

Stockton Sand Quarry Dredging

Revised Biodiversity Development Assessment Report

Prepared for Boral Resources (NSW) Pty Ltd 27 November 2020



Project number	Client	Project manager	LGA
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Declaration

This Biodiversity Development Assessment Report has been approved for submission by Niche Environment and Heritage.

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Executive summary

Context

Boral Resources (NSW) Pty Ltd (Boral) owns and operates the Stockton Sand Quarry (the Quarry), a long standing operation that currently extracts sand from the windblown (transgressive) sand dunes of Stockton Bight and transports up to 500,000 tonnes per annum (tpa) of sand products for use in the building, landscaping and construction markets.

Due to current and future demand for sand in the Hunter and Sydney markets, Boral is seeking approval for continued and expanded operations at the site through a State Significant Development (SSD) application.

The proposed development (hereafter referred to as the 'Project') involves the extraction of sand from within the former inland extraction area from the existing ground level to a depth of 15 m below sea level (-15 m AHD). As extraction will intercept the groundwater table (at approximately 1 m AHD) the primary method of sand extraction will involve dredging. To account for market fluctuations in demand, Boral are seeking a development consent period of 25 years for the SSD approval.

Boral is seeking approval for the Project under Part 4 of the NSW *Environmental Planning and Assessment Act 1997* (EP&A Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Boral to prepare a Biodiversity Development Assessment Report (BDAR) for the Stockton Sand Quarry expansion (the Project), which addresses the requirements of the NSW *Biodiversity Conservation Act 2016* (BC Act) and NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

The BDAR was submitted as part of the Environmental Impact Assessment (EIS) to Department of Planning, Industry and Environment (DPIE) in December 2019. The BDAR was reviewed by the Biodiversity Conservation Division (BCD), DPIE and Port Stephens Council.

Comments regarding the BDAR from the Agencies were provided to Boral and Niche in March 2020. The Agency comments related primarily to the requirement for further targeted threatened fauna and flora survey, including a hollow-bearing tree survey. This Revised BDAR has been prepared to address the March 2020 Agency comments, and has been updated to reflect the changes that have been made to the Threatened Biodiversity Database Collection (TBDC) and additional survey guidelines and advice regarding the BAM, that were not available at the time of the original submission.

Survey overview

An ecological assessment in accordance with the BAM was undertaken for the Project and consisted of:

- Site survey to determine the extent and occurrence of native vegetation and determine habitat for threatened biodiversity.
- Collection of data from 16 BAM plots.
- Targeted surveys for threatened flora during the months of May to September.
- Targeted surveys for a range of threatened fauna species, including: Wallum Froglet, Bush-stone Curlew, Koala, Powerful Owl, Barking Owl, Masked Owl, Brush-tailed Phascogale, Gang-gang Cockatoo, Glossy-black Cockatoo, and threatened microbats (Little Bentwing-bat, Southern Myotis, Eastern Cave Bat, Greater Broad-nosed Bat, Eastern Bentwing Bat).
- Surveys for breeding resources associated with threatened fauna.

Results

The subject site for the Project contains all areas proposed for ground disturbance and is approximately 38.14 ha. The subject site is largely located within the footprint of former inland extraction areas that were cleared over the past two decades and have since been rehabilitated with native plantings.

Native Vegetation

Native vegetation on the Subject land was identified and mapped in accordance with the BAM and BioNet Vegetation Classification. In total the subject site includes:

- 35.66 ha of vegetation which meets the definition of 'native vegetation' as per the BAM
- 2.48 ha non-native vegetation.

Two Plant Community Types (PCTs) were mapped within the subject site:

- PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast: approximately 32.99 ha recorded in five different condition classes that are representative of the age of the former quarry pit rehabilitation.
- 1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast: approximately 2.67 ha recorded in one condition class which is representative of historic plantings.

None of the PCTs recorded align to Threatened Ecological Communities (TECs) listed on the BC Act or EPBC Acts.

Threatened Species

No threatened flora were recorded within the subject site during targeted field surveys.

Three threatened fauna were recorded within the subject site during the field survey: Greater Broad-nosed Bat, Eastern Bentwing Bat and White-bellied Sea Eagle. All are regarded as 'ecosystem credit' species for this assessment given breeding habitat within the subject site was absent.

The assessment concluded that the Squirrel Glider (species credit) is likely to occur within the subject site due to a historic record within the subject site, known records throughout the locality, and the fact that the subject site contains foraging habitat for the species.

No breeding habitat as defined in the TBCD was recorded in the subject site for species credit fauna, which was confirmed during extensive field campaigns.

All ecosystem credit species as generated by the BAM database searches and calculator outputs, were assumed to be present.

Impact

The impact of the Project on ecological values are summarised as follows:

- Direct removal of 35.66 ha of native vegetation, noting that 5.19 ha has a site integrity score below that requiring a credit offset.
- Indirect impacts to immediately surrounding vegetation/habitat will be prevented via a series of mitigation measures.
- Removal of fauna habitat, consisting of a mix of rehabilitation land and remnant vegetation.
- Removal of micro habitat features such as hollow-bearing trees and logs.

SEPP 44. Koala habitat

Our assessment has concluded that the subject site does not contain potential Koala habitat as defined under State Environment Planning Policy 44 because Schedule 2 tree species do not constitute at least 15% of the total number of trees within the subject site. Therefore, the site does not constitute Core Koala habitat.

Commonwealth Assessment

The Project is to be assessed under the EPBC Act pursuant to the assessment bilateral agreement with the NSW Government. Therefore, this BDAR provides an assessment of potential impacts to EPBC Act listed threatened species and communities, applying the Biodiversity Assessment Method (BAM).

Our assessment concluded that seven threatened biodiversity listed on the EPBC Act have a moderate to high likelihood to utilise the subject site: Black-faced Monarch, White-throated Needle-tail, Spotted-tail Quoll, Long-nosed Potoroo, Koala, New Holland Mouse and Grey-headed Flying-fox. Many of these species were determined to potentially use the subject site occasionally given absence of detection during the field survey. Formal Assessment of Significance were completed for the Commonwealth listed threatened species, which concluded that that Project is unlikely to have a significant impact on any MNES.

Submission of an EPBC Act referral is not required.

Measures to Avoid, Minimise and Mitigate Impacts

As detailed in the Environmental Impact Statement (EIS), throughout the process of site planning Boral has considered alternative locations and processes. The current site utilises the former rehabilitated inland extraction area for most of the impact rather than remnant vegetation that occupies the remaining portion of the Boral site.

The Project has been designed to avoid or minimise impacts to vegetation and habitat and include:

- Undertaking vegetation clearing in accordance with the Vegetation Clearance Protocol described in section 5.1.4 (impacts arising from the construction will primarily relate to vegetation clearing).
- Fencing and signposting erected as close as possible to the edge of the subject site as described in section 5.1.4.
- Educating employees and/or contractors involved in the construction and operation of the Project.
- The preparation and implementation of a suitable Landscape and Rehabilitation Management Plan.
- Dust suppression.
- Procedures for the management of spills throughout the subject including the requirements for vehicles to carry spill kits.
- Management and removal of all rubbish from the subject site.
- Maintain current quarry speed limits to minimise the potential for fauna collision.

Offset Strategy

The result of running the Biodiversity Assessment Method Credit Calculator (BAM-C) is that the Project requires a total of 455 ecosystem credits and 558 species credits:

- Ecosystem credits:
 - PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast – 427 credits
 - 1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast – 28 credits.

- Species credits:
 - Squirrel Glider - 558 credits

Boral commits to satisfying the credit requirements using offset mechanisms allowed by the NSW Biodiversity Offset Scheme (i.e. retirement of biodiversity credits and/or contribution to the Biodiversity Conservation Fund).

Boral propose to implement a staged offset approach to reflect the progressive dredging of the site. The staged-offset would involve the retirement of the required credits over a period of approximately 20 years to reflect progressing vegetation/habitat removal.

No Commonwealth biodiversity offset is required given that there is no significant impact to any EPBC Act listed threatened biodiversity.

Conclusion

The impact avoidance, mitigation and offset hierarchy has been applied to the Project resulting in some unavoidable impacts. The credit calculation has determined the offset requirement for clearance of native vegetation (ecosystem credit requirement) and the offset requirement for Squirrel Glider. It is anticipated that the offset requirements would be met through retirement of biodiversity credits and/or contribution to the Biodiversity Conservation Fund.

The direct loss of habitat associated with the Project would be offset in accordance with the NSW Biodiversity Offset Scheme which would result in no net loss in biodiversity.

Glossary and list of abbreviations

Term or abbreviation	Definition
BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method Credit Calculator
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BC Reg	NSW <i>Biodiversity Conservation Regulation 2017</i>
BCF	Biodiversity Conservation Fund
BDAR	Biodiversity Development Assessment Report
BMP	Biodiversity Management Plan
BOS	NSW Biodiversity Offsets Scheme
BSA	Biodiversity Stewardship Agreement
BSSAR	Biodiversity Stewardship Site Assessment Report
CEEC	Critically Endangered Ecological Community
cm	Centimetre/s
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DBH	Diameter at Breast Height
DCP	Development Control Plan
DPIE	NSW Department of Planning, Industry and Environment (formerly DECCW, DECC, DEC, OEH)
EEC	Endangered Ecological Community
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	NSW <i>Fisheries Management Act 1994</i>
ha	Hectare/s
IBRA	Interim Biogeographic Regionalisation for Australia
km	Kilometre/s
LEP	Local Environment Plan
LGA	Local Government Area
Locality	The subject site and surrounds, nominally a 10 km radius from the subject site
m	Metre/s
MNES	Matters of National Environmental Significance (from the EPBC Act).
PCT	Plant Community Type
RDP	Rapid Data Point
SAII	Serious and Irreversible Impacts
SEARS	Secretary Environment Assessment Requirements
SSD	State Significant Development
TBDC	Threatened Biodiversity Database Collection
TEC	Threatened Ecological Community
VI	Vegetation Integrity as calculated by the BAM Calculator

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1. Introduction

1.1 Context

Boral Resources (NSW) Pty Ltd (Boral) owns and operates the Stockton Sand Quarry (the Quarry), a long standing operation that currently extracts sand from the windblown (transgressive) sand dunes of Stockton Bight and transports up to 500,000 tonnes per annum (tpa) of sand products for use in the building, landscaping and construction markets.

Due to current and future demand for sand in the Hunter and Sydney markets, Boral is seeking approval for continued operations at the site through a State Significant Development (SSD) application.

The proposed development (hereafter referred to as the 'Project') involves the extraction of sand from within the former inland extraction area from the existing ground level to a depth of 15 m below sea level (-15 m AHD). As extraction will intercept the groundwater table (at approximately 1 m AHD) the primary method of sand extraction will involve dredging. To account for market fluctuations in demand, Boral are seeking a development consent period of 25 years for the SSD approval.

Boral is seeking approval for the Project under Part 4 of the NSW *Environmental Planning and Assessment Act 1997* (EP&A Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Boral Resources (NSW) Pty Ltd (Boral) to prepare a Biodiversity Development Assessment Report (BDAR) for Stockton Sand Quarry expansion (the Project), which addresses the requirements of the NSW *Biodiversity Conservation Act 2016* (BC Act). The report was prepared in accordance with the Biodiversity Assessment Method (BAM) (OEH 2017a) and the Secretary Environmental Assessment Requirements (SEARs) for the Project, and also assesses the impacts of the Project on Matters of National Environmental Significance (MNES) under the EPBC Act.

The BDAR was submitted as part of the Environmental Impact Assessment (EIS) to Department of Planning, Industry and Environment (DPIE) in December 2019. The BDAR was reviewed by the Biodiversity Conservation Division (BCD), DPIE and Port Stephens Council.

Comments regarding the BDAR from the Agencies were provided to Boral and Niche in March 2020. The Agency comments related primarily to the requirement for further targeted threatened fauna and flora survey, including a hollow-bearing tree survey. This Revised BDAR has been prepared to address the March 2020 Agency comments, and has been updated to reflect the changes that have been made to the Threatened Biodiversity Database Collection (TBDC) and additional survey guidelines and advice regarding the BAM, that were not available at the time of the original submission.

1.2 The Project

The Stockton Sand Quarry is located in Fullerton Cove, approximately 9.8 kilometres (km) north-northeast of the Newcastle Central Business District (CBD), within the Port Stephens Local Government Area (LGA) (Figure 1 and Figure 2). Access to the site is via Nelson Bay Road and Coxs Lane.

The site is owned and operated by Boral and covers an approximate area of 246 hectares, comprising of:

- Lot 1 DP 1006399, comprising 234.0 hectares located on the eastern side of Nelson Bay Road.

- Lot 2 DP 1006399 comprising 10.4 hectares and located predominantly on the western side of Nelson Bay Road, with a small portion also positioned on the eastern side of Nelson Bay Road (formerly Part Lot 167, Part Portion 167).
- Lot 3 DP 664552 comprising 1.6 hectares and located wholly on the eastern side of Nelson Bay Road, within which the existing depot and weighbridge are located (formerly within Part Lot 3, Part Portion 3).

Boral previously quarried sand in the central area of Lot 1, to the east of Nelson Bay Road. This extraction commenced in 1996 and was completed in 2007 with the consent lapsing on 1 May 2009.

Following the exhaustion of the original extraction area in Lot 1 in 2007, Boral commenced extraction of windblown sand in the 2006 development consent area, which continues today.

The Project involves the extraction of sand from within the former inland extraction area (inclusive of pits 1 – 6) from the existing ground level to a depth of 15 m below sea level (-15 m AHD). As extraction will intercept the groundwater table (at approximately 1 m AHD) the primary method of sand extraction will involve dredging.

There is an estimated 9 million tonnes of sand resource within the Project extraction area. The Project would seek to permit a site-wide increase on the dispatch limit to 750,000 tpa (i.e. the windblown sand extraction area and the Project operations combined) up until 2028 when the site-wide limit would reduce to no more than 500,000 tpa. The increase in the site wide dispatch limit is sought to permit maximum flexibility across the two projects areas (located on the same site). A concurrent administrative amendment to DA 140-5-2006 to allow for the site-wide dispatch limit increase will be lodged with Department of Planning, Industry and Environment (DPIE).

Mobile plant and equipment utilised at the site would operate across both project areas and a docket system at the weighbridge would monitor outgoing product as a site total.

To account for market fluctuations in demand, Boral are seeking a development consent period of 25 years for the SSD approval.

1.3 The Subject Site

The subject site for the Project contains all areas proposed for ground disturbance and is approximately 38.14 ha (Figure 3). The subject site is largely located within the footprint of former inland extraction areas that were cleared over the past two decades and have since been rehabilitated with native plantings.

The extent of disturbance associated with the Project (subject site) will result in the clearing of:

- 35.66 ha of vegetation which meets the definition of ‘native vegetation’ as per the BAM; and
- 2.48 ha non-native vegetation.

Biodiversity values have been avoided as much as practical as detailed in section 5.1, and details of the mitigation measures proposed to reduce or prevent indirect impacts from the Project are detailed in section 5.1.4.

1.4 Approval and Assessment Process

The following legislation or planning instruments are relevant to the works associated with the Project.

1.4.1 State Approval and Assessment Process – Application of the BAM

For NSW State approval, the Project is to be assessed as State Significant Development (SSD) under Part 4 of the EP&A Act, which requires proponents to use the Biodiversity Offset Scheme (BOS) BAM to prepare a Biodiversity Development Assessment Report (BDAR) under the BC Act.

This BDAR describes the biodiversity values present within the subject site and identifies impacts from the Project on these values. This assessment has used the BAM Calculator (BAM-C) (version 1.2.7.2) to determine the biodiversity credits required to offset the Project.

1.4.2 Commonwealth Approval and Assessment Process

Matters of National Environmental Significance (MNES) are protected under the EPBC Act. The BAM requires proponents to identify and assess the impacts on all nationally listed threatened species and threatened ecological communities that may be present on or near the development site. Therefore, the BAM has partly been used to perform assessment of impacts under the EPBC Act. Further assessment of impacts under the EPBC Act has been undertaken via assessments of significance for EPBC Act listed species with the potential to be affected by the Project (Annex 8).

Under the EPBC Act, activities that have potential to result in significant impacts on MNES must be referred to the Commonwealth Minister for the Environment and Energy for assessment.

This report assesses the impact of the project on MNES.

1.4.3 Secretary Environmental Assessment Requirements (SEARs)

In addition to requirements under the BAM and Commonwealth environmental approvals process, this BDAR addresses specific requirements provided in the SEARs for the SSD application relating to biodiversity, issued in October 2018 by the DPIE. Table 1 below cross-references this report with the relevant SEARs.

Table 1. SEARs addressed in this BDAR

Requirement	Section addressed in report
Biodiversity – including: - accurate predictions of any vegetation to be cleared on site; - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, undertaken in accordance with the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report; and	This report follows the BAM. It provides an assessment of the impacts as per the BAM and assesses the Commonwealth EPBC Act Matters in relation to biodiversity.
- a strategy to offset any residual impacts of the development in accordance with the offset rules under the Biodiversity Offsets Scheme.	Section 7.
Office of Environment and Heritage	
1. Biodiversity impacts related to the proposed development (SSD 9490) are to be assessed in accordance with the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the <i>Biodiversity Conservation Act 2016</i> (s6.12), <i>Biodiversity Conservation Regulation 2017</i> (s6.8) and Biodiversity Assessment Method.	This document is a BDAR and follows the BAM.

Requirement	Section addressed in report
<p>2. The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the Biodiversity Assessment Method.</p>	<p>Section 5.1 details avoidance and minimisation. Section 5.2 details impacts (direct, indirect, prescribed). Section 6 details offsets.</p>
<p>3. The BDAR must include details of the measures proposed to address the offset obligation as follows:</p> <p>The total number and classes of biodiversity credits required to be retired for the development/project</p> <p>The number and classes of like-for-like biodiversity credits proposed to be retired;</p> <p>The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules;</p> <p>Any proposal to fund a biodiversity conservation action;</p> <p>Any proposal to conduct ecological rehabilitation (if a mining project);</p> <p>Any proposal to make a payment to the Biodiversity Conservation Fund.</p> <p>If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.</p>	<p>The offset strategy is detailed in section 7.</p> <p>Rehabilitation of the site is discussed in detail in the EES (2019) Landscape and Rehabilitation Strategy.</p>
<p>4. The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the Biodiversity Conservation Act 2016.</p>	<p>This assessment and field survey has been completed by Accredited Assessors (section 1.7)</p>

1.5 Consultation

As part of the project planning, Element Environment submitted correspondence to the Department of Planning, Industry and Environment (DPIE) - Biodiversity and Conservation Division (BCD) on the 17th July 2019 requesting to provide comments for the preparation of the Environmental Impact Statement.

A response was provided by DPIE on the 2nd August 2019, stating that the BCD has provided input into SEARs (reference DOC18/691590-1) which outline assessment requirements for Aboriginal cultural heritage, threatened biodiversity, impacts to National Parks and Wildlife Estate, soils and water, flooding, floodplain management and coastal erosion. BCD had no further assessment requirements at this stage of the project.

1.6 Assessment Objectives and Format

The primary objective of this assessment is to use the guidelines and methodology provided in the BAM to determine the impact the project would have on biodiversity, avoid and mitigate these impacts and then calculate the Project's biodiversity offset requirement.

This BDAR has two broad stages consistent with the BAM methodology:

Stage 1 – Biodiversity Assessment

- assessment of landscape features
- assessment of native vegetation

- assessment of threatened species and populations.

Stage 2 – Impact Assessment

- avoid and minimise impacts on biodiversity values
- consider impact and offset thresholds
- determine and calculate offset (credit) requirements.

1.7 Assessment Resources and Assessor Qualifications

This BDAR has been prepared by the accredited personnel and support staff identified in Table 2. Resources and survey guidelines used in the development of this BDAR are detailed in 3.1 and 4.1.

Table 2: Assessor qualifications and resources

Personnel	Qualifications	Tasks carried out
Luke Baker	Team Leader Ecology Accredited Biodiversity Assessor (BAAS 18088)	Flora and fauna field survey, data management, data entry, credit calculations, report preparation.
Rhidian Harrington	Ecologist and Director Accredited Biodiversity Assessor (BAAS 17095)	Quality assurance, report review, review of threatened bird and amphibian habitat.
Alex Christie	Ecologist Accredited Biodiversity Assessor (BAAS 18144)	Flora and fauna field survey and report preparation
Amanda Griffith	Senior Ecologist Accredited Biodiversity Assessor (BAAS 17066):	Flora and fauna field survey
Radika Michniewicz	Senior Ecologist Extensive fauna trapping experience, including project management and field assessment of long-term targeted Fauna Monitoring Projects for NSW Roads and Maritime Services.	Flora and fauna field survey, including trapping and spotlighting, and Wallum Toadlet transects after 20 mm of rain.
Jodie Danvers	Ecologist Extensive fauna trapping experience, including field assessment and reporting associated with long-term targeted Fauna Monitoring Projects for NSW Roads and Maritime Services.	Flora and fauna field survey, including trapping, spotlighting and Wallum Toadlet transects after 20 mm of rain.
Greg Tobin	GIS Specialist	Mapping

Table 3: Assessment resources and guidelines used

Assessment resources/guideline	
Resources	<ul style="list-style-type: none"> • Biodiversity Assessment Method (BAM) (OEH 2017a) • BAM Operational Manual – Stage 1 (OEH 2018b) • BAM Operational Manual – Stage 2 (DPIE 2019a) • BAM Calculator User Guide (OEH 2018c)
Survey guidelines	NSW <ul style="list-style-type: none"> • Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Method (DPIE 2020c).

Assessment resources/guideline

- 'Species credit' threatened bats and their habitats, NSW survey guide for the Biodiversity Assessment Method (OEH 2018a).
- Field survey methods for amphibians, Threatened species survey and assessment guidelines (DECC 2009).
- 2004 Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (DECC 2004).
- Lake Macquarie City Council (LMCC 2014a) Flora and Fauna Survey Guidelines Version 4.2.

Commonwealth

- Survey Guidelines for Australia's Threatened Frogs (DEWHA 2010a)
- Survey Guidelines for Australia's Threatened Bats (DEWHA 2010b)
- Survey Guidelines for Australia's Threatened Birds (DEWHA 2010c)
- Draft Survey Guidelines for Australia's Threatened Orchids (Commonwealth of Australia 2013)

It should be noted that throughout the course of this Project (commenced in 2017) significant changes to the assessment approach have arisen due to the following:

- The habitat definitions for dual credit species, and survey effort for some species credit flora and fauna have changed in the BioNet Threatened Biodiversity Data Collection (TBDC) since the project commenced.
- *Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Method (DPIE 2020c)* was released in April 2020, after the Environment Impact Statement (EIS) was submitted in December 2019.
- State Environmental Planning Policy (Koala Habitat Protection) 2019 (Koala SEPP), was released after the EIS was submitted to DPIE in December 2019.
- The Biodiversity Conservation Trust (BCT) released guidance material related to vegetation mapping and site stratification in March 2020. Whilst the guidance material was aimed as Biodiversity Stewardship Site Assessments, the content and interpretation of the BAM is relevant to BDARs.

At the time of this assessment the following is noted:

- Module 3 of the BAM has not yet been released.
- Some threatened biodiversity profiles in the TBDC have not yet been finalised (e.g. Mahony's Toadlet).
- Draft Guidelines for threatened birds has not yet been released. The BCD has advised that appropriate guidelines be used during the course of the project in lieu of formal bird survey guidelines.

2. Landscape Features

2.1 Methods

As detailed in Section 4 of the BAM (OEH 2017a), a landscape assessment for the Project is required, which was conducted within the BAM Calculator. Landscape value is an assessment of factors including:

- Native vegetation cover
- Rivers, streams and estuaries
- Areas of geological significance
- Habitat connectivity.

For each factor the current state of the landscape is assessed then compared with the state of the landscape if the Project were to proceed.

2.2 Landscape Features and Scoring

The inputs into the landscape features component of the BAM Calculator, along with the associated Figure reference, has been detailed in Table 4 below.

Table 4: Landscape features and scoring under the NSW BAM

Landscape features	Description	Figure reference
subject site size	38.14 ha	
IBRA bioregion/subregion	NSW North Coast IBRA region, and within Karuah Manning IBRA subregion.	Figure 4
NSW (Mitchell) Landscapes	One Mitchell landscape occurs across the subject site: Sydney - Newcastle Barrier and Beaches.	Figure 4
Rivers, streams and estuaries and Strahler stream order	No rivers, streams or estuaries occur within the subject site.	None occur within the subject site
Wetlands within and adjacent to development	No wetlands occur within or adjacent to the development. The closest mapped wetlands include Long Bight Swamp located approximately 2.3 km to the southwest of the subject site.	-
Cleared areas	The native vegetation proposed to be directly impacted for the Project has largely been subject to clearing due to historic quarrying operations. Rehabilitation of the former quarry pits have occurred over the past decade. The rehabilitation has been undertaken as per a series of rehabilitation management plans (section 3.1.2), which has entailed large-scale tubestock planting and seeding. Areas of 'cleared areas' (devoid of native vegetation) within the subject site, comprise portions of the former inland extraction area and associated infrastructure (Figure 6). These cleared areas total 2.48 ha.	'Cleared Areas' or 'non-native' areas is shown on Figure 6
Connectivity features	The subject site adjoins a native vegetation corridor which extends to the north and south along Stockton beach encompassing Worimi Regional Park and Worimi State Conservation Area. The corridor also adjoins the	Figure 1

Landscape features	Description	Figure reference
	wetlands (Long Bight Swamp) and riparian vegetation of Fullerton Cove approximately 2.3 km to the south-west.	
Buffer area (percent native vegetation cover)	<p>A 1,500 m buffer was applied to the subject site resulting in an overall buffer area of 1,220 ha. Aerial interpretation was used to map the area of native vegetation, and non-native vegetation within the locality. In total 596 ha is non-native (consisting of quarry pit, existing emplacement, infrastructure, rural residential and roads/rail links) and 624 ha is native vegetation.</p> <p>Total native vegetation cover</p> <p>Combining the estimated native vegetation cover resulted in 51% of the buffer area supporting native vegetation. This falls into the 30-70% category within the BAM Calculator.</p>	Figure 4
Site context	Site based assessment.	-
Geological significance	There are no karst, caves, crevices, cliffs or other areas of geological significance within the subject site. Such geographic significant features are located greater than 2 km away from the subject site, and thus none would be impacted by the Project.	-

3. Native Vegetation and Flora Assessment

3.1 Native Vegetation

3.1.1 Methods – Data Review

A review of relevant literature, databases and existing vegetation mapping was undertaken to identify vegetation, threatened flora and Threatened Ecological Communities (TECs) with potential to occur at the subject site. The literature review was undertaken prior to the field survey to inform field survey requirements. A likelihood of occurrence analysis (Annex 1) was then undertaken for each species/TEC, based on suitability of habitat present within the subject site.

Resources reviewed included the following:

- Database searches:
 - *NSW BioNet Atlas Database* (DPIE 2020d) for spatial records of threatened flora listed under the BC Act within a 10 kilometre (km) radius of the subject site.
 - *EPBC Act Protected Matters Search Tool (PMST)* (DAWE 2020) for list of flora and ecological communities identified as MNES known or with potential habitat within a 10 km radius of the subject site.
 - BAM Calculator candidate and predicted species list.
- Vegetation mapping: Greater Hunter Native Vegetation Mapping v4.0. VIS ID 3855 (OEH 2017b)
- Previous relevant studies including:
 - Eastcoast Flora Survey (2010) Vegetation of the Worimi Conservation Lands, Port Stephens, New South Wales: Worimi NP, Worimi SCA & Worimi RP - Final Report, November 2010, Stephen Bell & Colin Driscoll.
 - ERM (2005a) Fern Bay Estate, Species Impact Statement, Prepared for Winten Property Group and Continental Venture Capital Limited.
 - ERM (2005b) Stockton Sandpit Windblown Sand Extraction, Environmental Impact Statement, Prepared for Boral Resources (Country) Pty Limited.

3.1.2 Methods – Vegetation Validation

Prior to field validation, the subject site was stratified using aerial photographic interpretation (API), and through reference of rehabilitation management zones specified in management plans of the former quarry pit (Plate 1). The series of relevant management plans and monitoring reports for the site include:

- ERM (2007) Boral Resources (Country) Pty Ltd, Stockton Transgressive Dune Quarry Rehabilitation and Landscape Management Plan December 2007.
- ERM (2010) Boral Resources (Country) Pty Ltd, Stockton Transgressive Dune Quarry Rehabilitation and Landscape Management Plan August 2010.
- Environmental Compliance Services (2017) Stockton Transgressive Dune Quarry Rehabilitation and Landscape Management Plan, Prepared for Boral Resources, March 2017.
- Hunter Land Management (2015) Rehabilitation Assessment Boral Fullerton Cove, Prepared for Boral Resources, August 2015.



Plate 1. Approximate former quarry pit locations subject to native vegetation rehabilitation

Through the API process some of the rehabilitation areas were clearly defined. BAM plot location and an approach to survey transects were then plotted on field maps to guide survey effort.

A field survey was carried out on the following dates to stratify the vegetation as per the BAM:

- 27-29th September 2017
- 20th August 2018
- 26th May 2020
- 30th July 2020
- 1st July 2020.

The surveys completed in 2020 involved a comprehensive hollow-bearing tree assessment which allowed Niche to refine the vegetation zones of the site to reflect similar plot condition scores within each PCT, and stratify the site based on relevant mapping guidelines provided by the BCT in March 2020.

In total, 16 BAM plots were completed within the subject site to meet the minimum plot requirement as per the BAM (Table 5 and Figure 5). A significant number of transects were also completed which assisted in vegetation zone delineation (Figure 5).

3.1.3 Results – Vegetation Validation

The field survey confirmed that the subject site consisted predominately of native vegetation. For the most part, the subject site consisted of large portions of planted tubestock at varying ages and in-fill planting within patches of remnant vegetation, which was conducted over the past two decades to rehabilitate the former quarry pits.

As detailed in the OEH (2018b) Biodiversity Assessment Method Operational Manual, '*Planted native vegetation is treated in the same way as native vegetation if it meets the definition of native vegetation in*

Section 5A of the Local Land Services Act 2013. Where the vegetation is a mix of local and non-local planted species the assessor should consider the best matching PCT based on the local species present’.

As such, the zones that have been rehabilitated have been attributed to two Plant Community Types (PCTs) which likely occurred within the subject site prior to clearing or contain a structure and composition similar to that of the rehabilitated land.

Different condition classes were assigned to vegetation where obvious differences in structure and quality occurred, resulting in two PCTs and six vegetation categories (zones) as shown in Table 5. The vegetation zones generally reflected the age of the rehabilitation and areas of remnant vegetation.

Descriptions for those communities which occur within the subject site are provided in Annex 2 and the distribution is shown in Figure 6.

Table 5: Plant Community Types present across the subject site

Vegetation zone	Plant Community Type (PCT)	Vegetation formation	Vegetation class	Threatened Ecological Community (TEC)*	PCT % cleared ¹	Condition identifier input used in Calculator	Total (ha)	Plots required	Plots completed
1	PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Dry Sclerophyll Forests (Shrubby sub-formation)	Coastal Dune Dry Sclerophyll Forests	-	45	Zone 1	14.13	3	4
2						Zone 2	3.87	2	2
4						Zone 4	5.19	3	3
5						Zone 5	1.71	1	1
6						Zone 6	8.09	3	4
3	1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	Dry Sclerophyll Forests (Shrubby sub-formation)	South Coast Sands Dry Sclerophyll Forests	-	86	Zone 3	2.67	2	2
-	Non-native	-	-	-	-	Non-native	2.48	-	-
	Total						38.14	14	16
	Total native vegetation						35.66		

3.1.4 Plant Community Descriptions

Refer to Annex 2 for plant community descriptions and diagnostic species for each plant community.

3.1.5 Site Values

Flora

Floristic data recorded from floristic plots performed throughout the identified vegetation zones is included within Annex 3.

Plot and transect values

The results of the plot data and species list obtained during the field assessment is provided in Annex 4.

¹ The BAM defines ‘Percent Cleared Value’ as the percentage of a PCT that has been cleared as a proportion of its pre-1750 extent, as identified in the BioNet Vegetation Classification

Site integrity scores

The site value assessment was carried out by entering plot data into the BAM Calculator. The data provides quantitative measures of composition, structure and function for each vegetation zone (Annex 4). The BAM Calculator compares the values recorded with the benchmark for the vegetation class to provide the site value score. This score represents the overall condition of the vegetation compared against the benchmark.

The vegetation scores for each zone in the subject site have been provided in Table 6. The score from these inputs, coupled with data in the following section of this report, is used to determine the number of ecosystem credits that are required for development.

Vegetation zones that have a site integrity score of less than 17 out of 100 for a non-threatened ecological community do not need to be offset.

As shown in Table 6, vegetation zone 'Zone 4' had a score of 4.8 and, as such, does not require to be offset. The remainder of the vegetation zones had a site integrity score greater than 17 and therefore require biodiversity offsetting (section 6.1.1).

Table 6. Vegetation zones and site integrity scores

Vegetation zone	Plant Community Type (PCT)	Condition identifier input used in Calculator	Total (ha)	Site integrity	Offset required
1	PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Zone 1	14.13	43	Yes
2		Zone 2	3.87	19.8	Yes
4		Zone 4	5.19	4.8	No
5		Zone 5	1.71	39	Yes
6		Zone 6	8.09	47.7	Yes
3	1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	Zone 3	2.67	21	Yes

3.1.6 High Threat and Priority Weeds

The BCD has a list of 'High threat weeds' (HTW) which need to be taken into consideration in the BDAR.

During the field surveys, three high threat weeds were recorded within BAM plots: *Bidens pilosa* (Farmers Friend), *Ehrharta erecta* (Panic Veldtgrass) and *Eragrostis curvula* (Africa Lovegrass). Although the three high threat weeds were located across all vegetation zones, they were concentrated adjacent to existing disturbance areas. The cover of 'high threatened weeds' are considered in the site value scores for each BAM plot (Annex 4). Other HTW recorded outside of the BAM plots include *Chrysanthemoides monilifera* (Bitou bush), *Ageratina adenophora* (Crofton Weed) and *Senecio madagascariensis* (Fire weed).

3.1.7 Threatened Ecological Communities (TECs)

A list of TECs occurring or potentially occurring within the locality as generated from the database searches is detailed in section 3.1.1 and Annex 1. The database searches identified 25 TECs that have been identified as potentially occurring within the locality.

Based on the results of the detailed vegetation validation, and review of the Conservation Advice of the TECs, no TECs were recorded on the subject site or are considered likely to occur.

3.2 Threatened Flora

3.2.1 Methods - Threatened Flora

A total of 21 threatened flora with the potential to occur within the locality, or as generated by the BAM Calculator, are presented in Annex 1.

In total, approximately 112.5 hours of threatened flora survey was conducted across the site (Table 7 and Figure 5). Furthermore, the visibility of the landscape, particularly in the relatively younger rehabilitation areas (Zone 1, Zone 2, Zone 4), was relatively open resulting in limited observer obstruction during the transect walks.

A survey was also conducted in 2018 by Dr Amanda Griffiths during the recommended survey month (August) to determine the presence of *Diuris praecox*. The survey was considered necessary as *Diuris praecox* has been recorded within the locality and on total of 208 individual *Diuris praecox* were recorded within Boral's landholding in September 2003 (ERM 2005b).

The population recorded by ERM in 2003 was adjacent to walking tracks and roads where it was noted there was reduced competition for light (ERM 2005b). Follow up site visits in 2004 noted that half the population was not flowering, which may have been attributed to increased shrub density and competition for light (ERM 2005b). The August 2018 survey did not include transect lines as per the DPIE (2020c) plant survey guide as this guideline was only publicly available in April 2020 after the lodgement of the application in March 2020.

A follow-up targeted survey was therefore completed for *D. praecox* in August 2020 as per the DPIE (2020c) guidelines. The survey was completed after confirming with the BCD that the *Diuris praecox* was flowering in August. The survey entailed a series of transects as per the DPIE (2020c) guidelines, which was walked by ecologists Luke Baker and Jodie Danvers. Given the relatively open ground layer throughout much of the site, visibility to detect the species during the traverses was generally unimpeded.

Similarly, a targeted survey was completed for *Cyptostylis hunteriana* during early November 2020. Local populations around the Newcastle area were confirmed to be flowering mid-later October by BCD Threatened Species Officer. The survey entailed a series of transects as per the DPIE (2020c) guidelines, which was walked by ecologists Luke Baker and Jodie Danvers.

Table 7. Threatened flora survey timing and effort

Dates of survey	Consultant	Hours completed (total)
26 – 27 th September 2017	Luke Baker, Alex Christie	18 hours
20 th August 2018	Dr Amanda Griffith	7 hours
26 th May 2020	Luke Baker	3 hours
27 th – 28 th May 2020	Dr Radika Michniewicz, Jodie Danvers	8 hours
30 th June 2020	Luke Baker, Jodie Danvers	10 hours
1 st July 2020	Luke Baker, Jodie Danvers	9 hours
24 th – 25 th August 2020	Luke Baker, Jodie Danvers	29.5 hours
9 th – 12 th November 2020	Luke Baker, Jodie Danvers	28 hours
Total		112.5 hours

3.2.2 Threatened Flora Results (BC Act)

No threatened flora listed on the BC or EPBC Acts were recorded during the field surveys.

The historic clearing events have changed the resilience across large portions of the site, particularly for vegetation in Zone 1, Zone 2 and Zone 4. These vegetation zones had relatively low recruitment of native species, and were relatively open in terms of ground cover (see - Plate 5 as an example from Zone 4). We therefore consider vegetation Zone 1, Zone 2 and Zone 4 to have a low habitat preference for threatened flora.

Vegetation Zone 3 is dominated by a *Leptospermum* shrub thicket. The soil is more compacted compared to the open areas of bare sand. The ground cover within this vegetation zone is sheltered from direct sunlight due to the thicket, contains high litter cover and a protection from wind (Plate 3). Zone 3 may offer some habitat for threatened flora, however threatened flora were absent in this area during field survey.

Vegetation Zone 5 and Zone 6 offer greater resilience and native recruitment and would be more suited to threatened flora habitat for the associated subject species, however threatened flora were absent in this area during field survey (Plate 4).



Plate 2. Sand cover across the former quarry pit (vegetation zone 4)



Plate 3. Ground cover within former quarry pit (vegetation zone 3)



Plate 4. Native regeneration and high resilience in vegetation zone 6

In accordance with Section 6.4 of the BAM, the list of potentially occurring threatened flora species may be further refined where:

- habitat constraints listed for the species in the TBDC are absent from the subject site (or particular vegetation zones), or
- habitat constraints or microhabitats on which the species depends are sufficiently degraded such that the species is unlikely to use the subject site, or
- the species is vagrant in the IBRA subregion, or
- an expert report is prepared (in accordance with Subsection 6.5.2 of the BAM) stating that the species is unlikely to be present on the subject site.

Table 8 lists the candidate threatened flora species provides comment on the survey effort completed, and justifies where a species has been removed from further consideration.

Table 8: Candidate flora species predicted by the BAM Calculator to occur

Scientific Name	Recommended survey time (BAM)												Survey completed?	Considered further	
	J	F	M	A	M	J	J	A	S	O	N	D			
<i>Allocasuarina simulans</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Angophora inopina</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
<i>Callistemon linearifolius</i>	Y	Y	Y	Y					Y	Y	Y	Y		Survey was not completed during the recommended survey time, however given the relatively conspicuous nature of the species, it is highly likely the species would have been detected during the field surveys if present. The species is known to flower in spring and will not lose foliage over the winter months. As such, even without the flower present, <i>Callistemon</i> species within the current landscape would have been identified during the months that survey took place. We therefore regard our survey as suitable for detection of the species.	Not considered further.
<i>Corybas dowlingii</i>						Y	Y	Y						Survey was completed during recommended survey time. We did not detect the species during the field surveys. It should be noted that <i>Corybas dowlingii</i> forms clonal colonies and typically grows in gullies in tall open forest on well-drained gravelly soil at elevations of 10-200m (Jones 2004). Much of the subject site is below 10 m elevation, and the soil types across the site are not of a gravelly soil structure. As such, the habitat suitability at the site for this species is relatively low.	Not considered further.
<i>Cryptostylis hunteriana</i>	Y	Y									Y	Y		<p><i>Cryptostylis hunteriana</i> is known from the Gan Gan Hill and Tomaree Headland. The species is a saprophyte and therefore reliant on a symbiotic relationship with mycorrhizal fungus.</p> <p>Based on the relatively low natural regeneration evident within much of the former quarry pit, the potential for the species to occur on the rehabilitated quarry areas (Zone 1, Zone 2 and Zone 4) seems highly unlikely based on the current natural regeneration at the site and historic disturbance. Some potential may occur within Zone 5 and Zone 6 given these zones have greater soil resilience and recruitment.</p> <p>A survey was completed in November 2020 during the recommended survey time and when the local population was flowering (as indicated by BCD Threatened Species Officer).</p> <p>The field survey confirmed that the plant was not at the site.</p>	Not considered further.
<i>Diuris arenaria</i>									Y					Surveys were completed during recommended survey periods. The species can utilise 'dune/sandy hills' which fits the habitat types present within the subject site. The species has been previously recorded within the Worimi Conservation Lands along a powerline easement (near Bob's Farm)	Not considered further.

Scientific Name	Recommended survey time (BAM)												Survey completed?	Considered further	
	J	F	M	A	M	J	J	A	S	O	N	D			
														(Eastcoast Flora Survey 2010). The species was not recorded at the subject site by ERM in 2005 (ERM 2005b), nor was the species recorded at the Fern Bay Estate (approximately 1.1 km to the southwest) in 2005 despite targeted surveys by ERM (ERM 2005a). Within the subject site, some potential habitat occurs within vegetation Zone 5 and Zone 6 given these areas have a relatively intact soil profile. However, the species was not detected during targeted flora survey, nor historically at the subject site, and as such, is not required to be considered further as per the BAM.	
<i>Diuris praecox</i>							Y	Y						A survey was completed in August 2018 by Dr Amanda Griffiths, and again in August 2020 by Jodie Danvers and Luke Baker. The survey in August 2018 was not completed to the requirements of DPIE (2020b) survey guidelines, which were released in April 2020. The follow-up survey in accordance with DPIE (2020b) guidelines was completed in August 2020. The survey was carried out after confirming with the BCD that <i>Diuris praecox</i> within the Newcastle Region was flowering. The survey effort that was completed involved transects covering the entire areas as shown in Figure 5. Each transect was walked by two qualified ecologists. The survey did not record the <i>Diuris praecox</i> . Based on the relatively low natural regeneration evident within much of the former mine quarry pit, the potential for the species to occur on the rehabilitated quarry e pit encompassing areas (Zone 1, Zone 2, Zone 3 and Zone 4) seems highly unlikely. Some potential may occur within Zone 5 and Zone 6 given these areas have greater soil resilience and recruitment, however the survey confirmed that the species is not present.	Not considered further.
<i>Eucalyptus camfieldii</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time and given it is a conspicuous species it is unlikely to remain undetected following field survey.	Not considered further.
<i>Eucalyptus parramattensis subsp. decadens</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time and given it is a conspicuous species it is unlikely to remain undetected following field survey.	Not considered further.
<i>Melaleuca groveana</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time and given it is a conspicuous species it is unlikely to remain undetected following field survey.	Not considered further.

Scientific Name	Recommended survey time (BAM)												Survey completed?	Considered further	
	J	F	M	A	M	J	J	A	S	O	N	D			
<i>Prostanthera densa</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time and given it is a conspicuous species it is unlikely to remain undetected following field survey.	Not considered further.
<i>Rhizanthella slateri</i>										Y	Y	Y		<p>Survey completed during recommended survey period in September. We note that the species is relatively cryptic and as such the survey team looked for tips of bract breaking the surface of the sandy soil during surveys.</p> <p>Although the species was not detected during the surveys, we note that the LMCC (2014a) Flora and Fauna Survey Guidelines state that the species is 'difficult or impossible to detect even when flowering'. As such, Niche has investigated the known and potential habitat associated with the species, and notes the following:</p> <ul style="list-style-type: none"> - The subject site does not occur within the likely distribution range for the species as per DoE (2020a), but does occur within a 'known subregion' according to the TBDC given the known population at Bulledellah. - The population at Bulledellah is the closest known population to the subject site, approximately 50 km to the north, where the species occurs on the western slopes and base of Bulahdelah Mountain (known locally as Alum Mountain). - The species was not been recorded at the subject site by ERM, nor has the species been recorded during other investigations in the locality (e.g. ERM (2005a, 2005b); EastCoast Survey (2010)). <p>Based on the above we therefore conclude that there is a low likelihood for the species to be present.</p>	Not considered further.
<i>Senecio spathulatus</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time and given it is a conspicuous species it is unlikely to remain undetected following field survey. It should be noted that this species occurs on the frontal dune system, but the site does not occur on the frontal dune system complex.	Not considered further.
<i>Tetratheca juncea</i>							Y*	Y*	Y	Y	Y*	Y*		<p>A targeted survey was completed during the recommended survey period in September, and also during August 2018. We note that this species has since been listed in the TBDC to have a survey period only in September/October. We did not detect the species during our survey. We note that the species is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. The site predominately did not have a grassy ground cover as evident in the plot cover scores provided in Annex 4.</p> <p>The Threatened Species Profile also states that the 'majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape' (OEH 2018d). The Awaba soil landscape does not occur at the subject site.</p>	Not considered further.

Scientific Name	Recommended survey time (BAM)												Survey completed?	Considered further	
	J	F	M	A	M	J	J	A	S	O	N	D			
														<p>The Lake Macquarie Habitat suitability modelling using compiled species records shows core population densities around the Central Coast and North Coast Regions on Map 1 of LMCC (2014c). The closest record to the site is approximately 8 km to the south in Newcastle. Other records throughout NSW are situated away from similar dune vegetation to the site.</p> <p>Map 2 provided in LMCC (2014c) contains the mapped <i>Tetratheca juncea</i> habitat and distribution of records. The site does not occur within areas mapped by LMCC as 'modelled suitable <i>T. juncea</i>' habitat.</p> <p>Based on the information gathered, we conclude that the species has a low likelihood to occur at the site given the following:</p> <ul style="list-style-type: none"> - The species was not detected during field survey. - No modelled habitat by LMCC occurs within the subject site. - No records of the species have previously been recorded at the site, or during the current survey (we note however that the survey was completed during the correct survey times at the time of submission). - Records for the species indicates that the species may not coincide with the habitat present at the subject site. - Vegetation zones 1, Zone 2, Zone 3 and Zone 4 have low native recruitment, low resilience due to historic clearing and are unlikely to be suitable habitat for the species. 	
<i>Thesium australe</i>	Y	Y							Y	Y	Y	Y	<p>Survey completed during recommended survey period. It occurs on soils derived from sedimentary, igneous and metamorphic geology on a range of soils including black clay loams to yellow podzolics and peaty loams. The site contains sandy loams and as such is likely unsuitable regardless of survey.</p>	Not considered further.	

* survey time for the species as presented in the BAM calculator submitted January 2020.

3.2.3 Threatened Flora for Further Consideration

Our survey and analysis confirm that no threatened flora requiring species credits were recorded within the subject site.

3.2.4 Threatened Flora Results (EPBC Act)

No threatened flora as listed on the EPBC Act were recorded during the field survey. Threatened flora listed on the EPBC Act have been addressed in Annex 1. No threatened flora on the EPBC Act are likely to occur in the subject site based on the results of the field survey.

4. Fauna and Fauna Habitat Assessment

4.1 Fauna assessment

Comments regarding the BDAR from the Agencies were provided to Boral and Niche in March 2020. The Agency comments related primarily to the requirement for further targeted threatened fauna using guidelines provided in the TBDC and the Lake Macquarie Survey Guidelines. In particular, both BCD and PSC recommended that targeted survey threatened owls (Barking Owl, Masked Owl and Powerful Owl), Brush-tailed Phascogale, and threatened amphibians (Wallum Toadlet, Green-thighed Frog and Mahony's Toadlet). This revised BDAR has involved extensive targeted threatened fauna survey and assessment of habitat features for each of the subject threatened fauna, which has been described throughout this chapter.

4.1.1 Methods – Data Review

As for the native vegetation and flora assessment, a review of relevant literature, databases and existing vegetation mapping was undertaken to identify vegetation (fauna habitat) and threatened fauna with the potential to occur on the subject site. Data reviewed included:

- Database searches:
 - *NSW BioNet Atlas Database* (DPIE 2020d) for spatial records of threatened flora listed under the BC Act within a 10 kilometre (km) radius of the subject site.
 - *EPBC Act Protected Matters Search Tool* (PMST) (DAWE 2020) for list of flora and ecological communities identified as MNES known or with potential habitat within a 10 km radius of the subject site.
 - BAM-Calculator candidate and predicted species list.
- Previous relevant studies including:
 - Ecotone (2008) Vertebrate Fauna Survey Worimi Conservation Lands prepared for the NSW Department of Environment and Climate Change.
 - ERM (2005a) Fern Bay Estate, Species Impact Statement, Prepared for Winten Property Group and Continental Venture Capital Limited.
 - ERM (2005b) Stockton Sandpit Windblown Sand Extraction, Environmental Impact Statement, Prepared for Boral Resources (Country) Pty Limited.

Results of the searches and reviews were undertaken prior to field survey to inform field survey requirements. A likelihood of occurrence analysis (Annex 1) was then undertaken for each species, based on suitability of habitat present within the subject site.

4.1.2 Methods – Field Survey

The likelihood of occurrence for threatened fauna, along with the candidate threatened fauna as per the BAM Calculator dictated the survey method approach. The fauna survey was primarily designed to target threatened fauna that are regarded as ‘species credit’ fauna, and those listed as threatened on the EPBC Act.

The following guidelines or documentation were consulted to assist with establishing the survey plan:

- TBDC (May & June 2020) reviewed prior to field survey
- TBDC (June 2017) reviewed prior to field survey
- Lake Macquarie City Council Flora and Fauna Survey Guidelines LMCC (2014a)
- Threatened Species – Field Survey Methods (OEH 2015)
- Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians (DECC 2009)
- Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities Working Draft (Department of Environment and Conservation, 2004)
- Survey Guidelines for Australia’s Threatened Frogs (DEWHA 2010a)
- Survey Guidelines for Australia’s Threatened Bats (DEWHA 2010b)
- Survey Guidelines for Australia’s Threatened Birds (DEWHA 2010c)
- Survey Guidelines for Australia’s Threatened Mammals (DEWHA 2011a)
- Survey Guidelines for Australia’s Threatened Reptiles (DEWHA 2011b)
- Relevant Significant Impact Guidelines and Referral Guidelines for EPBC Act listed species.

Survey methods were selected to detect the target species identified during desktop research (i.e. threatened species with the potential to be impacted by the Project), as well as to employ a broad range of survey techniques that allowed for detection of the variety of fauna species groups.

Survey methods and effort is summarised in Table 10 with an overview of the survey dates provided in Table 9 below. Figure 7 and Figure 8 shows the location of the fauna survey effort.

Table 9. An overview of fauna field survey dates

Dates of survey	Ecologist	Key fauna survey tasks completed during field campaign
26 – 27 th September 2017	Luke Baker, Alex Christie	Habitat assessment, Bird survey, Anabat, SAT survey
20 th August 2018	Dr Amanda Griffith	Opportunistic bird survey
26 th – 28 th May 2020	Luke Baker, Dr Radika Michniewicz, Jodie Danvers	Camera trapping, spotlighting, call playback, stag watching, hollow-bearing tree mapping, bird survey, amphibian survey
30 th June 2020 - 1 st July 2020	Luke Baker, Jodie Danvers	Camera trapping, spotlighting, call playback, stag watching, hollow-bearing tree mapping, bird survey, amphibian survey
9 th November – 13 th November 2020	Luke Baker, Jodie Danvers	Spotlighting, stag watching, hollow-bearing tree watching, bird survey, amphibian survey

The field survey program was designed to detect potentially occurring threatened species and allow for an inventory of species to be compiled for the subject site. Although singular sightings of individual species were recorded during targeted surveys, repeat observations were not necessarily recorded. Incidental observations were recorded if the species had not been detected during targeted survey, was a threatened species, or was considered rare either within the subject site or more widely.

Details of the daily weather conditions have been provided in Annex 6. The mean weather conditions during the majority of the survey period (June 2020) consisted of day temperatures of 19 degrees, and at lowest temperature of approximately 12 degrees during night surveys.

During the November 2020 field campaigns the weather conditions during the majority of the survey consisted of day temperatures of 24 degrees, and lowest temperature at night of 16 degrees.

Heavy rainfall (approximately 33.2 mm) occurred prior to the May 2020 field survey, which provided the recommended amphibian survey conditions (20 mm recommended) specified in the Amphibian Guidelines (DECC 2009) to maximise detection of the Wallum Toadlet. Heavy rainfall also occurred on the 6th of November 17mm prior to the November 2020 field campaign.

During spotlighting, call-playback and stag watching, the wind conditions were relatively calm.

Table 10: Fauna survey effort

Fauna Group	Survey Technique	Survey effort	Details
All	Spotlighting	26/5/20 (start: 18.15) 27/5/20 (start: 18:30) 28/5/20 (start 18.20) 30/6/20 (start 18.00) 1/7/20 (start 18:15) 9/11/20 (start 9pm) 10/11/20 (start 8.45pm) 11/11/20 (start 9pm) 12/11/20 (start 8.30pm)	Spotlighting was undertaken by two ecologists within all habitat types of the subject site using LED torches. Each spotlighting session lasted for approximately one hour, with the exception of the November 2020 surveys which were approximately two hours each.
Mammals – arboreal	Camera trapping	59 camera traps Date established: 26/5/20 Date collected: 1/7/20 Total survey effort: 49,560 hours	A total of 59 baited camera traps (combination of Moultrie model MCG-12596, Scoutguard model SG562C, Reconyx model HC500) were set across the site. The cameras were placed in areas that were likely to yield the best results for target species (e.g. not within open bare sand areas). Each of the traps were mounted onto a tree at head height secured with the camera straps and a bait canister containing honey, oats and peanut butter was placed on an opposite tree at similar height. The bait cannister was secured with a nail and wire. The cameras remained in place for four weeks and the bait was changed at two weeks. Camera trap results were checked immediately after the field survey.
Mammals – ground	Camera trapping	21 camera traps Date established: 26/5/20 Date collected: 1/7/20 Total survey effort: 18,144 hours	A total of 21 baited camera traps (Scoutguard model SG562C) were set across the site. The cameras were set in all the vegetation zones. Each of the traps were mounted onto a tree at knee height secured with the camera straps and a bait canister containing honey, oats and peanut butter was placed on the ground and secured with a peg. The cameras remained in place for four weeks and the bait was changed at two weeks.
Mammals – Koala	SAT plot	3 x survey 26/07/2017 1 x survey 27/07/2017	SAT (Koala scat) surveys were conducted across the subject site at the locations shown in Figure 7. The bases (0 to 2 m from the trunk) of twenty such trees were searched for evidence of Koala scat by first circling around the tree looking for scats without disturbing the leaf litter (approximately 1 minute), then by raking through the leaf litter for scats (approximately 1 additional minute). In addition to SAT surveys, random tree

Fauna Group	Survey Technique	Survey effort	Details
			inspections were carried out during traverses of the subject site at selected feed trees searching for scats and characteristic bark scratches.
Bird	Diurnal survey	<p>1 x survey 26/07/2017, (2 hours) 15:30 into dusk</p> <p>1 x survey 27/07/2017 (2 hours) 6:55</p> <p>1 x survey 26/5/2020 (30 mins) 16:45</p> <p>1 x survey 30/6/20 (40 mins) 16:45</p> <p>1 x survey 1/7/2020 (25 mins) 16.45</p>	<p>To date, the DPIE has not yet published the 'Bird Survey Guidelines' to provide guidance in relation to BDARs. We were advised by BCD in June 2020 that Niche should apply the most relevant guidelines available (ie. DECC 2004, LMCC 2014a).</p> <p>Two ecologists conducted 20 minute, two hectare bird surveys at the areas shown on Figure 7. These were generally lengthened in time due to relatively low bird activity in most areas and additional species being recorded after or at the end of the 20 minute period. Incidental bird sightings were made throughout surveys activities with species of note being recorded. Birds were identified with the use of 10 X 42 binoculars or from their calls.</p>
Birds	Nocturnal survey – call playback	<p>26/5/20 (start: 17.15)</p> <p>27/5/20 (start: 17:40)</p> <p>28/5/20 (start 17.30)</p> <p>30/6/20 (start 5.16)</p> <p>1/7/20 (start 17:20)</p>	<p>Calls of targeted species (Powerful Owl, Masked Owl, Barking Owl and Bush-stone Curlew) were broadcast using a loud hailer for up to five minutes followed by five minutes of listening time. This process was repeated several times for each species at each survey site. A total of seven survey sites (two additional locations for only the Bush-stone Curlew in more suitable habitat were included) were established across the subject site in locations that offered sufficient vantage points and habitat features that may suit each species. Given the volume of the loud hailer and size of the subject site, the broadcasted calls at each survey location could be heard from all areas of the subject site.</p>
Birds	Nocturnal survey – stag watching	<p>26/5/20 (start: 17.15)</p> <p>27/5/20 (start: 17:40)</p> <p>28/5/20 (start 17.30)</p> <p>30/6/20 (start 5.16)</p> <p>1/7/20 (start 17:20)</p>	<p>Stag watching commenced prior to and during call playback. Vantage points were established near potential roost trees. Stag watching commenced prior to call playback, at approximately to 17:00 pm (prior to dusk) and continued for approximately 30-40 minutes coinciding with the call playback surveys. Six stag survey sites were established, and each was surveyed once during the survey program.</p>
Birds	General survey transects and tracks	Conducted in conjunction with all diurnal surveys	<p>Opportunistic bird surveys were conducted in conjunction with all diurnal surveys. Many of the threatened fauna requiring targeted survey were relatively conspicuous (e.g. Glossy-black Cockatoo and Gang-gang Cockatoo) and therefore would likely have been heard/or observed during activities such as camera trap deployment and hollow-bearing tree mapping.</p>

Fauna Group	Survey Technique	Survey effort	Details
			Furthermore, the extensive survey tracks completed across the area were also subsequently used to survey for nests of the Bush-stone Curlew.
Gang-gang Cockatoo hollow survey	Surveys were completed across six areas (as shown in Figure 8) by two ecologists to determine if the Gang-gang Cockatoo was utilise the tree hollows.	9/11/20 (start 5 pm) 10/11/20 (start 5.30 am) 11/11/20 (start 5.30 am) 12/11/20 (start 5.30 am) 13/11/20 (start 5.30 am)	Six areas as shown on Figure 8 were surveyed at dusk for an hour each to determine if Gang-gang cockatoos were utilising the tree hollows. Given the relatively conspicuous nature of the species, any calls or sighting throughout the site were noted. Each area was surveyed for an hour, watching the tree hollows in each area.
Microbats	Echolocation Call	2 x Anabat left for 2 x consecutive nights 26/09/2017 (5pm – 5am 10 hours); 27/09/2017(5pm – 5am 10 hours)	Anabat II bat detector and Anabat CF recorder units were deployed at two sites over two nights along potential flyways.
Amphibians	Spotlighting transects	26/5/20 (start: 18.15, 1.75 hr pp) 27/5/20 (start: 18:30, 1.25 hr pp) 28/5/20 (start 18.20, 1.5 hr pp) 9/11/20 (start 9pm, 2 hours pp) 10/11/20 (start 8.45pm, 2 hours pp) 11/11/20 (start 9pm, 2 hours pp) 12/11/20 (start 8.30pm, 2 hours pp)	Three amphibian transects were completed in conjunction with the general spotlighting transects described above. The spotlighting transects were carried out immediately after 20 mm of rainfall (as recorded on Tuesday 26 th May – 33 mm). The amount of rainfall did not result in any significant pool habitat or inundation areas being created within the subject site, nor within the patch of Swamp Sclerophyll Forest close to the subject site. The quarry manager confirmed that the site does not retain water following rainfall, with the exception being the Pasha Bulker storm in 2007 where a pool formed following days of heavy rainfall in the former quarry pit. The survey guidelines recommend ‘a 200 m transect within watercourses or inundation areas’ (DECC 2009). Given the subject sites does not contain water features, our survey approach was to cover a greater distance than the 200 m transects specified in the guidelines and complete a series of transects within all habitat types within the subject site. This enabled the team to cover greater ground during ideal conditions, and not limit the team to only 200 m transects within non-watercourse habitats. Males of the Wallum Froglet also call at any time of the year, especially after heavy rain and, as such, calls of the Wallum Froglet were listened for during the spotlighting transects and diurnal surveys.
Pale-headed Snake	Spotlighting transects	9/11/20 (start 9pm, 2 hours pp) 10/11/20 (start 8.45pm, 2 hours pp)	The Pale-headed Snake surveys were completed in conjunction with the general spotlighting transects described above. The area of the survey targeted locations where

Fauna Group	Survey Technique	Survey effort	Details
		11/11/20 (start 9pm, 2 hours pp) 12/11/20 (start 8.30pm, 2 hours pp)	tree hollows were present, including better condition habitat (that more suited the TBDC description) located outside of the subject site.
All	Survey tracks and transects		Opportunistic observations were made of fauna using binoculars and photography. Opportunistic survey included searches of micro habitat; under logs, waste piles (where limited areas of such habitat existed) or within heaped leaf litter, casual bird or mammal observations, or by listening for calls.

4.1.3 Fauna and Fauna Habitats

Fauna species recorded in the subject site are listed in Annex 5. A total 63 species were recorded during field surveys, comprising 44 birds, five amphibians, seven mammals, and seven reptiles.

Of the species recorded, the Brush-tailed Possum and Ring-tail Possum were the most commonly encountered species, detection via infrared cameras and spotlighting. The Swamp Wallaby was the most encountered mammal during the day surveys.

Three threatened fauna were recorded with the subject site; Greater Broad-nosed Bat, Eastern Bent-wing Bat and White-bellied Sea Eagle. Both the threatened microbats were recorded via Anabat, whilst the White-bellied Sea Eagle was recorded flying over the subject site on most days of the field surveys. A feather of a Glossy-black Cockatoo, and evidence of foraging on planted *Allocasuarina littoralis* trees (chewed cones) was also recorded at the locations shown on Figure 8.

Our assessment stratified the subject site into different habitat types, which were generally reflective of the rehabilitation efforts. The habitat types are shown on Figure 8 and are described below.

Habitat – Dune

Ground cover across much of younger rehabilitation areas (vegetation Zone 4) were generally sparse consisting of bare sand cover. The sandy substrate may provide burrowing habitat for small to medium-sized mammals, however only three small borrows were encountered during transects. The three borrows were quite old and were not deep, and no tracks were recorded outside the entrances. Two rabbits were observed during the site survey and are likely to have habitat within the open rehabilitated areas.



Plate 5. Dune habitat within former quarry pit

Habitat – Forest

Forest habitat has been grouped into three categories representing stratum and condition:

- Young open forest habitat: represents the younger rehabilitation areas. The height of the trees were approximately 3 – 5 m. Shrub and ground layer was quite open. The area would be suitable for foraging habitat during spring when many of the shrubs are flowering.
- Open forest habitat: The large-scale planting of the former quarry pits have resulted in a forest habitat type, ranging in canopy heights of 5-10 metres. Tree species mainly comprised *Eucalyptus pilularis*, *Cornelia gummifera* and *A. costata*. Midstorey cover comprised plantings of *Allocasuarina littoralis*, *Acacia species* and *Leptospermum*.
The *Allocasuarina littoralis* tubestock have created a foraging resource for the Gang-gang Cockatoo. Evidence of foraging was present with chewed cones beneath trees at the locations shown on Figure 8.
- Forest habitat: consisted of remnant vegetation or the older rehabilitated areas where occasional trees were not cleared during historical mining operations. These areas had all stratum layers intact, and a higher diversity and coverage compared to the younger areas of forest habitat. Tree hollows were present throughout the forest habitat type. Such areas are likely to provide greater breeding and foraging resources compared to the younger forest habitat types.



Plate 6. Young open forest – habitat



Plate 7. Open Forest – habitat



Plate 8. Forest habitat

Habitat – Shrub Thicket

A relatively homogenous planting of *Leptospermum laevigatum* and *L. trinervium* occurs within vegetation zone 3. Some scattered trees of *Angophora costata* and *Eucalyptus pilularis* have been planted in the area, however the vegetation zone is predominately a shrub thicket. Ground cover throughout this area is very sparse, consisting of a few native grass species and very few forbs.

This area during times of flower may be suitable foraging habitat for a range of bird species, and the Squirrel Glider, which is known to occur within the Worimi National Park.



Plate 9. Shrub thicket

Habitat – Tree Hollows and stags

A hollow-bearing tree survey was carried out during the May-July 2020 field survey. The location of hollow-bearing trees and stags are provided in Annex 7 and shown on Figure 8. The hollow-bearing trees were

restricted to vegetation Zone 5 and Zone 6, being the vegetation zones that consisted of remnant vegetation or rehabilitated areas that contained scattered remnant trees. All planted trees within the other vegetation zones of the subject site are not at an age where hollows have developed.

The hollow-bearing trees were typically *Angophora costata*, *Eucalyptus pilularis* and *Banksia serrata*, and ranged in size from 30 cm to greater than 80cm diameter at breast height. The size of the hollows ranged in size from 5 cm to over 30cm. The base of a hollow-bearing tree inspected for the presence of owl pellets or prey, to which no evidence of usage was observed during the time of the survey.

Areas of hollow-bearing trees were also observed from vantage points during stag watch and call-playback survey. No fauna were observed leaving the hollows during the survey activity.

A targeted survey of the Gang-gang cockatoo was completed during the recommended breeding season in November to determine if the species utilise the tree hollows. The survey confirmed the species is not utilising the site for breeding.

Many of the camera traps were also placed facing the hollow-bearing trees to increase detectability of hollow-dwelling species. As previously mentioned, only the Bush-tailed Possum and Ring-tail Possums were recorded on the cameras.

Aquatic habitat

There are no water features within the subject site such as creeks, swamps, dams or pools. The subject site does not contain Swamp Sclerophyll Forest or wetland/swamp habitat, which would retain pools or be inundated after heavy rains.

The May-July field surveys were conducted following 20 mm of rain to target threatened amphibians, including the Wallum Froglet, during the correct conditions. Despite the rain, the amount of rainfall did not result in any pool habitat or inundation areas forming within the subject site. The Quarry Manager confirmed that the site does not retain water following rainfall, with the exception being during the Pasha Bulker storm in 2007 where many days of heavy rainfall resulted in a pool forming in the former quarry pit.

The closest area that would retain pools or be inundated following heavy rainfall is immediately north of the subject site, near the quarry carpark. This area is shown on Figure 8 as Swamp Sclerophyll Forest. However, this area was not inundated following the 33 mm of rainfall. Following extended periods of heavier rainfall it is likely this area would become inundated and provide amphibian habitat. This area is separated from the subject site via an uphill slope that was once cleared for the former mine pit, and has since been sparsely rehabilitated.

4.1.4 Assessment of Threatened Fauna and Populations

Threatened species predicted or potentially occurring within the IBRA subregion as generated by the BAM Calculator were reviewed and refined post field survey on the basis of the vegetation types, condition and habitat features, as well as the results of field survey.

In accordance with Section 6.4 of the BAM the threatened fauna list of potentially occurring species may be further refined where:

- habitat constraints listed for the species in the TBDC are absent from the subject site (or particular vegetation zones), or
- habitat constraints or microhabitats on which the species depends are sufficiently degraded such that the species is unlikely to use the subject site, or

- the species is vagrant in the IBRA subregion, or
- an expert report is prepared (in accordance with Subsection 6.5.2 of the BAM) stating that the species is unlikely to be present on the subject site.

The list of predicted and candidate species generated via the BAM Calculator is presented in Table 11. A status for each species is provided which represents the basis for deciding whether a species was present or absent from the subject site. No ecosystem credit species were omitted from the BAM Calculator.

Table 11: List of Predicated and Candidate fauna species and assessment of credit requirement

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further				
		J	F	M	A	M	J	J	A	S	O	N	D						
Candidate threatened species																			
Regent Honeyeater (Breeding)	<i>Anthochaera Phrygia</i>													Y	Y	Y	Y	The subject site does not occur within the 'important Regent Honeyeater' map as per the BAM Important Areas Map. Therefore the 'species credit' component associated with Regent Honeyeater breeding habitat is not triggered. The Regent Honeyeater is therefore not considered further.	Not considered further
Bush Stone-curlew	<i>Burhinus grallarius</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	A targeted survey was completed using call playback, spotlighting and transects within the appropriate survey period. The species was not detected during targeted survey, and thus as per the BAM, the species is not required to be considered further.	Not considered further.
Gang-gang Cockatoo (Breeding)	<i>Callocephalon fimbriatum</i>	Y													Y	Y	Y	Breeding habitat as specified in TBCD (June 2020) ² includes: '(1) lone adult males have been identified at the site during the breeding season (October to January); or (2) an occupied nest has been found.' As per the directions on the TBCD, hollow-bearing tree survey has been used to identify whether potential nest hollows are present (defined as hollows in forest and woodland eucalypts; (i) at least 9 m above the ground and, (ii) with hollow diameter of 10 cm or larger). Such features were recorded within the subject site and are common throughout the locality within <i>Eucalyptus pilularis</i> and <i>Angophora costata</i> trees. Given potential habitat exists, the species was surveyed during the breeding season (October to January) in November 2020 to determine whether breeding is occurring on the site. DPIE is currently developing survey guidelines for threatened bird species. In the absence of guidelines, the BCD advised Niche in June 2020 to follow the best available guidelines for detecting breeding in this species, which will require surveys to be completed in October-January. Niche completed a week long survey of the hollow bearing tree areas as detailed in Table 10 which confirmed the species is not utilising the site for breeding.	Not considered further.
Glossy Black-Cockatoo (Breeding)	<i>Calyptorhynchus lathami</i>			Y	Y	Y	Y	Y	Y	Y								Similar to the Gang-gang Cockatoo, the DPIE have not yet released survey guidelines for this species. Breeding habitat as specified in the TBCD (June 2020) ³ includes: (1) begging birds of any age or sex have been identified at the site; or (2) lone adult males have been identified at the site during the breeding season (April to August); or (3) an occupied nest has been found. As per the directions provided in the TBCD (June 2020) we have surveyed for all potential nest hollows (defined as (i) at least 8 m above the ground and, (ii) in stems with a diameter of at least 30 cm and, (iii) hollow diameter is at least 15 cm and, (iv) stem angle is at least 45 degrees, and may be near-vertical or vertical).	Not considered further

² It should be noted that the definition of breeding habitat and hollow-bearing tree size/age have changed since the submission of the original BDAR.

³ It should be noted that the definition of breeding habitat and hollow-bearing tree size/age have changed since the submission of the original BDAR.

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further	
		J	F	M	A	M	J	J	A	S	O	N	D			
															<p>The species was surveyed using targeted bird surveys during the correct survey season. It should be noted that the species is highly recognisable and would have been observed during all the other survey activities had it been present. Evidence of the Glossy-black cockatoo was recorded at the site with a feather and chewed allocasuarina cones recorded (Figure 8). However, if the species was breeding in the subject site, it is likely we would have recorded the species during the survey. The species is relatively conspicuous, and given the amount of hours spent on-site during the correct breeding time, it is likely the species would have been detected if actively using hollow-bearing trees for breeding.</p> <p>Given it was not recorded during the field surveys, the habitat would not be regarded as known 'breeding habitat' as per the BAM guidelines.</p>	
Eastern Pygmy-possum	<i>Cercartetus nanus</i>	Y	Y	Y							Y	Y	Y	Y	<p>The subject site does not occur within a location that fits the distribution of the species as described in the Scientific Determination for the species - 'In New South Wales the species is found in coastal areas and at higher elevation in the south, but north of Newcastle at higher elevation only'. This is supported by the closest record for the Eastern Pygmy Possum, occurring 20 km to the north of the subject site.</p> <p>The species has also not been recorded during previous surveys of the Boral landholding by ERM (2005b), or nearby fauna surveys associated with Worimi Conservation Lands (Ecotone 2008), Fern Bay (ERM 2005a).</p> <p>Despite the habitat not being ideal for the species, we deployed an extensive number of camera traps across the subject site and undertook spotlighting survey across all habitat types. Our survey did not record the species. Although the timing was outside of the recommended survey time provided in the TBCD, we note that the LMCC (2014a) guidelines state that at any time of the year a survey may 'still detect the species, though the months of September to June are optimal'. Given ours and previous survey results, and that the subject site is outside the know distribution of the species, the species is considered to have a low likelihood of occurrence.</p>	Not considered further.
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	<p>The habitat descriptions provided in OEH (2018a) 'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method' note that the Large-eared Pied Bat breeding habitat occurs within 2 km of caves, scarps, cliffs, rock and disused quarries. The subject site does not occur within 2 km of such features. The species was also not recorded during the Anabat analysis. The use of bat call detector is the recommended method for recording this species LMCC (2014a). Given the absence of records and the distance from breeding resources, the subject site is unlikely to support habitat for the Large-eared Pied Bat.</p>	Not considered further.
Wallum Froglet	<i>Crinia tinnula</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	<p>There are no drainage lines, watercourses, dams or swamp-like vegetation within the subject site. The nearest swamp sclerophyll habitat that may become inundated following rainfall occurs immediately north of the subject site (as shown on Figure 8). Following over 30mm of rainfall, which is above the 20 mm specified as ideal survey conditions (LMCC 2014a), there pools or inundation within the Swamp sclerophyll Forest, nor within the subject site.</p> <p>Following 20 mm of rainfall, Dr Radika Michniewicz and Jodie Danvers completed three nights of spotlighting transects targeting the species. Given the subject sites does not contain water features, our survey approach was to cover a greater distance than the 200 m transects specified in the guidelines by</p>	Not considered further.

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further	
		J	F	M	A	M	J	J	A	S	O	N	D			
															<p>completing a series of transects within all habitat types of the subject site. This enabled the team to cover greater ground during ideal conditions, and did not limit surveys to 200 m transects within non-water course habitats. Males of the Wallum Froglet call at any time of the year, especially after heavy rain and, as such, calls of the Wallum Froglet were listened for during the spotlighting transects.</p> <p>The surveys did not detect the Wallum Froglet within the subject site. The lack of water bodies within the subject site means habitat for the species is unlikely to be present.</p>	
Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	<i>Dromaius novaehollandiae</i> - endangered population	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	<p>The Emu was not detected during the field surveys. No Emus were recorded on the camera traps, nor have they been previously recorded within the subject site by Boral staff.</p>	Not considered further.
White-bellied Sea-Eagle (Breeding)	<i>Haliaeetus leucogaster</i>							Y	Y	Y	Y	Y	Y	Y	<p>The White-bellied Sea-Eagle is a dual credit species, with breeding habitat triggering species credits.</p> <p>The White-bellied Sea-Eagle was recorded flying over the subject site during the September and July surveys.</p> <p>The TBDC states that '<i>Breeding habitat is live large old trees within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines AND the presence of a large stick nest within tree canopy; or an adult with nest material; or adults observed duetting within breeding period.</i></p> <p>Our survey effort has confirmed that no large stick nest are present within the subject site. Given we have covered the entire subject site intensively, it is highly unlikely that breeding habitat is present within the subject site.</p>	Not considered further.
Little Eagle (Breeding)	<i>Hieraetus morphnoides</i>								Y	Y	Y				<p>The Little Eagle is a dual credit species, with breeding habitat triggering species credits.</p> <p>Little Eagle Breeding habitat is defined in the TBDC as '<i>live (occasionally dead) large old trees within suitable vegetation AND the presence of a male and female; or female with nesting material; or an individual on a large stick nest in the top half of the tree canopy.</i></p> <p>The survey did not record the presence of the Little Eagle, nor did it record any large stick nests.</p> <p>Therefore, it is conclude that the subject site does not contain breeding habitat for the Little Eagle.</p>	Not considered further.
Pale-headed Snake	<i>Hoplocephalus bitorquatus</i>	Y	Y	Y									Y	Y	<p>The TBDC (as at June 2020) notes that the Pale-headed Snake can be found '<i>within 500m of moderate to good vegetation</i>', and further describes habitat as '<i>found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest</i>'. Both definitions of habitat, but particularly '<i>moderate to good vegetation</i>', are very broad and encompass most vegetation types, including derived native grasslands. The TBDC also states that the species utilise hollows.</p>	Not considered further.

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further		
		J	F	M	A	M	J	J	A	S	O	N	D				
															<p>The LMCC (2014a) survey guidelines describe habitat for the species as 'Loose bark, tree hollows in riparian habitat in dry eucalypt forest / woodland'. The species is also described as preferring Callitris woodlands (Scientific Committee Determination). The main prey is tree frogs although lizards and small mammals are also taken.</p> <p>The subject site does not contain riparian habitat, and the closest record to the subject site is 30 km to the immediate west.</p> <p>Within the immediate locality, habitat for this species is likely to be within Swamp Sclerophyll Forest where there are tree hollows. Riparian habitat does not occur within the subject site. The areas containing tree hollows (Zone 5 and Zone 6) are not located in riparian habitat, nor do they contain Callitris woodlands. Based on the habitat descriptions in the LMCC (2014a) guidelines, the species is unlikely to occur, but if the broader definition of the TBCD is used, potential habitat is present. As such a targeted survey was completed in November 2020 as detailed in Table 10 which confirmed the species is not utilising the site.</p>		
Swift Parrot (Breeding)	<i>Lathamus discolor</i>					Y	Y	Y	Y						<p>The species is a dual credit species, with the species credit component mapped as an important area. These mapped areas do not require survey as it is presumed that the species is present.</p> <p>The subject site does not occur within an important area.</p>	Not considered further.	
Green and Golden Bell Frog	<i>Litoria aurea</i>	Y	Y	Y									Y	Y	Y	<p>The BAM calculator lists the following habitat constraints in reference to potential habitat for the Green and Golden Bell Frog:</p> <ul style="list-style-type: none"> - 'Semi-permanent/ephemeral wet areas - Within 1km of wet areas/Swamps - Within 1km of swamp/Waterbodies - Within 1km of waterbody' <p>The above terms are very broad definitions (e.g. what constitutes a 'wet area?') with little guidance provided. When referenced in relation to the specific habitat requirements for the species as detailed in BioNet, habitat for the Green and Golden Bell Frog includes:</p> <ul style="list-style-type: none"> - 'marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha spp.</i>) or spikerushes (<i>Eleocharis spp.</i>). - water-bodies that are unshaded, free of predatory fish such as Plague Minnow.' <p>The subject site does not contain any of the above features.</p> <p>The closest dam to the subject site is approximately 350 m north of the subject site. This dam is separated from the subject site by Nelson Bay Road.</p> <p>The Project will not impact upon this water feature, nor any other known areas of potential habitat. Given such habitat requirements are absent for the species, it is unlikely that the Green and Golden Bell Frog would be present at the subject site.</p>	Not considered further.
Green-thighed Frog	<i>Litoria brevipalmata</i>	Y	Y	Y									Y	Y	<p>As stated in the TBDC, the Green-thighed Frogs 'occurs in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain' and ' Breeding occurs following heavy rainfall from spring to autumn, with larger temporary pools and</p>	Not considered further.	

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further				
		J	F	M	A	M	J	J	A	S	O	N	D						
															<p><i>flooded areas preferred</i>'. The TBDC recommends that survey be undertaken after rainfall events of >75 mm in 24 hrs or 150 mm over 72 hrs as the most probable time to survey and detect the species.</p> <p>In relation to the LMCC (2014a) Guidelines: preferred breeding/sheltering habitat is in ephemeral pools in creeklines and soaks in flood prone vegetation.</p> <p>As previously discussed, the subject site does not contain watercourses or riparian habitat, is not flood prone. Although the subject site was not visited after 75 mm of rainfall, the quarry manager has confirmed that the subject site does not hold water with the exception being following the Pasha Bulker storm in 2007 where a pool formed in the former quarry pit following days of heavy rainfall.</p> <p>In the context of other records for the species, the subject site is within 35 km of the closest record. The species has also not been detected during a fauna surveys of the site by ERM (2005b), at the Fern Bay development (ERM 2005a) nor within the Worimi Conservation lands (Ecotone 2008).</p> <p>There is no suitable habitat for this species present within the subject site.</p>				
Square-tailed Kite (Breeding)	<i>Lophoictinia isura</i>	Y												Y	Y	Y	Y	<p>Breeding habitat is living large old trees within suitable vegetation AND the presence of a male and female; or female with nesting material; or an individual on a large stick nest in the top half of the tree canopy.</p> <p>Our hollow-bearing tree survey confirmed the absent of large stick nests. Therefore, it is unlikely that breeding habitat of the species occurs within the subject site.</p>	Not considered further
Little Bentwing-bat (Breeding)	<i>Miniopterus australis</i>	Y	Y														Y	<p>The species is regarded as a dual credit species with breeding habitat triggering species credits. Breeding habitat includes:</p> <p>-Caves</p> <p>- Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave' observation type code 'E nest-roost' with numbers of individuals >500 or from the scientific literature.</p> <p>None of these features occur at the subject site or immediately adjacent.</p>	Not considered further.
Large Bentwing-bat (Breeding)	<i>Miniopterus schreibersii oceanensis</i>	Y	Y													Y	Y	<p>The species is regarded as a dual credit species with breeding habitat triggering species credits. habitat includes:</p> <p>--Caves</p> <p>- Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave' observation type code 'E nest-roost' with numbers of individuals >500 or from the scientific literature.</p> <p>None of these features occur at the subject site or immediately adjacent.</p>	Not considered further.
Southern Myotis (Breeding)	<i>Myotis macropus</i>	Y	Y	Y											Y	Y	Y	<p>The species is regarded as a dual credit species with breeding habitat triggering species credits. Breeding habitat as described in the TBDC includes:</p> <ul style="list-style-type: none"> - <i>Hollow bearing trees</i> - <i>Within 200 m of riparian zone Other</i> - <i>Bridges, caves or artificial structures within 200 m of riparian zone Waterbodies</i> 	Not considered further.

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further	
		J	F	M	A	M	J	J	A	S	O	N	D			
															<p>- This include rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site'</p> <p>The Bat survey guidelines (OEH 2018a) also state that habitat for the species is 'land within 200m of a waterbody with pools/ stretches 3m or wider including rivers, creeks, billabongs, lagoons, dams and other waterbodies on the subject site'.</p> <p>The subject site contains hollow-bearing trees, but is over 200 m from waterbodies. As such, no breeding habitat would be impacted.</p>	
Barking Owl (Breeding)	<i>Ninox connivens</i>					Y	Y	Y	Y	Y	Y	Y	Y	Y	<p>The species is regarded as a dual credit species with breeding habitat triggering species credits. As at June (2020), breeding can be identified by "suitable habitat AND 1. presence of male and female or 2. calling to each other (duetting) or 3. find nest or 4. existing breeding habitat identified".</p> <p>The subject site contains approximately 9.8 ha of suitable habitat. This is made up of the following vegetation zones: Zone 5 and Zone 6 which contain hollow-bearing trees.</p> <p>In order to determine the presence of breeding habitat, we completed the following survey (as detailed in section 4.1.2):</p> <ul style="list-style-type: none"> - Spotlighting - Call playback - Stag watching from key vantage points. <p>Our field survey did not record the Barking Owl on the subject site, nor any nests during the hollow-bearing tree surveys. Thus, despite the presence of potential habitat, under the BAM and available survey guidance material, breeding habitat is unlikely to be impacted.</p>	Not considered further.
Powerful Owl (Breeding)	<i>Ninox strenua</i>					Y	Y	Y	Y						<p>The species is regarded as a dual credit species with breeding habitat triggering species credits. As at June (2020), breeding can be identified by 'suitable habitat AND 1. presence of male and female or 2. calling to each other (duetting) or 3. find nest or 4. existing breeding habitat identified'.</p> <p>The subject site contains approximately 9.8 ha of suitable habitat. This is made up of the following vegetation zones: Zone 5 and Zone 6 which contain hollow-bearing trees.</p> <p>In order to determine the presence of breeding habitat, we completed the following survey (as detailed in section 4.1.2):</p> <ul style="list-style-type: none"> - Spotlighting - Call playback - Stag watching from key vantage points. <p>Our field survey did not record the Barking Owl on the subject site, nor any nests during the hollow-bearing tree surveys. Thus, despite the presence of potential habitat, under the BAM and available survey guidance material, breeding habitat is unlikely to be impacted.</p>	Not considered further.
Eastern Osprey (Breeding)	<i>Pandion cristatus</i>				Y	Y	Y	Y	Y	Y	Y	Y			<p>The species is regarded as a dual credit species with breeding habitat triggering species credits. As at June (2020) breeding is 'Presence of stick-nests in living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting'.</p>	Not considered further.

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further	
		J	F	M	A	M	J	J	A	S	O	N	D			
															The field survey confirmed the absence of stick nests. The species was also not recorded during the field survey. As such, breeding habitat for the Eastern Osprey is unlikely to be impacted.	
Squirrel Glider	<i>Petaurus norfolcensis</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The species was detected during previous surveys within the subject site in 2003 (ERM 2005) and is known to occur in the Worimi Conservation Lands (Ecotone 2008).	Considered further.
Brush-tailed Rock-wallaby	<i>Petrogale penicillata</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	According to the TBDC, habitat for the species is associated 'Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines'. There are no such features within 1km of the subject site, and thus no potential habitat is present.	Not considered further.
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	A targeted survey was completed using camera trapping following the TBDC guidelines (section 4.1.2). The survey involved extensive camera trapping (totalling 49,560 hours). The species was not detected during the targeted trapping.	Not considered further.
Koala (important habitat)	<i>Phascolarctos cinereus</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	<p>The Koala was not detected during targeted field survey (spotlighting, SAT surveys) (section 4.1.2). The Koala has also not been recorded by Boral staff working at the quarry.</p> <p>The Koala has been recorded throughout the locality, with the closest records according to Bionet being along Nelson Bay Road approximately 100 metres to the north of the subject site. The Koala has also been recorded throughout the stretch of the vegetation corridor which encompasses Worimi Regional Park and Worimi State Conservation Area.</p> <p>One of the most important factors influencing the distribution and numbers of Koalas in any area is the presence and density of their food tree species (OEH 2018e). Koalas feed almost exclusively on a few preferred tree species which are of primary and secondary importance. If primary tree food species are not present or occur in low density, Koalas must rely on secondary food tree species, but the number of animals per hectare is lower.</p> <p><i>Eucalyptus robusta</i> is regarded as a primary feed tree, but it is not present in the subject site in large numbers, nor was it a prominent species in the tubestock plantings. The dominant canopy species over most of the subsite site include <i>Eucalyptus pilularis</i>, <i>Corymbia gummifera</i> and <i>Angophora costata</i>, none of which are regarded as primary or secondary feed trees.</p> <p>The subject site does not contain a large proportion of important feed trees and is unlikely to be utilised by Koalas. This is supported by the absence of scratches and Koala scats observed during the field survey. This is further supported by the Recovery Plan for the Koala (DECC 2008) which notes that <i>arguably the most important factor influencing koala occurrence is the suite of tree species available. In any one area, koalas rely primarily on regionally specific primary and/or secondary food tree species. If primary food tree species are not present or occur in low density, koalas will rely on secondary food tree species, but the carrying capacity of the habitat (i.e. number of animals per hectare) is inevitably lower. Adequate floristic diversity is also important. Although primary and secondary food trees provide the bulk of a koala's diet, leaves from other species, including non-eucalypts, may provide a seasonal or supplementary dietary resource (Smith 1992). The quality of habitat is also influenced by the presence of suitable shelter trees, particularly in harsh climates.</i></p>	Not considered further as a species credit fauna.

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further		
		J	F	M	A	M	J	J	A	S	O	N	D				
															Based on the absence of suitable food trees it has been determined that important habitat for the Koala does not occur within the subject site, and therefore the Koala should be regarded as an ecosystem credit species.		
Koala, Hawks Nest and Tea Gardens population	<i>Phascolarctos cinereus</i> - endangered population	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	As above.	Not considered further.	
Common Planigale	<i>Planigale maculata</i>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The TBDC states that the Common Planigale 'inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water'. The subject site contains surface cover in vegetation Zone 3, Zone 5 and Zone 6, compared to the other vegetation zones which typically had low litter coverage. However, the site is located away from freshwater waterbodies. Targeted surveys for the species were conducted using baited camera traps placed at ground level to maximise the survey period for the species. A total of 18,144 hours of camera trapping was conducted. The camera traps did not record the species nor any other antechinus or mouse species. Based on the trapping results, the species has been considered unlikely to be present within the subject site.	Not considered further.	
Grey-headed Flying-fox (Breeding)	<i>Pteropus poliocephalus</i>												Y	Y	Y	The species is regarded as a dual credit species with breeding habitat triggering species credits. Breeding habitat is considered present if a camp site is known to occur. The field traverses confirmed that the subject site does not contain a camp site.	Not considered further.
Masked Owl (Breeding)	<i>Tyto novaehollandiae</i>					Y	Y	Y	Y						The species is regarded as a dual credit species with breeding habitat triggering species credits. Potential breeding habitat for the species as at June 2017 on BioNet is 'Living or dead trees with hollows greater than 20cm diameter'. Whilst the BioNet does not specify a process for confirming breeding habitat, we have assumed this it is similar to the other threatened owl species and is determined based on field survey. We have therefore completed a targeted survey for the Masked Owl during appropriate periods using a combination of call playback, spotlighting, stag watching and hollow-bearing tree mapping as detailed in section 4.1.2. Our field survey did not record the Masked Owl at the site, nor was it heard calling from a distance. Based on the result of the field survey the species is considered unlikely to breed within the subject site.	Not considered further.	
Mahony's Toadlet	<i>Uperoleia mahonyi</i>	Y	Y	Y									Y	Y	Y	As at June 2020, the TBDC profile for the Mahony's Toadlet is incomplete. The BioNet describes that the 'potential for the species to be more abundant/broadly distributed than currently thought, this combined with the location of this species (coastal fringe) and lots of PCT associations means it may frequently trigger SAIL. As such, it will need regular review of status/data'. The habitat description provided in the TBDC includes: - 'Inhabits ephemeral and semi-permanent swamps and swales on the coastal fringe of its range.' - 'Known records occur in heath or wallum habitats almost exclusively associated with leached (highly nutrient impoverished) white sand. Commonly associated with acid paperbark swamps,	Not considered further.

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further	
		J	F	M	A	M	J	J	A	S	O	N	D			
															<ul style="list-style-type: none"> - Mahony's Toadlet also is known to occur in wallum heath, swamp mahogany-paperbark swamp forest, heath shrubland and Sydney red gum woodland. - Recent studies suggest intact vegetation adjacent to and within water bodies is an important habitat feature for this species. - Known records are associated with shallow ephemeral/semi-permanent water bodies with limited flow of water. - Aquatic vegetation at breeding sites includes sedges (<i>Shoenopectus</i> spp., <i>Baumea</i> spp. and <i>Lepironia articulata</i>) and Broadleaf Cumbungi (<i>Typha orientalis</i>). - Females have been recorded up to 400m from water-bodies indicating moderate dispersal distances and use of multiple habitat types. - Tadpoles have been observed using leaf litter in the shallow verges of water bodies on sandy substrate. Rocks, logs and leaf litter may also be used for shelter and provide important foraging areas for invertebrate prey items.' <p>The subject site does not contain a water body. Survey was completed after 20 mm of rain which confirmed that the subject site does not retain pools of water following heavy rainfall. As such the subject site does not contain aquatic vegetation as described above, shallow pools, or drainage lines with limited flow.</p> <p>We note that the species may occur within 400 m of water and has been associated with Paperbark Forest. Paperbark Forest occurs outside of the subject site near the front entrance to the quarry from Nelson Bay Road. It did not hold water following 20 mm or rain and would likely require days of heavy rain to maintain potential habitat for the species.</p> <p>Given the absence of ephemeral, semi-permanent or permanent waterbodies in the subject site and within 400 m, and the absence of vegetation types that are known habitat for the species, the species is considered unlikely to occur.</p>	
Eastern Cave Bat	<i>Vespadelus trougtoni</i>	Y											Y	Y	<p>Habitat as per the TBDC that needs to be considered for this species includes:</p> <ul style="list-style-type: none"> - 'Caves - Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds'. <p>The subject site does not occur within 2 km of such features. As such, the subject site does not contain habitat for this species. Furthermore, the species was not detected during Anabat surveys</p>	Not considered further.
Predicted threatened species																
Regent Honeyeater	<i>Anthochaera phrygia</i>	No requirement to survey as assumed to be present based on habitat present														
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>															
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>															

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further
		J	F	M	A	M	J	J	A	S	O	N	D		
Speckled Warbler	<i>Chthonicola sagittata</i>														
Spotted Harrier	<i>Circus assimilis</i>														
Varied Sittella	<i>Daphoenositta chrysoptera</i>														
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>														
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>														
Little Lorikeet	<i>Glossopsitta pusilla</i>														
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>														
Little Eagle	<i>Hieraetus morphnoides</i>														
Golden-tipped Bat	<i>Kerivoula papuensis</i>														
Swift Parrot	<i>Lathamus discolor</i>														
Square-tailed Kite	<i>Lophoictinia isura</i>														
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>														
Little Bentwing-bat	<i>Miniopterus australis</i>														
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>														

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further	
		J	F	M	A	M	J	J	A	S	O	N	D			
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>															
Turquoise Parrot	<i>Neophema pulchella</i>															
Barking Owl	<i>Ninox connivens</i>															
Powerful Owl	<i>Ninox strenua</i>															
Eastern Osprey	<i>Pandion cristatus</i>															
Yellow-bellied Glider	<i>Petaurus australis</i>															
Koala	<i>Phascolarctos cinereus</i>															
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>															
Eastern Chestnut Mouse	<i>Pseudomys gracilicaudatus</i>															
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>															
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>															
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>															
Diamond Firetail	<i>Stagonopleura guttata</i>															
Common Blossom-bat	<i>Syconycteris australis</i>															

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further	
		J	F	M	A	M	J	J	A	S	O	N	D			
Masked Owl	<i>Tyto novaehollandiae</i>															

4.1.5 Threatened Fauna for Further Consideration

Through consideration of the candidate species list, one threatened fauna were determined for further consideration based on:

- Assumed presence (Squirrel Glider) given previous records within the subject site, surrounds and presence of habitat.

In order to determine the offset requirement, species polygons (areas of occupied/potential habitat for the species) must be completed. We have detailed the species polygons in Table 12. The biodiversity credits associated with the Squirrel Glider species polygon is detailed further in section 6.

Table 12. Threatened Fauna Species Polygon

Threatened Fauna	Consideration	Details																
Squirrel Glider	Assumed to be present given previous records	<p>The Squirrel Glider has been previously recorded at the site by ERM (2005b) and is known to occur widely throughout Worimi Conservation Lands (Ecotone 2008).</p> <p>The TBCD does not provide any guidance on the methods used to determine a species polygon for the Squirrel Glider. We have assumed that the area for the polygon relates to potential roosting and foraging habitat. Foraging habitat consists of eucalyptus sap, Acacias and nectar from a wide range of native flora. We have therefore assigned the vegetation zones provided in the table below to a species polygon. Foraging habitat is present within these vegetation zones. The total area is 26.60 ha as shown on Figure 10.</p>																
		<table border="1"> <thead> <tr> <th>Species Polygon</th> <th>Vegetation zone</th> <th>Total (ha)</th> </tr> </thead> <tbody> <tr> <td rowspan="3">PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast</td> <td>Zone 1</td> <td>14.13</td> </tr> <tr> <td>Zone 5</td> <td>1.71</td> </tr> <tr> <td>Zone 6</td> <td>8.09</td> </tr> <tr> <td>1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast</td> <td>Zone 3</td> <td>2.67</td> </tr> <tr> <td>Total</td> <td></td> <td>26.60</td> </tr> </tbody> </table>	Species Polygon	Vegetation zone	Total (ha)	PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Zone 1	14.13	Zone 5	1.71	Zone 6	8.09	1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	Zone 3	2.67	Total		26.60
		Species Polygon	Vegetation zone	Total (ha)														
		PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Zone 1	14.13														
			Zone 5	1.71														
			Zone 6	8.09														
1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	Zone 3	2.67																
Total		26.60																

4.1.6 Threatened Fauna (EPBC Act)

A total of 63 EPBC Act-listed fauna were considered in the assessment based on the database reviews detailed in section 4.1.1, with most species being Marine or Migratory bird species. Of the species considered, foraging habitat for seven were considered to have a moderate to high likelihood of occurring: Black-faced Monarch, White-throated Needletail, Spotted-tail Quoll, Long-nosed Potoroo, Koala, New Holland Mouse and Grey-headed Flying-fox.

The Grey-headed Flying-fox is only likely to utilise the subject site on occasion for foraging. No roosting camp sites were observed in the subject site or immediately adjacent. The species has been recorded throughout the Worimi conservation lands (Ecotone 2008).

The Long-nosed Potoroo, Koala, Spotted-tail Quoll and New Holland Mouse have been attributed a moderate likelihood of occurrence as all species have been recorded within Worimi Regional Park and

Worimi State Conservation Area and may utilise the subject site for foraging. However, none of these species were recorded during the field survey so any use of the subject site is likely to be low.

None of the above species were detected during the field surveys and based on specific habitat requirements for each species (Appendix 1), it is likely that subject site would only be used on an intermittent basis for foraging, if at all based on the surveyed habitat features. The extensive native vegetation that occurs throughout the land to the north and south within Worimi Regional Park and Worimi State Conservation Area are likely to offer greater habitat suitability for each of these species.

Given the likelihood of occurrence and potential use of the subject site, each of the threatened species have been considered in an EPBC Act Assessment of Significance (Annex 9).

5. Impact Assessment

The Impact Assessment forms Stage 2 of the BDAR as detailed in Section 8 of the BAM.

5.1 Avoid and Minimise Impacts

In accordance with the BAM, proponents must demonstrate the measures employed to avoid, mitigate and offset impacts of a Project on biodiversity values. This section of the report outlines the details from the Environment Impact Statement (Element Environment 2019) associated with avoidance planning, management and mitigation measures that Boral has incorporated into the Project design or will employ during construction, operation or completion of the Project to reduce impacts on biodiversity values.

5.1.1 Justification for the Project

As detailed in the Environmental Impact Statement (Element Environment 2019), Boral is a leading producer and supplier of building and construction materials in the country. Accordingly, a significant amount of development in NSW, including many of NSW's best known structures, are underpinned by Boral-supplied concrete, cement, asphalt and construction materials such as natural sand.

With the significant increase in approved infrastructure Projects in Sydney and other parts of NSW, the leading suppliers of natural sand are under pressure to meet this increased demand as natural sand has unique structural characteristics to manufactured sand and is essential to meet design specifications on many infrastructure and associated development Projects.

As Stockton Sand Quarry is one of Boral's few remaining natural sand quarries, Boral propose to meet part of this increased demand in natural sand by extracting the remaining sand from the same inland extraction area previously approved under the former 1996 development consent.

As detailed in the Environmental Impact Statement (Element Environment 2019), the expanded operations at Stockton Sand Quarry will provide:

- supply of essential natural sand to major infrastructure and associated development Projects;
- continued employment of four full time employees, one casual employee and truck/transportation drivers, with an additional two full time positions and two casual positions also created along with further employment benefits created through flow-on effects;
- optimal use of a regionally-significant resource; and
- economic benefits to the local community through the purchase of goods and services and local expenditure both directly and indirectly through employee wages.

Boral's operations provide substantial economic benefits at Federal, State and local levels while being committed to maintaining a good working relationship with the local community and implementing best practice environmental management across the site.

5.1.2 Justification for the Subject Site

Resource quality

Sand suitable for use in the construction and foundry industries occurs in the Stockton Bight dunes. Although the entire sand unit possesses some potential for a particular use, there are optimum areas from which these materials can be obtained. The sand within Boral's land holding comprises a fine to medium grained sand suitable for use as a fine aggregate in concrete.

Sand suitable for concrete use must comply with Australian Standard 2758.1-1998 "Aggregates and Rock for Engineering Purposes - Concrete Aggregates". Factors such as grain shape, composition and grading of the sand must be considered. The sand must be clean, fine to medium grained, and free of deleterious materials including friable particles, organic impurities, structurally weak substances, and alkali reactive materials. The sand in Boral's land holding meets these requirements and the main use proposed for the sand is concrete production within Boral's own concrete plants in the region.

Foundry sand suitable for the use and manufacture of cores and moulds in the casting of metal products must have chemical and physical properties that allow them to withstand the high temperatures of molten metal. The sand should be a fine silica sand, even grained, and low in deleterious matter such as shell, silica and limonite, as is the case with the dune sands at Anna Bay at the northern end of Stockton Bight. Sand in the Boral land holding does not generally meet foundry requirements due to unsuitable grading, given it is too coarse grained. Conversely, the very fine grained windblown dune sands along the northern end of Stockton Bight are generally not optimal for use in concrete, being too fine grained.

Leaching of the upper layers of vegetated dune sands, by organic acids, produces white, low iron sand below the organically enriched sandy topsoil layer. The leached white sand layer on Boral's property is of variable thickness but is generally thin. Below this thin white sandy capping there is a zone of iron enrichment, the sandy material within this zone being commonly termed 'coffee rock' or 'waterloo rock'. This material varies in character from a thin crusty layer of loosely bound iron coated sand grains to a thick layer of moderately iron stained amber-brown sand. 'Coffee rock' or 'waterloo rock' is unsuitable for concrete production and (where it occurs) is blended with the thin white sand layer above (where it occurs) to produce a fill sand.

Fill sand is used in numerous construction applications, including use as a support filler under house slabs, as a filter material for pipe bedding and as a drainage layer under roads. Sand used for this purpose does not have to conform to the rigid specifications outlined for specialised sands. The sand, however, needs to be reasonably 'clean' (some impurities such as charcoal, shell material, and iron-staining can be tolerated) and not too fine grained.

Sand suitable for use in glass manufacture must comply with rigid specifications. It should consist of almost pure quartz (i.e. minimum silica content of 99.5 percent), and be fine in grain size and low in shell, iron, and organic materials. Very few sand deposits, including sand on Boral's holding, meet these stringent requirements.

In the manufacture of Concrete, the fine aggregate component is achieved by blending Fine Sand with a Course Sand. In Boral's case, the Course sand is Manufactured Sand which is made from further processing of Quarry Dust which is a by-product of the crushing process.

Stockton Fine Sand is ideally matched to Boral's Peppertree Manufactured Sand which supplies most of Boral's Concrete production requirements in the Sydney and Hunter market. This means that Stockton Sand allows the greatest utilisation of manufactured sand in the Concrete blend, and therefore better utilises this scarce resource over a greater volume of total production that would otherwise have been produced with a less superior grading.

In this regard, Boral's Stockton fine sand reduces the natural fine sand usage, and avoids the need to find and develop a more resource intensive source of fine sand.

Locational factors

In terms of weight and volume, more sand products have to be quarried and transported to construction sites than any other type of resource material. It is for these reasons that extractive sand sources need to be located as close as possible to the point of usage. The value to weight ratio is very low, making transport costs to the market highly sensitive.

Establishing sand extraction operations close to the construction market represents considerable savings in terms of construction and associated transport costs for Projects undertaken in the region that are to be serviced by the quarry. Over the life of the quarry this represents a significant benefit to the local community and the state in terms of reduced transport and associated infrastructure maintenance costs.

Adjoining operations

Existing operations providing fine to medium grained sand suitable as fine concrete aggregate in the Lower Hunter Region are principally located in the barrier dune systems between Stockton and the Port Stephens peninsula. In addition to Boral's sand extraction operation at Fullerton Cove, operations in the Stockton Bight area are located at Salt Ash, Williamtown, Bobs Farm, Anna Bay and Raymond Terrace.

Minor quantities of manufactured sand are derived from quarrying and processing of hard rock (quarry dust). Manufactured sand is assisting to prolong the life of the natural sand reserves, however manufactured sand is generally not suitable for use in concrete on its own and is typically either used in road base or blended with natural sand to produce an acceptable grade concrete sand.

As transport distance adds significantly to the delivered price of sand into the Hunter Region, very little sand is imported into the region from outside.

Future demand

The demand for construction materials in major infrastructure and construction Projects in the Lower Hunter Region and Sydney has been high in recent years and is expected to be strong for the foreseeable future.

Fine grained construction sand is a major component of concrete, particularly for domestic applications. For example, an average three bedroom brick veneer home on a concrete slab foundation, with concrete paths and driveways, consumes in the order of 50 cubic metres of concrete, which contains 17.5 tonnes of fine grained construction sand.

Boral uses sand extracted from the site as the fine sand component in concrete production. The future demand for construction sand will correlate with anticipated growth in residential development, commercial development, and major infrastructure and construction Projects in the Lower Hunter Region and Sydney during the next 15 to 20 years.

Life of operation

The Project proposes to extract approximately 9 million tonnes of sand resource over a potential 25 year period.

Taking into account the sites existing operation, extracting sand from the transgressive dunes, the project is seeking to allow for maximum site transport limit of 750,000 tonnes per annum (tpa) (over the two projects) up until 2028 when the extraction on the transgressive dunes is due to cease. At this time the transport limit will reduce to 500,000 tpa.

To allow for flexibility between the two projects, the project has been assessed on the basis of a site wide maximum extraction and transport rate of 750,000 tpa.

5.1.3 Project Alternatives

Do nothing

Sand extracted from the Stockton Sand Quarry is used within the Hunter and Sydney regions. At present, due to sustained demand across the building and construction industry, Boral's sand resource across all assets have been substantially depleted.

If the proposed extraction of additional sand is not approved, the quarry will cease to operate in approximately three years' time due to current demand trends for natural sand products. This would result in loss of employment, reduced revenue to local service providers, reduced regional expenditure in the Port Stephens and Newcastle Local Government Areas (LGA), sterilisation of a valuable resource and shortages of raw materials for essential NSW infrastructure and associated development Projects.

The sand deposit at the site is highly suitable for use in concrete, is close to markets, and environmental impacts are less than for other alternatives on Boral's land and possibly less than for other sites in the region.

As detailed in the Environmental Impact Statement (Element Environment 2019), given that local demand for natural construction sand is unlikely to diminish, and given that the site is ideally located at the southern end of Stockton Bight to supply the Lower Hunter and Sydney market, it is most likely that other Stockton Bight sand suppliers further to the north would take up a shortfall in Boral's production. As such, there is a possibility that sand would be purchased from elsewhere, likely further away from the end use. In this case, it is likely that road transport impacts would be compounded, and would increase the cost of sand and concrete. Additionally, Boral would be required to purchase sand from other approved or yet to be approved Stockton Bight quarries. While it is not possible to clearly compare environmental impacts in this case, the Project has a limited environmental effect as it is confined to an area which has been disturbed by quarrying operations in the past. Because of the likelihood of alternate supply being a different grading there is a greater likelihood that more fine sand will be required for extraction and transport in order to produce one cubic metre of Concrete, when compared to the combination for Stockton Sand Grading with Boral's Manufactured Sand source.

In summary, should the Project not proceed, Boral would close the quarry in due course and have to rely on other sand sources locally or further afield, depleting those resources sooner. Importantly, not proceeding would mean that the community would lose the opportunity to allow the further development of an existing quarry operation. Conversely, alternative developments may require the disturbance of greenfield land parcels with more inherent environmental risks.

Alternative locations

As outlined earlier, Stockton Sand Quarry is one of Boral's few remaining natural sand quarries. With the significant increase in demand for natural sand, all of Boral's natural sand quarries are operating at full capacity.

As the quarry has a substantial remaining natural sand resource and is relatively close to Boral's existing Hunter and Sydney supply contracts, it is an ideal site to meet current and predicted future market demand for natural sand.

Other sand resources on Stockton Bight lie within the Worimi Conservation Lands, Crown lands and, to a lesser extent, on freehold lands. Most sand deposits on freehold lands are already owned or being extracted by the construction sand industry. A few isolated sand bearing properties remain but the size of the sand deposits are generally too small for economic development.

Many millions of tonnes of sand lie within the Worimi Conservation Lands or Crown lands on Stockton Bight but are currently unavailable for extraction by virtue of environmental protection zoning. Sand on Crown lands closer to Anna Bay which have appropriate zoning for extraction is generally too fine grained for concrete, being more suited to foundry applications and glass manufacture.

The dune sands on Stockton Bight need little or no processing to produce a grain size grading suitable for concrete manufacture. The only other source of sand in the region is the processing of soft rock. Friable sandstones at Blackhill, matrix sand from conglomerates at Teralba and overburden sediments in coal mines are examples, but in each of these cases, the cost of extraction and processing to produce suitably graded sand would be considerably higher than extracting the loose, naturally graded sands of Stockton Bight.

There are millions of tonnes of remaining sand suitable for production of concrete at the site. A number of alternative development scenarios were explored for the development of this remaining sand, culminating in the conclusion that the Project represents the most environmentally, socially and economically sensible option.

The proposed extraction area has been previously disturbed and as such the recommencement of sand extraction is considered to have a reduced direct environmental impact. The location of the site is separated from sensitive receptors, with Boral's current operations largely going unnoticed by the surrounding community and visually unobtrusive due to the presence of the dune system that surrounds the extraction area.

Alternative materials

There are few alternative materials to replace natural sand in the production of concrete. Alternative materials are emerging, which represent viable supplements to natural sands, but not as replacements to natural sands. In recognition of the value of such alternatives, Boral is becoming increasingly more active in recycling and in the production of manufactured sand.

Manufactured sand is a sand product created from quarry dust generated by the crushing of hard rock. Quarry dust is mainly blended into road bases, but many quarries process some of the dust to produce coarse sand for blending with finer grained natural sands to produce acceptable grade concrete sand.

To a significant extent, therefore, the alternative manufactured sand option is already being used to extend the life of natural fine grained sand sources. The inability of manufactured sand to be a complete replacement for natural sands is due to a number of factors. Quarry dust generally has a particle shape that is angular and often elongated, making concrete flow and concrete workability very difficult. Quarry dust also tends to be deficient in the fine end of the particle range and the addition of fine grained natural sand is required to fill out the grading. The addition of fine grained natural sand also helps concrete workability as the natural sands are often rounded.

Barmac crushing can be used to produce a dust with a better particle shape, but this in turn produces greater volumes of dust. A compromise is usually made, which invariably requires the use of natural sand to even out grain shape and particle size deficiencies.

Boral is engaged in ongoing research and development into the production of manufactured sand to supplement the natural sand market. In the immediate term Boral are investigating options to utilise glass sand or recovered sand from virgin excavated natural material (VENM). However, these sources are yet to receive approvals. In the case of glass sand, commercial production levels are low (as a new recovered resource and burgeoning industry) and the planning approvals necessary to permit the importation and blending of these materials to create building products is not widely accepted by consent authorities. Additionally, recovered sand product from processing VENM does not typically yield the same high quality product as that proposed to be extracted from the Stockton Sand Quarry. Cumulatively this would impact on the production of key building materials, in particular the production of concrete which would have wider implications for the building and construction industry within the Hunter and Sydney regions.

Alternative non-naturally occurring materials exist which can substitute to some extent for the naturally occurring construction sand sources. Examples are recycled building and demolition waste, granulated blast furnace slag and fly ash from coal fired power stations. However, these alternatives generally have high handling, transport and processing costs, although they are commonly used for roadbase and other applications.

Boral is actively involved in construction and demolition recycling with a major plant at Wetherill Park in Sydney and approved operations at Somersby on the Central Coast and Kooragang Island. The products from these operations supplement the natural sand market.

Whilst new innovation in alternative materials is emerging, the need for constant supply of natural sands for concrete production remains integral.

Alternative Project Design

Various options were considered when formulating the preferred concept of the Project. Such options included:

- extension of the extraction footprint beyond the 1996 development consent boundary, and subsequent extraction and dredging of this footprint. It was determined that this option would maximise access to sand resource, however would increase the clearing of remnant vegetation and habitat compared to the current proposal, and subsequently increase the projects offsetting requirement, and as such was not investigated further from a biodiversity perspective; and
- extension of the extraction footprint beyond the 1996 development consent boundary, inclusive of sand extraction to 4 m AHD with no dredging operations. It was determined that this option would reduce the degree of ground disturbance as is experienced with dredging, however would also increase the area of environmental impact (vegetation clearing, noise, and dust emissions) and fail to maximise use of the sand resource beneath 4m AHD.

With the above considered, confinement of the Project to the previously disturbed 1996 development consent boundary was considered to result in the most favourable environmental and social impacts.

Several configurations of infrastructure for the Project were considered to minimise the potential for adverse noise and air impacts to the closest sensitive receivers. Such options included positioning the wash plant in the southern extremity of the extraction area in order to maximise separation distance to these receivers.

5.1.4 Mitigation Measures (Construction and Post Construction)

A project specific Landscape and Rehabilitation Management Plan (will be prepared to reflect biodiversity management measures associated with the Project in order to protect and manage important biodiversity values. It is envisaged that the project specific plan would be similar to the existing Landscape and Rehabilitation Management (Boral, 2010) adopted in relation to the existing Windblown Sand Project. This existing Plan discusses key commitments relating to threatened species management, pest and weed management, fire management and site hygiene practices.

Mitigation measures to be undertaken during construction and post construction include:

Fencing and signposting

Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing at the edge of the proposed extraction area.

Signposting will be used to inform Project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with threatened species - e.g. speed limits along access roads to reduce potential for fauna vehicle strikes.

Employee Education and General Environmental Controls

Employees and contractors would be educated on and required to implement the following controls, to avoid or at least minimise potential environmental impacts associated with the Project:

- Minimise dust generation by minimising the extent and time that bare sand is exposed and by appropriate sand suppression.
- Procedures for the management of hydrocarbon and/or chemical spills throughout the Project site including the requirements for vehicles to carry spill kits.
- Ensuring vehicles remain on designated roads and tracks and abide by site speed limits, through use of signposting and driver education during the induction process and in on-going Project discussions.
- Management and removal of all rubbish from the Project site.

Vegetation Clearance Protocol

Boral has an established vegetation clearing protocol provided in the existing Windblown Project Landscape and Rehabilitation Management Plan (ERM 2010). This protocol would be adopted under a project specific Management Plan. This will include the following key protocols:

- Prior to clearing of native vegetation, ecologists are to survey for ground dwelling fauna and to remove any fauna/ fauna habitats to adjacent areas that would not be further disturbed.
- Prior to clearing of remnant hollow-bearing trees or habitat trees, ecologists are to be engaged to supervise felling. All hollow-bearing trees that are accessible safely from the ground are to be checked and identified fauna relocated. Hollows higher up and not accessible from the ground are to be identified and trees felled gently by an excavator or dozer and left overnight to allow fauna to relocate.
- Any fauna displaced during clearing are to be captured where possible and relocated to pre-planned areas (fauna to be captured and handled only by personnel trained to do so).
- In an event that fauna are injured during clearing, the NSW Wildlife Information, Rescue and Education Service (WIRES) will be contacted to handle and collect for appropriate care and rehabilitation.

5.1.5 Rehabilitation

The disturbance would be rehabilitated in accordance with the projects Rehabilitation Management Strategy (EES 2019a). As described in the Plan, a pond would be established with stable banks that would be rehabilitated with native vegetation, which would enhance fauna habitat surrounding the water body.

5.1.6 Pest and Weed Management

A project specific pest and weed management plan would be developed and implemented. It is envisaged that this plan would adopted protocols and strategies similar to those implemented under the existing management plan adopted for the Windblown Project (ERM 2010) with the following additional matters also included::

- Management protocols for feral animals such as dogs, rabbits and foxes within the rehabilitation area, and
- Management protocols for the identification of noxious or important environmental weeds within areas to be cleared (in order to avoid transporting the weeds to rehabilitation areas or other parts of the site).

5.1.7 Fire Management

Boral currently have a Bushfire Management Plan included in the Boral (2010) Stockton Transgressive Dune Quarry Environmental Management Strategy. Fire prevention and suppression are detailed within the Plan including emergency protocols should a fire occur. This Plan would be updated where required to reflect the findings and recommendations provided in the Bushfire Hazard Assessment for the Project (BPAD 2019).

5.2 Impact summary

An assessment of the potential impact of the Project on biodiversity is provided below. It considers direct and indirect impacts as defined in OEH (2018), which states:

“Direct impacts are those that directly affect habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat. When applying each factor, consideration must be given to all of the likely direct impacts of the proposed activity or development.”

Indirect impacts occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas. As with direct impacts, consideration must be given, when applying each factor, to all of the likely indirect impacts of the proposed activity or development.”

The Project would affect biodiversity, including threatened biodiversity through both direct and indirect impacts. The areas subject to direct and indirect impact are shown in Figure 11 and discussed below.

5.2.1 Direct Impacts

The Project would result in the unavoidable clearing of 35.66 ha of vegetation regarded as ‘native vegetation,’ as defined in the BAM, which comprises of:

- 32.99 ha of PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland
- 2.67 ha of PCT1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes.

The Project would result a direct impact to 26.60 ha of Squirrel Glider habitat.

As discussed in section 4.1.4, given the absence of a targeted threatened fauna survey, the following threatened fauna may have potential habitat at the site: Gang-gang Cockatoo, and Pale-headed Snake. If present, the species may be directly impacted by the Project.

These direct impacts cannot be further avoided or mitigated. As per the BAM, Section 6 details the biodiversity credits required to offset the unavoidable impacts of the Project.

5.2.2 Indirect Impacts

Indirect impacts associated with the Project will largely occur during the construction and operation of the Project, resulting in a short-term impact (i.e. the construction and rehabilitation phases of the Project) and will be minimised where possible through management procedures. A range of indirect impacts are likely to or could occur as a result of the Project, including:

- Increased noise and dust
- Changes to ground-water levels and flow patterns
- Increased spreading of weed propagules.

The indirect impacts described above are variable in terms of the distance they may extend from the subject site, and in many cases, due to mitigation measures, indirect impacts will be completely contained within the subject site. The area of indirect impact without mitigation measures has been attributed to a 50 m area around the boundary of the site.

Indirect impacts on the biodiversity values of areas surrounding the subject site, along with recommended mitigation measures to minimise identified impacts, are discussed in Table 13. Boral would be responsible for carrying out the mitigation measures.

Table 13: Indirect impacts

Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation measure	Mitigation measure	Expected success of mitigation measure
Edge effects	<p>The establishment of the new extraction area would result in the creation of new edges adjacent to areas of existing native vegetation immediately adjacent to the extraction area.</p> <p>The new edges could facilitate the establishment and spread of introduced plant species and increase light levels, however, appropriate monitoring and control measures would be implemented during and after construction to counteract the potential for weed occurrences.</p> <p>The extraction area would be progressively rehabilitated creating a pond structure, with stable vegetated banks.</p>	<p>Varying distance from subject site. Potentially occurring within 30 metres from the disturbance area throughout the active life of the Project.</p>	<p>Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing at the edge of the extraction area.</p> <p>Signposting and education will be also be used to inform Project personnel of no-go areas.</p> <p>Weed management and monitoring to be included in the project specific Landscape & Rehabilitation Management Plan.</p>	<p>Active weed, and pest management are anticipated to be successful at managing edge effects from the Project.</p>
Weeds	<p>Weeds have the opportunity to establish themselves in areas of disturbed vegetation. The greatest establishment of weeds are in areas already disturbed.</p> <p>The Project has the potential to increase or lead to the establishment of weed species where they do not currently exist through the operation of machinery during construction phases. New weed species can potentially be introduced as a result of the movement of construction vehicles and materials into the subject site.</p> <p>Areas more likely to be exposed to weed increases are areas of native vegetation that occur to the south of the subject site. However, weeds will be controlled during and after construction in accordance with the Landscape and Rehabilitation Management Plan and thus indirect impacts from weeds is likely to be negligible within the adjacent woodland areas.</p>	<p>Variable depending on topography. However, typically would occur within close proximity to the disturbance area.</p>	<p>Weed management and monitoring to be implemented in accordance with the project specific Landscape and Rehabilitation Management Plan.</p>	<p>Active weed control methods are likely to be successful in managing the spread of weeds within adjacent areas.</p>
Erosion and sedimentation	<p>Erosion of sand and associated sedimentation associated with the Project may involve the following:</p> <ul style="list-style-type: none"> • Alteration of sand structure beneath haul roads; and • The deposition of soil particulates in drainage lines and remnant vegetation surrounding the subject site. 	<p>Variable depending on topography and operation.</p>	<p>Sediment management measures will be implemented in accordance with project specific Erosion and Sedimentation Control Plan that will adopt mitigation and strategies similar to the existing recommendations in the Stockton Transgressive Dune Quarry(ERM 2010).</p>	<p>Sedimentation control are known to reduce sedimentation spills.</p>

Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation measure	Mitigation measure	Expected success of mitigation measure
Dust	Although dust will be generated from the construction and operation of the Project, it will be mitigated with dust suppression from a water truck, which is the practice with the current operations. Where feasible Boral utilise available water allocations.	Variable depending on wind conditions. Potential for dust emissions likely throughout life of Project.	Dust impacts will be mitigated through the onsite use of water suppression. Further, vegetation clearing protocols for the Project will seek to minimise exposed areas with the potential to generate dust by completing vegetation clearing as close to mining operations as practical.	Successful implementation of dust control would minimise dust. Current dust suppression mitigation works are ongoing at the Stockton Sand Quarry.
Fire	Historically, bushfires tend to be associated with a proficent growth of native grasses following large rain events. During summer, following rain events, dry swards of grasses pose a bushfire hazard when placed near a source of ignition. Vehicles driven through long grass with hot exhausts may cause a fire particularly during the hotter months of the year.	Potential to be widespread in locality, though unlikely.	A bushfire hazard assessment has been completed by BPAD (2019) as part of the Project. Boral also currently have a Bushfire Management Plan included in the Boral (2010) Stockton Transgressive Dune Quarry Environmental Management Strategy. Fire prevention and suppression are detailed within the Plan including emergency protocols should a fire occur. This Plan would be updated to reflect the recommendations of BPAD (2019) where required to reflect the Project.	Given the existing quarry operations have not resulted in any significant fires, the continued implementation of the Stockton Transgressive Dune Quarry Environmental Management Strategy and any project specific requirements would likely result in fire prevention.
Groundwater changes resulting in impacts to vegetation	Groundwater impacts as a result of the dredging are detailed in the Hydrogeological Impact Assessment (EES 2019b). A separate project specific groundwater management plan would also be prepared. The ESS (2019b) assessment concludes that the groundwater movement accounts for less than 0.5% of catchment drainage even in the driest recorded years, excavation of the aquifer sediments should have no discernible effect on catchment hydrology other than increasing the area available for water storage and direct recharge to the Stockton Sandbeds Aquifer in the subject site. The report concludes that the Project is unlikely to have an impact on vegetation surrounding the subject site.	EES (2019b) concludes that the Project it is unlikely to result in any impact to surrounding vegetation.	Groundwater monitoring and mitigation requirements will be included in an update to the existing Groundwater Monitoring and Management Plan (GMMP) (Jacobs, 2017). The GMMP describes the objectives of the groundwater management and monitoring and details the proposed types and locations of monitoring. It also describes the monitoring observations which would trigger actions, and the	Implementation of the Groundwater Monitoring and Management Plan would assist in minimising impacts to vegetation from groundwater changes.

Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation measure	Mitigation measure	Expected success of mitigation measure
			<p>proposed action and/or mitigation should triggers be exceeded.</p> <p>In summary, water levels and pH will need to be monitored in the field weekly during excavation and rehabilitation, and quarterly thereafter. Further laboratory analysis of collected samples will be required monthly throughout the Project duration and quarterly following completion of rehabilitation.</p>	
Fauna vehicle strike	No fauna have been hit via a vehicle over the past decade. This is likely attributed to enforced speed limits whilst on-site, and contractor awareness. Boral will continue to maintain the slow speed limits during the operation of the Project.	Likely to be successful given no fauna have been impacted by vehicle movement at the site to date.	Continue current slow speed limits around the quarry site. Continue current contractor awareness training regarding fauna operations.	Currently successful.

5.2.3 Impacts to Commonwealth Threatened Biodiversity

Formal Assessments of Significance have been provided in Annex 9 for the following EPBC Act listed threatened species: *Cryptostylis hunteriana* Black-faced Monarch, White-throated Needle-tail, Spotted-tail Quoll, Long-nosed Potoroo, Koala, New Holland Mouse and Grey-headed Flying-fox.

The Assessments conclude that a significant impact to Commonwealth listed threatened biodiversity is unlikely.

5.2.4 Potential Serious and Irreversible Impacts (SAII)

The BC Act and the *Local Land Services Act 2013* (LLS Act) imposes various obligations on decision-makers in relation to impacts on biodiversity values that are at risk of Serious and Irreversible Impacts (SAII). These obligations generally require a decision-maker to determine whether the residual impacts of a proposed development on biodiversity values (that is, the impacts that would remain after any proposed avoid or mitigate measures have been implemented) are serious and irreversible (DPIE 2019b).

No threatened biodiversity at risk of SAI (as assigned in the TBDC at June 2020) are known in the subject site or are considered to potentially be impacted by the Project.

5.2.5 Connectivity of Habitat

The subject site adjoins a large native vegetation corridor which extends along Stockton Beach to Anna Bay in the north and Stockton in the south (Figure 1). The stretch of the vegetation corridor encompasses Worimi Regional Park and Worimi State Conservation Area. The corridor also adjoins the wetlands (Long Bight Swamp) and riparian vegetation of Fullerton Cove approximately 2.3 kilometres to the southwest.

The removal of habitat within the subject site is unlikely to reduce the amount of important habitat features within the corridor to an extent that fauna roosting and foraging habitat would be significantly impacted. The removal of the vegetation from within the subject site is unlikely to restrict fauna movement along the Stockton Beach to Anna Bay corridor given the following:

- The area to be disturbed is centred on the former quarry pit which was predominately cleared over a decade ago.
- Vegetation would be retained along Nelson Bay Road and towards Stockton Beach allowing fauna movement along the corridor (as can be seen from Figure 8).
- The haul road that is currently in operation for the quarry operations would not be widened as part of the current proposal, thus no changes to fauna movement are likely.

5.2.6 SEPP 44 - Koala Habitat

At the time of EIS submission (December 2019), the State Environment Planning Policy 44 – Koala Habitat (SEPP 44) was in effect. SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline:

(a) by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and

(b) by encouraging the identification of areas of core koala habitat, and

(c) by encouraging the inclusion of areas of core koala habitat in environment protection zones.

SEPP 44 applies to Local Government Areas (LGAs) listed in Schedule 1, and where a development has an area of more than 1 ha.

The subject site exceeds 1 ha and is located within the Port Stephens LGA which is listed in Schedule 1 of SEPP 44, and as such, the SEPP applies to the subject site.

Under SEPP 44, 'potential Koala habitat' is defined as -

'areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component'.

Of the tree species listed in Schedule 2, only *Eucalyptus robusta* was recorded within and near the subject site. *E. robusta* comprised less than 15 per cent of the total number of trees present in the subject site, and therefore, as per the definition of SEPP 44, the habitat present is not regarded as 'potential Koala habitat'.

'Core Koala habitat' is defined in the SEPP as -

'an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population'.

The Koala was not recorded on the subject site during the surveys and there are no historical records of the species in the subject site. As discussed in Table 11, the Koala has been recorded within the locality, with the closest records being along Nelson Bay Road approximately 100 metres to the north of the subject site.

If a resident population of the Koala was present within the subject site, it is highly likely that there would be extensive sightings by Boral staff and rehabilitation contractors whilst working within the subject site. Given the lack of recent sightings and/or historical records in the subject site, the site is not considered to constitute 'core Koala habitat'.

It should be noted that the SEPP 44 Koala Habitat was replaced with SEPP Koala Habitat Protection 2019 (SEPP KHP), which took effect on 1 March 2020. Under clause 15 of the SEPP KHP, the transitional arrangement apply, and as such the former Koala SEPP applies to the Project given the EIS was submitted prior to commencement of SEPP KHP:

'Savings provision relating to development applications - A development application made, but not finally determined, before the commencement of this Policy in relation to land to which this Policy applies must be determined as if this Policy had not commenced. '

5.2.7 Port Stephens Council Comprehensive Koala Plan of Management

The Port Stephens Council Comprehensive Koala Plan of Management (CKPoM) has been prepared by Port Stephens Council and the Australian Koala Foundation (AKF) for the Port Stephens LGA. The CKPoM has an aim to 'encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline'.

The CKPoM includes a Koala habitat map for the Port Stephens LGA (Port Stephens Council 2007), which classifies Koala habitat into different categories based off a range of attributes and survey results. The subject site has been mapped as 'Supplementary' Koala habitat, which is defined as habitat where Marginal Koala Habitat Middle-ranking Community overlap' (Port Stephens Council 2002). This habitat is regarded in the CKPoM as 'important to the long-term conservation of Koalas in Port Stephens and thus also requires protection, albeit with less restrictions on development than Preferred Koala Habitat'.

The CKPoM also includes performance criteria to assist development applications in the Port Stephens LGA demonstrate that developments are consistent with the objectives associated with the CKPoM. Given this BDAR is associated with an SSD rather than a local government development application, the performance criteria are not relevant to this Project, however Boral has considered the aims and objectives of the performance criteria to minimise potential impact to the Koala as detailed in Table 14 and Table 15.

Given the Project will largely impact upon a rehabilitated former quarry pit, and will avoid decreasing the width of a wildlife corridor along Nelson Bay Road, it is highly unlikely that the Project would result in an impact to a Koala population in the Port Stephens LGA. The Project will also implement a series of mitigation measures (section 5.1.4) to avoid any potential indirect impacts to surrounding habitat.

Table 14. Consideration of aim and objectives of CKPoM

General Aims and Objectives of CKPoM Performance Criteria for Developments	Consideration in the Project
i) To ensure that the koala population in the Port Stephens LGA is sustainable over the long-term.	<p>The area to be impacted is not known to contain a resident Koala population.</p> <p>The area to be disturbed consists predominately of native rehabilitated land, which occurs within and immediately adjacent to a former quarry pit.</p> <p>The Project is highly unlikely to result in any decrease in the Koala population of the Port Stephens LGA.</p>
ii) To protect koala habitat areas from any development which would compromise habitat quality or integrity.	<p>The vegetation disturbance associated with the Project does not occur within areas of ‘important’ or ‘core Koala’ habitat as discussed in section 4.7.1.</p> <p>The Project would predominately involve the clearing of rehabilitated native vegetation within a former quarry pit. As such, impacts to large tracts of native vegetation and habitat have largely been avoided. The Project will not result in an impact to a Koala corridor, core habitat, important habitat or extensive koala habitat that would decrease a population of the Koala.</p>
iii) To ensure that any development within or adjacent to koala habitat areas occurs in an environmentally sensitive manner.	Boral will implement the mitigation measures detailed in section 5.1.4 to minimise all potential indirect impacts.
iv) To ensure that acceptable levels of investigation are undertaken, considered and accepted prior to any development in or adjacent to koala habitat areas.	This assessment has utilised the methodology of the BAM and associated threatened survey guidelines to survey for Koalas.
v) To encourage koala habitat rehabilitation and restoration.	<p>The Project would result in the clearing of native vegetation, conservatively estimated to be 35.66 ha, of which most is predominately rehabilitated land. Given the Project is located predominately within a former quarry pit and historically impacted areas, impacts to remnant vegetation is largely avoided. Mitigation measure to reduce potential habitat impacts are detailed in section 5.1.4.</p>
vi) Maintain interconnection between areas of Preferred and Supplementary Koala Habitat and minimise threats to safe koala movements between such areas.	The Project will impact areas mapped as ‘supplementary Koala habitat’ as per the CKPoM. Much of the areas to be impacted occur within the former quarry pit, and immediately adjacent areas. The removal of the vegetation would not restrict Koala movement

General Aims and Objectives of CKPoM Performance Criteria for Developments	Consideration in the Project
	throughout the landscape and mitigation measures (speed limits) would prevent Koala collisions, should they venture into the site during operation.
vii) To ensure that development does not further fragment habitat areas either through the removal of habitat or habitat links or through the imposition of significant threats to koalas.	As discussed in section the Project would not reduce Koala connectivity and movement through the landscape.
viii) To provide guidelines and standards to minimise impacts on koalas during and after development, including any monitoring requirements.	Boral will implement the mitigation measures detailed in section 5.1.4 to minimise all potential indirect impacts.
ix) To provide readily understandable advice to proponents preparing development applications and for Council officers involved in the assessment of those applications.	Not relevant

Table 15. Performance Criteria

Performance criteria	Response
a) Minimise the removal or degradation of native vegetation within Preferred Koala Habitat or Habitat Buffers;	<p>The Project justification is provided in section 5.1.</p> <p>The subject site contains limited primary or secondary preferred feed trees. The Project minimises impacts to remnant native vegetation/habitat by focusing the e majority of the subject site on the former quarry pit.</p>
b) Maximise retention and minimise degradation of native vegetation within Supplementary Koala Habitat and Habitat Linking Areas;	<p>As above, impacts to potential Koala habitat has been minimised as much as practical. The project is largely contained to an area of the site that was cleared in accordance with 1994 development consent to extract sand. Any existing vegetation is rehabilitation in various stages of growth that was planted by Boral. The project site contains few mature primary or secondary species preferred by Koalas. Moreover, Boral has occupied the site for almost 40 years during which time no Koalas have been observed to use the site. In this regard, despite the mapping identification, the project area does not provide Koala Habitat.</p> <p>The Project will not result in fragmentation or reduce Koala connectivity throughout the wider landscape. Land outside of the subject site will not be impacted by the Project.</p>
c) Minimise the removal of any individuals of preferred koala food trees, wherever they occur on a development site. In the Port Stephens LGA these tree species are Swamp Mahogany (<i>Eucalyptus robusta</i>), Parramatta Red Gum (<i>Eucalyptus parramattensis</i>), and Forest Red Gum (<i>Eucalyptus tereticornis</i>), and hybrids of	<p><i>Eucalyptus robusta</i> was quite rare in the subject site, with only a few noted within vegetation zone 2. These individuals were either planted as tubestock or been in the native seed mix.</p>

Performance criteria	Response
<p>any of these species. An additional list of tree species that may be important to koalas based on anecdotal evidence is included in Appendix 8</p>	<p>The dominant eucalypts on the subject site include <i>E. pilularis</i>, <i>Corymbia gummifera</i> and <i>Angophora costata</i>. The Project will therefore not impact on the important trees or hybrids.</p> <p><i>Corymbia gummifera</i> and <i>E. pilularis</i> are listed in Appendix 8 of the KPOM as ‘tree species that may be important’. These species will be impacted as they are dominant species within PC1646.</p> <p>The Project has minimised impacts by predominately using a former quarry pit and impacting largely upon planted trees.</p>
<p>d) Make provision, where appropriate, for restoration or rehabilitation of areas identified as Koala Habitat including Habitat Buffers and Habitat Linking Areas over Mainly Cleared Land. In instances where Council approves the removal of koala habitat (in accordance with dot points 1-4 of the above waive clause), and where circumstances permit, this is to include measures which result in a “net gain” of koala habitat on the site and/or adjacent land;</p>	<p>The Koala is regarded as an ‘ecosystem credit’ species as part of this BDAR (section 4.1.4, Table 11) that would be subsequently offset through PCT1646 and PCT1644. Both these PCTs contain ‘trees that may be important’ and would result in a net gain of Koala habitat.</p>
<p>e) Make provision for long term management and protection of koala habitat including both existing and restored habitat;</p>	<p>An overarching management plan will specify the mitigation measures and controls during construction and operation of the Project (see details provided in section 5.1.4).</p> <p>Long-term management and restoration of Koala habitat be through the provision of biodiversity credits for PCT1646 and PCT1644.</p>
<p>f) Not compromise the potential for safe movement of koalas across the site. This should include maximising tree retention generally and minimising the likelihood that the proposal would result in the creation of barriers to koala movement, such as would be imposed by certain types of fencing. The preferred option for minimising restrictions to safe koala movement is that there be no fencing (of a sort that would preclude koalas) associated with dog free developments within or adjacent to Preferred or Supplementary Koala Habitat, Habitat Buffers or Habitat Linking Areas.</p>	<p>The Project will not impeded Koala movement across the landscape.</p> <p>The Project will not introduce or enhance populations of feral and domestic dogs.</p>
<p>g) Be restricted to identified envelopes which contain all buildings and infrastructure and fire fuel reduction zone. Generally there will be no clearing on the site outside these envelopes. In the case of applications for subdivision, such envelopes should be registered as a</p>	<p>Not applicable.</p>

Performance criteria	Response
restriction on the title, pursuant to the Conveyancing Act 1919; and	
<p>h) Include measures to effectively minimise the threat posed to koalas by dogs, motor vehicles and swimming pools by adopting the following minimum standards.</p> <p>i) The development must include measures that effectively abate the threat posed to koalas by dogs through prohibitions or restrictions on dog ownership. Restrictions on title may be appropriate.</p> <p>ii) The development must include measures that effectively minimise the threat posed to koalas from traffic by restricting motor vehicle speeds, where appropriate, to 40 kph or less.</p> <p>iii) The development must reduce the risk of koala mortality by drowning in backyard swimming pools. Appropriate measures could include: trailing a length of stout rope (minimum diameter of 50mm), which is secured to a stable poolside fixture, in the swimming pool at all times; designing the pool in such a way that koalas can readily escape; or enclosing the pool with a fence that precludes koalas. This last option should include locating the fence away from any trees which koalas could use to cross the fence.</p>	<p>The Project will not introduce or enhance populations of feral and domestic dogs.</p> <p>Existing vehicle speeds within the quarry site would be adhered to and staff and contractors educated about Koala interactions to prevent Koala collisions.</p> <p>Final land use of the subject area will be detailed in a project specific Landscape and Rehabilitation Management Plan. This plan will consider measures to protect Koalas during Project decommissioning and rehabilitation.</p>

5.2.8 Cumulative Impacts

In relation to the Project, the cumulative impacts are considered to be the total impact on the environment that would result from the current proposal plus any additional impacts likely to occur due to subsequent Projects that are of a similar nature or that are partly or wholly contingent on the Project.

Identifiable cumulative impacts to be considered in the locality include the following quarry operations:

- Salt Ash Sand Project (Nelson Bay Road), which has approval to operate until 2030
- Cabbage Tree Road Sand Quarry, which has approval to operation until 2033
- Mackas Sand Project, Nelson Bay Road.

Each of the above quarry operations have a range of approved biodiversity impacts, and it is likely that over the next few decades, modification to existing operations may entail clearing of native vegetation and habitat. Niche is not able to quantify this as part of this BDAR, however it is likely that such impact would be within the existing operations leases. Residential, commercial and industrial development is also identified as a continuous cumulative biodiversity pressure associated with the wider Port Stephens and Newcastle LGAs. Whilst the Project will result in removal of native vegetation from within the North Coast IBRA region, the Project primarily will result in an impact to planted rehabilitation. The Project also involve an offset that will contribute to in-perpetuity managed conservation areas within the Bioregion.

6. Quantifying Offset Requirements

The BAM identifies the BAM Calculator as the appropriate tool for quantifying the offsets required, which is expressed as numbers of ecosystem and species credits. A calculation of the nature and extent of biodiversity credits required due to ecological impacts associated with the Project has been undertaken using the BAM Calculator.

No threatened biodiversity listed on the EPBC Act are required to be offset for the project, as the project does not result in a significant impact to any threatened biodiversity listed on the EPBC Act.

6.1.1 Summary of Ecosystem Credits Required

The results of the BAM Calculator, ecosystem offset credit requirements, including current, future and change in vegetation integrity scores are shown in Table 16.

Impacts to native vegetation communities within the development site generate a requirement for 455 ecosystem credits. These 455 ecosystem credits also cover the credit requirement for ecosystem credit species. The full BAM Calculator biodiversity credit report is provided in Annex 8.

Table 16. Ecosystem credit requirement

PCT	Vegetation zone	Impact area (ha)	Current Vegetation Integrity score	Future Vegetation Integrity score	Change in Vegetation Integrity Score	Biodiversity risk weighting	Required credits
PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	1	14.13	43	0	-43	1.5	228
	2	3.87	19.8	0	-19.8	1.5	29
	4	5.19	4.8	0	-4.8	1.5	0*
	5	1.71	39	0	-39	1.5	25
	6	8.09	47.7	0	-47.7	1.5	145
1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	3	2.67	21	0	-21	2	28
Total							455

*Credits not required as vegetation integrity score below 17

6.1.2 Summary of Species Credits Required

The results of the BAM-C species offset credit requirements are shown in Table 17. Threatened species identified or assumed to be present within the development site and likely to be impacted by the Project generate a requirement for a total of 558 species credits. The full BAM Calculator biodiversity credit report is provided in Annex 8.

Table 17. Species credits required

Threatened species	Habitat impacted (ha)	Required credits
Squirrel Glider	26.60	558
Total		558

7. Offset Strategy

Under the BAM, an offset strategy is not required to be submitted with the BDAR as the credits are to be formally retired with the establishment of a Biodiversity Stewardship Site, or purchasing of credits from the market, or payment into the Biodiversity Conservation Fund (BCF). However, as noted in the SEARs for the Project, a biodiversity offset strategy is required to be included in the Biodiversity Assessment.

7.1 Offset Requirements

Under the BAM, the biodiversity offsets must provide benefits to biodiversity to compensate for the adverse impacts of an action. Biodiversity offsets assist in achieving long-term conservation outcomes while providing development proponents with the ability to undertake actions that have unavoidable impacts on biodiversity.

Unavoidable impacts to biodiversity are those impacts that are residual (i.e. impacts that remain after impact avoidance, management and mitigation measures are employed to reduce the type or magnitude of biodiversity impacts). Section 5.1 of this report outlines the planning and consideration of alternative emplacement options that Boral has considered. Section 5.1.4 to section 5.1.7 of this report outline the management and mitigation actions that Boral will employ to further reduce direct and indirect impacts to biodiversity values as a result of this Project.

This section of the report describes the approach to biodiversity offsetting proposed for the Project in order to satisfy the BAM offsetting requirements.

Based on the results of the MNES Assessments of Significance contained in this report, the Project would not result in a significant impact to any threatened biodiversity listed on the EPBC Act, and thus would not require offsets for any Commonwealth MNES.

7.2 Offset Strategy Options

To satisfy the offset requirement, Boral has identified a range of options to meet the required offsets for the Project (Table 18). As demonstrated in the table and given Boral has the option to pay into the Biodiversity Conservation Fund (BCF) to satisfy the offset requirement, there is minimal risk for Boral not to meet their offset liability.

Table 18. Options to satisfy the offset requirement

Offset requirement	Credits required	Purchase credits on market	Payment into BCF	Utilise existing Boral Landholdings	Risk of offset not met
PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	427	If credits become available, Boral may pursue this option.	Yes – Boral can pay the equivalent credit cost into the BCF	The surrounding Boral landholdings may be considered as a biodiversity stewardship site. The surrounding vegetation consists of the same PCTs and would contain Squirrel Glider habitat.	No risk given the option to pay into the BCT Payment Fund.
1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	28				
<i>Squirrel Glider</i>	558				

7.3 Staged-Offset Approach

The proposal will result in progressive vegetation disturbance across five distinct stages spanning approximately 10 years. The area associated with each stage are indicated on Figure 12. Boral propose to progressively offset the five stages prior to vegetation disturbance.

The area of native vegetation and habitat associated with each offset stage is provided in Table 19, and the associated credits provided in Table 20.

The first offset stage is proposed in 2021, and would involve the retirement of the following credits prior to vegetation disturbance:

- PCT1644 - Coast Tea Tree/ Old Man Banksia coastal shrubland – 28 credits
- PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland – 120 credits
- Squirrel Glider – 210 credits

Table 19. Area of vegetation/habitat impact within each offset stage

Plant Community Type (PCT)	Vegetation zone	Staged-Offset Approach – Area (ha)					Area Total (ha)
		1 (Year 2021)	2 (Year 2023)	3 (Year 2026)	4 (Year 2031)	5 (Year 2038)	
Non-native	Non-native	1.28	0.50	0.00	0.44	0.26	2.48
PCT1644 - Coast Tea Tree/ Old Man Banksia coastal shrubland	Zone 3	2.67	0.00	0.00	0.00	0.00	2.67
PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland	Zone 1	4.34	0.47	1.64	4.98	2.71	14.13
	Zone 2	0.00	0.77	2.25	0.85	0.00	3.87
	Zone 4	0.34	4.10	0.74	0.00	0.00	5.19
	Zone 5	0.86	0.13	0.00	0.10	0.62	1.71
	Zone 6	2.16	1.02	1.61	0.42	2.88	8.09
Squirrel Glider							
1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	Zone 3	2.67	0	0	0	0	2.67
PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland	Zone 1	4.34	0.47	1.64	4.98	2.71	14.13
	Zone 5	0.86	0.13	0	0.1	0.62	1.71
	Zone 6	2.16	1.02	1.61	0.42	2.88	8.09
	Total	10.03	1.62	3.25	5.5	6.21	26.6

Table 20. Credits per offset staging

Credit Type	Vegetation zone	Total credits required	Credits per ha	Credits per stage (indicative year for credit retirement)				
				1 (Year 2021)	2 (Year 2023)	3 (Year 2026)	4 (Year 2031)	5 (Year 2038)
PCT1644 - Coast Tea Tree/ Old Man Banksia coastal shrubland	Zone 3	28	11	28	0	0	0	0
PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland	Zone 1	228	16	70	8	26	80	44
	Zone 2	29	8	0	8	13	8	0
	Zone 5	25	15	12	2	0	2	9
	Zone 6	145	18	38	18	29	8	52
Total ecosystem credits		455	-	148	36	68	98	105
Squirrel Glider	-	558	21	210	34	68	116	130

8. Summary

Boral have aimed to avoid and minimise environmental impacts from the Project through detailed design and siting of the Project, along with implementation of actions aimed at mitigating and managing potential indirect impacts from the Project as detailed in section 5.1.

The unavoidable impacts of the Project on ecological values include the clearing of 35.66 ha of vegetation regarded as 'native vegetation,' as defined in the BAM. Associated fauna habitat would also be directly impacted.

Seven Assessments of significance under the EPBC Act were required for threatened biodiversity (, Black-faced Monarch, White-throated Needle-tail, Spotted-tail Quoll, Long-nosed Potoroo, Koala, New Holland Mouse and Grey-headed Flying-fox), which concluded that a significant impact as a result of the Project was unlikely. As such, there is no requirement for an EPBC Act Referral regarding Commonwealth MNES, and no need to offset them.

Biodiversity offsets required for unavoidable impacts from the Project have been calculated as follows:

- PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast– 427 credits
- PCT1644- Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast – 28 credits.

One threatened species, the Squirrel Glider requires offsetting (558 credits) as a result of the Project.

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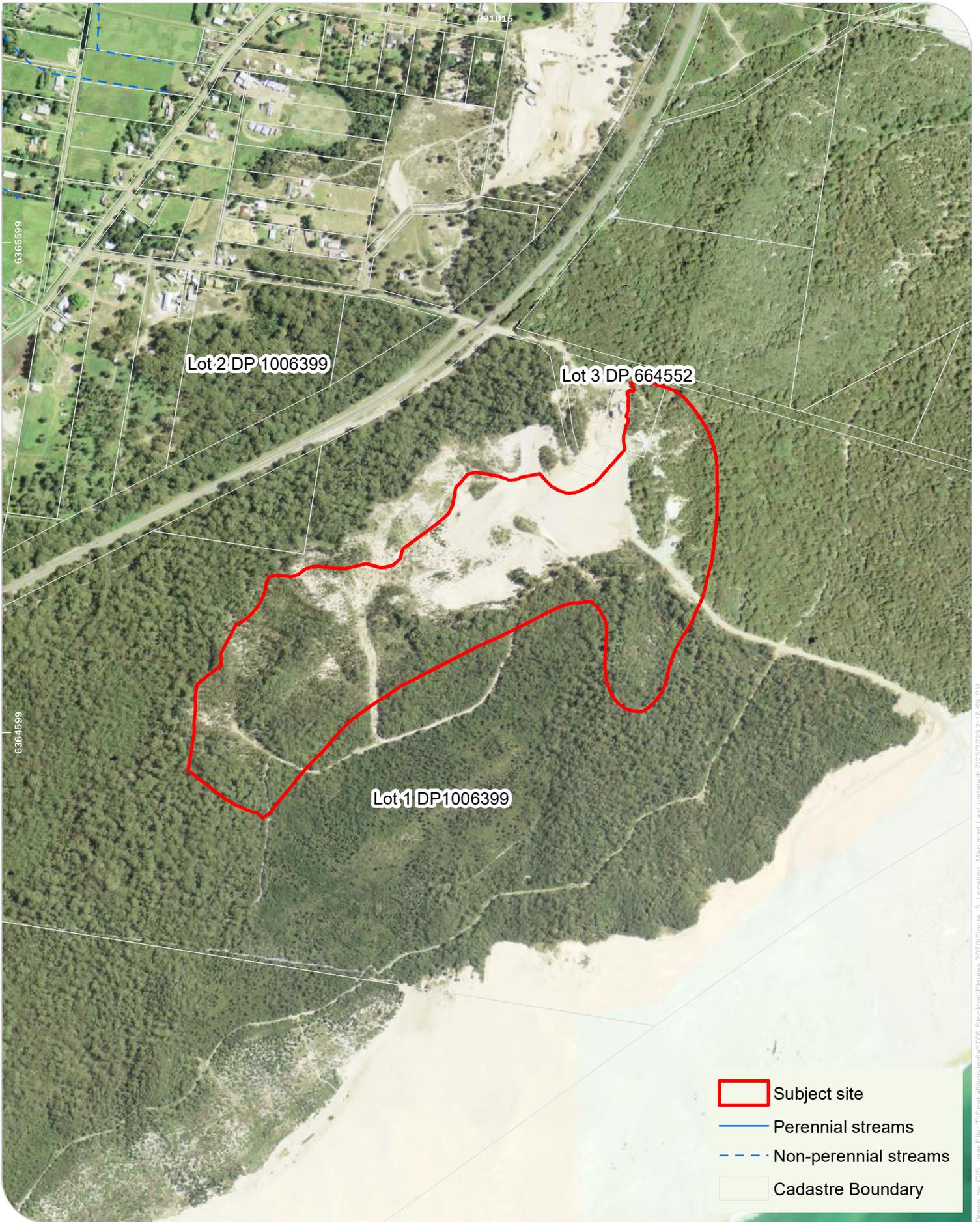
Figures

Figure 1. Regional Mapping (Element Environment 2019)



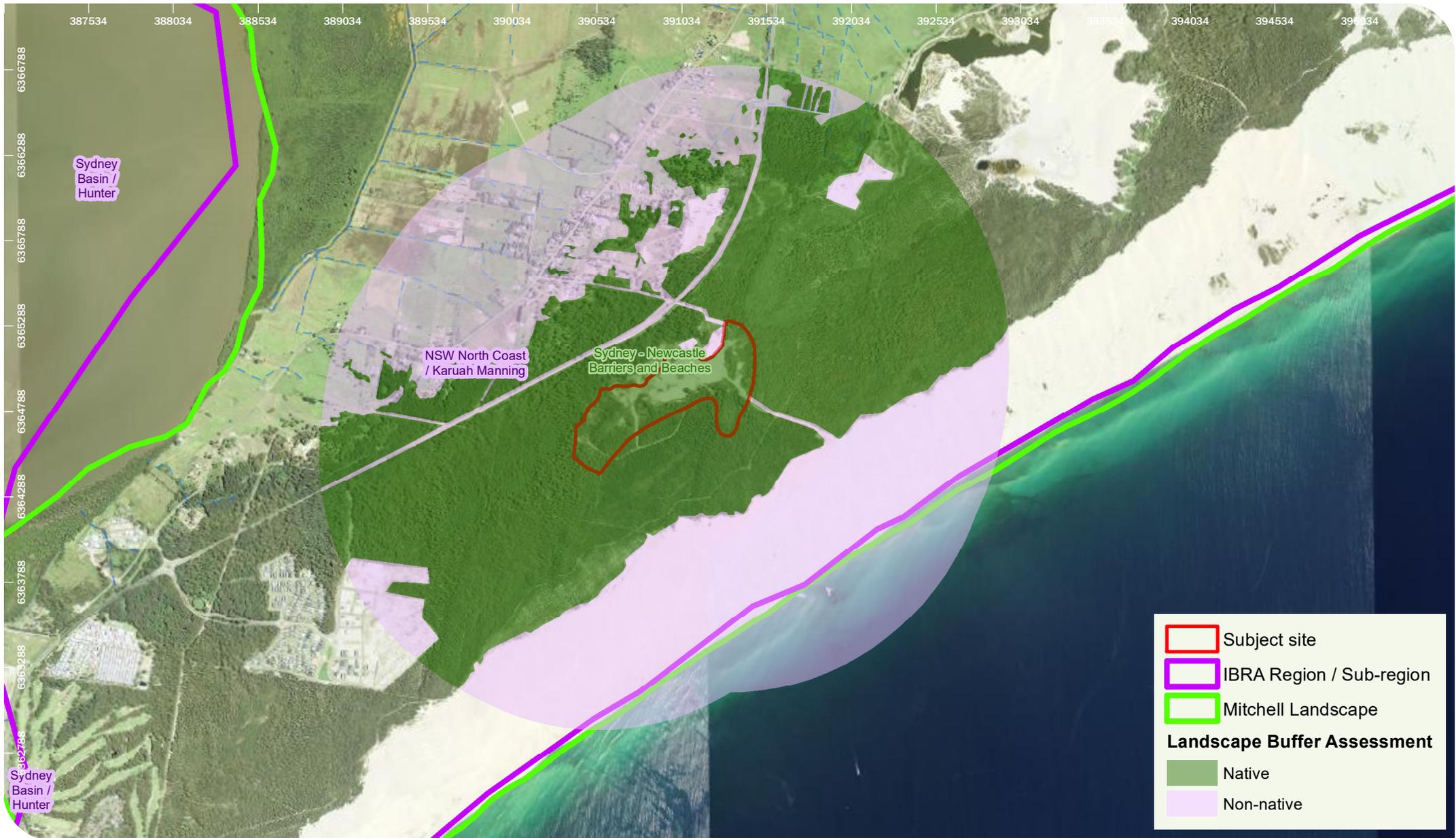
Figure 2. The Project (Element Environment)





- Subject site
- Perennial streams
- Non-perennial streams
- Cadastre Boundary

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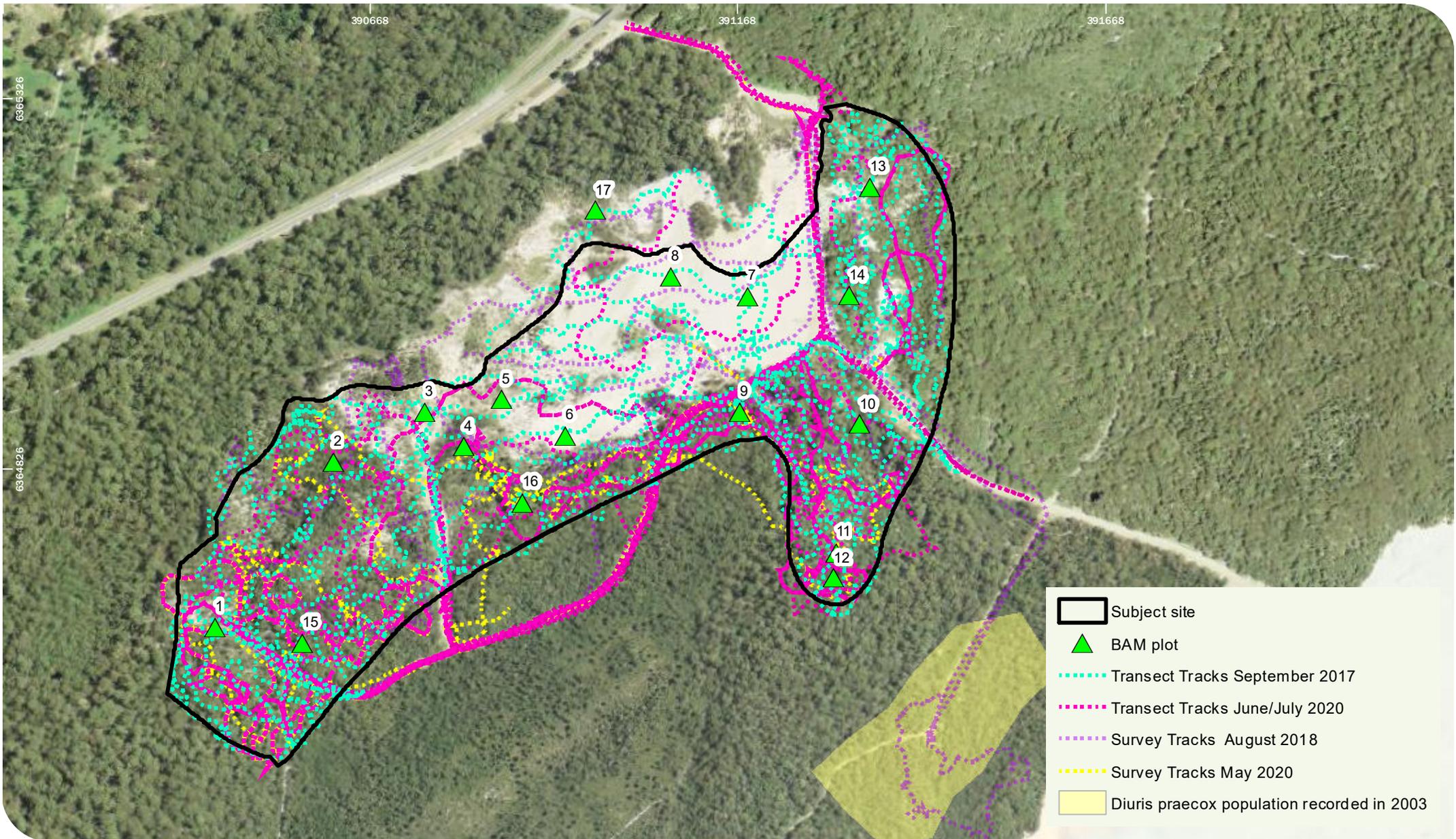
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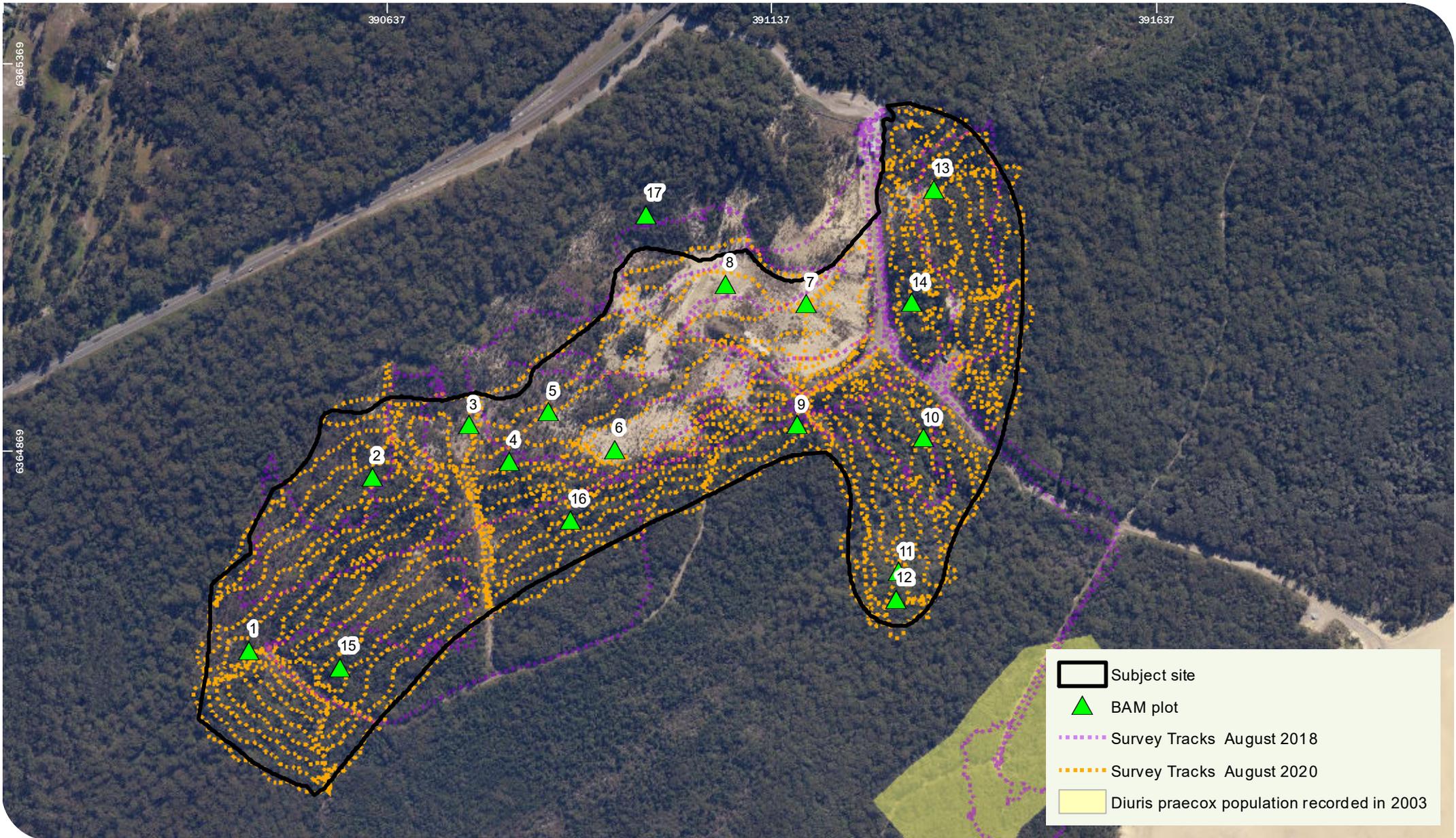
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Client: Boral Resources (NSW) Pty

Landscape Assessment
Stockton Sand Quarry Dredging Project

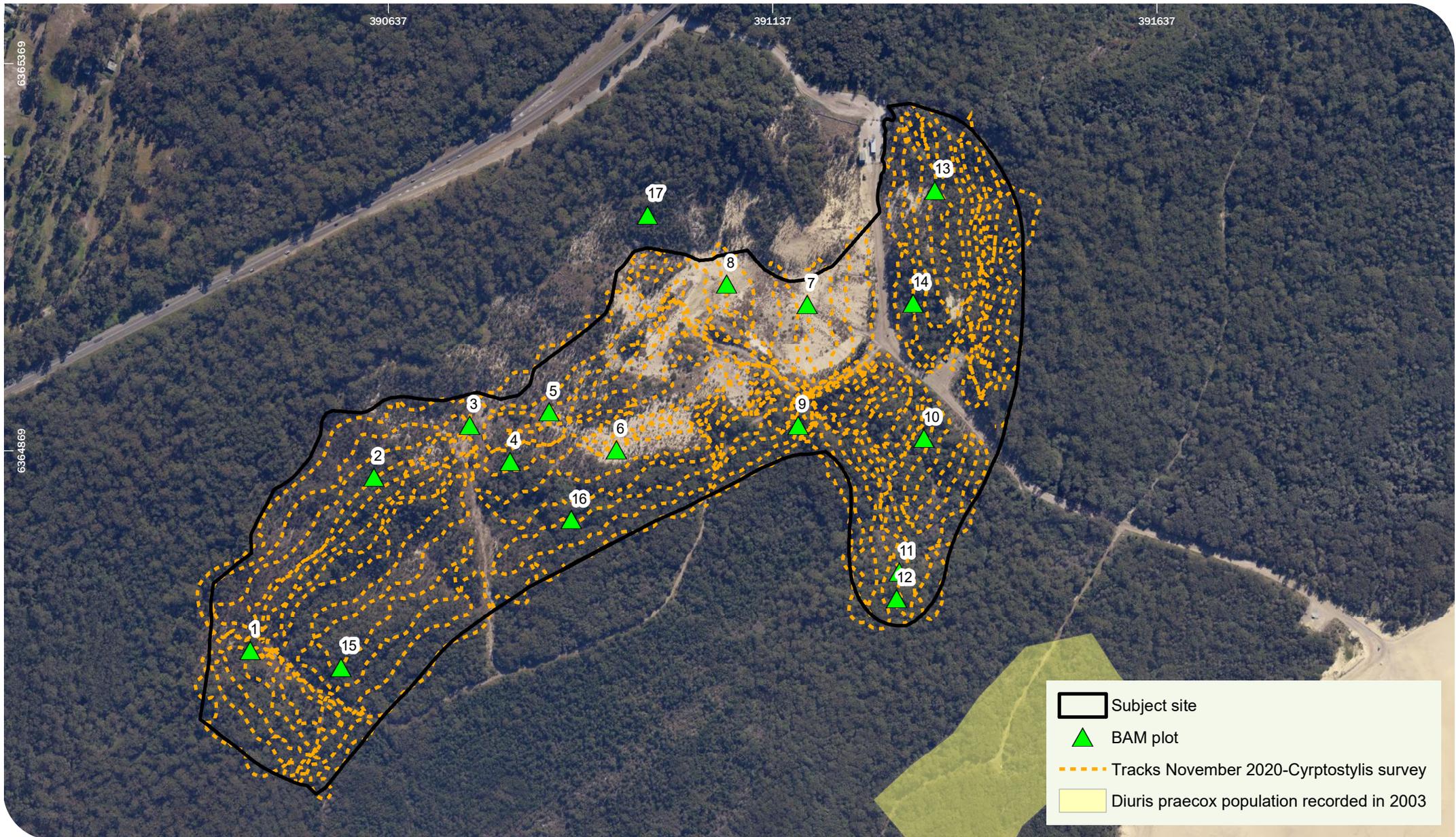
Figure 4



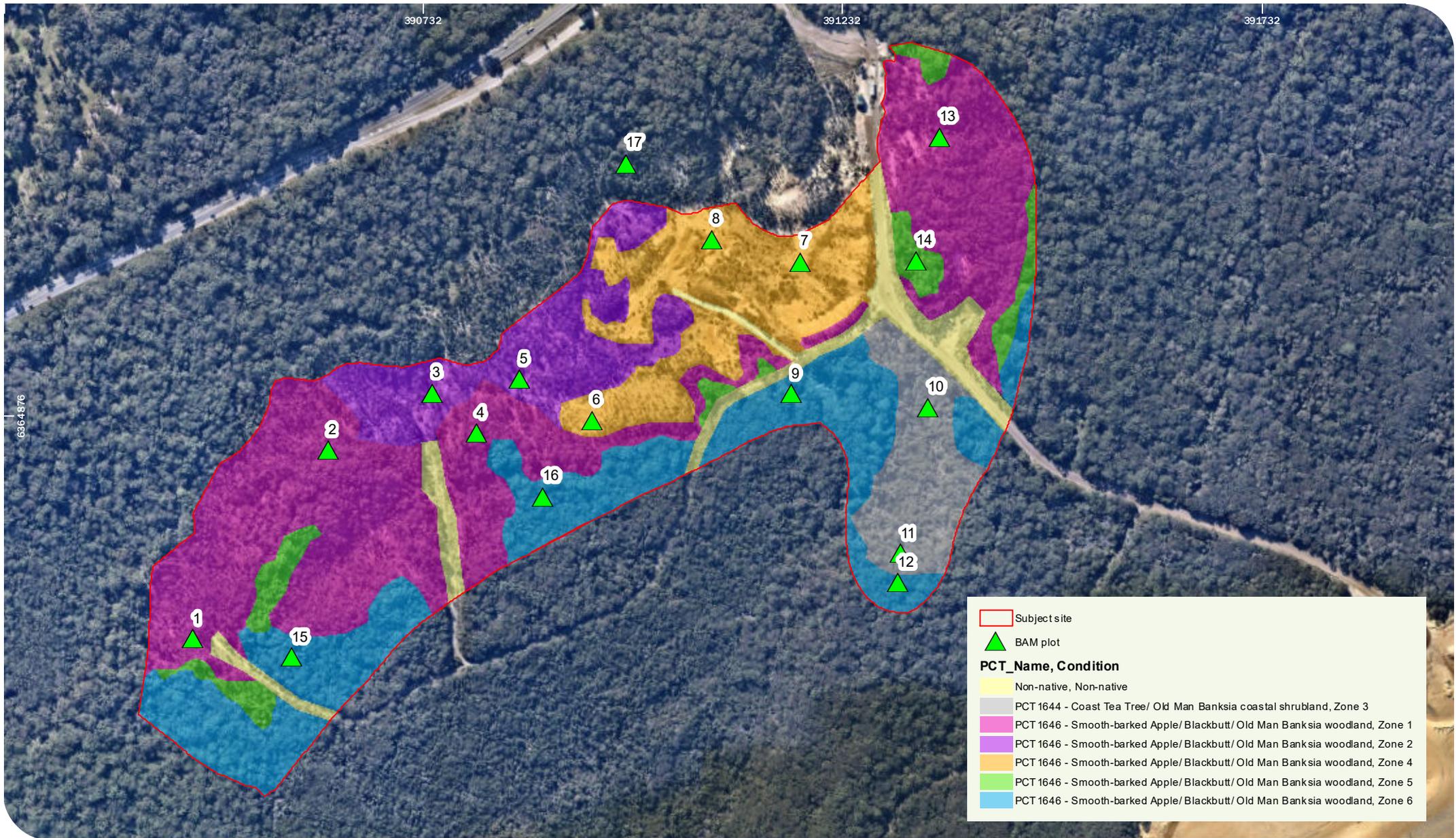
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- BAM plot
- Transect Tracks September 2017
- Transect Tracks June/July 2020
- Survey Tracks August 2018
- Survey Tracks May 2020
- Diuris praecox population recorded in 2003



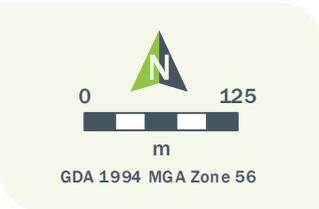
- Subject site
- ▲ BAM plot
- Survey Tracks August 2018
- Survey Tracks August 2020
- Diuris praecox population recorded in 2003



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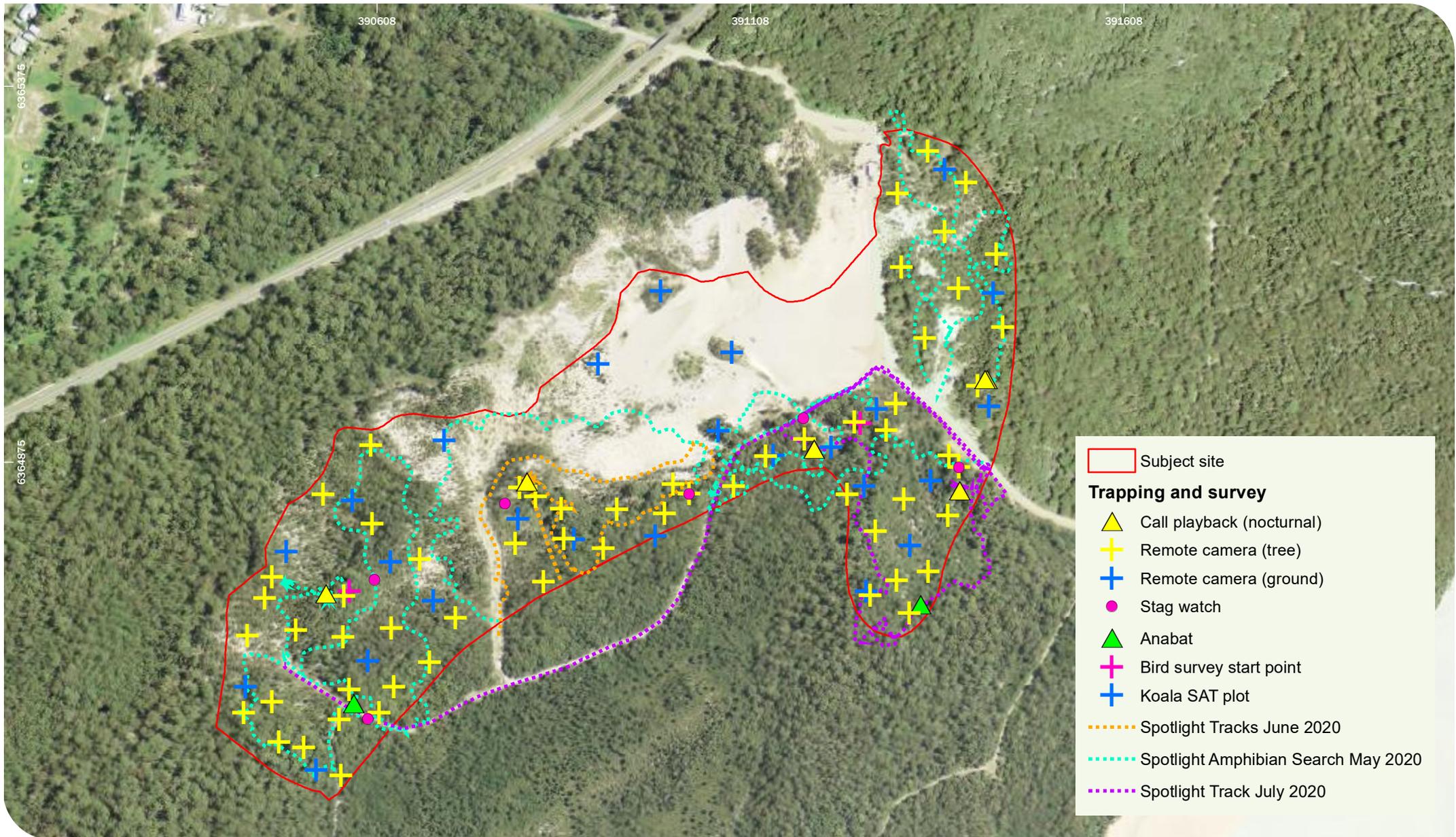
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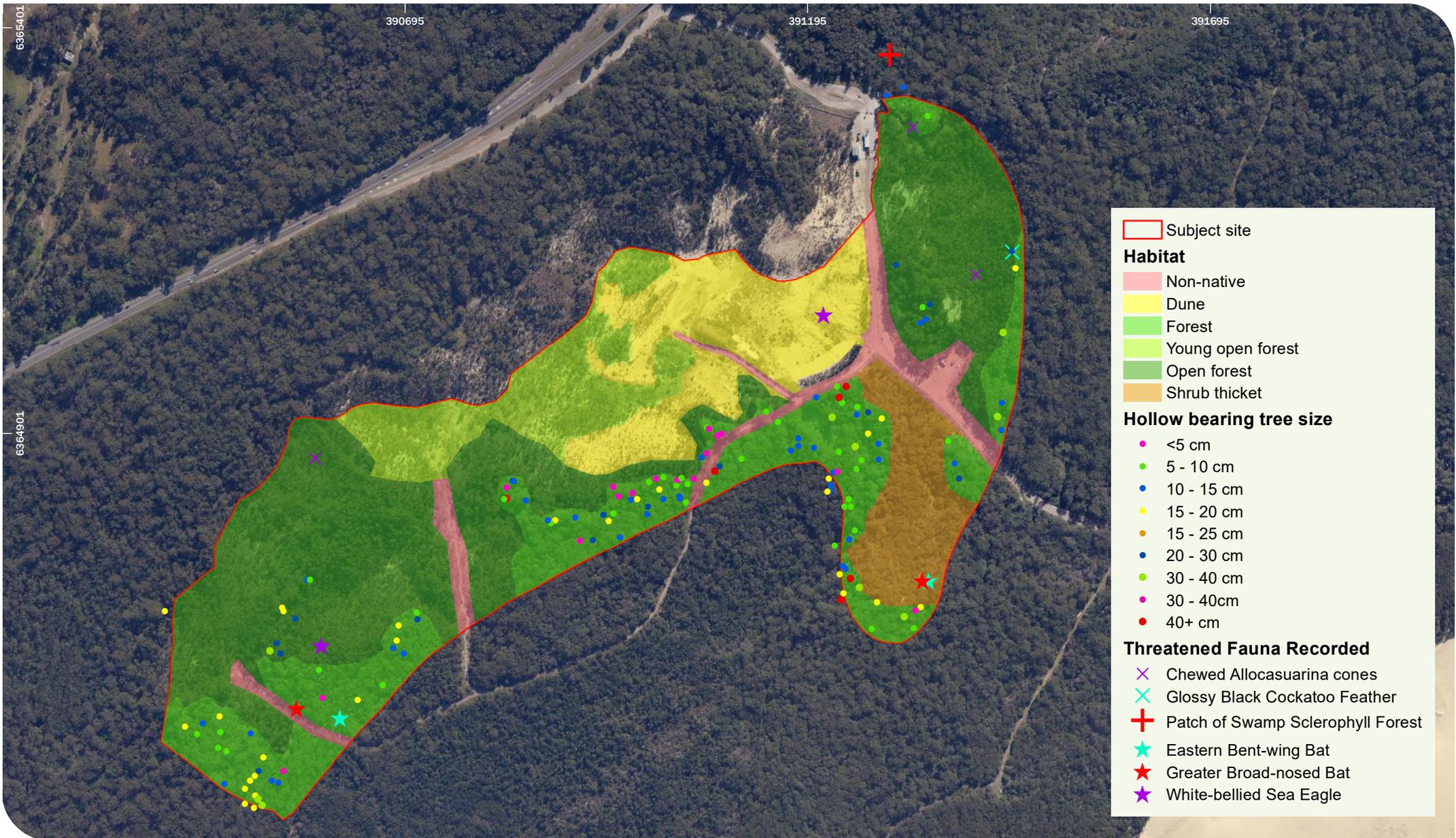
Niche PM: Luke Baker
 Niche Proj. #: 3706
 Client: Boral Resources (NSW) Pty

Survey effort - Flora
Stockton Sand Quarry Dredging Project

Figure 6



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Subject site

Habitat

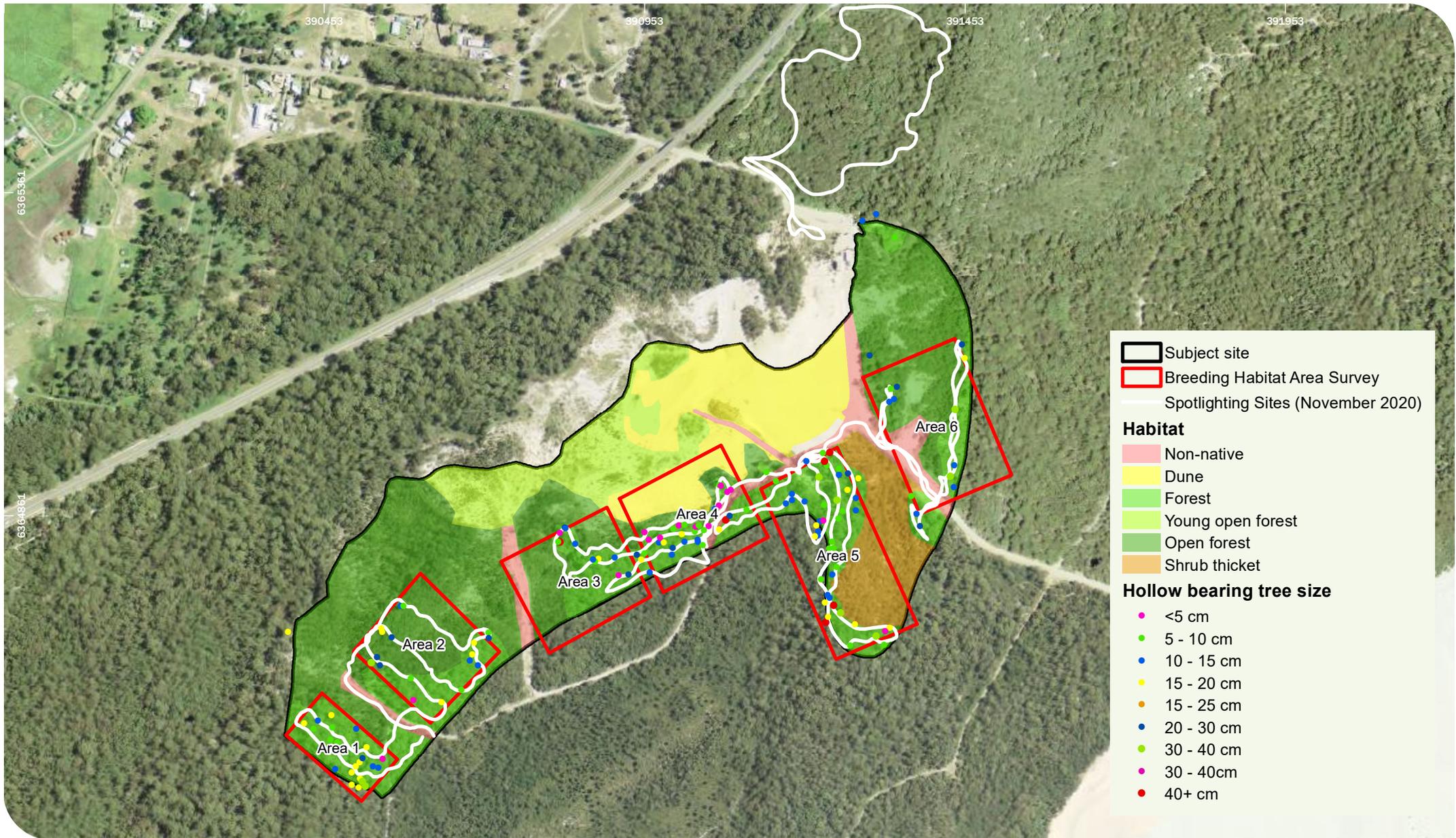
- Non-native
- Dune
- Forest
- Young open forest
- Open forest
- Shrub thicket

Hollow bearing tree size

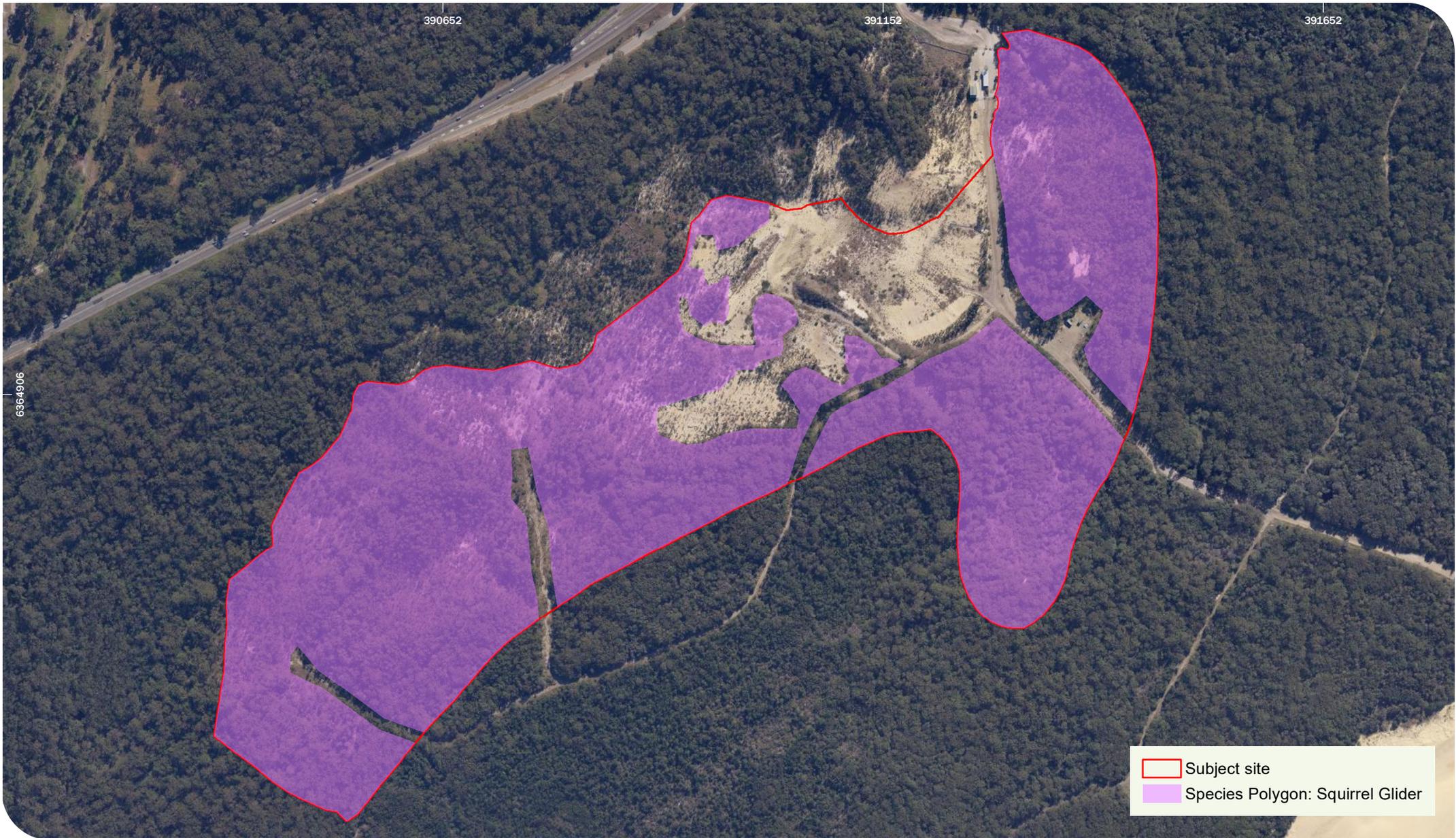
- <5 cm
- 5 - 10 cm
- 10 - 15 cm
- 15 - 20 cm
- 15 - 25 cm
- 20 - 30 cm
- 30 - 40 cm
- 30 - 40cm
- 40+ cm

Threatened Fauna Recorded

- Chewed Allocasuarina cones
- Glossy Black Cockatoo Feather
- Patch of Swamp Sclerophyll Forest
- Eastern Bent-wing Bat
- Greater Broad-nosed Bat
- White-bellied Sea Eagle



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Drawn by: Luke Baker. Last updated: 7/20/2020 6:19:27 PM. File: T:\Spatial\Working\3706_Stockton\Figures 2020\Figure_9_Species Polygon_SG.mxd



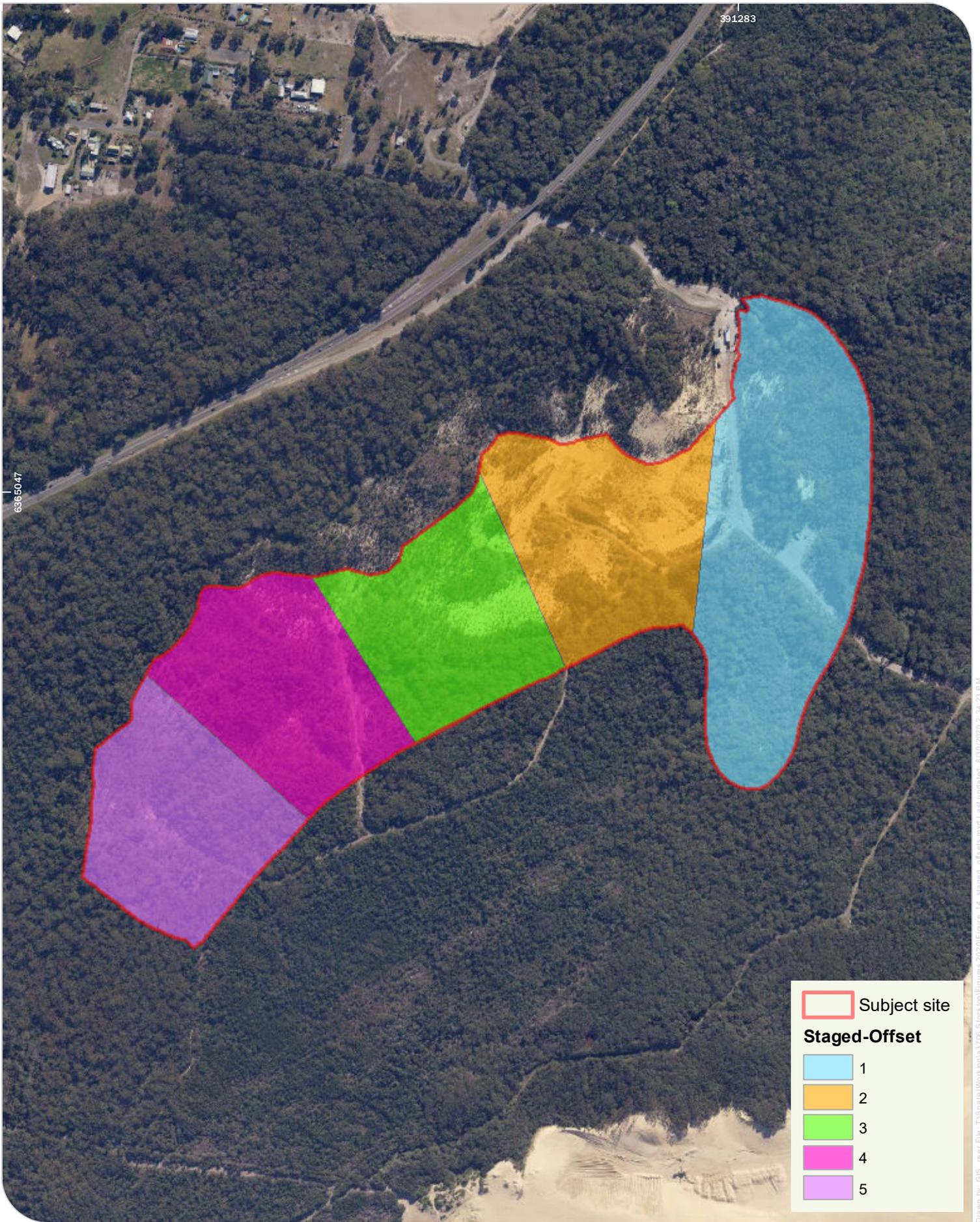
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**Area of direct and indirect impact
Stockton Sand Quarry Dredging Project**

Niche PM: Luke Baker
Niche Proj. #: 3706
Client: Boral Resources (NSW) Pty

Figure 11



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Niche PM: Luke Baker
Niche Proj. #: 3706
Client: Boral Resources (NSW) Pty

Staged-offset Approach
Stockton Sand Quarry Dredging Project

Figure 12

Annex 1. Likelihood of Occurrence

Threatened biodiversity likelihood of occurrence

A list of subject threatened flora and fauna and threatened ecological communities within the locality (10 km radius) was determined from database searches. The list of potentially impacted species is determined from consideration of this list. In order to adequately determine the relevant level of assessment to apply to potentially affected species, further analysis of the likelihood of those species occurring within the subject site was completed.

Five categories for 'likelihood of occurrence' were attributed to species after consideration of criteria such as known records, presence or absence of important habitat features on the subject site, results of the field surveys and professional judgement. This process was completed on an individual species basis.

Species considered further in formal assessments of significance (EPBC Act) were those in the 'Known', 'High' or 'Moderate' categories and where adverse impacts for the species could reasonably occur from the development. Species listed as a 'Low' or 'None' likelihood of occurrence are those for which there is limited or no habitat present within the subject site.

Likelihood rating	Threatened flora criteria	Threatened and migratory fauna criteria
Known	The species was observed within the subject site.	The species was observed within the subject site.
High	It is likely that a species inhabits or utilises habitat within the subject site.	It is likely that a species inhabits or utilises habitat within the subject site.
Moderate	Potential habitat for a species occurs on the site. Adequate field survey would determine if there is a 'high' or 'low' likelihood of occurrence for the species within the subject site.	Potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. Species unlikely to be wholly dependent on the habitat present within the subject site.
Low	It is unlikely that the species inhabits the subject site.	It is unlikely that the species inhabits the subject site. If present at the site the species would likely be a transient visitor. The site contains only very common habitat for this species which the species would not rely on for its on-going local existence.
None	The habitat within the subject site is unsuitable for the species.	The habitat within the subject site is unsuitable for the species.

Likelihood of Occurrence

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
Amphibians						
<i>Crinia tinnula</i>	Wallum Froglet	V	-	Wallum Froglets are found in paperbark swamps and sedge swamps of the coastal 'wallum' country. Their tadpoles are adapted to acid conditions and may be outcompeted by the Common Froglet. Males call from the base of vegetation in and around the breeding site and are almost impossible to locate. Calling occurs from Autumn to Spring, being most strongly associated with flooding following rainfall. Its range extends from SE QLD to the Kurnell Peninsular of Sydney.	Low to moderate as discussed in section 4.1.4.	Species
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	The Giant Burrowing Frog has been recorded breeding in a range of water bodies associated with sandy environments of the coast and adjacent ranges from the Sydney Basin south the eastern Victoria. It breeds in hanging swamps, perennial non-flooding creeks and occasionally permanent pools, but permanent water must be present to allow its large tadpoles time to reach metamorphosis.	None – no potential habitat given absence of waterbodies	Species
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	Inhabits a very wide range of water bodies including marshes, dams and streams, particularly those containing emergent vegetation such as bullrushes or spikerushes. It also inhabits numerous types of man-made water bodies including quarries and sand extraction sites. Optimum habitat includes water-bodies that are un-shaded, free of predatory fish such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available. Known records are associated with shallow ephemeral/semi-permanent water bodies with limited flow of water. Aquatic vegetation at breeding sites includes sedges (<i>Shoenoplectus</i> spp., <i>Baumea</i> spp. and <i>Lepironia articulata</i>) and Broadleaf Cumbungi (<i>Typha orientalis</i>).	Low as discussed in section 4.1.4.	Species
<i>Uperoleia mahonyi</i>	Mahony's Toadlet	E	-	Current observations indicate Mahony's Toadlet inhabits ephemeral and semi-permanent swamps and swales on the coastal fringe of its range. Known records occur in heath or wallum habitats almost exclusively associated with leached (highly nutrient impoverished) white sand. Commonly associated with acid paperbark swamps, Mahony's Toadlet also is known to occur in wallum heath, swamp mahogany-paperbark swamp forest, heath shrubland and Sydney red gum woodland. Recent studies suggest intact vegetation adjacent to and within water bodies is an important habitat feature for this species.	Low to moderate as discussed in section 4.1.4.	Species
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	Associated with streams in dry sclerophyll and wet sclerophyll forests and rainforests of more upland areas of the Great Dividing Range of NSW and down into Victoria. Breeding occurs along forest streams with permanent water where eggs are deposited within nests excavated in riffle zones by the females and the tadpoles swim free into the stream when large enough to do so. Outside of	Low to moderate as discussed in section 4.1.4.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				breeding, individuals range widely across the forest floor and can be found hundreds of metres from water.		
Birds						
<i>Actitis hypoleucos</i>	Common Sandpiper	-	M, MA	Utilises a wide range of coastal wetlands and some inland wetlands, mostly found around muddy margins or rocky shores. Forages in shallow water and on soft mud, roosts on rocks or vegetation such as mangroves. Northern hemisphere breeding.	Low – no wetlands or mangroves within subject site.	N/A
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	Low as discussed in section 4.1.4.	Species
<i>Apus pacificus</i>	Fork-tailed Swift	-	M	The Fork-tailed Swift is almost exclusively aerial, flying from less than one metre to at least 300 m above ground and probably much higher.	Low – no nests found in subject site. May fly over subject site on occasion.	N/A
<i>Arenaria interpres</i>	Ruddy Turnstone	-	M	Mainly found in coastal regions with exposed rock coast lines or coral reefs. Also found on rock platforms with shallow tidal pools, and occasionally beaches and estuaries. Northern hemisphere breeding.	Low – no rock platforms and tidal pools.	N/A
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V	-	Often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests.	Moderate – can occur in range of habitats.	Ecosystem
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	The Australasian Bittern is widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes and spikerushes.	Low – lack of habitat in subject site.	Species
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights.	Low - based on survey result – discussed in section 4.1.4.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	-	M	Prefers muddy edges of shallow or brackish wetlands, with inundated or emergent sedges, saltmarsh or other low vegetation. Also found foraging in sewage ponds and flooded paddocks. Northern hemisphere breeding.	Low – lack of habitat within subject site.	N/A
<i>Calidris canutus</i>	Red Knot	-	M, E	Usually found foraging in soft substrate near the edge of the water on intertidal mudflats. Also have been recorded at nearby lakes, sewage ponds and floodwaters. Roosts on sandy beaches, spits and islands. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
<i>Calidris ferruginea</i>	Curlew Sandpiper	E	CE, M	It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes the inland. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
<i>Calidris melanotos</i>	Pectoral Sandpiper	-	M	Prefers shallow fresh to saline wetlands, found at coastal lagoons, estuaries, bays, swamps, inundated grasslands, saltmarshes and artificial wetlands. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
<i>Calidris ruficollis</i>	Red-necked Stint	-	M	Mostly found in coastal areas including inlets, bays, lagoons and estuaries with intertidal mudflats. Occasionally on exposed ocean beaches and sometimes rocky shores and reefs. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
<i>Calidris tenuirostris</i>	Great Knot	V	M, CE	In NSW, this species has been recorded at scattered sites along the coast to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith. Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sand flats, 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. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-	The Gang-gang Cockatoo inhabits eucalypt open forests and woodlands with an acacia understorey. In summer it lives in moist highland forest types, and in winter it moves to more open types at lower elevations. This species requires tree hollows for nesting and sometimes for roosting. Eucalypt trees and acacia shrubs are used for foraging. Plantations of exotic pines are usually avoided.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. Discussed in section 4.1.4, however breeding habitat is not present.	Dual
<i>Calyptorhynchus lathami</i>	Glossy-black Cockatoo	V	-	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. Discussed in section	Dual

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				Great Dividing Range where stands of sheoak occur. Black Sheoak (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods.	4.1.4, however breeding habitat is not present.	
<i>Charadrius bicinctus</i>	Double-banded Plover	-	M	Found on littoral, estuarine and fresh or saline terrestrial wetlands, rocky beaches, bays and inlets. Sometimes found on exposed reefs and rock platforms. Migrates to breed in New Zealand.	Low – habitat preferences not in subject site.	N/A
<i>Charadrius leschenaultii</i>	Greater Sand Plover	V	M, V	Occur on sheltered sandy, shelly or muddy beaches with large intertidal mudflats or sandbanks, as well as sandy estuarine lagoons. Non-breeding in Australia.	Low – habitat preferences not in subject site.	N/A
<i>Charadrius mongolus</i>	Lesser Sand Plover	V	M, E	Inhabits large intertidal sand flats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops. Non-breeding in Australia.	Low – habitat preferences not in subject site.	N/A
<i>Chthonicola sagittata</i>	Speckled Warbler	V		The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Circus assimilis</i>	Spotted Harrier	V	-	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Cuculus optatus, Cuculus saturatus</i>	Oriental Cuckoo	-	M, MA	Mainly inhabits coniferous, deciduous and mixed forests. Breeds in northern hemisphere. Brood parasite, laying eggs in nests of other birds.	Low – habitat preferences not in subject site.	N/A
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	Found in coastal woodlands, dense scrub and heathlands, particularly where it borders taller woodlands.	Low – not within known range of species. No records occur within locality.	Species
<i>Diomedea antipodensis</i>	Antipodean Albatross	V	V, M, MA	The species ranges across the southern Pacific Ocean, east to the coast of Chile and west to eastern Australia. The Antipodean Albatross breeds biennially in colonies on ridges, slopes and plateaus of isolated subantarctic islands, usually in vegetation such as grass tussocks. This species regularly occurs in small numbers off the NSW south coast from Green Cape to Newcastle during winter where they feed on cuttlefish.	None	N/A
<i>Diomedea exulans</i>	Wandering Albatross	E	V, M, MA	The Wandering Albatross is marine, pelagic and aerial. The Wandering Albatross visits Australian waters from Fremantle, Western Australia to northern New South Wales between June and September each year.	None	N/A
<i>Diomedea gibsoni</i> , <i>Diomedea antipodensis gibsoni</i>	Gibson's Albatross	V	V, M, MA	The species is regularly encountered on trans-Tasman shipping routes and at seas off Sydney, and regularly occurs off the NSW coast usually between Green Cape and Newcastle. This species is known only to breed on the Adams, Disappointment and Auckland Islands in the subantarctic Auckland Island group. Potential forage in NSW waters during the winter is considered significant for the species.	None	N/A
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	-	Mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sand flats, and mangrove vegetation.	Low – habitat preferences not in subject site.	Species
<i>Epthianura albifrons</i>	White-fronted Chat	V	-	Low vegetation in salty coastal and inland areas and crops. Runs along ground and is found in local flocks in Winter.	Moderate	Ecosystem
<i>Erythrotriorchis radiatus</i>	Red Goshawk	CE	V	Distributed sparsely through northern and eastern Australia, from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW, and with scattered records in central Australia. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers. Very rare in NSW.	Low	Species
<i>Gallinago hardwickii</i>	Latham's Snipe	-	M	Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. Seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration.	Low – habitat preferences not in subject site.	N/A

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<i>Gallinago megala</i>	Swinhoe's Snipe	-	M	Occurs at edges of wetlands, swamps and freshwater streams. Also known to occur in grasslands, sewage ponds and drying claypans. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
<i>Gallinago stenura</i>	Pin-tailed Snipe	-	M	Occurs at edges of shallow freshwater swamps, ponds and lakes with emergent, sparse to dense cover of grass/sedge or other vegetation. Also found on more open wetlands, claypans and sewage ponds. Breeds in the northern hemisphere.	Low – habitat preferences not in subject site.	N/A
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Grantiella picta</i>	Painted Honeyeater	V	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits boree, brigalow and box-gum woodlands and box-ironbark forests.	None – out of range for species.	Ecosystem
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V	-	In NSW the Sooty Oystercatcher occupies rocky headlands, reefs and offshore islands along the entire coast, apparently as a single continuous population.	Low – habitat preferences not in subject site.	Species
<i>Haematopus longirostris</i>	Pied Oystercatcher	E	-	The Pied Oystercatcher inhabits marine littoral habitats, including islands. It occupies muddy, sandy, stony or rocky estuaries, inlets and beaches, particularly intertidal mudflats and sandbanks in large marine bays.	Low – habitat preferences not in subject site.	Species
<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle	V	MA	Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. It was also recorded during field survey flying over the subject site. No nest is present within the subject site.	Ecosystem/species
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. May nest in farmland, woodland and forest in tall trees.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem/species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	M, MA	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges.	Moderate – species can occur in a range of habitat types.	N/A
<i>Lathamus discolor</i>	Swift Parrot	E	CE	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem/species
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	V	M	Favours sheltered parts of the coast such as estuarine sand flats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches. Breeds in the northern hemisphere.	Low – habitat preferences not in subject site.	Species
<i>Limosa lapponica baueri</i>	Bar-tailed Godwit	-	M, V	Bar-tailed Godwit (spp baueri) is the eastern Australian / New Zealand sub species. Mainly found in coastal habitats such as intertidal sand flats, mudflats, estuaries, inlets, coastal lagoons and bays. Often found around beds of seagrass and saltmarsh. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
<i>Limosa limosa</i>	Black-tailed Godwit	V	M	Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sand flats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	Ecosystem
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Macronectes giganteus</i>	Southern Giant Petrel	E	E	The Southern Giant Petrel has a circumpolar pelagic range from Antarctica to approximately 20 S and is a common visitor off the coast of NSW. Over summer, the species nests in small colonies amongst open vegetation on antarctic and subantarctic islands, including Macquarie and Heard Islands and in Australian Antarctic territory.	None	EEC/Marine
<i>Macronectes halli</i>	Northern Giant-petrel	V	V	Breeding in Australian territory is limited to Macquarie Island and occurs during spring and summer.	None	EEC/Marine

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<i>Monarcha melanopsis</i>	Black-faced Monarch	-	M	Found along the coast of eastern Australia, becoming less common further south. Inhabits rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	Moderate – can occur in a range of habitat types.	N/A
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater	V	-	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (<i>E. albens</i>), Inland Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>), Blakely's Red Gum (<i>E. blakelyi</i>) and Forest Red Gum (<i>E. tereticornis</i>).	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Monarcha trivirgatus</i>	Spectacled Monarch	-	M	Coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. Prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	Low – habitat preferences not in subject site.	N/A
<i>Motacilla flava</i>	Yellow Wagtail	-	M	Breeds in temperate Europe and Asia. The Yellow Wagtail is a regular wet season visitor to northern Australia. Increasing records in NSW suggest this species is an occasional but regular summer visitor to the Hunter River region. The species is considered a vagrant to Victoria, South Australia and southern Western Australia. Habitat requirements for the Yellow Wagtail are highly variable, but typically include open grassy flats near water. Habitats include open areas with low vegetation such as grasslands, airstrips, pastures, sports fields; damp open areas such as muddy or grassy edges of wetlands, rivers, irrigated farmland, dams, waterholes; sewage farms, sometimes utilise tidal mudflats and edges of mangroves.	Low – habitat preferences not in subject site.	N/A
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	-	M	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. Found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.	Low – habitat preferences not in subject site.	N/A
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	Low – habitat preferences not in subject site.	Ecosystem
<i>Ninox connivens</i>	Barking Owl	V	-	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. Field surveys did not detect the species utilising hollows.	Ecosystem / species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance.		
<i>Ninox strenua</i>	Powerful Owl	V	-	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within turpentine tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. Field surveys did not detect the species utilising hollows. Species is discussed in section 4.1.4.	Ecosystem/species
<i>Numenius madagascariensis</i>	Eastern Curlew	-	CE, MA, M	A primarily coastal distribution. Found in all states, particularly the north, east, and south-east regions including Tasmania. Rarely recorded inland. Mainly forages on soft sheltered intertidal sand flats or mudflats, open and without vegetation or cover. Breeds in the northern hemisphere.	Low – habitat preferences not in subject site Not detected during field survey.	Ecosystem
<i>Numenius minutus</i>	Little Curlew	-	M	Feeds in short, dry grassland and sedgeland, including dry floodplains and black soil plains, which have scattered, shallow freshwater pools. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
<i>Numenius phaeopus</i>	Whimbrel	-	M	Usually found on intertidal mudflats of sheltered coasts. Also found in harbours, lagoons, estuaries and river deltas, often those with mangroves. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
<i>Pandion cristatus, Pandion haliaetus</i>	Eastern Osprey	V	M, MA	Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	No nests in subject site. May occasionally fly over the subject site.	Species
<i>Philomachus pugnax</i>	Ruff	-	M	Generally found in fresh, brackish to saline wetlands with exposed mudflats at the edges. Breeds in northern hemisphere.	Low – habitat preferences not in subject site.	N/A
<i>Phoebastria fusca</i>	Sooty Albatross	V	-	In Australian waters, this species is generally recorded in winter off the south coast from Tasmania to Western Australia, while there are occasional sightings off the NSW coast, north of Grafton. This pelagic or ocean-going species inhabits subantarctic and subtropical marine waters, spending the majority of its time at sea, and rarely occurs in continental shelf waters.	None	EEC/Marine
<i>Pluvialis fulva</i>	Pacific Golden Plover	-	M	Coastal habitats such as beaches, mudflats, sand flats, estuaries, lagoons and evaporation ponds in salt works. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<i>Pluvialis squatarola</i>	Grey Plover	-	M	Almost entirely in coastal areas including sheltered embayment's, estuaries and lagoons with mudflats and sand flats, and occasionally on rocky coasts with platforms or reef flats. Breeds in northern hemisphere.	Low – habitat preferences not in subject site.	N/A
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V	-	In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Pterodroma neglecta neglecta</i>	Kermadec Petrel (west Pacific subspecies)	V	V	Typically nests on the surface in loose colonies among rocks and vegetation. On Ball's Pyramid it nests only on steep cliffs above 400 m. On Phillip I. it nests under stands of African Olive. This species is marine and highly pelagic, rarely approaching land except at colonies.	None	EEC/Marine
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M	Found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. Inhabits tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.	Low – habitat preferences not in subject site.	Species
<i>Rostratula australis</i>	Australian Painted Snipe	E	E, MA	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. 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.	Low – may fly over site	Ecosystem
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum <i>Eucalyptus pauciflora</i> Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Sternula albifrons</i>	Little Tern	E	M	In Australia, Little Terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches.	Low – not recorded in subject site.	Species
<i>Thalassarche cauta (sensu stricto), Thalassarche cauta cauta</i>	Shy Albatross, Tasmanian Shy Albatross	V	V, M, MA	The Shy Albatross is a marine species occurring in subantarctic and subtropical waters, reaching the tropics in the cool Humboldt Current off South America.	None	EEC/Marine
<i>Thalassarche melanophris</i>	Black-browed Albatross	V	V, M, MA	The Black-browed Albatross has a circumpolar range over the southern oceans, and are seen off the southern Australian coast mainly during winter. Inhabits Antarctic,	None	N/A

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				subantarctic, subtropical marine and coastal waters over upwellings and boundaries of currents.		
<i>Tringa brevipes</i> , <i>Heteroscelus brevipes</i>	Grey-tailed Tattler	-	M, MA	Found on sheltered coasts with reefs and rock platforms, intertidal mudflats, estuaries and coastal lagoons, especially fringed with mangroves. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
<i>Tringa nebularia</i>	Common Greenshank	-	M	Variety of inland wetlands and sheltered coastal habitats of varying salinity. Found on mudflats, saltmarsh, mangroves in embayments, harbours, deltas and lagoons. Breeds in northern hemisphere.	Low – habitat preferences not in subject site.	N/A
<i>Tringa stagnatilis</i>	Marsh Sandpiper	-	M	Permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, salt pans, saltmarshes, estuaries, sewage farms and salt works. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. Nest hollows are usually located within dense forests or woodlands. Masked Owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. Field surveys did not detect the species utilising hollows.	Species/Ecosystem
<i>Xenus cinereus</i>	Terek Sandpiper	V	M, MA	The Terek Sandpiper mostly forages in the open, on soft wet intertidal mudflats or in sheltered estuaries, embayments, harbours or lagoons. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	Ecosystem
Mammals						
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals.	None – subject site not within 2 km of rocky cliff lines	Ecosystem and species
<i>Dasyurus maculatus</i>	Spotted-tail Quoll	V	E	The range of the Spotted-tailed Quoll has contracted considerably since European settlement. It is now found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. Only in Tasmania is it still considered relatively common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. The species was not detected during extensive trapping. It is unlikely to use the Subject Site.	Ecosystem
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20 m high. Two observations have been made of roosts in stem holes of living eucalypts. There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor. This species also	High	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites.		
<i>Kerivoula papuensis</i>	Golden-tipped Bat	V	-	Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Also recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Miniopterus australis</i>	Little Bentwing-bat	V	-	Coastal north-eastern NSW and eastern Queensland. The Little Bentwing-bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel hundreds of kilometres from feeding home ranges to breeding sites. They have a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects.	Moderate – thought unlikely to have breeding habitat given lack of hollows in subject site.	Ecosystem and species
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	-	Eastern Bentwing-bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Known – recorded in subject site, though no breeding habitat.	Ecosystem and species
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V	-	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Myotis macropus</i>	Southern Myotis	V	-	The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage.	Moderate – though no breeding habitat.	Ecosystem and species
<i>Petauroides volans</i>	Greater Glider	-	V	The Greater Glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows.	Low	Species
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range. Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias. There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps. Within a suitable vegetation community at least one species should flower heavily in winter and one	Previously been recorded in the subject site.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				species of eucalypt should be smooth barked. Endangered population in the Wagga Wagga LGA.		
<i>Petaurus australis</i>	Yellow-bellied Glider	V	-	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west of the divide. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest.	Low – species not recorded along Stockton beach corridor. Closest record is approximately 8km inland. The species was not detected during extensive targeted survey.	Species
<i>Phascolarctos cinereus</i>	Koala	V	V	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall.	Low likelihood to utilise the subject site on a regular basis. This is supported by the SAT and spotlighting survey which did not detect any usage of the subject site by Koalas. However it is noted that there are records throughout the locality. The Koala may move through the area, but given the site is predominately regeneration, is unlikely to use as main source of foraging habitat, and would likely utilise the surrounding bushland for movement given the protection from predators.	Species
<i>Phascolarctos cinereus</i>	Koala, Hawks Nest and Tea Gardens population	EP	-	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall.	As above	N/A
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo	V	V	Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy.	Moderate	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	Moderate	Ecosystem
<i>Pseudomys gracilicaudatus</i>	Eastern Chestnut Mouse	V	-	In NSW the Eastern Chestnut Mouse mainly occurs north from the Hawkesbury River area as scattered records along to coast and eastern fall of the Great Dividing Range extending north into Queensland. There are however isolated records in the Jervis bay area. In NSW the Eastern Chestnut Mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.	High – however no breeding habitat in subject site.	Ecosystem and species
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
<i>Syconycteris australis</i>	Common Blossom Bat	V	-	Coastal areas of eastern Australia from Hawks Nest in NSW to Cape York peninsula in Queensland. In areas, the distribution extends inland to coastal foothills. Common Blossom-bats often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps. They have also been recorded in a range of other vegetation communities, such as subtropical rainforest, wet sclerophyll forest and other coastal forests.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Reptiles						
<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake	V	-	The TBDC (as at June 2020) notes that the Pale-headed Snake can be found 'within 500m of moderate to good vegetation', and further describes habitat as 'found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest'. Both definitions of habitat, but particularly	Low – not detected during survey. Not previously recorded in subject site or surrounds.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				<p>'moderate to good vegetation', are very broad and encompass most vegetation types, including derived native grasslands. The TBDC also states that the species utilise hollows.</p> <p>The LMCC (2014a) survey guidelines describe habitat for the species as 'Loose bark, tree hollows in riparian habitat in dry eucalypt forest / woodland'. The species is also described as preferring Callitris woodlands (Scientific Committee Determination). The main prey is tree frogs although lizards and small mammals are also taken.</p> <p>The subject site does not contain riparian habitat, and the closest record to the subject site is 30 km to the immediate west.</p> <p>Within the immediate locality, habitat for this species is likely to be within Swamp Sclerophyll Forest where there are tree hollows. Riparian habitat does not occur within the subject site. The areas containing tree hollows (Zone 5 and Zone 6) are not located in riparian habitat, nor do they contain Callitris woodlands. Based on the habitat descriptions in the LMCC (2014a) guidelines, the species is unlikely to occur, but if the broader definition of the TBCD is used, potential habitat is present. As such a targeted survey was completed in November 2020 which confirmed the species is not utilising the site.</p>		
Flora						
<i>Angophora inopina</i>	Charmhaven Apple	V	V	Endemic to the Central Coast region of NSW. The known northern limit is near Karuah where a disjunct population occurs; to the south populations extend from Toronto to Charmhaven with the main population occurring between Charmhaven and Morisset. Occurs most frequently in Red Bloodwood Scribbly Gum woodland, wet heath, Red Mahogany Paperbark Sedge woodland and Stringybark Red Bloodwood forest.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
<i>Callistemon lineariifolius</i>	Netted Bottle Brush	V	-	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Recorded in 2000 at Coalcliff in the northern Illawarra. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically recorded in the Sydney area. Three of the remaining populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve and Spectacle Island Nature Reserve. The species has also been recorded from Yengo National Park.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
<i>Commersonia prostrata</i>	Dwarf Kerrawang	E	E	Occurs on sandy, sometimes peaty soils in a wide variety of habitats: snow gum woodland at Rose Lagoon; Blue-leaved Stringybark open forest at Tallong; and in	Low – not detected during survey. Relatively conspicuous	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				Brittle Gum low open woodland at Penrose; Scribbly Gum - Swamp Mahogany ecotonal forest at Tomago.	species. Not previously recorded in subject site or surrounds.	
<i>Corybas dowlingii</i>	Red Helmet Orchid	E	-	<i>Corybas dowlingii</i> is restricted to the central coast and Hunter regions of New South Wales where it is currently known from the Port Stephens, Bulahdelah, Lake Macquarie and Freemans Waterhole areas. It is known from the local government areas of Cessnock, Great Lakes, Lake Macquarie and Port Stephens. Sheltered areas such as gullies and southerly slopes in tall open forest on well-drained gravelly soil at elevations of 10-200 m	Low – habitat not suitable as species occurs in sheltered gullies.	Species
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	V	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum, Silvertop Ash, Red Bloodwood and Black She-oak and appears to prefer open areas in the understorey of this community.	Low – lack of remnant habitat given the subject site is mainly rehabilitated quarry pit. Lack of associated canopy species.	Species
<i>Diuris arenaria</i>	Sand Doubletail	E	-	Known from the Tomaree Peninsula near Newcastle. This species occurs in coastal heath and dry grassy eucalypt forest on sandy flats. Grows in gently undulating country in eucalypt forest with a grassy understorey on clay soil.	Low – lack of clay soil. Not previously recorded in the locality of the subject site.	Species
<i>Diuris praecox</i>	Rough Doubletail	V	V	Occurs between Ourimbah and Nelson Bay. Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey. Exists as subterranean tubers most of the year. It produces leaves and flowering stems in winter.	Low – species has been recorded adjacent to the subject site in remnant coastal dry sclerophyll forest. Targeted survey during the recommended survey time did not detect the species.	Species
<i>Eucalyptus camfieldii</i>	Heart-leaved Stringybark	V	V	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>		V	V	Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flowered Grevillea	V	V	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a	Low – not detected during survey. Relatively conspicuous	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	species. Not previously recorded in subject site or surrounds.	
<i>Maundia triglochinooides</i>		V	-	Grows in swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. Flowering occurs during warmer months. Diaspore is the seed and root tubers, which are probably dispersed by water.	None – no waterbodies	Species
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
<i>Melaleuca groveana</i>	Groves Paperbark	V	-	Widespread, scattered populations in coastal districts north of Yengo National Park to southeast Queensland. Also found as a disjunct population near Torrington on the northern tablelands. Grove's Paperbark grows in heath and shrubland, often in exposed sites, in low coastal hills, escarpment ranges and tablelands on outcropping granite, rhyolite and sandstone on rocky outcrops and cliffs.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
<i>Pericaria elatior</i>	Tall Knotweed	V	V	This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
<i>Phaius australis</i>	Southern Swamp Orchid	E	E	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas.	Low – lack of habitat preferences. Not detected during survey. Not previously recorded in subject site or surrounds.	Species
<i>Prostanthera densa</i>	Villous Mint Bush	V	V	This species has been recorded from the Currarong area in Jervis Bay, Royal National Park (Marley), Cronulla, Helensburgh and Port Stephens (Nelson Bay). The Sydney and Royal National Park populations were thought possibly extinct, but the species is now known to occur at Bass and Flinders Point in Cronulla. <i>Prostanthera densa</i> generally grows in sclerophyll forest and shrubland on coastal headlands and near coastal ranges, chiefly on sandstone, and rocky slopes near the sea.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
<i>Rhizanthella slateri</i>	Eastern Australian Undergrown Orchid	V	E	Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.	Low – no previous records and the majority of the subject site consists of rehabilitation which has changed the natural sandy soil base.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed.		
<i>Senecio spathulatus</i>	Coast Groundsel	E	-	Coast Groundsel occurs in Nadgee Nature Reserve (Cape Howe) and between Kurnell in Sydney and Myall Lakes National Park (with a possible occurrence at Cudmirrah). In Victoria there are scattered populations from Wilsons Promontory to the NSW border. Coast Groundsel grows on primary dunes.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E	V	Found only in NSW, in a narrow, linear coastal strip from Bulahdelah to Conjola State forest. On the south coast the species occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral rainforest. On the central coast it occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
<i>Tetratheca juncea</i>	Black-eyed Susan	V	V	Confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock. It is usually found in low open forest-woodland with a mixed shrub understorey and grassy groundcover. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. Cryptic species that requires survey in September-October.	Low – not detected during survey. Not previously recorded in subject site or surrounds. Habitat preferences absent given the subject site has been previously cleared.	Species
<i>Thesium australe</i>	Austral Toadlax	V	V	Austral Toad-flax is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Although originally described from material collected in the SW Sydney area, populations have not been seen in a long time. It may persist in some areas in the broader region. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (<i>Themeda australis</i>).	Low – headland habitat not present.	Species

Threatened Ecological Community (TEC) Likelihood of occurrence

Threatened Ecological Community	Description	BC	Act	EPBC	Act	Likelihood of occurrence within subject site
		Status		Status		
Central Hunter Grey Box - Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	<p>Central Hunter Grey Box-Ironbark Woodland occurs in the Central Hunter Valley between about Singleton and Muswellbrook. It is known to occur in the Cessnock, Singleton and Muswellbrook LGAs but may occur elsewhere within the Sydney Basin Bioregion. Central Hunter Grey Box-Ironbark Woodland occurs in areas of relatively low rainfall and high temperatures. It is associated mostly with Permian lithology, and is situated on gently undulating hills, slopes and valleys, or occasionally on rocky knolls.</p> <p>Central Hunter Grey Box-Ironbark Woodland typically forms a woodland dominated by Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>), Kurrajong (<i>Brachychiton populneus</i> subsp. <i>populneus</i>) and Grey Box (<i>Eucalyptus moluccana</i>). Other tree species such as Rough-barked Apple (<i>Angophora floribunda</i>) and Black Cypress Pine (<i>Callitris endlicheri</i>) may be present and occasionally dominate or co-dominate. A shrub layer is often present and common shrub species include Velvet Mock Olive (<i>Notelaea microcarpa</i> var. <i>microcarpa</i>), Coffee Bush (<i>Breynia oblongifolia</i>), Blackthorn (<i>Bursaria spinosa</i> subsp. <i>spinosa</i>), <i>Cassinia quinquefaria</i> and Sticky Hop-bush (<i>Dodonaea viscosa</i>). Subshrubs may also be common and include Narrawa Burr (<i>Solanum cinereum</i>), <i>Phyllanthus virgatus</i> and Small-leaf Bluebush (<i>Maireana microphylla</i>). Ground cover can be moderately dense to dense, and consist of numerous forbs and grass species as well as a small number of ferns, sedges and twiners. The more common species include Barbed Wire Grass (<i>Cymbopogon refractus</i>), Purple Wiregrass (<i>Aristida ramosa</i>), Kidney Weed (<i>Dichondra repens</i>), Poison Rock Fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>), Bristly Cloak Fern (<i>Cheilanthes distans</i>), Tall Chloris (<i>Chloris ventricosa</i>), Slender Tick-trefoil (<i>Desmodium varians</i>), Yellow Burr-daisy (<i>Calotis lappulacea</i>), Many-flowered Mat-rush (<i>Lomandra multiflora</i> subsp. <i>multiflora</i>), Blue Trumpet (<i>Brunoniella australis</i>) and <i>Glycine tabacina</i>.</p>	Endangered		Critically Endangered		None
Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions	<p>Central Hunter Ironbark-Spotted Gum-Grey Box Forest occurs in the central Hunter Valley mainly between Maitland and Muswellbrook. It has been recorded from Singleton, Cessnock and Muswellbrook LGAs but may occur elsewhere within the North Coast and Sydney Basin Bioregions. Central Hunter Ironbark-Spotted Gum-Grey Box Forest occupies undulating country including low rises and slopes, occurring on all aspects. It may also occur on alluvial and colluvial soils in valleys. It mostly occurs on clayey soils found on Permian sediments.</p> <p>Central Hunter Ironbark-Spotted Gum-Grey Box Forest typically forms an open forest or woodland dominated by Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>), Spotted Gum (<i>Corymbia maculata</i>) and Grey Box (<i>Eucalyptus moluccana</i>). Other tree species such as Red Ironbark (<i>Eucalyptus fibrosa</i>) and Forest Red Gum (<i>Eucalyptus tereticornis</i>) may be present, and occasionally dominate or co-dominate. A sparse layer of small trees including Bullock (<i>Allocasuarina leuhmannii</i>) or Silver-stemmed Wattle (<i>Acacia parvipinnula</i>) may be present in some areas. The shrub layer varies from sparse to moderately dense. Common shrub species include Gorse Bitter Pea (<i>Daviesia ulicifolia</i> subsp. <i>ulicifolia</i>), Grey Bush-pea (<i>Pultenaea spinosa</i>), Coffee Bush (<i>Breynia oblongifolia</i>), Needlebush (<i>Hakea sericea</i>) and Blackthorn (<i>Bursaria spinosa</i> subsp. <i>spinosa</i>). Ground cover can be sparse to moderately dense and consists of numerous forbs, a few grass species and occasional ferns and sedges. Common species include Poison Rock Fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>), Barbed Wire Grass (<i>Cymbopogon refractus</i>), Whiteroot (<i>Pratia purpurascens</i>), Many-flowered Mat-rush (<i>Lomandra multiflora</i> subsp. <i>multiflora</i>), <i>Pomax umbellata</i>, <i>Glycine tabacina</i>, Blue Flax-lily (<i>Dianella revoluta</i>), Slender Wire Lily (<i>Laxmannia gracilis</i>), <i>Vernonia cinerea</i> var. <i>cinerea</i>, Slender Tick-trefoil (<i>Desmodium varians</i>) and Kidney Weed (<i>Dichondra repens</i>).</p>	Endangered		Critically Endangered		None

Threatened Ecological Community	Description	BC	Act	EPBC	Act	Likelihood of occurrence within subject site
		Status		Status		
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Coastal Saltmarsh occurs in the intertidal zone on the shores of estuaries and lagoons that are permanently or intermittently open to the sea. It is frequently found as a zone on the landward side of mangrove stands. Characteristic plants include <i>Baumea juncea</i> , Sea Rush (<i>Juncus kraussii</i> subsp. <i>australiensis</i>), Samphire (<i>Sarcocornia quinqueflora</i> subsp. <i>quinqueflora</i>), Marine Couch (<i>Sporobolus virginicus</i>), Streaked Arrowgrass (<i>Triglochin striata</i>), Knobby Club-rush (<i>Ficinia nodosa</i>), Creeping Brookweed (<i>Samolus repens</i>), Swamp Weed (<i>Selliera radicans</i>), Seablite (<i>Suaeda australis</i>) and Prickly Couch (<i>Zoysia macrantha</i>). Occasionally mangroves are scattered through the saltmarsh. Tall reeds may also occur, as well as salt pans. Found in the tidal flats of estuaries and on the edges of intermittently opened coastal lagoons. Occurs in the upper limits of the tidal zone, and is frequently interspersed with bare ground and salt pans.	Endangered		Vulnerable		None
Coastal Upland Swamp in the Sydney Basin Bioregion	The Coastal Upland Swamp in the Sydney Basin Bioregion includes open graminoid heath, sedgeland and tall scrub associated with periodically waterlogged soils on the Hawkesbury sandstone plateaux. The Coastal Upland Swamp is generally associated with soils that are acidic and vary from yellow or grey mineral sandy loams with a shallow organic horizon to highly organic spongy black peat soils with pallid subsoils. The vegetation of the Coastal Upland Swamp may include tall open scrubs, tall closed scrubs, closed heaths, open graminoid heaths, sedgelands and fernlands. Larger examples may include a complex of these structural forms. The flora comprising the upland swamp is diverse there are 73 plant species listed as characterising the ecological community.	Endangered		Endangered		None
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Generally occur below 20 m elevation on level areas. They are dominated by herbaceous plants and have very few woody species. The structure and composition of the community varies both spatially and temporally depending on the water regime: Those that lack standing water most of the time are usually dominated by dense grassland or sedgeland vegetation, often forming a turf less than 0.5 metre tall and dominated by amphibious plants including <i>Paspalum distichum</i> (water couch), <i>Leersia hexandra</i> (swamp rice-grass), <i>Pseudoraphis spinescens</i> (mud grass) and <i>Carex appressa</i> (tussock sedge). Where they are subject to regular inundation and drying the vegetation may include large emergent sedges over 1 metre tall, such as <i>Baumea articulata</i> , <i>Eleocharis equisetina</i> and <i>Lepironia articulata</i> , as well as emergent or floating herbs such as <i>Hydrocharis dubia</i> (frogbit), <i>Philydrum lanuginosum</i> (frogsmouth), <i>Ludwigia peploides</i> subsp. <i>montevidensis</i> (water primrose), <i>Marsilea mutica</i> (nardoo) and <i>Myriophyllum</i> spp. (milfoils).	Endangered				None
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	Hunter Floodplain Red Gum Woodland generally forms a tall to very tall (18-35 m) woodland on floodplains and associated rises along the Hunter River and tributaries within the NSW North Coast and Sydney Basin Bioregions. Stands on major floodplains are generally dominated by <i>Eucalyptus camaldulensis</i> (River Red Gum) in combinations with <i>Eucalyptus tereticornis</i> (Forest Red Gum), <i>Eucalyptus melliodora</i> (Yellow Box) and <i>Angophora floribunda</i> (Rough-barked Apple). Within the community stands of <i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i> (River Oak) and <i>Casuarina glauca</i> (Swamp Oak) can form a part of this community. Dominant groundcovers include <i>Cynodon dactylon</i> (Couch), <i>Alternanthera denticulata</i> (Lesser Joyweed), <i>Austrostipa verticillata</i> (Slender Bamboo Grass), <i>Dichondra repens</i> (Kidney Weed), <i>Lepidium pseudohyssopifolium</i> (Peppergrass), <i>Pratia concolor</i> (Poison Pratia), <i>Urtica incisa</i> (Stinging Nettle), <i>Einadia hastata</i> (Berry Saltbush), <i>Amaranthus macrocarpus</i> var. <i>macrocarpus</i> (Dwarf Amaranth), <i>Cyperus fulvus</i> (Sticky Sedge), <i>Cynoglossum australe</i> (Australian Hound's Tongue), <i>Cyperus gracilis</i> (Slender Flat-sedge), <i>Glycine tabacina</i> (Variable Glycine), <i>Geranium solanderi</i> (Native Geranium) and <i>Microlaena stipoides</i> var. <i>stipoides</i> (Weeping Rice Grass).	Endangered				None

Threatened Ecological Community	Description	BC Status	Act Status	EPBC Status	Act Status	Likelihood of occurrence within subject site
Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	<p>Hunter Lowland Redgum Forest is an open forest where the most common canopy tree species are <i>Eucalyptus tereticornis</i>(Forest Red Gum) and <i>E. punctata</i> (Grey Gum). Other frequently occurring canopy species are <i>Angophora floribunda</i> (Rough-barked Apple), <i>E. crebra</i> (Narrow-leaved Ironbark), <i>E. moluccana</i> (Grey Box) and <i>Corymbia maculata</i> (Spotted Gum). The shrub layer is open and common shrub species include <i>Breynia oblongifolia</i> (Coffee Bush), <i>Leucopogon juniperinus</i> (Prickly Beard-heath), <i>Daviesia ulicifolia</i> (Gorse Bitter Pea) and <i>Jacksonia scoparia</i> (Dogwood). The ground cover typically comprises grasses and herbs with common species being <i>Microlaena stipoides</i> var. <i>stipoides</i> Forest Weeping Grass, <i>Pratia purpurascens</i> (Whiteroot), <i>Lomandra multiflora</i> (Many-flowered Mat-rush), <i>Cymbopogon refractus</i> (Barbed Wire Grass), <i>Cheilanthes sieberi</i> (Poison Rock Fern) and <i>Dichondra repens</i> (Kidney Weed).</p> <p>Occurs between Muswellbrook, Beresfield, Mulbring and Cessnock in the Lower Hunter in the Sydney Basin and North Coast bioregions. It has been recorded from the Maitland, Cessnock, Port Stephens, Muswellbrook and Singleton LGAs, but may occur elsewhere in these bioregions. Probably less than 500 hectares of this community remains.</p> <p>Hunter Lowland Redgum Forest occurs on the Permian sediments of the Hunter Valley floor. Much of the remaining community is disturbed and fragmented. The floristic composition and structure of the community is influenced by both the size and disturbance history of the remaining fragments. Consequently at heavily disturbed sites only some of the species which characterise the community may be present. Occurs on gentle slopes of depressions and drainage flats on the Hunter Valley floor.</p>	Endangered				None
Hunter Valley Foothslopes Slaty Gum Woodland in the Sydney Basin Bioregion	<p>Hunter Valley Foothslopes Slaty Gum Woodland is a woodland, or occasionally an open forest, with a sparse to moderately dense tree layer with occasional small trees and a moderately dense to dense shrub layer. The tree canopy is typically dominated by <i>Eucalyptus dawsonii</i> (Slaty Gum) and/or <i>Eucalyptus moluccana</i> (Grey Box). <i>Acacia salicina</i>(Cooba) and <i>Allocasuarina luehmannii</i> (Bulloak) may form a small tree layer or be part of the upper-most canopy. Other trees which may be present include <i>Brachychiton populneus</i> subsp. <i>populneus</i> (Kurrajong), <i>Callitris endlicheri</i>(Black Cypress Pine), <i>Eucalyptus crebra</i> (Narrow-leaved Ironbark) and <i>Eucalyptus punctata</i> (Grey Gum). The shrub layer includes species such as <i>Olearia elliptica</i> (Sticky Daisy Bush), <i>Acacia cultriformis</i> (Knife-leaved Wattle), <i>Canthium odoratum</i> (Shiny-leaved Canthium), <i>Notelaea microcarpa</i> var. <i>microcarpa</i> (Native Olive), <i>Dodonaea viscosa</i> subsp. <i>cuneata</i> (Wedge-leaf Hopbush), <i>Acacia decora</i> (Western Golden Wattle) and <i>Solanum brownii</i> (Violet Nightshade). The groundcover is typically sparse to very sparse and is relatively species poor. The most frequently occurring species include <i>Dichondra repens</i>(Kidney Weed), <i>Lomandra multiflora</i> subsp. <i>multiflora</i> (Many-flowered Mat-rush), <i>Aristida ramosa</i> (Wire Grass), <i>Brunoniella australis</i> (Blue Trumpet), <i>Cymbopogon refractus</i> (Barbed Wire Grass), <i>Desmodium brachypodum</i> (Large Tick-trefoil), <i>Fimbristylis dichotoma</i> (Common Fringe-rush) and <i>Sida corrugata</i>(Corrugated Sida).</p>	Vulnerable	Critically Endangered			None

Threatened Ecological Community	Description	BC	Act	EPBC	Act	Likelihood of occurrence within subject site
		Status		Status		
Hunter Valley Vine Thicket in the NSW North Coast and Sydney Basin Bioregions	<p>Hunter Valley Vine Thicket typically forms a low forest, usually less than 10 m tall, with a closed canopy dominated by small trees. The canopy may include <i>Elaeodendron australe</i> (Red Olive Plum), <i>Geijera parviflora</i> (Wilga), <i>Notelaea microcarpa</i> var. <i>microcarpa</i> (Native Olive), <i>Alectryon oleifolius</i> subsp. <i>elongatus</i> (Western Rosewood), <i>Melia azedarach</i> (White Cedar) and <i>Brachychiton populneus</i> subsp. <i>populneus</i> (Kurrajong). Emergent eucalypts are common and include <i>Eucalyptus albens</i> (White Box), <i>E. dawsonii</i> (Slaty Box) and <i>E. crebra</i> (Narrow-leaved Ironbark). A shrub stratum is usually present and includes <i>Olearia elliptica</i> subsp. <i>elliptica</i> (Sticky Daisy Bush) and <i>Rhagodia parabolica</i> (Mealy Saltbush). Vines are common and include <i>Cissus opaca</i> (Small-leaved Water Vine), <i>Marsdenia flavescens</i> (Hairy Milk Vine), <i>Parsonsia eucalyptophylla</i> (Gargaloo) and <i>Pandorea pandorana</i> subsp. <i>pandorana</i> (Wonga Vine). Ground cover is generally sparse and includes <i>Urtica incisa</i> (Stinging Nettle) and <i>Austrostipa verticillata</i> (Slender Bamboo Grass).</p> <p>Hunter Valley Vine Thicket has a highly restricted geographic distribution in the central Hunter Valley. The community occurs mostly as patches of less than 10 ha, with a few larger patches exceeding 100 ha. Approximately 85% of the pre-European distribution of the community remains. The largest occurrence is at Brushy Hill adjacent to Glenbawn Dam, north east of Scone. The only stand known to occur in a conservation reserve is at Mt Dangar within the Goulburn River National Park. Hunter Valley Vine Thicket has been recorded from the local government areas of Muswellbrook, Singleton, and Upper Hunter but may occur elsewhere within the Sydney Basin Bioregion and NSW North Coast Bioregion.</p>	Endangered				None
Hunter Valley Weeping Myall Woodland in the Sydney Basin Bioregion	<p>Hunter Valley Weeping Myall Woodland of the Sydney Basin bioregion typically has a dense to open tree canopy up to about 15 m tall, depending on disturbance and regrowth history. The most common tree is <i>Acacia pendula</i> (Weeping Myall), which may occur with <i>Eucalyptus crebra</i> (Narrow-leaved Ironbark), <i>A. salicina</i> (Cooba) and/or trees within the <i>A. homalophylla</i> - <i>A. melvillei</i> complex. Understorey shrubs may include <i>Canthium buxifolium</i> (Stiff Canthium), <i>Dodonaea viscosa</i> (Sticky Hopbush), <i>Geijera parviflora</i> (Wilga), <i>Notelaea microphylla</i> var. <i>microphylla</i> (Native Olive) and <i>Senna zygomphylla</i> (Silver Cassia). However, these shrubs are absent from some stands. The groundcover varies from dense to sparse, and is comprised of grasses such as <i>Austrodanthonia fulva</i> (a wallaby grass) and <i>Themeda australis</i> (Kangaroo Grass), and low shrubs and herbs such as <i>Chrysocephalum apiculatum</i> (Common Everlasting), <i>Einadia nutans</i> subsp. <i>nutans</i> (Climbing Saltbush), <i>Enchylaena tomentosa</i> (Ruby Saltbush), <i>Maireana microphylla</i> (Eastern Cotton Bush) and <i>Ptilotus semilanatus</i>.</p>	Critically Endangered		Critically Endangered		None
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	<p>Littoral Rainforest is generally a closed forest, the structure and composition of which is strongly influenced by its proximity to the ocean. The plant species of this community are predominantly rainforest species. Several species have compound leaves, and vines may be a major component of the canopy.</p> <p>Littoral Rainforest occurs only on the coast and is found at locations in the NSW North Coast Bioregion, Sydney Basin Bioregion and South East Corner Bioregion. Littoral Rainforest is very rare and occurs in many small stands. In total, it comprises less than one percent of the total area of rainforest in NSW. The largest known stand occurs in Iluka Nature Reserve, which is about 136 hectares in size. Not all stands of this community have been included in mapping for the Environmental Planning Policy 26, Littoral rainforest.</p> <p>Occurs on sand dunes and on soil derived from underlying rocks. Stands on headlands exposed to strong wind-action may take the form of dense, wind-pruned thickets. Stands are generally taller in sheltered sites such as hind dunes, although wind-pruning may still occur on their windward sides. Most stands occur within two kilometres of the sea, though are occasionally found further inland within reach of the maritime influence.</p>	Endangered		Critically Endangered		Low

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of occurrence within subject site
Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions	Restricted to a range of approximately 65 km by 35 km centred on the Cessnock - Beresfield area in the Central and Lower Hunter Valley. Within this range, the community was once widespread. A fragmented core of the community still occurs between Cessnock and Beresfield. Remnants occur within the Local Government Areas of Cessnock, Maitland, Singleton, Lake Macquarie, Newcastle and Port Stephens but may also occur elsewhere within the bioregion. Outliers are also present on the eastern escarpment of Pokolbin and Corrabare State Forests on Narrabeen Sandstone.	Endangered		None
Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions	Lower Hunter Valley Dry Rainforest mainly occurs on the Barrington footslopes along the northern rim of the Hunter Valley Floor, where it occupies gullies and steep hillslopes with south facing aspects. It is also known from south of the Hunter River at Mt Bright and Mt View. Lower Hunter Valley Dry Rainforest has been recorded from the local government areas of Cessnock, Maitland and Port Stephens, and is also likely to occur or have occurred in Muswellbrook, Singleton, Upper Hunter and Dungog LGAs. Lower Hunter Valley Dry Rainforest typically occurs on Carboniferous sediments in gullies and on steep hillslopes with south facing aspects. It is generally found at elevations less than 300 m ASL with a mean annual rainfall less than 900 mm	Vulnerable		None
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	<p>Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions is an ecological community of subtropical rainforest and some related, structurally complex forms of dry rainforest. Lowland Rainforest, in a relatively undisturbed state, has a closed canopy, characterised by a high diversity of trees whose leaves may be mesophyllous and encompass a wide variety of shapes and sizes. Typically, the trees form three major strata: emergents, canopy and sub-canopy which, combined with variations in crown shapes and sizes results in an irregular canopy appearance. The trees are taxonomically diverse at the genus and family levels, and some may have buttressed roots. A range of plant growth forms are present in Lowland Rainforest, including palms, vines and vascular epiphytes. In disturbed stands of this community the canopy cover may be broken, or the canopy may be smothered by exotic vines.</p> <p>The Hawkesbury River notionally marks the southern limit of Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions. South of the Sydney metropolitan area, Lowland Rainforest is replaced by Illawarra Subtropical Rainforest of the Sydney Basin Bioregion, which is listed as an endangered ecological community. Milton Ulladulla Subtropical Rainforest is also a related rainforest endangered ecological community that occurs still further south in the South East Corner Bioregion.</p>	Endangered	Critically Endangered	None

Threatened Ecological Community	Description	BC	Act	EPBC	Act	Likelihood of occurrence within subject site
		Status		Status		
Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion	<p>Lowland Rainforest on Floodplain is a rainforest community which now occurs only as small remnants in scattered localities on the NSW north coast, with less than 1000ha in total thought to remain. Larger stands of the community typically have a dense canopy, which blocks most light from reaching the ground, creating cool, moist conditions within. Lowland Rainforest on Floodplain supports a rich diversity of plants and animals. Typical tree species in the community include figs (<i>Ficus macrophylla</i>, <i>F. obliqua</i> and <i>F. watkinsiana</i>), palms (<i>Archontophoenix cunninghamiana</i> and <i>Livistona australis</i>), Silky Oak (<i>Grevillea robusta</i>), Black Bean (<i>Castanospermum australe</i>) and Brush Cherry (<i>Syzygium australe</i>). Animals present include fruit-eating rainforest pigeons, Noisy Pitta, Brush-turkey, pademelons, flying foxes, the Land Mullet skink and rainforest snails.</p> <p>Lowland Rainforest on Floodplain generally occupies riverine corridors and alluvial flats with rich, moist silts often in subcatchments dominated by basic volcanic substrates. Major examples once occurred, and remnants remain, on the floodplains of the Tweed, Richmond, Clarence, Bellinger, Macleay, Hastings, Manning, and Hunter Rivers. Other minor river systems also support the community. This community occurs on fertile soils in lowland river valleys.</p>	Endangered		Critically Endangered		None
Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion	<p>Quorrobolong Scribbly Gum Woodland is a low shrubby woodland with the overstorey dominated by <i>Eucalyptus racemosa</i> (Scribbly Gum). Other tree species present include <i>E. piperita</i> (Sydney Peppermint), <i>E. resinifera</i> (Red Mahogany), <i>Angophora costata</i> (Smooth-barked Apple) and <i>E. punctata</i> (Grey Gum). There is usually a well developed shrub layer with common species being <i>Leptospermum trinervium</i> (Slender Tea-tree), <i>Acacia parvipinnula</i> (Silver-stemmed Wattle), <i>Persoonia linearis</i> (Narrow-leaved Geebung) and <i>Leptospermum polygalifolium</i> (Tantoon). The ground layer is often sparse and frequently occurring species are <i>Imperata cylindrica</i> var. <i>major</i> (Blady Grass), <i>Panicum simile</i> (Two-colour Panic), <i>Pratia purpuracens</i> (Whiteroot), <i>Lomandra cylindrica</i> (Needle Mat-rush) and <i>Dianella revoluta</i>.</p> <p>Currently known from only a small area between Quorrobolong and Mulbring in the Cessnock local government area, but may also occur elsewhere within the Hunter Valley. The current known extent is about 70 hectares; the pre-European extent is estimated to have been only 160 hectares, reflecting the limited area of the sand deposit on which it occurs. Not known to occur within any conservation reserves. Occupies gentle slopes and rises on a residual sand deposit overlying the Permian clay sediments of the Hunter Valley floor.</p>	Endangered				None
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	<p>As the name suggests, this EEC is found on the river flats of the coastal floodplains. It has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include <i>Eucalyptus tereticornis</i> (forest red gum), <i>E. amplifolia</i> (cabbage gum), <i>Angophora floribunda</i> (rough-barked apple) and <i>A. subvelutina</i> (broad-leaved apple). <i>Eucalyptus baueriana</i> (blue box), <i>E. botryoides</i> (bangalay) and <i>E. elata</i> (river peppermint) may be common south from Sydney, <i>E. ovata</i> (swamp gum) occurs on the far south coast, <i>E. saligna</i> (Sydney blue gum) and <i>E. grandis</i> (flooded gum) may occur north of Sydney, while <i>E. benthamii</i> is restricted to the Hawkesbury floodplain.</p>	Endangered				None

Threatened Ecological Community	Description	BC	Act	EPBC	Act	Likelihood of occurrence within subject site
		Status		Status		
Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	<p>Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include <i>Eucalyptus tereticornis</i> (forest red gum), <i>E. siderophloia</i> (grey ironbark), <i>Corymbia intermedia</i> (pink bloodwood) and, north of the Macleay floodplain, <i>Lophostemon suaveolens</i> (swamp turpentine). Other trees may be scattered throughout at low abundance or locally common at few sites, particularly where there is an influence from lithic substrates upslope. These include <i>Eucalyptus moluccana</i> (grey box), <i>E. propinqua</i> (grey gum), <i>E. seeana</i> (narrow-leaved red gum), <i>Angophora subvelutina</i> (broad-leaved apple), <i>E. robusta</i> (swamp mahogany), <i>Eucalyptus resinifera</i> subsp. <i>hemilampra</i> (red mahogany), <i>E. acmenoides</i> (white mahogany), <i>Angophora woodsiana</i>, <i>A. paludosa</i> and rainforest trees such as <i>Ficus</i> spp. (figs) and <i>Cupaniopsis</i> spp. (tuckeroos). A layer of small trees may be present, including <i>Allocasuarina torulosa</i> (forest oak), <i>Alphitonia excelsa</i> (red ash), <i>Glochidion ferdinandi</i> (cheese tree), <i>Callistemon</i> spp. (bottlebrushes), <i>Melaleuca</i> spp. (paperbarks) and <i>Casuarina glauca</i> (swamp oak). Scattered shrubs include <i>Breynia oblongifolia</i> (coffee bush), <i>Acacia concurrens</i> (curracabah), <i>Commersonia</i> spp., and <i>Hibiscus</i> spp. Occasional vines include <i>Eustrephus latifolius</i> (wombat berry), <i>Parsonsia straminea</i> (common silkpod) and <i>Geitonoplesium cymosum</i> (scrambling lily). The groundcover is composed of abundant forbs, scramblers and grasses including <i>Imperata cylindrica</i> var. <i>major</i> (blady grass), <i>Themeda australis</i> (kangaroo grass), <i>Vernonia cinerea</i>, <i>Dianella caerulea</i> (blue flax lily), <i>Pratia purpurascens</i> (whiteroot), <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>, and <i>Dichondra repens</i> (kidney weed). The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.</p>	Endangered				None
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	<p>This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which <i>Casuarina glauca</i> (swamp oak) is the dominant species northwards from Bermagui. Other trees including <i>Acmena smithii</i> (lilly pilly), <i>Glochidion</i> spp. (cheese trees) and <i>Melaleuca</i> spp. (paperbarks) may be present as subordinate species, and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude, and <i>Melaleuca ericifolia</i> is the only abundant tree in this community south of Bermagui.</p> <p>The understorey is characterised by frequent occurrences of vines, <i>Parsonsia straminea</i>, <i>Geitonoplesium cymosum</i> and <i>Stephania japonica</i> var. <i>discolor</i>, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter.</p> <p>The composition of the ground stratum varies depending on levels of salinity in the groundwater. Under less saline conditions prominent ground layer plants include forbs such <i>Centella asiatica</i>, <i>Commelina cyanea</i>, <i>Persicaria decipiens</i> and <i>Viola banksii</i>; graminoids such as <i>Carex appressa</i>, <i>Gahnia clarkei</i>, <i>Lomandra longifolia</i>, <i>Oplismenus imbecillis</i>; and the fern <i>Hypolepis muelleri</i>. On the fringes of coastal estuaries, where soils are more saline, the ground layer may include the threatened grass species, <i>Alexfloydia repens</i>, as well as <i>Baumea juncea</i>, <i>Juncus kraussii</i>, <i>Phragmites australis</i>, <i>Selliera radicans</i> and other saltmarsh species.</p> <p>Known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes, Port Stephens, Maitland, Newcastle, Cessnock, Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Hawkesbury, Baulkham Hills, Hornsby, Lane Cove, Blacktown, Auburn, Parramatta, Canada Bay, Rockdale, Kogarah, Sutherland, Penrith, Fairfield, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. Major examples once occurred on the floodplains of the Clarence, Macleay, Hastings, Manning, Hunter, Hawkesbury, Shoalhaven and Moruya Rivers.</p>	Endangered		Endangered		Low

Threatened Ecological Community	Description	BC	Act	EPBC	Act	Likelihood of occurrence within subject site
		Status		Status		
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	<p>This swamp community has an open to dense tree layer of eucalypts and paperbarks although some remnants now only have scattered trees as a result of partial clearing. The trees may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality where the tree stratum is low and dense. For example, stands dominated by <i>Melaleuca ericifolia</i> typically do not exceed 8 m in height. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent.</p> <p>The most widespread and abundant dominant trees include <i>Eucalyptus robusta</i>(swamp mahogany), <i>Melaleuca quinquenervia</i> (paperbark) and, south from Sydney, <i>Eucalyptus botryooides</i> (bangalay) and <i>Eucalyptus longifolia</i>(woollybutt). Other trees may be scattered throughout at low abundance or may be locally common at few sites, including <i>Callistemon salignus</i> (sweet willow bottlebrush), <i>Casuarina glauca</i> (swamp oak) and <i>Eucalyptus resinifera</i> subsp. <i>hemilampra</i> (red mahogany), <i>Livistona australis</i> (cabbage palm) and <i>Lophostemon suaveolens</i> (swamp turpentine).</p> <p>A layer of small trees may be present, including <i>Acacia irrorata</i> (green wattle), <i>Acmena smithii</i> (lilly pilly), <i>Elaeocarpus reticulatus</i> (blueberry ash), <i>Glochidion ferdinandi</i> (cheese tree), <i>Melaleuca linariifolia</i> and <i>M. styphelioides</i>(paperbarks). Shrubs include <i>Acacia longifolia</i>, <i>Dodonaea triquetra</i>, <i>Ficus coronata</i>, <i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i> and <i>Melaleuca</i> spp. Occasional vines include <i>Parsonsia straminea</i>, <i>Morinda jasminoides</i> and <i>Stephania japonica</i> var. <i>discolor</i>.</p> <p>The groundcover is composed of abundant sedges, ferns, forbs, and grasses including <i>Gahnia clarkei</i>, <i>Pteridium esculentum</i>, <i>Hypolepis muelleri</i>, <i>Calochlaena dubia</i>, <i>Dianella caerulea</i>, <i>Viola hederacea</i>, <i>Lomandra longifolia</i>, <i>Entolasia marginata</i> and <i>Imperata cylindrica</i>. On sites downslope of lithic substrates or with soils of clay-loam texture, species such as <i>Allocasuarina littoralis</i>, <i>Banksia oblongifolia</i>, <i>B. spinulosa</i>, <i>Ptilothrix deusta</i> and <i>Themeda australis</i>, may also be present in the understorey.</p>	Endangered				Low
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	<p>A complex of vegetation types largely restricted to freshwater swamps in coastal areas. These also vary considerably due to fluctuating water levels and seasonal conditions. Characteristic species include sedges and aquatic plants such as <i>Baumea</i> species, <i>Eleocharis sphacelata</i>, <i>Gahnia</i> species, <i>Ludwigia peploides</i> subsp. <i>montevidensis</i> and <i>Persicaria</i> species.</p> <p>Occurs on sand dunes and low-nutrient sandplains along coastal areas in the Sydney Basin bioregion. It is known from the Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Woollahra, Waverley, Botany, Rockdale, Randwick, Sutherland and Wollongong local government areas, but is likely to occur elsewhere within the bioregion. Has been extensively cleared and filled and remnants are often small and disturbed.</p> <p>Largely restricted to freshwater swamps in swales and depressions on sand dunes and low nutrient sandplains such as those of the Warriewood and Tuggerah soil landscapes. Swampy areas on alluvium with a saline influence do not fall within this community.</p>	Endangered				None

Threatened Ecological Community	Description	BC	Act	EPBC	Act	Likelihood of occurrence within subject site
		Status		Status		
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	<p>Themeda Grassland on seacliffs and coastal headlands is found on a range of substrates in the NSW North Coast, Sydney Basin and South East Corner bioregions. Stands on sandstone are infrequent and small. Larger stands are found on old sand dunes above cliffs, as for example at Cape Banks and Henry Head in Botany Bay National Park, and on metasedimentary headlands, as for example at McCauleys Headland in Coffs Coast Regional Park, Look-at-me-now Headland, Dammerels Head and Bare Bluff in Moonee Beach Nature Reserve and Wilson's Headland in Yuraygir National Park. Individual stands of the community are often very small, a few square metres, but at some sites larger stands of up to several hectares or tens of hectares occur. Overall, the community has a highly restricted geographic distribution comprising small, but widely scattered patches.</p> <p>The community is found on a range of substrates, although stands on sandstone are infrequent and small. Larger stands are found on old sand dunes above cliffs, for example at Cape Banks and Henry Head in Botany Bay National Park, and on metasedimentary are rarely adamellite headlands on the north coast. Individual stands of the community are often very small, a few square metres, but at some sites larger stands of up to several hectares or tens of hectares occur. Overall, the community therefore has a highly restricted geographic distribution comprising small, but widely scattered patches.</p>	Endangered				None
Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion	<p>A low woodland dominated by trees of <i>Eucalyptus botryoides</i> and <i>Angophora floribunda</i> with a diverse understorey of sclerophyllous shrubs species including <i>Banksia integrifolia</i>, <i>Banksia serrata</i>, <i>Monotoca elliptica</i>, <i>Macrozamia communis</i>, <i>Acacia ulicifolia</i>, <i>Platysace lanceolata</i>, <i>Acacia suaveolens</i> and <i>Allocasuarina littoralis</i>. <i>Eucalyptus botryoides</i> is the dominant tree in the zone immediately behind the beach, while <i>Angophora floribunda</i> is dominant in the zone beyond up to 2 km from the beach.</p> <p>Largely restricted to coastal sands on the Umina, Woy Woy and Ettalong Sandplain, a beach ridge system within the Gosford local government area. Including ecotonal areas, less than 10% (being less than 10 hectares) of the community's estimated original cover of about 80 hectares remains. This comprises four main remnants at Umina, while a few smaller remnant patches and scattered trees around Pearl Beach and Patonga and elsewhere on the 'Peninsula' indicate its former distribution.</p>	Endangered				None
Warkworth Sands Woodland in the Sydney Basin Bioregion	<p>Warkworth Sands Woodland is a low woodland dominated by <i>Angophora floribunda</i> (Rough-barked Apple) and <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> (Coast Banksia). Other tree species may be present such as <i>Eucalyptus tereticornis</i> (Forest Red Gum) and <i>E. glaucina</i> (Slaty Red Gum). Shrub and ground layer species commonly present include <i>Acacia filicifolia</i> (Fern-leaved Wattle), <i>Melaleuca thymifolia</i> (Thyme Honey-myrtle), <i>Brachyloma daphnoides</i> (Daphne Heath), <i>Pteridium esculentum</i> (Bracken), <i>Pimelea linifolia</i> (Slender Rice Flower), <i>Imperata cylindrica</i> var. <i>major</i> (Blady Grass), <i>Chrysocephalum apiculatum</i> (Common Everlasting) and <i>Glycine clandestina</i>. Small drainage lines within the area occupied by this community may support the presence or higher abundance of certain species (such as <i>Melaleuca thymifolia</i>) and the absence or lower abundance of others (such as <i>Banksia integrifolia</i> subsp. <i>integrifolia</i>). Such areas are included as part of this community.</p>	Endangered		Critically Endangered		None
White Box, Yellow Box, Blakely's Red Gum Woodland and Derived Native Grassland	<p>White Box Yellow Box Blakely's Red Gum Woodland (commonly referred to as Box-Gum Woodland) is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: White Box <i>Eucalyptus albens</i>, Yellow Box <i>E. melliodora</i> and Blakely's Red Gum <i>E. blakelyi</i>. Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. The community also includes a range of mammal, bird, reptile, frog and invertebrate fauna species. Intact stands that contain diverse upper and mid-storeys and groundlayers are rare.</p>	Endangered		Critically Endangered		None

Annex 2. Plant Community Type

PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast

Habitat: PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland has been mapped as occurring throughout the majority of the subject site, in five different condition classes based on similar age of rehabilitation and natural succession:

- Zone 1 = 14.13 ha
- Zone 2 = 3.87 ha
- Zone 4 = 5.19 ha
- Zone 5 = 1.71 ha
- Zone 6 = 8.09 ha.

Whilst it is noted in this report that much of the subject site consists of planting, as per the OEH (2018) Biodiversity Assessment Method Operational Manual, '*Planted native vegetation is treated in the same way as native vegetation if it meets the definition of native vegetation in Section 5A of the Local Land Services Act 2013. Where the vegetation is a mix of local and non-local planted species the assessor should consider the best matching PCT based on the local species present*'. As such, we have aligned the areas of native rehabilitated land to PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland due to the following:

PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland occupied the subject site prior to vegetation clearing for the former inland extraction area; and

- The canopy tubestock planted within the subject site (*Eucalyptus pilularis*, *Corymbia gummifera*, and *Angophora costata*) are the dominant species of PCT1646.
- The structure of the PCT within the subject site is highly attributed to the age of the regeneration that has taken place over the past decade. The structure associated with each of the vegetation zones have been provided in the table below.

In summary, the vegetation recorded within the subject site is consistent with the description of PCT1646 due to the following:

- The dominant canopy species recorded within the subject site comprise *Eucalyptus pilularis*, *Corymbia gummifera*, and *Angophora costata* which are dominants within PCT1646
- The subject site occurs on quaternary dune sands
- The structure of the remnant condition class is an open forests to woodland dominated in the canopy by *Angophora*'s
- The structure of the remnant condition class consists of a sparse mid-stratum that is typically characterised by *Banksia*'s
- The structure of the remnant condition class is relatively sparse and is characterised by grasses and ferns.

Conservation Status: PCT1646 does not align to any TECs under the BC or EPBC Acts.

Condition classes: Five condition classes were assigned to PCT1646 within the subject site:

Vegetation zone	Description	Photo of vegetation zone
Zone 1	<p>Canopy: dominated by planted <i>Eucalyptus pilularis</i>, and <i>Corymbia gummifera</i>. The age of eucalypts are approximately 10 years old. None have developed hollows and are approximately 5 metres in height.</p> <p>Midstorey and shrub layer: Relatively sparse shrub layer consisting of planted native species: <i>Acacia sophorae</i>, <i>A. suaveolens</i>, <i>A. ulicifolia</i>, <i>Allocasuarina littoralis</i>, <i>Angophora costata</i>, <i>Aotus ericoides</i>, and <i>Leptospermum</i> species.</p> <p>Ground cover: Very sparse ground cover dominated by planted and naturally regenerating species including: <i>Lomandra longifolia</i>, <i>Pteridium esculentum</i>, <i>Imperata cylindrica</i>, <i>Hibbertia virgata</i>, and <i>Themeda australis</i>.</p>	 <p>Plate 10. Vegetation zone – Zone 1</p>
Zone 2	<p>Canopy: No large canopy present. Very sparse planted <i>Angophora costata</i> and <i>Corymbia gummifera</i>. Many of the canopy species are less than 2 metres in height and are sparsely scattered throughout the zone.</p> <p>Midstorey: Very sparsely scattered tubestock of <i>Acacia suaveolens</i>, <i>Allocasuarina littoralis</i>, <i>Banksia serrata</i>, <i>Bossiaea heterophylla</i> and <i>Dillwynia retorta</i>.</p> <p>Ground cover was particularly sparse in term of native vegetation cover. Some planted success of <i>Carpobrotus glaucescens</i>, <i>Lomandra longifolia</i>, <i>Pteridium esculentum</i>, <i>Imperata cylindrica</i>, <i>Hibbertia virgata</i>, and <i>Themeda australis</i>.</p>	 <p>Plate 11. Vegetation zone – Area 2</p>
Zone 4	<p>Canopy: No large canopy present. Very sparse planted <i>Angophora costata</i> and <i>Corymbia gummifera</i>. Many of the canopy species are less than 1 metres in height and are sparsely scattered throughout the zone.</p> <p>Midstorey: Very sparsely scattered tubestock of <i>Acacia suaveolens</i>, <i>Allocasuarina littoralis</i>, <i>Banksia serrata</i>, <i>Bossiaea heterophylla</i> and <i>Dillwynia retorta</i>.</p> <p>Ground cover was particularly sparse in term of native vegetation cover. Some planted success of <i>Carpobrotus glaucescens</i>, <i>Lomandra longifolia</i>, <i>Imperata cylindrica</i>, and <i>Themeda australis</i>.</p>	 <p>Plate 12. Vegetation zone – Zone 4</p>
Zone 5	<p>Canopy: dominated by <i>Eucalyptus pilularis</i>, <i>Angophora costata</i> and <i>Corymbia gummifera</i>. Typical height is approximately 10 metres and 20% Projected foliage cover.</p> <p>In-fill planting has occurred throughout the area, though has a high resilience.</p> <p>Midstorey and shrub layer: Relatively moderate cover of shrubs including: <i>Acacia sophorae</i>, <i>A. ulicifolia</i>, <i>Banksia integrifolia</i>, <i>B. serrata</i>, <i>Bossiaea rhombifolia</i>, <i>Leptospermum</i> species.</p> <p>Ground cover: Dominant species include: <i>Pteridium esculentum</i>, <i>Imperata cylindrica</i>, <i>Themeda australis</i>.</p>	 <p>Plate 13. Vegetation zone – Zone 5</p>

Vegetation zone	Description	Photo of vegetation zone
Zone 6	<p>Canopy: dominated by <i>Eucalyptus pilularis</i>, <i>Angophora costata</i> and <i>Corymbia gummifera</i>. Typical height is approximately 12 metres and 30% Projected foliage cover. Some in-fill planting though due to the resilience and natural succession, has been combined as one vegetation zone.</p> <p>Midstorey and shrub layer: Relatively moderate to dense cover of shrubs including: <i>Acacia sophorae</i>, <i>A. ulicifolia</i>, <i>Banksia integrifolia</i>, <i>B. serrata</i>, <i>Bossiaea rhombifolia</i>, <i>Leptospermum</i> species.</p> <p>Ground cover: Dominant species include: <i>Pteridium esculentum</i>, <i>Imperata cylindrica</i>, <i>Themeda australis</i>, <i>Glycine</i> species, <i>Hibbertia virgata</i>.</p>	 <p>Plate 14. Vegetation zone – Zone 6</p>

PCT1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast

Habitat: PCT1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes has been mapped as occurring to the east of the subject site as a 2.67 ha patch. The area has been historically cleared and rehabilitated with tubestock and natural regeneration comprising predominately of *Leptospermum laevigatum* (Plate 15).

The area of rehabilitation has been aligned to PCT1646 given the following:

- Dominance of *Leptospermum laevigatum* which is a key diagnostic species of the PCT
- Occasional *Banksia serrata* and *Angophora costata* which are also key diagnostic upper stratum species
- The following species were recorded in the vegetation zone and are diagnostic species of the PCT: *Acacia longifolia*, *Dodonaea triquetra*, *Ricinocarpos pinifolius*, *Monotoca elliptica*, *Kennedia rubicunda*, *Pteridium esculentum*, *Lomandra longifolia* and *Hardenbergia violacea*.

The structure of the PCT within the subject site is described as follows:

- Canopy: Occasional presence of *Angophora costata* more towards the patch boundaries. The canopy has a projected foliage cover of approximately 5-10 percent and is approximately 15 metres in height.
- Midstorey and shrub layer: Dominated by *Leptospermum laevigatum* which forms a thicket in areas. Other shrubs include *Allocasuarina littoralis*, *Acacia longifolia*, *Dodonaea triquetra*, *Ricinocarpos pinifolius*, *Monotoca elliptica*.
- Ground layer: A very sparse ground layer which is likely attributed to the high amounts of leave litter and the shading from the *Leptospermum laevigatum* across the vegetation zone. Common ground cover recorded included: *Imperata cylindrica*, *Themeda australis*, *Dianella caerulea*, and *Pomax umbellata*.

Conservation Status: This PCT does not align to a TEC under the BC or EPBC Acts.



Plate 15. PCT1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes within the subject site

Non-native vegetation

Portions of the subject site where there are no native species present have been attributed to a 'non-native' vegetation type. These areas typically include existing access tracks, haul road, areas of bare sand, and existing infrastructure.

Annex 4. BAM plot transect scores

Note: field data was collected in electronic format, therefore raw data sheets have not been provided in this report. We can supply the raw data files in an excel format as required.

Key to growth form groups: TG - Tree; SG - Shrub; GG - Grass and Grass-like; FG - Forb; EG - Fern; OG – Other; **Function codes:** NLT - Number of large trees; TSSC - Tree Stem Size Class; NTH - Number of trees with hollows; FL - Course Woody Debris (fallen logs); LL - mean leaf litter cover; HTW - High Threat Weeds

* 1 m² litter quadrats were placed at 5 m (left), 15 m (right), 25 m (left), 35 m (right) and 45 m (left) along the central 50 m transect, all positioned 5 m from the transect centreline and alternating to the left and right from the transect centreline (as indicated).

plot	pct	Patch size	Condition class	zone	easting	northing	bearing	Comp Tree	Comp Shrub	Comp Grass	Comp Forbs	Comp Ferns	Comp Other	Struc Tree	strucShrub	Struc Grass	Struc Forbs	Struc Ferns	Struc Other	Fun Large Trees	Fun Hollowtrees	Fun Litter Cover	Fun Len Fallen Logs	Fun Tree Stem 5to9	Fun Tree Stem 10to19	Fun Tree Stem 20to29	Fun Tree Stem 30to49	Fun Tree Stem 50to79	Fun Tree Regen	Fun High Threat Exotic
1	1646	101	Zone 1	56	390457.5	6364611	270	3	7	4	4	1	1	44.0	39.9	13.0	2.7	0.5	0.1	Absent	0	90	12	Y	Y	N	N	N	0	0.1
2	1646	101	Zone 1	56	390618.5	6364835	250	4	11	2	2	0	1	24.0	23.6	5.5	0.6	0.0	0.1	Absent	0	70	22	Y	Y	N	N	N	0	0.0
3	1646	101	Zone 2	56	390742.9	6364902	53	2	2	2	2	0	0	3.5	2.5	20.2	0.6	0.0	0.0	Absent	0	30	10	Y	N	N	N	N	0	0.0
4	1646	101	Zone 1	56	390795.4	6364855	8	3	8	3	3	1	2	41.5	12.0	0.4	6.1	0.1	1.0	Absent	0	80	8	Y	Y	Y	N	N	0	5.5
5	1646	101	Zone 2	56	390846.3	6364919	43	4	8	1	4	0	2	7.0	25.8	0.2	2.5	0.0	1.1	Absent	0	20	14	Y	N	N	N	N	0	5.0
6	1646	101	Zone 4	56	390933.9	6364870	38	3	4	0	0	0	2	7.5	4.0	0.0	0.0	0.0	0.3	Absent	0	5	26	Y	N	N	N	N	0	0.0
7	1646	101	Zone 4	56	391182	6365058	272	0	4	0	1	0	1	0.0	11.3	0.0	0.2	0.0	0.5	Absent	0	5	0	Y	N	N	N	N	0	5.0
8	1646	101	Zone 4	56	391073	6365084	86	0	4	0	1	0	1	0.0	5.9	0.0	0.2	0.0	0.5	Absent	0	5	5	Y	N	N	N	N	0	2.0
9	1646	101	Zone 6	56	391167.8	6364923	175	5	3	3	4	1	2	42.0	4.2	11.2	10.8	1.0	0.6	Present	4	80	10	Y	Y	Y	Y	Y	0	0.1
10	1644	101	Zone 3	56	6364885	391334	88	3	5	2	2	0	2	7.0	80.0	16.0	4.0	0.0	2.0	Absent	0	85	1	Y	Y	N	N	N	0	3.0
11	1644	101	Zone 3	56	391302.1	6364712	92	5	5	2	2	1	1	11.0	76.0	5.0	5.0	3.0	0.1	Absent	0	90	0	Y	N	N	N	N	0	5.0
12	1646	101	Zone 6	56	391298.6	6364678	190	4	7	4	3	1	4	66.5	45.6	5.1	1.2	70.0	4.6	Present	5	75	10	Y	Y	Y	Y	Y	0	2.0
13	1646	101	Zone 1	56	391348.1	6365205	200	5	6	0	1	0	1	40.0	7.1	0.0	1.0	0.0	0.5	Absent	0	50	0	Y	Y	Y	N	N	0	0.5
17	1646	101	Outside of impact area	56	390973	6365171	90	2	9	3	6	0	2	5.5	17.4	43.5	6.9	0.0	0.2	Absent	0	7.5	0	Y	N	N	N	N	0	0.2
14	1646	101	Zone 5	56	391321	6365056	110	2	3	3	4	1	2	25.0	0.5	9.0	0.5	3.0	0.3	Absent	3	80	18	Y	Y	Y	Y	N	1	2.0
15	1646	101	Zone 6	56	390576	6364585	112	3	5	4	5	1	4	20.0	7.7	7.1	1.6	15.0	0.4	Absent	4	75	22	Y	Y	Y	Y	Y	1	1.0
16	1646	101	Zone 6	56	390876	6364777	96	4	3	4	7	1	3	17.0	1.2	7.1	1.7	10.0	0.3	Absent	3	80	16	Y	Y	Y	Y	N	1	0.0

Annex 5. Fauna species list

Group	Scientific	Common name	Status	Observation	Camera trap
Amphibia	<i>Crinia signifera</i>	Common eastern froglet	P	H	
Amphibia	<i>Limnodynastes peronii</i>	Striped Marsh Frog	P	H	
Amphibia	<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog	P	H	
Amphibia	<i>Litoria caerulea</i>	Green Tree Frog	P	H	
Amphibia	<i>Litoria peronii</i>	Perons Tree Frog	P	H	
Reptilia	<i>Morelia spilota spilota</i>	Diamond Python	P	O	
Reptilia	<i>Pseudonaja textilis</i>	Eastern Brown Snake	P	O	
Reptilia	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	P	O	
Aves	<i>Cracticus tibicen</i>	Australian Magpie	P	H	X
Aves	<i>Corvus coronoides</i>	Australian Raven	P	O H	
Aves	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	P	H	
Aves	<i>Coracina novaehollandiae</i>	Black-faced cuckoo-shrike	P	O	
Aves	<i>Acanthiza pusilla</i>	Brown Thornbill		O	
Aves	<i>Anas castanea</i>	Chestnut teal	P	O	
Aves	<i>Platycercus elegans</i>	Crimson Rosella	P	O H	
Aves	<i>Artamus cyanopterus</i>	Dusky woodswallow	P	O	
Aves	<i>Platycercus eximius</i>	Eastern Rossella	P	O	
Aves	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	P	O H	
Aves	<i>Psophodes olivaceus</i>	Eastern Whipbird	P	O H	
Aves	<i>Eopsaltria australis</i>	Eastern Yellow Robin	P	O H	
Aves	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	P	O H	
Aves	<i>Eolophus roseicapillus</i>	Galah	P	O	
Aves	<i>Cracticus torquatus</i>	Grey butcherbird	P	O H	
Aves	<i>Rhipidura albiscapa</i>	Grey Fantail	P	H	
Aves	Welcome Swallow	<i>Hirundo neoxena</i>	P	O	
Aves	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	P	O H	
Aves	<i>Grallina cyanoleuca</i>	Magpie Lark	P	O	
Aves	<i>Dicaeum hirundinaceum</i>	Mistletoebird	P	O H	
Aves	<i>Dicaeum hirundinaceum</i>	Mistletoebird	P	O	
Aves	<i>Falco cenchroides</i>	Nankeen Kestrel		O	
Aves	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	P	O H	
Aves	<i>Philemon corniculatus</i>	Noisy Friar Bird	P	O H	
Aves	<i>Manorina melanocephala</i>	Noisy Miner	P	O H	X
Aves	Rufous Whilster	<i>Pachycephala rufiventris</i>	P	O	
Aves	<i>Strepera graculina</i>	Pied Currawong	P	O H	
Aves	<i>Trichoglossus moluccanus</i>	Rainbow Lorikeet		O, H	
Aves	<i>Neochmia temporalis</i>	Red-browed finch	P	O	
Aves	<i>Sericornis frontalis</i>	Scrub wren		O	
Aves	<i>Zosterops lateralis</i>	Silvereye	P	O H	
Aves	<i>Zosterops lateralis</i>	Silvereye	P	O	

Group	Scientific	Common name	Status	Observation	Camera trap
Aves	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	P	O H	
Aves	<i>Malurus cyaneus</i>	Superb Fairy-wren	P	O H	
Aves	<i>Podargus strigoides</i>	Tawny Frogmouth	P	H	
Aves	<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle	V, M	O	
Aves	<i>Sericornis frontalis</i>	White-browed Scrubwren	P	O H	
Aves	<i>Epthianura albifrons</i>	White-fronted chat	P	O	
Aves	<i>Rhipidura leucophrys</i>	Willie Wagtail	P	O H	
Aves	<i>Acanthiza nana</i>	Yellow Thornbill	P	O H	
Aves	<i>Lichenostomus chrysops</i>	Yellow-faced honeyeater	P	O	
Aves	<i>Calyptorhynchus funereus</i>	Yellow-tailed black-cockatoo	P	O	
Aves	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	P	O	
Mammalia	<i>Trichosurus vulpecula</i>	Common Brushtail Possum	P	O	X
Mammalia	<i>Pseudocheirus peregrinus</i>)	Common Ringtail Possum	P	O	X
Mammalia	<i>Miniopterus schreibersii</i>	Eastern Bentwing Bat	V	Anabat	
Mammalia	<i>Vulpes vulpes</i>	Fox	U	O H	
Mammalia	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	Anabat	Camera trap
Mammalia	<i>Oryctolagus cuniculus</i>	Rabbit	U	O	
Mammalia	<i>Wallabia bicolor</i>	Swamp Wallaby	P	O	
Reptilia	<i>Tiliqua scincoides</i>	Eastern Blue Tongue	P	O	
Reptilia	<i>Physignathus lesueurii</i>	Eastern water dragon	P	O	
Reptilia	<i>Eulamprus quoyii</i>	Eastern water-skink	P	O	
Reptilia	<i>Pseudechis porphyriacus</i>	Red-bellied black snake	P	O	
Reptilia	<i>Ctenotus robustus</i>	Striped Skink	P	O	

Key: W – heard; O – observed; U – ultrasonic bat call (D – definite ID, P – probable ID); V = Vulnerable.

Note: field data was collected in electronic format, therefore raw data sheets have not been provided.

Annex 6. Weather Condition

Weather conditions during survey and trapping (BoM 2020– Newcastle Nobby Station)

Date	Day	Temps		Rain	Max wind gust		9:00 AM				3:00 PM			
		Min	Max		Dir	Spd	Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
		°C	°C		mm	km/h	°C	%	km/h	°C	%	km/h		
May														
20	We	10.6	23.8	0			15		N	9				
21	Th	12.6	16.8	2			13.8	96	Calm					
22	Fr	8	16.6	8.2			11	78	Calm					
23	Sa	10.5	16.2	0.8			12.5	71	NW	37				
24	Su	10.4	18	0.2			14.5	69	SW	37				
25	Mo	8.6	16.5	0			16.4	56	SW	28				
26	Tu	12.2	20.2	33.2			15.1	97	Calm					
27	We	10.7	19.8	1.4			14.5	88	Calm					
28	Th	9.8	23.2	0			11.8	99	Calm					
29	Fr	11.2	19.2	0			16.2	77	Calm					
30	Sa	8.2	20	0.4			13.8	87	Calm					
31	Su	9.7	21.2	0.2			13	94	NW	9				
June														
1	Mo	12.9	22.6	0	W	57	14.9	83	NW	6	21.9	44	NW	33
2	Tu	8.6	15.8	0	WNW	54	10.4	69	WNW	35	14.5	59	W	22
3	We	9	18.1	0.6	S	61	12.7	67	WNW	26	16.9	54	SSW	30
4	Th	12	16.5	0	SSW	54	13.8	63	SW	24	15.2	66	SW	19
5	Fr	9.6	19.4	0	NW	26	12.1	77	NW	17	18.9	51	NW	13
6	Sa	8.3	18.2	0	NW	19	11.9	80	NW	11	17.4	69	SE	7
7	Su	7.5	17.1	0	SE	41	9.8	100	WNW	11	16.4	79	SSW	11
8	Mo	9.8	18.4	9.6	SSW	50	13.8	84	SW	17	15.8	75	SW	24
9	Tu	13.6	18.7	19.6	ESE	50	17.4	84	SE	30	17.8	87	SSE	26
10	We	15.2	17.3	6.6	ENE	43	15.4	100	ENE	22	16.7	99	E	17
11	Th	14.7	19.4	10.6	S	33	15.3		NW	13	18.5	84	SSW	11
12	Fr	14.7	18.1	0.2	SW	31	16.1	89	SSW	15	17.3	89	SSW	17
13	Sa	13.3	19.4	0	NNW	19	14.2	100	WNW	7	18.6	90	ESE	4
14	Su	14.2	21.1	11.2	NW	48	14.8		NNW	17	21.1	54	NW	28
15	Mo	11	19.3	0			13.3	67	WNW	30	18.8	47	NW	17
16	Tu	11.1	20	0			13.4	76	NW	24	19.5	56	NW	19
17	We	10.2	18.7	0	SE	54	14.2	78	WNW	9	17.9	78	SSE	41
18	Th	14.2	18.2	0.6	SE	43	16.2	74	S	22	17.5	62	SSE	17
19	Fr	10.1	19.2	0.4	ENE	28	10.7		NW	9	18.9	68	ENE	11
20	Sa	8.4	20.5	0	NW	28	9.9		NW	15	20.3	58	NNW	11
21	Su	9.8	15.3	0.2	W	56	12.5	98	NW	9	12.9	86	N	6
22	Mo	10.2	16.2	7.4	NW	54	12.7	76	NW	22	15.5	57	NW	33
23	Tu	8.9	16.1	0.2	NW	46	11.4	77	WNW	30	15.3	53	NW	28
24	We	9.9	18.1	0	NW	56	12.2	71	NW	39	17.7	52	WNW	30

Date	Day	Temps		Rain	Max wind gust		9:00 AM				3:00 PM			
		Min	Max		Dir	Spd	Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
		°C	°C		mm	km/h	°C	%	km/h	°C	%	km/h		
25	Th	10.2	17.7	0	NW	39	12.3	74	WNW	22	17.3	55	WNW	28
26	Fr	8.9	18.7	0	SSE	31	13	65	WNW	9	16.3	68	S	20
27	Sa	12.6	16.4	0	SSE	41	15.6	79	S	31	14.7	80	S	22
28	Su	11.6	15.7	0.4	S	39	13.8	78	WSW	11	15	75	S	26
29	Mo	9.2	18	0	ESE	20	11.7	98	NW	9	16.6	76	S	11
30	Tu	8.6	19	0	NNW	20	10.1	100	NW	11	18.7	59	N	9
July														
1	We	8.3	19.9	0.2	NW	30	10.7	83	NW	20	19.5	43	NW	20
2	Th	9.8	23.2	0	NW	44	12.9	76	NW	19	23	39	NW	24
3	Fr	12.8	20.4	0.2	S	31	15.3	73	SSW	9	20	47	W	13
November														
9	Mo	14.1	20.9	0	E	26	19.6	63	Calm		19.4	54	ESE	17
10	Tues	14.6	20.9	0	ENE	37	18.3	71	Calm		19.1	65	E	24
11	Wed	16.1	22.4	0	ENE	43	20.1	74	Calm		21.8	79	E	24
12	Thur	18.1	24.5	0	NE	41	21.2	79	N	17	22.4	83	ENE	28
13	Fri	19.3	26.4	2.8	W	81	21.9	83	NNE	11	22.8	79	ENE	24

Annex 7. Hollow-bearing tree register

Note: field data was collected in electronic format, therefore raw data sheets have not been provided in this report. We can supply the raw data files in an excel format as required.

ID no.	latitude	longitude	Habitat feature	No. hollows	Tree	Size category
97	-32.849141	151.833274	Hollow-bearing tree	2	Blackbutt	<5 cm
128	-32.852263	151.830274	Hollow-bearing tree	1	Eucalyptus pilularis	<5 cm
137	-32.851452	151.830804	Hollow-bearing tree	1	Angophora costata	<5 cm
250	-32.850558	151.838684	Hollow-bearing tree	1	Angophora	<5 cm
263	-32.849007	151.837667	Hollow-bearing tree	1	Bloodwood	<5 cm
277	-32.849143	151.834689	Hollow-bearing tree	1	Red Bloodwood	<5 cm
278	-32.849249	151.834758	Hollow-bearing tree	2	Blackbutt	<5 cm
282	-32.849217	151.834946	Hollow-bearing tree	1	Blackbutt	<5 cm
284	-32.849056	151.835259	Hollow-bearing tree	2	Angophora floribunda	<5 cm
287	-32.849077	151.835542	Hollow-bearing tree	2	Blackbutt	<5 cm
306	-32.849739	151.834242	Hollow-bearing tree	1	Angophora costata	<5 cm
337	-32.849096	151.835796	Hollow-bearing tree	1	Corymbia gummifera	<5 cm
338	-32.848783	151.835928	Hollow-bearing tree	1	Corymbia gummifera	<5 cm
340	-32.84851	151.83597	Hollow-bearing tree	1	Eucalyptus pilularis	<5 cm
342	-32.848564	151.836134	Hollow-bearing tree	1	Angophora costata	<5 cm
343	-32.848586	151.836152	Hollow-bearing tree	1	Angophora costata	<5 cm
95	-32.849067	151.833374	Hollow-bearing tree	3	Blackbutt	10 - 15 cm
96	-32.84929	151.833528	Hollow-bearing tree	8	Blackbutt	10 - 15 cm
98	-32.849486	151.834182	Hollow-bearing tree	1	Blackbutt	10 - 15 cm
101	-32.849511	151.833819	Hollow-bearing tree	2	Red bloodwood	10 - 15 cm
105	-32.851722	151.829204	Hollow-bearing tree	1	E pilularis	10 - 15 cm
112	-32.851841	151.829839	Hollow-bearing tree	1	Corymbia gummifera	10 - 15 cm
113	-32.852397	151.829489	Hollow-bearing tree	1	E pilularis	10 - 15 cm
121	-32.852369	151.830113	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm

ID no.	latitude	longitude	Habitat feature	No. hollows	Tree	Size category
127	-32.852389	151.830201	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
151	-32.850909	151.831748	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
152	-32.850971	151.831884	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
165	-32.847322	151.838867	Hollow-bearing tree	3	Blackbutt	10 - 15 cm
166	-32.847363	151.838791	Hollow-bearing tree	3	Blackbutt	10 - 15 cm
169	-32.848563	151.83985	Hollow-bearing tree	2	Angophora costata	10 - 15 cm
170	-32.848257	151.839861	Hollow-bearing tree	3	Blackbutt	10 - 15 cm
209	-32.850082	151.837762	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
210	-32.850053	151.837726	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
215	-32.848871	151.838217	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
217	-32.848698	151.838214	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
220	-32.848372	151.837937	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
223	-32.848164	151.837343	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
225	-32.848737	151.837363	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
227	-32.849015	151.837609	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
229	-32.849157	151.837579	Hollow-bearing tree	1	Angophora floribunda	10 - 15 cm
230	-32.849221	151.837575	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
233	-32.848712	151.837152	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
234	-32.848765	151.837053	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
245	-32.848927	151.839225	Hollow-bearing tree	1	Blackbutt	10 - 15 cm
253	-32.849756	151.837813	Hollow-bearing tree	6	Angophora	10 - 15 cm
267	-32.848629	151.837151	Hollow-bearing tree	10	Angophora costata	10 - 15 cm
273	-32.850138	151.830609	Hollow-bearing tree	2	Blackbutt	10 - 15 cm
280	-32.849292	151.834925	Hollow-bearing tree	3	Blackbutt	10 - 15 cm
290	-32.848828	151.835865	Hollow-bearing tree	4	Angophora costata	10 - 15 cm
316	-32.849706	151.834769	Hollow-bearing tree	1	Corymbia gummifera	10 - 15 cm
320	-32.849456	151.835137	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
327	-32.849286	151.835352	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
332	-32.849283	151.835573	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm

ID no.	latitude	longitude	Habitat feature	No. hollows	Tree	Size category
333	-32.849258	151.835569	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
345	-32.844738	151.838607	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
347	-32.844832	151.838375	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
99	-32.849508	151.833916	Hollow-bearing tree	1	Blackbutt	15 - 20 cm
106	-32.851758	151.828972	Hollow-bearing tree	1		15 - 20 cm
111	-32.851647	151.829433	Hollow-bearing tree	1	A costata	15 - 20 cm
114	-32.852624	151.829754	Hollow-bearing tree	1	Dead	15 - 20 cm
115	-32.852453	151.829759	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
116	-32.852365	151.829829	Hollow-bearing tree	1	E pilularis	15 - 20 cm
117	-32.852312	151.829892	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
120	-32.852107	151.83001	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
123	-32.852534	151.829894	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
126	-32.852667	151.829872	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
132	-32.850445	151.830281	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
133	-32.850489	151.830294	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
140	-32.851479	151.831269	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
149	-32.850656	151.831821	Hollow-bearing tree	1	Angophora costata	15 - 20 cm
150	-32.850826	151.831792	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
159	-32.850474	151.82872	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
172	-32.846761	151.840059	Hollow-bearing tree	2	Blackbutt	15 - 20 cm
202	-32.848419	151.838265	Hollow-bearing tree	1	Angophora costata	15 - 20 cm
203	-32.85046	151.838175	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
205	-32.850518	151.838755	Hollow-bearing tree	1	Angophora costata	15 - 20 cm
207	-32.850357	151.837733	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
208	-32.850146	151.837682	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
219	-32.848585	151.83808	Hollow-bearing tree	1	Angophora costata	15 - 20 cm
228	-32.849079	151.837553	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
231	-32.849224	151.837531	Hollow-bearing tree	1	Angophora floribunda	15 - 20 cm
240	-32.849114	151.835929	Hollow-bearing tree	1	Angophora floribunda	15 - 20 cm

ID no.	latitude	longitude	Habitat feature	No. hollows	Tree	Size category
281	-32.849286	151.835006	Hollow-bearing tree	2	Pink Bloodwood	15 - 20 cm
312	-32.849528	151.834624	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
328	-32.849179	151.835305	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
94	-32.849061	151.833358	Hollow-bearing tree	1	Blackbutt	20 - 30 cm
118	-32.852259	151.829945	Hollow-bearing tree	1	Eucalyptus pilularis	20 - 30 cm
130	-32.850956	151.830248	Hollow-bearing tree	1	Eucalyptus pilularis	20 - 30 cm
131	-32.850844	151.830198	Hollow-bearing tree	1	Dead tree	20 - 30 cm
134	-32.850572	151.830453	Hollow-bearing tree	1	Eucalyptus pilularis	20 - 30 cm
148	-32.850594	151.832072	Hollow-bearing tree	1	Eucalyptus pilularis	20 - 30 cm
161	-32.84671	151.838473	Hollow-bearing tree	5	Blackbutt	20 - 30 cm
163	-32.847157	151.838921	Hollow-bearing tree	5	Blackbutt	20 - 30 cm
173	-32.846569	151.840015	Hollow-bearing tree	3	Blackbutt	20 - 30 cm
201	-32.848348	151.838087	Hollow-bearing tree	1	E pilularis	20 - 30 cm
246	-32.8491	151.839282	Hollow-bearing tree	9	Blackbutt	20 - 30 cm
271	-32.84893	151.83611	Hollow-bearing stag	0		20 - 30 cm
308	-32.849736	151.834412	Hollow-bearing tree	1	Angophora costata	20 - 30 cm
313	-32.849458	151.834555	Hollow-bearing tree	1	Angophora costata	20 - 30 cm
321	-32.849368	151.835151	Hollow-bearing tree	1	Eucalyptus pilularis	20 - 30 cm
124	-32.852577	151.829936	Hollow-bearing tree	1	Eucalyptus pilularis	30 - 40 cm
125	-32.852645	151.829982	Hollow-bearing tree	1	Eucalyptus pilularis	30 - 40 cm
129	-32.850928	151.830108	Hollow-bearing tree	1	Angophora costata	30 - 40 cm
168	-32.848413	151.8398	Hollow-bearing tree	1	Angophora costata	30 - 40 cm
171	-32.847478	151.83989	Hollow-bearing tree	7	Blackbutt	30 - 40 cm
247	-32.85063	151.838533	Hollow-bearing tree	1	Angophora	30 - 40 cm
251	-32.850294	151.837945	Hollow-bearing tree	1	Angophora	30 - 40 cm
257	-32.84873	151.837907	Hollow-bearing tree	3	Blackbutt	30 - 40 cm
261	-32.848402	151.837606	Hollow-bearing tree	1	Angophora smooth	30 - 40 cm
206	-32.85043	151.837694	Hollow-bearing tree	6	Eucalyptus pilularis	40+ cm
222	-32.848061	151.837793	Hollow-bearing tree	1	Eucalyptus pilularis	40+ cm

ID no.	latitude	longitude	Habitat feature	No. hollows	Tree	Size category
252	-32.850195	151.837827	Hollow-bearing tree	2	Angophora	40+ cm
259	-32.848181	151.837702	Hollow-bearing tree	1	Blackbutt	40+ cm
270	-32.848984	151.836041	Hollow-bearing tree	3	Angophora costata	40+ cm
275	-32.849267	151.833275	Hollow-bearing stag	0		40+ cm
93	-32.850518	151.832062	Hollow-bearing tree	6	Blackbutt	5 - 10 cm
100	-32.849542	151.833858	Hollow-bearing tree	5	Blackbutt	5 - 10 cm
107	-32.851839	151.829128	Hollow-bearing tree	1	A costata	5 - 10 cm
108	-32.851994	151.82941	Hollow-bearing tree	1	E. Pilularis	5 - 10 cm
109	-32.852034	151.829521	Hollow-bearing tree	1	E pilularis	5 - 10 cm
110	-32.851817	151.829441	Hollow-bearing tree	1	A costata	5 - 10 cm
142	-32.851319	151.831604	Hollow-bearing tree	1	Eucalyptus pilularis	5 - 10 cm
158	-32.851144	151.830759	Hollow-bearing tree	1	Dead - unsure if hollows	5 - 10 cm
160	-32.845063	151.838918	Hollow-bearing tree	4	Blackbutt	5 - 10 cm
164	-32.847181	151.83882	Hollow-bearing tree	3	Blackbutt	5 - 10 cm
211	-32.849827	151.837624	Hollow-bearing tree	1	Angophora costata	5 - 10 cm
218	-32.848883	151.837988	Hollow-bearing tree	1	Eucalyptus pilularis	5 - 10 cm
221	-32.848288	151.837941	Hollow-bearing tree	1	Angophora costata	5 - 10 cm
242	-32.848444	151.836887	Hollow-bearing tree	1	Angophora floribunda	5 - 10 cm
244	-32.848675	151.83914	Hollow-bearing tree	3	Blackbutt	5 - 10 cm
248	-32.850756	151.838098	Hollow-bearing tree	3	Angophora	5 - 10 cm
249	-32.850752	151.838657	Hollow-bearing tree	3	Angophora	5 - 10 cm
254	-32.84966	151.837887	Hollow-bearing stag	0		5 - 10 cm
255	-32.848979	151.837923	Hollow-bearing tree	2	Angophora	5 - 10 cm
258	-32.848236	151.837739	Hollow-bearing tree	1	Blackbutt	5 - 10 cm
260	-32.84802	151.837643	Hollow-bearing tree	1	Blackbutt	5 - 10 cm
262	-32.848787	151.837687	Hollow-bearing tree	3	Angophora floribunda	5 - 10 cm
264	-32.849309	151.837811	Hollow-bearing stag	0		5 - 10 cm
265	-32.849393	151.837839	Hollow-bearing tree	3	Blackbutt	5 - 10 cm
266	-32.849396	151.837756	Hollow-bearing tree	2	Angophora smooth	5 - 10 cm

ID no.	latitude	longitude	Habitat feature	No. hollows	Tree	Size category
269	-32.848846	151.836394	Hollow-bearing tree	4	Angophora costata	5 - 10 cm
274	-32.850137	151.83065	Hollow-bearing tree	2	Blackbutt	5 - 10 cm
276	-32.849266	151.833242	Hollow-bearing stag	0		5 - 10 cm
279	-32.849438	151.834686	Hollow-bearing tree	3	Bloodwood	5 - 10 cm
283	-32.849099	151.835168	Hollow-bearing tree	1	Blackbutt	5 - 10 cm
285	-32.849043	151.835357	Hollow-bearing stag	0		5 - 10 cm
286	-32.849138	151.835529	Hollow-bearing stag	0		5 - 10 cm
288	-32.849054	151.835596	Hollow-bearing tree	3	Angophora costata	5 - 10 cm
289	-32.849124	151.835677	Hollow-bearing tree	3	Angophora costata	5 - 10 cm
305	-32.849736	151.83424	Hollow-bearing tree	1	Angophora costata	5 - 10 cm
334	-32.849329	151.835655	Hollow-bearing tree	1	Corymbia gummifera	5 - 10 cm
339	-32.848497	151.835938	Hollow-bearing tree	1	Eucalyptus pilularis	5 - 10 cm
344	-32.848384	151.836739	Hollow-bearing tree	1	Eucalyptus pilularis	5 - 10 cm

Annex 8. Ecosystem and species credits required (BAM-C Credit report)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00021010/BAAS17033/20/00021011	3706 Stockton Sand Dredging SSD_2020	19/11/2020
Assessor Name	Report Created	BAM Data version *
	27/11/2020	32
Assessor Number	BAM Case Status	Date Finalised
BAAS17033	Finalised	27/11/2020
Assessment Revision	Assessment Type	
0	Major Projects	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAI	Ecosystem credits
Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast											
3	1644_Area_3	Not a TEC	21	21.0	2.7			High Sensitivity to Potential Gain	2.00		28
										Subtotal	28

Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast										
1	1646_Area_1	Not a TEC	43	43.0	14.1			High Sensitivity to Potential Gain	1.50	228
2	1646_Area_2	Not a TEC	19.8	19.8	3.9			High Sensitivity to Potential Gain	1.50	29
4	1646_Area_4	Not a TEC	4.8	4.8	5.2			High Sensitivity to Potential Gain	1.50	0
5	1646_Area_5	Not a TEC	39	39.0	1.7			High Sensitivity to Potential Gain	1.50	25
6	1646_Area_6	Not a TEC	47.7	47.7	8.1			High Sensitivity to Potential Gain	1.50	145
									Subtotal	427
									Total	455

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAI	Species credits	
<i>Petaurus norfolcensis</i> / Squirrel Glider (Fauna)									
1646_Area_1	43.0	43.0	14.1	Vulnerable	Not Listed	2	False	304	
1644_Area_3	21.0	21.0	2.7	Vulnerable	Not Listed	2	False	28	
1646_Area_5	39.0	39.0	1.7	Vulnerable	Not Listed	2	False	33	
1646_Area_6	47.7	47.7	8.1	Vulnerable	Not Listed	2	False	193	
								Subtotal	558

Annex 9. EPBC Act Significant Impact Criteria Assessment

Matters for Assessment

Assessments of Significance and supplementary information (where relevant) are presented for the following MNES in relation to the Project:

- Black-faced Monarch
- White-throated Needletail
- Spotted-tail Quoll
- Long-nosed Potoroo
- Koala
- New Holland Mouse
- Grey-headed Flying-fox.

Koala

In assessing the significance of the impact from the proposed action on the Koala, the ‘EPBC Act referral guidelines for the vulnerable koala’ were applied to the assessment. The following information is presented prior to the Assessment of Significance for the Koala to demonstrate application of the guidelines and to assist with understanding the assessment and its conclusion.

Koala Habitat Assessment Scoring (Department of the Environment (2014). EPBC Act Referral Guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory). Commonwealth of Australia, 2014.):

Attribute	Score	Habitat Appraisal
Koala occurrence	+1	Koalas have not been recorded by Boral within the subject site nor their mining lease. Koalas have been encountered infrequently adjacent to the subject site as evident with the records from BioNet. The closest record is along Nelson Bay Road towards the entrance to the Quarry (record from 2013). The result of the survey indicates that the Koala is not frequently using the subject site.
Vegetation Structure and composition	0	Habitat scoring was applied across the subject site using floristic data and cover values from 400m ² quadrats. The mapping indicated that the majority of the subject site did not contain either two or more known primary or secondary feed trees that occupied more than 50% of the quadrat.
Habitat connectivity	+2	The subject site is part of a contiguous landscape of > 500 ha.
Key existing threats	+1	There is no known documented or anecdotal evidence of Koala mortality from dog attack or vehicle collision within the subject site or surrounds. Dogs, trucks, and vehicle movements are all present within the subject site.
Recovery value	0	Uncertain whether the habitat within the subject sites will be important in achieving the interim recovery objectives. The habitat is not thought to specifically act as a habitat refuge. The subject site has already been impacted and Koalas are still occurring within the locality which demonstrates that the subject site is not of significance importance to the survival of the population.
Total	4/10	

Koala (vulnerable)	
Criteria (Vulnerable Species)	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population of a species;	
It is considered unlikely that the Project would lead to a long-term decrease in the size of an important population of the Koala. The subject site is centred around the previously cleared mine pit. The location of the subject site does not occur within an area that is frequently used by Koalas, as evident in the results of the field survey. The location of the subject site would not fragment habitat, or impeded connectivity for the species given the surrounding native vegetation would remain intact. It is highly unlikely that the Project would decrease an important population of the Koala	Unlikely
reduce the area of occupancy of an important population;	
No important population occurs within the subject site. The Project is unlikely to reduce the occupancy of an important population as the subject site is not used on a regular basis by the Koala. The Koala can utilise a range of eucalypts for foraging, and as such, any portion of the site that contain eucalypts could be used by the Koala. However, our field survey results confirmed that the Koala is not utilising the subject site frequently.	Unlikely
fragment an existing important population into two or more populations;	
The Project is unlikely to increase fragmentation for the identified population. As previously discussed, the subject site would not result in fragmentation or obstruction of movement throughout the landscape.	Unlikely
adversely affect habitat critical to the survival of a species;	
The habitat within the subject site is not regarded as habitat critical to the survival of the Koala as determined through application of the Koala habitat assessment tool (DoE 2014), which is illustrated in the table above. The habitat within the disturbance area scores a 4/10. A score of less than 5 does not indicate critical habitat.	Unlikely
disrupt the breeding cycle of an important population	
Habitat within the subject site is not thought to be a key breeding area due to the low number of records surrounding the subject site, no signs of the Koala during field survey, and given the species has not been recorded by mine staff over the past decade. Therefore, removal of the habitat is unlikely to disrupt the breeding cycle of the population. The area constitutes a very small proportion of the overall habitat for the population as clearing evidence by the scale of the vegetation corridor along Stockton Beach.	Unlikely
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	
The subject site does not contain primary or secondary feed trees as defined in the DoE (2014) guideline. The surrounding locality offers a greater availability of foraging habitat for the Koala. The removal of potential habitat within the subject site is unlikely to have any impact on patterns of Koala movement, or impact foraging resources such that the species is likely to decline.	Unlikely
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	
Predatory species such as foxes and wild dogs are already established within the locality. The Project is unlikely to further encourage these threats from occurring.	Unlikely
introduce disease that may cause the species to decline, or	

<p>The main diseases affecting Koalas are chlamydial infections. The Project would not increase exposure to such infections as Koalas from the local population would not have increased contact with other Koala populations including infected populations.</p>	Unlikely
<p>interfere substantially with the recovery of the species.</p>	
<p>The following aspects are considered in relation to the possibility of the Project to interfere with the recovery of the Koala (from DoE 2014):</p> <p><i>Increasing koala fatalities in habitat critical to the survival of the koala due to dog attacks to a level that is likely to result in multiple, ongoing mortalities.</i></p> <p>There is no reason to suspect that dogs would become more prevalent within the subject site or surrounds as a result of the Project;</p> <p><i>Increasing koala fatalities in habitat critical to the survival of the koala due to vehicle-strikes to a level that is likely to result in multiple, ongoing mortalities.</i></p> <p>There have been no reported Koala fatalities due to vehicle strike within the quarry or along access roads. Additional vehicle movements are expected to occur as a result of the Project but are expected to presented a low risk to the Koala. The Project would ensure the continuation of the current regime of vehicle movements within the subject site. There are strict speed controls on the vehicles operating within the quarry and as such it is considered that the risk of increased fatalities such that multiple ongoing fatalities occur is very low;</p> <p><i>Facilitating the introduction or spread of disease or pathogens for example Chlamydia or Phytophthora cinnamomi, to habitat critical to the survival of the koala, that are likely to significantly reduce the reproductive output of koalas or reduce the carrying capacity of the habitat;</i></p> <p>The Project is not likely to introduce Chlamydia or Phytophthora cinnamomic to the subject site and surrounds. All works will be undertaken as per the BMP detailed in section 5 of this BDAR.</p> <p><i>Creating a barrier to movement to, between or within habitat critical to the survival of the koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the koala.</i></p> <p>The subject site would not create a barrier to Koala movement. As shown on Figure 8, a wildlife movement corridor would still remain.</p> <p><i>Changing hydrology which degrades habitat critical to the survival of the koala to the extent that the carrying capacity of the habitat is reduced in the long-term.</i></p> <p>The Project is unlikely to alter the hydrology to the extent that it would result in the degradation of remaining habitat critical to the survival of the Koala.</p>	Unlikely
<p>Conclusion: It is unlikely that the Project would result in a significant impact to an important population of the Koala.</p>	

Migratory Species - Black-faced Monarch, White-throated Needletail	
Criteria (Migratory Species)	Likelihood
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will: 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, or	
No important habitat for any of the potentially occurring migratory species is likely to occur within the subject site.	Unlikely
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	
No invasive species of particular significance to the identified migratory species are expected to be established as a result of the Project. The subject site is already affected by invasive plants including some high threat weeds and introduced fauna such as the Rabbit which have some potential to adversely impact most fauna occurring within the subject site and surrounds. New invasive species are unlikely to become established due to the Project if mitigation measures are adhered to, including pest and weed management.	Unlikely
seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	
None of the potentially occurring migratory species would have a significant proportion of their population occurring within the subject site.	Unlikely
<p>Conclusion: The Project would remove 35.66 hectares of native vegetation, which for the most part, consists of sparsely scattered tubestock with a lack of microhabitat features such as fallen logs and hollow-bearing trees. None of the above species occur in significant numbers within the subject site and the subject site does not support significant breeding habitat such that it may be used by a significant number of individuals to conduct any aspect of their lifecycle including foraging, breeding, overwintering or sheltering. The Project is not likely to result in a significant impact on the Black-faced Monarch or the White-throated Needletail.</p>	

Grey-headed Flying-fox (Vulnerable)	
Criteria (Vulnerable Species)	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population of a species;	
<p>It is not expected that any impacts on breeding or roosting habitat for the Grey-headed Flying-fox would result from the Project as breeding/roosting camps will not be impacted and do not occur in the subject site.</p> <p>Impacts from the Project constitute impacts to foraging habitat of which approximately 35.66 hectares would be cleared. The foraging habitat is considered to be of marginal quality for the species, being mostly rehabilitation, with areas of remnant woodland. There are a variety of different canopy species present within proposed disturbance areas, some of which may contribute to winter and spring food availability. The significance of this contribution is not expected to be high as the expanse of similar foraging habitat within the locality is high.</p> <p>Regardless, potential foraging habitat would remain relatively abundant within the locality and the currently proposed removal of foraging habitat is not expected to cause a long-term decrease to any population of the species.</p>	Unlikely
reduce the area of occupancy of an important population;	
<p>No Grey-headed Flying Fox camp sites occur in the subject site or immediate surrounds.</p> <p>The Grey-headed Flying Fox forage opportunistically, often at distances up to 30 km from camps, and occasionally up to 60-70 km per night, in response to patchy food resources (Augee and Ford 1999; Tidemann 1999). The subject site may be used on occasion for foraging given the species feeds on a variety of eucalypts, which occur within a wide range vegetation communities.</p> <p>The reduction of 35.66 ha of potential habitat for the species is relatively minor compared to the availability of habitat across the locality. And furthermore, the proposed development would not restrict the Grey-headed Flying-fox from utilising foraging habitat throughout the locality. We therefore conclude that the Project would not reduce the availability of occupancy for an important population such that any significant disruption to the species would occur.</p>	Unlikely
fragment an existing important population into two or more populations;	
The Project is unlikely to increase fragmentation for any population of the species. The Grey-headed Flying-fox is a mobile species and the Project would not impact on areas where the species is known to breed and roost.	None
adversely affect habitat critical to the survival of a species;	
<p>Habitat critical to the survival of the species has been loosely nominated within DECCW (2009) <i>Draft National Recovery Plan for the Grey-headed Flying-fox</i>. The Draft plan contains a definition for critical foraging habitat, and critical roosting habitat which have been addressed below:</p> <p><u>Critical Roosting Habitat</u></p> <p>DECCW (2009) states that habitat that meets at least one of the following criteria can be explicitly identified as habitat critical to survival, or essential habitat, for Grey-headed Flying-foxes. Roosting habitat that:</p> <ol style="list-style-type: none"> <i>is used as a camp either continuously or seasonally in > 50% of years</i> <p>Response: The subject site and immediate surrounds are not used as a camp site presently, or historically.</p> <ol style="list-style-type: none"> <i>has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 10 000 individuals, unless such habitat has been used only as a temporary refuge, and the use has been of limited duration (i.e. in the order of days rather than weeks or months)</i> 	Unlikely

Response: As discussed above, the subject site and immediate surrounds are not used as a camp site presently, or historically.

3. *has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 2 500 individuals, including reproductive females during the final stages of pregnancy, during lactation, or during the period of conception (i.e. September to May).*

Response: As above.

Critical Foraging Habitat

DECCW (2009) states that foraging habitat that meets at least one of the following criteria can be explicitly identified as habitat critical to survival, or essential habitat, for Grey-headed Flying Foxes. Natural foraging habitat that is:

1. *productive during winter and spring, when food bottlenecks have been identified (ParryJones and Augee 1991, Eby et al. 1999):*

Response: The DECCW (2009) do not provide guidance around what constitutes a ‘productive’ natural foraging habitat, nor a ‘food bottleneck’. As previously discussed, the subject site may be used on occasion for foraging given the species feeds on a variety of eucalypts. We have conservatively determined 30.66 ha of potential foraging habitat occurs within the Study Area.

Similar potential foraging habitat is relatively available throughout the locality which would not be impacted by the Project. For the most part, the foraging habitat surrounding the subject site is likely to be in a better condition to that of the subject site, given historic vegetation clearing and grazing has not occurred. As such, whilst the site does contain potential foraging habitat, it is unlikely to be of significantly productive during both winter and spring to an extent that it is critical foraging habitat for the species.

2. *known to support populations of > 30 000 individuals within an area of 50 km radius (the maximum foraging distance of an adult)*

Response: The subject site does not support a population of >30,000 individuals.

3. *productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May)*

Response: No, the subject site is highly unlikely to be productive for the species given absence of roost sites and the distance from known camps. As discussed above, the locality contains important feed trees and foraging habitat that is not impacted by the Project.

4. *productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions)*

Response: No, the subject site is highly unlikely to be productive for the species given absence of roost sites and the distance from known camps. No commercial crops or important commercial fruit trees would be impacted by the Project.

5. *known to support a continuously occupied camp*

Response: No camp site occur within the subject site.

disrupt the breeding cycle of an important population

The Project is unlikely to disrupt the breeding cycle of the species as breeding events for this species primarily take place within camps, none of which would be adversely impacted by the Project.

None

modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

The extent of foraging habitat to be removed is not considered sufficient to result in the decline of the species given the local abundance of similar habitat. The Project would not isolate areas of foraging habitat.

Unlikely

result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species’ habitat;

<p>The Project is unlikely to increase the likelihood of weeds being established in areas adjacent to disturbance areas that constitute potential foraging habitat for the species. The Project will include measures to control weeds becoming established in such areas through the implementation of a Landscape and Rehabilitation Plan.</p>	<p>Unlikely</p>
<p>Potential invasive predators such as the fox are likely to be already present within the subject site and the Project is not expected to increase the level of predation threat for the Grey-headed Flying-fox.</p>	
<p>introduce disease that may cause the species to decline, or</p>	
<p>There are no known documented diseases that are currently contributing to the decline of the species. The Project is not expected to cause an increased risk of any bat diseases.</p>	<p>Unlikely</p>
<p>interfere substantially with the recovery of the species.</p>	
<p>The Project does not directly or substantially interfere with any of the specific recovery objectives under the draft National Recovery Plan (Commonwealth of Australia 2017). A general objective is to lessen the currently operating threats to the species which includes the removal of foraging habitat. The Project is therefore not consistent with this general objective. However, the amount and type of foraging habitat removal is not considered to constitute substantial interference with the recovery of the species.</p>	<p>Unlikely</p>
<p>Conclusion: Impacts from the Project relate to the removal of foraging habitat for the Grey-headed Flying-fox within the proposed disturbance areas. Whilst protection of foraging habitat is considered important for this species, impacts from the Project are not considered to be significant for the following reasons:</p> <ul style="list-style-type: none"> • The habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution or size; • Similarly important foraging habitat occurs throughout the locality including within protected areas. 	

Spotted-tail Quoll Vulnerable)	
Criteria (Vulnerable Species)	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population of a species;	
The Spotted-tail Quoll was not recorded during the extensive field survey, nor has been recorded previously at the subject site and within the Boral mining lease. Impacts from the Project constitute impacts to potential foraging habitat of which approximately 35.66 hectares would be cleared. The foraging habitat is considered to be of marginal quality for the species, being mostly rehabilitation, with areas of remnant woodland. Potential foraging habitat would remain abundant within the locality. It is unlikely that the subject site provides the only foraging resource for the species in the locality. The proposed removal of potential foraging habitat is therefore not expected to cause a long-term decrease to any population of the species.	Unlikely
reduce the area of occupancy of an important population;	
It is unlikely that an important population of the Spotted-tail Quoll occurs in the subject site, as the species was not detected during the survey, and there is only one previous record of the species within a 10 km radius of the subject site. The Project would not impact the area of occupancy of the Spotted-tail Quoll for the following reasons: <ul style="list-style-type: none"> • The areas to be cleared are not sufficient in extent to impact the area of occupancy of the species at a 2km grid square scale (which is the standard unit for measuring area of occupancy according to the IUCN); and • Spotted-tail Quoll would still be expected to forage within the vicinity of the subject site, given potential foraging habitat extends beyond the subject site boundary. 	Unlikely
fragment an existing important population into two or more populations;	
The Project is unlikely to increase fragmentation for any population of the species. The Long-nosed Potoroo is a mobile species and the Project would not impact on areas where the species is known to occur.	None
adversely affect habitat critical to the survival of a species;	
Habitat critical to the survival of the species is not likely to include the subject site, as no known previous records occur in the subject site. Further, the majority of the subject site does not support the dense understorey that is considered important for the species, as it consists of rehabilitated areas where the understorey and ground cover is sparse. Therefore, the potential foraging habitat to be removed is not considered critical to the species survival.	Unlikely
disrupt the breeding cycle of an important population	
The Project is unlikely to disrupt the breeding cycle of the species as the habitat to be impacted by the Project is marginal and no known populations occur in the subject site.	None
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	
The extent of foraging habitat to be removed is not considered sufficient to result in the decline of the species given the local abundance of similar habitat. The Project would not isolate areas of foraging habitat.	Unlikely
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	

<p>The Project is unlikely to increase the likelihood of weeds being established in areas adjacent to disturbance areas that constitute potential foraging habitat for the species. The Project will include measures to control weeds becoming established in such areas through the implementation of a Landscape and Rehabilitation Plan.</p> <p>Potential invasive predators such as the fox are likely to be already present within the subject site and the Project is not expected to increase the level of predation threat for the Spotted-tail Quoll.</p>	Unlikely
introduce disease that may cause the species to decline, or	
<p>There are no known documented diseases that are currently contributing to the decline of the species. The Project is not expected to cause an increased risk of any diseases.</p>	Unlikely
interfere substantially with the recovery of the species.	
<p>Currently, there is no recovery plan for this species. The amount and type of foraging habitat removal required for the Project is not considered to constitute substantial interference with the recovery of the species.</p>	Unlikely
<p>Conclusion: Impacts from the Project relate to the removal of foraging habitat for the Spotted-tail Quoll Potoroo within the proposed disturbance areas. Whilst protection of foraging habitat is considered important for this species, impacts from the Project are not considered to be significant for the following reasons:</p> <ul style="list-style-type: none"> • The habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution or size; • Similarly important foraging habitat occurs throughout the locality including within protected areas. 	

Long-nosed Potoroo (Vulnerable)	
Criteria (Vulnerable Species)	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population of a species;	
The Long-nosed Potoroo was not recorded during the extensive field survey, nor has been recorded previously at the subject site and within the Boral mining lease. Impacts from the Project constitute impacts to potential foraging habitat of which approximately 35.66 hectares would be cleared. The foraging habitat is considered to be of marginal quality for the species, being mostly rehabilitation, with areas of remnant woodland. Potential foraging habitat would remain abundant within the locality. It is unlikely that the subject site provides the only foraging resource for the species in the locality. The proposed removal of potential foraging habitat is therefore not expected to cause a long-term decrease to any population of the species.	Unlikely
reduce the area of occupancy of an important population;	
It is unlikely that an important population of the Long-nosed Potoroo occurs in the subject site, as the species was not detected during the survey, and there is only one previous record of the species within a 10 km radius of the subject site. The Project would not impact the area of occupancy of the Long-nosed Potoroo for the following reasons: <ul style="list-style-type: none"> • The areas to be cleared are not sufficient in extent to impact the area of occupancy of the species at a 2km grid square scale (which is the standard unit for measuring area of occupancy according to the IUCN); and • Long-nosed Potoroo would still be expected to forage within the vicinity of the subject site, given potential foraging habitat extends beyond the subject site boundary. 	Unlikely
fragment an existing important population into two or more populations;	
The Project is unlikely to increase fragmentation for any population of the species. The Long-nosed Potoroo is a mobile species and the Project would not impact on areas where the species is known to occur.	None
adversely affect habitat critical to the survival of a species;	
Habitat critical to the survival of the species is not likely to include the subject site, as no known previous records occur in the subject site. Further, the majority of the subject site does not support the dense understorey that is considered important for the species, as it consists of rehabilitated areas where the understorey and ground cover is sparse. Therefore, the potential foraging habitat to be removed is not considered critical to the species survival.	Unlikely
disrupt the breeding cycle of an important population	
The Project is unlikely to disrupt the breeding cycle of the species as the habitat to be impacted by the Project is marginal and no known populations occur in the subject site.	None
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	
The extent of foraging habitat to be removed is not considered sufficient to result in the decline of the species given the local abundance of similar habitat. The Project would not isolate areas of foraging habitat.	Unlikely

result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;

<p>The Project is unlikely to increase the likelihood of weeds being established in areas adjacent to disturbance areas that constitute potential foraging habitat for the species. The Project will include measures to control weeds becoming established in such areas through the implementation of a Landscape and Rehabilitation Plan.</p> <p>Potential invasive predators such as the fox are likely to be already present within the subject site and the Project is not expected to increase the level of predation threat for the Long-nosed Potoroo.</p>	Unlikely
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introduce disease that may cause the species to decline, or

<p>There are no known documented diseases that are currently contributing to the decline of the species. The Project is not expected to cause an increased risk of any diseases.</p>	Unlikely
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interfere substantially with the recovery of the species.

<p>Currently, there is no recovery plan for this species. The amount and type of foraging habitat removal required for the Project is not considered to constitute substantial interference with the recovery of the species.</p>	Unlikely
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Conclusion: Impacts from the Project relate to the removal of foraging habitat for the Long-nosed Potoroo within the proposed disturbance areas. Whilst protection of foraging habitat is considered important for this species, impacts from the Project are not considered to be significant for the following reasons:

- The habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution (predominately the understorey is sparse) or size;
- Similarly important foraging habitat occurs throughout the locality including within protected areas.

New Holland Mouse (Vulnerable)

Preamble

The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.

The New Holland Mouse has been attributed a moderate likelihood of occurrence as the species has been recorded within Worimi Regional Park and Worimi State Conservation Area and may utilise the subject site for foraging.

Criteria (Vulnerable Species)

Likelihood

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

lead to a long-term decrease in the size of an important population of a species;

Impacts from the Project constitute impacts to foraging habitat of which approximately 35.66 hectares would be cleared. The foraging habitat is considered to be of marginal quality for the species, being mostly rehabilitation, with some areas of remnant woodland.

Over time, foraging habitat would be at least partially restored through rehabilitation works. Regardless of rehabilitation works, potential foraging habitat would remain abundant within the locality and the currently proposed removal of foraging habitat is not expected to cause a long-term decrease to any population of the species.

Unlikely

reduce the area of occupancy of an important population;

The Project would not impact the area of occupancy of the New Holland Mouse for the following reasons:

- The areas to be cleared are not sufficient in extent to impact the area of occupancy of the species at a 2km grid square scale (which is the standard unit for measuring area of occupancy according to the IUCN); and
- New Holland Mouse would still be expected to forage within the vicinity of the subject site, given potential habitat extends beyond the subject site boundary.

Unlikely

fragment an existing important population into two or more populations;

The Project is unlikely to increase fragmentation for any population of the species. The New Holland Mouse is a mobile species and the Project would not impact on areas where the species is known to occur.

None

adversely affect habitat critical to the survival of a species;

Habitat critical to the survival of the species is not likely to include the subject site, as no known previous records occur in the subject site. The potential foraging habitat to be removed is not considered critical to the species survival, given the majority of the area to be impacted consists of rehabilitated areas.

Unlikely

disrupt the breeding cycle of an important population

The Project is unlikely to disrupt the breeding cycle of the species as the habitat to be impacted by the Project is marginal (mostly rehabilitation) and no known populations occur in the subject site.

None

modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

The extent of foraging habitat to be removed is not considered sufficient to result in the decline of the species given the local abundance of similar habitat. The Project would not isolate areas of foraging habitat.

Unlikely

result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;

<p>The Project is unlikely to increase the likelihood of weeds being established in areas adjacent to disturbance areas that constitute potential foraging habitat for the species. The Project will include measures to control weeds becoming established in such areas through the implementation of a Landscape and Rehabilitation Plan.</p> <p>Potential invasive predators such as the fox are likely to be already present within the subject site and the Project is not expected to increase the level of predation threat for the New Holland Mouse.</p>	Unlikely
introduce disease that may cause the species to decline, or	
<p>There are no known documented diseases that are currently contributing to the decline of the species. The Project is not expected to cause an increased risk of any diseases.</p>	Unlikely
interfere substantially with the recovery of the species.	
<p>Currently, there is no recovery plan for this species. The amount and type of foraging habitat removal required for the Project is not considered to constitute substantial interference with the recovery of the species.</p>	Unlikely
<p>Conclusion: Impacts from the Project relate to the removal of foraging habitat for the New Holland Mouse within the proposed disturbance areas. Whilst protection of foraging habitat is considered important for this species, impacts from the Project are not considered to be significant for the following reasons:</p> <ul style="list-style-type: none"> • The habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution or size; • Similarly important foraging habitat occurs throughout the locality including within protected areas. 	

Contact Us

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Illawarra
Coffs Harbour
Central Coast
Gold Coast
Canberra



Our services

Ecology and biodiversity

Terrestrial
Freshwater
Marine and coastal
Research and monitoring
Wildlife Schools and training

Heritage management

Aboriginal heritage
Historical heritage
Conservation management
Community consultation
Archaeological, built and landscape values

Environmental management and approvals

Impact assessments
Development and activity approvals
Rehabilitation
Stakeholder consultation and facilitation
Project management

Environmental offsetting

Offset strategy and assessment (NSW, QLD, Commonwealth)
Accredited BAM assessors (NSW)
Biodiversity Stewardship Site Agreements (NSW)
Offset site establishment and management
Offset brokerage
Advanced Offset establishment (QLD)