strikes and entry nodes such as driveways that allow koalas access into fenced road corridors where they presumably become trapped (Phillips and Fitzgerald 2014). For this reason, we recommend that exclusion fencing be used in conjunction with specially constructed 'koala-grids' at entry points to the site (**Figure 8**). When located in driveways these koala-grids, which consist of a depression in the road covered by a grid of round pipes (**Figure 9**), are successful in preventing koalas from entering the road corridor (Biolink 2003 - 2009). This embodies best-practice design principals that will enforce exclusion by not allowing koalas to gain access to Old Cleveland Road East.

Figure 9. Example of EPBC-approved koala grid, fencing and signage used to manage access by koalas (Tip Road, Dunbogan, NSW).

5.3 Increasing Carrying Capacity

The notional carrying capacity of this site, calculated according to koala habitat classifications of the vegetation, is ~3 – 20 koalas. The number of koalas whose home ranges intersect with the site is not currently known, however SAT survey outcomes and observations made in the course of fieldwork suggest that it is closer to the minimum of this estimate. Increasing the carrying capacity of the site could be achieved by extending the geographic extent of koala habitat or by increasing the density of

PKFTs within existing habitat. This report recommends that a program of PKFT planting focus on areas in which overall native tree density is low, either in areas that are currently dominated by introduced species such as *P. elliottii,* in association with a weed control program, and/or in areas that support widely spaced, typically large PKFTs but exhibiting a current lack of recruitment. This circumstance is evident in some grassy paddock areas *e.g.* to the north-west of the communication / radio building. Plantings should utilise locally sourced heirloom seeds of the PKFT species currently found onsite, namely; *E. tereticornis*, *E. moluccana*, *E. microcorys* and *E. resinifera*.

5.4 Koala Management Plan

The Conservation Agreement pertaining to the study area that exists between Council and the Commonwealth requires RCC to develop a management plan for koalas and koala habitat. We recommend that the outcomes of this report be used to inform such a management plan. The management plan should also include a schedule for monitoring of the site using SAT methodology to inform on changes in koala activity levels and metapopulation structure over time. The SAT sites established by this study provide a baseline for such on-going monitoring.

Koala management of the site should include guidelines for koala-friendly development and construction to protect koalas from disturbance. By way of example these could include;

- Temporarily suspending the clearing of vegetation within a range of 25 m from any tree which is currently occupied by a koala until such time as the koala has moved from the tree by its own volition.
- Clearing of land should not commence until the area proposed for clearing has been inspected for the presence of koalas by a suitably qualified person and approved in writing.
- Approval to proceed with clearing is valid for the day on which the inspection is undertaken.

An alternative to the measures listed above is to temporarily fence any construction footprint with koala-proof fencing and enable dispersal of koalas from within the impact zone via one-way koala bridges (**Appendix D**).

Increasing the carrying capacity, as outlined in Section 5.3 above, is conceptually different to moving more koalas onto the site. If this were to be pursued in the form of assisted introductions, it would need to be qualified and follow a scientifically informed reintroduction program outlined in the management plan.

Koala management pertaining to the study area should also speak to the broader koala population. We recommend an evaluation of habitat connectivity across a geographic area that extends beyond the study area itself and incorporates such factors as barriers to local dispersal and effective connectivity elements in the environment.

References

Biolink. (2003 – 2009). *Management of koala issues in conjunctions with the proposed upgrading of Skyline Road*. Various reports for Lismore Council. Biolink Ecological Consultants, Uki, NSW.

Biolink. (2019). Redlands Coast Koala Population and Habitat Assessment. Report to Redlands City Council. Biolink Ecological Consultants, Uki, New South Wales.

Cardno. (2020). Ecological Assessment Report: Birkdale Land Survey. Report to Redland City Council. Cardno, Fortitude Valley, Queensland.

CSIRO. (1985). Division of soils: the soil landscapes of Brisbane and South-eastern Environs, Queensland. Adelaide, South Australia.

Phillips, S. and Callaghan, J. (2011). The spot assessment technique: a tool for determining localised levels of koala habitat use by koalas *Phascolarctos cinereus*. *Australian Zoologist,* **35**: 774-780.

Phillips, S. and Fitzgerald, M. (2014). *Review of koala road-kill data and issues associated with underpass use by koalas: Pacific Highway upgrades from Clothiers Creek to Ewingsdale*, NSW. Report to NSW Roads and Maritime Services. Biolink Ecological Consultants, Uki, NSW.

Smith, D.M., Larson, B.C., Kelty, M.J. and Ashton P.M.S. (1997). *The Practice of Silviculture: Applied Forest Ecology*. John Wiley & Sons, New York.

USC (University of Sunshine Coast). (2018). Redland Coast Koala Population Assessment Project. Report to Redlands City Council by University of Sunshine Coast, Detection Dogs for Conservation.

Van der Ree, R., Gagnon, J.W. and Smith, D.J. (2015). *Fencing: a valuable tool for reducing wildlife-vehicle collisions and funnelling fauna to crossing structures*. From Handbook of Road Ecology (eds. R. van der Ree, D.J. Smith and C. Grilo), John Wiley & Sons.

Appendix A

Site	Date	Easting	Northing	Activity	Site type	Activity category	Activity categorisation	Comments
Birk_01	26/05/2021	519930	6956689	3.33	primary	East Coast med-high	low	some lantana
Birk_02	26/05/2021	519670	6956943	30.00	primary	East Coast med-high	medium	4 x burnt scats found at trees 4,5,6,10
Birk_03	26/05/2021	519922	6956944	53.33	primary	East Coast med-high	high	grassy, big and small scats
Birk_04	26/05/2021	520173	6956935	0	primary	East Coast low	zero	dog scats found at tree 17 and tree 22
Birk_05	26/05/2021	519422	6957191	10.00	primary	East Coast med-high	low	dog scat at tree 8
Birk_07	26/05/2021	519936	6957190	83.33	primary	East Coast med-high	high	grassy
Birk_08	26/05/2021	520178	6957189	66.67	primary	East Coast med-high	high	dog scat on tree 19
Birk_09	27/05/2021	519418	6957444	30.00	primary	East Coast med-high	medium	mixed pellet age
Birk_10	26/05/2021	519671	6957447	20.00	primary	East Coast med-high	medium	grassy, loads of fallen branches - super spikey
Birk_A	27/05/2021	520063	6957327	16.67	supplementary	East Coast low	high	
Birk_B	27/05/2021	520302	6957331	33.33	supplementary	East Coast low	high	
Birk_C	27/05/2021	520053	6956823	0	supplementary	East Coast low	zero	grassy, dog scat at tree 21
Birk_D	27/05/2021	519562	6957077	3.33	supplementary	East Coast med-high	low	dog scat at tree 14 and 15. Grassy/weedy site, next to saltmarsh. Hard to rake.

Appendix B

Species	DBH (cm)	Easting	Northing
E. microcorys	21	520160.18	6957373.18
	21	520156.04	6957373.95
	23	520090.63	6957301.29
	26	520176.15	6957348.89
	31	519999.99	6957314.40
	33	520185.41	6957342.45
	36	520096.60	6957385.46
	37	520139.26	6957320.92
	38	520152.32	6957332.09
	41	520233.75	6957366.96
	74	520161.67	6957377.16
	79	520150.54	6957332.98
E. moluccana	11	519443.41	6957234.99
	11	519433.91	6957224.03
	12	519420.01	6957239.34
	12	519816.07	6957426.13
	12	519798.64	6957397.36
	12	519431.15	6957225.48
	13	519755.98	6957399.41
	13	519789.58	6957418.31
	13	519412.21	6957236.81
	13	519769.70	6957396.74
	13	519404.40	6957236.27
	13	519840.26	6957241.54
	14	519341.80	6957245.00
	14	519431.70	6957263.69
	14	519656.71	6957459.28
	14	519780.10	6957417.88
	15	519878.38	6957419.61
	15	519763.19	6957398.74
	15	519810.82	6957421.38
	15	519771.24	6957432.18
	15	519843.92	6957239.11
	15	519652.37	6957459.73
	16	519791.00	6957438.58
	16	519430.36	6957224.70
	16	519446.18	6957235.98
	16	519766.63	6957395.75
	16	519439.05	6957225.13
	16	519859.82	6957420.85

Species	DBH (cm)	Easting	Northing
E. moluccana	17	519802.65	6957432.35
	17	519574.43	6957457.31
	17	519758.42	6957386.24
	17	519402.27	6957262.85
	17	519426.81	6957222.83
	18	519788.80	6957418.42
	18	519798.79	6957427.93
	18	519416.20	6957267.15
	18	519457.43	6957230.75
	18	519432.55	6957235.45
	18	519763.28	6957392.76
	18	519376.37	6957247.94
	19	519411.76	6957268.04
	19	519377.04	6957231.44
	20	519443.32	6957241.41
	20	519424.56	6957245.43
	20	519640.47	6957430.40
	20	519443.21	6957233.10
	20	519376.54	6957229.89
	21	519344.76	6957243.45
	21	519807.76	6957418.72
	21	519772.73	6957438.72
	21	519830.82	6957389.33
	21	519360.96	6957245.75
	21	519736.00	6957444.64
	21	519808.18	6957433.56
	21	519433.88	6957203.32
	22	519806.39	6957428.13
	22	519371.26	6957262.68
	22	519364.63	6957253.94
	22	519622.94	6957465.21
	22	519798.35	6957218.80
	23	519722.02	6957410.77
	23	519870.88	6957423.93
	23	519396.06	6957269.29
	24	519790.67	6957417.75
	24	519478.45	6957219.42
	24	519760.21	6957392.10
	24	519389.71	6957253.90
	24	519664.41	6957454.29

Species	DBH (cm)	Easting	Northing
E. moluccana	24	519863.17	6957422.84
	25	519407.29	6957253.98
	25	519367.16	6957232.78
	25	519649.81	6957465.83
	25	519365.02	6957254.83
	25	519396.20	6957231.85
	25	519329.69	6957272.94
	25	519733.83	6957445.31
	25	519858.04	6957425.06
	25	519810.34	6957422.93
	25	519741.59	6957418.28
	26	519870.97	6957416.07
	26	519850.15	6957427.63
	26	519781.62	6957437.37
	26	519442.81	6957228.56
	27	519416.87	6957252.86
	27	519375.57	6957241.41
	27	519483.24	6957251.98
	27	519650.58	6957456.74
	27	519866.91	6957411.09
	27	519347.82	6957244.11
	27	519447.74	6957220.69
	27	519793.86	6957436.91
	28	519350.33	6957271.24
	28	519389.93	6957267.64
	28	519426.14	6957241.55
	28	519870.77	6957416.40
	28	519341.38	6957231.82
	29	519484.88	6957225.61
	29	519703.21	6957446.91
	29	519488.97	6957253.41
	29	519437.96	6957223.70
	29	519764.14	6957442.71
	30	519772.82	6957433.62
	30	519426.13	6957236.12
	30	519768.29	6957439.94
	30	519446.64	6957212.49
	31	519774.15	6957398.61
	31	519355.93	6957248.86
	31	519465.66	6957250.46
	31	519790.10	6957429.16
	32	519476.96	6957216.77
	32	519378.64	6957247.49

Species	DBH (cm)	Easting	Northing
E. moluccana	32	519738.32	6957415.84
	32	519769.17	6957437.17
	32	519410.81	6957289.42
	32	519357.65	6957273.67
	32	519384.09	6957256.90
	32	519800.57	6957427.48
	33	519745.24	6957419.49
	33	519470.70	6957250.78
	33	519800.76	6957428.70
	33	519659.34	6957434.13
	33	519661.42	6957437.01
	34	519349.72	6957255.96
	34	519796.40	6957418.62
	34	519436.96	6957278.53
	34	519330.93	6957244.02
	35	519773.59	6957425.42
	35	519479.17	6957236.92
	35	519659.65	6957441.44
	36	519725.67	6957410.77
	36	519314.86	6957258.01
	36	519320.71	6957278.16
	36	519649.20	6957455.09
	36	519382.26	6957224.56
	36	519805.00	6957421.71
	36	519395.44	6957251.46
	37	519405.13	6957194.73
	37	519320.32	6957276.16
	38	519382.40	6957250.04
	38	519415.04	6957218.64
	38	519595.45	6957443.65
	39	519599.72	6957455.39
	39	519788.50	6957418.97
	39	519840.36	6957427.64
	39	519378.81	6957226.23
	39	519571.48	6957401.93
	39	519768.64	6957411.47
	39	519469.17	6957222.76
	39	519815.08	6957180.56
	40	519386.80	6957225.00
	40	519782.90	6957437.15
	40	519592.89	6957450.63
	41	519364.03	6957250.18
	41	519326.77	6957232.95

Species	DBH (cm)	Easting	Northing
E. moluccana	41	519339.72	6957244.23
	41	519778.15	6957434.38
	41	519406.98	6957242.69
	41	519780.13	6957434.49
	41	519555.84	6957443.60
	42	519356.33	6957254.18
	42	519673.47	6957438.32
	42	519335.57	6957243.80
	43	519389.32	6957257.45
	43	519480.28	6957253.98
	43	519349.43	6957262.38
	44	519371.45	6957257.59
	44	519681.41	6957402.75
	44	519772.61	6957423.87
	45	519444.99	6957236.20
	45	519497.85	6957244.76
	45	519684.66	6957459.13
	45	519366.58	6957239.43
	45	519770.13	6957417.67
	45	519347.15	6957258.18
	45	519350.01	6957254.96
	46	519784.35	6957413.99
	46	519443.81	6957237.09
	46	519391.44	6957223.99
	46	519422.68	6957238.12
	46	519317.94	6957269.08
	47	519483.83	6957249.54
	48	519397.53	6957199.50
	48	519578.50	6957470.04
	48	519360.89	6957265.13
	48	519788.14	6957438.69
	49	519364.22	6957247.52
	49	519841.27	6957250.74
	50	519397.31	6957249.35
	50	519399.06	6957231.40
	50	519377.65	6957244.95
	50	519398.81	6957198.28
	51	519870.09	6957419.73
	52	519332.15	6957263.85
	53	519477.86	6957224.19
	53	519406.16	6957222.53
	54	519771.90	6957409.69
	55	519744.00	6957447.51

Species	DBH (cm)	Easting	Northing
E. moluccana	55	519795.92	6957426.60
	56	519448.79	6957199.53
	57	519781.89	6957421.86
	58	519720.70	6957451.31
	58	519869.77	6957406.32
	59	519326.20	6957246.58
	60	519779.61	6957410.37
	60	519577.80	6957464.61
	63	519779.41	6957415.55
	64	519857.61	6957403.80
	64	519858.41	6957405.35
	67	519772.09	6957405.49
	74	519863.94	6957405.89
	74	519480.76	6957244.56
	74	519705.30	6957454.77
	75	519347.95	6957262.16
	80	519770.25	6957430.19
	98	519419.62	6957244.22
	102	519470.29	6957244.91
	105	519491.35	6957255.18
E. resinifera	16	0.00	0.00
	46	0.00	0.00
E. tereticornis	11	519395.92	6957307.84
	11	520055.52	6956907.34
	11	520032.94	6956927.87
	11	520391.08	6957183.93
	11	519449.76	6957312.96
	11	520145.65	6956885.37
	11	519902.49	6957187.39
	11	519448.18	6957315.40
	11	520048.88	6956652.37
	11	520084.58	6956983.84
	11	519663.03	6957459.49
	11	520111.54	6956863.17
	11	520325.93	6957023.09
	11	519351.62	6957463.09
	11	520298.66	6957016.38
	11	519571.77	6957210.30
	11	519821.78	6956988.36
	11	520055.63	6956977.13
	11	520095.90	6956959.89
	11	520103.09	6956950.02
	12	520250.98	6956849.76

Species	DBH (cm)	Easting	Northing
E. tereticornis	12	519576.04	6957228.13
	12	519855.95	6956863.36
	12	519146.94	6957310.22
	12	520102.65	6956861.52
	12	520240.28	6956834.60
	12	519816.51	6956964.22
	12	520005.13	6956956.72
	12	520104.97	6956950.68
	12	519800.16	6957417.85
	12	520085.04	6957021.17
	12	520334.55	6957040.36
	12	520096.43	6956860.53
	12	519796.61	6957364.68
	12	519383.72	6957334.22
	12	519421.09	6957298.38
	12	520322.27	6957019.44
	12	520053.93	6956964.06
	12	520130.86	6956894.59
	12	520033.83	6956932.86
	13	519425.12	6957283.09
	13	519878.26	6956921.04
	13	519819.72	6957423.57
	13	519405.70	6957304.61
	13	520040.28	6956946.58
	13	519344.82	6957282.88
	13	519517.11	6957128.64
	13	519628.99	6956986.24
	13	519573.23	6957202.21
	13	519821.39	6957420.91
	13	519966.48	6956634.45
	13	520312.19	6957018.46
	13	520100.62	6956945.71
	13	520242.27	6956839.80
	13	520037.01	6957183.85
	13	520156.99	6956872.84
	13	519965.78	6956628.02
	13	519474.40	6957220.31
	13	519317.28	6957357.25
	13	520083.08	6956973.76
	13	519667.67	6957454.39
	14	519904.98	6956893.19
	14	519793.98	6957389.17
	14	519886.78	6956875.72

Species	DBH (cm)	Easting	Northing
E. tereticornis	14	520101.44	6956964.09
	14	520084.08	6956981.29
	14	519318.96	6957357.47
	14	519399.96	6957239.37
	14	520091.07	6957146.88
	14	520012.53	6956951.72
	14	520109.21	6956938.40
	14	520120.11	6956908.79
	14	519781.01	6956939.58
	14	519818.25	6956942.07
	14	519827.32	6957421.35
	14	520151.50	6956836.41
	14	520115.69	6956861.83
	14	519835.54	6956883.22
	14	520154.53	6956876.28
	14	520126.15	6956916.31
	14	520093.76	6957158.72
	14	520016.85	6957118.86
	14	519304.50	6957328.58
	14	520137.33	6956869.99
	15	519577.88	6957202.98
	15	520104.71	6956850.11
	15	520103.05	6956864.51
	15	520115.60	6956866.59
	15	519408.40	6957327.75
	15	520381.86	6957342.57
	15	520082.80	6957279.26
	15	519993.58	6956593.64
	15	519267.30	6957355.34
	15	519350.17	6957292.73
	15	519913.52	6956859.28
	15	519822.77	6956925.89
	15	520156.00	6956870.29
	15	520009.94	6956934.78
	15	520145.11	6956856.58
	15	520072.69	6956961.37
	15	519903.26	6956864.84
	15	519669.65	6956906.86
	15	520108.73	6956831.38
	15	519365.45	6957337.13
	15	520152.78	6956836.96
	15	520048.40	6956658.90
	15	519352.64	6957292.51

Species	DBH (cm)	Easting	Northing
E. tereticornis	15	520103.00	6956949.91
	15	520031.30	6957137.56
	15	520034.34	6956942.49
	16	520125.90	6957247.40
	16	520247.30	6956836.69
	16	519709.67	6956920.87
	16	519979.94	6957191.70
	16	520013.07	6957161.63
	16	519915.75	6957382.99
	16	519234.41	6957289.92
	16	520308.92	6957310.12
	16	519385.56	6957248.70
	16	519829.10	6957425.11
	16	519973.39	6957173.10
	16	519509.11	6957435.37
	16	520148.13	6956891.02
	16	520157.88	6956874.72
	16	520124.24	6956898.37
	16	519862.92	6956960.49
	16	519371.90	6957291.81
	16	520310.70	6957311.89
	16	520005.16	6957036.91
	16	519874.64	6956878.73
	16	519423.56	6957419.33
	16	519936.00	6956839.31
	16	520014.98	6957123.19
	16	519306.69	6957342.31
	16	519931.66	6956837.76
	16	520147.44	6956890.02
	16	520039.59	6956952.45
	16	520062.38	6957176.50
	16	520105.42	6957162.69
	17	520308.18	6957042.06
	17	519704.80	6956897.72
	17	520320.59	6957020.67
	17	519948.73	6957377.62
	17	519399.80	6957388.91
	17	519359.63	6957340.79
	17	519348.86	6957276.23
	17	519387.63	6957307.96
	17	520042.28	6956964.74
	17	520029.53	6956961.55
	17	520147.34	6956888.25

Species	DBH (cm)	Easting	Northing
E. tereticornis	17	520009.58	6956955.82
	17	520175.48	6957185.84
	17	520047.38	6957184.28
	17	519999.99	6957133.84
	17	519271.42	6957334.17
	17	519874.02	6956863.55
	17	520031.01	6956958.00
	17	519978.16	6957192.92
	17	520156.30	6956874.28
	17	520315.02	6956998.74
	17	519996.53	6957134.29
	17	520085.87	6957106.79
	17	519933.66	6957400.13
	17	520111.24	6956860.40
	17	519203.77	6957337.16
	17	519878.51	6956893.01
	17	519927.29	6956822.93
	17	520106.26	6956955.33
	17	520042.76	6956958.32
	17	520103.89	6956952.57
	17	520062.65	6956976.45
	18	519160.39	6957321.83
	18	520109.75	6956850.10
	18	520158.41	6956835.84
	18	519908.60	6956870.25
	18	519684.67	6957035.11
	18	520249.24	6957348.10
	18	520447.20	6957313.66
	18	519827.25	6957014.39
	18	519954.17	6956595.70
	18	519584.52	6957030.62
	18	520004.11	6957118.11
	18	519907.61	6957419.33
	18	520006.45	6957037.47
	18	519872.02	6956907.86
	18	519893.55	6957397.43
	18	519395.92	6957246.80
	18	519425.72	6957290.18
	18	520304.59	6957018.81
	18	519935.07	6956810.84
	18	519820.39	6956924.34
	18	519940.17	6956847.72
	18	520374.44	6957155.05

Species	DBH (cm)	Easting	Northing
E. tereticornis	18	520291.25	6957016.62
	18	519959.19	6957066.90
	18	520345.95	6957303.86
	18	520400.36	6957299.55
	18	519648.51	6956966.93
	18	519586.78	6957456.85
	18	519906.00	6956853.87
	18	520117.32	6956949.78
	18	519750.00	6956941.07
	18	520035.32	6957117.84
	18	520010.25	6957126.30
	18	520389.46	6957273.44
	18	519933.85	6957397.36
	18	519571.85	6957204.10
	18	520319.09	6957008.04
	18	519383.05	6957413.20
	18	519431.56	6957485.34
	18	520345.37	6957308.62
	18	519864.93	6956921.72
	18	520313.33	6957046.82
	18	519926.16	6957404.90
	18	519752.25	6956928.55
	18	520136.34	6956985.52
	18	519933.69	6956813.39
	18	519931.11	6956864.02
	18	519817.31	6956908.95
	18	519318.94	6957345.51
	18	519646.63	6956961.51
	18	519761.86	6957370.83
	19	520103.55	6956863.29
	19	519853.97	6956922.07
	19	519364.70	6957423.64
	19	519910.12	6957381.78
	19	519358.59	6957309.22
	19	520153.12	6957038.67
	19	519341.86	6957349.02
	19	520160.27	6956886.13
	19	519926.23	6956843.75
	19	519898.29	6957394.87
	19	519763.14	6957372.38
	19	519158.41	6957320.17
	19	519889.83	6956866.41
	19	519697.78	6956895.96

Species	DBH (cm)	Easting	Northing
E. tereticornis	19	520324.88	6957047.46
	19	520307.68	6957038.63
	19	519892.12	6956879.92
	19	519391.47	6957487.73
	19	519354.99	6957280.54
	19	520108.56	6956852.54
	19	519931.69	6957405.89
	19	519792.59	6956954.96
	19	519699.15	6957380.35
	19	519284.78	6957350.43
	19	519469.37	6957288.33
	19	519777.25	6956935.05
	19	519813.08	6956919.81
	19	520151.27	6956878.50
	19	519770.77	6957387.10
	19	520325.58	6957051.67
	19	519365.46	6957345.32
	19	519354.80	6957410.25
	19	519783.13	6956970.37
	19	519824.09	6956949.70
	19	519502.54	6957464.85
	20	520395.01	6957228.12
	20	519339.35	6957256.64
	20	519370.55	6957502.05
	20	519399.31	6957449.17
	20	519703.90	6956894.18
	20	519370.07	6957507.92
	20	520096.96	6957242.79
	20	520101.76	6956920.78
	20	519821.40	6956935.97
	20	520316.31	6956997.74
	20	519821.97	6956924.56
	20	519977.27	6957189.38
	20	519512.49	6957447.66
	20	519868.25	6956900.56
	20	519384.63	6957412.86
	20	519370.68	6957398.26
	20	519368.34	6957416.99
	20	520065.34	6957295.57
	20	520425.48	6957321.00
	20	519309.74	6957334.00
	20	519301.59	6957426.17
	20	520048.08	6957188.71

Species	DBH (cm)	Easting	Northing
E. tereticornis	20	519991.41	6957140.84
	20	520404.08	6957223.79
	20	520416.35	6957232.96
	20	520237.68	6957350.67
	20	519714.52	6956922.41
	20	519375.05	6957351.29
	20	520415.58	6957307.50
	20	519733.22	6956885.49
	20	519722.60	6956913.42
	20	520425.97	6957257.09
	20	520101.66	6956860.97
	20	519775.62	6956966.28
	20	520148.04	6957136.81
	20	519971.56	6956597.66
	20	519515.53	6957373.22
	20	519316.52	6957500.25
	20	519997.23	6957135.95
	20	519975.38	6957185.50
	20	519784.19	6956952.87
	20	520412.21	6957297.44
	20	520109.55	6957274.46
	21	520021.83	6957140.23
	21	519370.74	6957494.96
	21	520070.56	6957287.36
	21	520303.94	6957043.40
	21	519416.00	6957262.28
	21	520043.34	6957191.15
	21	519528.70	6957331.77
	21	519456.74	6957479.32
	21	519773.06	6956967.51
	21	520150.78	6957180.45
	21	519509.30	6957306.66
	21	519824.98	6956953.02
	21	520315.69	6957042.05
	21	519412.08	6957223.07
	21	519393.94	6957305.96
	21	519438.45	6957284.73
	21	519711.43	6956906.46
	21	520049.21	6957213.63
	21	519439.38	6957496.07
	21	520386.20	6957338.79
	21	519434.12	6957293.49
	21	519357.97	6957354.75

Species	DBH (cm)	Easting	Northing
E. tereticornis	21	520258.69	6957211.95
	21	519472.81	6957462.90
	21	519298.81	6957419.09
	21	520092.24	6957197.50
	21	519247.98	6957314.49
	21	519931.57	6957394.70
	21	520340.19	6957045.67
	21	520339.40	6957046.55
	21	520256.61	6957209.96
	21	519375.18	6957494.84
	21	520045.96	6957341.24
	21	519246.00	6957307.63
	21	519986.08	6957020.55
	21	519906.33	6957418.67
	21	519577.31	6957465.06
	21	519794.19	6956967.03
	21	519516.41	6957426.94
	21	519316.72	6957312.06
	21	519307.48	6957340.43
	21	519807.85	6956923.03
	22	519862.80	6956889.93
	22	519676.31	6956930.11
	22	519902.58	6957417.57
	22	519372.56	6957460.62
	22	520144.37	6957125.19
	22	519774.71	6956949.56
	22	520118.11	6956890.29
	22	520117.59	6956936.93
	22	520224.75	6957117.41
	22	519423.12	6957457.55
	22	519859.31	6956924.39
	22	519389.58	6957358.02
	22	520334.87	6957052.65
	22	519426.20	6957465.63
	22	520066.92	6957292.13
	22	519352.63	6957474.06
	22	520393.52	6957225.69
	22	519807.39	6956942.75
	22	519814.04	6956967.00
	22	519828.31	6956936.51
	22	519726.39	6957427.16
	22	519931.88	6956852.83
	22	519834.28	6956902.83

Species	DBH (cm)	Easting	Northing
E. tereticornis	22	519449.04	6957297.01
	22	520229.98	6957354.56
	22	520213.08	6957349.27
	22	519447.17	6957299.78
	22	519362.86	6957508.82
	22	520100.67	6956854.54
	22	520415.79	6957255.00
	22	519380.79	6957483.98
	22	519897.02	6956856.87
	22	519837.23	6956955.33
	22	519326.60	6957440.76
	22	520408.45	6957235.19
	22	519552.88	6957133.46
	23	520324.05	6957024.09
	23	520107.97	6956853.31
	23	520337.93	6957052.98
	23	519900.79	6957414.14
	23	520004.83	6957135.50
	23	520133.60	6957122.11
	23	519793.00	6956965.37
	23	519334.83	6957463.23
	23	519837.36	6956973.61
	23	520027.93	6957127.60
	23	519810.26	6956947.40
	23	520015.90	6957139.02
	23	519933.43	6956834.77
	23	519997.90	6957126.65
	23	519742.51	6957442.41
	23	519970.79	6957396.30
	23	519378.27	6957321.93
	23	519397.44	6957453.16
	23	520435.38	6957334.72
	23	519696.90	6956899.06
	23	520404.52	6957305.76
	23	519691.89	6957410.60
	23	519930.97	6956838.98
	23	519954.00	6957213.23
	23	519935.71	6956840.41
	23	519775.73	6956972.82
	23	520031.39	6957188.62
	23	519799.40	6956948.63
	23	519755.71	6956931.09
	23	519834.83	6957241.34

Species	DBH (cm)	Easting	Northing
E. tereticornis	23	519975.65	6957410.36
	23	519392.56	6957307.84
	23	519220.72	6957375.02
	23	520324.00	6957052.12
	23	520104.34	6957227.94
	23	520061.36	6957338.88
	23	519959.94	6957216.00
	23	519726.84	6956972.34
	23	519853.23	6956894.94
	23	520340.32	6957064.94
	23	519663.00	6956949.08
	23	519424.03	6957218.84
	23	519762.63	6956935.62
	23	520002.75	6957133.18
	23	519276.68	6957349.12
	23	520002.23	6957113.90
	23	520012.32	6957126.85
	23	519606.72	6957451.39
	23	519508.55	6957329.15
	23	519831.94	6956978.71
	23	519590.92	6957202.29
	24	520100.25	6956963.65
	24	520398.42	6957264.89
	24	519899.30	6956862.52
	24	520393.59	6957202.21
	24	520068.72	6957185.24
	24	519582.55	6957465.60
	24	519545.42	6957410.61
	24	520157.99	6956880.37
	24	519605.22	6957187.98
	24	519373.02	6957380.31
	24	519898.42	6956868.50
	24	520149.43	6956837.41
	24	519667.50	6956917.06
	24	520003.02	6957115.67
	24	520239.99	6956833.27
	24	519995.94	6957197.21
	24	519285.18	6957481.80
	24	519496.69	6957323.85
	24	520004.85	6957207.16
	24	520056.22	6957154.80
	24	519576.82	6957466.39
	24	519279.85	6957293.18

Species	DBH (cm)	Easting	Northing
E. tereticornis	24	520366.39	6957122.39
	24	519314.70	6957346.84
	24	520380.85	6957148.72
	24	519926.34	6957394.16
	24	519374.47	6957357.16
	24	519799.24	6957217.91
	24	520063.68	6957185.69
	24	519824.91	6956968.97
	24	519987.35	6957133.87
	25	519855.45	6956924.17
	25	519931.97	6957212.05
	25	519426.64	6957492.77
	25	519442.34	6957491.53
	25	519381.48	6957355.38
	25	519344.48	6957382.35
	25	520034.45	6956767.92
	25	520092.61	6957180.66
	25	519635.22	6956928.96
	25	520004.13	6957126.42
	25	519755.35	6956949.92
	25	519780.64	6956955.53
	25	519512.06	6957177.72
	25	519938.39	6957151.11
	25	520119.54	6957161.34
	25	519773.90	6957309.56
	25	519855.86	6956867.79
	25	519349.70	6957307.91
	25	520155.78	6957039.88
	25	519435.61	6957482.01
	25	519442.67	6957390.62
	25	520207.03	6957091.41
	25	519527.51	6957326.35
	25	519973.38	6957171.33
	25	520373.59	6957178.42
	25	520020.22	6957125.84
	25	519343.66	6957362.64
	25	519774.02	6956956.10
	25	519310.62	6957329.68
	25	519820.40	6956990.25
	25	519894.58	6957179.43
	25	520072.74	6957291.68
	25	519352.57	6957375.58
	25	519429.40	6957491.66

Species	DBH (cm)	Easting	Northing
E. tereticornis	25	519882.46	6956950.60
	25	519391.26	6957292.00
	25	519288.52	6957344.78
	25	519449.67	6957381.19
	25	519531.36	6957451.18
	25	519441.84	6957490.97
	25	519033.19	6956869.44
	25	519386.55	6957314.16
	25	520209.42	6957101.05
	25	519917.89	6956874.34
	25	519373.10	6957489.31
	25	519903.27	6956873.81
	25	519855.88	6956946.11
	25	519748.33	6956885.47
	25	519490.93	6957426.10
	25	519309.06	6957275.63
	25	519244.45	6957332.66
	25	520042.09	6957209.10
	25	519908.57	6956851.31
	25	520237.72	6956838.04
	25	520028.41	6957117.18
	25	520115.95	6957140.52
	25	520108.89	6956933.40
	26	519950.52	6957380.83
	26	519907.55	6956892.74
	26	520246.71	6956840.01
	26	519348.45	6957329.40
	26	519244.55	6957330.67
	26	519868.86	6956910.08
	26	519937.25	6956874.31
	26	519798.84	6956969.68
	26	519750.99	6956941.29
	26	520054.50	6956949.44
	26	519836.25	6957017.14
	26	519303.02	6957328.47
	26	519781.67	6956981.67
	26	519511.57	6957425.62
	26	519938.71	6957408.54
	26	519444.13	6957377.76
	26	519374.35	6957345.97
	26	520413.50	6957298.98
	26	519430.01	6957439.82
	26	519181.61	6957316.37

Species	DBH (cm)	Easting	Northing
E. tereticornis	26	519461.95	6957217.68
	26	519729.66	6957431.36
	26	519848.87	6956943.13
	26	520230.01	6956832.18
	26	520142.40	6956889.81
	26	519825.90	6956968.97
	26	519286.85	6957345.78
	26	519852.92	6956942.68
	26	519674.31	6956918.37
	26	519866.16	6956889.38
	26	519896.79	6956897.41
	26	519849.19	6956957.19
	26	520404.06	6957207.72
	26	519444.90	6957486.87
	26	519862.00	6956881.63
	26	519780.53	6956947.56
	26	519445.74	6957208.84
	26	519809.27	6956945.96
	26	519745.76	6956943.51
	26	520391.46	6957172.96
	26	520146.06	6957133.38
	26	519816.89	6956957.91
	26	519752.77	6956945.28
	26	520361.45	6957121.84
	26	519584.62	6957465.16
	26	520368.61	6957327.75
	26	519911.76	6957418.22
	26	519840.23	6957160.14
	27	519864.43	6956918.95
	27	519928.02	6957396.03
	27	520010.10	6957217.46
	27	519850.14	6956939.47
	27	519892.93	6956893.43
	27	520403.96	6957208.72
	27	519522.55	6957437.90
	27	520061.61	6956769.21
	27	519448.73	6957473.57
	27	519250.76	6957322.13
	27	519762.29	6956967.19
	27	519545.17	6957376.83
	27	519901.79	6957421.78
	27	520023.40	6957137.02
	27	520374.13	6957259.73

Species	DBH (cm)	Easting	Northing
E. tereticornis	27	519854.98	6956938.35
	27	519904.10	6956899.73
	27	519247.19	6957313.94
	27	519891.46	6956901.30
	27	519880.56	6956879.27
	27	519901.20	6956875.14
	27	519863.92	6956906.99
	27	519872.83	6956918.72
	27	520018.23	6957114.43
	27	520117.55	6957150.27
	27	520117.35	6957151.71
	27	519688.49	6957446.60
	27	519761.42	6956976.72
	27	519303.17	6957488.75
	27	519761.46	6956940.61
	27	519908.45	6957384.78
	27	519842.21	6957164.68
	27	519387.33	6957306.52
	27	519872.80	6956901.77
	27	520416.36	6957236.95
	27	519407.90	6957326.09
	27	519422.78	6957428.64
	27	519350.39	6957372.60
	27	519919.41	6956835.90
	27	519931.86	6957142.04
	27	519930.13	6957172.95
	27	519846.75	6956917.65
	27	519267.79	6957411.49
	27	519692.45	6957447.82
	27	519817.39	6956961.34
	27	520200.01	6957326.25
	28	519878.00	6956880.72
	28	519439.18	6957490.42
	28	519921.19	6956655.12
	28	519374.40	6957503.37
	28	519385.90	6957341.52
	28	519709.04	6956897.72
	28	519428.26	6957398.50
	28	519913.85	6956883.10
	28	520036.53	6957135.11
	28	519257.47	6957384.04
	28	520089.29	6957141.78
	28	519936.01	6957145.14

Species	DBH (cm)	Easting	Northing
E. tereticornis	28	519805.31	6956882.16
	28	519964.13	6957187.85
	28	520127.75	6956750.27
	28	519677.49	6956927.01
	28	519559.00	6957130.02
	28	519436.60	6957484.11
	28	519876.83	6956891.57
	28	520179.97	6957032.64
	28	519719.11	6956955.08
	28	519900.66	6956906.93
	28	519728.66	6957428.26
	28	520029.53	6957141.66
	28	520027.53	6957127.15
	28	520045.73	6957203.44
	28	519299.03	6957366.03
	28	519298.08	6957332.69
	28	519498.47	6957323.96
	28	519524.82	6957433.68
	28	519508.06	6957267.45
	28	519586.10	6957465.71
	28	520130.06	6956890.05
	28	520155.04	6956887.24
	28	519725.15	6956902.23
	28	520423.70	6957253.66
	28	519698.84	6956939.71
	28	520254.13	6956845.98
	28	519661.32	6956945.42
	28	519843.81	6956929.62
	28	520005.93	6957142.81
	28	519625.47	6956947.92
	28	519587.79	6957469.14
	28	519917.14	6956838.78
	28	520027.91	6957113.42
	28	520374.11	6957251.97
	28	520082.48	6957386.70
	28	519908.29	6957404.82
	28	519754.93	6957422.35
	29	519871.88	6956945.97
	29	520447.30	6957312.55
	29	519413.93	6957263.39
	29	519502.22	6957198.56
	29	519532.36	6957393.13
	29	519286.86	6957356.19

Species	DBH (cm)	Easting	Northing
E. tereticornis	29	519447.29	6957377.65
	29	519776.53	6956976.70
	29	519348.66	6957336.16
	29	519996.73	6956769.98
	29	519306.82	6957485.65
	29	519601.83	6957049.86
	29	519302.00	6957374.55
	29	519360.49	6957383.66
	29	519845.56	6956914.89
	29	520028.89	6957112.20
	29	520405.07	6957280.06
	29	519537.66	6957376.51
	29	519833.35	6957000.53
	29	519282.67	6957328.62
	29	519988.15	6957142.50
	29	519653.86	6957039.03
	29	519834.16	6956947.03
	29	519814.15	6956971.76
	29	519582.35	6957032.94
	29	519301.61	6957315.41
	29	519512.93	6957414.65
	29	520408.27	6957300.77
	29	520425.69	6957324.33
	29	520125.52	6957255.93
	29	519880.18	6956945.18
	29	520339.60	6957049.32
	29	519862.35	6956914.19
	29	520069.96	6957342.31
	29	519311.67	6957366.23
	29	519785.60	6956971.25
	29	519838.85	6956979.81
	29	519304.26	6957427.28
	29	519911.33	6957397.72
	30	519871.27	6956874.75
	30	519740.63	6957434.66
	30	519407.33	6957464.00
	30	519910.43	6956900.60
	30	520438.59	6957302.04
	30	520111.73	6957219.17
	30	519385.00	6957331.11
	30	519974.92	6956777.66
	30	519827.58	6956973.29
	30	519784.54	6956982.55

Species	DBH (cm)	Easting	Northing
E. tereticornis	30	519898.67	6956899.96
	30	519380.68	6957476.00
	30	519416.15	6957421.12
	30	519890.39	6956907.17
	30	520225.55	6957363.87
	30	519747.05	6956950.93
	30	519817.93	6956990.58
	30	519293.98	6957483.45
	30	519341.06	6957401.96
	30	519942.52	6956836.86
	30	519305.16	6957311.41
	30	519988.75	6957148.48
	30	519500.38	6957345.88
	30	519505.05	6957425.30
	30	519912.80	6957392.96
	30	519412.45	6957264.28
	30	519715.40	6956921.30
	30	519376.07	6957495.73
	30	519416.73	6957473.95
	30	519300.28	6957350.08
	30	520241.24	6956817.98
	30	520020.55	6957143.67
	30	519987.27	6957147.27
	30	519816.57	6956941.30
	30	519541.65	6957335.63
	30	519827.46	6956960.66
	30	520233.44	6956818.99
	31	520324.74	6957020.22
	31	520330.99	6957036.93
	31	519382.89	6957245.27
	31	519397.98	6957486.39
	31	520021.55	6957335.08
	31	519667.83	6956943.97
	31	520030.57	6957111.86
	31	520112.47	6957124.69
	31	519931.30	6956859.25
	31	519307.62	6957364.24
	31	519619.35	6956948.70
	31	519358.30	6957440.15
	31	519395.01	6957477.64
	31	519403.59	6957095.92
	31	519692.48	6957410.27
	31	520093.87	6957163.82

Species	DBH (cm)	Easting	Northing
E. tereticornis	31	519466.90	6957470.99
	31	519789.63	6956957.29
	31	519844.24	6956955.21
	31	520131.52	6957119.67
	31	519779.06	6956952.65
	31	519264.33	6957287.11
	31	520423.89	6957310.92
	31	520031.16	6957110.53
	31	519908.25	6956898.06
	31	519901.82	6956892.53
	31	519417.92	6957412.14
	31	519457.80	6957279.49
	31	519275.65	6957448.59
	31	519611.36	6956958.13
	31	519464.65	6957360.67
	31	519529.10	6957397.35
	31	520131.56	6957144.93
	31	519805.74	6957022.40
	31	519822.62	6957017.38
	31	519808.96	6956942.08
	31	519815.92	6956967.55
	31	520371.88	6957216.09
	32	519436.43	6957439.92
	32	519376.55	6957487.20
	32	520397.08	6957286.38
	32	519646.99	6956939.91
	32	519525.22	6957378.19
	32	519781.13	6956954.64
	32	520382.56	6957164.56
	32	519849.98	6956899.26
	32	519835.58	6956972.50
	32	520177.03	6957163.57
	32	519939.09	6956856.25
	32	520062.05	6957339.55
	32	520399.39	6957308.76
	32	520028.21	6957239.36
	32	519916.54	6956893.28
	32	520025.95	6957246.79
	32	520000.88	6957258.46
	32	519900.62	6956885.55
	32	519999.55	6957353.05
	32	519785.97	6956950.98
	32	519285.45	6957464.75

Species	DBH (cm)	Easting	Northing
E. tereticornis	32	519582.45	6957464.94
	32	519932.03	6957129.30
	32	519915.24	6956827.27
	32	519621.40	6956935.63
	32	519598.87	6957048.32
	32	519248.33	6957347.28
	32	520020.81	6957120.08
	32	519899.33	6957303.81
	32	519381.12	6957500.59
	32	519978.21	6957220.61
	32	519850.71	6957411.01
	32	519392.46	6957244.26
	32	519858.72	6956925.94
	32	519389.69	6957490.83
	32	519441.20	6957393.83
	32	519378.09	6957210.83
	32	520122.14	6957122.90
	32	519976.26	6957177.75
	32	519788.85	6956963.16
	32	519794.91	6956984.75
	32	519380.46	6957209.39
	32	519783.25	6957165.65
	32	520184.25	6957109.95
	32	519848.49	6956896.60
	32	520411.83	6957303.41
	32	519747.60	6956928.24
	32	519889.58	6956954.91
	32	520410.85	6957309.73
	32	519352.27	6957374.36
	32	519685.12	6956946.38
	32	519659.49	6956977.77
	32	520082.35	6957185.88
	32	519948.72	6957184.99
	32	520001.69	6956784.59
	32	519762.26	6956949.36
	32	519937.45	6956819.59
	32	519484.54	6957322.87
	32	519592.90	6957020.63
	32	519786.39	6956966.05
	32	519593.10	6957021.41
	32	519608.91	6957028.25
	32	519745.63	6956922.36
	33	519845.94	6957390.08

Species	DBH (cm)	Easting	Northing
E. tereticornis	33	520094.16	6957283.12
	33	519850.80	6956918.53
	33	520133.05	6957150.13
	33	519777.42	6956981.57
	33	519616.03	6957034.55
	33	519970.32	6957171.89
	33	519983.48	6957186.15
	33	519683.07	6956896.54
	33	520055.76	6957351.86
	33	520373.89	6957237.79
	33	519865.80	6956912.31
	33	519370.15	6957499.84
	33	519854.26	6956922.40
	33	520048.75	6957176.85
	33	519829.12	6956947.26
	33	520042.05	6957187.83
	33	520002.77	6956778.27
	33	519317.11	6957498.59
	33	520038.30	6957185.51
	33	519951.83	6956856.56
	33	519982.99	6957187.04
	33	519897.75	6957241.56
	33	519816.09	6956953.37
	33	519897.84	6957238.46
	33	520325.45	6957034.73
	33	520011.61	6957112.45
	33	519945.61	6956854.13
	33	519935.83	6957403.89
	33	519370.46	6957505.71
	33	520049.00	6957147.28
	33	519588.87	6957033.71
	33	519533.58	6957166.72
	33	520300.03	6957189.07
	33	519887.06	6957409.84
	34	520059.60	6957347.09
	34	520066.32	6956684.68
	34	519943.44	6957401.33
	34	519362.77	6957454.32
	34	519864.78	6956889.05
	34	520087.23	6957213.68
	34	519481.46	6957248.88
	34	520184.63	6957161.34
	34	519776.04	6956983.23

Species	DBH (cm)	Easting	Northing
E. tereticornis	34	519940.22	6957182.24
	34	520052.42	6957188.03
	34	519835.41	6957416.24
	34	519567.00	6957131.89
	34	520097.80	6956851.45
	34	519438.96	6957478.90
	34	519896.24	6956862.19
	34	520080.41	6957211.80
	34	519386.50	6957346.73
	34	520058.23	6957355.95
	34	519405.73	6957449.82
	34	519853.72	6957252.93
	34	520091.37	6957208.68
	34	519663.03	6957456.95
	34	519921.67	6957131.98
	34	520005.44	6957145.36
	34	519825.03	6956981.27
	34	520105.26	6956762.82
	34	519899.10	6956922.11
	34	519833.47	6956952.01
	34	519898.96	6957383.34
	34	520057.83	6957354.51
	34	519827.47	6956965.20
	34	520049.03	6957349.76
	35	520381.89	6957239.22
	35	519894.99	6956944.82
	35	519431.27	6957486.67
	35	519535.45	6957229.41
	35	519890.84	6956942.73
	35	519614.72	6956956.80
	35	520368.53	6957223.40
	35	519796.39	6957412.53
	35	519795.11	6957416.64
	35	519666.87	6956955.38
	35	519919.95	6956868.46
	35	519807.98	6957189.98
	35	519650.90	6956975.24
	35	519506.35	6957434.05
	35	520329.19	6957202.20
	35	519809.52	6956981.52
	35	520012.89	6957112.56
	35	519471.73	6957340.17
	35	519649.80	6956970.36

Species	DBH (cm)	Easting	Northing
E. tereticornis	35	519646.47	6956921.85
	35	519779.99	6956977.35
	35	519349.10	6957365.18
	35	520119.62	6957150.60
	35	520032.61	6957391.66
	35	519590.81	6957134.73
	35	520013.78	6957112.89
	35	519696.22	6956905.93
	35	519608.04	6957039.44
	35	519545.98	6957146.76
	35	519895.73	6957400.85
	35	519602.95	6957135.16
	36	519420.54	6957445.70
	36	519940.33	6957373.09
	36	520379.28	6957270.46
	36	519215.05	6957285.86
	36	519716.76	6956906.79
	36	519505.32	6957471.60
	36	520014.87	6957111.56
	36	519609.42	6957039.66
	36	520052.97	6957159.90
	36	519927.35	6956864.35
	36	519377.80	6957215.15
	36	519919.64	6957404.25
	36	520424.32	6957273.49
	36	519923.45	6957133.30
	36	519914.90	6957162.23
	36	519976.45	6957176.64
	36	519850.52	6956927.17
	36	519640.14	6956916.88
	36	519946.34	6956819.79
	36	519869.93	6957386.17
	36	519895.33	6957396.09
	36	519852.89	6956930.05
	36	519707.94	6956887.97
	36	519924.38	6956859.93
	36	519873.80	6956908.75
	36	519646.39	6956934.04
	36	519917.17	6957403.26
	36	519868.38	6956918.95
	36	519852.53	6957011.13
	36	519500.22	6957181.06
	36	519817.93	6956988.15

Species	DBH (cm)	Easting	Northing
E. tereticornis	37	519948.02	6956818.79
	37	519891.22	6957294.86
	37	519931.42	6956873.32
	37	520172.96	6957154.94
	37	519830.47	6956988.90
	37	519915.13	6957181.50
	37	519479.85	6957351.79
	37	519929.48	6957139.94
	37	519617.26	6956940.95
	37	519542.81	6957321.78
	37	519858.63	6957420.85
	37	520424.28	6957307.82
	37	519426.55	6957498.09
	37	519504.99	6957263.91
	37	519627.57	6957394.64
	37	520302.03	6957264.17
	37	519373.59	6957489.31
	37	519976.43	6957402.83
	37	520013.46	6957217.23
	37	519549.07	6957158.83
	37	519603.28	6957031.25
	37	520204.54	6957136.28
	37	520036.93	6957135.00
	37	519526.71	6957197.97
	37	519469.83	6957391.68
	37	519664.01	6957462.26
	37	519831.63	6956970.07
	37	519801.61	6956974.33
	37	519631.30	6956947.35
	37	519279.93	6957341.91
	38	520316.28	6957278.65
	38	519943.53	6956850.92
	38	519875.79	6956917.94
	38	519659.63	6956939.55
	38	520265.45	6957359.93
	38	519670.69	6957432.90
	38	519990.88	6957119.13
	38	520134.40	6957127.31
	38	520003.08	6957153.22
	38	520138.46	6957135.28
	38	519847.28	6956937.04
	38	519839.80	6957017.91
	38	520029.62	6956772.36

Species	DBH (cm)	Easting	Northing
E. tereticornis	38	519797.35	6957027.28
	38	519498.93	6957242.10
	38	519802.29	6956966.57
	38	520107.19	6956860.29
	38	519862.00	6956940.00
	38	519380.49	6957292.68
	38	519385.51	6957469.90
	38	519824.34	6956984.48
	38	519257.44	6957427.57
	38	519543.40	6957380.49
	38	520006.39	6957124.97
	38	519582.57	6957047.79
	38	519165.23	6957324.26
	38	520397.79	6957239.30
	38	520142.65	6957219.12
	38	519579.60	6957046.24
	38	519917.23	6957134.64
	38	519304.05	6957481.44
	38	519514.99	6957217.15
	38	519378.00	6957216.70
	38	520118.98	6957122.35
	38	519711.00	6957440.70
	38	520080.86	6957181.56
	38	519926.42	6957200.65
	38	519915.25	6956828.71
	38	519455.97	6957433.02
	38	519826.05	6957003.42
	38	519702.39	6957428.19
	39	520327.32	6957026.30
	39	519661.53	6956952.62
	39	519423.47	6957491.89
	39	520335.27	6957056.20
	39	520159.17	6957114.64
	39	520391.28	6957180.94
	39	519906.50	6956916.23
	39	519617.56	6956942.06
	39	520000.00	6957202.63
	39	519526.53	6957393.25
	39	519534.04	6957456.27
	39	519522.20	6957401.45
	39	519786.22	6957168.53
	39	519895.08	6956939.06
	39	519844.47	6956975.15

Species	DBH (cm)	Easting	Northing
E. tereticornis	39	519799.56	6956991.39
	39	519524.79	6957166.84
	39	519932.29	6957168.40
	39	519522.24	6957301.87
	39	519878.17	6957287.24
	39	519859.44	6956944.11
	39	519435.92	6957489.98
	39	519505.50	6957397.16
	39	519686.69	6957433.20
	39	520150.81	6957140.02
	39	519282.99	6957343.68
	39	520376.99	6957143.86
	39	519491.53	6957309.12
	40	519881.58	6957142.12
	40	520332.08	6957038.92
	40	519975.41	6957204.44
	40	519277.70	6957434.96
	40	519538.98	6957209.69
	40	519669.50	6957428.58
	40	519820.32	6957004.54
	40	519830.51	6957015.49
	40	519788.29	6957042.36
	40	519991.89	6956585.89
	40	520064.14	6957168.52
	40	519529.04	6957170.27
	40	519647.30	6956947.55
	40	519915.04	6956885.75
	40	519738.17	6956893.35
	40	520359.76	6957112.76
	40	519613.76	6957036.55
	40	520014.16	6957161.96
	40	520012.13	6956583.75
	40	519944.98	6956832.53
	40	520121.99	6957150.15
	41	520444.51	6957300.37
	41	519193.22	6957284.45
	41	519814.82	6956957.25
	41	519906.80	6956919.33
	41	519822.61	6957011.84
	41	519949.99	6957178.34
	41	519616.24	6957041.31
	41	519515.78	6957219.03
	41	519360.24	6957353.42

Species	DBH (cm)	Easting	Northing
E. tereticornis	41	519871.54	6957161.30
	41	519915.38	6957152.81
	41	519534.77	6957360.23
	41	519762.58	6956961.87
	41	519761.50	6956969.08
	41	519420.63	6957254.63
	41	519961.58	6957263.06
	41	519850.16	6956951.76
	41	519588.38	6957408.00
	41	519923.84	6956950.76
	41	519620.46	6956964.21
	41	520314.64	6957004.95
	41	519761.87	6956952.46
	41	519791.94	6956981.88
	42	519858.74	6957250.49
	42	519912.02	6957393.18
	42	520378.27	6957140.64
	42	519952.22	6957392.12
	42	519817.79	6957024.81
	42	519991.93	6957395.93
	42	519947.36	6957384.27
	42	519348.73	6957378.91
	42	519879.10	6956949.61
	42	520011.09	6957154.87
	43	519351.01	6957509.28
	43	519864.04	6956922.94
	43	519941.99	6957362.56
	43	519200.35	6957298.51
	43	519810.46	6957013.75
	43	520151.69	6957129.83
	43	519285.17	6957475.60
	43	519914.77	6957142.51
	43	519487.15	6957284.21
	43	519347.25	6957380.58
	43	519371.76	6957455.31
	43	519956.19	6957225.19
	43	519838.38	6957421.11
	43	519657.58	6956953.85
	43	519684.98	6957412.83
	43	519965.18	6957165.69
	43	519796.90	6956994.39
	43	519925.82	6956832.23
	43	520031.58	6957125.37

Species	DBH (cm)	Easting	Northing
E. tereticornis	43	519992.92	6957220.81
	43	520365.06	6957216.21
	43	519583.04	6957035.05
	43	519462.26	6957409.19
	43	519826.00	6956971.08
	43	519567.19	6957438.38
	43	519800.22	6956972.12
	43	520184.18	6957373.57
	44	519932.35	6957140.93
	44	519492.62	6957435.06
	44	519835.12	6957420.45
	44	519378.24	6957492.07
	44	519940.51	6957360.69
	44	519825.69	6956965.21
	44	519811.73	6957190.86
	44	519993.00	6957329.92
	44	520096.19	6957134.35
	44	519931.35	6957134.51
	44	519801.45	6956938.88
	44	520255.01	6956841.11
	44	519810.43	6957416.94
	44	519524.08	6957284.04
	45	520325.19	6957054.55
	45	519781.79	6957421.53
	45	519991.17	6957238.20
	45	519979.19	6957216.62
	45	519859.53	6956939.01
	45	520045.67	6957103.20
	45	519600.34	6957045.77
	45	519465.66	6957188.10
	45	519640.59	6956955.31
	45	519329.82	6957475.42
	45	519484.46	6957458.01
	45	519298.05	6957245.63
	45	520376.95	6957296.83
	45	519779.80	6957166.76
	45	519941.58	6956869.65
	45	519524.42	6957188.11
	45	519954.79	6956793.20
	45	520331.19	6957277.19
	45	519641.40	6956967.16
	45	519823.09	6957006.31
	45	520303.62	6957269.15

Species	DBH (cm)	Easting	Northing
E. tereticornis	46	520248.11	6956848.98
	46	519553.72	6957290.08
	46	519812.01	6956992.03
	46	520136.13	6957222.35
	46	519747.12	6956933.43
	46	519185.97	6957320.46
	46	519358.33	6957329.49
	46	520170.77	6957144.97
	46	519293.95	6957277.42
	46	520148.71	6957183.56
	46	519613.64	6957022.93
	46	520022.04	6957336.07
	46	519527.76	6957422.94
	46	520034.14	6957118.39
	46	519346.15	6957500.43
	46	519474.63	6957365.75
	46	519510.36	6957227.35
	46	519471.34	6957406.41
	46	520372.36	6957151.29
	46	520033.27	6957133.24
	46	519977.16	6957365.39
	46	519662.62	6956958.60
	46	519849.84	6956994.96
	46	519783.64	6956979.45
	46	519507.43	6957181.05
	46	520148.12	6957185.88
	46	519549.00	6957301.61
	47	519997.60	6957121.55
	47	519671.30	6956947.29
	47	519587.01	6957047.78
	47	519476.92	6957186.97
	47	519652.94	6956958.40
	47	520357.62	6957252.55
	47	519555.86	6957330.84
	47	519906.89	6957157.04
	47	519781.55	6956969.04
	47	519263.39	6957438.31
	48	519439.76	6957483.33
	48	519981.69	6957360.73
	48	519312.66	6957246.16
	48	519901.74	6956901.39
	48	519319.21	6957512.32
	48	520079.28	6956581.31

Species	DBH (cm)	Easting	Northing
E. tereticornis	48	519746.14	6956933.88
	48	519807.83	6957032.14
	48	519845.06	6957034.18
	48	519697.33	6956921.66
	48	519953.76	6957367.75
	48	520122.30	6957158.46
	48	519899.00	6956919.56
	48	519756.28	6956976.28
	48	520104.36	6956640.53
	48	519930.04	6957303.54
	48	519489.33	6957415.24
	49	519950.99	6957367.20
	49	519403.49	6957097.47
	49	519907.81	6956933.73
	49	519285.85	6957339.80
	49	519855.97	6956998.28
	49	519787.56	6956958.95
	49	519408.16	6957113.86
	49	519780.36	6956965.06
	49	519496.21	6957210.64
	50	519856.88	6957196.22
	50	519843.41	6956988.66
	50	520060.92	6956584.34
	50	520368.60	6957146.97
	50	520379.68	6957157.14
	50	519906.57	6956900.94
	50	519855.29	6957368.91
	50	519524.76	6957458.61
	50	519760.24	6956982.70
	50	519965.08	6956805.81
	50	519891.35	6957136.45
	51	519794.35	6956884.62
	51	519484.01	6957237.58
	51	519918.13	6957385.64
	51	520009.26	6957247.26
	51	519732.22	6957427.37
	51	519693.38	6957415.47
	51	519583.74	6957035.82
	51	519599.08	6957054.85
	51	519801.44	6957050.87
	51	519349.51	6957497.10
	51	519848.59	6957014.68
	51	519842.57	6957016.13

Species	DBH (cm)	Easting	Northing
E. tereticornis	51	519785.48	6956955.08
	51	519541.50	6957431.11
	52	520014.02	6957139.03
	52	520326.27	6957228.01
	52	520306.62	6957172.00
	52	519995.06	6957197.54
	52	520041.60	6956911.69
	52	519931.66	6956598.95
	52	519975.39	6957127.57
	52	519503.11	6957450.44
	52	519916.43	6957133.65
	52	519799.01	6956954.84
	52	519246.25	6957407.54
	53	519501.74	6957270.23
	53	520015.83	6957156.08
	53	519688.54	6957412.82
	53	520016.83	6957161.62
	53	519312.64	6957419.40
	53	520119.63	6957153.81
	53	520078.45	6957216.46
	53	519890.94	6957184.64
	53	519662.29	6956935.56
	53	519863.81	6956959.83
	53	520167.23	6957150.63
	53	519828.90	6956995.33
	53	519602.62	6957045.76
	53	520385.03	6957164.56
	53	519889.21	6957154.85
	53	519850.36	6957014.02
	53	519893.81	6956944.05
	53	519297.35	6957242.42
	53	519889.80	6957154.96
	53	519900.09	6956919.45
	53	519288.72	6957472.38
	54	519897.49	6957390.33
	54	520038.47	6957107.75
	54	519709.91	6957434.94
	54	519564.39	6957349.44
	54	520091.44	6956651.08
	54	519860.32	6957369.45
	54	519447.79	6957194.33
	54	519917.71	6956944.68
	54	520083.52	6956995.36

Species	DBH (cm)	Easting	Northing
E. tereticornis	54	520024.45	6957176.34
	54	519783.35	6957164.10
	54	519893.51	6956943.50
	54	519552.17	6957368.95
	55	519895.16	6957410.16
	55	520407.64	6957281.27
	55	519940.99	6957172.93
	55	519511.03	6957214.39
	55	519867.25	6957377.64
	55	519318.22	6957323.02
	55	519348.57	6957470.74
	55	519854.07	6957409.00
	55	520061.16	6957217.15
	55	519324.58	6957287.46
	55	519532.59	6957289.12
	56	519851.02	6956930.16
	56	519819.81	6957170.36
	56	519519.01	6957326.25
	56	520439.06	6957288.52
	56	520374.11	6957133.23
	56	519882.58	6956963.45
	56	519506.71	6957289.83
	56	519708.02	6957425.19
	56	519675.31	6957419.82
	56	519618.48	6957024.80
	57	519874.07	6956952.94
	57	519758.19	6957121.05
	57	519932.92	6956822.81
	57	519582.99	6957432.15
	57	519809.98	6957138.47
	57	519852.30	6956930.94
	57	519887.42	6956902.30
	57	519863.99	6956953.29
	57	519750.81	6956954.58
	57	519973.05	6957270.13
	58	520046.43	6957206.54
	58	519970.05	6956699.46
	58	519991.74	6957342.77
	58	520041.98	6957204.67
	58	520161.89	6957149.97
	58	519948.60	6957176.68
	58	519851.44	6957254.16
	58	519581.07	6957469.59

Species	DBH (cm)	Easting	Northing
E. tereticornis	59	520061.84	6957147.15
	59	519884.63	6957253.55
	59	519533.32	6957194.74
	59	519793.44	6957417.41
	59	519889.88	6957382.70
	59	520135.36	6957113.91
	60	520345.72	6957106.03
	60	520186.45	6957112.35
	60	519945.00	6957266.19
	60	519699.83	6957431.19
	60	520014.05	6957215.24
	60	519993.74	6957359.49
	60	519895.27	6957296.40
	60	519595.82	6957055.41
	60	519748.87	6956977.52
	60	519666.18	6957451.29
	60	519855.18	6957180.83
	60	520341.87	6957108.36
	61	520370.86	6957136.89
	61	519971.51	6957356.09
	61	519862.66	6956980.99
	61	519299.44	6957443.01
	61	520315.05	6957013.81
	61	519768.71	6956964.41
	61	519757.99	6957117.29
	61	519993.05	6957358.05
	61	519933.46	6956608.80
	61	520138.64	6957181.69
	61	520019.55	6956772.82
	61	519926.55	6956975.34
	62	519347.63	6957499.87
	62	519530.40	6957216.57
	62	519833.99	6957024.34
	62	520119.41	6957144.73
	62	519996.29	6957228.89
	62	519577.70	6957458.30
	62	520279.03	6957153.66
	62	519806.65	6957035.02
	62	519819.66	6957022.59
	62	519905.62	6957162.35
	62	519497.34	6957237.00
	62	519842.71	6957044.16
	63	520094.59	6957184.09

Species	DBH (cm)	Easting	Northing
E. tereticornis	63	519920.49	6957321.17
	63	519907.13	6956937.16
	63	519841.79	6956961.97
	63	520151.29	6957191.86
	63	519898.73	6957361.41
	64	519525.14	6957143.80
	64	520058.83	6957181.05
	64	519610.03	6957047.19
	64	519667.76	6957452.18
	64	519955.07	6957387.02
	64	519591.44	6957158.88
	65	519966.68	6957241.34
	65	519841.92	6957411.58
	65	519895.09	6956945.82
	65	519848.11	6957146.72
	65	519530.77	6957206.49
	66	519996.74	6957262.12
	66	520085.49	6957235.61
	66	519605.83	6957452.27
	66	519929.46	6957124.77
	67	519589.33	6957386.39
	67	520124.81	6957123.78
	67	519584.83	6957039.81
	67	519498.13	6957234.90
	67	519929.27	6957129.20
	67	520015.99	6956714.01
	67	519581.10	6957427.39
	67	520165.32	6957192.06
	67	520163.05	6957194.61
	67	519825.99	6957023.80
	68	519928.66	6956816.17
	68	519837.40	6956934.62
	68	520016.68	6956712.34
	68	520149.00	6957357.35
	68	519981.01	6957125.01
	68	519601.35	6957058.28
	68	519612.67	6957030.79
	68	519943.82	6956603.80
	68	520030.34	6956913.26
	69	519839.31	6957264.03
	69	519990.56	6956623.22
	69	519556.50	6957297.50
	69	520401.01	6957273.86

Species	DBH (cm)	Easting	Northing
E. tereticornis	69	519980.93	6957379.67
	69	519937.46	6957189.11
	69	519898.23	6957357.76
	69	519949.46	6956790.66
	69	520173.94	6957149.29
	69	519581.87	6957106.94
	69	519382.85	6957286.03
	69	519860.91	6957245.06
	69	520311.01	6957196.91
	69	519972.06	6956844.12
	69	519792.94	6956987.52
	70	519841.63	6957414.01
	70	519977.17	6956829.27
	70	519338.60	6957219.98
	70	519497.73	6957291.83
	70	519881.37	6956951.27
	70	519631.34	6956974.71
	70	519998.65	6957158.44
	71	519257.67	6957254.66
	71	519924.39	6956927.16
	71	519937.76	6957188.22
	71	519947.45	6957258.65
	71	519638.15	6957401.49
	71	520079.91	6957205.38
	71	519798.53	6956963.70
	71	519865.21	6956848.39
	71	519411.05	6957191.17
	72	520013.68	6957291.67
	72	519950.66	6956621.96
	72	520188.17	6957096.10
	72	519998.70	6957192.55
	72	519258.57	6957261.75
	72	520079.59	6956951.94
	73	519668.60	6957417.61
	74	519758.08	6957114.85
	74	519981.63	6957138.86
	74	520084.18	6956677.67
	74	519802.59	6957032.48
	74	520013.99	6956756.44
	74	519896.93	6956923.11
	75	519919.55	6957283.96
	75	519867.93	6957369.89
	75	519943.81	6957207.93

Species	DBH (cm)	Easting	Northing
E. tereticornis	75	519992.02	6957154.35
	75	520064.61	6956667.85
	75	519678.61	6956953.04
	76	520012.05	6957262.43
	76	519951.15	6956863.43
	76	519938.96	6957318.15
	76	519550.51	6957132.13
	77	519970.63	6957360.19
	77	519339.98	6957219.64
	78	519945.87	6957255.00
	79	520271.14	6957155.66
	79	520004.14	6957377.97
	79	519843.13	6957123.02
	79	519992.75	6956634.29
	79	519932.29	6956799.32
	80	519159.60	6957321.72
	80	519529.97	6957137.04
	80	519753.56	6956881.14
	81	519991.91	6956600.29
	81	519913.57	6957254.06
	81	519942.59	6957365.66
	81	519838.28	6957112.18
	82	519853.25	6957271.87
	82	519582.66	6957412.10
	84	519264.30	6957267.61
	84	519906.57	6957259.94
	84	519942.87	6957360.24
	85	519822.22	6957015.17
	85	520019.13	6957242.48
	86	519245.07	6957411.42
	86	519925.67	6956923.73
	87	520049.03	6956741.76
	87	519972.18	6957341.69
	87	519478.96	6957166.81
	87	519265.68	6957263.18
	88	519990.47	6956626.87
	88	519847.27	6957177.29
	90	519971.54	6957373.26
	90	519455.29	6957191.66
	90	519954.94	6957006.20
	91	519833.40	6957153.28
	91	520189.98	6957356.84
	91	519975.57	6956636.54

Species	DBH (cm)	Easting	Northing
E. tereticornis	91	519517.64	6957266.99
	92	519761.07	6957131.02
	92	519879.20	6957134.71
	92	519860.31	6957365.13
	93	519953.56	6957007.76
	93	519875.14	6957249.36
	94	519599.19	6957002.12
	102	519974.24	6956789.84
	102	519610.12	6956985.16
	106	519593.26	6957059.84
	108	519847.03	6957395.73
	108	519906.64	6957186.50
	115	520244.42	6956826.95
	118	519980.57	6957036.73
	118	519973.87	6956684.50
	123	519933.32	6956949.08
	175	519784.97	6957006.92

Appendix C

Table 1. Canopy compositions at SAT sites located in RE 12.3.11 / 12.3.6: *E. tereticornis* +/- *E. siderophloia, C. intermedia* open forest on alluvial plains usually near coast / *M. quinquenervia* +/- *E. tereticornis, L. suaveolens, C. intermedia* open forest on coastal alluvial plains

	E.tereticornis	*E.siderophloia*	*E. moluccana*	*C.intermedia*	*C. citriodoria*	*C. gummifera*	*Casuarina glauca*	*Allocasuarina littoralis*	*Acacia sp.*
Birk_02	56.67% (n=17)	30% (n=9)		10% (n=3)			3.33% (n=1)		
Birk_05	16.67% (n=5)	16.67% (n=5)	23% (n=7)	6.67% (n=2)	13.33% (n=4)	3.33% (n=1)	13.33% (n=4)		6.67% (n=2)
Birk_09	20% (n=6)			43.34% (n=13)	3.33% (n=1)			33.33% (n=10)	
Birk_10	66.67% (n=20)		30% (n=9)		3.33% (n=1)				
Birk_D							100% (n=30)		

Table 2. Canopy compositions at SAT sites located in mapped high value regrowth 12.3.11 / 12.3.6: *E. tereticornis* +/- *E. siderophloia, C. intermedia* open forest on alluvial plains usually near coast / *M. quinquenervia* +/- *E. tereticornis, L. suaveolens, C. intermedia* open forest on coastal alluvial plains

	E.tereticornis	*E.siderophloia*	*E.racemosa*	*L. suaveolens*	*C.intermedia*	*C. citriodoria*	*Casuarina glauca*	*Allocasuarina littoralis*	*Pinus elliottii*	*M. quinquenervia*
Birk_03	60% (n=18)	3.33% (n=1)			3.33% (n=1)			3.33% (n=1)	30% (n=9)	
Birk_07	43.33% (n=13)	30% (n=9)		16.67% (n=5)		3.33% (n=1)	6.67% (n=2)			
Birk_08	16.67% (n=5)		6.67% (n=2)	13.33% (n=4)		3.33% (n=1)		56.67% (n=17)		3.33% (n=1)

Table 3. Canopy compositions at three SAT sites located in mapped high value regrowth 12.5.2 / 12.5.3. / 12.3.6: *C. intermedia, E. tereticornis* open forest on remnant Tertiary surfaces, usually near coast and on deep red soils/ *E. racemosa* woodland on remnant Tertiary surfaces / *M. quinquenervia* +/- *E. tereticornis, L. suaveolens, C. intermedia* open forest on coastal alluvial plains

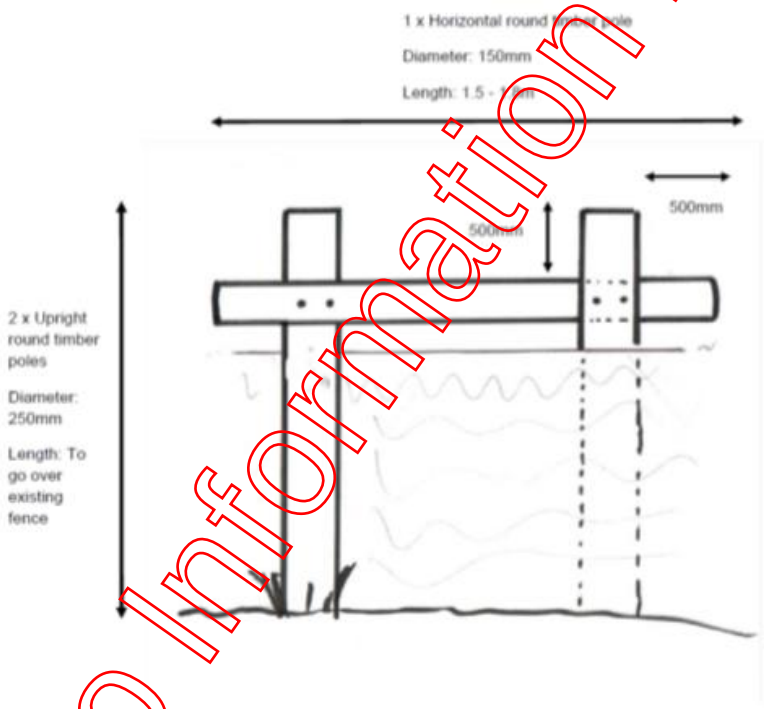
	E.tereticornis	*E.resinifera*	*E.racemosa*	*E. microcorys*	*L. suaveolens*	*C.intermedia*	*Allocasuarina littoralis*	*M. quinquenervia*
Birk_A	16.67% (n=5)		30% (n=9)	6.67% (n=2)		30% (n=9)		16.67% (n=5)
Birk_B		6.67% (n=2)	13.33% (n=4)		3.33% (n=1)	10% (n=3)	46.67% (n=14)	20% (n=6)

Appendix D

Koala bridge concept design. Note the minimum requirements for diameter of poles. The upright poles must be erected within 50 cm of the fence or will not be used by koalas. These structures, when modified with metal sheeting around one side to prevent koalas from climbing them from one direction only, form a one-way crossing structure whereby koalas can disperse from any fenced construction footprint (see **Section 5.1**), or escape a road corridor (see **Section 5.2**).

Not to scale

a) Koala bridge design concept



b) View of koala bridge design from above

Family	Scientific Name	Common Name	NC Act Status^	EPBC Act Status*	Migratory Status	Migratory Category	Marine Status	Source	Atlas of Living Australia Records	Wildlife Online Records	Habitat Requirements	Likelihood of Occurrence
Land Plants												
Myrtaceae	*Melaleuca irbyana*		E	-	-	-	-	WO	5	1	Open eucalypt forest in poorly drained, usually clay, sandstone or alluvial soils.	Unlikely - the species has been recorded proximate to the Project Area; however, regional ecosystems within the Project Area do not normally contain the species.
Najadaceae	*Najas tenuifolia*	Water nymph	SL	-	-	-	-	WO	1	1	Grows in freshwater less than 3 m deep; widespread.	Unlikely - although there are a large number of occurrence records from around the Project Area, the Project Area does not contain habitat (i.e. freshwater ecosystems) consistent with the requirements of the species.
Amphibians												
Hylidae	*Litoria olongburensis*	Wallum sedge frog	V	Vulnerable	-	-	-	PMST	1	0	An "acid" frog confined to the coastal sandplain wallum swamps. Their life-cycle is adapted to the acidic pH (2.8-5.5) of these wetlands. Frogs are highest in abundance in relatively undisturbed wallum swamps. Breeding habitat is characterised by the presence of emergent sedges, with upright species such as Baumea spp. and Schoenusspp. preferred by adult frogs for perching. Frogs can be found in breeding habitat all year. However, little is known about habitat use when breeding is not occurring and drier areas adjacent to primary habitat may also be utilised. Breeding occurs mainly in spring, summer and autumn after rain. Eggs are laid singly in water at the base of sedges.	Unlikely - the Project Area consists primarily of modified grasslands and does not contain wallum swamp.
Birds												
Accipitridae	*Pandion cristatus*	Eastern osprey	SL	-	Migratory	Migratory Wetlands Species	Listed	PMST/WO	28	11	Occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia (Johnstone & Storr 1998; Marchant & Higgins 1993; Olsen 1995). They require extensive areas of open fresh, brackish or saline water for foraging (Marchant & Higgins 1993). They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes (Czechura 1985; Domm 1977; Fleming 1987; Gosper 1983; Gosper & Holmes 2002; Johnstone & Storr 1998; Olsen 1995; Roberts & Ingram 1976). They exhibit a preference for coastal cliffs and elevated islands in some parts of their range (Boekel 1976; Domm 1977), but may also occur on low sandy, muddy or rocky shores and over coral cays (Marchant & Higgins 1993). They may occur over atypical habitats such as heath, woodland or forest when travelling to and from breeding sites (Czechura 1985; Hindwood 1988; Pruett-Jones & O'Donnell 2004; Roberts & Ingram 1976).	Possible - nearby records; however there are no wetlands within the Project Area.
Apodidae	*Hirundapus caudacutus*	White-throated needletail	V	Vulnerable	Migratory	Migratory Terrestrial Species	Listed - overfly marine area	PMST/WO	145	1	In Australia, the White-throated Needletail is almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground (Coventry 1989; Tarburton 1993; Watson 1955). Because they are aerial, it has been stated that conventional habitat descriptions are inapplicable (Cramp 1985), but there are, nevertheless, certain preferences exhibited by the species. Although they can hover most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees in clearings below the canopy, but they are less commonly recorded flying above woodland (Higgins 1999). They also commonly occur over heathland (Cooper 1971; Learmonth 1951; McFarland 1986), but less often over treeless areas, such as grassland or swamps (Cooper 1971; Gosper 1981; Learmonth 1951). When flying above farmland, they are more often recorded above partly cleared pasture, plantations or remnant vegetation at the edge of paddocks (Emison & Pyke 1978; Tindall 1982; Tarburton 1993). In coastal areas, they are sometimes seen flying over sandy beaches or mudflats (Cooper 1971; Crompton 1936; Davis 1960), and often around coastal cliffs and other areas with prominent updraughts, such as ridges and sand-dunes (Cooper 1971; Dawson et al. 1991; Loyn 1990; Mitchell et al. 1996; Schulz & Kristensen 1994). They are sometimes recorded above islands well out to sea (Brandis et al. 1992; Cooper 1971; Warham 1957).	**Known** - there are a large number of occurrence records recorded from the vicinity of the Project Area and there is suitable habitat (i.e. open forest) within the Project Area.
Ardeidae	*Botaurus poiciloptilus*	Australasian bittern	E	Endangered	-	-	-	PMST	1	0	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bulrushes (Typha spp.) and spikerushes (Eleocharis spp.). Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. Feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. Breeding occurs in summer from October to January; nests are built in secluded places in densely-vegetated wetlands on a platform of reeds; there are usually six olive-brown eggs to a clutch.	Unlikely - although there are a large number of occurrence records from around the Project Area, the Project Area does not contain habitat (i.e. wetlands) consistent with the requirements of the species.
Cacatuidae	*Calyptorhynchus lathami lathami*	South-eastern glossy black-cockatoo	V	Vulnerable	-	-	-	PMST	7	0	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (Allocasuarina littoralis) and Forest Sheoak (A. torulosa) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, Allocasuaraina diminuta, and A. gymnathera. Belah is also utilised, and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (Casuarina cristata). Feeds almost exclusively on the seeds of several species of she-oak (Casuarina and Allocasuarina species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites. A single egg is laid between March and May.	**Likely** - the habitat surrounding the Project Area is highly suitable. The species is very nomadic; as such, the existence of few occurrence records (i.e.<10) do not necessarily indicate that the species would not use the Project Area surrounds ofr foraging purposes on a seasonal basis.
Charadriidae	*Charadrius bicinctus*	Double-banded plover	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST/ WO	20	3	Found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. It occurs on muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers. The species is sometimes associated with coastal lagoons, inland saltlakes and saltworks. It is also found on seagrass beds, especially Zostera, which, when exposed at low tide, remain heavily saturated or have numerous water-filled depressions. This species sometimes utilises kelp beds (R.J. Pierce in Marchant & Higgins 1993). The Double-banded Plover is found on open grassy areas including short pasture, ploughed or newly cropped paddocks, swards, airstrips, and sports grounds such as golf courses or race-tracks near the coast and further inland (R.J. Pierce in Marchant & Higgins 1993). The species is sometimes found on exposed reefs and rock platforms with shallow rock pools and also on coastal sand dunes. It sometimes takes advantage of floodwaters, drowned river valleys and occasionally areas of bare ploughed ground (R.J. Pierce in Marchant & Higgins 1993).	Possible - The species may occur in grassland, which is present within the Project Area. Although the habitat within the Project Area is sub-optimal; the areas immediately surrounding are highly suitable for the species.
Charadriidae	*Charadrius leschenaultii*	Greater sand plover	V	Vulnerable	Migratory	Migratory Wetlands Species	Listed	PMST/ WO	232	19	Almost entirely restricted to coastal areas, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders. Diet includes insects, crustaceans, polychaete worms and molluscs. Prey is detected visually by running a short distance, stopping to look, then running to collect the prey.	Unlikely - although there are a large number of occurrence records from around the Project Area, the Project Area does not contain habitat consistent with the requirements of the species.
Charadriidae	*Charadrius mongolus*	Lesser sand plover	E	Endangered	Migratory	Migratory Wetlands Species	Listed	PMST/ WO	26	24	Almost entirely coastal, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms. Highly gregarious, frequently seen in flocks exceeding 100 individuals; also often seen foraging and roosting with other wader species. Roosts during high tide on sandy beaches, spits and rocky shores; forage individually or in scattered flocks on wet ground at low tide, usually away from the water's edge. Diet includes insects, crustaceans, molluscs and marine worms. Prey is usually detected visually with the birds making short, quick runs, with abrupt stops to lunge at the ground or look for prey.	Unlikely - although there are a large number of occurrence records from around the Project Area, the Project Area does not contain habitat consistent with the requirements of the species.
Charadriidae	*Charadrius veredus*	Oriental plover	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST/ WO	0	1	Immediately after arriving in non-breeding grounds in northern Australia, Oriental Plovers spend a few weeks in coastal habitats such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches or nearby reefs, or in near-coastal grasslands, before dispersing further inland (Bigg 1981; Bransbury 1985; Crawford 1972; Murlis et al. 1988; Serventy & Whittell 1976; Storr 1977, 1980, 1984b). Thereafter they usually inhabit flat, open, semi-arid or arid grasslands, where the grass is short and sparse, and interspersed with hard, bare ground, such as claypans, dry paddocks, playing fields, lawns and cattle camps (Boekel 1980; Carruthers 1966; Close 1982; Fletcher 1980; Pedler 1982; Storr 1980), or open areas that have been recently burnt (Boekel 1980; Chatto 2003; Crawford 1972; Garnett 1986; Storr 1977). At the onset of the Wet Season, some may move into lightly wooded grasslands (Storr 1977). Some remain in estuarine and littoral environments, and a few are occasionally recorded around terrestrial wetlands or flooded paddocks (Boekel 1980; Close 1982; McCrie 1984). Vagrants in southern Australia have been recorded in saltmarsh (Park 1983; Patterson 1983; Pedler 1982).	Unlikely - although there are a large number of occurrence records from around the Project Area, the Project Area does not contain habitat (i.e. estuarine mudflats and sandbanks) consistent with the requirements of the species.
Charadriidae	*Pluvialis fulva*	Pacific golden plover	SL	-	Migratory	Migratory Wetlands Species	Listed	PMST/ WO	224	19	In non-breeding grounds in Australia this species usually inhabits coastal habitats, though it occasionally occurs around inland wetlands. Pacific Golden Plovers usually occur on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as Sarcocornia, or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks. The species is also sometimes recorded on islands, sand and coral cays and exposed reefs and rocks. They are less often recorded in terrestrial habitats, usually wetlands such as fresh, brackish or saline lakes, billabongs, pools, swamps and wet claypans, especially those with muddy margins and often with submerged vegetation or short emergent grass. Other terrestrial habitats inhabited include short (or, occasionally, long) grass in paddocks, crops or airstrips, or ploughed or recently burnt areas, and they are very occasionally recorded well away from water (Marchant & Higgins 1993). On its breeding grounds it occurs in tundra (Dement'ev & Gladkov 1951).	Unlikely - although there are a large number of occurrence records from around the Project Area, the Project Area does not contain habitat consistent with the requirements of the species.
Charadriidae	*Pluvialis squatarola*	Grey plover	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST	3	0	In non-breeding grounds in Australia, Grey Plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes. The species is also very occasionally recorded further inland, where they occur around wetlands or salt-lakes (Marchant & Higgins 1993 and references therein). On their breeding grounds they inhabit tundra (Dement'ev & Gladkov 1951).	Unlikely - there are few occurrence records from around the Project Area, the Project Area does not contain habitat consistent with the requirements of the species.
Cuculidae	*Cuculus optatus*	Oriental cuckoo	SL	-	Migratory	Migratory Terrestrial Species	-	PMST/ WO	8	1	The species uses a range of vegetated habitats such as monsoon rainforest, wet sclerophyll forest, open woodlands and appears quite often along edges of forests, or ecotones between forest types. This cuckoo feeds arboreally, foraging for invertebrates on loose bark on the trunks and branches of trees, and among the foliage, including in mistletoes. It will forage from the ground, but requires shrubs or trees from which it sallies and returns to consume prey items. Caterpillars are a favoured food.	Possible - the Project Area occurs along a forest edge that contains open woodland and forest.
Laridae	*Gelochelidon nilotica*	Gull-billed tern	SL	-	-	-	-	WO	561	14	Found in freshwater swamps, brackish and salt lakes, beaches and estuarine mudflats, floodwaters, sewage farms, irrigated croplands and grasslands. They are only rarely found over the ocean.	**Likely** - there are a large number of occurrence records recorded from the vicinity of the Project Area and there is suitable habitat (i.e. grassland) within the Project Area.

Laridae	*Hydroprogne caspia*	Caspian tern	SL	-	-	-	-	WO	335	19	Mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near-coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks. They also use artificial wetlands, including reservoirs, sewage ponds and saltworks. In offshore areas the species prefers sheltered situations, particularly near islands, and is rarely seen beyond reefs (Higgins & Davis 1996). Large numbers may shelter along the coast, behind coastal sand-dunes or coastal lakes during rough weather, and have been recorded inland after storms (Higgins & Davies 1996).	Unlikely - although there are a large number of occurrence records from around the Project Area, the Project Area does not contain habitat (i.e. wetlands) consistent with the requirements of the species.
Laridae	*Sterna hirundo*	Common tern	SL	-	-	-	-	WO	14	3	Marine, pelagic and coastal. In Australia, they are recorded in all marine zones, but are commonly observed in near-coastal waters, both on ocean beaches, platforms and headlands and in sheltered waters, such as bays, harbours and estuaries with muddy, sandy or rocky shores. Occasionally they are recorded in coastal and near-coastal wetlands, either saline or freshwater, including lagoons, rivers, lakes, swamps and saltworks. Sometimes they occur in mangroves or saltmarsh and, in bad weather, in coastal sand-dunes or coastal embayments (Brandis et al. 1992; Chatto 2006; Higgins & Davies 1996; Hitchcock 1965; Morris 1989; Morris et al. 1981, 1990; Wood 1991).	Unlikely - although there are a large number of occurrence records from around the Project Area, the Project Area does not contain habitat (i.e. wetlands) consistent with the requirements of the species.
Laridae	*Sternula albifrons*	Little tern	SL	-	-	-	-	WO	257	5	Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands. The nest is a scrape in the sand, which may be lined with shell grit, seaweed or small pebbles. Both parents incubate up to three well-camouflaged eggs for up to 22 days, aggressively defending the nest against intruders until the young fledge at 17 - 19 days. Often seen feeding in flocks, foraging for small fish, crustaceans, insects, worms and molluscs by plunging in the shallow water of channels and estuaries, and in the surf on beaches, or skipping over the water surface with a swallow-like flight.	Unlikely - although there are a large number of occurrence records from around the Project Area and the species may occur several km from the coast, the Project Area does not contain habitat (i.e. harbours, rivers and inlets) consistent with the requirements of the species.
Laridae	*Thalasseus bergii*	Crested tern	SL	-	-	-	-	WO	65	17	The species inhabits tropical and subtropical coastlines, foraging in the shallow waters of lagoons (Higgins and Davies 1996, del Hoyo et al. 1996), coral reefs (del Hoyo et al. 1996), estuaries (Urban et al. 1986, del Hoyo et al. 1996), bays, harbours and inlets (Higgins and Davies 1996), along sandy, rocky, coral (del Hoyo et al. 1996) or muddy shores, on rocky outcrops in open sea, in mangrove swamps (Langrand 1990) and also far out to sea on open water (del Hoyo et al. 1996). It shows a preference for nesting on offshore islands (Urban et al. 1986, del Hoyo et al. 1996), low-lying coral reefs, sandy or rocky coastal islets, coastal spits, lagoon mudflats (del Hoyo et al. 1996), and artificial islets in saltpans and sewage works (Urban et al. 1986, del Hoyo et al. 1996) within 3 km of the coast (del Hoyo et al. 1996).	Unlikely - although there are a large number of occurrence records from around the Project Area, the Project Area does not contain habitat (i.e. wetlands) consistent with the requirements of the species.
Meliphagidae	*Anthochaera phrygia*	Regent honeyeater	CR	Critically Endangered	-	-	-	PMST	3	0	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast. Birds are occasionally seen on the south coast.	Unlikely - the Project Area does not contain habitat (i.e. woodlands) consistent with the requirements of the species.
Monarchidae	*Monarcha melanopsis*	Black-faced monarch	SL	-	Migratory	Migratory Terrestrial Species	Listed - overfly marine area	PMST/ WO	36	4	Mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest (Blakers et al. 1984; Bravery 1970; Emison et al. 1987; Ford et al. 1980; Gill 1970; Gosper 1992; Laurance et al. 1996; Morris et al. 1981; Officer 1969; Schodde & Mason 1999; Smith 1984; Storr 1984c). The species also occurs in selectively logged and 20—30 years old regrowth rainforest (Laurance et al. 1996). It is also sometimes found in nearby open eucalypt forests (mainly wet sclerophyll forests), especially in gullies with a dense, shrubby understorey as well as in adjacent mallee forests and woodlands, often with a patchy understorey. The species especially occurs in 'marginal' habitats during winter or during passage (migration) (Blakers et al. 1984; Emison et al. 1987; Ford et al. 1985; Gosper 1992; Kavanagh et al. 1985; Marchant 1979b; Morris et al. 1981; Officer 1969; Recher & Holmes 1985; Schodde & Mason 1999; Storr 1984c).	Unlikely - the Project Area does not contain habitat (i.e. rainforest) consistent with the requirements of the species. The speces may occur in surrounding eucalypt forest; however the Project Area consists primarily of modified grassland which is not suitable for the species.
Monarchidae	*Myiagra cyanoleuca*	Satin flycatcher	SL	-	Migratory	Migratory Terrestrial Species	Listed - overfly marine area	PMST	2	0	Mainly inhabit eucalypt forests, often near wetlands or watercourses. They generally occur in moister, taller forests than the Leaden Flycatcher, Myiagra rebecula, often occurring in gullies (Blakers et al. 1984; Emison et al. 1987; Officer 1969). They also occur in eucalypt woodlands with open understorey and grass ground cover, and are generally absent from rainforest (Emison et al. 1987; Officer 1969). In south-eastern Australia, they occur at elevations of up to 1400 m above sea level, and in the ACT, they occur mainly between 800 m above sea level and the treeline (Emison et al. 1987; Taylor & COG 1992).	**Known** - the Project Area contains an open understorey and grass ground cover adjacent to eucalypt woodland which are known to support the species.
Monarchidae	*Symposiachrus trivirgatus*	Spectacled monarch	SL	-	Migratory (as Monarcha trivirgatus)	Migratory Terrestrial Species	Listed - overfly marine area (as Monarcha	PMST/ WO	19	2	Dense vegetation, mainly in rainforest but also in moist forest or wet sclerophyll and occasionally in other dense vegetation such as mangroves, drier forest and woodlands.	Unlikely - the Project Area does not contain habitat (i.e. dense vegetation) consistent with the requirements of the species.
Phaethontidae	*Phaethon lepturus*	White-tailed tropicbird	SL	-	-	-	-	WO	2	1	The white-tailed Tropicbird can be found over pelagic waters and the coasts of tropical and subtropical seas. It feeds on small fish, especially flying-fish, squid and some crustaceans (especially crabs). Its diet varies locally; e.g. in the Seychelles, it consists mostly of fish. Most prey is caught by plunge-diving, but flying-fish can be taken on the wing. Breeding occurs seasonally in places, but can also occur seasonally. The species is loosely colonial, nesting in rocky crevices or a sheltered scrape on the ground on small-remote islands. Nests are placed preferably in inaccessible spots on cliffs where take-off is easy. It is resident and dispersive, with both adults and juveniles wandering extensively (del Hoyo et al. 1992).	Unlikely - the Project Area does not contain habitat (i.e. pelagic waters or coastal areas) consistent with the requirements of the species.
Procellariidae	*Calonectris leucomelas*	Streaked shearwater	SL	-	Migratory	Migratory Marine Birds	Listed	PMST	0	0	Found in both pelagic and inshore waters both during migration and during the summer breeding season. The greatest breeding concentration are on offshore islands of Japan, with a preference for these with forested slopes.	Unlikely - the Project Area does not contain habitat (i.e. pelagic waters or inshore water, although inshore water is adjacent) consistent with the requirements of the species.
Rhipiduridae	*Rhipidura rufifrons*	Rufous fantail	SL	-	Migratory	Migratory Terrestrial Species	Listed - overfly marine area	PMST/ WO	220	1	Mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (Eucalyptus microcorys), Mountain Grey Gum (E. cypellocarpa), Narrow-leaved Peppermint (E. radiata), Mountain Ash (E. regnans), Alpine Ash (E. delegatensis), Blackbutt (E. pilularis) or Red Mahogany (E. resinifera); usually with a dense shrubby understorey often including ferns. They also occur in subtropical and temperate rainforests; for example near Bega in south-east NSW, where they are recorded in temperate Lilly Pilly (Acmena smithi) rainforest, with Grey Myrtle (Backhousia myrtifolia), Sassafras (Doryphora sassafras) and Sweet Pittosporum (Pittosporum undulatum) as dominants. They occasionally occur in secondary regrowth, following logging or disturbance in forests or rainforests. When on passage, they are sometimes recorded in drier sclerophyll forests and woodlands, including Spotted Gum (Eucalyptus maculata), Yellow Box (E. melliodora), ironbarks or stringybarks, often with a shrubby or heath understorey. They are also recorded from parks and gardens when on passage. In north and north-east Australia, they often occur in tropical rainforest and monsoon rainforests, including semi-evergreen mesophyll vine forests, semi-deciduous vine thickets or thickets of paperbarks (Melaleuca spp.) (Higgins et al. 2006).	**Likely -** the Project Area adjoins a gully dominated by eucalypts and the species is known to inhabit habitat edges
Rostratulidae	*Rostratula australis*	Australian painted snipe	E	Endangered	-	-	Listed - overfly marine area (as Rostratula	PMST	0	0	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves. Breeding is often in response to local conditions and can occurs from September to December. Incubation and care of young is all undertaken by the male only. Forages nocturnally on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter.	Unlikely - the Project Area does not contain habitat (i.e. fringes of swamps or marshy areas) consistent with the requirements of the species.
Scolopacidae	*Actitis hypoleucos*	Common sandpiper	SL	-	Migratory	Migratory Wetlands Species	Listed	PMST	16	0	Utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags (Geering et al. 2007; Higgins & Davies 1996).	Unlikely - the Project Area does not contain habitat (i.e. coastal or inland wetlands) consistent with the requirements of the species.
Scolopacidae	*Arenaria interpres*	Ruddy turnstone	SL	-	Migratory	Migratory Wetlands Species	Listed	PMST/ WO	104	32	Mainly found on coastal regions with exposed rock coast lines or coral reefs. It also lives near platforms and shelves, often with shallow tidal pools and rocky, shingle or gravel beaches. It can, however, be found on sand, coral or shell beaches, shoals, cays and dry ridges of sand or coral. It has occasionally been sighted in estuaries, harbours, bays and coastal lagoons, among low saltmarsh or on exposed beds of seagrass, around sewage ponds and on mudflats. In north Australia it is known to occur in a wide variety of habitats, and may prefer wide mudflats. In southern Australia the Ruddy Turnstone prefers rockier coastlines and is less numerous on large embayments with extensive mudflats. On Flinders Island, Tasmania, it has been sighted around rocky reefs during spring and summer, and moves to bays and estuaries for autumn and winter. In south-west Australia, it may occur on pebble-strewn shores of saltlakes near the coast. On Rottnest Island, the Ruddy Turnstone prefers shores with scattered fragments of limestone. In New Zealand it has occasionally been recorded in paddocks or grassy areas. Surveys demonstrate that the Ruddy Turnstone can live away from coastal areas in habitats such river beds, and on inland lakes and adjacent farmland (Higgins & Davies 1996).	Unlikely - the Project Area does not contain habitat (i.e. exposed rock coastlines or coral reefs) consistent with the requirements of the species.
Scolopacidae	*Calidris acuminata*	Sharp-tailed sandpiper	SL	-	Migratory	Migratory Wetlands Species	Listed	PMST/ WO	264	22	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season. They may be attracted to mats of algae and water weed either floating or washed up around terrestrial wetlands, and coastal areas with much beachcast seaweed. Sometimes they occur on rocky shores and rarely on exposed reefs (Higgins & Davies 1996).	Unlikely - the Project Area does not contain habitat (i.e. fresh or brackish wetlands) consistent with the requirements of the species.
Scolopacidae	*Calidris alba*	Sanderling	SL	-	Migratory	Migratory Wetlands Species	Listed	PMST	2	0	Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands. Generally occurs in small flocks, however may associate freely with other waders. Individuals run behind receding waves, darting after insects, larvae and other small invertebrates in the sand, then dart back up the beach as each wave breaks. Also feeds on plants, seeds, worms, crustaceans, spiders, jellyfish and fish, foraging around rotting heaps of kelp, at the edges of shallow pools on sandspits and on nearby mudflats. Roosts on bare sand, behind clumps of beach-cast kelp or in coastal dunes. Breeding occurs in the Northern Hemisphere.	Unlikely - the Project Area does not contain habitat (i.e. tidal mudflats or bare open coastal lagoons) consistent with the requirements of the species.
Scolopacidae	*Calidris canutus*	Red knot	E	Endangered	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST/ WO	217	18	Occurs in small numbers on intertidal mudflats, estuaries, bays, inlets, lagoons, harbours and sandflats and sandy beaches of sheltered coasts. It is occasionally found on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms and is a rare visitor to terrestrial saline wetlands and freshwater swamps. It usually forages near the water's edge, with feeding activity regulated by the tide as birds closely follow the tide-edge. The diet consists of worms, bivalves, gastropods, crustaceans and echinoderms. The birds roost on sandy beaches, spits, islets and mudflats close to feeding grounds, usually in open areas. It is rarely found on inland lakes or swamps.	Unlikely - the Project Area does not contain habitat (i.e. intertidal mudflats, estuaries, lagoons etc.) consistent with the requirements of the species.
Scolopacidae	*Calidris ferruginea*	Curlew sandpiper	CR	Critically Endangered	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST/ WO	485	33	It generally occupies littoral and estuarine habitats. Is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. It roosts on shingle, shell or sand beaches; spits or islets on the coast or in wetlands; or sometimes in salt marsh, among beach-cast seaweed, or on rocky shores. Curlew Sandpipers are omnivorous, feeding on worms, molluscs, crustaceans, insects and some seeds. Birds breed at 2 years of age and the oldest recorded bird is 19 years old. Most birds caught in Australia are between 3 and 5 years old.	Unlikely - the Project Area does not contain habitat (i.e. estuarine areas or intertidal mudflats) consistent with the requirements of the species.

Scolopacidae	*Calidris melanotos*	Pectoral sandpiper	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST	0	0	Prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. The species is usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands (Higgins & Davies 1996).	Unlikely - the Project Area does not contain habitat (i.e. fresh or saline wetlands) consistent with the requirements of the species.
Scolopacidae	*Calidris ruficollis*	Red-necked stint	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST/ WO	569	28	Mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally they have been recorded on exposed or ocean beaches, and sometimes on stony or rocky shores, reefs or shoals. They also occur in saltworks and sewage farms; saltmarsh; ephemeral or permanent shallow wetlands near the coast or inland, including lagoons, lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in saltflats. They sometimes use flooded paddocks or damp grasslands. They have occasionally been recorded on dry gibber plains, with little or no perennial vegetation (Higgins & Davies 1996).	Unlikely - the Project Area does not contain habitat (i.e. coastal areas) consistent with the requirements of the species.
Scolopacidae	*Calidris tenuirostris*	Great knot	CR	Critically Endangered	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST/ WO	549	28	Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. Migrates to Australia from late August to early September, although juveniles may not arrive until October-November. Most birds return north in March and April, however some individuals may stay over winter in Australia. Forages for food by methodically thrusting its bill deep into the mud to search for invertebrates, such as bivalve molluscs, gastropods, polychaete worms and crustaceans.	Unlikely - the Project Area does not contain habitat (i.e. coastal areas with intertidal mudflats or sandflats) consistent with the requirements of the species.
Scolopacidae	*Gallinago hardwickii*	Latham's snipe	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST	15	0	Occurs in permanent and ephemeral wetlands up to 2000 m above sea-level (Chapman 1969; Naarding 1981). They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Frith et. al. 1977; Naarding 1983; Weston 2006, pers. comm.). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (Frith et al. 1977; Naarding 1983).	Unlikely - the Project Area does not contain habitat (i.e. permanent or ephemeral wetlands) consistent with the requirements of the species.
Scolopacidae	*Limicola falcinellus (syn. Calidris falcinellus)*	Broad-billed sandpiper	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST	96	0	Occurs in sheltered parts of the coast, favouring estuarine mudflats but also occasionally occur on saltmarshes, shallow freshwater lagoons, saltworks and sewage farms, and in areas with large soft intertidal mudflats, which may have shell or sandbanks nearby. Occasionally they occur on reefs or rocky platforms. They have also been recorded in creeks, swamps and lakes near the coast, particularly those with bare mudflats or sand exposed by receding water. They often favour mud among, or fringed by, mangroves, particularly on the seaward side and sometimes occur in estuaries edged by saltmarsh. They are rarely recorded inland. Foraging occurs on exposed flats of soft mud or wet sand at edges of coastal and near-coastal wetlands, often around channels on mudflats or in accumulated mud in swales between shell banks. In northern Australia, they forage in soft mud near mangroves, but may remain on same muddy section, even though fresher substrate may be exposed by the receding tide. They also forage in shallow water on muddy edges of ponds. They roost on the banks of sheltered sandy, shelly or shingly beaches (Higgins & Davies 1996). They nest on the ground, frequently in the top of a tussock (Cramp 1985).	Unlikely - the Project Area does not contain habitat (i.e. estuarine mudflats) consistent with the requirements of the species.
Scolopacidae	*Limosa lapponica baueri*	Nunivak Bar-tailed godwit	V	Vulnerable	-	-	-	PMST/ WO	0	46	It is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Less frequently it occurs in salt lakes and brackish wetlands, sandy ocean beaches and rock platforms. It often occurs around beds of seagrass, and sometimes in nearby saltmarsh or the outer margins of mangrove areas. It forages at low to mid tide in shallow water or along the water's edge on sandy substrates on intertidal flats, banks and beaches or on soft mud substrates. Its diet consists of worms, molluscs, crustaceans, insects and some plant material. In NSW its high tide roost areas on sandy beaches, sandbars, spits and near-coastal saltmarsh are frequently shared with other shorebirds. It is rarely found on inland wetlands with areas of short grass such as farmland, paddocks and airstrips. In large part, the observed decline in Bar-tailed Godwit (Western Alaskan) numbers across Australia stems from ongoing loss of intertidal mudflat habitat at key migration staging sites in the Yellow Sea.	Unlikely - the Project Area does not contain habitat (i.e. coastal habitats) consistent with the requirements of the species.
Scolopacidae	*Limosa limosa*	Black-tailed godwit	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST/ WO	48	4	Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps. Individuals have been recorded in wet fields and sewerage treatment works. Forages for insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs, frog eggs and tadpoles in soft mud or shallow water. Roosts and loafs on low banks of mud, sand and shell bars. Frequently recorded in mixed flocks with Bar-tailed Godwits.	Unlikely - the Project Area does not contain habitat (i.e. coastal habitats) consistent with the requirements of the species.
Scolopacidae	*Numenius madagascariensis*	Eastern curlew	E	Critically Endangered	Migratory	Migratory Wetlands Species	Listed	PMST/ WO	610	36	It generally occupies coastal lakes, inlets, bays and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. Occasionally, the species occurs on ocean beaches (often near estuaries) and coral reefs, rock platforms, or rocky islets It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. It roosts on sandy spits and islets, especially on dry beach sand near the high-water mark, and among coastal vegetation, including low saltmarsh or mangroves. May also roost on wooden oyster leases or other similar structures The Eastern Curlew is carnivorous, mainly eating crustaceans (including crabs, shrimps and prawns), small molluscs, as well as some insects. The birds may delay breeding until three to four years of age. Within Australia, females birds which do not migrate, move northward in winter.	Unlikely - the Project Area does not contain habitat (i.e. coastal waterbodies) consistent with the requirements of the species.
Scolopacidae	*Numenius minutus*	Little curlew	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST	2	0	Congregates around pools, river beds and water-filled tidal channels, and shallow water at edges of billabongs. The species prefers pools with bare dry mud (including mudbanks in shallow water) and they do not use pools if they are inland, dry, flooded or heavily vegetated (Higgins & Davies 1996). May also rest in grassy, open woodlands and on bare blacksoil plains, or on dry or recently burnt grasslands on floodplains, which may be without vegetation for hundreds of metres, and occasionally on mudflats when nearby grasslands are inundated or around swamps. Resting has also been recorded under partly submerged vegetation. After freshwater pools dry up, roosting may occur in the shallows of reservoirs and the sea (Higgins & Davies 1996).	Unlikely - the Project Area does not contain habitat (i.e. waterbodies) consistent with the requirements of the species.
Scolopacidae	*Numenius phaeopus*	Whimbrel	SL	-	Migratory	Migratory Wetlands Species	Listed	PMST/ WO	755	53	Often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms. It has been infrequently recorded using saline or brackish lakes and coastal areas. It also used saltflats with saltmarsh, or saline grasslands with standing water left after high spring-tides, and in similar habitats in sewage farms and saltfields (Higgins & Davies 1996).	Unlikely - the Project Area does not contain habitat (i.e. intetidal mudflats or other waterbodies) consistent with the requirements of the species.
Scolopacidae	*Philomachus pugnax (syn. Calidris pugnax)*	Ruff (Reeve)	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST	0	0	Found on generally fresh, brackish or saline wetlands with exposed mudflats at the edges. It is found in terrestrial wetlands including lakes, swamps, pools, lagoons, tidal rivers, swampy fields and floodlands. They are occasionally seen on sheltered coasts, in harbours, estuaries, seashores and are known to visit sewage farms and saltworks. They are sometimes found on wetlands surrounded by dense vegetation including grass, sedges, saltmarsh and reeds. They have been observed on sand spits and other sandy habitats including shingles. The Ruff forages on exposed mudflats, in shallow water and occasionally on dry mud. They have been observed foraging in dry waterside plants and in swampy areas next to aeration tanks in sewage farms. They prefer to roost amongst shorter vegetation (Higgins & Davies 1996).	Unlikely - the Project Area does not contain habitat (i.e. fresh, brackish or saline wetlands) consistent with the requirements of the species.
Scolopacidae	*Tringa brevipes*	Grey-tailed tattler	SL	-	Migratory	Migratory Wetlands Species	Listed (as Heteroscelus brevipes)	PMST/ WO	563	46	Often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. It can also be found at intertidal rocky, coral or stony reefs as well as platforms and islets that are exposed at low tide. It has been found around shores of rock, shingle, gravel or shells and also on intertidal mudflats in embayments, estuaries and coastal lagoons, especially fringed with mangroves. In Moreton Bay, Queensland, it is most abundant in areas with dense beds of seagrass. In Tasmania it is also abundant in areas with seagrass beds. It is less often seen on open flat sandy beaches or sandbanks, especially around accumulated seaweed or isolated clumps of dead coral. It is occasionally found around near-coastal wetlands, such as lagoons and lakes and ponds in sewage farms and saltworks. Inland records for the species are rare with sightings on river banks and the edges of rock pools (Higgins & Davies 1996).	Unlikely - the Project Area does not contain habitat (i.e. sheltered coasts with reefs and rock platforms or with intertidal mudflats) consistent with the requirements of the species.
Scolopacidae	*Tringa glareola*	Wood sandpiper	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST	2	0	Most well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They are typically associated with emergent, aquatic plants or grass, and dominated by taller fringing vegetation, such as dense stands of rushes or reeds, shrubs, or dead or live trees, especially Melaleuca and River Red Gums Eucalyptus camaldulensis and often with fallen timber. They also frequent inundated grasslands, short herbage or wooded floodplains, where floodwaters are temporary or receding, and irrigated crops. They are also found at some small wetlands only when they are drying. They are rarely found using brackish wetlands, or dry stunted saltmarsh. Typically they do not use coastal flats, but are occasionally recorded in stony wetlands. This species uses artificial wetlands, including open sewage ponds, reservoirs, large farm dams, and bore drains (Higgins & Davies 1996).	Unlikely - the Project Area does not contain habitat (i.e. freshwater wetlands) consistent with the requirements of the species.
Scolopacidae	*Tringa incana*	Wandering tattler	SL	-	Migratory	Migratory Wetlands Species	Listed (as Heteroscelus incanus)	PMST/ WO	0	1	Generally found on rocky coasts with reefs and platforms, points, spits, piers, offshore islands and shingle beaches or beds. It is occasionally seen on coral reefs or beaches, and tends to avoid mudflats (Higgins & Davies 1996). Foraging habitat is among rocks or shingle, or in shallow pools at edges of reefs or beaches, mainly along the tideline. Wandering Tattlers have been recorded roosting or perching on top of boulders surrounded by or close to water (Higgins & Davies 1996).	Unlikely - the Project Area does not contain habitat (i.e. rocky coastal areas) consistent with the requirements of the species.
Scolopacidae	*Tringa nebularia*	Common greenshank	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST/ WO	348	24	Found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. The edges of the wetlands used are generally of mud or clay, occasionally of sand, and may be bare or with emergent or fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, and dead or live trees. It was once recorded with Black-winged Stilts (Himantopus himantopus) in pasture, but are generally not found in dry grassland (Higgins & Davies 1996).	Unlikely - the Project Area does not contain habitat (i.e. inland wetlands or coastal habitats) consistent with the requirements of the species.
Scolopacidae	*Tringa stagnatilis*	Marsh sandpiper	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST/ WO	32	1	Lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In north Australia they prefer intertidal mudflats (Higgins & Davies 1996), although surveys in Kakadu National Park recorded more birds around shallow freshwater lakes than in areas influenced by tide (Bamford 1988). At the Top End they often use ephemeral pools on inundated freshwater and tidal floodplains (Higgins & Davies 1996). Three of the five sites with highest recorded numbers are saltwater habitats (Hunter Estuary, NSW; Port Hedland Saltworks, Western Australia; Tullakool Evaporation Ponds, NSW) (Watkins 1993). In the south-east Gulf of Carpentaria they have been recorded round both saline and fresh waters (Garnett 1989). Elsewhere they said to avoid, or rarely occur in, tidal habitats, and rarely occur on beaches. In Western Australia they prefer freshwater to marine environments. In south-east Australia they prefer inland saline lakes and coastal saltworks. They are found infrequently around mangroves (Higgins & Davies 1996).	Unlikely - the Project Area does not contain habitat (i.e. permanent or ephemeral wetlands) consistent with the requirements of the species.
Scolopacidae	*Xenus cinereus*	Terek sandpiper	SL	-	Migratory	Migratory Wetlands Species	Listed - overfly marine area	PMST/ WO	453	26	In Australia, has been recorded on coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks located near mangroves, but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools. Generally roosts communally amongst mangroves or dead trees, often with related wader species. Breaks up into smaller flocks or even solitary birds when feeding in open intertidal mudflats. The diet includes worms, crabs and other crustaceans, small shellfish and the adults and larvae of various flies, beetles and water-bugs. Feeding is undertaken by moving rapidly and erratically over soft, wet mud, pecking or probing at the surface.	Unlikely - the Project Area does not contain habitat (i.e. mudflats or lagoons) consistent with the requirements of the species.
Strigidae	*Ninox strenua*	Powerful owl	V	-	-	-	-	WO	30	7	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine Syncarpia glomulifera, Black She-oak Allocasuarina littoralis, Blackwood Acacia melanoxylon, Rough-barked Apple Angophora floribunda, Cherry Ballart Exocarpus cupressiformis and a number of eucalypt species.	Possible - The species has not been recorded within close proximity to the Project Area. The species may potentially forage across the Project Area and shelter in nearby densely vegetation areas.

Mammals												
Phascolarctidae	*Phascolarctos cinereus*	Koala (combined populations of Queensland, New South Wales and the Australian	E	Endangered	-	-	-	PMST/ WO	8216	3991	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Inactive for most of the day, feeding and moving mostly at night. Spend most of their time in trees, but will descend and traverse open ground to move between trees. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size. Generally solitary, but have complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery. Females breed at two years of age and produce one young per year.	**Known -** the species has been recorded witin the Project Area on numerous occasions as part of investigations undertaken for the Project.
Pseudocheiridae	*Petauroides volans*	Central greater glider	E	-	-	-	-	WO	7	#N/A	The greater glider (southern and central) is an arboreal nocturnal marsupial, predominantly solitary and largely restricted to eucalypt forests and woodlands of eastern Australia. It is typically found in highest abundance in taller, montane, moist eucalypt forests on fertile soils, with relatively old trees and abundant hollows – e.g. north-eastern NSW (Andrews et al. 1994; Smith et al. 1994a,b), south-eastern NSW (Kavanagh 2000), eastern Vic (van der Ree et al. 2004) – but also occurs in drier habitats in south-eastern Qld (Eyre 2004). The distribution may be patchy even in continuous areas of habitat, such as Tantawangalo State Forest in NSW (Kavanagh 2000). It is likely that only a proportion of forest in potential habitat areas is suitable for the species, as the structural attributes of the forest overstorey and forage quality it relies on vary considerably across the landscape (Eyre 2002; Youngentob et al. 2011).	**Likely -** the Project Area contains habitat attributes (but not necessarily all attributes), such as live and dead hollow-bearing trees for denning, feed trees, large trees, habitat connectivity across the landscape as defined by the *Guide to Greater Glider Habitat in Queensland* (Department of Environment and Science 2022).
Pteropodidae	*Pteropus poliocephalus*	Grey-headed flying-fox	C	Vulnerable	-	-	-	PMST	23	7	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young. Annual mating commences in January and conception occurs in April or May; a single young is born in October or November. Site fidelity to camps is high; some camps have been used for over a century. Can travel up to 50 km from the camp to forage; commuting distances are more often <20 km. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. Also forage in cultivated gardens and fruit crops.	**Likely -**There are no known camps within the Project Area; however, the Project Area contains numerous trees from the favoured foraging genera for the species. There are numerous camps in nearby areas that would likely travel to the Project Area for foraging purposes.
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked echidna	SL	-	-	-	-	WO	10	1	Found throughout Australia; lives in forests and woodlands, heath, grasslands and arid environments.	**Known -** the species is a habitat generalist capable of persisting in a wide variety of natural areas, such as those within or adjacent to the Project Area.

**Nature Conservation Act 1992*: CR; Critically Endangered; E = Endangered; V = Vulnerable; SL = Special Least Concern; C = Least Concern
**Environment Protection and Biodiversity Conservation Act 1999*: CE = Critically Endangered; E = Endangered; V = Vulnerable

Marine species were not considered in this assessments, including: Humpback whale (*Megaptera novaeangliae*), Australian humpback dolphin, (*Sousa sahulensis*), Dugong (*Dugong dugon*) Great white shark (*Carcharodon carcharias*), Loggerhead Turtle (*Caretta caretta*), Green Turtle (*Chelonia mydas*), Hawksbill Turtle (*Eretmochelys imbricata*), Olive Ridley Turtle, Pacific Ridley Turtle (*Lepidochelys olivacea*), Flatback Turtle (*Natator depressus*), Leatherback Turtle, Leathery Turtle, Luth (*Dermochelys coriacea*).

General Habitat	Survey site 1	Survey site 2	Survey site 3
Habitat feature			
Coarse woody debris (>10cm diameter & >0.5 in length)	300cm	400cm	0cm
Hollow bearing trees	1	0	0
Decorticating bark	5%	5%	0
Course litter (> 2cm)	10%	40%	40%
Fine litter	10%	10%	10%
Stones/boulders	0%	0%	0%
Permanent water	absent	absent	absent
Ephermeral water	absent	absent	absent
Habitat disturbance			
Weed cover	10%	10%	10%
Clearing	0%	0%	95%
Bare ground	0%	0%	15%
Erosion	0%	0%	0%
Grazing	0%	0%	0%

Species	DBH (cm)	Height (m)	Spread (m)	Habitat Features	Health Score	Notes	Latitude	Longitude
Corymbia intermedia	35	18	9	0	0	-	-27.5126	153.204
Corymbia intermedia	10	4	1.5	0	0	-	-27.5108	153.204
Corymbia intermedia	15	10	4	0	0	-	-27.5098	153.201
Eucalyptus moluccana	45	18	16	0	0	-	-27.5088	153.2
Eucalyptus siderophloia	40	16	12	0	0	-	-27.5087	153.201
Eucalyptus siderophloia	60	16	12	0	0	-	-27.5085	153.201
Eucalyptus siderophloia	60	18	18	0	0	-	-27.5088	153.201
Eucalyptus siderophloia	20	9	4	0	0	-	-27.509	153.2
Eucalyptus siderophloia	20	9	3	0	0	-	-27.509	153.2
Eucalyptus siderophloia	35	15	19	0	0	-	-27.5083	153.201
Eucalyptus siderophloia	25	12	8	0	0	-	-27.5089	153.2
Eucalyptus siderophloia	20	6	4	0	0	-	-27.5104	153.202
Eucalyptus siderophloia	25	9	3	0	0	-	-27.5104	153.202
Eucalyptus siderophloia	15	6	4	0	0	-	-27.5103	153.202
Eucalyptus siderophloia	15	6	3	0	0	-	-27.5102	153.202
Eucalyptus siderophloia	15	7	2	0	0	-	-27.5104	153.202
Eucalyptus siderophloia	50	18	14	0	0	-	-27.5104	153.202
Eucalyptus siderophloia	15	7	3	0	0	-	-27.5104	153.202
Eucalyptus siderophloia	15	7	2	0	0	-	-27.5104	153.202
Eucalyptus siderophloia	50	16	15	0	0	-	-27.5105	153.202
Eucalyptus siderophloia	15	8	4	0	0	-	-27.5105	153.202
Eucalyptus siderophloia	15	7	3	0	0	-	-27.5104	153.202
Eucalyptus siderophloia	20	9	4	0	0	-	-27.5104	153.202
Eucalyptus siderophloia	15	7	2	0	0	-	-27.5105	153.202
Eucalyptus siderophloia	15	6	2	0	0	-	-27.5105	153.202
Eucalyptus siderophloia	29	9	5	0	0	-	-27.5106	153.202
Eucalyptus siderophloia	20	9	4	0	0	-	-27.5106	153.202
Eucalyptus tereticornis	70	20	25	0	0	-	-27.5108	153.202
Eucalyptus tereticornis	20	8	4	0	0	-	-27.5102	153.203
Eucalyptus tereticornis	25	11	5	0	0	-	-27.5099	153.202
Eucalyptus tereticornis	10	3	2	0	0	-	-27.512	153.204
Eucalyptus tereticornis	20	10	5	0	0	-	-27.5121	153.204
Eucalyptus tereticornis	30	12	10	0	0	-	-27.5126	153.204
Eucalyptus tereticornis	25	4	10	0	0	-	-27.5128	153.204
Eucalyptus tereticornis	15	6	3	0	0	-	-27.512	153.204
Eucalyptus tereticornis	20	6	4	0	0	-	-27.512	153.204
Eucalyptus tereticornis	15	6	3	0	0	-	-27.512	153.204
Eucalyptus tereticornis	20	6	3	0	0	-	-27.512	153.204
Eucalyptus tereticornis	15	6	2	0	0	-	-27.512	153.204
Eucalyptus tereticornis	1500	23	20	0	0	-	-27.5116	153.204
Eucalyptus tereticornis	25	10	6	0	0	-	-27.512	153.204
Eucalyptus tereticornis	25	8	4	0	0	-	-27.512	153.204
Eucalyptus tereticornis	8	5	1.5	0	0	-	-27.5115	153.203
Eucalyptus tereticornis	60	18	12	0	0	-	-27.5113	153.203
Eucalyptus tereticornis	30	8	5	0	0	-	-27.5114	153.204
Eucalyptus tereticornis	30	8	5	0	0	-	-27.5115	153.203
Eucalyptus tereticornis	15	4	2	0	0	-	-27.5112	153.203
Eucalyptus tereticornis	10	4	1	0	0	-	-27.5111	153.203
Eucalyptus tereticornis	80	15	18	0	0	-	-27.5113	153.203
Eucalyptus tereticornis	15	5	2	0	0	-	-27.5112	153.203
Eucalyptus tereticornis	18	5	3	0	0	-	-27.5109	153.203
Eucalyptus tereticornis	18	5	3	0	0	-	-27.5109	153.203
Eucalyptus tereticornis	18	5	4	0	0	-	-27.5111	153.203
Eucalyptus tereticornis	15	5	2	0	0	-	-27.511	153.203
Eucalyptus tereticornis	15	5	2	0	0	-	-27.5111	153.203
Eucalyptus tereticornis	10	6	1.5	0	0	-	-27.5111	153.203

Species	DBH (cm)	Height (m)	Spread (m)	Habitat Features	Health Score	Notes	Latitude	Longitude
Eucalyptus tereticornis	18	5	3	0	0	-	-27.5109	153.203
Eucalyptus tereticornis	15	5	2	0	0	-	-27.511	153.203
Eucalyptus tereticornis	10	6	3	0	0	-	-27.5111	153.203
Eucalyptus tereticornis	15	8	2	0	0	-	-27.5111	153.203
Eucalyptus tereticornis	15	6	2	0	0	-	-27.5111	153.203
Eucalyptus tereticornis	15	6	2	0	0	-	-27.5111	153.203
Eucalyptus tereticornis	15	5	2	0	0	-	-27.511	153.203
Eucalyptus tereticornis	10	6	3	0	0	-	-27.511	153.203
Eucalyptus tereticornis	10	5	2	0	0	-	-27.511	153.203
Eucalyptus tereticornis	20	6	3	0	0	-	-27.511	153.203
Eucalyptus tereticornis	15	5	3	0	0	-	-27.511	153.203
Eucalyptus tereticornis	10	4	1	0	0	-	-27.511	153.203
Eucalyptus tereticornis	10	5	2	0	0	-	-27.511	153.203
Eucalyptus tereticornis	10	4	2	0	0	-	-27.511	153.203
Eucalyptus tereticornis	20	6	4	0	0	-	-27.5109	153.203
Eucalyptus tereticornis	10	6	5	0	0	-	-27.511	153.203
Eucalyptus tereticornis	15	5	4	0	0	-	-27.511	153.203
Eucalyptus tereticornis	20	6	5	0	0	-	-27.5109	153.203
Eucalyptus tereticornis	30	7	5	0	0	-	-27.511	153.203
Eucalyptus tereticornis	18	6	3	0	0	-	-27.5113	153.204
Eucalyptus tereticornis	15	7	3	0	0	-	-27.511	153.203
Eucalyptus tereticornis	10	5	1	0	0	-	-27.511	153.203
Eucalyptus tereticornis	35	8	7	0	0	-	-27.5112	153.203
Eucalyptus tereticornis	25	6	4	0	0	-	-27.5111	153.204
Eucalyptus tereticornis	15	5	3	0	0	-	-27.5113	153.204
Eucalyptus tereticornis	15	7	2	0	0	-	-27.5113	153.203
Eucalyptus tereticornis	60	18	16	0	0	-	-27.5087	153.201
Eucalyptus tereticornis	80	18	14	0	0	-	-27.5087	153.201
Eucalyptus tereticornis	50	18	12	0	0	-	-27.509	153.201
Eucalyptus tereticornis	25	12	7	0	0	-	-27.5086	153.201
Eucalyptus tereticornis	25	9	4	0	0	-	-27.5088	153.2
Eucalyptus tereticornis	25	9	6	0	0	-	-27.5072	153.2
Eucalyptus tereticornis	30	12	7	0	0	-	-27.5078	153.2
Eucalyptus tereticornis	90	18	16	0	0	-	-27.5094	153.201
Eucalyptus tereticornis	90	20	18	0	0	-	-27.5094	153.201
Eucalyptus tereticornis	20	12	3	0	0	-	-27.5089	153.2
Eucalyptus tereticornis	45	18	16	0	0	-	-27.5093	153.201
Eucalyptus tereticornis	10	6	2	0	0	-	-27.5111	153.204
Eucalyptus tereticornis	30	6	5	0	0	-	-27.5111	153.204
Eucalyptus tereticornis	20	6	5	0	0	-	-27.5111	153.204
Eucalyptus tereticornis	10	5	2	0	0	-	-27.5111	153.204
Eucalyptus tereticornis	10	5	2	0	0	-	-27.511	153.204
Eucalyptus tereticornis	10	6	3	0	0	-	-27.511	153.203
Eucalyptus tereticornis	25	6	4	0	0	-	-27.5111	153.204
Eucalyptus tereticornis	15	6	3	0	0	-	-27.5111	153.204
Eucalyptus tereticornis	15	6	4	0	0	-	-27.511	153.204
Eucalyptus tereticornis	29	7	3	0	0	-	-27.5109	153.204
Eucalyptus tereticornis	10	5	2	0	0	-	-27.511	153.204
Eucalyptus tereticornis	10	6	3	0	0	-	-27.511	153.204
Eucalyptus tereticornis	20	5	4	0	0	-	-27.5109	153.204
Eucalyptus tereticornis	20	6	4	0	0	-	-27.5109	153.203
Eucalyptus tereticornis	20	7	5	0	0	-	-27.5109	153.204
Eucalyptus tereticornis	20	7	6	0	0	-	-27.5109	153.204
Eucalyptus tereticornis	90	18	29	0	0	-	-27.5109	153.203
Eucalyptus tereticornis	129	18	26	0	0	-	-27.5108	153.203
Eucalyptus tereticornis	20	6	5	0	0	-	-27.5109	153.203

Species	DBH (cm)	Height (m)	Spread (m)	Habitat Features	Health Score	Notes	Latitude	Longitude
Eucalyptus tereticornis	15	8	2	0	0	-	-27.5109	153.203
Eucalyptus tereticornis	25	7	6	0	0	-	-27.5107	153.203
Eucalyptus tereticornis	20	7	5	0	0	-	-27.5107	153.203
Eucalyptus tereticornis	18	6	4	0	0	-	-27.5108	153.203
Eucalyptus tereticornis	15	6	4	0	0	-	-27.5108	153.203
Eucalyptus tereticornis	18	7	5	0	0	-	-27.5107	153.203
Eucalyptus tereticornis	10	3	6	0	0	-	-27.5107	153.203
Eucalyptus tereticornis	15	6	4	0	0	-	-27.5107	153.203
Eucalyptus tereticornis	18	4	7	0	0	-	-27.5107	153.203
Eucalyptus tereticornis	20	10	3	0	0	-	-27.5104	153.203
Eucalyptus tereticornis	22	6	4	0	0	-	-27.5107	153.204
Eucalyptus tereticornis	15	8	5	0	0	-	-27.5105	153.203
Eucalyptus tereticornis	10	6	2	0	0	-	-27.5105	153.203
Eucalyptus tereticornis	40	15	15	0	0	-	-27.5106	153.203
Eucalyptus tereticornis	20	7	4	0	0	-	-27.5101	153.204
Eucalyptus tereticornis	30	7	19	0	0	-	-27.5102	153.204
Eucalyptus tereticornis	8	5	2	0	0	-	-27.5101	153.204
Eucalyptus tereticornis	18	7	4	0	0	-	-27.5102	153.204
Eucalyptus tereticornis	50	20	15	0	0	-	-27.5095	153.2
Eucalyptus tereticornis	65	20	16	0	0	-	-27.5095	153.2
Eucalyptus tereticornis	120	18	18	0	0	-	-27.5093	153.2
Eucalyptus tereticornis	15	10	3	0	0	-	-27.5093	153.2
Eucalyptus tereticornis	200	12	10	0	0	-	-27.5102	153.202
Eucalyptus tereticornis	25	9	4	0	0	-	-27.5102	153.203
Eucalyptus tereticornis	10	4	2	0	0	-	-27.5096	153.2
Eucalyptus tereticornis	20	8	6	0	0	-	-27.5103	153.202
Eucalyptus tereticornis	90	18	24	0	0	-	-27.5105	153.202
Lophostemon suaveolens	20	12	3	0	0	-	-27.509	153.201
Lophostemon suaveolens	10	10	2	0	0	-	-27.5088	153.201
Lophostemon suaveolens	25	6	4	0	0	-	-27.511	153.203
Lophostemon suaveolens	10	10	2	0	0	-	-27.509	153.201
Lophostemon suaveolens	15	8	3	0	0	-	-27.5085	153.201
Lophostemon suaveolens	20	8	4	0	0	-	-27.5078	153.201
Lophostemon suaveolens	40	12	8	0	0	-	-27.5087	153.201
Lophostemon suaveolens	20	10	5	0	0	-	-27.5087	153.201
Lophostemon suaveolens	20	9	4	0	0	-	-27.5084	153.2
Lophostemon suaveolens	15	9	3	0	0	-	-27.5087	153.2
Lophostemon suaveolens	20	9	5	0	0	-	-27.5078	153.2
Lophostemon suaveolens	20	7	2	0	0	-	-27.5078	153.2
Lophostemon suaveolens	20	9	4	0	0	-	-27.5106	153.201
Lophostemon suaveolens	29	10	4	0	0	-	-27.5104	153.202
Lophostemon suaveolens	25	7	4	0	0	-	-27.5099	153.201
Lophostemon suaveolens	15	6	3	0	0	-	-27.5106	153.201
Lophostemon suaveolens	20	19	3	0	0	-	-27.5115	153.203
Lophostemon suaveolens	20	6	2	0	0	-	-27.5104	153.204
Lophostemon suaveolens	15	8	2	0	0	-	-27.5104	153.202
Lophostemon suaveolens	30	12	5	0	0	-	-27.51	153.202
Lophostemon suaveolens	15	8	3	0	0	-	-27.5101	153.205
Melaleuca quinquenervia	20	6	4	0	0	-	-27.5106	153.201
Melaleuca quinquenervia	20	4	3	0	0	-	-27.5102	153.204
Melaleuca quinquenervia	10	6	2	0	0	-	-27.5101	153.204
Melaleuca quinquenervia	25	6	5	0	0	-	-27.5105	153.202
Melaleuca quinquenervia	25	8	4	0	0	-	-27.5114	153.203

Matters of National Environmental Significance Significant Impact Assessment

Birkdale Community Precinct

Raptor ENVIRONMENTAL

22 March 2023

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Document Information

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Version	Effective Date	Description of Revision	Prepared by	Reviewed by
1	07/10/2022	Draft for comment	M. Timms	D. Francis
2	28/11/2022	Amended with updated Development Footprint	M. Timms	D. Francis
3	01/12/2022	Amended as per comments	M. Timms	D. Francis
4	20/03/2023	Amended as per comments	M. Timms	D. Francis

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1 Endangered Species and Ecological Communities

1.1 Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)

***Environment Protection and Biodiversity Conservation Act 1999* Listing Status:** Endangered

***Nature Conservation Act 1992* Listing Status:** Endangered

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**
Lead to a long-term decrease in the size of a population	**Possible.** The Significant Impact Guidelines specify that "*a 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:* • *a geographically distinct regional population, or collection of local populations, or* • *a population, or collection of local populations, that occurs within a particular bioregion.*" For the purposes of the Koala, the aspect of the definition that relates to "geographically distinct" populations does not apply because of the relative continuity of the species across the range in which it is listed. Given this, determining what is a population must rely on the bioregion. Within the southeast Queensland bioregion there are several genetically distinct local populations (Kjeldsen et al. 2019, Lee et al. 2009). The Project Area falls within the Koala Coast local population of the southeast Queensland bioregional population. There are no publicly available contemporary estimates of the size of the Koala Coast population. As of 2010, the estimate of the Koala population in the Koala Coast was 1991 ± 488 animals (Department of Environment and Resource Management, 2012). Despite protection measures in Queensland, an independent review published in 2015 determined that the decline in peri-urban Koala populations in the Koala Coast and Pine Rivers areas of South East Queensland showed no evidence of

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**
	slowing, and rates of decline may even be increasing (Rhodes et al. 2015). As such, the size of the Koala Coast population is assumed to be lower than the estimate of 1991 animals provided in 2010. The Conservation Advice for Koala states that the highest population estimate for the southeast Queensland Bioregion Koala population is 15,821 animals (produced in 2012). Assuming a consistent rate of exponential decline, the population in the southeast Queensland bioregion is estimated to consist of 11,477 individuals (Department of Agriculture, Water and the Environment, 2022). For the purposes of the Project Area, multiple studies have been undertaken of koalas to inform the extent of the Project's Development Footprint. Specifically, prior studies of the koalas within the Project Area found: *"With at least 10 koalas using the area in and around the Birkdale Precinct in 2021, and at least 21 koalas detected over the past four years, it is clear that Birkdale Precinct is an important habitat. With the level of connection, it also is an important corridor for koalas of the Redland Coast. High presence of koalas in the Precinct is also a sign of good habitat quality."* and "*With a total area of 62 ha, the density of koalas in this area is approx. 0.1 koala per ha*" (University of the Sunshine Coast, 2021) and *"A notional koala carrying capacity for the site was calculated with reference to koala habitat type classifications. Mapped remnant vegetation on the site is currently estimated as likely ≤ 6 koalas, however if mapped regrowth vegetation reaches remnant status the total number that the study area could support increases to ~ 20 koalas. In this context, the carrying capacity of the site as a whole could be enhanced by increasing the density of Preferred Koala Food Trees (PKFTs) within existing habitat. This report recommends that a program of PKFT planting focus on areas in which overall native tree density is low, including areas that are currently dominated by introduced species such as Pinus elliottii and areas that have widely spaced, typically large PKFTs but otherwise exhibit current lack of recruitment."* (Biolink, 2021).

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**
	The USC (2021) assessment included drone surveys, detection dog surveys and scat genetic analysis. The density of Koalas was calculated in this assessment based on the area of land (i.e 62 ha) by the number of Koalas detected during the surveys. The Biolink (2021) assessment included mapping of koala habitat based on a four-tiered koala habitat classification hierarchy applied to mapped Regional Ecosystems and supported by field surveys to determine Koala activity using the Spot Analysis Technique (Phillips et al., 2011). Subsequently, the Biolink assessment determined the carrying capacity of the Project Area by coding the habitat within the Regional Ecosystem and High-value Regrowth spatial layers using the abovementioned classification hierarchy criteria. The listing advice for the Koala (Department of Agriculture, Water and the Environment, 2022) includes a report by the Australian National University (Youngentob et al., 2021) that reviews koala habitat assessment criteria and methods and discussed key characteristics of koala habitat relevant insofar as the EPBC Act is concerned. Below is a summary of the characterisation of koala habitat types within the Project Area based on the Australian National University Report (Youngentob et al., 2021) and as per the methodology described in the Ecological Assessment Report (Raptor Environmental, October 2022). Koala habitat categories are shown in **Figure 1**.

Habitat Category	Based on ANU Report (Youngentob et al., 2021)	
	Locally important koala tree (LIKT)	**Ancillary koala habitat tree**
A	LIKT trees dominate the vegetation community	Ancillary koala habitat trees in scattered in the vegetation community
B	LIKT scattered	Ancillary koala habitat trees dominate the vegetation community
C	Areas cleared, do not support LIKT or ancillary trees OR support isolated LIKT or ancillary trees	

The table below includes a comparison of Koala habitat types estimated based on pre-construction and post-construction areas.

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)

Significant Impact Criteria	Impact Assessment

Habitat Category	Pre-construction (ha)	Post-construction (ha)	Reduction of habitat type (ha)
A	34.43	32.4	~1.8
B	4.8	1.96	~2.9
C	22.8	4.3	~18.5

Based on the assessments undertaken by the USC and Biolink it is estimated that the Project Area supports an average of 6 to 10 koalas at any one time (although 21 genetically distinct Koala have been identified in the area). Koala assessments by way of Drone (USC, 2021), detection dog (USC, 2021), SAT (Bioloink, 2021), KRAM (Cardno, 2021) or incidental/active searches (Cardno 2021, Raptor Environmental 2023) did not identify koalas or koala activity within areas mapped as Category C (defined above). While a 0.1 koala/ha has been applied to the entire site by USC (2021), it is likely the density within Category C is significantly less given that past survey effort has failed to detect the species in this area. However, it is probable that Koalas would utilise Category C areas for dispersal opportunities.

USC (2021) estimated the density of koalas to 0.1/ha based on the total number detected divided by the total area of land (i.e. 6 koalas / 62ha = 0.1). Applying this density to the total clearing footprint of Categories A and B means that the proposed development will impact the habitat of ~0.5 of a koala. If a modest allowance is made for impacts on Category C and the overall estimate is adjusted upward then ~0.9 of a koala will be directly impacted by the proposal.

Potential indirect impacts as a result of the Project include a reduction in the suitability of the surrounding koala habitat due to an increase in lighting and noise potential to limit movement opportunities during the construction phase, increased risk of injury and mortality, increase in weed invasion and/or spread and potential and increased intensity. Indirect impacts are unlikely to lead to a long-term decrease in the size of a population. The *Conservation Advice for Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory* (Department of Agriculture, Water and

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**
	the Environment, 2022) states there are an estimated 11,477 individuals in southeast Queensland as of 2021. Taking into account direct impacts of the project (and assuming that, 21 koalas would be impacted by the proposal), at most, 0.2% of the population will be impacted. Consequently, the Project may contribute to an overall long-term decrease in the population.
Reduce the area of occupancy of the species	**Unlikely.** The area of occupancy for koala is estimated at 19,428 km^2 (DAWE, 2022) and is calculated using a 2x2 km grid cell method based on the IUCSN Red List Guidelines 2014 (IUCN, 2014). The Development Footprint is located within 1 grid square, with direct impacts limited to the existing highly modified central portion of the Project Area (i.e. direct impact to koala habitat, 2.3 ha of Category A, 4 ha of Category B and 18.7 ha of Category C koala habitat types). It is possible that the Development Footprint will result in a reduction in habitat; however, further consideration of on-ground offsets is required in the design to determine if there will be a reduction in the area of occupancy of the Koala. The Project provides opportunities to improve the condition of the remaining Category B areas and restore some portions of Category C areas with the long-term aim to enhance these to Category A condition. Increased monitoring of the Project Area will assist in improving the health of the Birkdale population by facilitating veterinary care of individuals reported with chlamydia as part of disease management programs (e.g. as discussed in USC, 2021). Consequently, an overall reduction in the area of occupancy of the Koala is not anticipated.
Fragment an existing population into two or more populations	**Unlikely.** Within the context of the southeast Queensland bioregion population, or even the Koala Coast local population, the Project will not fragment an existing population. Further within the context of the Project Area, the Development Footprint incorporates strategic measures to retain Koala habitat patches. The Project design also incorporates mitigation measures between these areas (i.e. reduced speed zones,

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**
	including a 30/km per hr speed limit for the ring road, and restrictions/limitations to night traffic), where possible. The Project is unlikely to fragment an existing population considering the southern portion of the Site adjoining the Tingalpa Creek corridor will be retained and enhanced by the Project. Additionally, dispersal opportunities will be maintained within the Development Footprint within the operational phase of the Project.
Adversely affect habitat critical to the survival of a species	**Unlikely.** Habitat critical to the survival of a species is the area that the species relies on to halt decline and promote the recovery of the species. The Significant Impact Guidelines define critical habitat as: *"Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:* • *for activities such as foraging, breeding, roosting, or dispersal* • *for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)* • *to maintain genetic diversity and long term evolutionary development, or* • *for the reintroduction of populations or recovery of the species or ecological community.* *Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act."* The Recovery Plan for the Koala poses seven key questions to consider in the evaluation of Koala habitat (Department of Agriculture, Water and the Environment, 2022). These are: **a) whether the habitat is used during periods of stress (examples flood, drought or fire)** ○ A total of 70% of Koalas in the Birkdale Precinct are likely infected with chlamydia (USC, 2021). It is well known that stress (including habitat fragmentation) increases susceptibility to

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**
	infection by pathogens and reduces tolerance of infection; and the high rate of chlamydia infection within the Birkdale population may indicate the prevalence of external stressors. Further, the Development Footprint is adjacent to a flood hazard area associated with Tingalpa Creek and is predominately mapped as a potential bushfire hazard buffer and medium potential bushfire intensity area adjoining medium and high bushfire intensity areas (SPP, 2022). The Development Footprint is likely to be utilised as a refuge during periods of stress as a result of flood and bushfire events. Dispersal opportunities through the Development Footprint will be maintained in the operational phase. ○ It is possible that additional stress associated with the construction phase of the development could increase susceptibility to infection. Increased monitoring of the Koalas within the Project Area will assist in improving the health of the Birkdale population by facilitating veterinary care of individuals reported with chlamydia as part of disease management programs (e.g. as discussed in USC, 2021). **b) whether the habitat is used to meet essential life cycle requirements (e.g. foraging, breeding, social behaviour, dispersal)** ○ Based on the assessments by the USC and Biolink it is estimated that the Project Area supports between 6 and 10 koalas and as such habitat within the Project Area meets essential life cycle requirements for Koalas. Based on the above review of Koala Habitat within the Development Footprint, impacts on Koala habitat estimate 0.9 of a koala (i.e. 0.2 % of the koala population) will be impacted by the proposal. **c) the extent to which the habitat is used by important populations** ○ Important populations of Koala have not yet been defined (Department of Agriculture, Water and the Environment, 2022). Despite this, it is likely that the southeast Queensland population will be considered an important population as it is one of the three largest in Queensland. The Project Area is known to have supported 21 individual Koalas over a four-year period (USC, 2021). As such, the Project Area supports an estimated 0.2% of the southeast Queensland bioregional population, and 1.1% of the Koala Coast population. It is relevant to note that the Project Area likely supports a larger percentage of the Koala Coast

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**
	population and that the figure stated in this report refers to a population estimate conducted in 2010 in the absence of contemporary data for the population. **d) whether the habitat is necessary to maintain genetic diversity and long-term evolutionary development** ○ Ecological corridors within the Project Area will be retained and enhanced by the Project as such genetic diversity and long-term evolutionary development will be maintained. The study conducted by USC states that, "*the connectivity to corridors and other habitat patches makes the Precinct a valuable link for koala movement and dispersal and therefore gene flow. Therefore, this area and its habitat should be conserved and protected for koalas, and rehabilitated where appropriate, to increase carrying capacity*." As such, the habitat is considered important in terms of promoting gene flow and maintaining genetic diversity. **e) whether the habitat is necessary for use as corridors to allow the species to move freely between sites used to meet essential life cycle requirements** ○ The Development Footprint portion of the Project Area contains Category C and some Category A and B koala habitat (i.e. a patchy corridor that enables Koala to transit from intact habitat patches to the north and south); however, the Tingalpa Creek corridor to the west provides a more valuable source of habitat and connectivity for Koala. As such, the habitat within the Development Footprint provides ground that allows for Koala movement opportunities between habitats. The study conducted by USC found strong evidence that the Birkdale Precinct is used as a movement corridor, "*with at least 10 koalas using the area in and around the Birkdale Precinct in 2021, and at least 21 koalas detected over the past four years, it is clear that Birkdale Precinct is an important habitat. With the level of connection, it also is an important corridor for koalas of the Redland Coast*." As such, the Birkdale Precinct is considered an important necessary habitat corridor for Koala. **i) whether the habitat is necessary to ensure the long-term future of the species or ecological community through reintroduction or re-colonisation** ○ The distribution of Koala populations is broad and the Koala habitat within the Development Footprint is not considered necessary to ensure the long-term future of Koala populations.

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**
	Including the Koala Coast population. However, these areas may be necessary for ensuring the long-term future of the localised Birkdale Koala sub-population. **g) any other way in which habitat may be critical to the survival of a listed threatened species or a listed threatened ecological community (EPBC Act).** The Project protects Koala habitat including Category A and patches of Category B which are known to support Koalas. Whilst the Development Footprint directly impacts Category C habitat and patches of Category B habitat, the Project includes enhancement of retained habitat, and retention of patches of Category B habitat within the design. As such, the Project is unlikely to adversely affect habitat critical to the survival of a species.
Disrupt the breeding cycle of a population	**Unlikely.** Koalas may not breed every year if conditions are not suitable and breeding may be unsuccessful due to poor health (e.g. Chlamydia) (Department of Agriculture, Water and the Environment, 2022). Additionally, Koala movement is known to increase during breeding season (usually September to February). The construction phase of the Project will be staged over several years. As such, construction activities cannot reasonably be undertaken outside of the Koala breeding season or all events that would provide stress to Koala (i.e. droughts, flooding) in full. It is possible that noise associated with construction and operational activities could obscure Koala vocalisations (i.e. bellows) which are closely associated with their breeding behaviour (Jiang *et al.*, 2022). As such, the Project will not conduct construction works between the hours of 6pm and 6am. With improved koala health monitoring and management and construction and operational phase management plans incorporating light and noise management protocols the Project is unlikely to disrupt the breeding cycle of Koalas.
Modify, destroy, remove, isolate or decrease the availability or quality of	**Unlikely.** The Project will reduce the availability of Koala habitat to the extent that the Project will result in a direct impact to 0.9 of a Koala as detailed above. The Koala habitat within the broader Project Area will be protected and enhanced through restoration and the design will include Koala movement infrastructure,

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**
habitat to the extent that the species is likely to decline	reduced speed zones, limitations to night traffic (where possible). As such, Koala movement will be maintained within the Development Footprint in the operational phase. Improved Koala health monitoring and management programs will assist and support the long-term growth of the Koala Coast population. Therefore, impacts to koala habitat as a result of the Project are unlikely to result in the decline of the species.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	**Unlikely.** Invasive flora species that currently occur within the Project Area are not a primary threat to Koalas according to their profile on the Species Profile and Threats Database; however, weeds that inhibit Koala movement (such as *Lantana camara*) may reduce habitat quality (Department of Agriculture, Water and the Environment, 2022). The introduction of domestic dogs associated with the development component of the Project also poses a potential threat to Koala. It is understood that the existing Conservation Agreement between the Commonwealth and Council includes ongoing weed management of the Conservation Area (Department of the Environment and Energy, 2019). As such Council's weed-management program for the Project Area has commenced as evidenced during the field assessment. On-going invasive species management actions will be included in the Operational management plan for the Project. The Project is unlikely to result in invasive species becoming established in Koala habitat.
Introduce disease that may cause the species to decline	**Unlikely.** Koalas may be impacted by two known diseases and pathogens: Chlamydia and myrtle rust (which impacts their favoured genus of habitat and fodder tree). Chlamydia is a bacterial infection that affects almost all Koalas in South east Queensland, including the Project Area (USC, 2021). Infertility from Chlamydia is a contributing factor to the current decline in Koala numbers. The Project is unlikely to introduce additional chlamydia to the local population (given that it is already known to occur within 70% of the resident population [USC, 2021]). A key action highlighted in the Redlands Coast Koala Conservation Action Plan is

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**
	Koala health including proactively manage disease (e.g. Chlamydia) in locations where koala populations have identified high rate of incidents (through a capture and treatment program) (Redland City Council, 2021). Examples of successful Koala health monitoring and management programs in South East Queensland include The Mill koala monitoring and vaccination programs. The Project will improve koala health monitoring and management and such the health of the Koalas within the Project Area is likely to improve long-term as a result of the Project. Myrtle rust also has the potential to decrease Koala habitat quality through the infection of Myrtaceae trees, and increased vehicular and pedestrian movement during the construction and operational phases of the Project. The Construction and Operational Management Plans are to include protocols for the minimisation and management of diseases and pathogens. The Project is unlikely to introduce disease that may cause Koalas to decline and will support Koala health and population growth through improved monitoring and management of Chlamydia.

Interfere with the recovery of the species.	**Unlikely.**
	
	The National Recovery Plan for the Koala contains several strategies and priority actions to facilitate the recovery of the species. The action relates to the following supporting and on-ground strategies:
	
	• **<u>Supporting strategies:</u>**
	  ○ **Strategy 1: Build and share knowledge.**
	  The Project supports building and sharing knowledge through improved Koala health monitoring. Monitoring reporting will build on the existing knowledge of Koala populations, health and responses to health management.
	  ○ **Strategy 2: Engage and partner with the community in listed Koala conservation.**
	  Council has engaged and partnered with the community in Koala conservation by completing an extensive community consultation process for the Project with a focus on conservation outcomes for the Project Area. Council also undertakes extensive community engagement

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**
	under the *Redlands Coast Koala Conservation Plan 2022 - 2027* and the community-led Koala Watch Program to assist in early-stage disease intervention and management. ○ **Strategy 3: Increase the area of protected habitat for the listed Koala.** The Project includes the protection and enhancement of the Conservation Area (containing koala habitat). The Project proposes the restoration of Category B and C habitat and has the potential to increase protected habitat for Koala (to be confirmed as part of the detailed design). ○ **Strategy 4: Integrate listed Koala conservation into policy, statutory and land use plans.** Redland City Council has adopted the Redlands Coast Koala Conservation Plan 2022-2027 and Redlands Coast Koala Conservation Action Plan 2022-2027 which outlines statutory obligations, future-proofing, performance measures in the short, medium and long-term and Action plan objectives (Redland City Council, 2021) (Redland City Council, 2021b). • **<u>On-ground strategies:</u>** ○ **Strategy 5: Strategically restore listed Koala habitat.** Redland City Council details the management action of protecting and improving koala habitat. The actions include habitat evaluation, land acquisitions, healthy Council bushland, more koala habitat on Council land, improving koala movement and safeguard koala habitat (Redland City Council, 2021b). Additionally, Council details long-term desired outcomes including "*consistent and demonstrable evidence of net gain of high-quality habitat to support increased koala density and abundance across the city* (Redlands City Council, 2021)." The Project will include the restoration of areas of Category B and C habitat.

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**
	○ **Strategy 6: Actively manage listed Koala metapopulations**[1] Redland City Council's current actions include advancing management practice for koala conservation outcomes including: ▪ "*Provide policy advice to ensure koala habitat is prioritised in land conservation and management initiatives.* ▪ *Provide policy advice to guide the consideration of koala habitat with regard to statutory planning strategies and applications.* ▪ *Continue to develop a better understanding of koala population requirements to advance management responses* ▪ *Facilitate increased health and disease management outcomes for koalas.* ▪ *Recognise, motivate and commemorate koala conservation efforts.* ▪ *Develop and maintain productive, integrated partnerships to influence and achieve greater funding for koala conservation outcomes.* ▪ *Maintain information network with community, universities, wildlife carers, environmental groups and other stakeholder to guide and assist with koala conservation outcomes*" (Redland City Council, 2021). Redland City Council is actively managing the Koala Coast population, through the implementation of the *Redlands Coast Conservation Plan and Action Plan 2022-2027*. The Project will incorporate improved health monitoring and management and as a result. The project is unlikely to interfere with the recovery of the species.

[1] Metapopulation is defined as "*The set of biological populations within a larger area, where movement or gene flow from one biological population to at least some other patches is possible and is important for maintaining abundance and distribution at regional scale, even if such movement is infrequent.*" (Department of Agriculture, Water and the Environment, 2022).

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**

Conclusion: The assessment against the significant impact criteria indicated that that the Project is unlikely to have a significant impact on Koala as the Project has been assessed as follows:

- An overall long-term decrease in the population is not anticipated as the Project will impact 0.2 % of the estimated southeast Queensland Koala population.
- An overall reduction in the area of occupancy of the Koala is not anticipated as the Project provides opportunities to improve the condition of remaining Category B areas and restore some portions of Category C areas with the long-term aim to enhance these to Category A condition. The Project will also adopt avoidance measures to minimize clearing to the furthest extent practicable.
- The Project is unlikely to fragment an existing population considering that the southern portion of the Site adjoining the Tingalpa Creek corridor will be retained and enhanced by the Project, and connectivity will be maintained across the Development Footprint in the operational phase.
- The Project is unlikely to adversely affect habitat critical to the survival of a species as the Project includes retention of patches of Category B habitat within the design and the Category A habitat within the Conservation Area.
- With improved koala health monitoring and management and construction and operational phase management plans incorporating light and noise management protocols the Project is unlikely to disrupt the breeding cycle of Koalas.
- The Koala habitat within the broader Project Area will be protected and enhanced through restoration and the design will include Koala movement infrastructure, reduced speed zones, limitations to night traffic (where possible). Impacts on koala habitat as a result of the Project are unlikely to result in the decline of the species.
- The Project Area is subject to an existing Weed Management Plan and continued invasive species management will be included in the Operational management plan for the Project. The Project is unlikely to result in invasive species becoming established in Koala habitat.
- The Project is unlikely to introduce disease that may cause Koalas to decline and will support Koala health through improved monitoring and management of Chlamydia.
- The Project is unlikely to interfere with the recovery of the species as Redland City Council is actively managing the Koala Coast population, through the implementation of the *Redlands Coast Conservation Plan and Action Plan 2022-2027.*

Koala - combined populations of Queensland, New South Wales and the Australian Capital Territory (*Phascolarctos cinereus*)	
Significant Impact Criteria	**Impact Assessment**
	Redland City Council are finalising the negotiation of a Conservation Agreement with the Commonwealth which includes a request for a declaration that actions do not require approval under Part 9 of the EPBC Act. As such, Redland City Council propose to meet their Commonwealth obligations for the Project through the Conservation Agreement.

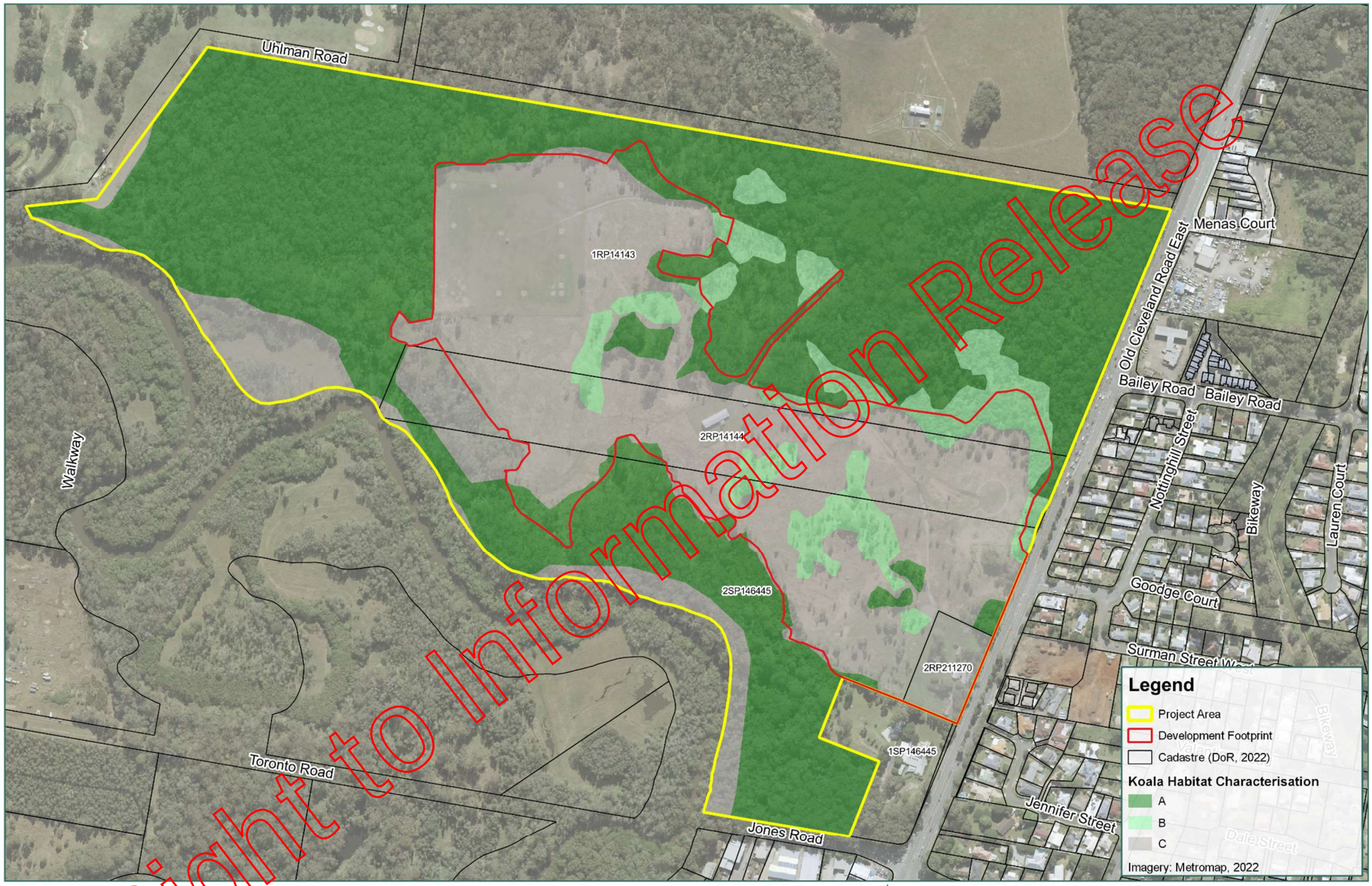


Figure 1. Koala habitat characterisation.

1.2 Greater glider - southern and central (*Petauroides volans*)

***Environment Protection and Biodiversity Conservation Act 1999 Listing* Status:** Endangered

***Nature Conservation Act 1992* Listing Status:** Endangered (listed as *Petauroides volans*)

Greater glider - southern and central (*Petauroides volans*)	
Significant Impact Criteria	**Impact Assessment**
Lead to a long-term decrease in the size of a population	**Unlikely.** The Project Area and surrounds are not known to contain a Greater glider population (ALA, 2023). The nearest records of a live specimen are located within Greater Glider Reserve, approximately 3km to the south-east of the Project Area. Although the species has not been recorded proximate to the Project Area for some time, the Conservation Area contains habitat attributes suitable for use by the species (but not necessarily all attributes), such as live and dead hollow-bearing trees for denning, feed trees, large trees and habitat connectivity across the landscape (as defined by the Guide to Greater Glider Habitat in Queensland) (Eyre *et al.*, 2022). However, the Development Footprint itself lacks areas of contiguous canopy cover that would limit the capability of the Greater glider to move through the area. As such, the Project is considered unlikely to further lead to a long-term decrease in the size of a Greater glider population. Given that the Project Area is not within an area that supports a known population, (and that the species has not been recorded within the Project Area); the Project is not considered likely to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of the species	**Unlikely.** The area of occupancy of the Greater glider is calculated using a 2x2 km grid cell method based on the IUCN Red List Guidelines 2019 (IUCN, 2019). Using these guidelines, the Project Area resides within 1 grid square, with potential minor indirect impacts to retained vegetation anticipated. The Development Footprint lacks areas of contiguous canopy cover. This absence limits the capability of the Greater glider to den, move through or forage in the area. While vegetation within the Conservation

Greater glider - southern and central (*Petauroides volans*)	
Significant Impact Criteria	**Impact Assessment**
	Area provides habitat that the species may occupy, the Project avoids all areas of potential Greater glider habitat within the Conservation Area. As such, the Project is considered unlikely to cause a reduction in the area of occupancy for the species.
Fragment an existing population into two or more populations	**Unlikely.** The Project Area has undergone extensive ecological survey (including targeted surveys for Greater glider in 2022), does not support a known population of Greater glider (Cardno, 2020 and Raptor Environmental, 2023). Additionally, the balance of the Project Area has previously been subject to a high degree of modification (such that the Development Footprint would already be considered 'fragmented' in terms of its usability by Greater glider). The Conservation Area is connected to a regional biodiversity corridor which will be protected and enhanced as part of the Project (Department of Infrastructure, Local Government and Planning, 2017). Given the existing level of fragmentation and the lack of recent records for Greater glider within and surrounding the Project Area; the Project is not considered likely to further fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of a species	**Unlikely.** The Conservation Advice (DAWE, 2022) defines 'habitat critical to the survival of the Greater glider' as containing the characteristics described below including: **a. Large contiguous areas of eucalypt forest, which contain mature hollow-bearing trees and a diverse range of the species' preferred food species in a particular region; and** ○ The Conservation Area forms part of a habitat area characterised by a eucalypt forest that contains mature hollow-bearing trees. The Development Footprint lacks a contiguous canopy and is unlikely to support Greater glider habitat. **b. smaller or fragmented habitat patches connected to larger patches of habitat, that can facilitate dispersal of the species and/or that enable recolonization; and**

Greater glider - southern and central (*Petauroides volans*)	
Significant Impact Criteria	**Impact Assessment**
	○ The Conservation Area is connected to larger areas of habitat associated with the Lower Tingalpa and Coolnwynpin Creek Catchment. The Conservation Area is connected to a regional biodiversity corridor which will be protected and enhanced as part of the Project (Department of Infrastructure, Local Government and Planning, 2017). The habitat within the Conservation Area supports the dispersal of Greater gliders. The Development Footprint lacks a contiguous canopy and is unlikely to support Greater glider habitat. **c. cool microclimate forest/woodland areas (e.g. protected gullies, sheltered high elevation areas, coastal lowland areas, southern slopes); and** ○ The Conservation Area adjoins Tingalpa Creek and a tidal waterway is located within the southern extent of the Project Area. The tidal waterway within the Conservation Area supports a protected marine habitat characterised by ponded areas. **d. areas identified as refuges under future climate changes scenarios; and** ○ The tidal waterway corridor within the southern extent of the Conservation Area will be retained and enhanced and provides a climate refuge that contributes to the Project Area's resilience to drying conditions and will provide a cooler refuge during periods of bushfire and heatwaves (DCCEEW, 2022). **e. short-term or long-term post-fire refuges (i.e. unburnt habitat within or adjacent to recently burnt landscapes) that allow the species to persist, recover and recolonise burnt areas.** ○ Redland City Council's Parks and Conservation Planned Burn Program includes hazard reduction burns within the Project Area (i.e. low intensity) (Redland City Council, 2022b). As such habitat critical to the survival of the Greater glider is present in the Conservation Area, however, the Development Footprint does not meet any of the above criteria and is not considered habitat critical to the survival of the Greater glider.
Disrupt the breeding cycle of a population	**Unlikely.** The Conservation Area contains potential Greater glider habitat including suitable breeding hollows that will be retained and enhanced for the Project. The Development Footprint does not support suitable Greater glider habitat due to the lack of a contiguous canopy. Potential indirect impacts include the potential for

Greater glider - southern and central (*Petauroides volans*)	
Significant Impact Criteria	**Impact Assessment**
	construction activities to result in the introduction or spread of invasive. A Waste Management Plan will be developed as part of the Construction Environmental Management Plan (CEMP) and will specify the disposal and removal of waste during construction to minimise the risk of attracting invasive fauna species. A Weed Management Plan will be developed as part of the CEMP and weed management within Greater glider habitat will be managed as per Council's Invasive Species Management Plan. Specifically, Council will control invasive plants and animals within the Conservation Area and this will include targeted control of invasive species identified within the Ecological Assessment Report (Raptor Environmental, 2023) The Project is unlikely to disrupt the breeding cycle of Greater gliders.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Unlikely.** The targeted field surveys did not record Greater gliders within the Project Area. However, the broad contiguous areas of habitat in the Conservation Area support potential habitat for Greater gliders. Greater gliders have been recorded in Greater Glider Reserve (ALA, 2023), approximately 3km to the south-east of the Project Area. The Project Area is connected to this local reserve via an Coolnwynpin Creek. The Conservation Area will be protected and enhanced as part of the Project and the Development Footprint does not contain suitable habitat due to the lack of contiguous canopy cover. The Project is unlikely to cause further decline of the species. Greater glider populations within the Redlands City Council Local Government Area have already undergone extensive decline. Multiple ecological investigations undertaken for the Project indicate that Greater glider was not recorded within the Project Area. As such, the Project Area is located in an area that has already experienced localised decline of Greater glider populations. As such, the Project is not considered likely to cause further decline of the species.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the	**Unlikely.** The Conservation Advice for the Greater glider states that two invasive species may pose threat to the species: the feral cat (*Felis catus*) and European fox (*Vulpes vulpes*). Greater glider remains have been found in stomach contents of both species; however Greater glider comprised a small amount of the

Greater glider - southern and central (*Petauroides volans*)	
Significant Impact Criteria	**Impact Assessment**
endangered or critically endangered species' habitat	contents, and it was unclear whether were consumed as live prey or as carrion (Threatened Species Scientific Committee, 2022). Both the feral cat and European fox have previously been recorded within the Project Area; as such, the Project could not cause the establishment of the feral cat or European red fox within the Project Area.
Introduce disease that may cause the species to decline	**Unlikely.** Greater gliders are not directly impacted by any known diseases. Therefore, the Project is unlikely to introduce a disease that could cause the species to decline.
Interfere with the recovery of the species.	**Unlikely.** There is not currently a published recovery plan for the species. The species' approved Conservation Advice includes a large number of priority recovery and management actions for the species (Threatened Species Scientific Committee, 2022). The recovery action categories relate to: 1. Conservation and management priorities – habitat loss, disturbance and modification; climate change; invasive species and ex-situ recovery actions. 2. Stakeholder and community engagement. 3. Survey and monitoring. 4. Various information and research priorities. The Project would not interfere with stakeholder or community engagement across the species' range, nor would it interfere with high-level monitoring and research priorities. However, the Project is of relevance to management priority 1 (Conservation and management priorities – habitat modification). Direct impacts to Greater glider are avoided through consolidation of the design within the highly modified Development Footprint and avoiding clearing of Greater glider habitat. Potential indirect impacts as a result of the Project on surrounding habitat within the Conservation Area are avoided and mitigated through routine controls and

Greater glider - southern and central (*Petauroides volans*)	
Significant Impact Criteria	**Impact Assessment**
	the Redland City Council Prescribed Burn Project. The Project is considered unlikely to interfere with the recovery of the species.
Conclusion: The Project is unlikely to have a significant impact on the Greater Glider.	

1.3 Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland Bioregion

***Environment Protection and Biodiversity Conservation Act 1999* Listing Status:** Endangered

***Nature Conservation Act 1992* Listing Status:** Not applicable

Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland Bioregion	
Significant Impact Criteria	**Impact Assessment**
Reduce the extent of an ecological community	**Unlikely.** The Project will not result in a direct impact on the Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland Bioregion threatened ecological community (TEC). It is also relevant to note that the Conservation Area boundary has been modified to incorporate the ground-truthed mapped extent of the TEC to ensure no direct impacts occur as a result of the Project. Potential indirect impacts to the TEC include changes to the hydrological regime,(i.e. irrigation and stormwater), potential for increased edge effects (i.e. weed invasion) and altered fire regimes. Impacts associated with potential changes in hydrological regime are managed through the measures outlined in the Stormwater Management Plan including bioretention basins, diversion and treatment swales and a water reuse system and expansive irrigation area. Weed invasion is currently managed through the mandatory outcomes of the Conservation Agreement (i.e. application of the Environmental Early Works and Social Management Plan (Cardno, 2021)), routine controls and Council's invasive species management

Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland Bioregion	
Significant Impact Criteria	**Impact Assessment**
	program. Fire will be managed via Council's Parks and Conservation Planned Burn Program. The abovementioned measures will ensure the long-term maintenance of the ecological community. The extent of the indirect impacts is unlikely to reduce the extent of the TEC.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	**Unlikely.** The Project does not involve the removal of the Subtropical Eucalypt Floodplain Forest TEC or clearing within its extent.
Adversely affect habitat critical to the survival of an ecological community	**Unlikely.** The Conservation Advice states that habitat most critical to the survival of the TEC includes patches that are assessed as "best condition" (i.e. classes A and B) (Department of Climate Change, Energy, the Environment and Water (2022) The Ecological Assessment Report assessed the patches of TEC as A2 – Good Condition, as such the TEC within the Conservation Area is considered habitat critical to the survival of the species (Raptor Environmental, 2023) The Development Footprint does not directly impact the TEC. Potential indirect impacts including modified hydrology, edge effects (i.e. weed invasion) and altered fire regimes are managed through the measures indicated in the Stormwater Management Plan, the Environmental Early Works and Social Management Plan and Council's Parks and Conservation Planned Burn Program. The stormwater design integrates measures to avoid impacts to the TEC including the provision of bioretention basins and water-sensitive design elements in carparks to reduce the amount of stormwater runoff entering TEC. The Project is unlikely to adversely affect habitat critical to the survival of the TEC.
Modify or destroy abiotic (non-living) factors (such as	**Unlikely.**

Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland Bioregion	
Significant Impact Criteria	**Impact Assessment**
water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	The proposed irrigation of the Development Footprint will marginally modify the hydrology of the areas supporting the TEC; however, the extent of the impact is likely to be minimal considering the TEC is a floodplain community.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	**Unlikely.** The Project will marginally modify the hydrological regime and may increase edge effects (including weed invasion) and the existing fire regime may be altered which has the potential to alter the species composition of the Subtropical Eucalypt Floodplain Forest TEC. Impacts associated with weed invasion are managed through the conditions of the Conservation Agreement, routine controls and Council's invasive species management program. Fire will be managed via Council's Parks and Conservation Planned Burn Program. Potential indirect impacts associated with a modified hydrological regime are managed through the mitigation measures outlined in the Stormwater Management Plan. The Project does not propose practices such as regular burning practices or flora or fauna harvesting that could cause a substantial change in the species composition of the TEC.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:	**Unlikely.** As described above, the Project may lead to the introduction of invasive species during the construction and operational phases of the Project. Similar changes to the hydrology of the community may also result in similar impacts.

Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland Bioregion	
Significant Impact Criteria	**Impact Assessment**
– assisting invasive species, that are harmful to the listed ecological community, to become established, or **– causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**	The Project may also cause regular mobilization of fertilisers, herbicides or other pollutants that may kill or reduce the integrity of the adjacent Subtropical Eucalypt Floodplain Forest TEC. This would potentially occur during weed control efforts in other areas, or during landscaping works following the Project's construction phase. It is understood that the existing Conservation Agreement between the Commonwealth and Council includes ongoing weed management of the Conservation Area (Department of the Environment and Energy, 2019). Council's weed-management program for the Project Area has commenced as evidenced during the field assessment. On-going invasive species management actions will be included in the Operational management plan for the Project, as such, it is unlikely that the Project will reduce the quality or integrity of the TEC.
Interfere with the recovery of an ecological community.	**Unlikely.** The Conservation Advice for the TEC states that the recommended recovery actions for the TEC are designed to provide guidance for: • planning, management and restoration of the ecological community by landholders, NRM and community groups and other land managers. • conditions of approval for relevant controlled actions under national environment law; and, • prioritising activities in applications for Australian Government funding programs (Department of the Environment and Energy, 2018). The priority conservation actions focus on protecting and restoring the ecological community, communication and research. These include measures to: • Protect the ecological community to prevent further losses; • Restore the ecological community by the active abatement of threats, appropriate management, restoration and other conservation initiatives;

Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland Bioregion	
Significant Impact Criteria	**Impact Assessment**
	• Communicate, engage with and support people to increase understanding of the value and function of the ecological community and encourage their efforts in its protection and recovery; and • Research and monitoring to improve our understanding of the ecological community and the best methods to aid its management and recovery. The Project will protect the two areas of TEC in the Conservation Area and will minimise indirect impacts through the inclusion of best-practice stormwater management design, weed and fire management. Further, the Construction and Operational Management Plans for the project will include ongoing management protocols.
Conclusion: The Project is unlikely to have a significant impact on the TEC.	

1.4 Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community

***Environment Protection and Biodiversity Conservation Act 1999* Listing Status:** Endangered

***Nature Conservation Act 1992* Listing Status:** Not applicable

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community	
Significant Impact Criteria	**Impact Assessment**
Reduce the extent of an ecological community	**Unlikely.** The Project will not result in a direct impact on the Coastal Swamp Oak Threatened Ecological Community (TEC). The TEC is predominately inundated by the tidal regime of Tingalpa Creek, as such, whilst the outflow of freshwater may marginally increase during significant events, the TEC is unlikely to reduce in extent due to indirect impacts associated with changes to the hydrology downstream of the wetland. Further indirect impacts include the potential for weed invasion and altered fire regimes. Impacts associated with weed invasion are managed through the conditions of the Conservation Agreement, routine controls and Council's invasive species management program. Fire will be managed via Council's Parks and Conservation Planned Burn Program. Thus ensuring the long-term maintenance of the ecological community. The extent of the indirect impacts is unlikely to reduce the extent of the TEC. It is also relevant to note that the Conservation Area boundary has been modified to incorporate areas that present opportunities to restore degraded vegetation which could support the TEC in the future following restoration.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	**Unlikely.** The Project does not involve the removal of the Coastal Swamp Oak Forest TEC or clearing within its extent.

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community	
Significant Impact Criteria	**Impact Assessment**
Adversely affect habitat critical to the survival of an ecological community	**Unlikely.** The hydrology downstream of the wetland will be modified by the Project; however, the extent of the impact cannot yet be determined in the absence of detailed Stormwater Plans and hydraulic modelling. The Project's design incorporates strategic measures to avoid impacts to the TEC and surrounding wetland, including the provision of bioretention basins, water tanks and water-sensitive design elements in carparks to reduce the amount of stormwater runoff entering the wetland area and TEC. The TEC is predominately inundated by the tidal regime of Tingalpa Creek as such the Project is unlikely to adversely affect habitat critical to the survival of the TEC.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	**Unlikely.** The hydrology downstream of the wetland will be modified by the Project; however, the extent of the impact is likely to be marginal considering the TEC is predominately inundated by the tidal regime of Tingalpa Creek.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for	**Unlikely.** Nationally, much of what remains of the Coastal Swamp Oak TEC consists of regrowth, and the integrity of the remaining patches (such as that proximate to the Project Area) is severely compromised, particularly by weed invasion and changes to hydrological processes (Department of the Environment and Energy, 2018). As such, the TEC is susceptible to weed invasion (noting that changes to hydrological regimes may also alter the species composition of the Coastal Swamp Oak TEC).

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community	
Significant Impact Criteria	**Impact Assessment**
example through regular burning or flora or fauna harvesting	The Project does not propose practices such as regular burning practices or flora or fauna harvesting that could cause a substantial change in the species composition of the TEC. Additionally, the Project proposes restoration on an additional patch of Coastal Swamp Oak that does not currently meet the condition thresholds to be considered the TEC. However, restoration of the patch's understorey with native species would enable the patch to constitute the TEC in the future. Impacts associated with weed invasion are managed through the conditions of the Conservation Agreement, routine controls and Council's invasive species management program. Fire will be managed via Council's Parks and Conservation Planned Burn Program.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: **– assisting invasive species, that are harmful to the listed ecological community, to become established, or** **– causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**	**Unlikely.** As described above, the Project may lead to the introduction of invasive species during the construction and operational phases of the Project. Similar changes to the hydrology of the community may also result in similar impacts. The Project may also cause regular mobilization of fertilisers, herbicides or other pollutants that may kill or reduce the integrity of the adjacent Coastal Swamp Oak TEC. This would potentially occur during weed control efforts in other areas, or during landscaping works following the Project's construction phase. It is understood that the existing Conservation Agreement between the Commonwealth and Council includes ongoing weed management of the Conservation Area (Department of the Environment and Energy, 2019). Council's weed-management program for the Project Area has commenced as evidenced during the field assessment. On-going invasive species management actions will be included in the Operational management plan for the Project, as such, it is unlikely that the Project will reduce the quality or integrity of the TEC.

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community	
Significant Impact Criteria	**Impact Assessment**
Interfere with the recovery of an ecological community.	**Unlikely.** The Conservation Advice for the TEC states that the recommended recovery actions for the TEC are designed to provide guidance for: • planning, management and restoration of the ecological community by landholders, NRM and community groups and other land managers. • conditions of approval for relevant controlled actions under national environment law; and, • prioritising activities in applications for Australian Government funding programs (Department of the Environment and Energy, 2018). The priority actions focus on protecting and restoring the ecological community, communication and research. These include measures to: • Protect remaining patches. • Planning to minimise further clearing. • Manage actions to minimise impacts. • Minimise indirect impacts. • Prevent the introduction and spread of exotic species. • Manage recreational pressures. • Manage weeds and pests. • Manage trampling, browsing and grazing. • Undertake restoration. • Manage fire. • Raise awareness. • Provide information. • Coordinate efforts. • Mapping. • Modelling sea-level rise impacts.

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community	
Significant Impact Criteria	**Impact Assessment**
	• Understanding fire. • Understanding regrowth. • Monitoring. The Project will protect the patches of TEC in the Conservation Area and will minimise indirect impacts through the inclusion of best-practice stormwater management design. Further, the Construction and Operational Management Plans for the project will include ongoing invasive species management. Restoration of a patch of Casuarina glauca within the Conservation Area aims to increase the extent of TEC within the Project Area in the future.
Conclusion: The Project is unlikely to have a significant impact on the TEC.	

2 Vulnerable Species

2.1 South-eastern glossy black cockatoo (*Calyptorphynchus lathami lathmi*)

***Environment Protection and Biodiversity Conservation Act* 1999 Listing Status:** Vulnerable

***Nature Conservation Act 1992* Listing Status:** Vulnerable

South-eastern glossy black cockatoo (*Calyptorphynchus lathami lathmi*)	
Significant Impact Criteria	**Impact Assessment**
Lead to a long-term decrease in the size of an important population of the species	**Unlikely.** A population of South-eastern glossy black cockatoo has not been recorded or identified within the Project Area, although the areas within and surrounding the Project Area are suitable for intermittent foraging use by the species. South-eastern glossy black cockatoos rely on nine species of she-oaks (*Allocasuarina spp*. and *Casuarina spp.*) for feeding, with species used varying depending on the region. Birds often only feed on one or two species in one region (Department of Climate Change, Energy, the Environment and Water, 2022a). In south-east Queensland and north-east New South Wales, they show a preference for: • Black sheoak (*A. littoralis*), and • Forest sheoak (*A. torulosa*). There are also records of them feeding on: • Stringybark sheoak (*A. inophloia)* • Coastal sheoak (*C. equisetifolia*), • River sheoak (*C. cunninghamiana)* and • Swamp sheoak (*C. glauca*). The Project Area and surrounds are known to contain Black sheoak and Swamp sheoak. The Development Footprint will require the removal of scattered juvenile Black sheoak((i.e. foraging resources); however, the majority of such trees in the Project Area will be retained. Specifically, RE 12.1.1 dominated by Swamp

South-eastern glossy black cockatoo (*Calyptorphynchus lathami lathmi*)	
Significant Impact Criteria	**Impact Assessment**
	sheoak and RE 12.5.3 (which supports Black sheoak) and breeding habitat within the Conservation Area will be retained for the project within the Conservation Area. The Development Footprint contains two hollows with characteristics consistent with those preferred by the South-eastern glossy black-cockatoo. One of the significant hollow-bearing trees will be retained and one will be removed as it was assessed as structurally unsafe to retain within the Development Footprint. The Project is unlikely to lead to a long-term decrease in the size of an important population of South-eastern glossy black cockatoo.
Reduce the area of occupancy of an important population	**Unlikely.** The Conservation Advice describes the area of occupancy 44.00km^2 and estimates 34% was impacted by fires (Department of Climate Change, Energy and the Environment and Water, 2022). Important populations for the species have not yet been defined. The Development Footprint provides limited foraging opportunities and one hollow-bearing tree within the Development Footprint which will be impacted that could be suitable for use by the species for sheltering or breeding purposes. The Conservation Area contains suitable foraging and breeding habitat. The species has previously been recorded in Atlas of Living Australia, records collected from citizen-science databases are subject to some degree of uncertainty. Upon scrutiny of the record of a Glossy Black Cockatoo within the Development, the record has been denatured to protect the taxon (coordinate uncertainty increased by ~30,000m). Additionally, Atlas of Living Australia records for the species collected within the vicinity of the Project include five individuals along Tingalpa Creek, approximately 1.75 km northwest of the Development Footprint. The Development Footprint impacts limited foraging opportunities and will impact one potential nest tree. Foraging and breeding habitat for the South-eastern glossy black cockatoo will be retained in the Conservation Area, as such the Project is unlikely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	**Unlikely.** The Project Area is not known to support an important population that could be fragmented.

South-eastern glossy black cockatoo (*Calyptorphynchus lathami lathmi*)	
Significant Impact Criteria	**Impact Assessment**
Adversely affect habitat critical to the survival of a species	**Unlikely.** In the Redlands City Council Local Government Area South-eastern glossy black cockatoo are recorded predominantly on North Stradbroke Island and the Southern Moreton Bay Islands and records are also scattered on the mainland (Atlas of Living Australia, 2022). The Development Footprint contains limited foraging habitat for the species (noting that foraging habitat is present in the broader Project Area). There is one hollow-bearing tree within the Development Footprint that could be suitable for use by the species for sheltering or breeding purposes. The Project includes the restoration of a patch of vegetation dominated by *Casuarina glauca* which will improve the condition of foraging resources of South-eastern glossy black cockatoo. The Development Footprint impacts limited foraging opportunities and will impact one potential nest tree. Foraging and breeding habitat for the South-eastern glossy black cockatoo will be retained in the Conservation Area, As such, the Project is unlikely to adversely affect habitat critical to the survival of a species.
Disrupt the breeding cycle of an important population	**Unlikely.** The Project Area is not known to support an important population that utilises the area for breeding purposes or otherwise. A single hollow-bearing tree within the Development Footprint provides suitable breeding habitat for the South-eastern glossy black cockatoo and will be impacted by the Project. The hollow-bearing trees indicates characteristics of the traits for potential nesting hollows detailed in the Conservation Advice (Department of Climate Change, Energy, the Environment and Water, 2022) including: 1) >8 m above ground; 2) Located in branches >30 cm in diameter; 3) Branch or stem no more than 45o from vertical; and 4) Minimum entrance diameter of >15 cm. A single tree containing potential breeding habitat will be impacted as a result of the Project. This tree is unstable and considered a safety hazard and is, therefore, unable to be retained for the Project. Hollows

South-eastern glossy black cockatoo (*Calyptorphynchus lathami lathmi*)	
Significant Impact Criteria	**Impact Assessment**
	will be salvaged and installed within the Conservation Area. No net loss in hollows will occur as a result of the Project. Clearing of the potential habitat tree will avoid peak breeding season (i.e. February – August) (BirdLife, 2022). The Project is unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Unlikely.** Areas within and surrounding the Project Area are suitable intermittent foraging habitat for the South-eastern glossy black cockatoo. The Development Footprint location will require the removal of scattered juvenile Black sheoak; however, the majority of such trees in the Conservation Area will be retained. The Project includes the restoration of a patch of vegetation dominated by *Casuarina glauca* which will improve the condition of foraging resources for South-eastern glossy black cockatoo. The Project is unlikely to result in the modification, destruction, removal or isolation of quality habitat to the extent that the species would likely decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	**Unlikely.** The South-eastern glossy black cockatoo is susceptible to impacts from both invasive flora and fauna. As it relates to weeds, the Conservation Advice for the South-eastern glossy black cockatoo states that: "*Invasive weeds have the ability to change the floristic and structural characteristics of habitat, thereby changing resource availability. Furthermore, some weeds may increase the flammability of the habitat, amplifying wildfire risks*" (Department of Climate Change, Energy, the Environment and Water, 2022a) It is understood that the existing Conservation Agreement between the Commonwealth and Council includes ongoing weed management of the Conservation Area (Department of the Environment and Energy, 2019). As such Council's weed-management program for the Project Area has commenced as evidenced during the field assessment. Continued weed management actions will be included in the Operational management plan for the Project. The Project is unlikely to result in invasive species becoming established in South-eastern glossy black cockatoo habitat.

South-eastern glossy black cockatoo (*Calyptorphynchus lathami lathmi*)	
Significant Impact Criteria	**Impact Assessment**
	As it relates to invasive fauna, the Conservation Advice states, "*Based on studies of the Kangaroo Island subspecies C. l. halmaturinus (Garnett et al. 1999; Mooney & Pedler 2005), nest predation by common brushtail possums may be a threat. Predation by introduced predators such as feral cats (Felis catus) and European red fox (Vulpes vulpes) does not appear to be a major threat. Further research is required to fully understand the extent of the threat of predation on south-eastern glossy black cockatoos, including both native and introduced predators"* (DCCEEW, 2022). As such, the Project is not considered likely to result in the introduction of any invasive species which are known to harm the South-eastern glossy black cockatoo; although it may result in a localised increase in predatory native species, such as the Common brushtail possum (which are known to thrive in modified environments and habitat edges).
Introduce disease that may cause the species to decline	**Unlikely.** Psittacine beak and feather disease (PBFD) is the only known disease that impacts parrots such as the South-eastern glossy black cockatoo. The Conservation Advice for the South-eastern glossy black cockatoo states that: "*PBFD is a potentially fatal disease caused by psittacine circovirus, typically transferring between adults, nestlings and contaminated nest hollows. Although south-eastern glossy black cockatoos are susceptible to PBFD, the threat level is relatively low compared to other threats. With decreasing nesting hollows and intensified competition (see Competition for nest hollows), it is possible that the likelihood of disease transmission could be greater in the future*" (Department of the Environment, 2015). Presently, the distribution of PBFD is thought to be Australia-wide, including Tasmania. Consequently, the Project would not introduce the disease to the Project Area or its surrounds (Department of the Environment, 2015).

South-eastern glossy black cockatoo (*Calyptorphynchus lathami lathmi*)	
Significant Impact Criteria	**Impact Assessment**
Interfere with the recovery of the species.	**Unlikely.** The species' approved Conservation Advice (Department of Climate Change, Energy, the Environment and Water, 2022a) includes a large number of priority recovery and management actions for the species. The recovery action categories relate to: 1. Clearing of native vegetation/timber harvesting and habitat fragmentation (i.e. inappropriate fire regimes and competition for nest hollows). 2. Stakeholder and community engagement. 3. Monitoring and surveying known populations, breeding sites, feeding sites and habitat. 4. Various further research topics. The Project will not interfere with stakeholder or community engagement across the species range, nor would it interfere with high-level monitoring and research priorities. The Project requires the direct removal of scattered juvenile She-oak (*Allocasuarina littoralis*) which provides limited foraging opportunities for the South-eastern glossy black cockatoo. The Project Area retains and enhances foraging habitat within the Conservation Area.
Conclusion: The Project is unlikely to have a significant impact on the South-eastern glossy black cockatoo.	

2.2 White-throated needletail (*Hirundapus caudacutus*)

***Environment Protection and Biodiversity Conservation Act 1999* Listing Status:** Vulnerable – Marine, Migratory

***Nature Conservation Act 1992* Listing Status:** Vulnerable

White-throated needletail (*Hirundapus caudacutus*)	
Significant Impact Criteria	**Impact Assessment**
Lead to a long-term decrease in the size of an important population of the species	**Unlikely.** Important populations of White-throated needletail have not yet been identified; however, the Project will retain the majority of the existing vegetation along the northern, western and southern fringes of the Project Area that would provide habitat for the species. As such, it will not substantially modify, destroy or isolate an area of habitat for the White-throated needletail (noting that the Project Area has been subject to previous modification and therefore does not support what is considered 'important habitat' in accordance with the *Draft referral guideline for 14 birds listed as migratory species under the EPBC Act* [Commonwealth of Australia, 2015]). The species' habitat in Australia consists of non-breeding habitat only. The species is, "found across a range of habitats, more often over wooded areas, where it is almost exclusively aerial. Large tracts of native vegetation, particularly forest, may be a key habitat requirement for species. Found to roost in tree hollows in tall trees on ridge-tops, on bark or rock faces. Appears to have traditional roost sites." (Commonwealth of Australia, 2015). Such habitat is present along the northern, western and southern extents of the Project Area; however, the Development Footprint largely avoids areas that would be considered 'important habitat' for the species.
Reduce the area of occupancy of an important population	**Unlikely.** Important populations of White-throated needletail have not yet been identified. As above, the Project is unlikely to reduce the area of occupancy for the species given that the Development Footprint avoids high-value contiguous ecological habitats and is located within a historically modified area.
Fragment an existing important population into two or more populations	**Unlikely.** As above. The Project does not contain an important population that could be fragmented by the Project. Additionally, the Project Area does not further fragment the existing potential habitat for the species.

White-throated needletail (*Hirundapus caudacutus*)	
Significant Impact Criteria	**Impact Assessment**
Adversely affect habitat critical to the survival of a species	**Unlikely.** White-throated needletail habitat "*is found across a range of habitats, more often over wooded areas (where it is almost exclusively aerial). Large tracts of native vegetation, particularly forest, may be a key habitat requirement for species. Found to roost in tree hollows in tall trees on ridge-tops, on bark or rock faces*" (Commonwealth of Australia, 2015). The Development Footprint does not contain densely wooded areas that would be considered critical habitat for the species (noting that more appropriate habitat is present in the broader Project Area). As such, the Project is considered unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	**Unlikely.** While the White-throated needletail is found across a range of habitats, Australia does not contain known breeding habitat for the species, therefore the Project would not disrupt the breeding cycle for an important population (Commonwealth of Australia, 2015).
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Unlikely.** In Australia, the White-throated Needletail is mostly aerial, from heights of less than 1 m up to more than 1000 m above the ground (Tarburton 1993). The species roosts in trees amongst dense foliage in the canopy or in hollows. While the species does not breed in Australia, the loss of roosting sites in Australia may be contributing to the decline of the species (Tarbuton, 2014). The Development Footprint is located within densely vegetated areas and is therefore unlikely to decrease the availability of roosting habitat for the species such that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species	**Unlikely.** There are no known invasive species that are harmful to the White-throated needletail (Commonwealth of Australia, 2015).

White-throated needletail (*Hirundapus caudacutus*)	
Significant Impact Criteria	**Impact Assessment**
becoming established in the vulnerable species' habitat	
Introduce disease that may cause the species to decline	**Unlikely.** There are no reported diseases that are harmful to the White-throated needletail that would potentially be introduced by the Project (Threatened Species Scientific Committee, 2019).
Interfere with the recovery of the species.	**Unlikely.** There is no published recovery plan for the species. Conservation priorities listed in the species' Conservation Advice (Threatened Species Scientific Committee, 2019) include: • Working with governments in East Asia to minimise destruction of key breeding habitats. • Identification and protection of important habitats in Australia. The Project will not inhibit future work with governments in East Asia to minimise destruction of key breeding habitats, nor will it inhibit the identification and protection of important habitats in Australia. As such, the Project will not interfere with the recovery priorities for the species.
Conclusion: The Project is unlikely to have a significant impact on the White-throated Needletail.	

2.3 Grey-headed flying-fox (*Pteropus poliocephalus*)

***Environment Protection and Biodiversity Conservation Act 1999* Listing Status:** Vulnerable

***Nature Conservation Act 1992* Listing Status:** Least Concern

Grey-headed flying-fox (*Pteropus poliocephalus*)	
Significant Impact Criteria	**Impact Assessment**
Lead to a long-term decrease in the size of an important population of the species	**Unlikely.** The Project Area does not contain a known roost site for the Grey-headed flying-fox. The closest recorded roost site that hosts Grey-headed flying-foxes is located 2.5 km southeast of the Project Area. The Listing Advice does not define an 'important population' and the advice estimates a population size of 320,000-400,000 individuals (TSSC, 2001). The impacts of the Project are not considered to impact upon the habitat surrounding this camp location given its considerable distance from the Project Area. The Project Area contains suitable foraging habitat including Eucalyptus and Melaleuca. The Conservation Area supports foraging resources that will be retained for the Project. The Development Footprint will directly impact foraging resources for the species, however, the foraging resources impacted are limited to scattered and predominately juvenile trees (the exact impact is to be quantified following the completion of the tree retention plan). In addition, two patches of semi-mature and mature eucalypt trees will be retained as part of the design. The Project is unlikely to lead to a long-term decrease in the size of an important population of Grey-headed flying-fox.
Reduce the area of occupancy of an important population	**Unlikely.** While the Project Area contains suitable foraging habitat for the species; the Project Area does not support an important population. The Project is unlikely to reduce the area of occupancy of an important population.

Grey-headed flying-fox (*Pteropus poliocephalus*)	
Significant Impact Criteria	**Impact Assessment**
Fragment an existing important population into two or more populations	**Unlikely.** The Project Area does not support an important population that could be fragmented.
Adversely affect habitat critical to the survival of a species	**Unlikely.** The Development Footprint supports vegetation that provides foraging opportunities for the Grey-headed flying fox including scattered winter and spring flowering foraging species. Winter and spring flowering vegetation communities are noted as critical habitat for the survival of the species (DoE, 2021). The Development Footprint is characterised by scattered retained individual trees and cleared areas. Therefore, the foraging habitat within the Development Footprint is unlikely to represent critical habitat for the Grey-headed flying fox.
Disrupt the breeding cycle of an important population	**Unlikely.** Given the separation distance between the Project Area and the closest known breeding colony, no indirect impacts as a result of the Project are expected on the breeding colony. The Project Area does not support an important population that utilises the area for breeding purposes.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Unlikely.** The Project will require the removal of scattered vegetation supporting foraging habitat for the species. Given the wide availability of foraging habitat in the surrounds and the fact that the species is known to travel wide distances for foraging (i.e. up to 40km), the Project is considered unlikely to adversely impact the species' habitat to the extent that it is likely to decline (Commonwealth of Australia, 2021).
Result in invasive species that are harmful to a	**Unlikely.**

Grey-headed flying-fox (*Pteropus poliocephalus*)	
Significant Impact Criteria	**Impact Assessment**
vulnerable species becoming established in the vulnerable species' habitat	Neither the Grey-headed Flying-fox Recovery Plan nor the species' Listing Advice contains any invasive species that are harmful to the species or its habitat (Commonwealth of Australia, 2021; Threatened Species Scientific Committee, 2001).
Introduce disease that may cause the species to decline	**Unlikely.** There is very little information available on the impact of disease on Australian flying-fox populations, including Grey-headed flying-foxes. The main area of impact of disease is associated with the public perception of bats as a source of zoonotic diseases (i.e. Lyssavirus) (Commonwealth of Australia, 2021). The incidence of Lyssavirus in Grey-headed flying-fox populations is low (<1 %). There are no known diseases that negatively impact the health of the Grey-headed flying fox (that are not already present throughout the population) that could be introduced by the Project.
Interfere with the recovery of the species.	**Unlikely.** The overall objectives of this Grey-headed flying fox recovery plan are: 1. to improve the Grey-headed flying-fox's national population trend by reducing the impact of the threats outlined in this plan on Grey-headed Flying-foxes through habitat identification, protection, restoration and monitoring, and 2. to assist communities and Grey-headed flying-foxes to coexist through better education, stakeholder engagement, research, policy and continued support to fruit growers (Commonwealth of Australia, 2021). The Project will not interfere with recovery objective 1, which relates to habitat identification, protection restoration and monitoring. Further, the Project will not interfere with recovery objective 2, which relates to community education and stakeholder engagement, research and policy development.

Grey-headed flying-fox (*Pteropus poliocephalus*)	
Significant Impact Criteria	**Impact Assessment**
Conclusion: The Project is unlikely to have a significant impact on the Grey-headed flying-fox.	

3 Migratory Species

3.1 Rufous fantail (*Rhipidura rufifrons*)

***Environment Protection and Biodiversity Conservation Act 1999* Listing Status:** Marine, Migratory

***Nature Conservation Act 1992* Listing Status:** Special Least Concern

Rufous fantail (*Rhipidura rufifrons*)	
Significant Impact Criteria	**Impact Assessment**
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	**Unlikely.** The Rufous fantail favours "*moist, dense habitats, including mangroves, rainforest, riparian forests and thickets, and wet eucalypt forests with a dense understorey. When on passage a wider range of habitats are used including dry eucalypt forests and woodlands and Brigalow shrublands*" (Commonwealth of Australia, 2015). Such habitat is present along the western and southern extents of the Project Area; however, the Development Footprint largely avoids areas that would be considered 'important habitat' for the species. The Project will retain the majority of the existing vegetation along the northern, western and southern fringes of the Project Area. As such, it will not substantially modify, destroy or isolate an area of habitat for the Rufous fantail (noting that the Project Area has been subject to previous modification and therefore does not support what is considered 'important habitat' in accordance with the *Draft referral guideline for 14 birds listed as migratory species under the EPBC Act* [Commonwealth of Australia, 2015]).
Result in an invasive species that is harmful to the migratory species becoming established in an	**Unlikely.** Invasive species which pose a known threat to the Rufous fantail include the Black Rat (*Rattus rattus*) and invasive vines of riparian habitat (i.e. rubber vine *Cryptostegia grandiflora*). Such species (i.e. Lantana and

Rufous fantail (*Rhipidura rufifrons*)	
Significant Impact Criteria	**Impact Assessment**
area of important habitat for the migratory species, or	Black Rat) are already established within the Project Area and surrounds; as such, the Project will not result in their introduction.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	**Unlikely.** The Project Area does not contain an ecologically significant proportion (i.e. 4,800 individuals) of a population of the Rufous fantail in accordance with the guidance provided in the *Draft referral guideline for 14 birds listed as migratory species under the EPBC Act* (Commonwealth of Australia, 2015). The Project will not disrupt the lifecycle of an ecologically significant proposal of a population of Rufous fantail.
Conclusion: The Project is unlikely to have a significant impact on the Rufous fantail.	

3.2 Satin flycatcher (*Myiagra cyanoleuca*)

***Environment Protection and Biodiversity Conservation Act 1999* Listing Status:** Marine, Migratory

***Nature Conservation Act 1992* Listing Status:** Special Least Concern

Satin flycatcher (*Myiagra cyanoleuca*)	
Significant Impact Criteria	**Impact Assessment**
Substantially modify (including by fragmenting, altering fire regimes, altering	**Unlikely.**

Satin flycatcher (*Myiagra cyanoleuca*)	
Significant Impact Criteria	**Impact Assessment**
nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	The species' preferred habitat consists of "*eucalypt forest and woodlands, at high elevations when breeding. They are particularly common in tall wet sclerophyll forest, often in gullies or along water courses. In woodlands they prefer open, grassy woodland types. During migration, habitat preferences expand, with the species recorded in most wooded habitats except rainforests. Wintering birds in northern Qld will use rainforest - gallery forests interfaces, and birds have been recorded wintering in mangroves and paperbark swamps.*" (Commonwealth of Australia, 2015). Such habitat is present along the western and southern extents of the Project Area; however, the Development Footprint largely avoids areas that would be considered 'important habitat' for the species. The Project will retain the majority of the existing vegetation along the northern, western and southern fringes of the Project Area. As such, it will not substantially modify, destroy or isolate an area of habitat for the Satin flycatcher (noting that the Project Area has been subject to previous modification and therefore does not support what is considered 'important habitat' in accordance with the *Draft referral guideline for 14 birds listed as migratory species under the EPBC Act* [Commonwealth of Australia, 2015]).
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	**Unlikely.** Invasive species which pose a known threat to the Satin flycatcher include the Black Rat (*Rattus rattus*) and invasive vines of riparian habitat (i.e. rubber vine *Cryptostegia grandiflora*). Such species (i.e. Lantana and Black rat) are already established within the Project Area and surrounds; as such, the Project could not result in their introduction.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the	**Unlikely.** The Project Area does not contain an ecologically significant proportion (i.e. 1,700 individuals) of a population of the Satin flycatcher in accordance with the guidance provided in the *Draft referral guideline for 14 birds listed as migratory species under the EPBC Act* (Commonwealth of Australia, 2015).

Satin flycatcher (*Myiagra cyanoleuca*)	
Significant Impact Criteria	**Impact Assessment**
population of a migratory species.	
Conclusion: The Project is unlikely to have a significant impact on the Satin flycatcher.	

4 References

Atlas of Living Australia (2023) Greater glider records for the Redland City Council Local Government Area.

Atlas of Living Australia (2022) South-eastern glossy black cockatoo records for the Redland City Council Local Government Area.

Biolink. (2021). Birkdale Community Precinct: Koala Habitat Assessment and Recommendations.

Biolink (2019) Redlands Coast Koala Population and Habitat Assessment (Final Report for Redlands), (online) https://www.redland.qld.gov.au/download/downloads/id/3297/redlands_coast_koala_population_and_habitat_assessment.pdf, Biolink ecological consultants, New South Wales.

Cardno (2021) Environmental Early Works and Social Land Management Plan prepared by Cardno (dated 23 November 2021).

Cardno (2020). Ecological Assessment Report – Birkdale Land Survey.

Commonwealth of Australia (2015). Draft referral guideline for 14 birds listed as migratory species under the EPBC Act.

Commonwealth of Australia (2021). National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus.*

Department of Agriculture, Water and the Environment (2022). 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 (2022). National Recovery Plan for the Koala Phascolarctos cinereus (combined populations of Queensland, New South Wales and the Australian Capital Territory). Department of Agriculture, Water and the Environment, Canberra.

Department of the Environment and Energy (2019) Conservation Agreement for the protection and conservation of biodiversity values on land at Lot 1 on RP14143, Lot 2 on RP14144 and Lot 2 pm SP146445, also known as 362-388 Old Cleveland Road, Birkdale, Queensland, Canberra.

Department of the Environment (2015). Psittacine Beak and Feather Disease and other identified Threats to Australian threatened Parrots.

Department of Climate Change, Energy, the Environment and Water (2022). Approved Conservation Advice for the Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions. Canberra: Department of Climate Change, Energy, the Environment and Water.

Department of Climate Change, Energy, the Environment and Water (2022a). Conservation advice for *Calyptorhynchus lathami lathami* (south-eastern glossy black cockatoo), Canberra.

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

Department of the Environment and Energy (2018). Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community. Canberra: Department of the Environment and Energy.

Department of Environment and Resource Management (2012). Koala Coast – Koala Population Report 2010.

Department of Infrastructure, Local Government and Planning (2017) ShapingSEQ - South East Queensland Regional Plan 2017. Queensland Government, Brisbane.

Dique, D. S., Thompson, J., Preece, H. J., de Villiers, D. L., & Carrick, F. N. (2003). Dispersal patterns in a regional koala population in south-east Queensland. Wildlife Research, 30(3), 281-290.

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, Department of Environment and Science, Queensland Government, Brisbane. CC BY 4.0.

IUCN (2019) IUCN Red List

Kjeldsen SR, Raadsma HW, Leigh KA, Tobey JR, Phalen D, Krockenberger A, Ellis WA, Hynes E, Higgins DP & Zenger KR (2019). Genomic comparisons reveal biogeographic and Phascolarctos cinereus (Koala) Conservation Advice Threatened Species Scientific *Committee 36 anthropogenic impacts in the koala* (Phascolarctos cinereus): a dietary-specialist species distributed across heterogeneous environments. Heredity 122,525-544.

Lee E, Madden K. and Wilmott L. Application of the koala spotlighting survey method in the Campbelltown area for estimates of koala densities and total population size. In The Abstracts, Australian Mammal Society Conference 2019. https://australianmammals.org.au/conferences/conference-2019.

Norman, J. A., Phillips, S. S., Blackmore, C. J., Goldingay, R., & Christidis, L. (2019). Integrating measures of long-distance dispersal into vertebrate conservation planning: scaling relationships and parentage-based dispersal analysis in the koala. Conservation Genetics, 20(5), 1163-1174.

Phillips, Stephen & Callaghan, John. (2011). The Spot Assessment Technique: A tool for determining localised levels of habitat use by Koalas Phascolarctos cinereus. Australian Zoologist. 35. 10.7882/AZ.2011.029.

Raptor Environmental (2023) Ecological Assessment Report – Birkdale Community Precinct, Brisbane.

Redlands City Council. N.d. Biodiversity Research Projects – Greater Glider.

Redland City Council (2021) Redlands Coast Koala Conservation Plan 2022-2027, (online) https://www.redland.qld.gov.au/download/downloads/id/4743/redlands_coast_koala_conservation_plan_2022-2027.pdf

Redland City Council (2021b) Redlands Coast Koala Conservation Action Plan 2022-2027, (online) https://www.redland.qld.gov.au/download/downloads/id/4744/redlands_coast_koala_conservation_action_plan_2022-2027.pdf

Rhodes, JR, Beyer, HL, Preece, HJ & McAlpine, CA 2015, South East Queensland koala population modelling study, UniQuest, Brisbane.

SPP (2022) Bushfire Hazard Area Map. State Planning Policy.

Threatened Species Scientific Committee (2001). Commonwealth Listing Advice on *Pteropus poliocephalus* (Grey-headed Flying-fox).

Threatened Species Scientific Committee (2019). Conservation Advice *Hirundapus caudacutus* White-throated Needletail. Canberra: Department of the Environment and Energy.

Tarburton, M.K. (1993). Radiotracking a White-throated Needletail to roost. Emu. 93:121--124.

Tarburton, M.K. (2014). Status of the White-throated Needletail *Hirundapus caudacutus* in Australia: Evidence for a marked decline. Australian Field Ornithology 31, 122-140.

USC. (2021) Detection Dogs for Conservation Birkdale Community Precinct Project Koala survey report. University of the Sunshine Coast.

Whisson, D. A., Zylinski, S., Ferrari, A., Yokochi, K., & Ashman, K. R. (2020). Patchy resources and multiple threats: How do koalas navigate an urban landscape?. Landscape and Urban Planning, 201, 103854.

Youngentob, K.N, Marsh, K.F., Skewes, J., A review of koala habitat assessment criteria and methods, report prepared for the Department of Agriculture, Water and the Environment, Canberra, November. CC BY 4.0.

Setout Point Table (MGA94)		
Point	Eastings	Northings
SP1	519787.736	6956878.543
SP2	519789.622	6956877.554
SP3	519790.5857	6956872.459
SP4	519783.1479	6956872.911
SP5	519761.5032	6956871.542
SP6	519765.5111	6956876.734
SP7	519773.5844	6956876.344
SP8	519775.5672	6956877.388
SP9	519784.2783	6956878.506

Vegetation Community Description
Permanent Disturbance Area - Marine Plants
Community 1 - Actively eroding bank with scattered Grey Mangrove with Salt couch, Mangrove fern and bare soil.
Permanent Disturbance Area - Cleared
Community 2 - Actively eroding cleared area with bare soil.
Adjacent Vegetation - To be avoided
Community 3 - Grey mangrove and River mangrove overtopped with Eucalypt Woodland to Open Forest
Community 4 - Forest red gum and Northern grey ironbark over a native understorey

Legend

- Conservation Area Boundary
- Impact Area
- Existing informal track
- Setout Point
- 0.5 m Surface Contours (derived from survey data)
- Highest Astronomical Tide (C/-State of Qld)

Vegetation Community

Permanent Disturbance Area - Marine Plants (159m2)

- Community 1

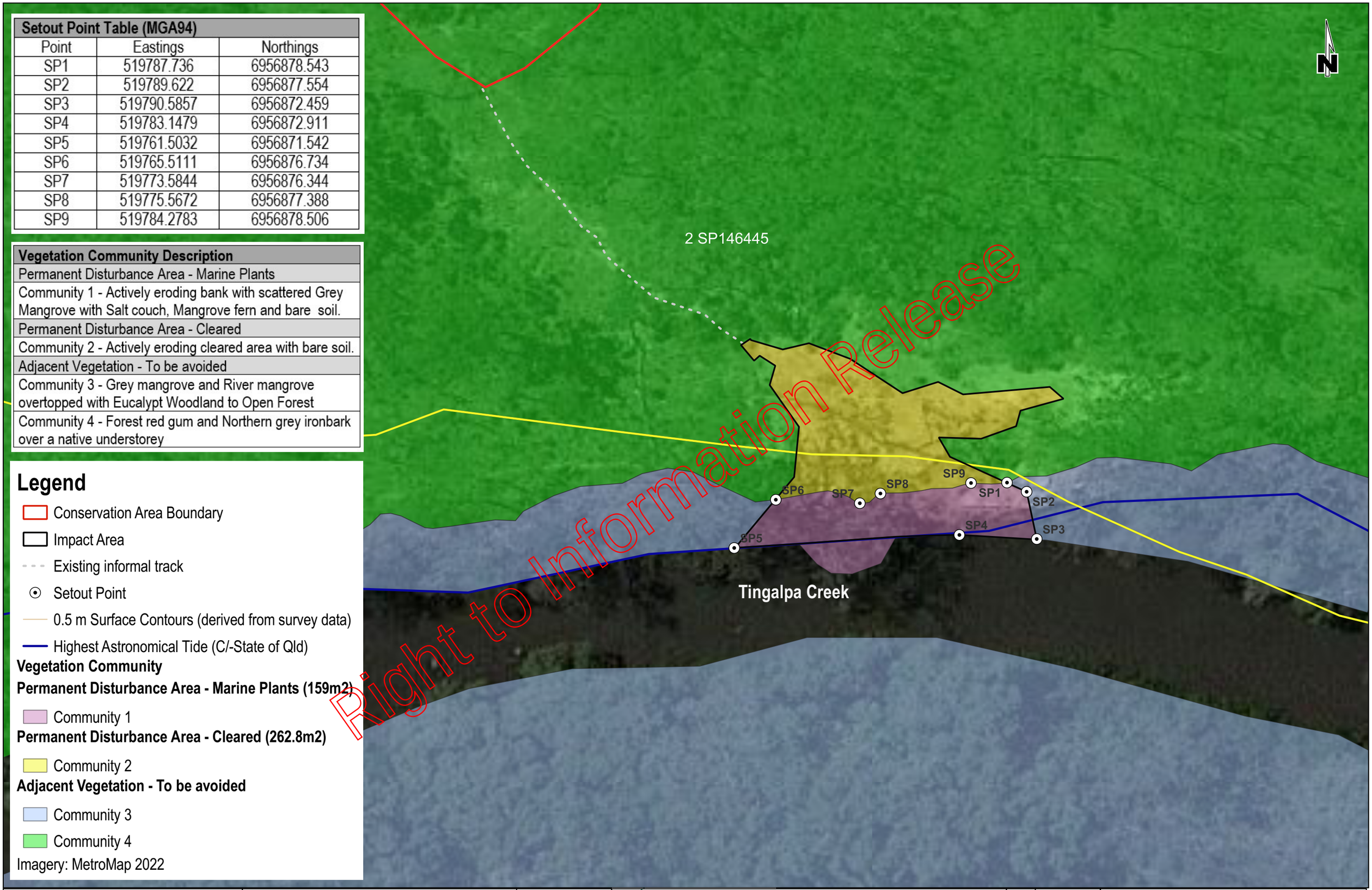
Permanent Disturbance Area - Cleared (262.8m2)

- Community 2

Adjacent Vegetation - To be avoided

- Community 3
- Community 4

Imagery: MetroMap 2022



Project **Birkdale Community Precinct** **Proposed Kayak Launch Area**	Client: Redlands City Council C/- Jacobs Title Marine Plant Disturbance Plan	Drawn M.T. Checked D.F.	Raptor ENVIRONMENTAL	B 06/03/2023 A 28/02/2023 REV DATE	Figure No: AS SHOWN Figure 1 Scale: 1 :250 A3 File Ref: 2022_023 Sheet size