

APPENDIX E

BIODIVERSITY DEVELOPMENT
ASSESSMENT REPORT

Stockton Sand Quarry Dredging

Biodiversity Development Assessment Report | 21 February 2020

Prepared for Boral Resources (NSW) Pty Ltd



Document control

Project number	Client	Project manager	LGA
3706	Boral Resources (NSW) Pty Ltd	Luke Baker	Port Stephens
Version	Author	Review	Status
D1	Luke Baker	Sian Griffiths	Draft 1
Rev0	Luke Baker	Boral Resources & Element Environment	Rev0
Rev1	Luke Baker	Boral Resources & Element Environment	Rev1
Rev2	Luke Baker	Boral Resources & Element Environment	Rev2

© Niche Environment and Heritage Pty Ltd (ACN 137 111 721) 2018

Copyright protects this publication. All rights reserved. Except for purposes permitted by the Australian Copyright Act 1968, reproduction, adaptation, electronic storage, transmission and communication to the public by any means is prohibited without our prior written permission. Any third party material, including images, contained in this publication remains the property of the specified copyright owner unless otherwise indicated, and is used subject to their licensing conditions.

Disclaimer

While Niche Environment and Heritage Pty Ltd uses care and diligence in the preparation of this report, it is not responsible or liable for any mistakes, misprints, omissions or typographical errors. None of Niche Environment and Heritage Pty Ltd, nor its editors or authors are responsible for the results of any actions taken on the basis of information in this publication. Niche Environment and Heritage Pty Ltd and its editors and authors expressly disclaim all and any liability and responsibility to any person or organisation in respect of, or as a consequence of, anything done or omitted to be done by any person or organisation in reliance, whether wholly or partially, upon the whole or part of any of the contents of this publication, including any photographs, statements or descriptions. No representation is made as to the suitability of this publication for any particular purpose. The views expressed in this publication are not necessarily endorsed by this publication, its editors or authors, or the owners or management of Niche Environment and Heritage Pty Ltd.

Enquiries should be addressed to:

Sydney Head Office
Niche Environment and Heritage
02 9630 5658
info@niche-eh.com
PO Box 2443 North Parramatta
NSW 1750 Australia

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 market, 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.

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Boral to assess the ecological values and impacts associated with the Project, and provide a Biodiversity Development Assessment Report (BDAR). This BDAR has applied the OEH (2017) Biodiversity Assessment Methodology (BAM) to describe and assess the ecological values within the Study Area and surrounds, and determine if the Project is likely to have an impact on threatened biodiversity listed under the NSW *Biodiversity Conservation Act 2016* (BC Act). This report also has assessed the potential impacts of the Project on Matters of National Environmental Significance (MNES) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Study area

The Study Area for the Project contains all areas proposed for ground disturbance, and is approximately 38.14 hectares, predominately contained within the footprint of the former inland extraction area, which has since been rehabilitated with native tubestock.

In total the Study Area includes:

- 32.75 hectares of rehabilitated land comprising of native vegetation;
- 2.91 hectares of remnant native vegetation; and
- 2.48 hectares of non-native vegetation.

Survey overview

Surveys within the Study Area were undertaken in accordance with the BAM over a period of 27th – 29th of September 2017 by Accredited Assessors – Luke Baker and Alex Christie (section 3.2 and 4.2). The survey included the collection of flora plot and transect data, threatened flora surveys and random meanders, Ultrasonic call recording for bats (Anabats), diurnal bird surveys, spotlighting, Koala Spot assessments and opportunistic survey.

An additional targeted orchid survey was completed by Accredited Assessor and Ecologist Amanda Griffiths on the 20th August 2018.

Native vegetation Assessment

Vegetation validation was undertaken as per the BAM which confirmed that the Study Area contained the following best fit Plant Community Types (PCTs):

- PCT 1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast; and
- PCT 1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast.

One non-native vegetation type that does not align to any PCT was also recorded within the Study Area. Different condition classes were given to the PCTs which were generally related to the age of the rehabilitation that has taken place over the past decade.

Threatened flora

During the field survey, no threatened flora were recorded within the area proposed to be developed.

A population of the threatened orchid – *Diuris praecox* was recorded by ERM in 2003 approximately 300 metres from the Study Area to the east. A targeted survey for the orchid was undertaken within the Study Area during the recommended survey time in August 2018. The species was not detected during the field survey. This assessment concluded that there was a low likelihood for *Diuris praecox* to occur within the Study Area given the Study Area predominately consisted of rehabilitated land within a former quarry pit, the species was not recorded during the targeted survey, and the species was not recorded within the Study Area during surveys completed by ERM (2005).

Threatened fauna

Three threatened fauna were recorded with the Study Area: Greater Broad-nosed Bat, Eastern Bentwing Bat and White-bellied Sea Eagle. Both the threatened microbats were recorded on both anabats located in the Study Area, whilst the White-bellied Sea Eagle was recorded flying over the Study Area on all days of the field survey.

An additional 16 threatened fauna were regarded to have the potential to occur within the Study Area but were not recorded, most likely due to their potential use of the Study Area or wider locality being limited to sporadic occurrences (e.g. nomadic birds) (Appendix 1). These species include the following:

- Birds - Dusky Woodswallow, White-fronted Chat, Red Goshawk, White-throated Needletail, Black-faced Monarch, Australian Painted Snipe; and
- Mammals: Little Bentwing-bat, Eastern False Pipistrelle, Eastern Freetail-bat, Southern Myotis, Squirrel Glider, Koala Long-nosed Potoroo, New Holland Mouse, Grey-headed Flying-fox and Yellow-bellied Sheath-tail-bat.

The Koala and Squirrel Glider, whilst not recorded during the field survey, have been previously recorded surrounding the Study Area based on Bionet records.

Under the BAM, only those threatened fauna that are regarded as 'species credit' fauna, or significantly impacted under the Commonwealth EPBC Act, require offsetting. Of the species recorded, or have habitat within the Study Area, only one threatened fauna species – the Squirrel Glider, has been regarded as a species credit fauna for this assessment. The remaining species are regarded as 'ecosystem credits' species due to the lack of breeding habitat, important habitat, or have been attributed as an 'ecosystem credit' fauna in the Bionet Atlas. Furthermore, no significant impacts to any EPBC Act listed fauna are likely to occur.

SEPP 44. Koala habitat

Our assessment has concluded that the Study Area does not contain *potential Koala habitat* as defined under the current SEPP 44, given Schedule 2 tree species do not meet at least 15% of the total number of trees within the Study Area. The site therefore does not constitute 'Core Koala habitat' under the current SEPP 44. A discussion on SEPP 44 Koala habitat is provided in section 4.8.

It is noted that the current SEPP 44, is to be replaced with the SEPP 44 Koala Habitat Protection 2019, which has changes to the definition of Koala habitat. Whilst the new SEPP 44 is not yet in effect, it is noted that the Study Area contains Koala feed trees (mainly planted tubestock), however is unlikely to be regarded as 'Core Koala habitat'.

Impacts – Native vegetation

The main impact on biodiversity associated with the Project is clearing of native vegetation and habitat, of which is predominately rehabilitation land from the former quarry pit. The extent of clearing of native vegetation communities is conservatively estimated at 38.14 hectares. An offset for the impact to native vegetation as per the BAM has been provided.

Impacts – Threatened flora

No threatened flora are likely to be impacted by the Project given the lack of suitable habitat and results of the field survey. It is therefore unlikely that the Project will result in a significant impact to any threatened flora. No biodiversity offset is therefore required for threatened flora.

Impacts – Threatened fauna

One species credit fauna, and eight EPBC listed threatened and migratory fauna are considered to be affected by the Project. Most of these species are likely to utilise the foraging habitat of the Study Area on an intermittent basis.

The Squirrel Glider would be offset according to the requirements of the BAM.

Assessments of Significance completed for the EPBC Act listed fauna, has indicated that the Project is unlikely to have a significant impact toward the Australian Painted Snipe, Black-faced Monarch, White-throated Needletail, Red Goshawk, Long-nosed Potoroo, Koala, New Holland Mouse and Grey-headed Flying-fox.

Avoidance and minimisation

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. A detailed discussion regarding avoidance and alternatives has been provided in section 5.1.

Mitigation and management

To minimise and mitigate potential indirect impact, a number of measures have been proposed, which would be updated in existing biodiversity management plans. The measures 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 Study Area as described in section 5.1.4;
- Educating employees and/or contractors involved in the construction and operation of the Project;
- Update and implementation of the existing Landscape and Rehabilitation Management Plan as described in section 5.1.5;
- Dust suppression;
- Procedures for the management of spills throughout the Study Area including the requirements for vehicles to carry spill kits; and
- Management and removal of all rubbish from the Study Area.

Credit calculations

As per the BAM, once impacts have been avoided and minimised as far as practical, the proponent must offset the development impacts. The offset is determined using the BAM calculator and is expressed in terms of ecosystem credits and species credits.

Based on our analysis, the ecosystem credits required to offset the Project equate to the following:

- Total of 396 credits for PCT 1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast; and
- Total of 37 credits for PCT 1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast.

The species credit required for the Project include:

- A total of 521 credits for the removal of 26.59 hectares of foraging habitat for the Squirrel Glider.

Offset strategy

In order to satisfy the biodiversity offset requirement for the Project, Boral proposes a number of options available to offset the credits for native vegetation and the Squirrel Glider. The options available to Boral include the following:

1. Purchase credits on market;
2. Payment into BCT Fund; and/or
3. Utilise existing Boral Landholdings and consider establishing Stewardship sites.

Given the options available, there is minimal risk in Boral not being able to satisfy their offset liability. No offset is required under the Commonwealth, given the project is unlikely to impact any threatened biodiversity under the EPBC Act.

Abbreviations

Acronym	Term/Definition
BAM	Biodiversity Assessment Methodology
BAM Calculator	Biodiversity Credit Calculator
BC Act	<i>Biodiversity Conservation Act 2016 (NSW)</i>
BDAR	Biodiversity Development Assessment Report
BMP	Biodiversity Management Plan
BOS	<i>NSW Biodiversity Offsets Scheme</i>
DPIE	NSW Department of Planning, Industry and Environment
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EES	Environment, Energy and Science Group (part of the Department of Planning, Industry, and Environment)
ha	Hectare/s
IBRA	Interim Biogeographic Regionalisation for Australia
MNES	Matters of National Environmental Significance (from the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>).
OEH	Office of Environment and Heritage (formerly DECCW, DECC, DEC)
PEA	Preliminary Environmental Assessment
PCT	Plant Community Type
SAIL	Serious and Irreversible Impacts
SEARs	Secretary's Environmental Assessment Requirements
SSD	State Significant Development
TEC	Threatened Ecological Community
tpa	tonnes per annum

Table of Contents

Executive summary	i
Abbreviations	5
1. Introduction to Biodiversity Development Assessment	9
1.1 Introduction	9
1.2 The Project.....	9
1.3 Project description.....	10
1.4 Study area	10
1.5 State approval and assessment process.....	11
1.6 Commonwealth approval and assessment process	11
1.7 Secretary Environmental Assessment Requirements	11
1.8 Assessment objectives and format.....	12
1.9 Assessment resources and assessor qualifications	13
1.10 Consultation.....	13
2. Landscape assessment	14
2.1 Landscape assessment - methods	14
3. Native vegetation and flora assessment	16
3.1 Data review.....	16
3.2 Plant community delineation and mapping	16
3.2.5 High threat.....	18
3.3 Threatened flora	19
4. Assessment of fauna and habitat	22
4.1 Bionet Atlas & EPBC Act Protected Matters Search	22
4.2 Methods – field survey	22
4.3 Recommended fauna survey effort in BAM	24
4.4 Fauna habitat.....	31
4.5 Connectivity of fauna habitat	34
4.6 Fauna recorded during field surveys	34
4.7 Threatened fauna	34
4.8 State Environment Planning Policy 44 – Koala Habitat	37
4.9 Port Stephens Koala Plan of Management.....	39
5. Impact Assessment	42
5.1 Avoid and minimise impacts.....	42

5.2	Impact Summary.....	50
5.3	Quantifying offset requirements.....	55
6.	Offset strategy.....	57
6.1	NSW Offset Requirements.....	57
6.2	Offset strategy options.....	57
7.	Conclusion.....	59
	References.....	61
	Figures.....	63
	Appendix 1. Likelihood of occurrence	46
	Appendix 2. Plant Community Type Descriptions	46
	Appendix 3. Floristic plot data	51
	Appendix 4. Plot BAM attribute scores	55
	Appendix 5. Fauna species list in Study Area	57
	Appendix 6. Biodiversity Credit Calculator Report	58
	Appendix 7. Threatened species assessments of significance under the EPBC Act.....	59

List of Figures

Figure 1: Regional	64
Figure 2: The project.....	65
Figure 3. Study Area	66
Figure 4: Landscape Assessment	67
Figure 5: Survey effort – Flora and fauna	68
Figure 6: Validated Vegetation Mapping.....	69
Figure 7: Threatened biodiversity	70

List of Tables

Table 1. SEARs addressed in this BDAR	11
Table 2: Landscape features and scoring under the NSW BAM.....	14
Table 3. Vegetation mapping and alignment for vegetation types within the Study Area.....	17
Table 4. Vegetation zones and site integrity scores.....	18
Table 5. Recommended threatened flora survey time matrix as specified in BAM.....	20

Table 6. Fauna survey details and effort within the Study Area	23
Table 7. Recommended threatened fauna survey time matrix as specified in BAM	25
Table 8. Consideration of aim and objectives of CKPoM	40
Table 9. Indirect impacts and mitigation measures	52
Table 10 : Ecosystem credit requirements	56
Table 11: Species credit species requirements – Squirrel Glider	56
Table 12. Options to satisfy the offset requirement	58
Table 13: Likelihood of occurrence criteria	46
Table 14. Likelihood of occurrence threatened biodiversity.....	46

1. Introduction to Biodiversity Development Assessment

1.1 Introduction

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 market, 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 (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).

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

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Boral to assess the ecological values and impacts associated with the Project, and provide a Biodiversity Development Assessment Report (BDAR). This BDAR has applied the OEHS (2017) Biodiversity Assessment Methodology (BAM) to describe and assess the ecological values within the Study Area and surrounds, and determine if the Project is likely to have an impact on threatened biodiversity listed under the NSW *Biodiversity Conservation Act 2016* (BC Act). This report has also assessed the potential impacts of the Project on Matters of National Environmental Significance (MNES) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This report also identifies avoidance, mitigation and offsets for the Project.

1.2 The Project

1.2.1 General description of the Site

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

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

- Lot 1 DP 1006399, comprising 234 hectares and located predominantly on the eastern side of Nelson Bay Road, with a small portion also situated on the western 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); and

- Lot 3 DP 664552 comprising 1.619 hectares and located wholly on the eastern side of Nelson Bay Road, and within which the existing depot and weighbridge are located (formerly within Part Lot 3, Part Portion 3).

Access to the site is via Crown Reserve, Lot 7300 DP1130730, for which Boral has an existing licence.

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 exhausted in 2007 with the consent lapsing on 1 May 2009.

Following the completion 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.

1.3 Project description

1.3.1 Description of the Proposal

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). An administrative amendment to DA 140-5-2006 to allow for the site wide dispatch limit increase will also 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.

1.4 Study area

The Study Area occurs within Boral's landholding and encompasses the area of direct and indirect impact associated with the Project (Figure 2). In total the Study Area is 38.14 hectares in size which predominately includes the footprint of the former inland extraction area, which has since been rehabilitated with native tubestock.

In total the Study Area includes:

- 32.75 hectares of rehabilitated land comprising of native vegetation;
- 2.91 hectares of remnant native vegetation; and
- 2.48 hectares of non-native vegetation.

Within the Study Area, the land directly disturbed by the Project is referred to as the 'subject site'. The area of direct and indirect impact is referred to as the Study Area.

1.5 State approval and assessment process

1.5.1 Application of the BAM

This BDAR has applied the BAM in order to assess impacts on biodiversity. The BAM is a new framework for assessment of biodiversity impacts and determination of offsetting requirements for major Projects under the NSW Biodiversity Offsets Scheme (BOS).

This assessment has used the BAM Calculator (version 1.2.1.00).

1.6 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 Study Area. 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 (Appendix 7).

1.7 Secretary Environmental Assessment Requirements

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 Department of Planning, Industry and Environment (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 6.
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 Biodiversity Conservation Act 2016 (s6.12), Biodiversity Conservation Regulation 2017 (s6.8) and Biodiversity Assessment Method.	This assessment follows the BAM.

Requirement	Section addressed in report
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.	Section 5.1 details avoidance and minimisation. Section 5.2 details impacts. Section 5.3 details offsets.
3. The BDAR must include details of the measures proposed to address the offset obligation as follows: The total number and classes of biodiversity credits required to be retired for the development/project The number and classes of like-for-like biodiversity credits proposed to be retired; The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules; Any proposal to fund a biodiversity conservation action; Any proposal to conduct ecological rehabilitation (if a mining project); Any proposal to make a payment to the Biodiversity Conservation Fund. 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.	The offset strategy is detailed in section 6. Rehabilitation of the site is discussed in detail in the EES (2019) Landscape and Rehabilitation Strategy.
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.	This assessment and field survey has been completed by an Accredited Assessor (section 1.9)

1.8 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. In addition, impacts on Commonwealth MNES are addressed through the process of the BAM and by assessments of significance for potentially impacted species.

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

Stage 1 – Biodiversity Assessment

- assessment of landscape features;
- assessment of native vegetation; and
- assessment of threatened species and populations.

Stage 2 – Impact Assessment

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

To address the SEARs, section 6 of this BDAR has detailed the offset strategy associated with the Project.

1.9 Assessment resources and assessor qualifications

This BDAR has been prepared by the following accredited assessors or experts:

- Luke Baker – Senior Ecologist/Ecology Team Leader/Accredited Biodiversity Assessor: flora and fauna field survey, data management, data entry, credit calculations, review of credit calculations, report preparation;
- Alex Christie – Field survey, data collation; and
- Amanda Griffiths – Targeted orchid survey.

1.10 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.

2. Landscape assessment

2.1 Landscape assessment - methods

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

- native vegetation cover;
- rivers, streams and estuaries;
- areas of geological significance; and
- 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.

2.1.1 Landscape features

The inputs into the landscape features component of the BAM Calculator, along with the associated Figure reference, has been detailed in Table 2 below.

Table 2: Landscape features and scoring under the NSW BAM

Landscape features	Description	Figure reference
IBRA bioregion/subregion	NSW North Coast IBRA region, and within Karuah Manning IBRA subregion.	Figure 3. Study Area Figure 4
Mitchell Landscapes	One Mitchell landscape occurs across the Study Area: Sydney - Newcastle Barrier and Beaches.	Figure 3. Study Area Figure 4
Rivers, streams and estuaries and Strahler stream order	No rivers, streams or estuaries occur within the Study Area.	Figure 3. Study Area Figure 4
Wetlands within and adjacent to development	None	-
Cleared areas	The native vegetation present within the Study Area has been subject to historic clearing. As such much of the vegetation within the Study Area comprises of native rehabilitation from tubestock planting and seeding. Cleared areas within the Study Area comprise the former inland extraction area and associated infrastructure. Within the locality, residential and rural land use is more predominant to the west.	Figure 3. Study Area Figure 4

Landscape features	Description	Figure reference
Connectivity features	The Study Area adjoins a large 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 wetlands (Long Bight Swamp) and riparian vegetation of Fullerton Cove approximately 2.3 km to the south-west.	Figure 3. Study Area Figure 4
Buffer area (percent native vegetation cover)	<p>A 1,500 m buffer was applied to the Study Area resulting in an overall buffer area of 1,220 ha. Aerial interpretation was used to map the area of native vegetation, and introduced vegetation within the locality. In total, 579 ha is non-native vegetation (consisting of quarry pit, existing emplacement, infrastructure, rural residential and roads/rail links etc.), and 641 ha is native vegetation.</p> <p>Total native vegetation cover</p> <p>Combining the estimated native vegetation cover resulted in 52% of the buffer area supporting native vegetation. This falls into the 30-70% category within the BAM Calculator.</p>	Figure 3. Study Area Figure 4
Site context	Site based assessment.	-
Geological significance	There are no karst, caves, crevices, cliffs or other areas of geological significance within the Study Area.	-

3. Native vegetation and flora assessment

3.1 Data review

3.1.1 Bionet - Atlas of NSW Wildlife Database

A review of spatial records of threatened flora within a 10 km radius of the Study Area was undertaken using data obtained from the Bionet - Atlas of NSW Wildlife. Utilising Data from the Atlas of NSW Wildlife, a review of threatened flora was undertaken within a 10km radius of the Study Area. This was used to inform and assist in planning the field survey.

3.1.2 EPBC Act Protected Matters Search

A Protected Matters Search (EPBC Act) was carried out for a 10 km radius of the Study Area. Results were considered during field survey planning and the likelihood of occurrence analysis (detailed in Appendix 1), performed prior to field survey and updated post field survey. The results of the search are provided in Appendix 1.

3.2 Plant community delineation and mapping

Vegetation within the Study Area was validated using the BAM during a field survey completed on the 27-29th September 2017. In total, 13 BAM plots/transects were completed within the Study Area to meet the minimum plot requirement as per the BAM (Figure 5).

Walking meanders were undertaken between plot locations. At a minimum, the combined foot traverses complied with the recommended number and length of traverses per area of stratification unit (vegetation community) according to DEC (2004) survey guidelines. The walking meanders were also used to survey for threatened flora species across the Study Area.

The field survey confirmed that the Study Area consisted predominately of native rehabilitation, mainly tubestock and some native seeding that had occurred over the past decade.

As detailed in 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, the areas that have been rehabilitated have been attributed to two Plant Community Types (PCTs) which likely occurred within the Study Area prior to clearing or contain a structure 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 five vegetation categories as shown in Table 3. The vegetation categories generally reflected the age of rehabilitation that has occurred within the Study Area over the past decade.

Descriptions for those communities which occur within the Study Area are provided in Appendix 2 and vegetation community mapping is shown in Figure 6.

Table 3. Vegetation mapping and alignment for vegetation types within the Study Area

Vegetation zone	Plant Community Type (PCT)	Vegetation formation	Vegetation class	Threatened Ecological Community (TEC)*	PCT % cleared	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	Rehabilitation_Area 1	19.77	3	4
2						Rehabilitation_Area 2	3.87	2	2
3						Rehabilitation_Area 4	5.20	3	3
4						Remnant	2.91	2	2
5	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	Rehabilitation_Area 3	3.91	2	2
-	Non-native	-	-	-	-	Non-native	2.48	-	-
	Total						38.14	12	13
	Total native vegetation						35.66		

3.2.3 Plant community descriptions

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

3.2.4 Site values

Flora

Floristic data recorded from floristic plots performed throughout the identified vegetation zones (Figure 6) is included within Appendix 3.

Plot and transect values

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

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 (Appendix 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 Study Area have been provided in Table 4. 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 non-threatened ecological community, do not need to be offset. As shown in Table 4, the 'Rehabilitation Area 4' vegetation zone had a score of 7.9, and as such, does not require to be offset. The remainder of the vegetation zones had a site integrity of 17 and therefore require biodiversity offsetting.

Table 4. 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	Rehabilitation_ Area 1	19.77	42.2	Yes
2		Rehabilitation_ Area 2	3.87	22.2	Yes
3		Rehabilitation_ Area 4	5.20	7.9	No
4		Remnant	2.91	46.4	Yes
5	1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	Rehabilitation_ Area 3	3.91	19	Yes

3.2.5 High threat and priority weeds

The Environment, Energy and Science (EES) Group (formally OEH – now part of DPIE) has a list of 'High threat weeds' which need to be taken into consideration in the BDAR. During the field surveys, three high threat weeds were recorded within the BAM plots: *Bidens pilosa* (Farmers Friend), *Ehrharta erecta* (Panic Veldtgrass), and *Eragrostis curvula* (Africa Lovegrass). The three high threat weeds were generally located across all vegetation zones, however were concentrated adjacent to existing disturbance areas. The cover of 'high threatened weeds' are considered in the site value scores for each BAM plot (Appendix 4).

3.2.6 Threatened ecological communities

A list of Threatened Ecological Communities (TECs) occurring or potentially occurring within the locality as generated from the database searches detailed in section 3.1, is provided in Appendix 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 or are likely to occur within the Study Area.

3.3 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 Table 5 and Appendix 1.

The walking meanders and targeted threatened orchid survey, were used to survey for threatened flora across the Study Area. In total, approximately 18 hours of threatened flora random meanders were conducted between the 26 to 27th of September 2017, and 7 hours were completed on 20th August 2018.

The targeted field surveys were completed during the recommended survey times for most of the threatened flora as per the BAM calculator (Table 5). Surveys completed outside the recommended survey times have been addressed for each species in Table 5.

A targeted survey was completed during the recommended survey month (August) to determine the presence of *Diuris praecox*, given a total of 208 individual *Diuris praecox* were recorded within Boral landholding in September 2003 (ERM 2005). The population recorded in 2003 was adjacent to walking tracks and roads where it was noted there was reduced competition for light (ERM 2005). Follow up site visits in 2004 noted that the half the population were not flowering which may have been attributed to increased shrub density and competition for light (ERM 2005).

During the targeted survey, the population that had been previously recorded on Boral landholdings was not flowering. An inspection of the area where the population was recorded noted that the area of habitat was relatively dense with shrubs which may have been the reason for the known population to either not be in flower, or potentially no longer persist.

During the field survey, no BC Act or EPBC Act listed threatened flora were recorded. The previously cleared nature of the Study Area, which has changed the sites resilience, is likely attributed to the absence of threatened flora. Given the field survey was completed during the recommended survey times for those species identified in the BAM (Table 5), the flora habitat requirements, and the conspicuous nature of the species, it is highly unlikely that threatened flora occur within the Study Area. As such, all the threatened flora generated by the BAM calculator has been assumed absent.

Table 5. Recommended threatened flora survey time matrix as specified in BAM

Scientific Name	Recommended survey time (BAM)												Consideration
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
<i>Allocasuarina simulans</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.
<i>Angophora inopina</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.
<i>Callistemon linearifolius</i>	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Survey completed during recommended survey time – not detected during targeted flora survey. Unlikely to remain undetected during the survey.
<i>Corybas dowingii</i>						Yes	Yes	Yes					Survey completed during recommended survey time – not detected during targeted flora survey. Unlikely to remain undetected during the survey.
<i>Cryptostylis hunteriana</i>	Yes	Yes									Yes	Yes	The survey was not completed during the recommended survey time. However, the species is unlikely to have habitat within the Study Area due to the following: <ul style="list-style-type: none"> The majority of the Study Area consisted of a rehabilitated quarry pit and as such, the sandy soil does not have resilience. The species prefers moist sands and moist to dry clay loam which are absent from Study Area.
<i>Diuris arenaria</i>								Yes	Yes				Survey completed during recommended survey time – not detected during targeted flora survey.
<i>Diuris praecox</i>							Yes	Yes					Survey completed during recommended survey time – not detected during targeted flora survey.
<i>Eucalyptus camfieldii</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.
<i>Eucalyptus parramattensis subsp. decadens</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.
<i>Melaleuca groveana</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.
<i>Prostanthera densa</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.
<i>Rhizanthella slateri</i>									Yes	Yes	Yes		Survey completed during recommended survey time– not detected during targeted flora survey.
<i>Senecio spathulatus</i>	Yes								Yes	Yes	Yes	Yes	Survey completed during recommended survey time – not detected during targeted flora survey.

Scientific Name	Recommended survey time (BAM)												Consideration
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
<i>Tetraloche juncea</i>							Yes	Yes	Yes	Yes	Yes	Yes	Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.
<i>Thesium australe</i>	Yes	Yes							Yes	Yes	Yes	Yes	Survey completed during recommended survey time – not detected during targeted flora survey.

4. Assessment of fauna and habitat

4.1 Bionet Atlas & EPBC Act Protected Matters Search

Similar to that in Section 3.1.1, a review of spatial records of threatened fauna within a 10 km radius of the Study Area was undertaken using data obtained from the Bionet Atlas, and predicted threatened biodiversity were generated from an EPBC Act Protected Matters Search.

Eighty-five threatened fauna have been previously recorded or have modelled habitat within a 10 km radius of the Study Area (Appendix 1) according to the database searches. The potential for these species to occur within the Study Area is discussed in Section 3.1 and Appendix 1. The results were considered during field survey planning and the likelihood of occurrence analysis, performed prior to field survey and updated post field survey.

4.2 Methods – field survey

The fauna field surveys incorporated both targeted survey using established survey techniques (as described in Table 6) and habitat-based assessment.

Habitat assessment considered the type and condition of habitats for fauna species. Habitat features recorded within the survey area included:

- Topographic features (such as slope, aspect and landscape position);
- Geology/soil type;
- Dominant vegetation community composition, structure and condition of strata levels;
- Form, quality and location of water sources;
- The presence, number, size and condition of unique habitat features (such as tree hollows and crevices, loose tree bark, fallen timber mistletoe and any rock outcropping or scattered surface rock); and
- The level of disturbance.

The fauna survey design effort had an emphasis on detection of species credit fauna and EPBC Act listed fauna where available habitat was present for such species. Since ecosystem credit species (see Appendix 1) have a high likelihood of being present on the site (based on the presence of habitat surrogates) specific targeted survey was not always performed for these species.

Table 6. Fauna survey details and effort within the Study Area

Method	Effort and Timing	Details	Targeted species (NSW listed)	Targeted species (Commonwealth listed)
Diurnal bird surveys	1 x survey 26/07/2017 (2 hours) 1 x survey 27/07/2017 (2 hours)	20 minute, 2 hectare bird surveys were extended in time due to relatively low bird activity in most areas and additional species being recorded after or at the end of the typical standard 20 min period. Incidental bird sightings were made throughout surveys activities with species of note being recorded spatially. Birds were identified with the use of 10 X 42 binoculars or from their calls.	All birds	All birds
Anabat survey	2 x Anabat left for 2 consecutive nights 26/09/2017 - 27/09/2017	Two Anabat II bat detector and Anabat CF recorder unit was deployed at two sites over two nights along potential flyways.	Eastern Cave Bat, Southern Myotis, Large-eared Pied Bat, Eastern False Pipistrelle.	-
Koala SAT	3 x survey 26/07/2017 1 x survey 27/07/2017	SAT (Koala scat) surveys were conducted across the Study Area. In addition to SAT surveys random tree inspections were carried out during traverses of the Study Area at selected feed trees searching for scats and characteristic bark scratches.	Koala	Koala
Opportunistic survey	During all activities	Opportunistic observations were made of fauna aided with binoculars and photography as appropriate. Opportunistic survey included searches of habitat such as under logs, rocks or waste piles (where limited areas of such habitat existed) or within heaped leaf litter, casual bird or mammal observations or observations of their calls.	All species	All species

4.3 Recommended fauna survey effort in BAM

Threatened fauna predicted or potentially occurring within the IBRA subregion were reviewed. This list was refined post field survey for the Study Area within the BAM Calculator on the basis of the vegetation types, condition and habitat features as well as the results of field survey. The list of predicted and candidate species generated via the BAM Calculator is in Table 7. A status for each species is provided which represents the basis for deciding whether a species was present or absent from the Study Area. No ecosystem credit species were omitted from the BAM Calculator, despite there being very limited or no habitat present within the Study Area for many of the predicted species.

Table 7. Recommended threatened fauna survey time matrix as specified in BAM

Common Name	Scientific Name	Recommended survey time												Consideration
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Candidate threatened species														
Regent Honeyeater (Breeding)	<i>Anthochaera Phrygia</i>									Yes	Yes	Yes	Yes	No breeding habitat likely. Study Area does not contain following habitat preferences: <ul style="list-style-type: none">rough-barked trees, including <i>Casuarina</i> sp, ironbarks and rough-barked <i>Angophora</i> sp.Breeding timing and location appears tied to flowering of key Eucalypt and mistletoe species in box-ironbark woodlands and forests, including: <i>Eucalyptus sideroxylon</i>, <i>E. melliodora</i>, <i>E. albens</i>, <i>E. leucoxylon</i>, <i>E. robusta</i>, <i>Corymbia maculata</i>, and the mistletoe species <i>Amyema cambagei</i> on <i>Casuarina cunninghamiana</i>, <i>A miquelli</i> and <i>Dendrothoe vitelline</i> (DoE, 2016)
Bush Stone-curlew	<i>Burhinus grallarius</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No – species not detected during survey. Furthermore, only four records occur within the locality (Fern Bay 2011, Stockton beach 1998, Kooragang island 2008, Horseshoe Bay 2010). Unlikely to be present.
Gang-gang Cockatoo (Breeding)	<i>Callocephalon fimbriatum</i>	Yes									Yes	Yes	Yes	No – breeding habitat unlikely. Requires tree hollows in large living eucalypts for breeding – these were absent from the Study Area.
Glossy Black-Cockatoo (Breeding)	<i>Calyptorhynchus lathamii</i>			Yes	Yes	Yes	Yes	Yes	Yes					No – no breeding habitat unlikely. Requires tree hollows in large living eucalypts for breeding – these were absent from the Study Area.
Eastern Pygmy-possum	<i>Cercartetus nanus</i>	Yes	Yes	Yes						Yes	Yes	Yes	Yes	No – closest record is 20 kilometres to the north of the Study Area. The Scientific Determination notes the species only occurs higher elevations north of Newcastle.
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No caves in the Study Area. Not within 2 kilometres of rocky outcrops or boulder piles.
Wallum Froglet	<i>Crinia tinnula</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No – no habitat present within the Study Area.

Common Name	Scientific Name	Recommended survey time												Consideration
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	<i>Dromaius novaehollandiae</i> - endangered population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No – species not detected during survey. Unlikely to be present in Study Area. No records in Study Area.
White-bellied Sea-Eagle (Breeding)	<i>Haliaeetus leucogaster</i>							Yes	Yes	Yes	Yes	Yes	Yes	Recorded during field survey flying over the Study Area. Breeding habitat is not present in Study Area as no nests were recorded.
Little Eagle (Breeding)	<i>Hieraaetus morphnoides</i>								Yes	Yes	Yes			No – species not detected during survey. Breeding habitat is not present in Study Area as no nests were recorded.
Pale-headed Snake	<i>Hoplocephalus bitorquatus</i>	Yes	Yes	Yes								Yes	Yes	No - habitat within Study Area is not suitable. The species tends to occur in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest where there are large standing old and dead trees with hollows and exfoliating bark. The species prefers Callitris woodlands.
Swift Parrot (Breeding)	<i>Lathamus discolor</i>					Yes	Yes	Yes	Yes					No – species not detected during survey. Breeding habitat is not present in Study Area.
Green and Golden Bell Frog	<i>Litoria aurea</i>	Yes	Yes	Yes							Yes	Yes	Yes	No habitat present
Green-thighed Frog	<i>Litoria brevipalmata</i>	Yes	Yes	Yes								Yes	Yes	No habitat present
Square-tailed Kite (Breeding)	<i>Lophoictinia isura</i>	Yes								Yes	Yes	Yes	Yes	No – species not detected during survey. Breeding habitat is not present in Study Area as no nests were recorded.
Little Bentwing-bat (Breeding)	<i>Miniopterus australis</i>	Yes	Yes										Yes	No – breeding habitat which includes caves, mines, tunnels, do not occur in Study Area.
Eastern Bentwing-bat (Breeding)	<i>Miniopterus schreibersii oceanensis</i>	Yes	Yes									Yes	Yes	Recorded in Study Area however – breeding habitat which includes caves, mines, tunnels, do not occur in Study Area.
Southern Myotis (Breeding)	<i>Myotis macropus</i>	Yes	Yes	Yes							Yes	Yes	Yes	Not recorded in Study Area. Breeding habitat which includes caves, mines, tunnels, drains and beneath bridges within 200m of large permanent watercourses, does not occur in Study Area.

Common Name	Scientific Name	Recommended survey time												Consideration
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Barking Owl (Breeding)	<i>Ninox connivens</i>					Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No hollows of sufficient size in Study Area (Nest hollows are vertical or sloping with opening diameter 20-46cm and 20-300cm depth).
Powerful Owl (Breeding)	<i>Ninox strenua</i>					Yes	Yes	Yes	Yes					No hollows of sufficient size in Study Area (Nest hollows are vertical or sloping with opening diameter 20-46cm and 20-300cm depth).
Eastern Osprey (Breeding)	<i>Pandion cristatus</i>				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		No – species not detected during survey. Breeding habitat is not present in Study Area as no nests were recorded.
Squirrel Glider	<i>Petaurus norfolcensis</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes - Detected during previous surveys within the Study Area and surrounds in 2003, and is known to occur throughout the Stockton Beach area.
Brush-tailed Rock-wallaby	<i>Petrogale penicillata</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No habitat present
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No – lack of habitat given the Study Area predominately consists of rehabilitation. The Study Area lacks trees with hollows. The species is known to hunt predominantly in rough-barked trees of >25cm DBH where available and requires numerous tree hollows of 2.5-4 cm entrance diameter which are absent throughout the majority of the Study Area.
Koala (important habitat)	<i>Phascolarctos cinereus</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes – not detected during field survey. However it is noted that the species has been recorded through the locality and adjacent to Boral's Landholding. The field survey results however demonstrates that if the Koala were present, it is unlikely to utilise the Study Area on a regular basis. Given the Study area is predominately planted tubestock, or juvenile eucalypts, the surrounding vegetation would likely provide a greater food source. The Koala is more likely to utilise the bushland surrounding the Study Area for movement given the ground cover is relatively bare across much of the Study Area offering the species little protection during movement.

Common Name	Scientific Name	Recommended survey time												Consideration
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Koala, Hawks Nest and Tea Gardens population	<i>Phascolarctos cinereus</i> - endangered population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No – not detected during field survey.
Common Planigale	<i>Planigale maculata</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No – unlikely to have habitat in the Study Area as the species utilises dense ground cover for shelter, and also may build nests in in crevices, hollow logs, under bark or rocks. Within the Study Area, ground cover was sparse, along with hollow bearing logs. The site lacks surface rocks.
Grey-headed Flying-fox (Breeding)	<i>Pteropus poliocephalus</i>										Yes	Yes	Yes	No breeding camps in the Study Area.
Masked Owl (Breeding)	<i>Tyto novaehollandiae</i>					Yes	Yes	Yes	Yes					No breeding habitat present. The Study Area generally lacks hollows with >40cm diameter and >100cm depth. No evidence of usage.
Mahony's Toadlet	<i>Uperoleia mahonyi</i>	Yes	Yes	Yes							Yes	Yes	Yes	No habitat present
Eastern Cave Bat	<i>Vespadelus troughtoni</i>	Yes										Yes	Yes	No habitat. Not within 2 kilometres of caves, rocky outcrops or boulder piles
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>													
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>													

Common Name	Scientific Name	Recommended survey time												Consideration
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>													
Little Eagle	<i>Hieraaetus 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</i>													
Little Bentwing-bat	<i>Miniopterus australis</i>													
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>													
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 Sheathtail-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												Consideration
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Masked Owl	<i>Tyto novaehollandiae</i>													

4.4 Fauna habitat

There was a clear difference in fauna habitat across the Study Area attributed to the age of regeneration.

Areas of relatively young regeneration (Rehabilitation Area 4) contained scattered logs, generally sparse ground cover (<5% ground cover) and lacked a mid and canopy stratum (Photo 1). Whilst older regeneration areas (Rehabilitation Area 1, 2 and 3) had a developing canopy and midstorey cover, with Area 3 containing a relatively dense shrub layer (Photo 2), whilst the patch of remnant vegetation had stratum layers intact (Photo 3). As such, the remnant and older patches of rehabilitation would offer greater foraging habitat for a variety of fauna, including that of nectivorous birds and the Squirrel glider (*Petaurus norfolcensis*).

For the most part, all the rehabilitation areas did not contain trees old enough to contain hollows, and as such, roosting and breeding habitat for a range of hollow-dependent species, such as microbats, was absent. Few hollows within areas of the remnant vegetation occur, however none of these had any evidence of owl usage (e.g. pellets or caracisis).

Logs have been scattered throughout the rehabilitation areas which provide habitat for reptiles and small ground-dwelling mammals, and foraging resources for granivorous birds. There were no large den sites recorded that would be suitable for the spotted-tailed quoll (eg hollow-bearing logs of sufficient hollow depth).

As previously noted, the rehabilitation ground cover was particularly sparse, however the sandy substrate may provide habitat for small to medium-sized mammals to create burrows for shelter.

No habitat in the form of bush rock or rock platform was identified, or was there any permanent or ephemeral aquatic habitats on the site.



Photo 1. Open areas of rehabilitated mine pit. Occasional logs and tubestock.



Photo 2. Older areas of rehabilitation – some fallen logs and high leaf litter present.



Photo 3. Remnant vegetation – stratum layer intact

4.5 Connectivity of fauna habitat

The Study Area adjoins a large native vegetation corridor which extends along Stockton Beach to Anna Bay in the north and Stockton in the south. 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 south-west.

The removal of vegetation (mainly tubestock plantings within the former mine pit) and habitat within the Study Area are not limiting ie. the habitat features surrounding the site contains a range of habitat features which are not extensive within the Study Area (hollow-bearing trees, fallen logs). The removal of habitat within the Study Area is therefore unlikely to reduce the amount of important habitat features within the corridor so much that fauna roosting and foraging habitat would be significantly impacted.

The removal of the vegetation within the Study Area, 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 mine pit which was historically cleared.
- Vegetation would be retained along Nelson Bay Road and towards Stockton Beach allowing fauna movement along the corridor (as can be seen from Figure 3).
- The haul road that is currently in operation for the mine operations would not be widened as part of the current proposal, thus no changes to fauna movement are likely.

4.6 Fauna recorded during field surveys

Fauna field surveys using the methods described in Section 4.2 were undertaken in each of the identified habitats, with the suite of methods employed in each habitat type dependant on the potential presence of subject threatened fauna within that habitat type. Notable opportunistic sightings whilst travelling within the Study Area were also recorded. A complete species list is provided in Appendix 5.

A total of 28 fauna were recorded during field surveys within or immediately adjacent to the Study Area. The results comprised of three reptiles, four mammals, and 21 birds. A complete fauna list is provided in Appendix 5.

The suite of fauna recorded were predominantly locally common species tolerant of at least moderate disturbance and lower condition vegetation or degraded habitats.

Some mobile species recorded would primarily be dependent on the adjacent woodland areas but would take advantage of parts of the Study Area to forage (e.g. Squirrel Glider).

4.7 Threatened fauna

Three threatened fauna were recorded with the Study Area: Greater Broad-nosed Bat, Eastern Bentwing Bat and White-bellied Sea Eagle. Both the threatened microbats were recorded on both anabats located in the Study Area, whilst the White-bellied Sea Eagle was recorded flying over the Study Area on all days of the field survey.

An additional 16 threatened fauna have the potential to occur within the Study Area but were not recorded, most likely due to their potential use of the Study Area or wider locality being limited to sporadic occurrences (e.g. nomadic birds) (Appendix 1). These species include the following:

- Birds - Dusky Woodswallow, White-fronted Chat, Red Goshawk, White-throated Needletail, Black-faced Monarch, Australian Painted Snipe; and

- Mammals: Little Bentwing-bat, Eastern False Pipistrelle, Eastern Freetail-bat, Southern Myotis, Squirrel Glider, Koala Long-nosed Potoroo, New Holland Mouse, Grey-headed Flying-fox and Yellow-bellied Sheath-tail-bat.

Of these threatened fauna, only the Squirrel Glider is regarded as species credit fauna that would require offsetting under the BC Act.

The Eastern Bentwing Bat, Sooty Owl and White-bellied Sea Eagle, are regarded as both an ecosystem and species credit species, with the species credit component triggered by the presence of breeding habitat. The Eastern Bentwing Bat has breeding habitat within caves and artificial tunnels, neither of which occur within the Study Area, and as such, has been regarded as an ecosystem credit species for this assessment.

The field survey confirmed that no White-bellied Sea Eagle nests occur within the Study Area, and as such, this species has been regarded as an ecosystem credit species for this assessment. And similarly, breeding habitat for the Sooty Owl which includes large tree hollows (hollows approximately 12 metres high in the tree, of approximately 35–50cm internal diameter and approximately 1–3+ metres deep (LMCC 2014)) were absent, thus has been regarded as an ecosystem credit species.

In relation to the Koala, the EES database notes that the Koala is also listed as dual credit species, with the 'species credit' component triggered if the species has 'important habitat' within the Study Area.

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 Study Area. The Koala has been recorded throughout the stretch of the vegetation corridor which encompasses Worimi Regional Park and Worimi State Conservation Area.

As stated in OEH (2018) 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. 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.

Eucalyptus robusta is regarded as a primary feed tree, however did not occur in the Study Area in large numbers. It was also not a tubestock species that was planted in abundance.

For the most part of the Study Area, dominant canopy species that have been planted include *Eucalyptus pilularis*, *Corymbia gummifera* and *Angophora costata*, none of which are regarded as primary or secondary feed trees. As such, the Study Area does not contain a large portion of important feed trees and are therefore not of foraging preference. This is supported by the absence of scratches and Koala scats observed during the field survey.

This is further supported in the DECC (2008) Recovery Plan for the Koala, which notes that '*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.*'

In regards to suitable Koala shelter trees, the canopy height is generally less than 10 metres, with some portions of the rehabilitation not reaching 2 metres in height. Furthermore the density of canopy cover is quite low across all vegetation zones, on average at 5 percent cover. Given the generally low canopy height and cover, the Study Area is unlikely to contain suitable shelter trees for the species.

As discussed further in section 4.8, the site also does not contain 'potential habitat' as described in the SEPP 44. Thus, the site also does not meet the definition of 'core habitat' as per the SEPP 44.

It is therefore our conclusion, that important habitat for the Koala does not occur within the Study Area, and thus has been regarded as an ecosystem credit species. Key considerations in regards to this conclusion include:

- Lack of primary and secondary feed trees;
- The Study Area is not regarded as 'potential habitat' or 'core habitat' under the SEPP 44;
- The canopy height and cover is low – thus is unlikely to provide suitable shelter trees;
- Koalas are more likely to move within the surrounding intact bushland; and
- Koalas are more likely to utilise the surrounding intact bushland given the variety of foraging habitat present.

4.7.1 Species credit fauna

As discussed in section 4.7, the survey resulted in only one species credit fauna being assumed present within the Study Area, namely the Squirrel Glider.

The Squirrel Glider was recorded within the Study Area during the ERM (2005) field survey, and throughout vegetation that aligned to PCT 1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands. Bionet records for the species occur within the stretch vegetation corridor encompasses Worimi Regional Park and Worimi State Conservation Area.

According to the OEHS (2019) threatened species profile, the Squirrel Glider inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest and Blackbutt-Bloodwood forest with heath understorey in coastal areas, and prefers mixed species stands with a shrub or Acacia midstorey. It is also noted that the species requires abundant tree hollows for refuge and nest sites.

The Study Area offers little refuge and nest sites, given 32.75 hectares consists of rehabilitation which contains juvenile eucalypts that have not yet developed hollows. Refuge and nest sites are more likely to occur within the remnant vegetation that surrounds the Study Area.

The Study Area does provide foraging habitat for the Squirrel Glider given the presence of Acacias, Leptospermums and Banksias. However, as described in the vegetation descriptions in Appendix 2, the shrubs are relatively sparsely scattered throughout the vegetation zones, with the exception of the 'remnant' and 'rehabilitation zone Area 3'. As such, we have attributed the following vegetation zones within the Study Area to foraging habitat for the species:

- Rehabilitation Area 1 – approximately 19.77 hectares;
- Rehabilitation Area 3 – approximately 3.91 hectares; and
- Remnant – approximately 2.91 hectares.

In total, approximately 26.59 hectares of potential habitat for the Squirrel Glider has been mapped as per Figure 7.

The remaining vegetation zones, such as 'Rehabilitation zone Area 1' and 'Rehabilitation zones Area 2' are unlikely to provide sufficient foraging habitat at the time of the survey given the sparse shrub layer.

4.7.2 EPBC Act listed fauna

A total of 63 EPBC Act listed fauna were considered in the assessment based on the database reviews detailed in Section 4.1, with most the species being Marine or Migratory bird species. Of these species considered, eight were considered to have a moderate to high likelihood to utilise the habitat features of the Study Area for foraging: Australian Painted Snipe, Black-faced Monarch, White-throated Needletail, Red Goshawk, Long-nosed Potoroo, Koala, New Holland Mouse and Grey-headed Flying-fox.

The threatened/migratory birds (Australian Painted Snipe, Black-faced Monarch, White-throated Needletail, Red Goshawk) may utilise the Study Area on occasion for foraging. None of these species were detected during the bird surveys completed as part of this assessment. Based on the specific habitat requirements of each of the species (Appendix 1), and the lack detection during surveys, it is likely that the habitat features within the Study Area would only be used on an intermittent basis for foraging. 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 availability for each of the species.

The Grey-headed Flying Fox is only likely to utilise the Study Area on occasion for foraging. No roosting camp sites were observed in the Study Area, nor known to occur within close proximity to the Study Area.

The Long-nosed Potoroo, Koala and New Holland Mouse have been attributed a moderate likelihood of occurrence as both these species have been recorded within Worimi Regional Park and Worimi State Conservation Area and may utilise the Study Area for foraging.

Impacts of the Project on these EPBC Act listed species are considered further in Section 5.

4.8 State Environment Planning Policy 44 – Koala Habitat

State Environment Planning Policy 44 – Koala Habitat (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 Study Area 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 Study Area.

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 Study Area. *E. robusta* comprised less than 15 per cent of the total number of trees present in the Study Area, and therefore, as per the definition of SEPP 44, the habitat present is not regarded as 'potential Koala habitat'.

Under SEPP 44, 'Core Koala habitat' is defined 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 has not been recorded on the Study Area and there are no historical records of the species in the Study Area. As discussed in section 4.7.1, 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 Study Area (OEH Bionet).

If a resident population of the Koala was present within the Study Area, it is highly likely that there would be extensive sightings by Boral staff and rehabilitation contractors whilst working within the Study Area. Given the lack of recent sightings and/or historical records in the Study Area, the Study Area is not considered to constitute 'core Koala habitat'. Furthermore, as detailed in section 4.7.1, the Study Area predominately comprises areas of native rehabilitation with no canopy cover. Also, given the only potential food tree present (*E. robusta*) is relatively scarce across the Study Area, the Study Area is considered unlikely to provide vital habitat for any potential local breeding population, should it occur. For these reasons, the Study Area does not meet the definitions of 'potential Koala habitat' and 'Core Koala habitat' as per SEPP 44.

It should be noted that the current SEPP 44, is to be replaced with SEPP Koala Habitat Protection 2019 (SEPP KHP), which will take effect on 1 March 2020. Whilst SEPP KHP is not yet in effect, it is noted that the definition of 'Koala habitat' will be amended and is supported by an expanded list of Koala feed trees under schedule 2.

Under SEPP KHP, the study area contains tree species (*Eucalyptus robusta*, *Angophora costata* and *Corymbia gummifera*) which are listed as Koala feed trees listed in schedule 2 of SEPP KHP. However it should be noted, that the majority of these trees have been planted within the Study Area, and the large list of feed trees in the SEPP KHP includes species that are associated with most of the PCTs that occur along the coastal stretch along Worimi Regional Park and Worimi State Conservation Area.

As discussed in section 4.7.1, Niche did not detect any usage of the Study Area by the Koala. However, we note that there are records for the Koala along the coastal corridor of Worimi Regional Park and Worimi State Conservation Area (section 4.7.1), with the closest record located approximately 100 metres from the Study Area. These records are associated with a number of PCTs, with the closest records being associated with PCT 1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland.

Within the Study Area, 31.75 hectares of PCT 1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland occurs, with only approximately 2.91 hectares being remnant vegetation, and the remainder consisting of planted tubestock. As discussed in section 4.7.1, our findings indicate less favourable conditions for the Koala given the lack of foliage protection in the rehabilitation areas within the Study Area despite the Koala potentially being associated with PCT 1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland within the locality.

In relation to 'Core Koala' habitat under SEPP KHP, it is defined as –

‘(a) an area of land where koalas are present, or

(b) an area of land—

(i) which has been assessed by a suitably qualified and experienced person in accordance with the Guideline as being highly suitable koala habitat, and

(ii) where koalas have been recorded as being present in the previous 18 years.’

Similar to the assessment completed under the existing provisions of SEPP 44, we conclude that the Study Area does not meet the definition of ‘Core Koala habitat’. We have based this conclusion on the following:

- The Koala, or evidence of the Koala utilising the Study Area was not detected by Niche during the field surveys undertaken (section 4.2).
- Boral staff and rehabilitation contractors have not reported any Koala activity within the Study Area. It is likely that if a resident population was present within the Study Area, regular occurrence of the Koala would be sighted by staff and contractors.
- There are no records of the Koala within the Study Area in the past 18 years.
- We do not regard the habitat as being ‘highly suitable’ given:
 - The vegetation consists predominately of native rehabilitation, which lack a canopy layer.
 - As discussed in section 4.7.1, the canopy height and vegetation cover are low – thus the Study Area is unlikely to provide suitable shelter habitat, which restricts use of the Study Area as an important movement corridor for the Koala.
 - Preferred feed trees make up less than 15% of trees within the vegetation zone.
- Koalas are more likely to move/occur within the surrounding intact bushland.
- Koalas are more likely to utilise the surrounding intact bushland given the diversity of foraging and shelter resources present.

4.9 Port Stephens 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 (PSC 2007), which classifies Koala habitat into different categories based off a range of attributes and survey results. The Study Area has been mapped as ‘Supplementary’ Koala habitat, which is defined as habitat ‘where Marginal Koala Habitat Middle-ranking Community overlap’ (PSC 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 8.

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 8. 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.	The area to be impacted is not known to contain a resident Koala population. Area to be disturbed consists predominately of native rehabilitation land, which occurs within, and immediately adjacent to a former quarry pit. The Project is highly unlikely to result in any decrease in the Koala population of the Port Stephens LGA.
ii) To protect koala habitat areas from any development which would compromise habitat quality or integrity.	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. 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.
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.
v) To encourage koala habitat rehabilitation and restoration.	The Project would result in the clearing of native vegetation, conservatively estimated to be 35.66 ha of which 32.75 ha is rehabilitation. Given the Project is located predominately within a former quarry pit and historically impacted areas, largely avoids impacts to remnant vegetation. Mitigation measure to reduce potential habitat impacts are detailed in section 5.1.4.
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 throughout the landscape.
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 4.7.1, the 'supplementary Koala habitat' would not restrict 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	Not relevant

General Aims and Objectives of CKPoM Performance Criteria for Developments	Consideration in the Project
Council officers involved in the assessment of those applications.	

5. Impact Assessment

The Impact Assessment below forms Stage 2 of the BDAR as detailed in 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 Study Area

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 on 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 economical development.

Many millions of tonnes of sand lie on 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)

Impacts arising from the construction will primarily relate to vegetation clearing. Boral proposes to undertake the following mitigation and management actions during construction.

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; and
- Management and removal of all rubbish from the Project site.

Vegetation Clearance Protocol

The vegetation clearing protocol provided in Boral's Landscape and Rehabilitation Management Plan (ERM 2010) is to be adhered to. This Plan includes 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); and
- 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 2019). 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.

Update of Stockton Quarry Landscape and Rehabilitation Management Plan

Boral's Stockton Sand Quarry Landscape and Rehabilitation Management Plan (ERM 2010) will be updated to reflect biodiversity management measures associated with the Project in order to protect and manage

important biodiversity values. Currently, the existing Plan discusses key commitments relating to threatened species management, pest and weed management, fire management and site hygiene practices.

5.1.6 Pest and weed management

The existing Plan (ERM 2010) would be updated to include a section relating to pest and weed management activities of the Project including:

- 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

The Project would affect biodiversity, including threatened biodiversity, through both direct and indirect impacts during construction and operation. The majority of impacts on biodiversity would occur during construction from clearing of native vegetation and removal of habitat.

The direct and indirect impacts associated with Project and measures to offset and manage biodiversity in the long term are outlined the following sections.

5.2.1 Direct Impacts

The following residual direct impacts would result from the Project:

- Clearing of native vegetation and associated habitat, conservatively estimated to be 35.66 ha of which 32.75 ha is rehabilitation; and
- Clearing of species credit fauna habitat for the following:
 - Squirrel Glider habitat estimated to be 26.59 ha.

Direct impact to native vegetation and habitat

The Project would result in the clearing of 35.66 hectares of vegetation regarded as 'native vegetation,' as defined in the BAM, which comprises of:

- 31.75 ha of PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland, of which 28.84 ha is rehabilitated land and 2.91 hectares is remnant native vegetation; and
- 3.91 ha of PCT1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes.

The rehabilitated land has been subject to previous clearing for the former inland extraction area, and now comprises of planted tubestock of varying ages as described in Section 3.2. The previous site disturbance is evident in all vegetation zones, in particular that of 'Rehabilitation Area 4' which contained a very low vegetation integrity score of 7 (see Section 5.3).

Direct impact to Squirrel Glider habitat

As previously discussed in Section 4.7, the Squirrel Glider was not recorded during the field survey however has been previously recorded at the site by ERM (2005), and is known to occur throughout the locality.

As previously discussed the following vegetation zones within the Study Area provide foraging habitat for the species:

- Rehabilitation Area 1 – approximately 19.77 ha;
- Rehabilitation Area 3 – approximately 3.91 ha; and
- Remnant – approximately 2.91 ha.

In total, approximately 26.59 ha of potential habitat for the Squirrel Glider would be cleared as part of the Project (Figure 7).

Direct impacts to EPBC Act listed fauna

As discussed above, the Project is not likely to result in a significant impact to any threatened biodiversity listed under the EPBC Act.

As discussed in Section 4.7, seven threatened fauna species listed on the EPBC Act may utilise the Study Area on occasional foraging. The Project would result in the loss of 35.66 ha of foraging habitat which for the most part, consists of sparsely scattered tubestock with a general lack of microhabitat features such as fallen logs and hollow-bearing trees.

Assessments of Significance have been completed in Appendix 7 for the following EPBC Act listed threatened or migratory species: Australian Painted Snipe, Black-faced Monarch, White-throated Needletail, Red Goshawk, Long-nosed Potoroo, New Holland Mouse and Grey-headed Flying-fox. The Assessments of Significance have concluded that a significant impact to these species is unlikely.

5.2.2 Indirect impacts

Indirect impacts associated with the Project will largely occur during the construction 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; and
- Increased spreading of weed propagules.

The indirect impacts described above are variable in terms of the distance they may extend from the Study Area, and in many cases, due to mitigation measures, indirect impacts will be completely contained within the Study Area.

Indirect impacts on the biodiversity values of areas surrounding the Study Area, along with recommended mitigation measures to minimise identified impacts, are discussed in Table 9. Boral would be responsible for carrying out the mitigation measures.

Table 9. Indirect impacts and mitigation measures

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, however appropriate monitoring and control measures would be implemented during and after construction, to counter act the potential for weed occurrences.</p> <p>The extraction area would be progressively rehabilitated creating a pond structure, with stable vegetated banks.</p>	Varying distance from subject site. Potentially occurring within 50 metres from the disturbance area throughout the active life of the Project.	<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 updated Landscape & Rehabilitation Management Plan.</p>	Active weed, and pest management are anticipated to be successful at managing edge effects from the Project.
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. New weed species can potentially be introduced as a result of the movement of construction vehicles and materials into the Study Area.</p> <p>Areas more likely to be exposed to weed increases are areas of native vegetation that occur to the south of the Study Area. 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 minor within the adjacent woodland areas.</p>	Variable depending on topography. However, typically would occur within close proximity to disturbance area.	Weed management and monitoring to be implemented in accordance with the updated Landscape and Rehabilitation Management Plan.	Active weed control methods are likely to be successful in managing the spread of weeds within adjacent areas.
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 Study Area. 	Variable depending on topography and operation.	Sediment management measures will be implemented in accordance with the recommendations in the Stockton Transgressive Dune Quarry Erosion and Sedimentation Control Plan (ERM 2010).	Sedimentation control are known to reduce sedimentation spills.

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	Dust will be generated from the construction and operation of the Project, however will be mitigated with dust suppression from a water truck, which is the practice with the current operations.	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 on-going at the Stockton Sand Quarry.
Fire	Historically, arid zone bushfires tend to be associated with a proficient 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 would likely assist in fire prevention.
Groundwater changes resulting in impacts to vegetation	Groundwater impacts as a result of the dredging are detailed in EES (2019). The report 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 Study Area. The report concludes that the Project is unlikely to have an impact on vegetation surrounding the Study Area.	EES (2019) 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 detail 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>	

5.2.3 Cumulative impacts

Cumulative impacts are the successive, incremental and combined impacts (both positive and negative) of an activity on the environment (Franks et al., 2010). They can arise from the compounding activities of a single operation given the interaction of that operation with past, current and future activities that may or may not be related to the existing development. Cumulative impacts may also arise through the interaction of one development with other types of activities and industries, such as grazing and broad scale agriculture.

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 is 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 which predominately is rehabilitation within the North Coast IBRA region, the Project will also involve an offset that will contribute to in-perpetuity managed conservation areas within the Bioregion.

5.2.4 Serious and irreversible impacts

No threatened species which have potential to experience Serious and Irreversible Impacts (SII) as a result of the Project were recorded in the Study Area.

5.3 Quantifying offset requirements

The BAM identifies the BAM Calculator as the appropriate tool for quantifying the offsets required in both Ecosystem Credit and Species Credit terms. A calculation of the nature and extent of offset credits required due to biodiversity impacts associated with the Project has been undertaken using the BAM Calculator.

5.3.1 Summary of ecosystem credits required

The ecosystem credits to be retired for the Project as determined by the Biodiversity Credit Calculator are shown in Table 10.

Table 10 : Ecosystem credit requirements

Zone	PCT	Vegetation zone name	Vegetation integrity loss	Area (ha)	Biodiversity risk weighting	Potential SAIL	Ecosystem credits	Total
1	Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Rehab_Area1	42.2	19.8	1.5	-	313	396
2		Rehab_Area2	22.2	3.9	1.5	-	32	
3		Rehab_Area4	7.9	5.3	1.5	-	0	
4		Remnant	46.4	2.9	1.5	-	51	
5	Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	Rehab_Area3	19	3.9	2	-	37	37

5.3.2 Summary of species credits required

The species credits to be retired for the Project have been provided in Table 11 which indicates that 521 Squirrel Glider species credits are required for the impact to 26.59 ha of foraging habitat.

Table 11: Species credit species requirements – Squirrel Glider

Vegetation zone name	Habitat condition (vegetation integrity) loss	Area (ha)	Biodiversity risk weighting	Species credits
1644_Rehab_Area3	19	3.91	2	37
1646_Rehab_Area1	42.2	19.77	2	417
1646_Remnant	46.4	2.91	2	67
		26.59	Total	521

6. 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, 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.

6.1 NSW 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 a Commonwealth offset.

6.2 Offset strategy options

Boral has identified a range of options to meet the required offsets for the Project, these are provided in Table 12. As demonstrated in the table, given Boral has the option to pay into the BCT Payment Fund to satisfy the offset requirement, there is minimal risk for Boral not to meet the offsetting liability.

Table 12. 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	396	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. However, Boral will only explore this option dependant on the BCT Payment Fund feasibility.	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	37				
Squirrel Glider	521				

7. Conclusion

This report provides a BDAR in accordance with the BAM in order to address the potential impacts associated with the Project. This report also provides assessments for threatened biodiversity listed under the EPBC Act.

The Project will result in the disturbance of 35.66 ha of native vegetation. Indirect impacts may include dust, erosion and sedimentation which will be mitigated by measures provided in section 5.1 of this report.

During the field survey it was confirmed that the Study Area mainly comprised of native regeneration. The 'best fit' PCT associated with the vegetation included the following PCTs:

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

Both the PCTs do not align to any TECs under the BC Act or EPBC Act.

No threatened flora are likely to be impacted by the Project given the lack of habitat and absence of threatened flora during the field survey.

Sixteen threatened and migratory fauna species are considered to have a moderate or higher likelihood of occurrence within the Study Area, however most of these species were determined to only utilise the Study Area for foraging on an intermittent basis. Of these species, only one species credit fauna, the Squirrel Glider was assumed to be present within the Study Area, and impacted by the development. No further assessment of impacts are required for the ecosystem credit fauna species based on the requirements of the BAM and the offsetting of the associated PCTs.

Those threatened fauna species which are listed under the EPBC Act that were attributed a moderate likelihood to forage within the Study Area include: Australian Painted Snipe, Black-faced Monarch, White-throated Needletail, Red Goshawk, Long-nosed Potoroo, Koala, New Holland Mouse and Grey-headed Flying-fox. An EPBC Act Assessment of Significance for each of these species has been completed and concluded that a significant impact to any EPBC Act listed threatened fauna is unlikely.

Mitigation measures associated with indirect impacts have been proposed through the revision and implementation of existing management plans.

In accordance with the BAM, the following credits will be required to be offset:

Ecosystem credits:

- Total of 396 credits for PCT 1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast; and
- Total of 37 credits for PCT 1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast.

Species credits:

- A total of 521 credits for the removal of 26.59 ha of foraging habitat for the Squirrel Glider.

In order to satisfy the biodiversity offset requirement for the Project, Boral proposes a number of options available to offset the credits for native vegetation and Squirrel Glider. The options available to Boral include the following:

1. Purchase credits on market;
2. Payment into BCT Fund; and/or
3. Utilise existing Boral Landholdings and consider establishing Stewardship sites. However, at present, this is the last resort given the BCT Payment Fund option.

Given the options available, there is minimal risk in Boral not being able to satisfy their offset liability. No offset is required under Commonwealth legislation, given the Project is unlikely to impact any threatened biodiversity under the EPBC Act.

References

Boral Resources (2010) Stockton Transgressive Dune Quarry Environmental Management Strategy.

Bushfire Planning and Design (2019) Bushfire Assessment Report Stockton Sand Quarry Dredging LOT 3 DP 664552, Lots 1 and 2 DP 1006399 Cocks Lane, Fullerton Cove

Commonwealth of Australia (2017) Draft National Recovery Plan for the Grey-headed Flying-fox (*Pteropus poliocephalus*), Commonwealth of Australia 2017'.

Department of Environment and Conservation (2004). Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft. NSW Department of Environment and Conservation.

Department of Environment and Climate Change (2008). Recovery plan for the Koala (*Phascolarctos cinereus*). NSW Department of Environment and Climate Change.

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.

Department of the Environment (2016). National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*), Commonwealth of Australia.

Department of Environment and Energy (2018) Protected Matters Search tool. Accessed June 2019.

Department of Environment and Resource Management (2012). National recovery plan for the Red Goshawk *Erythrotriorchis radiatus*. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra. Queensland Department of Environment and Resource Management, Brisbane.

Department of Planning and Environment (2016) Explanation of Intended Effect: State Environmental Planning Policy No 44 – Koala Habitat Protection

Element Environment (2019) Stockton Sand Dredging – State Significant Development - Environmental Impact Statement, Prepared for Boral Resources, Element Environment, October 2019.

Environment Australia (2000). Revision of the Interim Biogeographic Regionalisation for Australia (IBRA) and development of Version 5.1 - Summary Report. Environment Australia, Canberra.

ERM (2005) ERM Stockton Sandpit Windblown Sand Extraction, Environment Impact Statement. Prepared for Boral Resources (Country) Pty Limited June 2005.

ERM (2010) Stockton Transgressive Dune Quarry, Rehabilitation and Landscape Management Plan, Boral Resources (NSW), August 2010

Environmental Earth Sciences (2019) Hydrogeological Impact Assessment, Stockton Sand Quarry, Cocks Lane, Fullerton Cove, NSW, Element Environment

Environmental Earth Sciences (2019) Rehabilitation strategy for Stockton Sand Quarry Dredging, Cocks Lane, Fullerton cove, NSW, 2 September 2019, Prepared for Boral resources (NSW)

Jacobs (2017) Groundwater Monitoring and Management Plan. Prepared for Boral Resources.

Lake Macquarie City Council (2014) Interim Lake Macquarie LMCC Large Forest Owl Planning and Management Guidelines 2014

Office of Environment and Heritage (2011). BioMetric Vegetation Types Database. Available online at: http://www.environment.nsw.gov.au/resources/nature/BioMetric_Vegetation_Type_CMA.xls

Office of Environment and Heritage (2017) Biodiversity Assessment Methodology. Published by: Office of Environment and Heritage for the NSW Government. Dated August 2017.

Office of Environment and Heritage (2018). NSW Threatened Species Information. <http://www.environment.nsw.gov.au/threatenedspecies/>. NSW Office of Environment and Heritage.

Office of Environment and Heritage (2018) Threatened Species Profiles. <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx>

Office of Environment and Heritage (2018) Koala habitat and feed trees – fact sheet, online <https://www.environment.nsw.gov.au/topics/animals-and-plants/native-animals/native-animal-facts/koala/koala-habitat>

Office of Environment and Heritage (2018) Biodiversity Assessment Method Operational Manual – Stage 1. Published by: Office of Environment and Heritage. Dated May 2018.

Office of Environment and Heritage (2019) Squirrel Glider – Bionet Database – Species information

Port Stephens Council (2002). Port Stephens Council Comprehensive Koala Plan of Management (CKPoM): CKPoM Resource Document – June 2002. Prepared by Port Stephens Council, the Australian Koala Foundation and the NSW National Parks and Wildlife Service.

Port Stephens Council (2007) Port Stephens Local Government Area, Koala Habitat Planning Tool, Map prepared by Land Use Planning, Sustainable Planning Group. Printed February, 2007

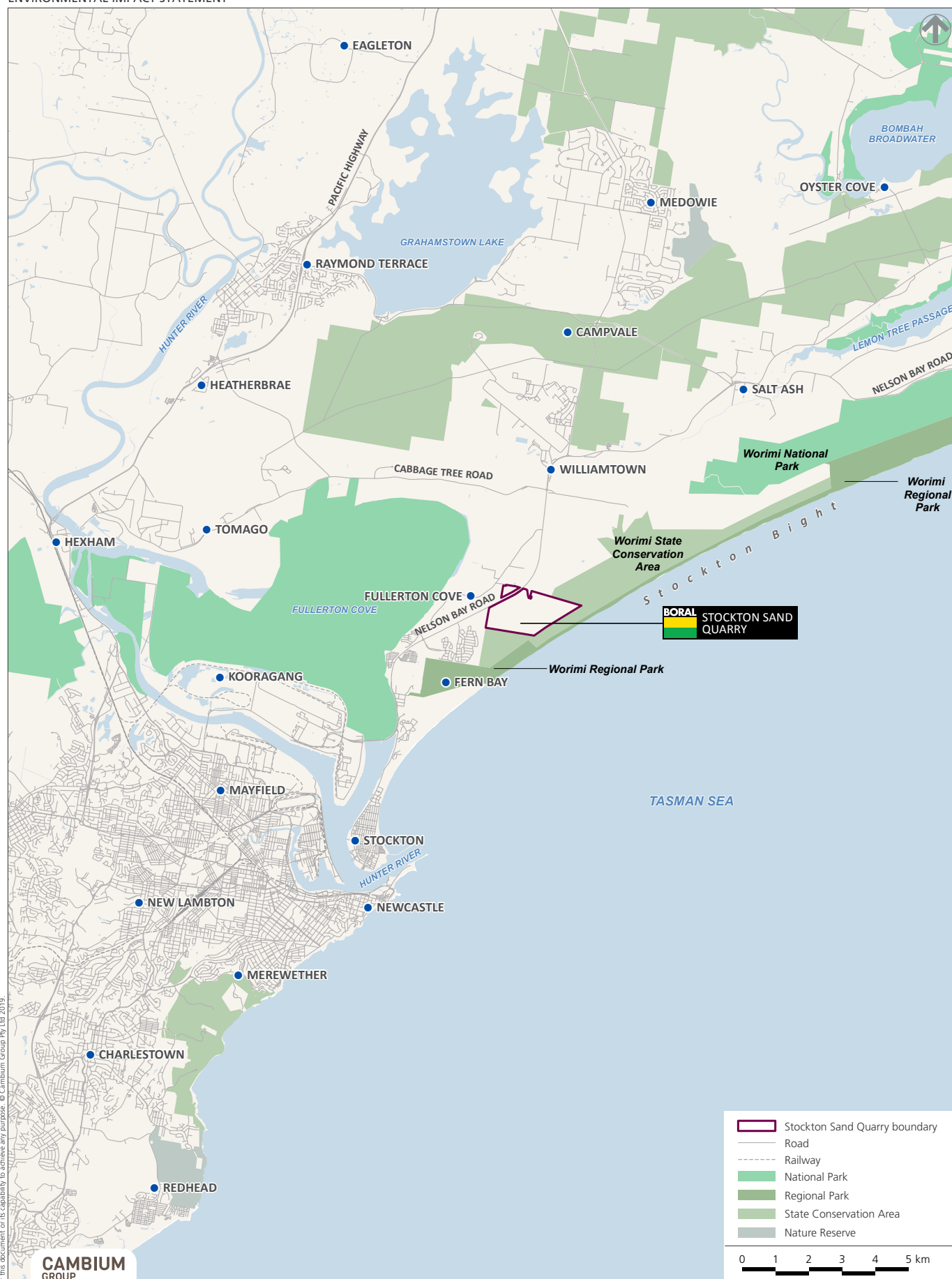
Smith, M (1992) Koalas and Land Use in Gunnedah Shire: A Report on the Bearcare Project. NSW National Parks & Wildlife Service, Hurstville.

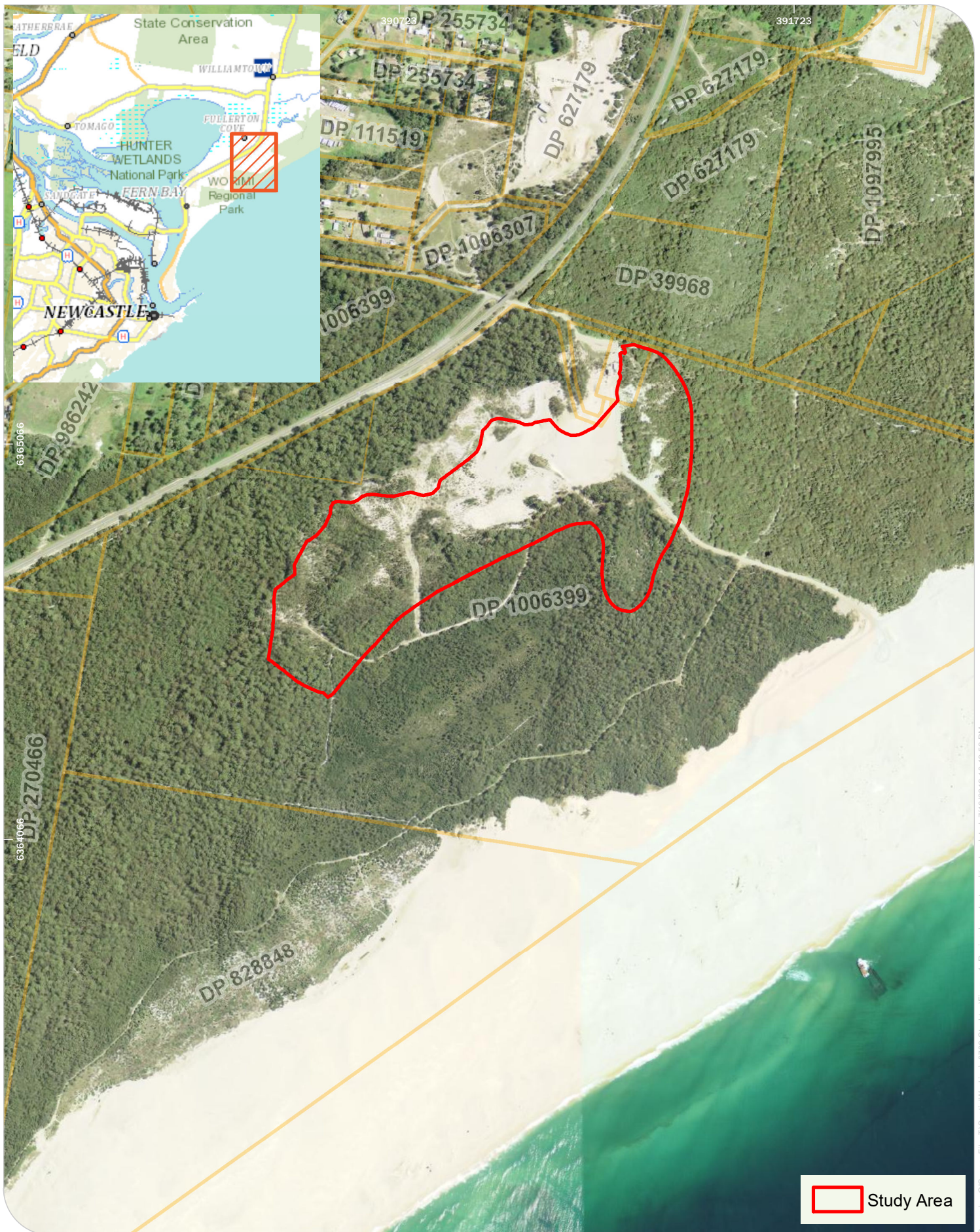
State Environmental Planning Policy No. 44 – Koala Habitat Protection


Figures

Figure 1a
Regional context (Element 2019)


STOCKTON SAND QUARRY DREDGING
ENVIRONMENTAL IMPACT STATEMENT





 Study Area

niche
Environment and Heritage

0  250
m
GDA 1994 MGA Zone 56

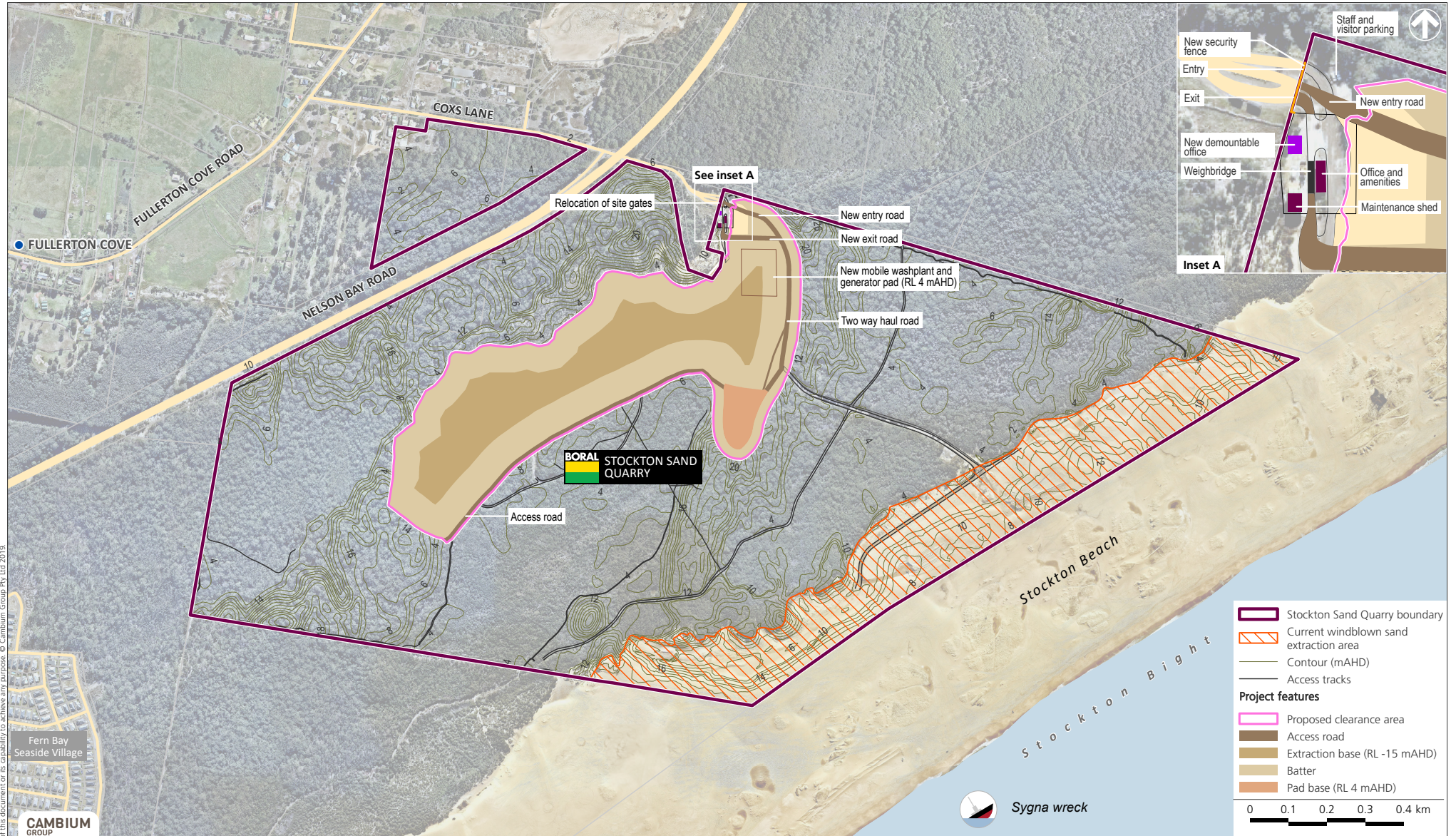
Niche PM: Luke Baker
Niche Proj. #: 3706
Client: Boral Resources (NSW) Pty

Regional
Stockton Sand Quarry Dredging Project

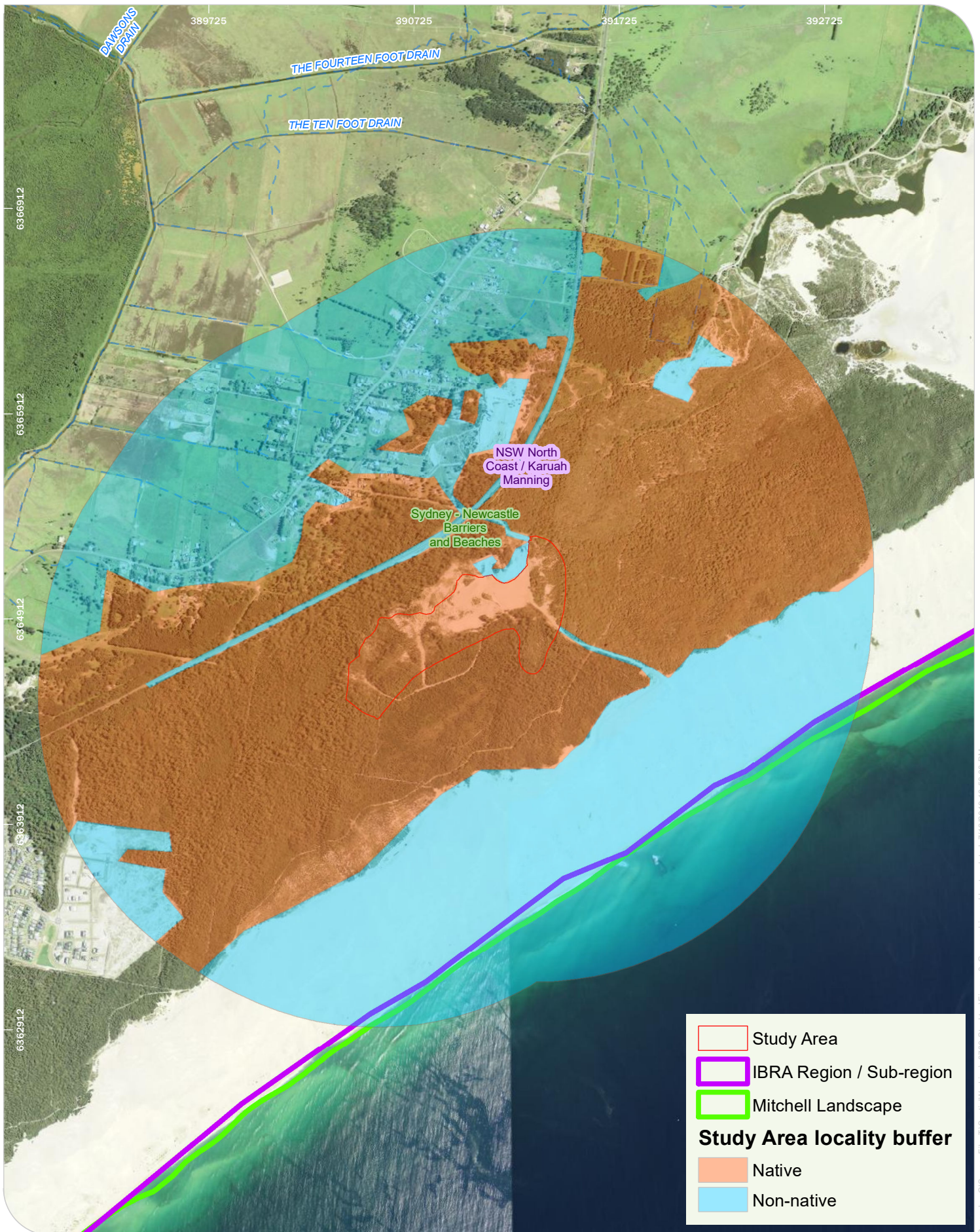
Figure 1b

Figure 2a
The Project (Element 2019)

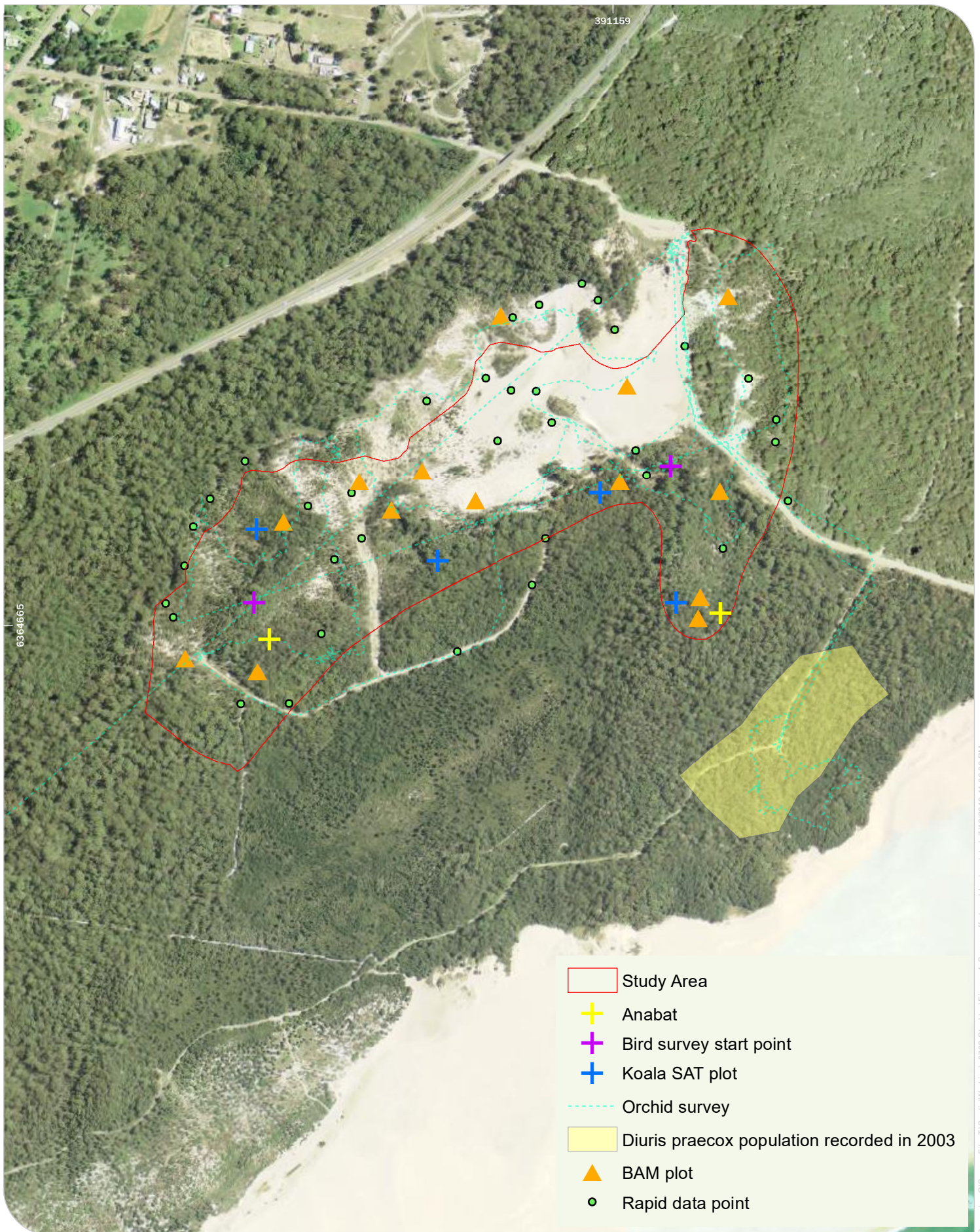
STOCKTON SAND QUARRY DREDGING
ENVIRONMENTAL IMPACT STATEMENT



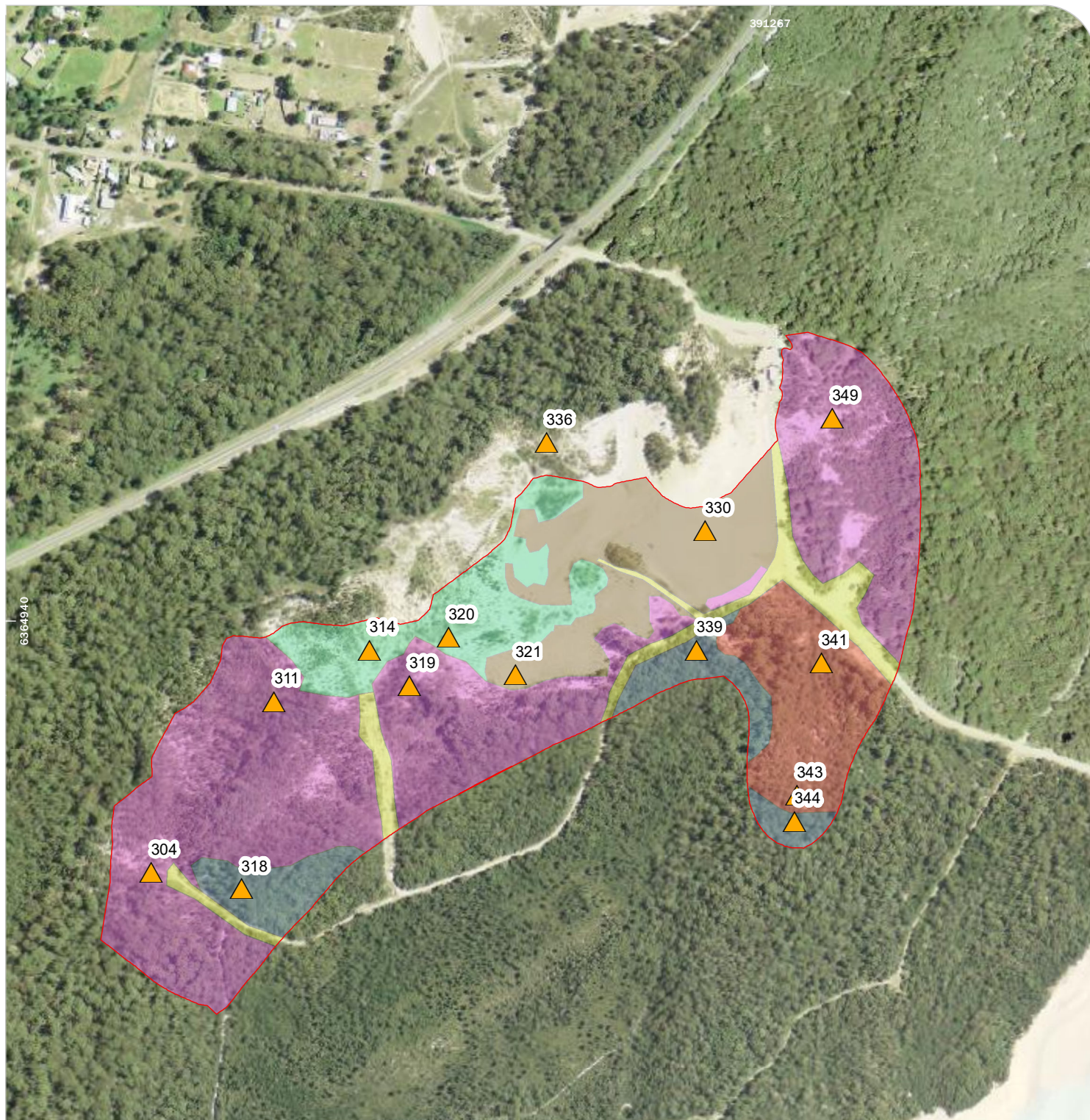




Drawn by: GIS_user File: T:\Spatial\Working\3706 Stockton\Figure_3_Geographic.mxd Last updated: 7/16/2019 10:59:38 PM



Drawn by: GIS_user File: T:\Spatial\Working\3706 Stockton\Figure_4_Survey effort.mxd Last updated: 7/16/2019 11:00:36 PM



Study Area

BAM_plots

PCT_Name, Condition

Non-native, Non-native

PCT1644 - Coast Tea Tree/ Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast, Rehabilitation_Area_3

PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast, Rehabilitation_Area_1

PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast, Rehabilitation_Area_2

PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast, Rehabilitation_Area_4

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

niche
Environment and Heritage

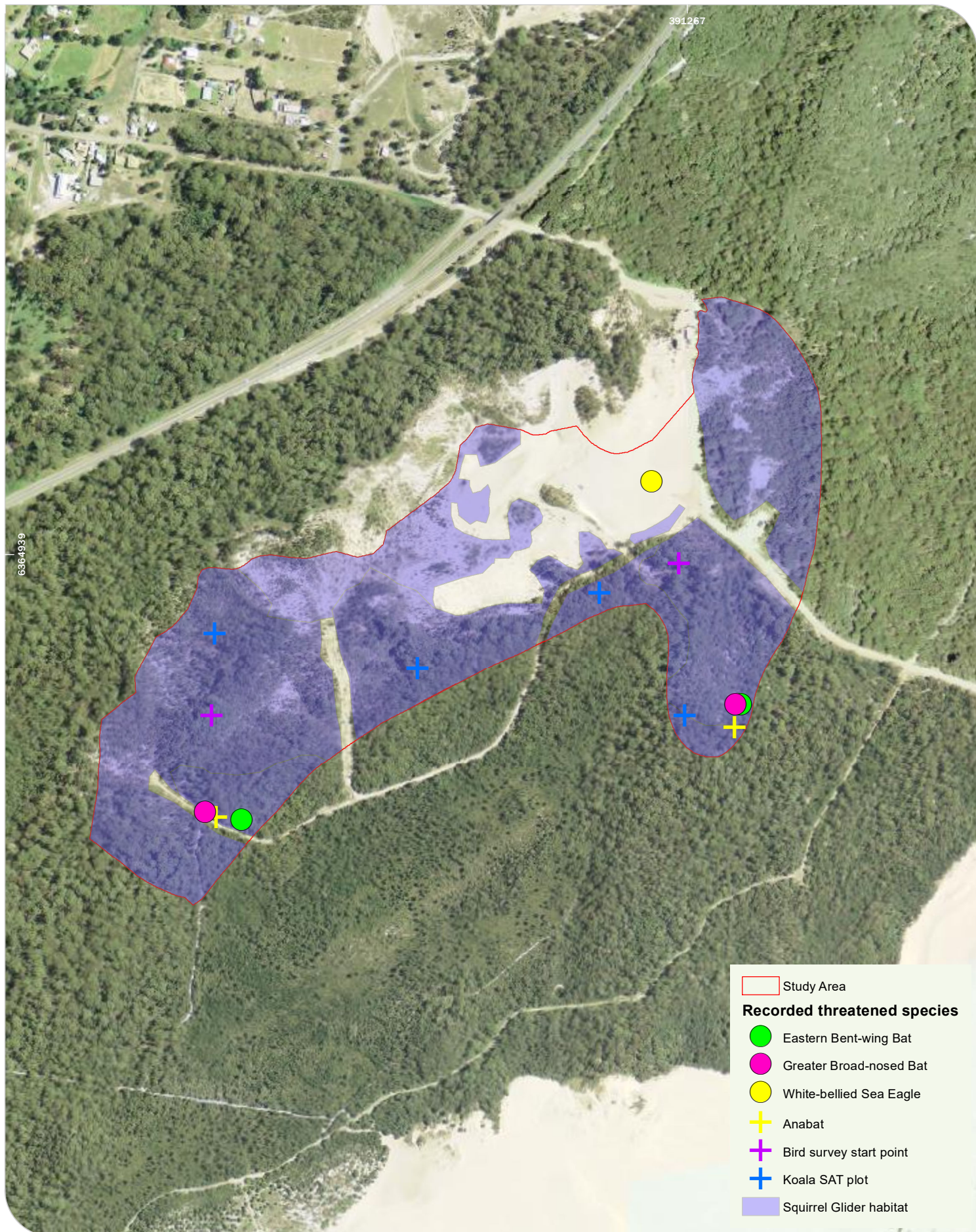


GDA 1994 MGA Zone 56

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

Validated vegetation mapping
Stockton Sand Quarry Dredging Project

Figure 5



Drawn by: GIS_user File: T:\Spatial\Working\3706 Stockton\Figure_6_Ts.mxd Last updated: 7/16/2019 11:28:37 PM

Appendix 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 detailed in section 3.1 and section 4.1. 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 Study Area was completed.

Five categories for 'likelihood of occurrence' (Table 13) 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 (BC Act, 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 Study Area.

Table 13: Likelihood of occurrence criteria

Likelihood rating	Threatened flora criteria	Threatened and migratory fauna criteria
Known	The species was observed within the Study Area.	The species was observed within the Study Area.
High	It is likely that a species inhabits or utilises habitat within the Study Area.	It is likely that a species inhabits or utilises habitat within the Study Area.
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 Study Area.	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 Study Area.
Low	It is unlikely that the species inhabits the Study Area.	It is unlikely that the species inhabits the Study Area. 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 Study Area is unsuitable for the species.	The habitat within the Study Area is unsuitable for the species.

Table 14. Likelihood of occurrence threatened biodiversity

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 – no Paperbark swamps and sedge swamps.	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.	None – no potential habitat given absence of waterbodies	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 breeding, individuals range widely across the forest floor and can be found hundreds of metres from water.	None – no potential habitat given absence of waterbodies	Species
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 Study Area.	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	Low – lack of woodland habitat. Study area predominately comprises of rehabilitation.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				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.		
<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 Study Area. May fly over Study Area 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.	None – 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.	N/A
<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 Study Area.	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 – not detected during survey.	Ecosystem
<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 Study Area.	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 Study Area.	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 Study Area.	N/A

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<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 Study Area.	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 Study Area.	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 Study Area.	N/A
<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 Study Area.	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 Study Area.	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 Study Area.	N/A
<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 Study Area.	N/A
<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

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<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 Study Area.	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.	Moderate	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 Study Area.	N/A
<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 Study Area.	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 Study Area.	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.	Low – very marginal habitat for nesting given absence of hollow. May occasionally forage in Study Area.	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<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 Study Area.	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 Study Area.	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.	Known -. Recorded during field survey flying over the Study Area. No nest in Study Area.	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.	Low - No nest in Study Area. May fly over site.	Ecosystem/species
<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.	Low – no records in locality. Highly unlikely to have breeding habitat in Study Area.	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 Study Area.	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 Study Area.	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	Low – habitat preferences not in Study Area.	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				on mudflats and in water less than 10 cm deep, around muddy lakes and swamps. Northern hemisphere breeding.		
<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
<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>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 Study Area.	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 Study Area.	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 Study Area.	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 Study Area.	Ecosystem
<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	Low – lack of tree hollows in Study Area	Ecosystem/species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				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.		
<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 Study Area 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 Study Area.	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 Study Area.	N/A
<i>Pandion cristatus</i> , <i>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 Study Area. May occasionally fly over the Study Area.	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 Study Area.	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 Study Area.	N/A
<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 Study Area.	N/A
<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	None	EEC/Marine

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				stands of African Olive. This species is marine and highly pelagic, rarely approaching land except at colonies.		
<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 Study Area.	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.	Moderate	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 Study Area.	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, subantarctic, subtropical marine and coastal waters over upwellings and boundaries of currents.	None	N/A
<i>Tringa brevipes, 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 Study Area.	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 Study Area.	N/A
<i>Tringa stagnatilis</i>	Marsh Sandpiper	-	M	Permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltmarshes, estuaries, sewage farms and salt works. Northern hemisphere breeding.	Low – habitat preferences not in Study Area.	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.	Low – lack of hollows in Study Area.	Species/Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<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 Study Area.	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 – Study Area not within 2 km of rocky cliff lines	Ecosystem and species
<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 appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites.	High	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 Study Area.	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 Study Area, 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.	Moderate	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.	None – lack of old trees and tree hollows	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<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 species of eucalypt should be smooth barked. Endangered population in the Wagga Wagga LGA.	Previously been recorded in the Study Area.	Species
<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.	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 Study Area on a regular basis. This is supported by the SAT and spotlighting survey which did not detect any usage of the Study Area 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
<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	Moderate	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.		
<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 Study Area.	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.	Moderate	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.	Known – recorded in Study Area	Ecosystem
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 Study Area or surrounds.	Species
<i>Callistemon linearifolius</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 Study Area 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 Brittle Gum low open woodland at Penrose; Scribbly Gum - Swamp Mahogany ecotonal forest at Tomago.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in Study Area or surrounds.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<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 Study Area is mainly rehabilitated mine 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 Study Area.	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 Study Area in remnant coastal dry sclerophyll forest. Targeted survey during the recommended survey time did not detect the species. However, it is recognised that the species is cryptic. Regardless, given the disturbed nature of the majority of the Study Area which comprises of rehabilitation with a lack of resilience, it is unlikely the species would be present.	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 Study Area or surrounds.	Species
<i>Eucalyptus parramattensis subsp. 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	Low – not detected during survey. Relatively conspicuous	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				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.	species. Not previously recorded in Study Area or surrounds.	
<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 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.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in Study Area or surrounds.	Species
<i>Maundia triglochinosoides</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 Study Area 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 Study Area or surrounds.	Species
<i>Persicaria 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 Study Area 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 Study Area 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 Study Area or surrounds.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
<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. 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.	Low – no previous records and the majority of the Study Area consists of rehabilitation which has changed the natural sandy soil base.	Species
<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 Study Area 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 Study Area or surrounds.	Species
<i>Tetradlea 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 Study Area or surrounds. Habitat preferences absent given the Study Area has been previously cleared.	Species
<i>Thesium australe</i>	Austral Toadflax	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 Study Area
		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 Bulloak (<i>Allocasuarina luehmannii</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 Status	Act Status	EPBC Status	Act Status	Likelihood of occurrence within Study Area
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> (Peppercress), <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 Study Area
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 Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	<p>Hunter Valley Footslopes 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 Status	Act Status	EPBC Status	Act Status	Likelihood of occurrence within Study Area
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 flavescent</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>Aurolastipa 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 Status	Act Status	EPBC Status	Act Status	Likelihood of occurrence within Study Area
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 Status	Act Status	EPBC Status	Act Status	Likelihood of occurrence within Study Area
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 Status	Act Status	EPBC Status	Act Status	Likelihood of occurrence within Study Area
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 Status	Act Status	EPBC Status	Act Status	Likelihood of occurrence within Study Area
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 botryoides</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 Status	Act Status	EPBC Status	Act Status	Likelihood of occurrence within Study Area
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. glauca</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

Appendix 2. Plant Community Type Descriptions

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 Study Area, in four different condition classes:

- Rehabilitation Area 1 = 19.72 ha (Photo 4)
- Rehabilitation Area 2 = 3.87 ha (Photo 5)
- Rehabilitation Area 4 = 5.20 ha (Photo 6)
- Remnant = 3.91 ha (Photo 7).

Whilst it is noted in this report that much of the Study Area 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 Study Area prior to vegetation clearing for the former inland extraction area; and
- The canopy tubestock planted within the Study Area (*Eucalyptus pilularis*, *Corymbia gummifera*, and *Angophora costata*) are the dominant species of PCT1646.




The structure of the PCT within the Study Area 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 Study Area is consistent with the description of the PCT due to the following:

- The dominant canopy species recorded within the Study Area comprised of *Eucalyptus pilularis*, *Corymbia gummifera*, and *Angophora costata* which are dominants of PCT1646;
- The Study Area occurs on quaternary dune sands;
- The structure of the remnant condition class is an open Forests to woodlands dominated in the canopy by *Angophora*'s;
- The structure of the remnant condition class consists of a sparse mid-stratum is typically characterised by *Banksia*'s; and
- 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 Act or EPBC Act.

Condition classes: Four condition classes were assigned to PCT1646 within the Study Area:

Condition class	Description	Photo of vegetation zone
<p>Rehabilitation Area 1</p> <p>Area = 19.72 ha</p>	<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>Photo 4. PCT1646 Rehabilitation_Area_1 within the Study Area</p>
<p>Rehabilitation Area 2</p> <p>Area = 3.87 ha</p>	<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>Photo 5. PCT1646 Rehabilitation_Area_2 within the Study Area</p>
<p>Rehabilitation Area 4</p> <p>Area = 5.20 ha</p>	<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>Photo 6. PCT1646 Rehabilitation_Area_4 within the Study Area</p>

Condition class	Description	Photo of vegetation zone
<p>Remnant</p> <p>Area = 3.91 ha</p>	<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.</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>Photo 7. PCT1646 Remnant within the Study Area</p>

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

Habitat: PCT1646 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes has been mapped as occurring to the east of the Study Area as a 3.91 hectare patch. The area has been historically cleared and rehabilitated with tubestock and natural regeneration comprising predominately of *Leptospermum laevigatum* (Photo 8).

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; and
- 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 Study Area 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 State or Commonwealth legislation.



Photo 8. PCT1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes within the Study Area

Non-native vegetation

Portions of the Study Area 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.

Appendix 3. Floristic plot data

Plot Data extracted from Fulcrum digital data collection – Evidence of the raw Fulcrum data files can be provided upon request as handwritten datasheets are no longer used. The below species lists can be provided in excel format upon request.

Species	Common Name	3706LB343		3706LB320		3706LB319		3706LB314		3706LB311		3706LB344		3706LB339		3706LB336		3706LB330		3706LB321		3706LB304		3706LB341		3706LB349	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
<i>Carpobrotus glaucescens</i>	Pigface			1	20	1	30	0.5	10							5	30	0.2	3			0.5	10	1	5	1	5
<i>Hydrocotyle bonariensis</i> *																		0.1	2								
<i>Platysace lanceolata</i>	Shrubby Platysace	1	5											2	20												
<i>Bidens pilosa</i> *	Cobbler's Pegs					0.2	20	0.3	20							0.1	5										
<i>Cassinia arcuata</i>	Sifton Bush					0.2	1									0.2	1										
<i>Chrysanthemoides monilifera</i> *		5	10			0.5	5					2	30	0.1	1	0.2	1					0.1	1	2	10		
<i>Heterotheca grandiflora</i> *	Telegraph Weed			1	50			50	1000							0.1	20	1	100								
<i>Hypochaeris radicata</i> *	Catsear															0.1	2										
<i>Sonchus oleraceus</i> *	Common Sowthistle					0.1	1																				
<i>Pandorea pandorana</i>	Wonga Wonga Vine	0.1	1									2	50	0.1	1												
<i>Wahlenbergia gracilis</i>	Sprawling Bluebell			0.5	30	0.1	20	0.1	1					0.2	20	0.5	50					0.1	1				
<i>Petrorhagia dubia</i> *								0.1	1																		
<i>Allocasuarina littoralis</i>	Black She-Oak	1	1	1	2					2	5			2	3	0.5	1			0.5	1			1	3	5	5
<i>Carex spp.</i>						0.1	1																				
<i>Pteridium esculentum</i>	Bracken	3	100			0.1	1					70	200	1	20							0.5	5				

Species	Common Name	3706LB343		3706LB320		3706LB319		3706LB314		3706LB311		3706LB344		3706LB339		3706LB336		3706LB330		3706LB321		3706LB304		3706LB341		3706LB349	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
<i>Hibbertia virgata</i>										0.1	1	0.5	5			0.2	5										
<i>Leucopogon parviflorus</i>	Coastal Beard-heath	5	10	2	10	5	5			20	50	40	30	2	10	1	20					2	10	15	20		
<i>Ricinocarpus pinifolius</i>	Wedding Bush									0.5	10					0.1	1					0.2	5				
<i>Aotus ericoides</i>										0.5	3									0.5	1					1	3
<i>Bossiaea heterophylla</i>	Variable Bossiaea			0.2	2											0.2	1					0.2	2				
<i>Bossiaea rhombifolia</i>						0.5	5			1	30	1	20			0.2	15	0.2	2			30	50	5	20	1	5
<i>Bossiaea scolopendria</i>				0.5	5											0.5	1										
<i>Dillwynia retorta</i>				1	20					1	10							1	5	2	10				2	8	
<i>Glycine tabacina</i>	Variable Glycine			0.1	1							0.5	20			0.1	1							1	3		
<i>Hardenbergia violacea</i>	False Sarsaparilla			1	20	0.5	5			0.1	2							0.5	2	0.1	1	0.1	1	1	2		
<i>Kennedia rubicunda</i>	Dusky Coral Pea											2	10	0.5	10	0.1	2			0.2	3					0.5	3
<i>Acacia longifolia</i>		5	20	20	20	5	5	2	10	0.1	3	1	10			5	10	10	50	0.5	1	5	15	10	20	2	5
<i>Acacia suaveolens</i>	Sweet Wattle			0.1	1	0.2	1			0.1	2																
<i>Acacia ulicifolia</i>	Prickly Moses					0.2	1			0.1	1	0.1	1					0.1	1			0.5	10				
<i>Gonocarpus tetragynus</i>	Poverty Raspwort											0.5	10														
<i>Gonocarpus teucroides</i>	Germander Raspwort	2	10	0.5	20					0.5	20					0.5	20					0.1	1				
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush			0.2	2	0.2	3			5	50	2	50	1	10	0.5	10					2	20	5	15		
<i>Eustrephus latifolius</i>	Wombat Berry											0.1	1														

Species	Common Name	3706LB343		3706LB320		3706LB319		3706LB314		3706LB311		3706LB344		3706LB339		3706LB336		3706LB330		3706LB321		3706LB304		3706LB341		3706LB349	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
<i>Angophora costata</i>	Sydney Red Gum	3	3	3	5	0.5	2	3	6	2	2	60	20	5	3	5	10			5	10	2	3	5	3	20	20
<i>Corymbia gummifera</i>	Red Bloodwood	3	2	2	4					10	10	5	2	3	1							2	3			3	2
<i>Eucalyptus pilularis</i>	Blackbutt	2	2			40	30			10	20			30	15							40	25			10	5
<i>Leptospermum laevigatum</i>	Coast Teatree	60	50	1	1																			80	100		
<i>Oenothera indecora subsp. bonariensis*</i>				0.5	20			15	500									5	150								
<i>Corybas aconitiflorus</i>	Spurred Helmet Orchid											0.2	10														
<i>Gastrodia sesamoides</i>	Cinnamon Bells													0.1	1												
<i>Oxalis rubens</i>														0.5	20												
<i>Passiflora spp.*</i>						0.5	1																				
<i>Dianella caerulea var. producta</i>		3	6	0.5	20	5	100			0.1	1	0.5	10	20	200	0.3	10					2	30	3	25		
<i>Breynia oblongifolia</i>	Coffee Bush					0.1	1																1	1			
<i>Poranthera corymbosa</i>										0.1	1																
<i>Poranthera ericifolia</i>																0.1	1										
<i>Cynodon dactylon</i>	Common Couch													0.2	10												
<i>Ehrharta erecta*</i>	Panic Veldtgrass																						1	10			
<i>Eragrostis brownii</i>	Brown's Lovegrass							0.2	3													0.5	10				
<i>Eragrostis curvula*</i>	African Lovegrass			5	100	5	50											5	50							0.5	6
<i>Imperata cylindrica</i>	Blady Grass	3	200			0.1	5	20	1000	0.5	20	1	50	10	100	40	1000					10	50				

Species	Common Name	3706LB343		3706LB320		3706LB319		3706LB314		3706LB311		3706LB344		3706LB339		3706LB336		3706LB330		3706LB321		3706LB304		3706LB341		3706LB349	
		C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
<i>Melinis repens</i> *	Red Natal Grass			40	1000	40	1000	50	1000					0.2	20	50	1000	1	30			0.5	5	2	100		
<i>Panicum maximum</i> *	Guinea Grass					40	1000							1	50									3	80		
<i>Rytidosperma spp.</i>												0.1	1														
<i>Themeda australis</i>	Kangaroo Grass	2	100									2	50			3	50					0.5	30	11	100		
<i>Banksia integrifolia</i>	Coast Banksia											0.5	1											1	2	2	3
<i>Banksia serrata</i>	Old-man Banksia	2	3	1	2	1	3	0.5	1			1	3	2	3					2	10						
<i>Persoonia levis</i>	Broad-leaved Geebung											2	1														
<i>Persoonia oblongata</i>		5	10	1	3	0.8	3	0.5	1	0.1	1			0.2	1	10	30			1	3	2	5			1	2
<i>Pomaderris elliptica</i>																										0.1	1
<i>Pomax umbellata</i>	Pomax															0.5	15										
<i>Exocarpos cupressiformis</i>	Cherry Ballart											1	1														
<i>Gnidia squarrosa</i> *				2	100			5	500							0.1	2	0.1	5								

Note: * = exotic species; C = Cover; A = Abundance

Appendix 4. Plot BAM attribute scores

Composition and structure

PCT	Condition	Plot	Easting	Northing	Zone	Compass direction	Tree	Shrub	Grass and grass like	Forb	Fern	Other
1646	Rehab_Area1	3706LB304	6364611	390457.51	56	270	5	7	3	3	1	1
1646	Rehab_Area1	3706LB311	6364835	390618.45	56	250	4	10	1	4	0	1
1646	Rehab_Area2	3706LB314	6364902	390742.93	56	53	4	2	2	3	0	5
1646	Rehab_Area1	3706LB319	6364855	390795.4	56	8	5	7	2	4	1	2
1646	Rehab_Area2	3706LB320	6364919	390846.3	56	43	6	6	0	5	0	2
1646	Rehab_Area4	3706LB321	6364870	390933.9	56	38	3	3	0	2	0	1
1646	Rehab_Area4	3706LB330	6365058	391182.0	56	272	1	3	0	1	0	1
1646	Rehab_Area4	3706LB353	6265083	391077.0	56	96	0	10	3	2	0	1
1646	Remnant	3706LB339	6364923	391167.8	56	175	6	2	2	7	1	0
1644	Rehab_Area3	3706LB341	391334	6364885	56	88	4	5	1	3	0	2
1644	Rehab_Area3	3706LB343	6364712	391302.1	56	92	2	4	1	2	1	2
1646	Remnant	3706LB344	6364678	391298.6	56	190	4	7	3	6	1	2
1646	Rehab_Area1	3706LB349	6365205	391348.1	56	200	6	5	0	2	0	0

Function scores

PCT	Condition	Plot	Tree	Shrub	Grass and grass like	Forb	Fern	Other	Regen
1646	Rehab_Area1	3706LB304	44.6	39.9	11.0	4.1	0.5	0.1	Absent
1646	Rehab_Area1	3706LB311	24.0	22.6	0.5	6.6	0.0	0.1	Absent
1646	Rehab_Area2	3706LB314	4.1	2.5	20.2	0.0	0.0	0.0	Absent
1646	Rehab_Area1	3706LB319	42.6	11.8	0.2	45.4	0.0	1.0	Absent
1646	Rehab_Area2	3706LB320	8.5	24.3	0.0	2.7	0.0	1.1	Absent
1646	Rehab_Area4	3706LB321	7.5	2.0	0.0	2.2	0.0	0.1	Absent

PCT	Condition	Plot	Tree	Shrub	Grass and grass like	Forb	Fern	Other	Regen
1646	Rehab_Area4	3706LB330	0.2	10.3	0.0	1.0	0.0	0.5	Absent
1646	Rehab_Area4	3706LB353	0	5	1	0.5	0	0.1	Absent
1646	Remnant	3706LB339	42.2	2.2	10.2	23.2	1.0	0.0	Present
1644	Rehab_Area3	3706LB341	8.0	80.0	11.0	11.0	0.0	2.0	Absent
1644	Rehab_Area3	3706LB343	11.0	75.0	5.0	5.1	3.0	0.0	Absent
1646	Remnant	3706LB344	66.5	45.6	3.1	7.2	70.0	0.6	Present
1646	Rehab_Area1	3706LB349	41.0	5.1	0.0	2.5	0.0	0.0	Absent

Function scores (continued)

PCT	Condition	Plot	5-9	10 to 19	20-29	30-49	50-79	No >50cm	HBT	Litter cover	FL	High threat weed
1646	Rehab_Area1	3706LB304	Y	Y	N	N	N	0	0	90.0	12.0	0.0
1646	Rehab_Area1	3706LB311	Y	Y	N	N	N	0	0	70.0	22.0	0.0
1646	Rehab_Area2	3706LB314	Y	N	N	N	N	0	0	30.0	10.0	0.3
1646	Rehab_Area1	3706LB319	Y	Y	Y	N	N	0	0	80.0	8.0	5.2
1646	Rehab_Area2	3706LB320	Y	N	N	N	N	0	0	20.0	14.0	5.0
1646	Rehab_Area4	3706LB321	Y	N	N	N	N	0	0	5.0	26.0	0.0
1646	Rehab_Area4	3706LB330	Y	N	N	N	N	0	0	5.0	0.0	5.0
1646	Rehab_Area4	3706LB353	Y	N	N	N	N	0	0	5	5	0
1646	Remnant	3706LB339	Y	Y	Y	Y	Y	0	4	80.0	10.0	0.0
1644	Rehab_Area3	3706LB341	Y	Y	N	N	N	0	0	85.0	1.0	1.0
1644	Rehab_Area3	3706LB343	Y	N	N	N	N	0	0	90.0	0.0	0.0
1646	Remnant	3706LB344	Y	Y	Y	Y	Y	0	5	75.0	10.0	0.0
1646	Rehab_Area1	3706LB349	Y	Y	Y	N	N	0	0	50.0	0.0	0.5

Appendix 5. Fauna species list in Study Area

Group	Scientific name	Common name	Status	Observation type
Aves	<i>Cracticus tibicen</i>	Australian Magpie	P	H
Aves	<i>Corvus coronoides</i>	Australian Raven	P	O H
Aves	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	P	H
Aves	<i>Platycercus elegans</i>	Crimson Rosella	P	O H
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>Rhipidura albiscapa</i>	Grey Fantail	P	H
Aves	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	P	O H
Aves	<i>Dicaeum hirundinaceum</i>	Mistletoebird	P	O H
Aves	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	P	O H
Aves	<i>Manorina melanocephala</i>	Noisy Miner	P	O H
Aves	<i>Strepera graculina</i>	Pied Currawong	P	O H
Aves	<i>Zosterops lateralis</i>	Silvereye	P	O H
Aves	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	P	O H
Aves	<i>Malurus cyaneus</i>	Superb Fairy-wren	P	O H
Aves	<i>Sericornis frontalis</i>	White-browed Scrubwren	P	O H
Aves	<i>Rhipidura leucophrys</i>	Willie Wagtail	P	O H
Aves	<i>Acanthiza nana</i>	Yellow Thornbill	P	O H
Aves	<i>Corvus coronoides</i>	Australian Raven	P	H
Mammalia	<i>Trichosurus vulpecula</i>	Common Brushtail Possum	P	O
Mammalia	<i>Oryctolagus cuniculus</i>	Rabbit	U	O
Mammalia	<i>Miniopterus schreibersii</i>	Eastern Bentwing Bat	V	Anabat
Mammalia	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	Anabat
Reptilia	<i>Physignathus lesueurii</i>	Eastern water dragon	P	O
Reptilia	<i>Pseudechis porphyriacus</i>	Red-bellied black snake	P	O
Reptilia	<i>Eulamprus quoyii</i>	Eastern water-skink	P	O

Key: P = Protected; V = Vulnerable; E = Endangered; - U = not listed under act (exotic/introduced species).

Appendix 6. Biodiversity Credit Calculator Report

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00016526/BAAS17033/19/00016527	3706 Stockton SSD	26/11/2019
Assessor Name	Report Created	BAM Data version *
	09/12/2019	22
Assessor Number	BAM Case Status	Date Finalised
	Open	To be finalised
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	Vegetation integrity loss / gain	Area (ha)	Constant	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								
5	1644_Rehab_Area	19.0	3.9	0.25	High Sensitivity to Potential Gain	2.00		37
	3							
							Subtotal	37

BAM Credit Summary Report

Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast								
1	1646_Rehab_Area 1	42.2	19.8	0.25	High Sensitivity to Potential Gain	1.50		313
2	1646_Rehab_Area 2	22.2	3.9	0.25	High Sensitivity to Potential Gain	1.50		32
3	1646_Rehab_Area 4	7.5	5.3	0.25	High Sensitivity to Potential Gain	1.50		0
4	1646_Remnant	46.4	2.9	0.25	High Sensitivity to Potential Gain	1.50		51
							Subtotal	396
							Total	433

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAIL	Species credits
<i>Petaurus norfolcensis</i> / <i>Squirrel Glider</i> (Fauna)						
1646_Rehab_Area1	42.2	19.77	0.25	2	False	417
1646_Rehab_Area4	7.5	0	0.25	2	False	0
1646_Remnant	46.4	2.91	0.25	2	False	67
1644_Rehab_Area3	19.0	3.91	0.25	2	False	37
					Subtotal	521

Appendix 7. Threatened species assessments of significance under the EPBC Act

Matters for Assessment

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

- Australian Painted Snipe
- Black-faced Monarch
- White-throated Needletail
- Red Goshawk
- 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 been encountered infrequently adjacent to the Study Area as evident with the records from Bionet. This is within 2 km of the Study Area boundary. Survey data concludes that the Koala is not frequently using the Study Area.
Vegetation Structure and composition	0	Habitat scoring was applied across the Study Area using floristic data and cover values from 400m ² quadrats. The mapping indicated that the majority of the Project area 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 area is part of a contiguous landscape of > than 500 hectare.
Key existing threats	+1	There is no known documented or anecdotal evidence of Koala mortality from dog attack or vehicle collision within the Study Area or surrounds. Dogs, trucks, and vehicle movements are all present within the Study Area.
Recovery value	0	Uncertain whether the habitat within the Study Areas will be important in achieving the interim recovery objectives. The habitat is not thought to specifically act as a habitat refuge. The Study Area has already been impacted and Koalas are still occurring within the locality which demonstrates that the Study Area 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. Given the Study Area has been previously cleared, and the population of Koala within the locality are still utilising the habitat features of the stretch of the vegetation corridor which encompasses Worimi Regional Park and Worimi State Conservation Area, indicates that the removal of the vegetation within the Study Area is unlikely to decrease the size of the Koala population within the locality.	Unlikely
reduce the area of occupancy of an important population;	
No important population occurs within the Study Area. The Study Area has historically been cleared and now predominately consists of rehabilitated native vegetation. The Project would not impact the area of occupancy of any population of the Koala as the areas to be cleared are not sufficient in extent to impact the area of occupancy of the Koala at such a scale to decrease foraging and sheltering habitat. Koalas would still be expected to occur within the vicinity of the locality.	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 Study Area has been previously cleared, and the Koalas have still persisted within the locality. The removal of native vegetation within the Study Area would not isolate a population. Movement would not be restricted.	Unlikely
adversely affect habitat critical to the survival of a species;	
The habitat within the Study Area 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 disturbance area is not thought to be a key breeding area due to the low number of records, lack of evidence during field surveys, and the historic cleared habitat. 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 Study Area has been previously cleared and rehabilitated. The current rehabilitation does not contain primary or secondary feed trees. The surrounding locality offers a greater availability of foraging habitat for the Koala. The removal of the vegetation within the Study Area is unlikely to have any impact on patterns of Koala movement.	Unlikely
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	
Invasive species such as foxes that may impact on the Koala 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 Study Area 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 would be negligible, with the Project mostly ensuring the continuation of the current regime of vehicle movements within the Project area. 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>This is considered unlikely as there would be no new sources of contamination as a result of the Project. The Project would not lead to Koalas being transported to the site from other areas. If vehicles coming to and from the quarry are considered to be a potential agent of <i>Phytophthora cinnamomi</i>, the Project would not lead to a change in the source areas where vehicles travel from to arrive at the quarry and therefore it is not considered that the Project increases the risk of <i>Phytophthora cinnamomi</i> spread;</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 proposed disturbance footprint is an extremely small proportion of Koala habitat for the population and the species. Its removal would have a minor impact on patterns of Koala movement and no isolation between populations would occur from the Project; and</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: Impacts from the Project largely relate to the removal of habitat that has not been defined as being critical to the survival of the Koala.</p> <p>Due to the apparent limited use of the Study Area and its extremely small extent in relation to other habitat where Koala records occur, it is not considered that removal of this habitat alone would significantly adversely impact a Koala population.</p>	

Migratory Species - Black-faced Monarch, White-throated Needletail	
Preamble: The above species all have potential habitat within the Study Area that would be impacted from the proposed action. All of the species subject to this assessment are considered to occur within the Study Area on an irregular basis and the habitat within the Study Area is similar to widespread and common habitat within the locality for these species.	
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 considered to occur within the Study Area.	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 Study Area 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 Study Area 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 Study Area.	Unlikely
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 Study Area and the Study Area 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.	

Australian Painted Snipe (Endangered)

Preamble

The Australian Painted Snipe requires habitat that provides cover, foraging substrate and close proximity to water. The size of waterbodies used is variable from lakes and rivers to ephemeral puddles although the most important habitats appear to be those that are routinely wet. Cover requirements are variable and relatively flexible with grasses, rushes and reeds, low scrub, lignum, cane grasses or samphire all used (Marchant and Higgins, 2003). Occasionally wet-sown crops are used.

There are no NSW BioNet records of the species within a 10 kilometre radius of the Study Area. While the area does not appear to be a stronghold for the species, it can be cryptic due to choosing habitats that people do not typically frequent. There is a marginal quantity of habitat found in the Study Area.

The Project would remove 35.66 hectares of native vegetation which provides potential foraging habitat for the Australian Painted Snipe, which for the most part, consists of sparsely scattered tubestock with a lack of microhabitat features such as fallen logs and hollow-bearing trees. Australian Painted Snipe was not detected during the bird surveys completed as part of this assessment. Based on the specific habitat requirements, and the lack detection during surveys, it is likely that the habitat features within the Study Area would only be used on an intermittent basis for foraging. 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 availability for the species.

Criteria (Endangered Species)	Likelihood
An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of a population of a species;	
The population is considered to be a single Australia wide unit thus it is an important population. The Project would remove 35.66 hectares of marginal foraging habitat for the species, which is a minor component of the species potential habitat. Therefore the chance of any long term decrease in the population size due to this action is negligible.	Very unlikely
reduce the area of occupancy of the species;	
The extent of impact within the Study Area is limited to the removal of approximately 35.66 ha of marginal foraging habitat for the species, most of which is rehabilitation. This will not reduce the overall area of occupancy of the population as it occurs Australia wide and is not in any way restricted to that patch. The species is likely to persist throughout the broader Study Area and region at similar levels to present. It should be noted that the rehabilitation of the Study Area would involve the establishment of a pond, which would provide habitat for the species.	Unlikely
fragment an existing population into two or more populations;	
The action will not fragment the population of this highly mobile species.	Unlikely
adversely affect habitat critical to the survival of a species;	
Critical habitat for this species includes a wide range of lakes and wetlands of many forms. The action will not change drainage to or from any wetland.	Unlikely
disrupt the breeding cycle of a population	
It seems unlikely that the Study Area would form regular breeding habitat for the species, given the lack of waterbodies.	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 action will remove around 35.66 ha of marginal potential foraging habitat. The species will not decline from this habitat impact alone.	Unlikely
result in invasive species that are harmful to a endangered species becoming established in the endangered species' habitat;	

The Project is unlikely to result in an increase in the presence and establishment of invasive species which may impact the Australian Painted Snipe. Any invasive species already have access to establish in the Study Area. The action could potentially improve habitat by controlling weed species and replacing them with native species., which is to be undertaken as part of the proposed mitigation measures.	Unlikely
introduce disease that may cause the species to decline, or	
The Project is unlikely to introduce disease which may lead to a decline of this species.	Unlikely
interfere substantially with the recovery of the species.	
The Project will not impede or interfere substantially with any targeted recovery actions for this species.	Unlikely
Conclusion: The Project is unlikely to have a significant impact on the Australian Painted Snipe.	

Red Goshawk (Vulnerable)

Preamble

This species inhabits coastal and sub-coastal tall open forests and woodlands, tropical savannas traversed by wooded or forested rivers, and the edges of rainforests, usually on fertile soils. The Red Goshawk rarely breeds in areas with fragmented native vegetation. The stick nests, in which 1–2 eggs are laid, are restricted to trees that are taller than 20 m and within 1 km of a watercourse or wetland. The species hunts within a home range of up to 200 km² in open forests and gallery forests, taking mostly medium to large birds.

The Project would remove 35.66 hectares of native vegetation which provides potential foraging habitat for the Red Goshawk, which for the most part, consists of sparsely scattered tubestock with a lack of microhabitat features such as fallen logs and hollow-bearing trees. Red Goshawk was not detected during the bird surveys completed as part of this assessment. Based on the specific habitat requirements, and the lack detection during surveys, it is likely that the habitat features within the Study Area would only be used on an intermittent basis for foraging. 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 availability for the species.

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 not expected that any impacts on breeding habitat for Red Goshawk would result from the Project as nests were not recorded in the Study Area.

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 rehabilitated land, with a small area of remnant woodland. The significance of this contribution is not expected to be high as the expanse of similar foraging habitat within the locality is high.

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 Red Goshawk 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 2 km grid square scale (which is the standard unit for measuring area of occupancy according to the IUCN); and
- Red Goshawk would still be expected to forage within the vicinity of the Study Area, given potential habitat extends beyond the Study Area 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 Red Goshawk is a mobile species and the Project would not impact on breeding habitat.

None

adversely affect habitat critical to the survival of a species;

Foraging habitat of the type to be removed by the Project is not considered important for the species. Further, given that similar habitat is locally common and well represented within adjacent conservation reserves, the 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 no nests were recorded in the Study Area.

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 the Landscape and Rehabilitation Plan.</p> <p>Potential invasive predators such as the fox are likely to be already present within the Study Area and the Project is not expected to increase the level of predation threat for the Red Goshawk.</p>	Unlikely
introduce disease that may cause the species to decline, or	
The Project is not expected to cause an increased risk of any diseases.	Unlikely
interfere substantially with the recovery of the species.	
<p>The Project does not directly or substantially interfere with any of the specific recovery objectives under the National Recovery Plan (Department of Environment and Resource Management 2012), which include:</p> <ul style="list-style-type: none"> • Monitor Red Goshawk habitat and determine territory occupancy and productivity, and use DNA analyses of feathers to determine adult survival rates; • Collate information on known nest sites from the past 25 years and produce descriptive maps of important habitat and ensure information is secure; • Conduct searches to identify previously unknown pairs of Red Goshawks, nest sites, and habitats critical for Red Goshawk survival; • Identify important populations and nest sites, and use the information to inform monitoring programs and state and federal government planning frameworks; • Provide specific information and advice to assist with the identification, acquisition and management of important habitat for the Red Goshawk; • Conduct research to understand the relationship between habitat fragmentation, prey density and population persistence to better inform management; • Protect habitat through acquisition or voluntary conservation agreements; • Reduce the effects of Red Goshawk habitat fragmentation and degradation by encouraging landholders to protect and manage threatened Red Goshawk territories; • Train personnel from state and local government to identify and understand the threats to Red Goshawk habitat; • Produce and distribute information on the conservation status and habitat requirements of the Red Goshawk; • Provide feedback to the public and agency personnel on progress of Red Goshawk recovery; and • Review the effectiveness of the community awareness program. <p>The removal of marginal foraging habitat as a result of 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 Red Goshawk within the Study Area. 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 	

Grey-headed Flying-fox (Vulnerable)	
<p>Preamble</p> <p>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.</p> <p>The Grey-headed Flying Fox is only likely to utilise the Study Area on occasion for foraging. No roosting camp sites were observed in the Study Area, nor known to occur within close proximity to the Study Area.</p>	
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 Study Area.</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 a small area 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>Over time, foraging habitat would be at least partially restored through rehabilitation works and retention of the topsoil would occur as part of rehabilitation works, aiding in maintaining fertility of habitats. 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.</p>	Unlikely
reduce the area of occupancy of an important population;	
<p>The Project would not impact the area of occupancy of the Grey-headed Flying-fox for the following reasons:</p> <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 • Grey-headed Flying-fox would still be expected to forage within the vicinity of the Study Area, given potential habitat extends beyond the Study Area 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 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 the draft National Recovery Plan for this species (Commonwealth of Australia 2017) guidelines or a recovery plan for the species, however “productive” areas are acknowledged as potentially being foraging habitat critical to the survival of the species. However, no measure of productivity is given. Whilst the timing of productivity is considered to be important in determining whether habitat is critical to the survival of the species, the timing given as being important covers the entirety of the year (see Commonwealth of Australia 2017).</p> <p>Foraging habitat of the type to be removed by the Project is considered important for the species, due to its capacity to add in some measure to locally available winter foraging resources.</p>	Unlikely

However, given that similar habitat is locally common, is well represented within adjacent conservation reserves, and that winter flowering pulses are not considered to be particularly high within the habitat to be cleared, the habitat to be removed is not considered critical to the species survival.	
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;	
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. Potential invasive predators such as the fox are likely to be already present within the Study Area and the Project is not expected to increase the level of predation threat for the Grey-headed Flying-fox.	Unlikely
introduce disease that may cause the species to decline, or	
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.	Unlikely
interfere substantially with the recovery of the species.	
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.	Unlikely
<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; and • Rehabilitation of areas to be cleared will occur which should mitigate the loss of foraging habitat to some extent. 	

Long-nosed Potoroo (Vulnerable)

Preamble

This species 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.

The Long-nosed Potoroo 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 Study Area 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 a small area 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;

It is unlikely that an important population of the Long-nosed Potoroo occurs in the Study Area, as there is only one previous record of the species within a 10 km radius of the Study Area.

The Project would not impact the area of occupancy of the Long-nosed Potoroo 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
- Long-nosed Potoroo would still be expected to forage within the vicinity of the Study Area, given potential habitat extends beyond the Study Area 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 Study Area, as no known previous records occur in the Study Area. Further, the majority of the Study Area 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 Study Area.

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 Study Area and the Project is not expected to increase the level of predation threat for the Long-nosed Potoroo.</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 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:</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 (understorey sparse) or size; • Similarly important foraging habitat occurs throughout the locality including within protected areas; and • Rehabilitation of areas to be cleared will occur which should mitigate the loss of foraging habitat to some extent. 	

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 Study Area 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 a small area of remnant woodland.	Unlikely
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.	
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: <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); andNew Holland Mouse would still be expected to forage within the vicinity of the Study Area, given potential habitat extends beyond the Study Area 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 Study Area, as no known previous records occur in the Study Area. 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 Study Area.	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 Study Area 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 (mostly rehabilitation areas) or size; • Similarly important foraging habitat occurs throughout the locality including within protected areas; and • Rehabilitation of areas to be cleared will occur which should mitigate the loss of foraging habitat to some extent. 	

Niche Environment and Heritage

A specialist environmental and heritage consultancy.

Head Office

Niche Environment and Heritage

PO Box 2443 North Parramatta NSW 1750

Email: info@niche-eh.com

All mail correspondence should be through our Head Office