530 Raymond Terrace Road, Thornton (Stage 2)

Biodiversity Development Assessment Report

FINAL REPORT

Prepared for Thornton Brentwood Pty Ltd

6 June 2022

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- CLIENT: Land Link Property Group: Nick Whitton James Turner
- Thornton Brentwood Pty Ltd.
- Catalyst Project Consulting Pty Ltd: Nick Whitton
- Department of the Environment and Energy for access to the Protected Matters Search Tool of the Australian Government.
- NSW Office of Environment and Heritage for access to the BioNet Atlas of NSW Wildlife and the Threatened Species Profile Database.

Biosis staff involved in this project were:

Anthony Cable (Aquatic ecology), Brooke Corrigan (Botany), Dr Caragh Heenan (Zoology), Dave Kazemi and Sonika Kumar

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Glossary

APZ	Asset Protection Zone
BC Act	NSW *Biodiversity Conservation Act 2016*
Biosecurity Act	NSW *Biosecurity Act 2015*
DEE	Commonwealth Department of the Environment and Energy
DCDB	Land and Property Information(LPI) digital cadastral database
DPIE	NSW Department of Planning, Industry and Environment (now DPE)
DPE	NSW Department of Planning and Environment (formerly DPIE)
DPI	NSW Department of Primary Industries
DTDB	Digital topographic databases
Ecosystem credit species	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT.
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
LEP	Local Environment Plan
Locality	Area located within 5 kilometres radius from the subject land
LPI	NSW Land and Property Information
MNES	Matters of National Environmental Significance protected by a provision of Part 3 of the EPBC Act
OEH	NSW Office of Environment and Heritage
Koala use tree species	Tree species listed under Schedule 3 of the State Environmental Plaining Policy Biodiversity and Conservation 2021.
PCT	Plant Community Type
RoTAP	Rare or Threatened Australian Plant
RFS	NSW Rural Fire Service
SEPP	State Environmental Planning Policy
Subject land	The outer extent of predicted direct impacts associated with the construction of the proposed Stage 2 subdivision located at 530 Raymond Terrace Road, Thornton, New South Wales (Lot 20 DP 10419).
VIS	NSW Vegetation Information System
WM Act	NSW *Water Management Act 2000*

Certification and Declarations

I certify that this report has been prepared on the basis of the requirements of, and information provided under, the Biodiversity Assessment Method (DPIE 2020a) and s6.15 of the *Biodiversity Conservation Act 2016*.

In preparing this assessment I have acted in accordance with the Accredited BAM Assessor Code of Conduct.

I declare that I have considered the circumstances and there is no actual, perceived or potential conflict of interest.

Signature: Rebecca Dwyer

Date: 06/06/2022

BAM Assessor Accreditation Number: BAAS17067

Summary

Thornton Brentwood Pty Ltd is undertaking the staged subdivision development of Lot 20 DP 10419 at 530 Raymond Terrace Road Thornton (the project). The project involves three stages of subdivision with Development approval (DA 11-932) has been given for Stage 1 and Stage 3 of project which are in various states of development.

The project is considered a 'local development' and is to be assessed under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). In accordance with DA consent conditions A2 and A3 (DA 11-932) and in accordance with clause 4.22 (4) of the EP&A Act, DA approval is required for the proposed subdivision and development of Stage 2 (the proposal) of the project, assessment of impacts to the biodiversity values of Stage 2 is required for DA submission.

The subject land encompasses all of Stage 2 areas, including Asset Protection Zones (APZ), and contains native vegetation which would be removed by the proposal. Therefore the proposal requires assessment of impacts to the biodiversity values of the subject land in accordance with the *Biodiversity Conservation Act 2016* (BC Act). Under the BC Act, clearing of vegetation exceeding the area clearing threshold triggers entry into the Biodiversity Offset Scheme (BOS) and the preparation of a Biodiversity Assessment Development Report (BDAR) is required. The proposal would exceed the area threshold, this report has therefore been prepared to meet the requirements of the BOS.

This BDAR assesses the biodiversity values identified in the Stage 2 subject land only. An assessment of the biodiversity values identified in Stage 3 of the development has been documented separately (Biosis 2020).

Field investigation, undertaken in accordance with the Biodiversity Assessment Method 2020 (BAM) (DPIE 2020a), recorded 3.01 hectares of native vegetation within the subject land, representing two threatened ecological communities (TEC). Several threatened species were considered likely to occur within the subject land and targeted threatened species surveys were conducted.

The impact of the development is confined to 3.73 hectares total across Stage 2, with a total of 3.01 hectares of native vegetation to be removed. This assessment has determined residual impacts to two plant community types (PCT), which include 1592 *Spotted Gum – Red Ironbark – Grey Gum Shrub – Grass Open Forest of the Lower Hunter* and 1598 *Forest Red Gum grassy open forest on floodplains of the lower Hunter*, both of which comprise part of BC Act listed threatened ecological communities. This assessment had also determined impacts and habitat for Brush-tailed Phascogale *Phascogale tapoatafa* (BC Act, Vulnerable) within the subject land. Impacts will require retirement of ecosystem and species credits under the BOS. Credits requiring retirement include 66 ecosystem credits for PCT 1592, 4 ecosystem credits for PCT 1598 and 70 Brush-tailed Phascogale species credits. This offset obligation will be discharged either through the purchase and retirement of ecosystem and species credits or through payment to the Biodiversity Conservation Fund.

Stage 1 – Biodiversity assessment

1 Introduction

Biosis was commissioned by Land Link Property Group on behalf of Thornton Brentwood Pty Ltd to update the biodiversity assessment of Stage 2 (the proposal) of a three-stage subdivision development (the project) at what was known as Lot 20 DP 10419 at 530 Raymond Terrace Road, Thornton, New South Wales (NSW).

Development approval (DA 11-932) has been given for the broader project (Stages 1 and 3). In 2016, the biodiversity values and predicted impacts of Stage 1 were assessed by Parsons Brinckerhoff (Parsons Brinckerhoff 2016) using the *NSW BioBanking Assessment Methodology* (BBAM) (OEH 2014). Stage 3 of the project was assessed separately (Biosis 2020) and works have been approved and since commenced.

According to Council's notice of determination consent conditions A2 and A3, and clause 4.22 (4) of the EP&A Act, a DA approval is required for the proposed subdivision and development of Stage 2 (the subject land) of the project. DA submission for the Stage 2 development will require assessment of impacts to the biodiversity values of the subject land.

After consultation with the NSW Rural Fire Service (RFS) and Maitland City Council (Council), Land Link Property Group have finalised the layout of Stage 2. The proposal include thirty residential lots, access roads, a detention basin and Asset Protection Zone (APZ) in the north of subject land.

The purpose of this assessment was to apply the BAM to the proposed Stage 2 development in accordance with the BC Act, and provide Thornton Brentwood with a BDAR. The BDAR is to be submitted to Council as the approval authority, as part of a DA for the proposed Stage 2 development.

The BDAR also considers potential impacts to Matters of National Environmental Significance (MNES) in accordance with the *Environmental Protection and Biodiversity Conservation Act 2016* (EPBC Act).

1.1 Purpose of this assessment

This BDAR will:

- Address the BAM (DPIE 2020a) and the BOS.
- Identify how the proponent has avoided and minimised impacts to biodiversity.
- Identify any potential impact that could be characterised as serious and irreversible.
- Describe the offset obligations required to compensate for any unavoidable biodiversity impacts resulting from the proposed development.
- Consider and assess the proposal in accordance with other relevant legislation such as the Commonwealth EPBC Act.

All biodiversity assessments have been undertaken in accordance with the BAM, and this BDAR has been prepared and reviewed by Accredited Assessor Rebecca Dwyer (BAAS 17067). Updates to this report have been prepared by Brooke Corrigan (BAAS 19061) and Brendon True (BAAS18155) and reviewed by Mitch Palmer (BAAS 17051). This BDAR describes the outcome of the development assessment case (00011844) conducted consistent with the BAM.

1.2 The subject land, development footprint and assessment area

The terms subject land, development footprint and assessment area are used throughout this BDAR and are defined as follows.

- The subject land is the area of land subject to the development and where the BAM has been applied. It is located in the south of Lot 425 DP1232828, which prior to the broader project commencing was known as 530 Raymond Terrace Road, Thornton, NSW.
- The development footprint the area of land that is directly impacted by a proposed development, including access roads, asset protection zones (APZ) and areas used to store construction materials. The development footprint covers all of the subject land.
- The assessment area includes the subject land and the area of land within the 1500 m buffer zone surrounding the subject land.

The subject land and development footprint are shown on Figure 1.

1.3 Sources of information

Sources of information used in this assessment include relevant databases, spatial data, literature and previous site reports.

In order to provide a context for the subject land, records of flora and fauna from within 5 kilometres (the 'locality') were collated from the following databases and were reviewed:

- Commonwealth Department of the Environment and Energy (DEE) Protected Matters Search Tool for MNES protected by the EPBC Act.
- NSW Office of Environment and Heritage (OEH) BioNet Atlas of NSW Wildlife, for species, populations and ecological communities listed under the BC Act.
- PlantNET (The Royal Botanic Gardens and Domain Trust).
- BirdLife Australia, the New Atlas of Australian Birds 1998-2015.
- NSW Department of Primary Industry (DPI) Spatial Dara Portal.
- Other sources of biodiversity information relevant to the subject land were sourced from:
  - The NSW Plant Community Types, as held within the BioNet Vegetation Classification database (DPIE 2021).
  - Relevant vegetation mapping, including *Lower Hunter Vegetation Mapping* (Cockerill, Harrington, & Bagel 2013).
  - BioBanking Assessment Statement Report Lot 20 DP 10419 Raymond Terrace Road, Thornton (Parsons Brinckerhoff 2016).

Basemap data was obtained from LPI 1:25,000 digital topographic databases (DTDB), with cadastral data obtained from LPI digital cadastral database (DCDB).

The following spatial datasets were utilised during the development of this report:

- Mitchell Landscapes Version 3.0.
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7.
- Directory of Important Wetlands (DIWA).

- Ramsar wetland mapping.
- NSW Soil and Land Information System.

Mapping has been produced using a Geographic Information System (GIS). The following maps and data have been provided:

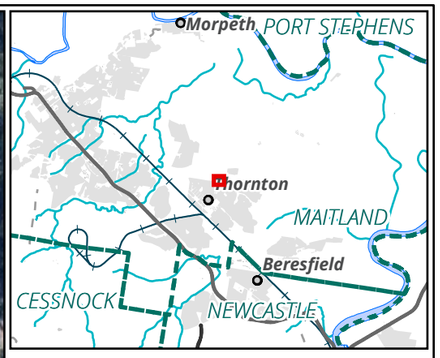
- Digital mapping with aerial photography showing 1:1000 or finer.
- Site map as described in subsection 3.1.1 of the BAM.
- Location map as described in subsection 3.1.2 of the BAM.
- Landscape map with features including 1500 metre buffer, as described in section 3.1.3 of the BAM.

1.4 Legislative requirements

The project has been assessed against relevant biodiversity legislation and government policy, including:

- *Environment Protection and Biodiversity Conservation Act 1999.*
- *Environmental Planning and Assessment Act 1979.*
- *Biodiversity Conservation Act 2017.*
- *Fisheries Management Act 1994.*
- *Water Management Act 2000.*
- *Biosecurity Act 2015.*
- State Environmental Planning Policy (Biodiversity Conservation) 2021*.
- *Maitland Local Environmental Plan 2011* (MCC 2011a).
- *Maitland Development Control Plan 2011* (MCC 2011b).

* The SEPP Biodiversity and Conservation 2021 commenced on 1 March 2022. The SEPP Biodiversity and Conservation 2021 consolidates, transfers and repeals provisions of 11 SEPPs with the aim of reducing the complexity of the NSW planning system. Of the 11 SEPPs, the SEPP (Koala Habitat Protection) 2020 (Koala SEPP 2020) is relevant to the subject land. The intent and provisions of the Koala SEPP 2020 are included in Chapter 3 of the SEPP Biodiversity and Conservation 2021 and remain unchanged. These largely administrative changes to the NSW planning system are reflected in this BDAR.



Legend

- Subject land
- Development footprint

Figure 1 Subject land

0 10 20 30 40

Metres

Scale: 1:1,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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37183, Date: 22 April 2022,
Drawn by: JB, Checked by: BT, Last edited by: jbeckius
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2 Landscape Context

This chapter describes the landscape and site context of the subject land, describing the landscape features present within the subject land and within a 1500 metre buffer, as required by the BAM (DPIE 2021). Figure 3 shows the location of the subject land and landscape features within the 1500 metre buffer.

2.1 Subject land description

2.1.1 Native vegetation cover

Vegetation within the assessment area (1500 metre buffer area) was assessed using aerial photographic interpretation, field survey results and existing vegetation mapping (Figure 3).

The total area of the assessment area is 829.9 hectares, with the area of native vegetation mapped within the assessment area being 232.4 hectares. This is a native vegetation cover of 28 % (>10-30 % class as defined in Section 3.2.3 of the BAM) and this value was entered into the BAM calculator.

Cleared areas within the assessment area include 597.8 hectares.

2.1.2 Bioregions

The subject land occurs within the Sydney Basin IBRA bioregion and the Hunter IBRA subregion. The Sydney Basin Bioregion extends from just north of Batemans Bay to Nelson Bay on the central coast, and almost as far west as Mudgee. The total area of the bioregion is 3,624,008 hectares and it occupies about 4.53 per cent of NSW and is one of two bioregions contained wholly within the state (OEH 2017a).

2.1.3 Rivers and streams

The subject land is located within the Hunter Local Land Services Region and the Hunter River catchment. The Hunter River is located approximately 5 kilometres east of the subject land and is the closest major waterbody. Grahamstown Reserve is also located approximately 13 kilometres to the north east.

An unnamed first and second order stream are located on the northern boundary of the subject land which joins the stream approximately 1 kilometre to the east of the subject land. This is part of a coastal wetland and is mapped within the biodiversity values map. This wetland is upstream of Francis Greenway Creek, a fourth order waterway to the south-east of the subject land. Francis Greenway Creek is classified as habitat for the threatened Purple-spotted Gudgeon *Mogurnda adspersa* by the NSW Department of Primary Industry (DPI 2019, DPI 2013).

2.1.4 Wetlands

One coastal wetland listed under the State Environment Planning Policy (Coastal Management) and occurs approximately one kilometre to the east of the subject land. No coastal wetland listed under the SEPP occur within the subject land and no direct impacts will occur as a result of the proposal.

2.1.5 Connectivity

Habitats within the subject land are primarily those associated with dry sclerophyll forests. For highly mobile fauna species and seed/pollen dispersal of some flora species, habitats within the subject land are well connected to the remnant native vegetation to the west and more fragmented native vegetation to the north. The higher quality habitat connectivity links for fauna and flora occur to the west and north of the subject land, where most of the moderate and good condition vegetation remnants are located, and barriers to dispersal are minor (Figure 4).

The subject land is well connected to bushland to the west with moderate disturbances such as unsealed vehicle tracks, these are not considered to be barriers to species movement within the area to the east and south of the subject land existing residential development provides a barrier for all fauna species (Figure 4).

The northern boundary of the subject land is adjacent to Raymond Terrace Road, a single carriageway road with regular traffic, this may prove a minor barrier to some species including gliders and frogs but is not considered to prevent movement to the north. To the west of the subject land remnant native bushland is well connected, the only barrier to these areas is a wooden post and wire fence with barbed wire, this may prevent some movement of larger species such as macropods but is not considered a barrier to dispersal.

At a larger scale the subject land is only moderately well connected to large remnant patches of bushland to the south-west through corridors approximately 70 to100 metres wide. Surrounding these corridors are areas of residential development, cleared paddocks and previously cleared and disturbed land (Figure 4).

2.1.6 Geological features

There were no recorded karst, caves, crevices, cliffs or other areas of geological significance within the subject land or within the 1,500 metre buffer area surrounding the subject land.

2.1.7 Areas of outstanding biodiversity value

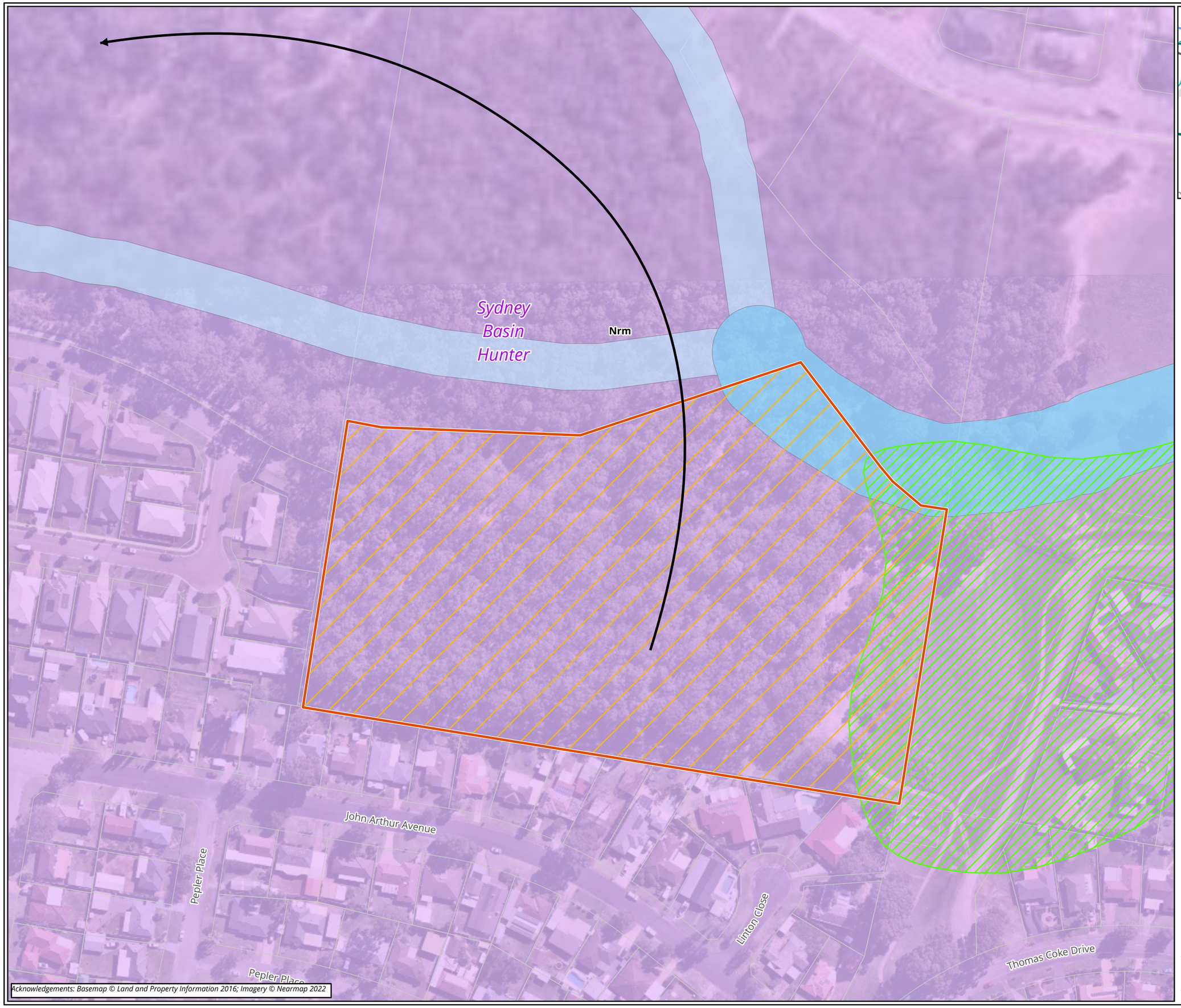
There are no areas of outstanding biodiversity or biodiversity values mapped within the subject land.

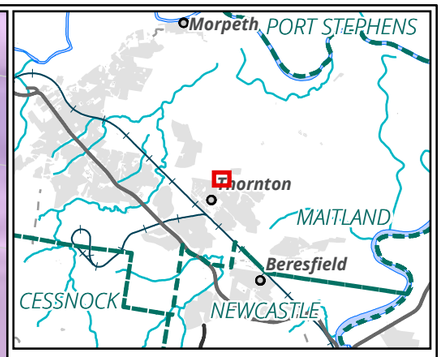
2.1.8 NSW (Mitchell) Landscape

The subject land occurs within the *Newcastle Coastal Ramp* Mitchell Landscape which occurs as undulating lowlands and low to steep hills on complex patterns of faulted and gently folded carboniferous conglomerate, lithic sandstone, felspathic sandstone and mudstone. It has a general elevation between 50 to 275 metres with local relief of 40 to 150 metres.

The landscape features a woodland of Spotted Gum *Corymbia maculata*, Forest Red Gum *Eucalyptus tereticornis*, Red Ironbark *Eucalyptus sideroxylon*, White Mahogany *Eucalyptus acmenoides*, Large-fruited Grey Gum *Eucalyptus canaliculata*, with sub-tropical rainforest elements in sheltered gullies.

On lower slopes there are similar eucalypts, with Forest Oak *Allocasuarina torulosa* and grasses, merging to a forest of Smooth-barked Apple *Angophora costata*, Red Bloodwood *Corymbia gummifera*, Blackbutt *Eucalyptus pilularis*, with Bracken *Pteridium esculentum* and grasses nearer the coast (Mitchell 2002).





Legend

- Subject land
- Development footprint
- Lot
- IBRA Sub-region
- Habitat connectivity

HydroLine stream order buffers

- 1
- 2

Acid sulfate soil risk - soil hazard

- High probability of occurrence

Mitchell landscapes

- Nrm,Newcastle Coastal Ramp

Figure 2 Site map

0 10 20 30 40 50

Metres

Scale: 1:1,500 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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37183, Date: 22 April 2022,
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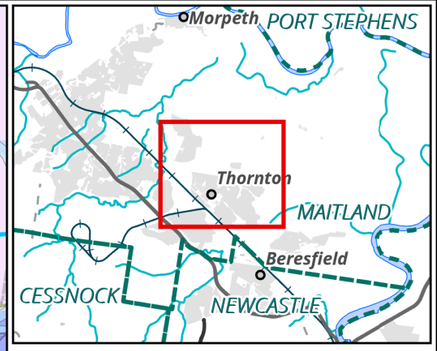

Legend

- Subject land
- Development footprint
- Assessment area
- Lot
- Habitat connectivity
- IBRA Sub-region
- Riparian buffers - Important wetlands
- Local wetlands
- Riparian buffers - Local wetlands

Coastal Management SEPP

- Coastal Wetlands

HydroLine stream order buffers

- 1
- 2
- 3
- 4

Acid sulfate soil risk - soil hazard

- High probability of occurrence
- No known occurrence

Mitchell landscapes

- Het,Lower Hunter Channels and Floodplains
- Nrm,Newcastle Coastal Ramp

Figure 3 Location map

0 100 200 300 400 500

Metres

Scale: 1:12,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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Matter: 37183, Date: 21 April 2022,
Drawn by: JB, Checked by: BT, Last edited by: jbeckius
Layout: 37183_F3_Location
Project: P:\37100s\37183\Mapping\37183_Thornton_BDAR_Updates\37183_Thornton_BDAR_Updates.aprx

Acknowledgements: Basemap © Land and Property Information 2016

3 Native vegetation

The subject land supports 3.01 hectares of native vegetation with varying levels of disturbance such as informal tracks. Native shrub and mid layer vegetation strata are mostly sparse across most of the subject land except where the subject land intersects wetter sections such as the riparian area in the north.

3.1 Native vegetation and habitat assessment

3.1.1 Native vegetation extent

The extent of native vegetation, threatened ecological communities and vegetation integrity within the subject land was determined using the results of site investigations and Section 4 of the BAM (DPIE 2020a).

Figure 5 provides a map of the native vegetation extent recorded within the subject land and development footprint, as assessed during field investigations undertaken in August and November 2018 and April 2021. The figure includes all areas of native vegetation (native ground cover and areas with canopy) within the subject land. Areas not shown as native vegetation cover within Figure 5, are considered non-native vegetation, and are addressed further below.

3.1.2 Review of existing information

The Stage 1 Biodiversity Assessment Report (Parsons Brinckerhoff 2016), regional vegetation mapping (Cockerill, Harrington, & Bagel 2013) and database searches were reviewed to inform the site investigations. Based on the results of the background review and the requirements of the BAM with respect to this BDAR, appropriate surveys were designed for the subject land.

3.1.3 Field investigation of biodiversity values

An ecological assessment, detailed mapping and targeted surveys were undertaken by qualified and experienced Biosis ecologists Alejandro Barreto (Botanist) and Sarah Allison (Zoologist) in August and November 2018. Additional field investigations were undertaken in April 2021 by experienced Biosis ecologist Brooke Corrigan (Consultant Restoration Ecologist) and Dr Caragh Heenan (Project Zoologist). Surveys were conducted under the terms of Biosis' Scientific Licence issued by the Energy, Environment and Science Division (EES) under the *National Parks and Wildlife Act 1974* (SL100758, expiry date 31 May 2022). Fauna survey was conducted under approval CSB 17/892 from the NSW Animal Care and Ethics Committee (expiry date 31 January 2023).

The subject land was surveyed in accordance with the BAM (DPIE 2020a), which involved:

- The identification and mapping of PCTs according to the structural definitions of Lower Hunter Vegetation Mapping (Cockerill, Harrington, & Bagel 2013).
- The identification of native and exotic plant species, according to the Flora of NSW (Harden 1992, Harden 1993, Harden 2000, Harden 2002), with reference to recent taxonomic changes.
- Incidental observations using the "random meander" method (Cropper 1993).
- Identification of fauna habitats and assessment of their condition and value to threatened fauna species.
- Observations of animal activity and searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and diggings).

- Targeted surveys of threatened flora and fauna within the subject land in accordance with the *NSW Guide to surveying Threatened Plants* (OEH 2016).
- An assessment of the natural resilience of the vegetation of the site.
- Identification of previous and current factors threatening the ecological function and survival of native vegetation within and adjacent to the subject land.

The conservation significance of plant species and plant communities was determined according to:

- BC Act for significance within NSW.
- EPBC Act for significance within Australia.

Detailed mapping of PCTs was conducted using hand-held (uncorrected) tablet units (Samsung Galaxy Tab 3) using the ArcGIS Collector application and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 5 metres) and dependent on the limitations of aerial photo rectification and registration. Areas of native vegetation for which a PCT could validly be assigned were identified and delineated in the field, and their condition determined. Identification of PCTs within the subject land was confirmed with reference to the community profile descriptors (and diagnostic species tests) held within the Lower Hunter Vegetation Mapping project (Cockerill, Harrington, & Bagel 2013) and NSW BioNet Vegetation Classification database (DPIE 2021b).

Detailed surveys included the completion of the requisite number of vegetation integrity survey plots within each broad condition state of each mapped PCT in accordance with the BAM. The locations of surveyed plots are shown in Figure 6. Targeted surveys for candidate species credit flora and fauna species were also undertaken and are described in detail in Section 4.2.

Further details of targeted survey for threatened flora and fauna species are provided in Section 4.2 below.

3.1.4 Local data

No local data was used in this assessment.

3.1.5 Non-native vegetation

Parts of the subject land were dominated by exotic grasses with no native over storey or mid storey cover met the definition of non-native as native vegetation (Figure 5).

Areas not shown as native vegetation cover within Figure 5, were considered to not provide habitat for threatened species and as such are not included for further assessment in accordance with Section 5.1.1.5 of the BAM (DPIE 2020a).

3.1.6 Plant community types

The following Plant Community Types (PCT) were assessed as present within the subject land:

- PCT 1592 *Spotted Gum – Red Ironbark – Grey Gum Shrub – Grass Open Forest of the Lower Hunter* (Table 1).
- PCT 1598 *Forest Red Gum grassy open forest on floodplains of the lower Hunter* (Table 2).

Table 1 to Table 2 provide detailed descriptions of the two PCTs recorded within the subject land. PCTs recorded within the subject land are shown on Figure 5.

Table 1 PCT 1592

PCT 1592 Spotted Gum – Red Ironbark – Grey Gum Shrub – Grass Open Forest of the Lower Hunter	
Vegetation formation	KF_CH5A Dry Sclerophyll Forests (Shrub/grass sub- formation)
Vegetation class	Hunter- Macleay Dry Sclerophyll Forests
Extent within subject land	Approximately 3.0 hectares
Condition	Moderate This PCT is in a moderate condition due to the dominance, cover and diversity of native canopy, midstorey and groundcover species. However, past ground disturbance (tracks, edge effect and clearing) and moderate weed infestation (between 5% and 45% cover) have negatively impacted some of the subject land.
Vegetation zones	1592_Moderate
Description	This PCT dominates the subject land. Native canopy species recorded within the vegetation include Spotted Gum *Corymbia maculata,* Red Ironbark *Eucalyptus fibrosa,* Narrow-leaved Ironbark *Eucalyptus crebra,* Grey Ironbark *Eucalyptus paniculata,* Narrow-leaved Stringybark *Eucalyptus sparsifolia and* Grey Box *Eucalyptus moluccana.* Native species such as - Common Silkpod *Parsonsia straminea*, Cherry Ballart *Exocarpos cupressiformis,* Gorse Bitter Pea *Daviesia ulicifolia*,, Prickly Beard-heath *Leucopogon juniperinus,* Native Blackthorn *Bursaria spinosa,* Coffee Bush *Breynia oblongifolia,* Sweet Pittosporum *Pittosporum undulatum* dominated the mid storey. The ground storey recorded a variety of native sedges and herbs for which included Wiry Panic *Entolasia stricta,* Kangaroo Grass *Themeda triandra,* Threeawn Speargrass *Aristida vagans,* Wire Grass *Cymbopogon refractus,* - Common Couch *Cynodon dactylon,* Variable Sword-sedge *Lepidosperma laterale,* Weeping Grass *Microlaena stipoides,* Blue Flax-lily *Dianella caerulea* and *Lomandra species*. Exotic species were recorded in moderate to heavy densities. Weed species recorded included Lantana *Lantana camara*, Asparagus Fern *Asparagus aethiopicus*, Mother of millions *Bryophyllum delagoense,* Cape Daisy *Osteospermum ecklonis* and African Olive *Olea europaea subsp. cuspidata.*
Survey effort	Two BAM plots were completed within this PCT in accordance which informed the finalised mapping.
Justification of PCT	Floristic composition, soil type and landscape position aligns with Spotted Gum – Red Ironbark – Grey Gum Shrub – Grass Open Forest of the Lower Hunter (DPIE 2021) and the BC Act listed Endangered Ecological Community (EEC) *Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion* final determination (NSW Scientific Committee 2019) based on the following: • Landscape position in Permian sediments of the Hunter Valley floor in Sydney Basin Bioregion. • Location within the Maitland LGA. • The canopy is dominated by Spotted Gum and Red Ironbark. • Presence of Coffee Bush, Native Blackthorn, Kangaroo grass and Wiry Panic.
TEC Status	Commonwealth EPBC Act: This PCT is not associated with any EPBC listed TEC. NSW BC Act: This community is consistent with the EEC *Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion*.

PCT 1592 Spotted Gum – Red Ironbark – Grey Gum Shrub – Grass Open Forest of the Lower Hunter	
Estimate of percent cleared value (BioNet Vegetation Classification Database)	44 %
Photo 1 ***Spotted Gum-Red Ironbark-Grey Gum Shrub-Grass Open Forest*** **within the subject land**	
Photo 2 ***Spotted Gum-Red Ironbark-Grey Gum Shrub-Grass Open Forest*** **within the subject land (Plot 1)**	

Table 2 PCT 1598

PCT 1598 Forest Red Gum grassy open forest on floodplains of the lower Hunter	
Vegetation formation	Forested Wetlands
Vegetation class	Coastal Floodplain Wetlands
Extent within subject land	Approximately 0.1 hectares
Condition	Moderate This PCT is in a moderate condition due to the dominance, cover and diversity of native canopy, mid storey and groundcover species. However, past ground disturbance (tracks, edge effect and clearing) and high weed infestation (between 5% and 45% cover) have negatively impacted most of the subject land.
Vegetation zones	1598_Moderate
Description	This PCT dominates the riparian area north of the subject land and extends within the high bank along the boundary with Stage 2. The dominant native canopy species is Forest Red Gum *Eucalyptus tereticornis* with White Mahogany *Eucalyptus acmenoides* and Thin-leaved Stringybark *Eucalyptus eugenioides* sub-dominant, Spotted Gum also occurs. The shrub layer is heavily infested with Lantana and Crofton Weed *Ageratina adenophora* but retains a diversity of native species including Sweet Pittosporum, Coffee Bush, Native Blackthorn, Green Wattle *Acacia irrorata* Cherry Ballart, Gorse Bitter Pea, Prickly Beard-heath. Scrambling Lily *Geitonoplesium cymosum* features heavily in the mid strata and the ground layer contains Weeping Grass, *Hydrocotyle sibthorpioides,* Swamp Pennywort *Centella asiatica*, Maidenhair fern *Adiantum aethiopicum,* Water Plaintain *Alisma plantago-aquatica*, Saw Sedge *Gahnia aspera* and Slender Knotweed *Persicaria decipiens* along with Blue Flax-lily, Lomandra species, Forest Hedgehog Grass *Echinopogon ovatus,* Bordered Panic *Entolasia marginata,* Two Colour Panic *Panicum simile* and Kangaroo Grass. Exotics include, Paspalum *Paspalum dilatatum,* Slender Pigeon Grass *Setaria parviflora*, Easter Cassia *Senna pendula* var. *glabrata,* Asparagus Fern and others.
Survey effort	One BAM plot was completed within the PCT which informed the finalised mapping. The plot is located on the floor of the drainage line along the channel in the most representative vegetation. The plot extends outside the subject land but provides the most accurate assessment available given practical limitations.
Justification of PCT	Floristic composition, soil type and landscape position aligns with Forest Red Gum grassy open forest on floodplains of the lower Hunter (DPIE 2021) and the BC Act listed Endangered Ecological Community (EEC) *Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions* final determination (NSW Scientific Committee 2011) based on the following: • Landscape position in depressions and drainage flats on Permian sediments of the Hunter Valley floor in the Sydney Basin Bioregion. • Location within the Maitland LGA. • The canopy is dominated by Forest Red Gum. • Presence of Coffee Bush, Gorse Bitter Pea, Prickly Beard-heath, Whiteroot, and Weeping Grass.

PCT 1598 Forest Red Gum grassy open forest on floodplains of the lower Hunter	
TEC Status	Commonwealth EPBC Act: This PCT is consistent with the CEEC *River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria.* NSW BC Act: This community is consistent with the EEC *Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions*.
Estimate of percent cleared value (BioNet Vegetation Classification Database)	0 % (percent cleared category 'not assessed').
Photo 3 *Forest Red Gum grassy open forest on floodplains of the lower hunter* within the subject land (Plot 3)	
Photo 4 *Forest Red Gum grassy open forest on floodplains of the lower hunter* within the subject land	

3.1.7 Threatened ecological communities

The PCTs within the subject land are consistent with the Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion and Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions EECs listed under the NSW BC Act and the communities within the subject land are detailed in Table 3 and illustrated in Figure 8. The communities cover approximately 3.01 hectares.

Table 3 Summary of BC Act TECs within the subject land

BC Act TEC	Listing status	Area (Ha)
Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion	Endangered	3.0
Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	Endangered	0.1

3.2 Vegetation integrity assessment

3.2.1 Vegetation zones and patch size class

PCTs within the subject land were assessed and stratified, based on broad condition state, into vegetation zones in accordance with Section 4.3 of the BAM. This resulted in two vegetation zones identified within the subject land. Table 4 describes each of the zones, and provides details on the numbers of BAM floristic plots undertaken in each zone.

Patch size classes for each vegetation zone present within the subject land were assessed as per Section 4.3.2 of the BAM (DPIE 2020a) using a select process in ArcGIS. All native vegetation with a gap of less than 100 metres from the next area of native vegetation (or ≤ 30 metres for non-woody ecosystems), is considered a single patch, with a patch able to extend onto adjoining land.

Native vegetation within the subject land was mapped sequentially and it was found to form part of a relatively large / small patch of connecting vegetation with an area of over 100 hectares.

Patch size classes for each vegetation zone are also outlined in Table 4 below.

Table 4 Vegetation zones within the subject land

Vegetation zone	Plant Community Type	BAM plots completed	Impact assessment area	Patch size class
VZ1_1592_Moderate	1592 Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	1	3.0 ha	>100 ha
VZ2_1598_Moderate	1598 Forest Red Gum grassy open forest on floodplains of the lower Hunter	1	0.1 ha	>100 ha

3.2.2 Vegetation integrity

Vegetation integrity, or condition, was assessed using data obtained from undertaking BAM plots within the vegetation zones, as per Section 4.3.4 of the BAM (DPIE 2020a). Plot data was collected via:

- A 20 metre x 50 metre quadrat and 50 metre transect for assessment of site attributes and function.
- A 20 metre x 20 metre quadrat, nested within the larger quadrat for full floristic survey to determine composition and structure of the PCT.

The minimum number of BAM plots per vegetation zone was determined using Table 3 of the BAM (DPIE 2020a). A total of three BAM plots have been completed within the vegetation zones present (Figure 6).

Assessment of vegetation integrity was undertaken using standard benchmark data as outlined in the BAM and held in the BioNet Vegetation Classification database. A list of flora species was compiled for each BAM

plot completed and is included in Appendix 3. Records of all flora species will be submitted to EES for incorporation into the Atlas of NSW Wildlife.

3.2.3 Vegetation integrity score

Plot data was entered into the BAM calculator to determine vegetation integrity score. Plot data are presented in Appendix 3, with vegetation integrity scores for each vegetation zones provided in Table 5.

Table 5 Vegetation zone integrity scores

Vegetation zone	Composition score	Structure score	Function score	Vegetation integrity score*	IBRA subregion
VZ1_1592_Moderate	51.4	31.9	52.7	44.2	Hunter
VZ2_1598_Moderate	94.4	33.3	99.3	67.9	Hunter

*Benchmark (pristine) condition vegetation would receive a VI score of 100.

As outlined in Section 9.2.1 of the BAM, an offset is required for impacts on native vegetation where the vegetation integrity score is:

- ≥15 where the PCT is representative of an endangered or critically endangered ecological community.
- ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community.
- ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat.

As such, ecosystem credit offsets are required for both vegetation zones.

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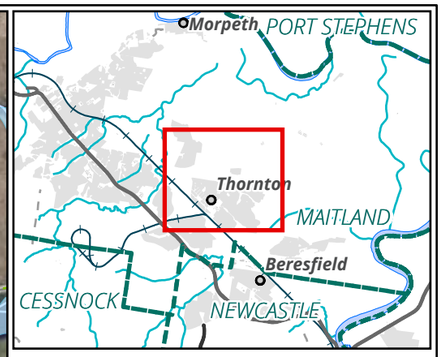


Legend

- Subject land
- Development footprint
- Assessment area
- Native vegetation

Figure 4 Native vegetation extent

0 100 200 300 400

Metres

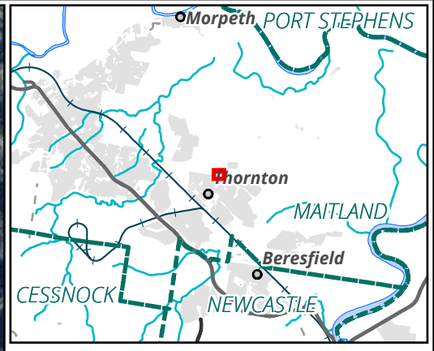
Scale: 1:11,500 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 37183, Date: 21 April 2022,
Drawn by: JB, Checked by: BT, Last edited by: jbeckius
Layout: 37183_F4_NativeVeg
Project: P:\37100s\37183\Mapping\37183_Thornton_BDAR_Updates\37183_Thornton_BDAR_Updates.aprx



Legend

- Subject land
- Development footprint
- Hollow-bearing tree

Plant Community Type

- 1592 - Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter
- 1598 - Forest Red Gum grassy open forest on floodplains of the Lower Hunter
- Urban Native/Exotic

Figure 5 Vegetation within the subject land

0 10 20 30 40

Metres

Scale: 1:1,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 37183, Date: 21 April 2022,
Drawn by: JB, Checked by: BT, Last edited by: jbeckius
Layout: 37183_F5_BiosisVeg
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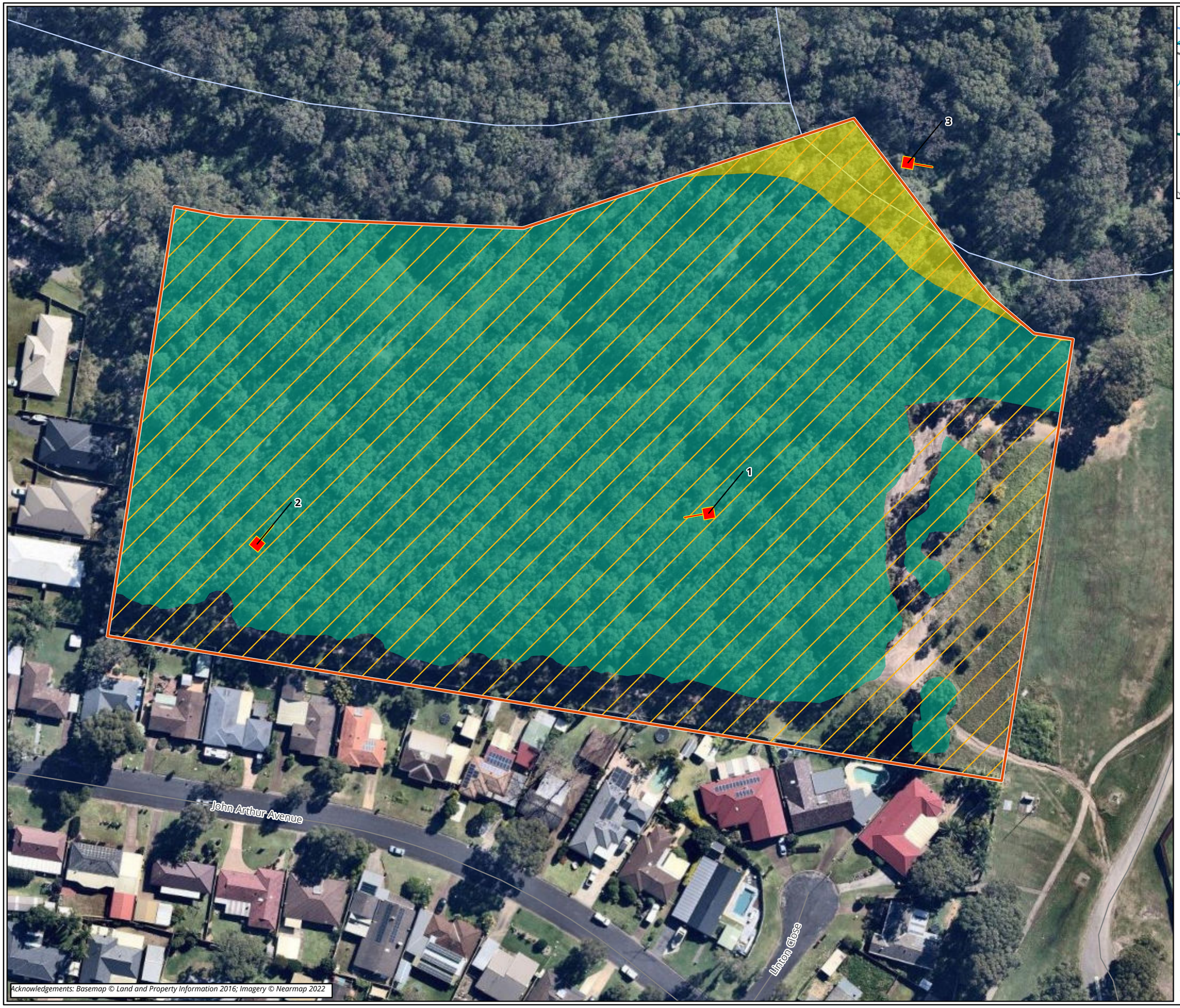

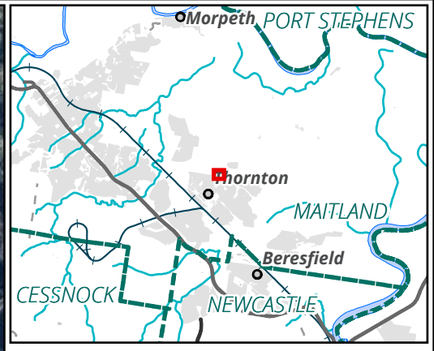

Legend

- Subject land
- Development footprint
- BAM plot

Vegetation zone

- VZ1_PCT 1592_Moderate
- VZ2_PCT 1598_Moderate

Figure 6 Vegetation zones and plot locations

0 10 20 30 40 Metres

N

Scale: 1:1,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 37183, Date: 22 April 2022,
Drawn by: JB, Checked by: BT, Last edited by: jbeckius
Layout: 37183_F6_VZ
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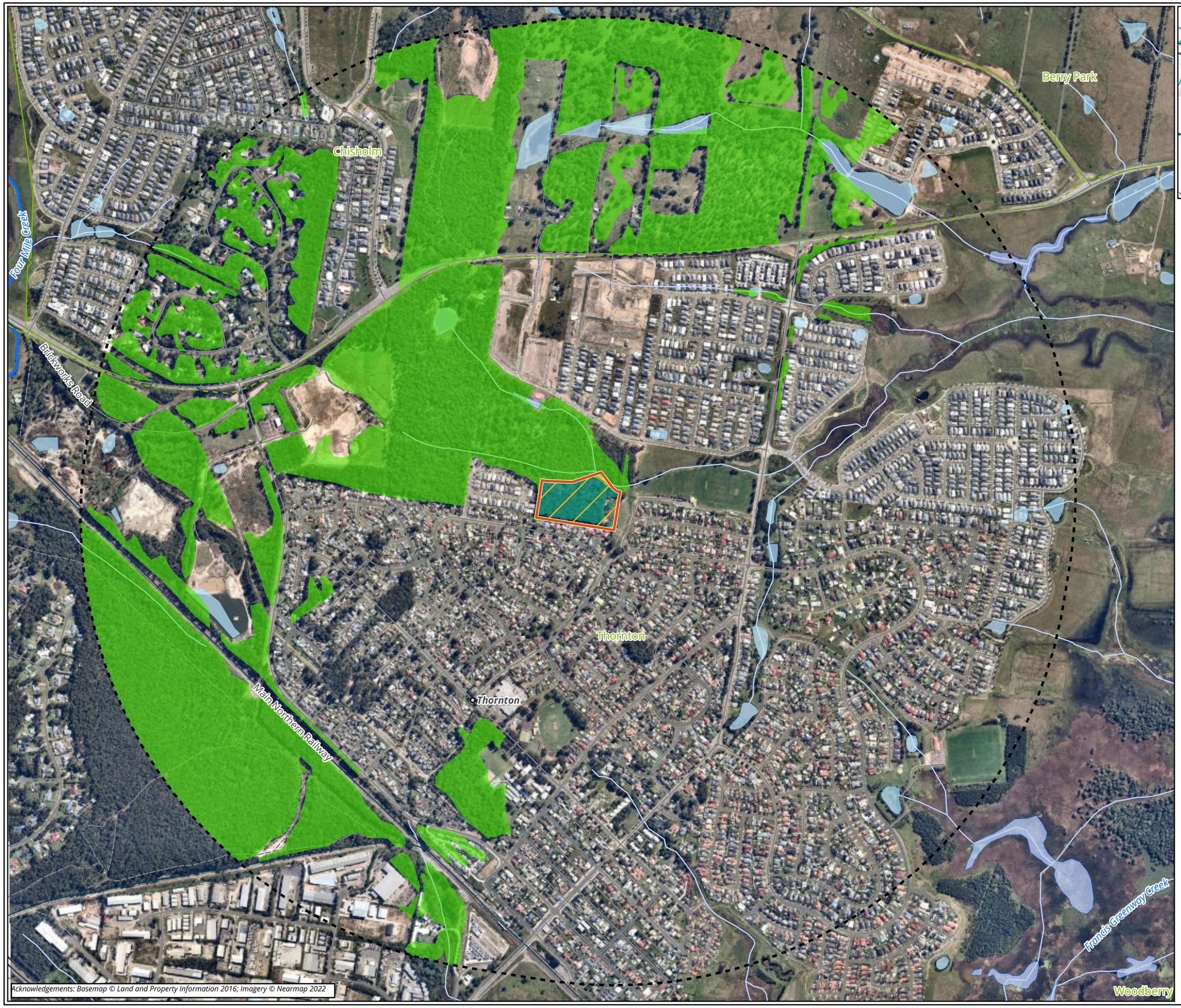
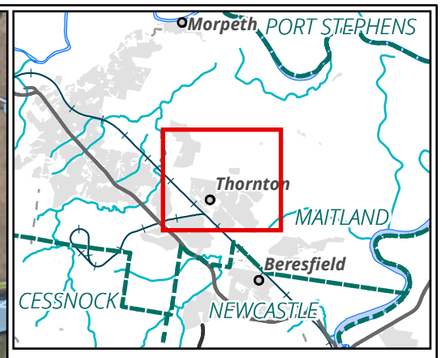




Legend

- Subject land
- Development footprint
- Assessment area

Vegetation zone

- VZ1_PCT 1592_Moderate
- VZ2_PCT 1598_Moderate

Patch size

- ≥100ha (1592 Low, 1598 Low)

Figure 7 Patch size

0 100 200 300 400

Metres

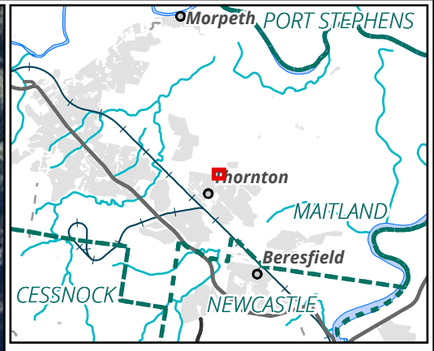
N

Scale: 1:11,500 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 37183, Date: 22 April 2022,
Drawn by: JB, Checked by: BT, Last edited by: jbeckius
Layout: 37183_F7_PatchSize
Project: P:\37100s\37183\Mapping\37183_Thornton_BDAR_Updates\37183_Thornton_BDAR_Updates.aprx



Legend

- Subject land
- Development footprint

BC Act and EPBC Act TECs

- Lower Hunter Spotted Gum Ironbark Forest
- Hunter Lowland Red Gum Forest

Figure 8 Threatened ecological communities within the study area

0 10 20 30 40

Metres

Scale: 1:1,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 37183, Date: 21 April 2022,
Drawn by: JB, Checked by: BT, Last edited by: jbeckius
Layout: 37183_F8_TECs
Project: P:\37100s\37183\Mapping\37183_Thornton_BDAR_Updates\37183_Thornton_BDAR_Updates.aprx

4 Threatened species

4.1 Ecosystem credit species

A list of predicted species (ecosystem credit species) expected to occur within the subject land was generated as per Section 5 of the BAM. Impacts to these species require assessment, however targeted survey is not required as these species are assumed to occur, based on the occurrence of the PCTs, habitat constraints, native vegetation cover in the landscape and calculated patch sizes. These species are identified as ecosystem credit species in the Threatened Biodiversity Data Collection (TBDC). Table 6 lists the ecosystem credit species that could not be discounted, based on geographical restrictions or a lack of suitable habitat, from using the subject land on occasion.

These species were considered when prescribing management and mitigation measures for the project, and a number have been specifically considered as part of the assessment under the Commonwealth EPBC Act.

Table 6 Ecosystem credit species (predicted species) with potential to occur

Common name	Scientific name	Habitat type	Habitat constraint	Geographic limitations	Sensitivity to gain class	NSW listing status	Comm. listing status
Barking Owl	*Ninox connivens*	Foraging	--	--	High	V	--
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis*	--	--	--	Moderate	V	--
Black Falcon	*Falco subniger*				Moderate	V	
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	--	--	--	High	V	--
Diamond Firetail	*Stagonopleura guttata*						
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	Foraging	--	--	High	V	--
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	--	--	--	High	V	--
Eastern Coastal Freetail-bat	*Mormopterus norfolkensis*	--	--	--	High	V	--
Gang-gang Cockatoo	*Callocephalon fimbriatum*	Foraging	--	--	Moderate	V	--
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	Foraging	--	--	Moderate	V	--

Common name	Scientific name	Habitat type	Habitat constraint	Geographic limitations	Sensitivity to gain class	NSW listing status	Comm. listing status
Greater Broad-nosed Bat	*Scoteanax rueppellii*	--	--	--	High	V	--
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis*	--	--	--	Moderate	V	--
Grey-headed Flying-fox	*Pteropus poliocephalus*	Foraging	--	--	High	V	V
Hooded Robin (south-eastern form)	*Melanodryas cucullata*	--	--	--	Moderate	V	--
Koala	*Phascolarctos cinereus*	Foraging	--	--	High	V	V
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	Foraging	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding	--	Very high	V	--
Little Bentwing-bat	*Miniopterus australis*	Foraging	--	--	High	V	--
Little Eagle	*Hieraaetus morphnoides*	Foraging	--	--	Moderate	V	--
Little Lorikeet	*Glossopsitta pusilla*	--	--	--	High	V	--
Masked Owl	*Tyto novaehollandiae*	Foraging	--	--	High	V	--
Painted Honeyeater	*Grantiella picta*	--	Mistletoes present at a density of greater than five mistletoes per hectare	--	Moderate	V	V
Powerful Owl	*Ninox strenua*	Foraging	--	--	High	V	--
Regent Honeyeater	*Anthochaera phrygia*	Foraging	--	--	High	CE	CE
Scarlet Robin	*Petroica boodang*	--	--	--	Moderate	V	--

Common name	Scientific name	Habitat type	Habitat constraint	Geographic limitations	Sensitivity to gain class	NSW listing status	Comm. listing status
Speckled Warbler	*Chthonicola sagittata*	--	--	--	High	V	--
Spotted-tailed Quoll	*Dasyurus maculatus*	--	--	--	High	V	E
Square-tailed Kite	*Lophoictinia isura*	Foraging	--	--	Moderate	V	--
Swift Parrot	*Lathamus discolor*	Foraging	--	--	Moderate	E	CE
Turquoise Parrot	*Neophema pulchella*	--	--	--	High	V	--
Varied Sittella	*Daphoenositta chrysoptera*	--	--	--	Moderate	V	--
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Foraging	--	--	High	V	--
White-throated Needletail	*Hirundapus caudacutus*				High		V
Yellow-bellied Glider	*Petaurus australis*	--	--	--	High	V	--
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	--	--	--	High	V	--

4.2 Species credit species

Species credit species are threatened species for which vegetation surrogates and/or landscape features cannot reliably predict the likelihood of their occurrence, or components of their habitat. These candidate species are identified as species credit species in the TBDC. A targeted survey or an expert report is required to confirm the presence of these species on the subject land, or alternatively the species can be assumed to be present (DPIE 2020a).

Appendix 2 provides the lists of species credit species predicted to occur within the subject land based on the IBRA subregion on within which the project occurs, the native vegetation cover present within the 1500 metre assessment area, the PCTs present within subject land, and patch sizes listed in Table 4.

The potential for a species to occur within the subject land was assessed in accordance with Section 5.2 of the BAM and species with geographical restrictions, or habitat constraints not present, were not required to be assessed. Seventeen predicted species credit species have been excluded from occurring within the subject land based on a lack of suitable habitat, substantial degradation of existing potential habitat or lack of required microhabitat features.

A detailed assessment of potential for occurrence, and potential for impact, for all species credit species predicted to occur within the subject land is provided in Appendix 2. Species credit species considered to potentially occur within the subject land, and thus considered 'candidate species credit species' have been the subject of the target of threatened species surveys.

One species credit species (Squirrel Glider *Petaurus norfolcensis*) not predicted by the BAM Calculator (BAM-C) or BioNet to occur within the subject land was added to the assessment as a candidate species credit species as suitable habitat was deemed to be present within the subject land.

All candidate species credit species considered as part of this assessment, and their associated method of assessment, are listed in Table 7 (flora species) and Table 8 (fauna species).

Threatened flora

Habitat for threatened flora species within the subject land is considered to be very limited. Historical and ongoing disturbance in the form of vegetation removal, recreational four wheel driving and invasion of dense and smothering exotic plant species has significantly degraded the habitats present. However, Marginal habitat can be found within the subject land native vegetation.

Table 7 provides a list of candidate flora species credit species considered in this assessment, each species' required survey period and the relevant method of assessment. Further detail of the targeted surveys undertaken are provided below.

Table 7 Candidate flora species credit species

Species name	Common name	Survey period	Method of assessment
Callistemon linearifolius	Netted Bottle Brush	October-January	Targeted survey
Cynanchum elegans	White-flowered Wax Plant	All year	Targeted survey
Eucalyptus glaucina	Slaty Red Gum	All year	Targeted survey
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	August-November	Targeted survey
Pomaderris queenslandica	Scant Pomaderris	All year	Targeted survey
Rutidosis heterogama	Heath Wrinklewort	All year	Targeted survey
Thesium australis	Austral Toadflax	November-February	Targeted survey

Threatened fauna

Fauna habitat assessment was undertaken to determine whether the vegetation to be impacted by the proposal contained microhabitats suitable to support the candidate fauna species credit species, as outlined in Appendix 2.

The habitat assessment focussed on the presence/absence of the following features within the subject land:

- Habitat trees including large hollow-bearing trees, availability of flowering shrubs and feed tree species.
- Condition of native vegetation and the presence of exotic species.
- Condition of waterways and associated habitat for aquatic threatened species.
- Quantity of ground litter and logs.
- Searches for indirect evidence of threatened species (e.g. nests, scats, tracks, etc.).
- General degradation of the site as a result of past land management practices and lack of maintenance.

Fauna habitat within the subject land was found to be moderately degraded due to previous and ongoing disturbance, the lack of understorey and fallen timber or rocks for foraging and shelter. Hollows within the subject land provide potential breeding habitat for a number of threatened species. Although the overall condition of the site is considered to be somewhat degraded, mature habitat values such as the moderately high abundance of hollows do occur. As such, the potential presence of the majority of the listed fauna species outlined below is considered to be on a transient basis, as they disperse through the site foraging or as part of their larger home range.

Due to the number and proximity of local records, the connectivity of higher quality habitat on the west of the subject land and the potential for fauna to utilise the subject land for breeding and/or foraging, targeted fauna survey was conducted for threatened fauna species credit species identified in Table 8.

Table 8 provides a list of candidate fauna species credit species considered in this assessment, each species' required survey period and the relevant method of assessment. Further detail of the targeted surveys undertaken are provided below.

Table 8 Candidate fauna species credit species

Species name	Common name	Survey period	Method of assessment
Burhinus grallarius	Bush Stone-curlew	All year	Targeted survey
Callocephalon fimbriatum	Gang-gang Cockatoo	October-January	Targeted survey
Calyptorhynchus lathami	Glossy Black-cockatoo	January-September	Targeted survey
Cercartetus nanus	Eastern Pygmy-possum	October-March	Targeted survey
Chalinolobus dwyeri	Large-eared Pied Bat	November-January	Targeted survey
Haliaeetus leucogaster	White-bellied Sea-eagle	July-December	Targeted survey
Hieraaetus morphnoides	Little Eagle	August-October	Targeted survey
Hoplocephalus bitorquatus	Pale-headed Snake	November-March	Targeted survey
Lophoictinia isura	Square-tailed Kite	September-January	Targeted survey
Myotis macropus	Southern Myotis	October-March	Targeted survey
Ninox connivens	Barking Owl	May-December	Targeted survey
Petaurus norfolkensis	Squirrel Glider	All year	Targeted survey
Phascogale tapoatafa	Brush-tailed Phascogale	December-June	Targeted survey
Phascolarctos cinereus	Koala	All year	Targeted survey
Planigale maculata	Common Planigale	All year	Targeted survey
Vespadulus troughtoni	Eastern Cave Bat	November-January	Targeted survey

4.2.1 Threatened species survey details

Targeted threatened species surveys of the subject land were undertaken 20-21 August 2018, 12-16 November 2018 and 28 April 2021. Weather observations for each survey date are shown in Table 9.

Table 9 Weather observations during targeted flora and fauna surveys (Maitland, NSW)

Survey undertaken	Survey date	Temperature (°C)		Humidity %	Cloud (eighths)	Moon (eighths)	Wind	Rain (mm)
		Min.	Max.					
Diurnal bird survey, habitat assessment and Targeted flora survey	20/08/2018	4	17	42	0	0	Moderate	0
Diurnal bird survey, habitat assessment and Targeted flora survey	21/08/2018	3	19	44	0	0	Moderate	0
Nocturnal survey, Anabat Survey, Terrestrial and Arboreal Trapping	12/11/2018	14	25	62	4	2	Light	0 (17.2 mm over 7 days preceding)
	13/11/2018	15	27	53	4	2	Light	0 (17 mm over 7 days preceding)
	14/11/2018	16	26	76	8	3	Calm	0 (17 mm over 7 days preceding)
	15/11/2018	17	26	59	0	3	Light	0 (17 mm over 7 days preceding)
Targeted flora survey	28/04/2021	8	23	99	7	6	Moderate	0

Information from the Australia Government Bureau of Meteorology website.

Details of surveys undertaken as part of the current assessment are provided below.

Threatened Flora

Despite the assessed lack of habitat within the subject land, targeted surveys for threatened flora were undertaken in accordance with the *NSW Guide to surveying Threatened Plants and their habitats* (DPIE 2020c). This included a comprehensive survey of all vegetation zones, using parallel line traverses separated by 10 metres and conducted on 8 August 2018. Follow-up surveys in November 2018 and April 2021 were undertaken for Netted Bottle Brush *Callistemon linearis*, Small-flower Grevillea *Grevillea parviflora* subsp. *parviflora* and Austral Toadflax *Thesium australe*.

Targeted surveys did not record any threatened flora species within the subject land or in adjoining native vegetation.

Figure 9 Candidate flora survey effort illustrates the candidate flora species survey undertaken.

Fauna habitat assessments

Due to the number and proximity of local records, the connectivity of higher quality habitat within the subject land and the potential for fauna to utilise the subject land for breeding and/or foraging, targeted fauna survey was conducted for threatened fauna species credit species identified in Table 8.

Targeted surveys were conducted in accordance with state and federal guidelines which include the BAM and Commonwealth guidelines for threatened fauna, including:

- Survey Guidelines for Australia's Threatened Birds (DEWHA 2010a).
- Survey Guidelines for Australia's Threatened Reptiles (DEWHA 2011).
- Survey Guidelines for Australia's Threatened Frogs (DEWHA 2010b).
- Spot Assessment Technique (SAT) (Phillips & Callaghan 2011).

Searches for Grey-headed Flying-fox camps were conducted in daylight hours in November 2018 following closure of arboreal and terrestrial traps, and again in April 2021. No roosting habitat was determined within the subject land for cave-roosting microbat species including: Large-eared Pied Bat, Eastern Cave Bat, Eastern Bentwing-bat and Little Bentwing-bat.

There are no hollows detected within the subject land to be cleared that are suitable for use by large forest owls based on size, location, and orientation, and they are not considered suitable for breeding based on topography. The hollow-bearing trees within the APZ portion of subject land would not be cleared under the proposal.

Table 10 outlines the fauna survey effort undertaken as part of the current assessment. Figure 10 shows targeted survey locations.

Table 10 Targeted fauna survey effort details

Survey undertaken	Survey dates	Target species	Survey effort
Diurnal bird survey and habitat assessment	20-21 August 2018 28 April 2021	Glossy-black Cockatoo Gang-gang Cockatoo Little Eagle Square-tailed Kite White-bellied Sea-eagle Barking Owl Powerful Owl Masked Owl	Bird survey of 2 hours (1 hour total for 1 person on two days in the morning). Habitat assessment including searches of the subject land for nests and mapping of suitable hollows.
Diurnal Bird Survey and search for Flying Fox camps	12-16 November 2018	Gang-gang Cockatoo	Bird survey of 4 hours (1 person for a total of one hour in the morning on four days).
Spotlighting and call-playback	13, 14, 15 November 2018	Squirrel Glider Brush-tailed Phascogale Koala Pale-headed Snake Green-thighed Frog Bush Stone-curlew Barking Owl	3.5 person hours over three nights. Playback for frogs during spotlighting in suitable locations. Playback for Koala and birds conducted during spotlighting at opportunistic locations within spotlight transect.
Anabat detectors	12-16 November	Southern Myotis Eastern Cave Bat Large-eared Pied Bat	One detector over 4nights.
Koala SAT plots	13 and 14 November	Koala	1 SAT conducted

Survey undertaken	Survey dates	Target species	Survey effort
Arboreal Trapping	12-16 November	Squirrel Glider Brush-tailed Phascogale Eastern Pygmy-possum	40 trap nights (10 traps over 4 nights).
Terrestrial Trapping	12-16 November	Common Planigale Brush-tailed Phascogale Eastern Pygmy-possum	100 trap nights (25 traps over 4nights).

Three threatened species were recorded within the subject land during targeted survey. Varied Sittella *Daphoenositta chrysoptera* was detected within Stage 3 of the project during diurnal bird survey in August. Little Bentwing-bat and Yellow-bellied Sheathtail-Bat *Saccolaimus flaviventris* were recorded in both the subject land and Stage 3 on multiple nights. There is no breeding habitat within the subject land for Little Bentwing-bat, impacts to this species include removal of foraging habitat only. These species are ecosystem credit species for habitat within the subject land and impacts to their habitat will be offset via ecosystem credits. A further two threatened fauna species, Masked Owl and Brush-tailed Phascogale were recorded outside the subject land but within the broader project locality, in well-connected vegetation containing the same habitat features as the subject land.

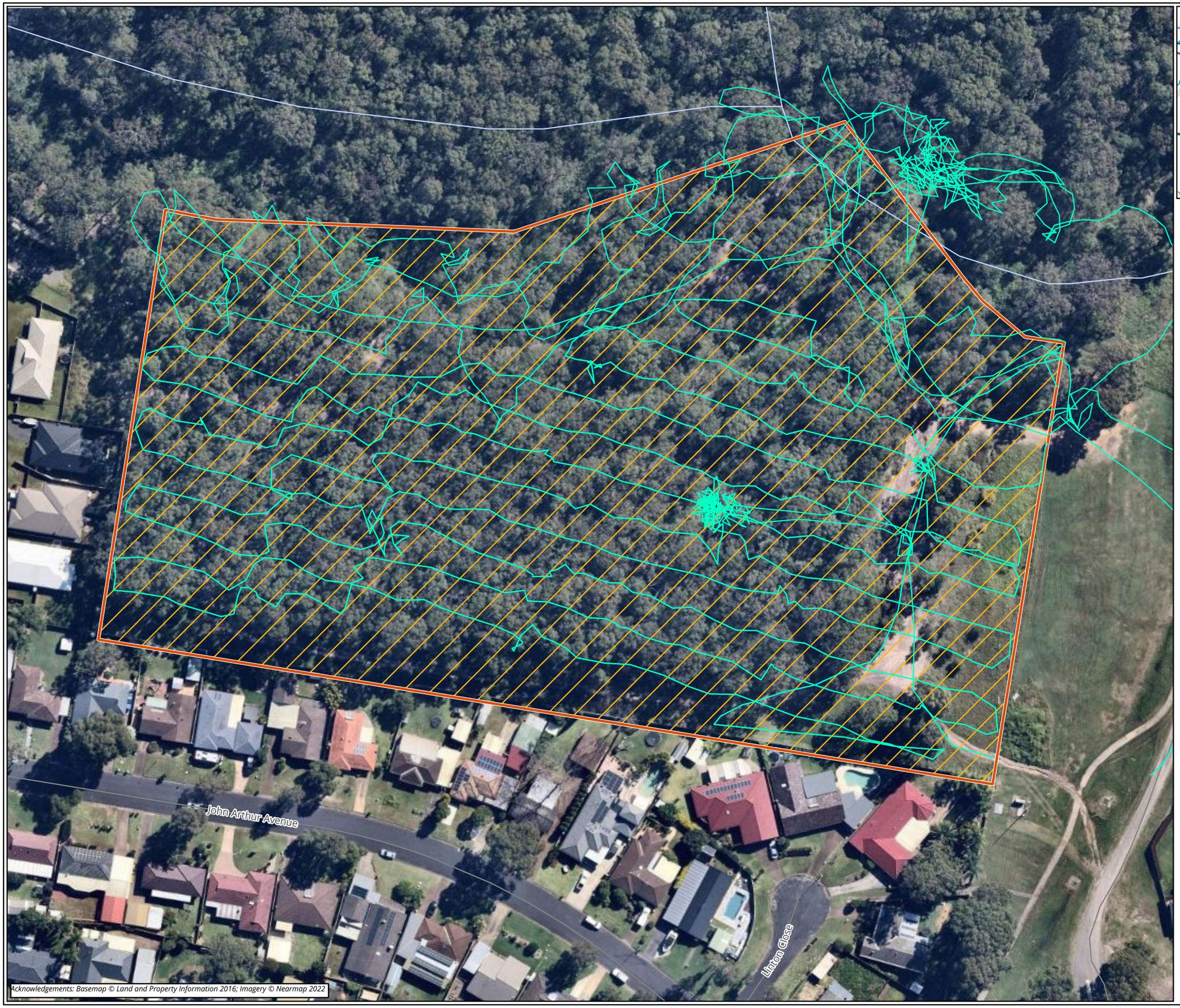
A Masked Owl call was heard in response to Bush Stone-curlew call playback, the owl was then spotted flying over the subject land during subsequent call playback of this species call. The subject land to be cleared is considered to be foraging habitat only for this species as no suitable hollows were detected during previous or current survey of the subject land and the topography of the site is not suitable for Masked Owl breeding habitat. This species is a dual credit species and foraging habitat will be offset through via ecosystem credits. No suitable hollow-bearing trees occur within the subject land are to be cleared for nesting by Masked Owl and it is not considered suitable breeding habitat and therefore no species credits are required.

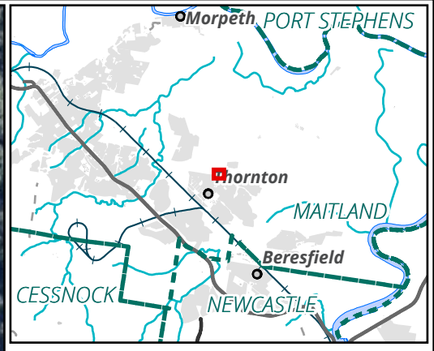
Brush-tailed Phascogale was recorded in vegetation adjacent to the subject land following spotlighting survey. Habitat values within the subject land are consistent with those observed in the broader project area and Brush-tailed Phascogale are considered to utilise the entire vegetation patch for foraging and breeding. This species is a species credit species and as such impacts to its habitat will require the retirement of species credits (further detailed in Section 8).

Potential suitable hollows for nesting by Glossy-black Cockatoo were observed within the subject land, however these hollows were in use by Sulphur-crested Cockatoos during bird surveys. Suitable hollows within the subject land may also provide breeding habitat for Gang-Gang Cockatoo. Bird survey conducted during the species breeding season (August and November) did not detect this species.

Large-eared Pied Bat and Eastern Cave Bat were retained as candidate species as a precautionary approach given the wider areas known history of mining and potential for old mine workings to provide habitat for these species. Anabat survey recorded one *Vespadelus* species, Little Forest Bat *Vespadelus vulturnus*, calls attributed to this species were identified with a high level confidence. One poor quality suspected Vespadelus call was not identified to the species level as the call duration was short and the call quality was impacted by the Doppler Effect, shifting the length of each pulse.

Surveys were considered sufficient to determine the presence Eastern Cave Bat and Large-eared Pied Bat given that no calls for these species were recorded, the surrounding locality does not provide areas of significant geological formations (caves, cliffs, karst systems, rocky outcrops with overhangs) and that previous records are from greater than two kilometres from the subject land and occur in conjunction with quarries/ mined areas (indicated by species record notes). In addition no breeding habitat for these species will be impacted and impacts are considered unlikely.





Legend

- Subject land
- Development footprint
- Flora targeted survey

Figure 9 Flora survey effort

0 10 20 30 40

Metres

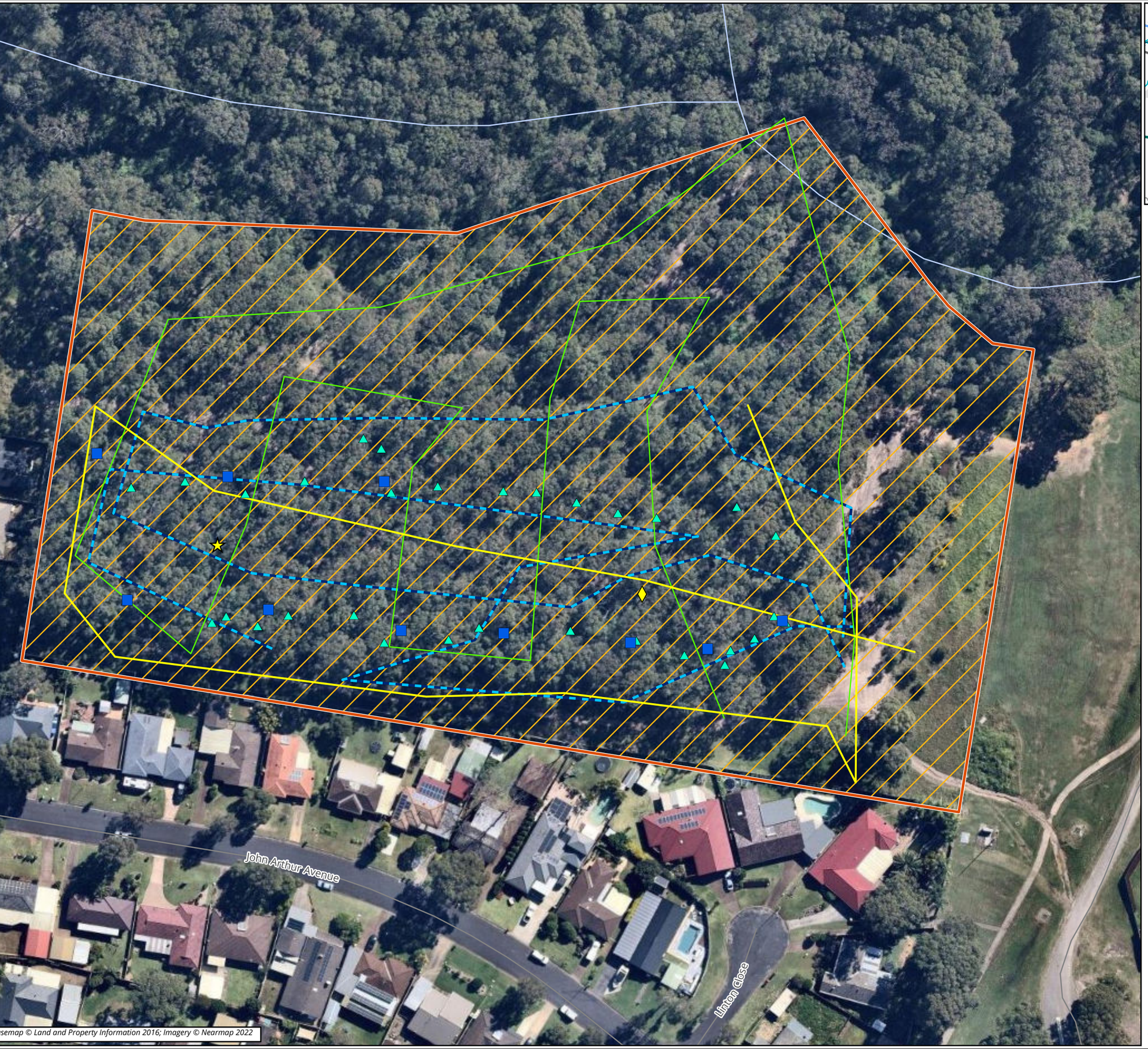
N

Scale: 1:1,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 37183, Date: 22 April 2022,
Drawn by: JB, Checked by: BT, Last edited by: jbeckius
Layout: 37183_F9_FloraSurvey
Project: P:\37100s\37183\Mapping\37183_Thornton_BDAR_Updates\37183_Thornton_BDAR_Updates.aprx



Legend

- Subject land
- Development footprint
- Spotlight
- Bird survey 1
- Bird survey 4
- Elliot A
- Elliot B
- SAT survey
- Anabat

Figure 10 Fauna survey effort

0 10 20 30 40

Metres

N

Scale: 1:1,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 37183, Date: 21 April 2022,
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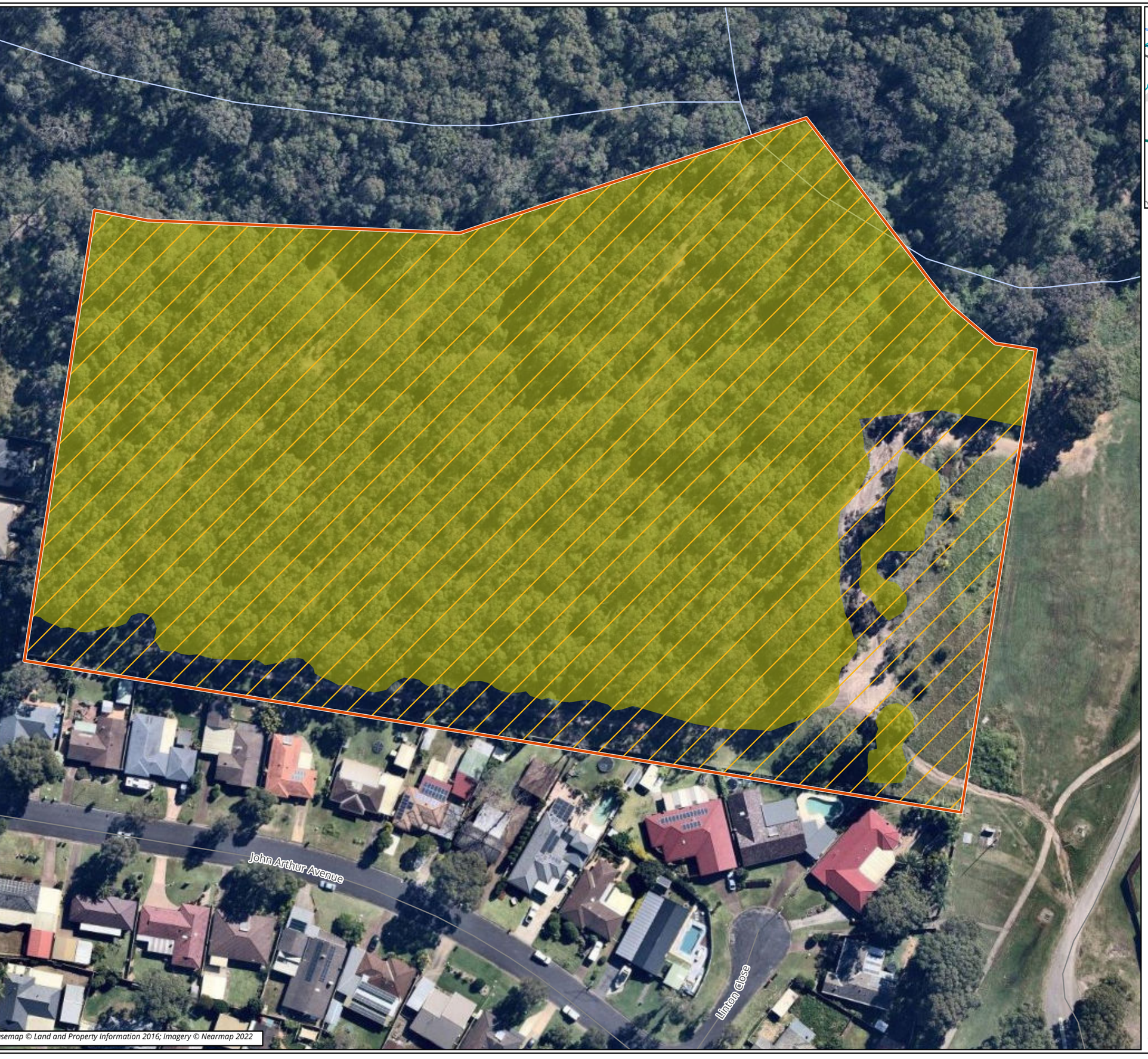
Project: P:\37100s\37183\Mapping\37183_Thornton_BDAR_Updates\37183_Thornton_BDAR_Updates.aprx

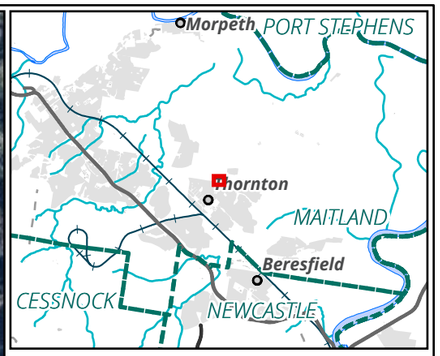
4.2.2 Threatened species summary and polygons

Table 11 provides details of threatened species impacted by the project and outlines the attributes that comprise the threatened species polygons. The presence of threatened species impacted by the project is illustrated on Figure 11. As Masked Owl, Little Bentwing-bat and Yellow-bellied Bent-wing Bat are only considered to be present for foraging (ecosystem credits), species polygons are not prepared for these species.

Table 11 Threatened species polygons within the development footprint and impact assessment area

Threatened species	Impact (ha / No. indiv.)	Unit of measure	Biodiversity risk weighting	Polygon attributes
Brush-tailed Phascogale ***Phascogale tapoatafa***	3.01 ha	Area	2	All of vegetation zones 1 and 2.





Legend

- Subject land
- Development footprint

Threatened species polygon

- Brush-tailed Phascogale

Figure 11 Threatened species polygon

0 10 20 30 40 Metres

N

Scale: 1:1,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 37183, Date: 21 April 2022,
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Layout: 37183_F11_ThreatenedSpcs
Project: P:\37100s\37183\Mapping\37183_Thornton_BDAR_Updates\37183_Thornton_BDAR_Updates.aprx

Stage 2 – Impact assessment (biodiversity values)

5 Avoid and minimise impacts

5.1 Actions to avoid/minimise project impacts

The principal means to reduce impacts on biodiversity values within the broader project area are to avoid and minimise removal of native vegetation and associated habitat for threatened species. Additionally measures to minimise and mitigate indirect and off-site or downstream impacts during construction and operation of the proposal have also been identified.

Figure 12 shows the final development footprint. The final proposal footprint (including construction and operation) as well as indirect impact zones where applicable is shown in Figure 13.

Site selection and planning

The footprint of the subject land has been selected, in part, to minimise impacts to native vegetation and flora and fauna habitats present within the broader area (vegetation to the north of the subject land). The Stage 2 subject land was selected in accordance with local planning of Thornton (Thornton North Master Plan) and selection of the subject land for development has been considered to avoid impacts to biodiversity where possible whilst providing residential housing for the Thornton locality.

The BioBanking Assessment Statement undertaken by Parsons Brinckerhoff (2016) identified biodiversity constraints to development across the entirety of 530 Raymond Terrace Road and adjacent Lot 131 DP 1223790 to the west. Biodiversity values identified during the assessment included:

- A substantial area of native vegetation zoned as E3 – Environmental Management north of the subject land extending to Stage 1 of the project.
- Riparian vegetation and fauna corridors within the E3 zone.
- Vegetation consistent with the Hunter Lowlands Redgum Forest EEC within the E3 zone, north of the subject land.
- Vegetation consistent with Lower Hunter Spotted Gum Ironbark Forest EEC within the subject land, and to the west.

The biodiversity constraints identified during the BioBanking Assessment Statement (Parsons Brinckerhoff 2016) were considered in the subsequent concept design and final project design. Key design elements were altered in the early design phase to reduce direct impacts to EEC vegetation and focus impacts of the project within areas containing non-native vegetation and more heavily disturbed native vegetation.

The subject land is located such that direct impacts to better condition Hunter Lowland Redgum Forest EEC (within the E3 zone) are avoided and the east /west fauna and riparian corridor is maintained. Moreover, indirect impacts to better condition remnant vegetation adjoining the subject land are able to be minimised through careful management of APZ areas which will provide a manageable 'buffer' separating the EEC vegetation from the operational infrastructure.

By incorporating biodiversity constraints in to the early design phase, the proposed development of the subject land has been able to restrict direct impacts to:

- Removal of 0.56 hectares of previously disturbed land and exotic vegetation.
- Removal of 3.0 hectares of Lower Hunter Spotted Gum Ironbark Forest EEC and Brush-tailed Phascogale habitat.

- Removal of 0.1 hectares of Hunter Lowland Redgum Forest EEC.
- Removal of 9 hollow-bearing trees within the subject land (retention of 7 hollow-bearing trees). Hollow-bearing trees in the APZ are to be identified and marked prior to construction to be retained.

A range of practical measures to mitigate and manage potential direct and indirect impacts to biodiversity values during the construction and operational phases of the proposal are described in detail in the following report sections.

Construction

Direct and indirect impacts to biodiversity values retained within the subject land (e.g. winter flowering mature eucalypts and other canopy trees) and adjoining the subject land may occur if adequate mitigation and management measures are not in place during construction of the proposal.

The following mitigation and management measures are to be implemented in order to mitigate and manage potential direct and indirect impacts during construction:

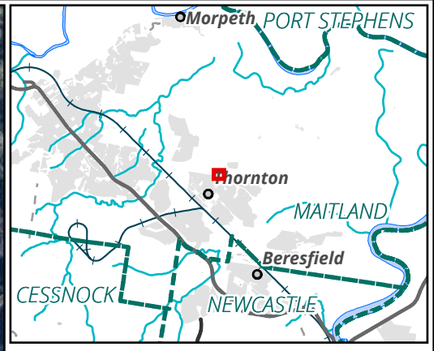
- Prior to construction, a Construction Environmental Management Plan (CEMP) is to be developed which includes standard measures, including:
  - Installation of appropriate exclusion fencing to the boundary of the retained vegetation and any construction areas where there is some potential for accidental encroachment. This will include appropriate signage such as 'No Go Zone' or 'Environmental Protection Area'. Identification of any 'No Go Zones' in site inductions for all construction personnel.
  - All site perimeter fencing is to be of a design that excludes terrestrial fauna, so as to minimise the risk of Koala ingress to the construction site.
  - Internal fencing / barricades are to be used to establish tree protection zones (TPZs) around retained native trees in accordance with the Standards Australia Committee (2009).
  - All material stockpiles, vehicle parking and machinery storage should be located within the areas proposed for clearing, and not in areas of native vegetation that are to be retained.
  - Sedimentation and erosion control measures including silt fencing, sediment traps, etc. to prevent sediment-laden stormwater exiting the construction areas and to prevent scouring and erosion of land beyond the development footprint. All erosion and sediment control measures are to be constructed and installed in accordance with relevant guidelines, are to be regularly maintained for the duration of the construction period and are to be carefully removed at completion of works.
  - Sediment and erosion control measures should follow recommendations of The Blue Book – Managing Urban Stormwater: Soils and Construction (Landcom 2004).
  - Dust suppression measures to ensure dust deposition beyond the construction area is minimised.
  - Weed and pathogen management including weed hygiene protocols for personnel, machinery and construction materials entering and exiting construction areas to minimise risk of weed and pathogen introduction and spread.
  - Waste management is to ensure food scraps and other organic waste that may attract introduced predators (e.g. fox, cats) or other pests (e.g. rats) is not stored for prolonged periods within the construction site.

- Development of a Biodiversity Management Plan (BMP) for inclusion in the Construction Environmental Management Plan. The BMP will outline measures for staged vegetation clearing to manage fauna species during tree removal, including having a spotter / catcher present. Staged removal involves clearing of understorey vegetation and non-hollow-bearing trees (Phase 1), with removal of hollow-bearing trees supervised by an ecologist 24-48 hours after (Phase two).
- The BMP will detail procedures for dealing with trapped or injured wildlife during the construction period with particular focus on rescue and care of native fauna.

- As far as practicable, all construction activities are to undertaken during daylight hours to minimise noise impacts on fauna utilising adjacent habitats.
- Selection and retention of suitable logs (>10 centimetres diameter only) and hollows for placement within retained native vegetation adjoining the subject land.
- Where appropriate native vegetation cleared from the subject land should be mulched for re-use on the site to stabilise bare ground.
- Security lighting within the construction site is to be minimised and where required, is to be oriented such that light spill beyond the subject land and in to patches of retained vegetation is minimised.
- Installation of nest boxes prior to commencement of vegetation clearing for construction to allow time for microbats and other hollow-dependent fauna to encounter these new resources prior to removal of existing hollows within trees to be removed.

Operation

- Stormwater generated from roof, hardstand and landscaped areas associated with the development is to be detained and treated on-site such that any discharge to the associated retained native vegetation within the subject land is not of substantially different volume relative to the pre-development regime.
- All perimeter fencing and some internal fencing (e.g. between retained canopy trees) is to be of a 'fauna-friendly' design which minimises potential impacts to flying and gliding arboreal mammals (e.g. sugar gliders) which may utilise retained trees within the subject land. Any residential properties adjoining the retained vegetation should also be fenced.
- Landscaping of the subdivision is to use locally native species where practicable to limit the potential spread of weeds in to adjoining retained native vegetation and maximise the foraging resources available for highly mobile species.
- Speed limits on residential roads and speed-limiting measures should be implemented to reduce potential vehicle-strikes on crossing fauna. Fauna crossing signs should be included in road design and information regarding sensitive fauna provided to future residents.
- Properties adjacent to retained vegetation should avoid use of outdoor lights facing the retained vegetation and have a light-blocking or screening barrier to prevent light disturbance to fauna.
- Biosis recommends the new subdivision be maintained as a cat free subdivision, to prevent negative interactions towards fauna, including Brush-tailed Phascogale. Responsible ownership of cats should also be highlighted to residents. And residents should be educated on the presence of the threatened marsupial within the locality.



Legend

- Subject land
- Development footprint
- Proposed development
- Hollow-bearing tree

BC Act and EPBC Act TECs

- Lower Hunter Spotted Gum Ironbark Forest
- Hunter Lowland Red Gum Forest

Vegetation zone

- VZ1_PCT 1592_Moderate
- VZ2_PCT 1598_Moderate

Figure 12 Final development footprint

0 10 20 30 40

Metres

N

Scale: 1:1,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 37183, Date: 22 April 2022,
Drawn by: JB, Checked by: BT, Last edited by: jbeckius
Layout: 37183_F12_FDF
Project: P:\37100s\37183\Mapping\37183_Thornton_BDAR_Updates\37183_Thornton_BDAR_Updates.aprx

Acknowledgements: Basemap © Land and Property Information 2016; Imagery © Nearmap 2022; Proposed development supplied from Land Link Property 2022

6 Impacts that are unable to be avoided

Assessment of direct and indirect impacts unable to be avoided has been undertaken in accordance with the BAM (DPIE 2020b). The following direct and indirect impacts are unable to be avoided in progressing the proposal.

6.1 Direct impacts

Direct impacts arising from Stage 2 of the project include:

- Removal of 3.0 hectares of moderate condition PCT 1592 *Spotted Gum – Red Ironbark – Grey Gum Shrub – Grass Open Forest of the Lower Hunter* consistent with *Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion* EEC listed under the BC Act.
- Removal of 0.1 hectares of moderate condition PCT 1598 *Forest Red Gum grassy open forest on floodplains of the lower Hunter* consistent with Hunter Lowland Redgum Forest EEC listed under the BC Act.
- Removal of a total of 3.1 hectares of native vegetation providing limited foraging resources for threatened fauna.
- Removal of 9 hollow-bearing trees providing potential nesting for Brush-tail Phascogale, and/or roosting for microbats.

These impacts will be permanent, will occur from the outset of the development and represent the result of efforts to avoid and minimise impacts at the project design phase. Mitigation measures outlined in Section 5.1 above will help to minimise the potential impacts to biodiversity values that remain present within the subject land.

A summary of PCTs/zones directly impacted is demonstrated in Table 12. A summary of the direct impacts to species credit habitat or individuals is demonstrated in Table 13.

Table 12 Summary of direct impacts to vegetation

Zone	PCT	TEC	Area within subject land (ha)	Area impacted (ha)	VI Score
VZ1	PCT 1592 *Spotted Gum – Red Ironbark – Grey Gum Shrub – Grass Open Forest of the Lower Hunter*	Lower Hunter Spotted Gum Ironbark Forest EEC	3.0	3.0	44.2
VZ2	PCT 1598 *Forest Red Gum grassy open forest on floodplains of the lower Hunter*	Hunter Lowlands Redgum Forest EEC	0.1	0.1	67.9

Table 13 Summary of direct impacts species credit habitat or individuals

Species	Sensitivity	Area (ha) or count
Brush-tailed Phascogale ***Phascogale tapoatafa***	High Sensitivity to Potential Gain	3.01 ha

6.1.1 Loss of hollow bearing trees

The proposal would remove nine hollow-bearing trees. These hollows are suitable for smaller hollow-dependent species such as Brush-tailed Phascogale, woodland birds and microbats.

6.2 Indirect impacts

Potential indirect impacts arising from the project are outlined and addressed in Table 14.

Table 14 Avoidance and minimisation of impact

Indirect impact	Assessment / likelihood of occurrence
Inadvertent impacts on adjacent habitat or vegetation.	The vegetation within the subject land is currently disturbed through community use of the area having created walking/bike tracks. Current disturbance includes domestic pets, walkers, motor-bike and pushbike riders and wood collection, though community use proposed development is unlikely to result in inadvertent impacts on adjacent retained habitat or vegetation. Mitigation measures should be implemented during the construction and operations phases of the project to ensure no encroachment to adjacent vegetation and habitat by construction workers or the public during the operation of the project.
Reduced viability of adjacent habitat due to edge effects.	The proposal will not result in a significant increase in edge effects impacting upon the retained vegetation. The majority of the subject land has been historically disturbed and as such edge effects have been an ongoing impact to the vegetation that is to be retained (E3 zone). The proposal will increase edge effects to a small portion of vegetation present on private land to the north-west of the subject land. This vegetation will remain connected to other areas of vegetation and as such any increased edge effects are expected to result in negligible impacts.
Reduced viability of adjacent habitat due to noise, dust or light spill.	Mitigation measures outlined above and standard construction environmental controls will ensure potential impacts are minimised. Light spill from the adjacent residencies currently occurs within the subject land. Outdoor lighting of future houses may increase this impact on the vegetation within the EE area.
Transport of weeds and pathogens from the site to adjacent vegetation.	The potential introduction and spread of weeds and pathogens will be managed through implementation of weed hygiene controls as part of a CEMP during construction.
Increased risk of starvation, exposure and loss of shade or shelter.	The proposal is positioned adjacent to existing development to the south and east. The vegetation to the west and north will continue to provide habitat for fauna. Retention of E3 area will provide a movement corridor and some habitat

Indirect impact	Assessment / likelihood of occurrence
	retained for fauna. The proposal will result in reduction of shelter sites for hollow-dependent fauna. Given the small scale of the project it is unlikely to increase the risk of starvation, exposure and loss of shade or shelter such a significant impact would result.
Loss of breeding habitats.	The proposal will remove up to nine hollow-bearing trees and retain seven hollow-bearing trees within the APZ. These trees have been assessed as likely to be suitable for use by Brush-tailed Phascogale and some other threatened species. At least four hollow-bearing trees were recorded along the northern boundary of the subject land within the E3 area. The loss of nine trees is not considered substantial when considered at the scale of the home ranges for the species likely to utilize them as habitat.
Trampling of threatened flora species.	No threatened flora species were recorded within the subject land.
Inhibition of nitrogen fixation and increased soil salinity.	The proposal will not result in the removal of a substantial area of native vegetation, there is also large patches of vegetation, both within and adjacent to the subject land, that will not be impacted. As such it is not considered likely that nitrogen fixation or soil salinity will be impacted such that adjacent habitat will be negatively affected.
Fertiliser drift.	Fertilisers and herbicides are unlikely to be used during the operational phase to manage landscaped and other open space areas within the proposed subdivision.
Rubbish dumping.	The CEMP will clearly set out waste management areas and procedures during construction of the subdivision. Potential rubbish dumping within the retained vegetation following completion of the project may occur but is unlikely to significantly increase given the current access available to the general public.
Wood collection.	The heightened security during the construction and operation of the subdivision is likely to deter wood collection activities. Potential wood collection within the retained vegetation following completion of the project may occur but is unlikely to significantly increase given the current access available to the general public. Fencing of the residential blocks adjacent to the E3 zone may mitigate potential wood collection.
Increase in predatory species populations.	Predatory species populations are unlikely to increase from the removal of current potential foraging habitat, construction activity or resulting land use. Waste management measures implemented as part of the CEMP and during operation of the subdivision (refer Section 5.1) will also mitigate the potential increase in predator species populations.
Increase in pest animal populations.	Rabbits were noted as a pest species within the subject land, it is unknown whether this species is currently being controlled within the area however the proposal is unlikely to result in an increase in the rabbit population on site given it will reduce the extent of potential forage and shelter habitat available.
Change in fire regime of native	The construction and operation of the subdivision is unlikely to lead to a

Indirect impact	Assessment / likelihood of occurrence
vegetation and associated habitats	substantial change in the fire regime of adjacent vegetation and habitats. APZs will largely be provided by the proposed road and detention basin along the northern boundary of the subject land.
Disturbance to specialist breeding and foraging habitat.	No specialist breeding or foraging habitat are considered to occur within the subject land. Foraging habitat exists within the subject land for Masked Owl, foraging and breeding habitat exists for Brush-tailed Phascogale. Larger areas of potential foraging habitat occur outside of the subject land to the west and north.
Fragmentation of movement corridors.	Vegetation within the subject land is considered to provide a fragmented movement corridor, the vegetation is located at the terminal edge of this movement corridor with residential dwellings and an oval located to the east and south. Retention of the E3 zoned vegetation will maintain a movement corridor through the landscape. Given the position of the subject land and width of the retained corridor the proposal is not expected to decrease the overall corridor functionality such that it would significantly impact dispersal through the landscape.
Cumulative impacts	This BDAR has been prepared for Stage 2 of the project, whereby Stage 1 and 3 have already been approved and works commenced. There may be cumulative impacts related to clearance of vegetation, loss of hollow-bearing trees, and increased competition for remaining resources across the three stages as well as resulting from development within the locality. Retention of the E3 zoned vegetation will maintain a movement corridor through the landscape.

6.3 Prescribed impacts

Assessment of prescribed biodiversity impacts are outlined and addressed in Table 15 below.

Table 15 Assessment of prescribed impacts

Prescribed impact	Assessment / likelihood of occurrence
Karst, caves, crevices, cliffs, rocks and other geological features of significance	No karst, caves, crevices, cliffs and other features of geological significance will be impacted by the proposed works and no threatened species associated with these features were recorded during the assessment. No bush rock will be impacted by the proposed works and no threatened species associated with this habitat feature were recorded during the assessment.
Occurrences of human-made structures and non-native vegetation	No human made structures will be impacted by the proposed works and no threatened species associated with this habitat feature were recorded during the assessment. A total of 0.56 hectares of disturbed area/exotic vegetation will be removed as a result of the proposal. This non-native vegetation within the subject land and broader area is not associated with habitat of any threatened species known or likely to occur in the locality. It is possible some highly mobile threatened species including threatened raptors and large forest owls forage in areas of non-native vegetation from time to time however similar habitat is extensive in the locality and subregion. The loss of this non-native vegetation is expected to result in negligible impact to threatened species.
Corridors or other areas of connectivity linking habitat for threatened entities	As outlined in Figure 4 an existing movement corridor provides connectivity of habitats occurring within the subject land. The direct impacts to this movement corridor are restricted to the removal of 3.0 hectares of PCT 1592 vegetation and 0.1 hectares of PCT 1598 vegetation. Such an impact is considered low when considered at the locality scale and at the bioregional scale. The proposal would not sever the connectivity present in the broader locality and as such, impacts to species using the corridor is considered low. The proposal is not considered to impact on the movement of threatened species that maintains their survival. Species considered likely to utilise the subject land are highly mobile and connectivity will be maintained within remnant vegetation at the E3 riparian zone. The construction and operation of the proposal is not expected to substantially alter the groundwater or surface hydrology that sustains threatened species and threatened ecological communities.
Water bodies or any hydrological processes that sustain threatened entities	The construction and operation of the proposal is not expected to substantially alter the groundwater or surface hydrology that sustains threatened species and threatened ecological communities.
Where the proposed development may result in vehicle strike on threatened fauna or on animals that are part of a threatened ecological community	Within the subject land there will be an increase in vehicular traffic through the development of residential streets. Threatened fauna species recorded within the subject land include birds and bats which may continue to forage within retained vegetation but are unlikely to collide with vehicles. Brush-

Prescribed impact	Assessment / likelihood of occurrence
	tailed Phascogale may occasionally cross roads to remnant or planted vegetation and residential areas. Traffic slowing measures should be implemented to reduce the risk of vehicle strike in combination with awareness such as fauna crossing signs and information provided to future residents.

6.4 Impacts considered uncertain

The proposal will have only minor direct impacts to biodiversity in the locality and may have some indirect impacts to adjacent habitats. The severity and consequence of direct and indirect impacts are sufficiently well understood that a detailed adaptive management strategy which includes measures to monitor impacts, is not considered necessary. The CEMP will include actions to monitor, assess and adaptively manage the effectiveness of planned mitigation measures.

7 Impact summary

7.1 TECs and threatened species

This section outlines the impact summary for the project which has identified and assessed impacts on TECs and threatened species that are at risk of a SAII including:

- Addressing all criteria for each TEC listed as at risk of an SAII present on the subject land.
- Addressing all criteria for each threatened species at risk of an SAII present on the subject land.
- Documenting all sources of data, information, references used or consulted.
- Identification of impacts requiring offset.
- Identification of impacts not requiring offset.
- Identification of areas not requiring offset.

Figure 14 shows the location of impacts requiring offset, impacts not requiring offset and areas not requiring assessment.

7.2 Serious and irreversible impacts

In accordance with Clause 6.7 of the BC Regulation an impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because:

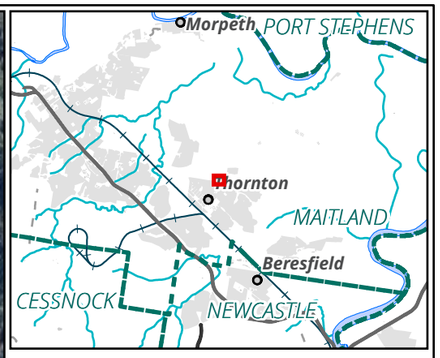
a) *Principle 1: It will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline.*

b) *Principle 2: It will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size.*

c) *Principle 3: It is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution.*

d) *Principle 4: The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.*

No threatened entities considered to meet the above principles may be impacted by the proposal, threefold, SAII assessment has not been undertaken.



Legend

- Subject land
- Development footprint
- Indirect impact

Figure 13 Estimated zones of indirect impact for the proposal

0 10 20 30 40 N

Metres

Scale: 1:1,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 37183, Date: 22 April 2022,
Drawn by: JB, Checked by: BT, Last edited by: jbeckius
Layout: 37183_F13_IndirectImpact
Project: P:\37100s\37183\Mapping\37183_Thornton_BDAR_Updates\37183_Thornton_BDAR_Updates.aprx

7.3 Identification of impacts requiring offset

7.3.1 Impacts to native vegetation (ecosystem credits)

As outlined in Section 9.2.1 of the BAM, the assessor must determine an offset for all impacts of proposals on PCTs that are associated with a vegetation zone that has a vegetation integrity score of:

a) ≥15, where the PCT is representative of an EEC or a CEEC.

b) ≥17, where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or represents a vulnerable ecological community.

c) ≥20, where the PCT does not represent a TEC and is not associated with threatened species habitat.

On this basis, offsets are required for both vegetation zones.

The offset requirement for the proposal was calculated using the BAM Calculator. Table 16 provides a summary of the ecosystem credit offsets required for impacts from proposed development at the subject land.

Table 16 Offsets required (ecosystem credits)

Vegetation zone	Area (ha)	Impact	VI score	Offset required	TEC	HBTs	Credit requirement
PCT 1592_Moderate	3.0	Clearance	40.8	Yes	Yes	Yes	66
PCT 1598_Moderate	0.1	Clearance	67.9	Yes	Yes	Yes	4

7.3.2 Impacts to threatened species and their habitat

As outlined in Section 9.2.2 of the BAM an offset is also required for the impacts of the proposals on the habitat of threatened species assessed for ecosystem credits and associated with a PCT in a vegetation zone with a vegetation integrity score of ≥17.

The offset requirement for the proposal was calculated using the BAM Calculator. Table 17 provides a summary of the species credit offsets required for impacts from proposed development at the subject land.

Table 17 Offsets required (species credits)

Vegetation zone	Species	Habitat condition (vegetation integrity score) loss	Area (ha)	Biodiversity risk weighting	Credit requirement
PCT 1592_Moderate	Brush-tailed Phascogale	-44.2	3.0	2	66
PCT 1598_Moderate	Brush-tailed Phascogale	-67.9	0.1	22	4

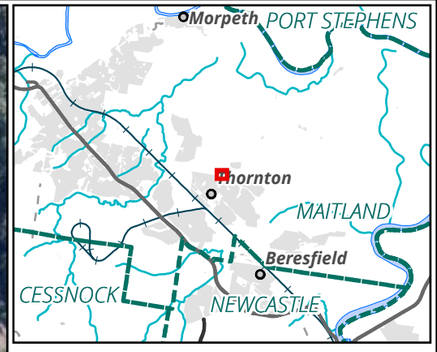
The species polygon for Brush-tailed Phascogale is illustrated in Figure 14 below.

7.4 Identification of impacts not requiring offset

As detailed in Section 7.3, all native vegetation proposed to be removed requires offset for ecosystem credits and species credits (Brush-tailed Phascogale).

7.5 Identification of areas not requiring assessment

All areas not mapped as native vegetation within the subject land does not require further assessment as they are not considered habitat for threatened species. These areas are illustrated on Figure 14.



Legend

- Subject land
- Development footprint
- HyrdoLine (Biosis 2018)
- HydroLine (LPI 2016)

Impacts requiring offset

- PCT 1592, 1598
- Brush-tailed Phascogale

Impacts not requiring assessment

- Urban Native/Exotic

Figure 14 Impacts requiring offset or not requiring assessment

0 10 20 30 40 N

Metres

Scale: 1:1,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 37183, Date: 22 April 2022,
Drawn by: JB, Checked by: BT, Last edited by: jbeckius
Layout: 37183_F14_Offset
Project: P:\37100s\37183\Mapping\37183_Thornton_BDAR_Updates\37183_Thornton_BDAR_Updates.aprx

8 Biodiversity credit report

Offsetting through the transfer and retirement of biodiversity credits, or paying into the BCT Offset Fund, is required for the current assessment for impacts to two vegetation zones at the subject land. A biodiversity credit report are provided on the following pages.

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00011844/BAAS17067/18/00011845	530 Raymond Terrace Road Thornton Stage 2	24/11/2021
Assessor Name	Report Created	BAM Data version *
Alejandro Barreto	06/06/2022	50
Assessor Number	BAM Case Status	Date Finalised
BAAS18057	Finalised	06/06/2022
Assessment Revision	Assessment Type	BOS entry trigger
3	Part 4 Developments (General)	BOS Threshold: Area clearing threshold

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

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

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Forest Red Gum grassy open forest on floodplains of the lower Hunter											
2	1598_Moderate	Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	67.9	67.9	0.11	PCT Cleared - 0%	High Sensitivity to Potential Gain	Endangered Ecological Community	Not Listed	2.00	4
										Subtotal	**4**
Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter											
1	1592_Moderate	Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions	44.2	44.2	3	PCT Cleared - 44%	High Sensitivity to Potential Gain	Endangered Ecological Community		2.00	66
										Subtotal	**66**
										Total	**70**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits

Phascogale tapoatafa / Brush-tailed Phascogale (Fauna)									
1592_Moderate	44.2	44.2	3			Vulnerable	Not Listed	False	66
1598_Moderate	67.9	67.9	0.11			Vulnerable	Not Listed	False	4
								Subtotal	**70**

9 Assessment against biodiversity legislation and policies

9.1 Environment Protection and Biodiversity Conservation Act 1999

An assessment of the impacts of the proposal on MNES, against heads of consideration outlined in Commonwealth of Australia (2013) was prepared to determine whether referral of the project to the Commonwealth Minister for the Environment is required.

Three EPBC Act listed species were considered to potentially occur within the subject land on occasion, these included Grey-headed Flying-fox, Koala and Large-eared Pied Bat. The presence of a low number of secondary feed tree species, being Grey-box *Eucalyptus moluccana* as listed in the Approval Recovery Plan for the Koala (DECC 2008) is considered unlikely to provide substantial habitat for the Koala such that it would support a population or individual for more than a short period of time. Secondary feed trees may provide habitat on occasion during dispersal.

Assessment of the subject land was undertaken in accordance with the Department of the Environment *EPBC Act referral guidelines for the vulnerable Koala* (DoE 2014) using the Koala habitat assessment tool provided in Table 4 of the referral guidelines document. Habitat is considered to be critical to the survival of the koala is the area scores a five or more in accordance with this tool. The results of this assessment are provided in Table 18 below.

Table 18 Koala habitat assessment tool criteria

Attribute	Coastal	Score
Koala Occurrence	No signs of Koala activity were recorded during the assessment, there are no previous records in the OEH BioNet Atlas of Koala within the subject land in the last two years or within 2 km of the edge of the impact area within the last 10 years.	0
Vegetation composition	Has forest or woodland with one known Koala food tree species	1
Habitat connectivity	The area is part of contiguous landscape > 500 hectares. No major landscape features, infrastructure or clearing prevents movement. One single carriageway highway may prevent movement to a degree in the south but is not considered a substantial barrier.	2
Key existing threats	The area scores 0 for Koala occurrence and is likely to have some degree of dog or vehicle threat present	1
Recovery value	Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1 of the referral guidelines.	0
Total score		4

Targeted survey was undertaken for Grey-headed Flying-fox, Koala and Large-eared Pied Bat including spotlighting, call playback, Anabat detectors and Spot Assessment Technique (SAT) (Phillips & Callaghan 2011) surveys as outlined in section 4.2.1. These species were not recorded during targeted survey of the subject land. The subject land occurs at the edge of previously cleared land and is not considered to provide important habitat corridor. Removal of 3.01 hectares of potential foraging habitat is therefore considered unlikely to impact to these mobile species.

Other MNES relevant to the project are summarised in Table 19.

Table 19 Assessment of the project against the EPBC Act

Matter of NES	Project specifics	Potential for significant impact
Threatened species	A total of 6 threatened flora and 20 threatened fauna species have been recorded or are predicted to occur in the locality (5 kilometre radius). The proposal will remove 7.01 hectares of fauna habitat, targeted survey did not detect any EPBC Act listed threatened species and therefore no impacts to Commonwealth listed threatened species are expected to result from the project.	No impact is expected to any EPBC listed species.
Threatened ecological communities	No TECs listed under the EPBC Act, *River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria*, was mapped in the subject land.	Significant impact unlikely to result from the proposal primarily because removal proposed of this TEC is 0.1 ha. This assessment can be found in Appendix 4.
Migratory species	A total of 34 migratory bird species have been recorded or are predicted to occur in the locality. The subject land does not provide important habitat for any of these species.	Significant impact unlikely to result from the proposal.
Wetlands of international importance (Ramsar sites)	The subject land does not flow directly into a Ramsar site (OEH 2017b) and the development is not likely to result in a significant impact.	The proposal will not result in changes to the ecological character of any Ramsar site.

On this basis, the MNES listed under EPBC Act are not considered to be subject to significant impacts and referral of the proposal to the Commonwealth Minister for the Environment will not be required.

9.2 Fisheries Management Act 1994

Database searches of a 5 kilometre radius surrounding the subject land did not return any records of FM Act or EPBC Act listed threatened fish or other aquatic species, and none are considered likely to occur within the subject land given the limited and mostly disturbed nature of aquatic habitats available.

The proposal is unlikely to significantly impact any threatened species, populations or ecological communities listed under the FM Act.

9.3 Water Management Act 2000

The WM Act provides for the sustainable and integrated management of the state's water for the benefit of both present and future generations based on the concept of ecologically sustainable development. Under the WM Act an approval is required to undertake controlled activities on waterfront land, unless that activity is otherwise exempt under Section 91E of the Act. Waterfront land is defined within the Act as the bed of any river, lake or estuary and any land within 40 meters of the river banks, lake shore or estuary mean high water mark. No waterways traverse the subject land. However, given the proximity of the subject land to the waterway within the retained riparian vegetation (Figure 5), consultation with the Natural Resource Access Regulator (NRAR) regarding the requirement for a Controlled Activity Approval (NRAR 2018) is recommended.

9.4 Environmental Planning and Assessment Act 1979

9.4.1 Maitland Local Environmental Plan (2011)

The project has minimised impacts to native vegetation and flora and fauna habitats and is therefore consistent with the related environmental (biodiversity) objectives of General Residential (R1) zoning in the Maitland LEP (2011). The proposed activities are listed as Permitted with Consent.

9.4.2 SEPP Coastal Management 2018

Coastal Management SEPP aims to promote a co-ordinated approach to land use planning in the coastal zone of NSW in a manner consistent with the objects of the *Coastal Management Act 2016* (CM Act). The SEPP has replaced the now repealed:

- SEPP No. 14 Coastal Wetlands.
- SEPP No. 26 Littoral Rainforests.
- SEPP No. 71 Coastal Protection.

The subject land is not within a 'coastal zone' as defined by clause 6 of this policy and therefore the Coastal Management SEPP does not apply to this project.

9.4.3 SEPP Biodiversity and Conservation 2021

Chapter 4: Koala Habitat Protection 2021

The subject land is zoned R1 within the City Of Maitland LGA. Development of such land must consider Chapter 4 of SEPP Biodiversity and Conservation 2021 as it:

- Is within an LGA listed on Schedule 2 of the SEPP Biodiversity and Conservation 2021
- Is 1 hectare or more.
- Does not have an approved Koala Plan of Management applying to it.

Although the subject land contains four Koala use tree species listed under Schedule 3 of the SEPP Biodiversity and Conservation 2021, the subject land has not been assessed as containing core Koala habitat as:

- The subject land has not been assesses as being highly suitable Koala habitat nor were Koala present at the time of assessment.
- The subject land has not been assesses as being highly suitable Koala habitat nor have Koala been recorded on the subject land in the last 18 years.

One previous record of Koala occurs more than four kilometres from the subject land, no Koalas have been recorded within the subject land and the habitat is deemed marginal for Koala. Therefore, no further assessment under Chapter 4 of the SEPP Biodiversity and Conservation 2021 is required.

9.5 *Biosecurity Act 2015*

The Biosecurity Act outlines biosecurity risks and impacts, which in relation to the current assessment includes those risks and impacts associated with weeds. A biosecurity risk is defined as the risk of a biosecurity impact occurring, which for weeds includes the introduction, presence, spread or increase of a pest into or within the State or any part of the State. A pest plant has the potential to out-compete other organisms for resources, including food, water, nutrients, habitat and sunlight and /or harm or reduce biodiversity.

A priority weed is any weed identified in a local strategic plan, for a region that includes that land or area, as a weed that is or should be prevented, managed, controlled or eradicated in the region. Where a local strategic plan means a local strategic plan approved by the Minister under Division 2 of Part 4 of the LLS Act.

The General Biosecurity Duty states:

> *All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.*

Five Priority Weeds for Hunter Region (which includes the Maitland LGA) were recorded in the subject land Table 20.

Table 20 Priority Weeds recorded within the subject land

Scientific Name	Common Name	Relevant Biosecurity Duty
Lantana camara	Lantana	General Biosecurity Duty
Asparagus aethiopicus	Ground asparagus	General Biosecurity Duty
Olea europaea subsp. cuspidata	African Olive	**Regional Recommended Measure** *Land managers mitigate the risk of the plant being introduced to their land. Land managers reduce impacts from the plant on priority assets. Land managers prevent spread from their land where feasible.*
Senecio madagascariensis	Fireweed	General Biosecurity Duty
Bryophyllum delagoense	Mother-of-millions	**Regional Recommended Measure** *Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land. Land managers reduce impacts from the plant on priority assets.*

10 Conclusion

This assessment has been completed in accordance with the BAM (DPIE2020a) on behalf of Thornton Brentwood Pty Ltd.

The site assessment identified areas of the following PCTs within the subject land:

- 1592 *Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter*.
- 1598 *Forest Red Gum grassy open forest on floodplains of the lower Hunter*.

The PCTs are associated with the following EECs listed under the NSW BC Act:

- Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion EEC.
- Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions EEC.

Through an iterative design process, which considered the biodiversity values known and likely to occur within the broader project boundary, a subject land for Stage 2 was identified that minimises biodiversity impacts to the removal or modification of the following:

- 3.0 hectares of PCT 1592 *Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter*.
- 0.1 hectares of PCT 1598 *Forest Red Gum grassy open forest on floodplains of the lower Hunter*.
- Removal of nine hollow-bearing trees providing potential roosting for threatened ecosystem credit microbats.
- Removal of 3.01 hectares of habitat for the species credit species Brush-tailed Phascogale.
- 0.56 hectares of previously disturbed land and exotic vegetation.

No threatened flora species were recorded within the subject land during field investigation undertaken in accordance with the BAM.

Two threatened fauna species, Little Bentwing-bat and Yellow-bellied Sheathtail-Bat, were recorded within the subject land. Three additional species, Varied Sittella, Brush-tailed Phascogale and Masked Owl, were recorded within the broader project boundary. Habitat within the subject land is suitable for foraging and breeding by the Brush-tailed Phascogale. Given that connectivity of the subject land to surrounding habitat for this species is good, the subject land is considered to support this species and requires species credits for offsetting under the BOS. No breeding habitat occurs within the subject land for Yellow-bellied Sheathtail-Bat, Little Bentwing-bat or Masked Owl and impacts will include the removal of foraging habitat only. Impacts to habitat of the Yellow-bellied Sheathtail-Bat, Little Bentwing-bat, Masked Owl and Varied Sittella are offset under the BOS via ecosystem credits.

Measures to avoid and minimise impacts to biodiversity values of the project were considered during the design and planning stage of the proposal, resulting in substantial minimisation of direct impacts on identified EECs and habitat connectivity. Measures to mitigate potential indirect impacts to biodiversity values are detailed in Section 5.

The proposal will not impact any candidate species or ecological communities at risk of *Serious and Irreversible Impact* as outlined in Section 9 of the BAM (DPIE 2020a).

Residual impacts to native vegetation will require retirement of 70 ecosystem credits and 70 Brush-tailed Phascogale species credits in accordance with the Biodiversity Offsets Scheme, as outlined in Table 21 and Table 22.

Table 21 Summary of ecosystem credits

PCT code	Plant community type name	Ecosystem credits required
1592	*Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter*	66
1598	*Forest Red Gum grassy open forest on floodplains of the lower Hunter*	4
	Total	70

Table 22 Summary of species credits

Species Credit Species	Species credits required
Brush-tailed Phascogale *Phascogale tapoatafa*	70
Total	70

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Appendices

Appendix 1 Survey methods

Appendix 1.1 Nomenclature

The flora taxonomy (classification) used in this report follows the most recent Flora of NSW (Harden 1992, Harden 1993, Harden 2000, Harden 2002). All doubtful species names were verified with the on-line Australian Plant Name Index (Australian National Botanic Gardens 2007). Flora species, including threatened species and introduced flora species, are referred to by both their common and then scientific names when first mentioned. Subsequent references to flora species cite the common names only, unless there is no common name, for which scientific name will be used. Common names, where available, have been included in threatened species tables and the complete flora list in Appendix 3.

Names of vertebrates follow the Census of Australian Vertebrates maintained by the DAWE (DSEWPaC 2009). In the body of this report vertebrates are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only.

Appendix 1.2 Permits and licences

The flora and fauna assessment was conducted under the terms of Biosis' Scientific Licence issued by EES (SL100758, expiry date 31 May 2022). The BAM Assessment and quality review of the BDAR was carried out by Accredited Assessors Rebecca Dwyer (BAAS 17067) and Mitch Palmer (BAAS17051).

Appendix 1.3 Limitations

Field surveys were undertaken in accordance with the BAM. Ecological surveys provide a sampling of flora and fauna at a given time and season. Factors influencing detectability of species during survey include species dormancy, seasonal conditions, ephemeral status of waterbodies, and migration and breeding behaviours of some fauna. In many cases, these factors do not present a significant limitation to assessing the overall biodiversity values of a site.

The field survey was conducted across three seasons which are suitable time to determine the presence of most threatened species. No candidate species credit species were surveyed for out of season.

Surveys undertaken, combined with habitat assessments and desktop analysis are considered sufficient to reach the conclusions herein in regards to this and all other species' likelihood of occurrence within the subject land.

Database searches, and associated conclusions on the likelihood of species to occur within the assessment area, are reliant upon external data sources and information managed by third parties.

Appendix 2 BAM Candidate species assessment

Table A. 1 Candidate species assessment

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Commonwealth listing status	Candidate species credit species	Rationale
Flora									
Bynoe's Wattle ***Acacia bynoeana***	--	--	--	Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple.	High	E1	V	No	Sandy soils or associated species are not present within the subject land. No habitat present for the species.
Netted Bottle Brush ***Callistemon linearifolius***	--	--	--	Grows on the coast and adjacent ranges in a variety of communities including Cumberland Dry Sclerophyll Forests, Coastal Floodplain Wetlands, Sydney Coastal Heaths and North Coast Wet Sclerophyll Forests.	High	V	--	Yes	Marginal habitat exists within the subject land native vegetation.
Red Helmet Orchid ***Corybas dowlingii***	--	--	--	Grows in sheltered gullies and southerly slopes in Northern Hinterland Wet Sclerophyll Forests and North Coast Wet Sclerophyll Forests. Grows in well-drained gravelly soils.	Moderate	E1	--	No	Well-drained gravelly soils are not present within the subject land. No habitat present for the species.
Leafless Tongue Orchid ***Cryptostylis hunteriana***	--	--	--	Grows in a variety of communities including Sydney Coastal Dry Sclerophyll Forests, Coastal Heath Swamps, New England Dry Sclerophyll Forests and Sydney Coastal Heaths. Grows in sandy soils.	High	V	V	No	Sandy soils not present within the subject land. No habitat present for the species.
White-flowered Wax Plant ***Cynanchum elegans***	--	--	--	Grows in rainforest gully scrub and steep slope on the edge of dry rainforests in a variety of communities including Coastal Floodplain Wetlands, Maritime Grasslands, Coastal Valley Grassy Woodlands and Northern Hinterland Wet Sclerophyll Forests.	High	V	V	Yes	Marginal habitat exists within the subject land native vegetation.
Rough Doubletail ***Diuris praecox***	--	--	Newcastle LGA	Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey.	Moderate	V	V	No	Subject site lies outside the Newcastle LGA.
Slaty Red Gum ***Eucalyptus glaucina***	--	--	--	Grows in grassy woodland and dry eucalypt forest. Grows on deep, moderately fertile and well-watered soils.	High	V	V	Yes	Marginal habitat exists within the subject land native vegetation.
Eucalyptus parramattensis subsp. decadens	--	--	--	Grows on wet sites subject to periodic inundation in Coastal Swamp Forests. Grows in deep, low nutrient sandy soils.	High	V	V	No	Wet sandy soils subject to periodic inundation not present within the subject land. No habitat present for the species.
Heath Wrinklewort ***Rutidosis heterogama***	--	--	--	Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides	High	V	V	Yes	Marginal habitat exists within the subject land native vegetation.
Small-flower Grevillea ***Grevillea parviflora*** **subsp.** ***parviflora***	--	--	--	Grows in sandy or light clay soils including tertiary alluviums over thin shales and lateritic ironstone gravels.	High	V	V	Yes	Marginal habitat exists within the subject land native vegetation.

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Commonwealth listing status	Candidate species credit species	Rationale
North Rothbury Persoonia ***Persoonia pauciflora***	--	--	Within 10 km of North Rothbury	It is found in dry open forest or woodland dominated by Spotted Gum *Corymbia maculata*, Broad-leaved Ironbark *Eucalyptus fibrosa* and/or Narrow-leaved Ironbark *Eucalyptus crebra* and supporting a moderate to sparse shrub layer and grassy groundcover. The majority of the population is known to occur on silty sandstone soils derived from the Farley Formation. Plants are absent from comparable habitat that is grazed and/or frequently burnt or slashed.	High	CE	CE	No	The subject land is not within 10 kilometres of North Rothbury.

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Commonwealth listing status	Candidate species credit species	Rationale
Scant Pomaderris ***Pomaderris queenslandica***	--	--	--	Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.	High	E	--	Yes	Marginal habitat exists within the subject land native vegetation.
Singleton Mint Bush ***Prostanthera cineolifera***	--	--	--	Grows in open woodlands on exposed sandstone ridges. Usually found in association with shallow or skeletal sands. Fire response is unknown, but other Prostanthera species are fire sensitive, with recruitment occurring from the soil seed bank following a fire.	High	V	V	No	Exposed sandstone ridges or skeletal sandy soils not present within the subject land. No habitat present for the species.
Pterostylis chaetophora	--	--	--	Preferred habitat is seasonally moist, dry sclerophyll forest with a grass and shrub understorey. vegetation characterised by grassy open forests or derived native grasslands of Cabbage Gum and Grey Box on gentle flats, or that are dominated by Spotted Gum with any of Broad-leaved Ironbark, Grey Ironbark or Narrow-leaved Ironbark	Moderate	V	--	No	Heavy weed loads within potential habitat would prevent the species occupying or persisting in the space.
Black-eyed Susan ***Tetratheca juncea***	--	--	--	Usually found growing in soils from the Awaba soil landscape comprising of low nutrient sandy, skeletal soils, sandy loam soils and clay soils on sandstone or conglomerate substrates.	High	V	V	Yes	Marginal habitat exists within the subject land native vegetation.
Austral Toadflax ***Thesium australe***	--	--	--	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	Moderate	V	V	Yes	Marginal habitat exists within the subject land native vegetation.
Birds									
Regent Honeyeater ***Anthochaera phrygia***	Breeding	--	--	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany. Other tree species may be regionally important. Flowering of associated species such as Thin-leaved Stringybark *Eucalyptus eugenioides* and other Stringybark species, and Broad-leaved Ironbark *E. fibrosa* can also contribute important nectar flows at times. Nectar and fruit from the mistletoes *Amyema miquelii, A. pendula* and *A. cambagei* are also utilised. The species breeds between July and January in Box-Ironbark and other temperate woodlands and riparian gallery forest dominated by River Sheoak. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and Sheoaks. Also nest in mistletoe *haustoria*.	High	CE	CE	No.	Species credit species for mapped important areas only. The project will not impact on any mapped 'Important Areas' as referred to in the Threatened Species Profile Database for Regent honeyeater. Species unlikely to breed within the subject land as habitat is degraded by disturbance and no breeding records occur within the locality, no mistletoe was recorded during field survey. There are only two previous records of Regent Honeyeater within 5 km of the subject land, the most recent of which is 16 years old.
Bush Stone-curlew ***Burhinus grallarius***	--	Fallen/standing dead timber including logs	--	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Nest on the ground in a scrape or small bare patch.	High	E1	--	Yes.	Potential habitat within the subject land is considered marginal given the lack of fallen timber. Targeted survey did not detect this species.

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Commonwealth listing status	Candidate species credit species	Rationale
Gang-gang Cockatoo ***Callocephalon fimbriatum***	Breeding	--	--	In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. May also occur in sub-alpine Snow Gum *Eucalyptus pauciflora* woodland and occasionally in temperate rainforests. Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.	High	V	--	Yes	Hollows with potential to be utilised for breeding occur within the subject land, targeted survey required.
Glossy Black-Cockatoo ***Calyptorhynchus lathami***	Breeding	--	--	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak *Allocasuarina littoralis* and Forest Sheoak *A. torulosa* are important foods. Feeds almost exclusively on the seeds of several species of she-oak *Casuarina* sp. and *Allocasuarina* sp., shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites. A single egg is laid between March and May.	High	V	--	Yes	Potential habitat is considered marginal as no foraging resources (*Allocasuarina littoralis* or *Allocasuarina torulosa*) occur within the subject land. Hollows potentially suitable for breeding exist within the subject land, survey did not detect this species.
White-bellied Sea-Eagle ***Haliaeetus leucogaster***	Breeding	--	--	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest). Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Nests are large structures built from sticks and lined with leaves or grass.	High	V	--	Yes	Potential for breeding habitat to occur within the subject land.
Little Eagle ***Hieraaetus morphnoides***	Breeding	--	--	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	Moderate	V	--	Yes	Potential for breeding habitat to occur within the subject land.

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Commonwealth listing status	Candidate species credit species	Rationale
Swift Parrot ***Lathamus discolor***	Breeding	--	--	Migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*. Commonly used lerp infested trees include Inland Grey Box *E. microcarpa*, Grey Box *E. moluccana* and Blackbutt *E. pilularis*.	Moderate	E1	CE	No	The project will not impact on any 'Important Areas' as referred to in the Threatened Species Profile Database for Swift Parrot.
Square-tailed Kite ***Lophoictinia isura***	Breeding	--	--	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Appears to occupy large hunting ranges of more than 100km2. Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	Moderate	V	--	Yes	Potential for breeding habitat to occur within the subject land.
Barking Owl ***Ninox connivens***	Breeding	--	--	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance. Two or three eggs are laid in hollows of large, old trees. Living eucalypts are preferred though dead trees are also used. Nest sites are used repeatedly over years by a pair, but they may switch sites if disturbed by predators (e.g. goannas).	High	V	--	Yes	A low number of hollows potentially providing breeding resources for this species. Barking Owl was not recorded during the assessment and some potential hollows were seen utilised by Sulphur-crested Cockatoo.

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Commonwealth listing status	Candidate species credit species	Rationale
Powerful Owl ***Ninox strenua***	Breeding	--	--	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angophora floribunda*, Cherry Ballart *Exocarpos cupressiformis* and a number of eucalypt species. Species known to breed in old hollow eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines (DEC 2006). Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. While the female and young are in the nest hollow the male Powerful Owl roosts nearby (10-200 m) guarding them, often choosing a dense "grove" of trees that provide concealment from other birds that harass him.	High	V	--	No	Species breeding habitat is not present within the subject land, hollows on site not large enough.
Masked Owl ***Tyto novaehollandiae***	Breeding	--	--	Lives in dry eucalypt forests and woodlands from sea level to 1100m. A forest owl, but often hunts along the edges of forests, including roadsides. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Species known to breed in old hollow eucalypts, live or dead but commonly live, in a variety of topographic positions from gully to upper slope, with hollows greater than 40 cm wide and greater than 100 cm deep; there is no relationship with distance to streams (DEC 2006). Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	High	V	--	No	Habitat trees with large hollows are present within the subject land, largely contained within the APZ, where hollow-bearing trees will be retained. Large hollows are present within the development site, however these are not suitable for breeding as they are not greater than 40 cm wide and 100 cm deep. In addition the topography of the site is not suitable for Masked Owl habitat.
Mammals									
Eastern Pygmy-possum ***Cercartetus nanus***	--	--	--	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. Also feeds on insects throughout the year; this feed source may be more important in habitats where flowers are less abundant such as wet forests. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum *Pseudocheirus peregrinus* dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.	High	V	--	Yes	Suitable habitat present within the subject land.

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Commonwealth listing status	Candidate species credit species	Rationale
Large-eared Pied Bat ***Chalinolobus dwyeri***	--	Cliffs Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.	--	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin *Petrochelidon ariel*, frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies.	Very High	V	V	Yes.	Species roosting or breeding habitat not present within the subject land. The species has potential to forage over subject land however previous records are >2km from the subject land and occur near mines. The geology of the surrounding area is predominantly alluvial deposits and unlikely to form caves. No Karst or cave systems are mapped within the locality, the closest cave system is to the north at Gloucester.
Little Bentwing-bat ***Miniopterus australis***	Breeding	--	--	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Very High	V	--	No.	Species breeding habitat not present within the subject land.
Eastern Bentwing-bat ***Miniopterus schreibersii oceanensis***	Breeding	--	--	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. At other times of the year, populations disperse within about 300 km range of maternity caves. Cold caves are used for hibernation in southern Australia. Hunt in forested areas, catching moths and other flying insects above the tree tops.	Very High	V	--	No.	Species breeding habitat not present within the subject land.
Southern Myotis ***Myotis macropus***	--	Hollow bearing trees Within 200 m of riparian zone Bridges, caves or artificial structures within 200 m of riparian zone	--	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface.	High	V	--	Yes.	Suitable hollow bearing trees present within 200 m of riparian zone.
Squirrel Glider ***Petaurus norfolcensis***	--	--	--	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Feeds on Acacia gum, eucalypt sap, nectar, honeydew and manna, invertebrates and pollen.	High	V	--	Yes.	Marginal habitat present within the subject land. Higher-quality habitat within subject land and locality.

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Commonwealth listing status	Candidate species credit species	Rationale
Brush-tailed Rock-wallaby ***Petrogale penicillata***	--	Land within 1km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliff lines	--	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night. Highly territorial and have strong site fidelity with an average home range size of about 15 ha. Live in family groups of 2 to 5 adults and usually one or two juvenile and sub-adult individuals. Dominant males associate and breed with up to four females. 6 Breeding is likely to be continuous, at least in the southern populations, with no apparent seasonal trends in births.	Very High	E1	V	No.	No suitable habitat present within the subject land.
Brush-tailed Phascogale ***Phascogale tapoatafa***	--	Hollow bearing trees	--	Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. Agile climber foraging preferentially in rough barked trees of 25 cm DBH or greater. Feeds mostly on arthropods but will also eat other invertebrates, nectar and sometimes small vertebrates. Females have exclusive territories of approximately 20 - 40 ha, while males have overlapping territories often greater than 100 ha. Nest and shelter in tree hollows with entrances 2.5 - 4 cm wide and use many different hollows over a short time span. Mating occurs May - July; males die soon after the mating season whereas females can live for up to three years but generally only produce one litter.	High	V	--	Yes	Habitat present within the subject land.
Koala ***Phascolarctos cinereus***	Breeding	--	--	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Inactive for most of the day, feeding and moving mostly at night. Spend most of their time in trees, but will descend and traverse open ground to move between trees. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size. Generally solitary, but have complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery. Females breed at two years of age and produce one young per year.	High	V	V	Yes.	Marginal habitat within subject land, one record within the locality (<5kms from subject land).

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Commonwealth listing status	Candidate species credit species	Rationale
Common Planigale ***Planigale maculata***	--	--	--	Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. They are active at night and during the day shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks. They are fierce carnivorous hunters and agile climbers, preying on insects and small vertebrates, some nearly their own size. They breed from October to January. The female builds a nest lined with grass, eucalypt leaves or shredded bark.	High	V		Yes	Marginal habitat within subject land.
Grey-headed Flying-fox ***Pteropus poliocephalus***	Breeding	--	--	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. Also forage in cultivated gardens and fruit crops.	High	V	V	No	Species breeding habitat not present within the subject land.
Eastern Cave Bat ***Vespadelus troughtoni***	--	Caves Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds.	--	A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.		V		Yes	Species breeding habitat not within the subject land. This species may forage over the subject land, however previous records are >2km from the subject land and occur near quarries. The geology of the surrounding area is predominantly alluvial deposits and unlikely to form caves. No Karst or cave systems are mapped within the locality, the closest cave system is to the north at Gloucester.
Amphibians									
Green and Golden Bell Frog ***Litoria aurea***	--	Semi-permanent ephemeral wet areas Within 1km of wet areas swamps Within 1km of swamp waterbodies Within 1km of waterbody	--	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes *Typha* spp. or spikerushes *Eleocharis* spp. Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow *Gambusia holbrooki*, have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas.	High	E1	V	No.	Although some wet depressions with fringing and emergent vegetation occur within the subject land, habitat was considered unsuitable due to high degree of shading of these depressions. No recent local records exist in the locality. Existing populations to the west of the subject land are disjunct from waterways within the subject land and therefore it is considered unlikely the subject land is providing connectivity to more suitable habitat.

Species	Habitat type	Habitat constraints	Geographic limitations	Threatened Biodiversity Data Collection habitats (OEH 2018)	Sensitivity to gain class	NSW listing status	Commonwealth listing status	Candidate species credit species	Rationale
Green-thighed Frog ***Litoria brevipalmata***	--	--	--	Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. It prefers wetter forests in the south of its range, but extends into drier forests in northern NSW and southern Queensland. Breeding occurs following heavy rainfall from spring to autumn, with larger temporary pools and flooded areas preferred. Frogs may aggregate around breeding sites and eggs are laid in loose clumps among waterplants, including water weeds. The larvae are free swimming. The frogs are thought to forage in leaf-litter.	Moderate	V	--	No	No previous records from the locality habitat is degraded and marginal.
Reptiles									
Pink-tailed Legless Lizard ***Aprasia parapulchella***	-	Within 50 m of rocky areas	-	Fossorial species, which lives beneath surface rocks and occupies ant burrows. It feed on ants, particularly their eggs and larvae. Thought to lay eggs within the ant nests under rocks that it uses as a source of food and shelter. Key habitat features are a cover of native grasses, particularly Kangaroo Grass (Themeda australis), sparse or no tree cover, little or no leaf litter, and scattered small rock with shallow embedment in the soil surface.	High	V	V	No	Species habitat not present within the subject land.
Striped Legless Lizard ***Delma impar***	-	-	-	Generally occurs in lowland native grasslands occurring on gently undulating plains having soils of basaltic origin. Grasses are dominated by perennial, tussock-forming grasses such as *Themeda triandra*, *Austrostipa* spp. and *Austrodanothonia* spp. Inhabits secondary grasslands only when they occur within 2 km of primary grassland.	Moderate	V	V	No	Species habitat not present within the subject land.
Pale-headed Snake ***Hoplocephalus bitorquatus***	--	--	--	The Pale-headed Snake is a highly cryptic species that can spend weeks at a time hidden in tree hollows. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest. In drier environments, it appears to favour habitats close to riparian areas. Shelter during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees. The main prey is tree frogs although lizards and small mammals are also taken. The Pale-headed Snake is relatively unusual amongst elapid snakes in that it is well adapted to climbing trees.	High	V		Yes	Marginal habitat present including hollows suitable for sheltering. No previous records from the locality.

Appendix 3 BAM Plot data

Appendix 3.1 BAM plot field data

Table A. 2 Flora species recorded in the subject land from BAM plots (Plot 1)

Family	Scientific Name	Common Name	BAM Growth Form / Exotic Status	Cover
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower	Forb (FG)	0.1
Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern	N/A	15
Asteraceae	*Senecio madagascariensis*	Fireweed	N/A	0.1
Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell	Forb (FG)	0.1
Convolvulaceae	*Dichondra repens*	Kidney Weed	Forb (FG)	0.1
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine	Other (OG)	0.1
	Hardenbergia violacea	False Sarsaparilla	Other (OG)	0.2
	Daviesia ulicifolia	Gorse Bitter Pea	Shrub (SG)	0.7
Fabaceae (Mimosoideae)	*Acacia falcata*		Shrub (SG)	0.5
Lobeliaceae	*Pratia purpurascens*	Whiteroot	Forb (FG)	0.1
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush	Grass & grasslike (GG)	0.4
	Lomandra multiflora	Many-flowered Mat-rush	Grass & grasslike (GG)	0.3
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	N/A	0.1
Myrtaceae	*Corymbia maculata*	Spotted Gum	Tree (TG)	15
	Eucalyptus moluccana	Grey Box	Tree (TG)	15
	Eucalyptus paniculata	Grey Ironbark	Tree (TG)	1
Oleaceae	*Olea europaea* subsp. *cuspidata*	African Olive	High Threat Exotic	0.7

Family	Scientific Name	Common Name	BAM Growth Form / Exotic Status	Cover
Phormiaceae	*Dianella caerulea*	Blue Flax-lily	Forb (FG)	0.6
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush	Shrub (SG)	0.4
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn	Shrub (SG)	0.8
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	N/A	0.1
Poaceae	*Aristida vagans*	Threeawn Speargrass	Grass & grasslike (GG)	7
	Cymbopogon refractus	Barbed Wire Grass	Grass & grasslike (GG)	2
	Entolasia stricta	Wiry Panic	Grass & grasslike (GG)	0.2
	Eragrostis brownii	Brown's Lovegrass	Grass & grasslike (GG)	0.2
	Microlaena stipoides	Weeping Grass	Grass & grasslike (GG)	0.5
	Panicum effusum	Hairy Panic	Grass & grasslike (GG)	0.1
	Paspalidium distans		Grass & grasslike (GG)	0.1
	Rytidosperma fulvum	Wallaby Grass	Grass & grasslike (GG)	0.1
	Rytidosperma pallidum	Silvertop Wallaby Grass	Grass & grasslike (GG)	0.1
	Themeda australis	Kangaroo Grass	Grass & grasslike (GG)	5
Rubiaceae	*Opercularia diphylla*	Stinkweed	Forb (FG)	0.1
Verbenaceae	*Lantana camara*	Lantana	N/A	0.5

Table A. 3 Flora species recorded in the subject land from BAM plots (Plot 2)

Family	Scientific Name	Common Name	BAM Growth Form / Exotic Status	Cover
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower	Forb (FG)	0.1
Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern	High Threat Exotic	15
Asteraceae	*Osteospermum ecklonis*	Cape Daisy	N/A	3
Convolvulaceae	*Dichondra repens*	Kidney Weed	Forb (FG)	0.3
Crassulaceae	*Bryophyllum delagoense*	Mother of millions	N/A	4
Fabaceae (Faboideae)	*Glycine microphylla*	Small-leaf Glycine	Other (OG)	0.1
	Hardenbergia violacea	False Sarsaparilla	Other (OG)	0.2
Iridaceae	*Patersonia sericea*	Silky Purple-Flag	Forb (FG)	0.4
Juncaceae	*Juncus usitatus*		Grass & grasslike (GG)	1
Lobeliaceae	*Pratia purpurascens*	Whiteroot	Forb (FG)	0.4
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush	Grass & grasslike (GG)	0.8
Myrtaceae	*Corymbia maculata*	Spotted Gum	Tree (TG)	20
	Eucalyptus fibrosa	Red Ironbark	Tree (TG)	4
	Eucalyptus moluccana	Grey Box	Tree (TG)	2
Oleaceae	*Olea europaea* subsp. *cuspidata*	African Olive	N/A	0.5
Phormiaceae	*Dianella caerulea*	Blue Flax-lily	Forb (FG)	0.5
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn	Shrub (SG)	0.3
	Pittosporum undulatum	Sweet Pittosporum	Shrub (SG)	0.9
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	N/A	0.1
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	N/A	1
	Paspalum dilatatum	Paspalum	N/A	0.1

Family	Scientific Name	Common Name	BAM Growth Form / Exotic Status	Cover
	Poaceae indeterminate	Grasses, reeds and bamboos	N/A	0.1
	Aristida vagans	Threeawn Speargrass	Grass & grasslike (GG)	0.5
	Cymbopogon refractus	Barbed Wire Grass	Grass & grasslike (GG)	0.4
	Cynodon dactylon	Common Couch	Grass & grasslike (GG)	0.4
	Entolasia stricta	Wiry Panic	Grass & grasslike (GG)	8
	Microlaena stipoides	Weeping Grass	Grass & grasslike (GG)	0.8
	Paspalidium distans		Grass & grasslike (GG)	0.1
	Rytidosperma fulvum	Wallaby Grass	Grass & grasslike (GG)	0.2
	Rytidosperma pallidum	Silvertop Wallaby Grass	Grass & grasslike (GG)	0.2
	Themeda australis	Kangaroo Grass	Grass & grasslike (GG)	1
Verbenaceae	*Lantana camara*	Lantana	N/A	1

Table A. 4 Flora species recorded in the subject land from BAM plots (Plot 3)

Family	Scientific Name	Common Name	BAM Growth Form / Exotic Status	Cover
Adiantaceae	*Adiantum aethiopicum*	Maidenhair Fern	Fern (EG)	10
Alismataceae	*Alisma plantago-aquatica*	Water Plantain	Forb (FG)	2
Apiaceae	*Centella asiatica*	Swamp Pennywort	Forb (FG)	5
Apiaceae	*Hydrocotyle sibthorpioides*	A Hydrocotyl	Forb (FG)	5
Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern	High Threat Exotic	0.1
Asteraceae	*Ageratina adenophora*	Crofton Weed	High Threat Exotic	0.1
Asteraceae	*Brachyscome multifida*	Cut-leaved Daisy	Forb (FG)	0.2
Asteraceae	*Eclipta platyglossa*	Yellow Twin-heads	Forb (FG)	0.1
Asteraceae	*Euchiton involucratus*	Star Cudweed	Forb (FG)	0.2
Asteraceae	*Ozothamnus diosmifolius*	Ball Everlasting	Shrub (SG)	1
Convolvulaceae	*Dichondra repens*	Kidney Weed	Forb (FG)	2
Cyperaceae	*Gahnia aspera*	Saw Sedge	Grass & grasslike (GG)	3
Cyperaceae	*Schoenoplectus mucronatus*	River Clubrush	Grass & grasslike (GG)	1
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush	Shrub (SG)	1
Fabaceae	*Acacia irrorata*	Green Wattle	Shrub (SG)	0.2
Fabaceae	*Desmodium varians*	Slender Tick-trefoil	Other (OG)	0.2
Fabaceae	*Glycine microphylla*	Small-leaf Glycine	Other (OG)	0.5
Fabaceae	*Kennedia rubicunda*	Dusky Coral-pea	Other (OG)	0.1
Fabaceae	*Senna pendula* var. *glabrata*	Easter Cassia	Introduced	2
Goodeniaceae	*Goodenia bellidifolia*	Daisy-leaved Goodenia	Forb (FG)	0.1
Lobeliaceae	*Lobelia purpurascens*	Whiteroot	Forb (FG)	2

Family	Scientific Name	Common Name	BAM Growth Form / Exotic Status	Cover
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily	Other (OG)	1
Malvaceae	*Sida rhombifolia*	Paddys Lucerne	Introduced	2
Myrtaceae	*Corymbia maculata*	Spotted Gum	Tree (TG)	5
Myrtaceae	*Eucalyptus acmenoides*	White Mahogany	Tree (TG)	25
Myrtaceae	*Eucalyptus tereticornis*	Forest Redgum	Tree (TG)	5
Phormiaceae	*Dianella longifolia*	Blue Flax Lily	Forb (FG)	0.1
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn	Shrub (SG)	1
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum	Shrub (SG)	3
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	Introduced	2
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass	Grass & grasslike (GG)	5
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	High Threat Exotic	3
Poaceae	*Entolasia marginata*	Bordered Panic	Grass & grasslike (GG)	5
Poaceae	*Microlaena stipoides*	Weeping Grass	Grass & grasslike (GG)	10
Poaceae	*Oplismenus aemulus*	Basket Grass	Grass & grasslike (GG)	1
Poaceae	*Panicum simile*	Two Colour Target	Grass & grasslike (GG)	5
Poaceae	*Paspalum dilatatum*	Paspalum	High Threat Exotic	10
Poaceae	*Setaria parviflora*	Slender Pigeon Grass	Introduced	5
Poaceae	*Themeda triandra*	Kangaroo Grass	Grass & grasslike (GG)	5
Polygonaceae	*Persicaria decipiens*	Slender Knotweed	Forb (FG)	0.5
Ranunculaceae	*Clematis aristata*	Old Man's Beard	Other (OG)	0.1
Rosaceae	*Prunus* spp.	A Plum	Introduced	0.5
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballarat	Shrub (SG)	0.1

Family	Scientific Name	Common Name	BAM Growth Form / Exotic Status	Cover
Solanaceae	*Solanum prinophyllum*	Forest Nightshade	Forb (FG)	0.1
Verbenaceae	*Lantana camara*	Lantana	High Threat Exotic	15
Verbenaceae	*Verbena bonariensis*	Purple Top	Introduced	1

Appendix 4 Significant Impact Criteria assessments

River-flat Eucalypt Forest on Coastal Floodplains of Southern New South Wales and Eastern Victoria – Critically Endangered Ecological Community (CEEC)

River-flat Eucalypt Forest on coastal floodplains of southern NSW and eastern Victoria occurs on alluvial landforms related to coastal river floodplains and associated sites where transient water accumulates, including floodplains, river-banks, riparian zones, lake foreshores, creek lines (including the floors of tributary gullies), floodplain pockets, depressions, alluvial flats, fans, terraces, and localised colluvial fans. Floodplains may be occasionally or more often saturated, water-logged or inundated.

River-flat Eucalypt Forest occurs on coastal floodplains of southern NSW and eastern Victoria occurs on productive agricultural land, or in close proximity to coastal areas, where continuing population growth and urban development is expected. Historically, clearing was primarily for timber and agriculture, and actions such as culling of native fauna were undertaken largely to support agricultural productivity, while in recent times it is more likely to occur for residential and industrial development. The nature of some areas of the ecological community has changed structurally due to clearing, followed by regrowth that is likely to be subject to altered fire and water regimes and livestock grazing.

River-flat Eucalypt Forest within the subject land

River-flat Eucalypt Forest aligns with PCT 835, which is primarily in a moderate condition within the subject land. A total of 0.1 hectares of River-flat Eucalypt Forest occurs within the impact area which is subject to self-assessment under the EPBC Act. An assessment of the impacts of this vegetation in accordance with the *Matters of National Environmental Significance Significant impact guidelines* is provided below in the table below.

Table A.23 SIC assessment for River-flat eucalypt forest

SIC assessment for critically endangered and endangered ecological community
Reduce the extent of an ecological community.
The extent of the River-flat Eucalypt Forest includes approximately 0.1 ha within the subject land, of which 0.1 ha will be removed under the current proposal. The vegetation to be impacted, either directly or indirectly, as a result of the proposed works equates to less than 1% of the River-flat Eucalypt Forest recorded within the broader local area. In addition, during the planning stages of the project, efforts were made to ensure that potential impacts to River-flat Eucalypt Forest are avoided and minimised. The amount of vegetation to be removed is minimal. Hence, it is unlikely that a relatively localised impact along the edge of the extent of occurrence of River-flat Eucalypt Forest will result in a significant reduction of the extent of the CEEC.
Fragment or increase fragmentation of an ecological community.
The proposed works is confined to the disturbed edge of the River-flat Eucalypt Forest. In addition, the contiguous stands of the River-flat Eucalypt Forest will be retained. Hence, whilst the works may result in minor fragmentation to the patch of the ecological community, is not determined to cause a substantial decrease to the community within the local extent. The removal of the vegetation is not likely to decrease condition or increase fragmentation to adjoining bushland.
Adversely affect habitat critical to the survival of an ecological community.
All EPBC listed vegetation is considered critical habitat to the survival of River-flat Eucalypt Forest. Given this, a total of 0.1 hectares of River-flat Eucalypt Forest was found to meet the listing criteria and will be removed or disturbed within the subject land. As the proposal will result in a reduction in the community's area as a result of vegetation removal, the

SIC assessment for critically endangered and endangered ecological community
project would be considered likely to have an adverse effect on habitat that is critical to the community's survival. However, the works are limited to edge-affected areas of the River-flat Eucalypt Forest community and will be limited to thinning of understory vegetation where possible. Thus, although removal of River-flat Eucalypt Forest within the subject land will occur, it is unlikely to adversely affect the ecological community as a whole.
Modify or destroy abiotic factors necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.
Alterations to hydrological patterns may also occur, which may cause some impact to River-flat Eucalypt Forest due to its occurrence on the riverbanks of drainage lines across the subject land. Mitigation measures would ensure that downstream indirect impacts (such as sediment and nutrient transportation) would be controlled and would not impact remaining areas of River-flat Eucalypt Forest in the locality. As such, the project is not expected to result in impacts that modify or destroy abiotic factors necessary for the survival of the CEEC.
Cause a substantial change in the species composition of an occurrence of an ecological community, including a decline or loss of functionally important species, for example through regular burning or flora and fauna harvesting.
The occurrence of River-flat Eucalypt Forest is defined as the patch of the community that occurs within the subject land and extends into an adjacent area in a contiguous manner without major breaks in connectivity to the north of the subject land. The community occurs in a landscape where introduced vegetation cover is significant and intensive land clearing has taken place over the past 150 years. Land use impacts from drainage works, clearing, cropping and grazing have reduced the community integrity and functionality (e.g. loss of hydrological functioning, reduced flora species richness, reduced genetic exchange across the community due to fragmentation). Clearing required for the proposal is unlikely to further reduce species diversity and simplify community structure. The adjacent areas of the community within the broader area will remain intact and are unlikely to suffer substantial changes in species composition.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to: - ***Assisting invasive species establishment*** ***- Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community.***
All River-flat Eucalypt Forest within the subject land is subject to existing weed invasion, pest animals, erosion and chemical inputs as a result of surrounding land uses. Nonetheless, the proposed works are not considered to increase weed or pest invasion, or cause mobilisation of fertilisers, herbicides or other chemical within the CEEC. Construction activities can be managed through standard practices to avoid further sedimentation and pollution. Therefore, the proposed works are unlikely to cause a substantial reduction in the quality or integrity of an occurrence of the CEEC.
Interfere with the recovery of an ecological community.
River-flat Eucalypt Forest does not currently have an adopted or made recovery plan. However, within the Commonwealth Conservation Advice (DAWE 2020) recovery strategies have been listed to support the recovery of River-flat Eucalypt Forest. Some of the priority conservation actions significant to the proposed works are: • Protect and conserve remaining areas of the ecological community. • Avoid further clearance and destruction of the ecological community. • Retain other native vegetation near patches of the ecological community, where they are important for connectivity, diversity of habitat, and/or act as buffer zones between the ecological community and threats or development zones. • Protect patches identified as wildlife refuges, or of regional importance in formal conservation reserves. • Protect mature and over-mature trees and stags, particularly with hollows.

SIC assessment for critically endangered and endangered ecological community
Interference with the objectives of the Commonwealth conservation advice can be minimised by implementing management strategies and ensuring any potential impacts are avoided if possible. Impacts to River-flat Eucalypt Forest have been avoided and minimised through the initial project design phase, retaining large, intact patches of the community and mature canopy trees where possible. However, as the proposed works will cause clearing of the community, it is determined the proposed actions are considered likely to interfere with recovery actions.
Conclusion.
Based on the assessment provided above, it is concluded that River-flat Eucalypt Forest is unlikely to be significantly impacted by the project. This conclusion was made on the basis that the proposed action is unlikely to contribute to substantial fragmentation of the community, unlikely to contribute to local scale reduction in the extent and functionality of the community, unlikely to result in impacts that modify or destroy abiotic factors necessary for the survival of the CEEC and is unlikely to cause a substantial reduction in the quality or integrity of an occurrence of the CEEC.