



# Mount Penang Parklands Flora and fauna assessment

FINAL REPORT

Prepared for Gyde Consulting

13 May 2022

## Biosis offices

### NEW SOUTH WALES

#### Albury

Phone: (02) 6069 9200  
Email: [albury@biosis.com.au](mailto:albury@biosis.com.au)

#### Newcastle

Phone: (02) 4911 4040  
Email: [newcastle@biosis.com.au](mailto:newcastle@biosis.com.au)

#### Sydney

Phone: (02) 9101 8700  
Email: [sydney@biosis.com.au](mailto:sydney@biosis.com.au)

#### Western Sydney

Phone: (02) 9101 8700  
Email: [sydney@biosis.com.au](mailto:sydney@biosis.com.au)

#### Wollongong

Phone: (02) 4201 1090  
Email: [wollongong@biosis.com.au](mailto:wollongong@biosis.com.au)

### VICTORIA

#### Ballarat

Phone: (03) 5304 4250  
Email: [ballarat@biosis.com.au](mailto:ballarat@biosis.com.au)

#### Melbourne

Phone: (03) 8686 4800  
Email: [melbourne@biosis.com.au](mailto:melbourne@biosis.com.au)

#### Wangaratta

Phone: (03) 5718 6900  
Email: [wangaratta@biosis.com.au](mailto:wangaratta@biosis.com.au)

## Document information

**Report to:** Gyde Consulting

**Prepared by:** Dr Caragh Heenan  
Jake Schwebel  
Taliah Darcy-Shaw

**Biosis project no.:** 36927

**File name:** 36927.Mount.Penang.Parklands.FFA.FIN.20220513

**Citation:** Biosis 2022. Mount Penang Parklands FFA. Report for Gyde Consulting. Heenan, C, Schwebel, J., Darcy-Shaw, T. Biosis Pty Ltd. Sydney, NSW. Project no. 36927

## Document control

Version	Internal reviewer	Date issued
Draft version 01	Rebecca Dwyer	25/3/2022
Draft version 02	Mitchell Palmer	10/5/2022
Final version 01	Caragh Heenan	13/5/2022

## Acknowledgements

Biosis acknowledges the contribution of the following people and organisations in undertaking this study:

- Gyde Consulting: Mark Schofield.
- Hunter and Central Coast Development Corporation: Jennifer Passfield.
- Department of Agriculture, Water and the Environment for access to the Protected Matters Search Tool of the Australian Government.
- NSW Environment, Energy and Science Group for access to the BioNet Atlas of NSW Wildlife.
- NSW Department of Primary Industries Fisheries for access to the predicted distribution maps for threatened species and fish communities.

Biosis staff involved in this project were:

- Jenny Beckius and Astrid Mackegard (mapping).

© Biosis Pty Ltd

This document is subject to copyright and may only be used for the purposes in respect of which it was commissioned and in accordance with the Terms of Engagement of the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Disclaimer:

Biosis Pty Ltd has completed this assessment in accordance with the relevant federal, state and local legislation and current industry best practice. The company accepts no liability for any damages or loss incurred as a result of reliance placed upon the report content or for any purpose other than that for which it was intended.

# Contents

<b>Glossary.....</b>	<b>v</b>
<b>Summary .....</b>	<b>vii</b>
<b>1 Introduction .....</b>	<b>1</b>
1.1 Project background .....	1
1.2 Scope of assessment .....	1
1.3 Location of the study area .....	1
<b>2 Methods .....</b>	<b>3</b>
2.1 Database and literature review .....	3
2.2 Field investigation .....	3
2.2.1 Flora assessment .....	3
2.2.2 Fauna assessment .....	4
2.2.3 Targeted surveys .....	4
2.2.4 Permits and licences .....	9
2.2.5 Limitations .....	9
<b>3 Results .....</b>	<b>10</b>
3.1 Vegetation communities .....	10
3.2 Aquatic habitats .....	13
3.3 Threatened species .....	13
3.3.1 Priority weeds .....	15
<b>4 Ecological impacts and recommendations .....</b>	<b>22</b>
4.1 <i>Environment Protection and Biodiversity Conservation Act 1999</i> .....	22
4.2 <i>Environmental Planning and Assessment Act 1979</i> .....	23
4.3 Local Environmental Plans and Development Control Plans .....	24
4.4 <i>Water Management Act 2000</i> .....	24
4.5 <i>Fisheries Management Act 1994</i> .....	24
<b>5 Conclusion .....</b>	<b>25</b>
<b>References.....</b>	<b>26</b>
<b>Appendices .....</b>	<b>28</b>
<b>Appendix 1 Flora .....</b>	<b>29</b>
<b>Appendix 2 Fauna .....</b>	<b>42</b>
<b>Appendix 3 Microbat call analysis .....</b>	<b>70</b>
Survey method and effort .....	70
Reference library .....	70
Call identification .....	70
Summary of results and survey effort .....	71

Threatened species summary .....	72
Call characteristics used to differentiate overlapping species.....	72
Limitations and assumptions.....	73
Qualifications .....	73
Example time versus frequency graphs.....	74
<b>Appendix 4 Tests of Significance.....</b>	<b>81</b>
Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion .....	81
Woodland bird species.....	83
Squirrel Glider <i>Petaurus norfolcensis</i> .....	85
Tree-hollow roosting microchiropteran bats .....	88

## Tables

Table 1	Fauna species subject to targeted survey .....	4
Table 2	Weather observations during targeted fauna surveys (Gosford, NSW).....	5
Table 3	Summary of targeted survey method and results .....	7
Table 4	Vegetation communities of the study area .....	11
Table 5	Assessment of habitat for threatened fauna species.....	14
Table 6	Priority weeds within the study area .....	15
Table 7	Assessment of the project against the EPBC Act.....	22
Table 8	Summary of Tests of Significance.....	23
Table A.1	Flora species recorded from the study area .....	29
Table A.2	Threatened flora species recorded/predicted to occur within 5 kilometres of the study area .....	32
Table A.3	Vertebrate fauna recorded from the study area (current assessment).....	42
Table A.4	Threatened fauna species recorded, or predicted to occur, within 5 kilometres of the study area .....	45
Table A.5	Migratory fauna species recorded or predicted to occur within 5 kilometres of the study area .....	69
Table A.6	Confidence ratings of call identification .....	71
Table A.7	Bat call analysis results .....	71
Table A.8	Test of Significance for Kincumber Scribbly Gum Forest Ecological Community in the Sydney Basin Bioregion .....	81
Table A.9	Test of Significance for woodland bird species .....	84
Table A.10	Test of Significance for Squirrel Glider .....	86
Table A.11	Test of Significance for tree-hollow roosting microchiropteran bats.....	89

## Figures

Figure 1	Location of the study area .....	2
Figure 2	Ecological values of the study area .....	16
Figure 3	Threatened flora species recorded within 5 kilometres of the study area.....	20
Figure 4	Threatened fauna species recorded within 5 kilometres of the study area.....	21

## Photos

Photo 1	PCT 1642 <i>Scribbly Gum - Red Bloodwood - Old Man Banksia</i> heathy woodland of southern Central Coast .....	12
Photo 2	Urban native/Exotic .....	13

## Glossary

<b>BC Act</b>	<i>NSW Biodiversity Conservation Act 2016</i>
<b>Biosecurity Act</b>	<i>Biosecurity Act 2015</i>
<b>BOS</b>	Biodiversity Offsets Scheme
<b>CBD</b>	Central Business District
<b>CEEC</b>	Critically Endangered Ecological Community
<b>CM Act</b>	<i>Coastal Management Act 2016</i>
<b>DCP</b>	Development Control Plan
<b>DAWE</b>	Department of Agriculture Water and the Environment
<b>DPI</b>	Department of Primary Industries
<b>DPIE</b>	NSW Department of Planning, Industry and Environment
<b>EEC</b>	Endangered Ecological Community
<b>EES</b>	NSW Environment, Energy and Science Group
<b>EIS</b>	Environmental Impact Statement
<b>EP&amp;A Act</b>	<i>Environmental Planning and Assessment Act 1979</i>
<b>EPBC Act</b>	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
<b>FM Act</b>	<i>Fisheries Management Act 1994</i>
<b>GIS</b>	Geographic Information System
<b>KTP</b>	Key Threatening Process
<b>LEP</b>	Local Environmental Plan
<b>LGA</b>	Local Government Area
<b>LLS</b>	Local Land Services
<b>Matters of NES</b>	Matters of National Environmental Significance
<b>NPW Act</b>	<i>National Parks and Wildlife Act 1974</i>
<b>NSW</b>	New South Wales
<b>PCT</b>	Plant Community Type
<b>SEPP</b>	NSW State Environmental Planning Policy
<b>SIC</b>	Significant Impact Criteria
<b>SIS</b>	Species Impact Statement

<b>TEC</b>	Threatened Ecological Community
<b>ToS</b>	Test of Significance
<b>WM Act</b>	<i>Water Management Act 2000</i>

## Summary

---

Biosis Pty Ltd was commissioned by Gyde Consulting on behalf of the Hunter and Central Coast Development Corporation (HCCDC) to undertake a Flora and Fauna Assessment (FFA) at Mount Penang Parklands (the study area). The HCCDC is responsible for the promotion, coordination and management of the orderly economic development of the Central Coast Growth Centre under the *Growth Centres (Development Corporations) Act 1974*. Biosis understands that the HCCDC proposes to upgrade water, sewer and road infrastructure within the study area.

The study area is defined by the development footprint plus a 20 metre buffer to account for adjacent areas likely to be directly or indirectly affected by the proposed works (Figure 1). Identified constraints will be used to guide detailed design, with an emphasis on avoiding impacts where feasible.

The study area predominantly comprises of urban native/exotic vegetation. However, approximately 0.38 hectares of remnant native vegetation occurs in the north-east and west of the study area. The study area contains habitat for threatened fauna species listed under the New South Wales (NSW) *Biodiversity Conservation Act 2016* (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Impacts associated with the proposed works are generally considered minor and localised and are not considered likely to result in a significant affect to threatened species or communities listed under the BC Act or EPBC Act. A number of safeguards are provided to further minimise and mitigate impacts to native vegetation and habitats.

### Ecology values and impacts

Key ecological values include:

- Approximately 0.38 ha of Kincumber Scribbly Gum Forest.
- Habitat for threatened fauna species generally comprising vegetation of various *Acacia* spp. and *Eucalyptus* spp. that provide foraging habitat and sheltering hollows.
- 18 hollow-bearing trees were mapped in the vicinity of the proposed works.
- The following BC Act listed threatened fauna species were determined to have a moderate or greater likelihood of occurrence within the study area based on habitat requirements or targeted survey:
  - Dusky Woodswallow *Artamus cyanopterus cyanopterus* (Vulnerable, BC Act).
  - Varied Sittella *Daphoenositta chrysoptera* (Vulnerable, BC Act).
  - Eastern False Pipistrelle *Falsistrellus tasmaniensis* (Vulnerable, BC Act).
  - Little Lorikeet *Glossopsitta pusilla* (Vulnerable, BC Act).
  - Eastern Coastal Free-Tailed Bat *Micronomus norfolkensis* (Vulnerable, BC Act).
  - Little Bent-winged Bat *Miniopterus australis* (Vulnerable, BC Act).
  - Large Bent-winged Bat *Miniopterus orianae oceanensis* (Vulnerable, BC Act).
  - Southern Myotis *Myotis macropus* (Vulnerable, BC Act).
  - Turquoise Parrot *Neophema pulchella* (Vulnerable, BC Act).
  - Squirrel Glider *Petaurus norfolcensis* (Vulnerable, BC Act).

- Scarlet Robin *Petroica boodang* (Vulnerable, BC Act).
- Yellow-bellied Sheath-tailed Bat *Saccolaimus flaviventris* (Vulnerable, BC Act).
- Greater Broad-nosed Bat *Scoteanax rueppellii* (Vulnerable, BC Act).

Large Bent-winged Bat was determined to be using the study area for transient foraging only.

No Matters of National Significance or their habitat, listed under the Commonwealth EPBC Act were located within the study area. There are no expected impacts to the threatened species and communities with the potential to occur within the study area.

Two large dams and one waterway occurs within the study area. The waterway is classified as a first order stream, under the *Water Management Act 2000* (WM Act). As a public authority, HCCDC does not need to obtain a controlled activity approval from the Natural Resources Access Regulator for any controlled activities that it carries out in, on or under waterfront land, as such a controlled activity permit is not required.

## Recommendations

Terrestrial environmental safeguards that should be implemented are as follows:

- Hollow-bearing trees should be avoided where possible with works sited to retain these features.
- To the fullest extent practicable, minimise disturbance to any native vegetation surrounding the study area.
- Where possible, any trees to be retained should be protected in accordance with Australian Standard AS4970 – 2009 Protection of trees on development sites (Standards Australia 2009).
- In the unlikely event that unexpected threatened species are identified during the project, works should cease and an ecologist contacted.
- Should hollow-bearing trees need to be removed, it should occur in a two-stage process:
  - Stage 1: Surrounding shrubs and canopy to be removed and the hollow-bearing tree/s to be knocked by arborist or excavator and left standing for 24-48 hours prior to hollow-bearing tree removal, to allow time for fauna to escape and relocate naturally.
  - Stage 2: Ecologist or arborist (if high in tree) to inspect hollows and/or habitat trees for the presence of fauna. Excavator operator or arborist to again knock or disturb the habitat tree prior to felling, with the intent to encourage the final movement of fauna out of hollows/nests. During felling, the tree is felled as carefully as possible and placed on the ground, for example branch-by-branch to allow for regular checks for fauna by the Ecologist. Lengths cut from trees during felling should be divided in a manner that will preserve integrity of any hollows present and placed in retained vegetation to provide habitat for ground dwelling fauna. Any fauna displaced are either captured and inspected for injury prior to relocation in a pre-allocated area, or allowed to self-relocate into adjacent retained habitats. Injured fauna are to be taken to a local veterinarian or a WIRES representative is to be contacted as soon as possible.
- Three priority weeds within the Greater Sydney Local Land Services (LLS) region were identified within the study area (Appendix 1, Section 3.3.1). Appropriate measures should be implemented to minimise the spread of these species.
- Appropriate erosion and sediment control measures should be installed at all sites to avoid sedimentation of receiving water bodies or other indirect impacts to surrounding biodiversity values.

# 1 Introduction

---

## 1.1 Project background

Biosis Pty Ltd was commissioned by Gyde Consulting on behalf of the HCCDC to undertake a FFA of the study area (Figure 1). It is understood that road and sewerage works are required within the study area to improve vehicle and pedestrian access, relieve pressure on the surrounding road network and enable further subdivision and divestment.

The objective of this FFA is to determine the presence of any threatened ecological communities (TECs) within the study area and, where applicable, assess the impacts of the project on any threatened species, populations and/or ecological communities (entities), or their habitat, listed under the Commonwealth EPBC Act and NSW BC Act. Works undertaken at this site are to be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and these investigations will be used to inform the Review of Environmental Factors (REF) being prepared for the proposed works.

## 1.2 Scope of assessment

The objectives of this investigation are to:

- Describe the flora and fauna values observed within the study area.
- Determine the likelihood of occurrence of threatened biota or for the likelihood for their habitat to occur within the study area.
- Undertake standard targeted flora and fauna surveys in accordance with *Flora and Fauna Guidelines* (Central Coast Council 2019).
- Determine the potential impacts from the proposed works to threatened biota and other ecological values and provide recommendations to assist with mitigation.
- Map native vegetation and other habitat features.
- Review the implications of relevant biodiversity legislation and policy.
- Recommend any further assessments of the site that may be required (such as targeted searches for threatened biota).

## 1.3 Location of the study area

The study area is located approximately 8 kilometres West of Gosford and approximately 80 kilometres north of the Sydney Central Business District (CBD) (Figure 1). It encompasses 18.48 hectares of public land and the adjacent road reserves. It is currently zoned primarily SP1 (Special Activities) and a small section of SP2 Infrastructure is located within the study area to the north, outside of the development footprint.

The study area is within the:

- Sydney Basin Bioregion.
- Greater Sydney LLS region.
- Gosford Local Government Area (LGA).



**Legend**

- Study area
- Development footprint
- IBRA Region/Subregion
- Lot

**Figure 1 Location of the study area**

0 100 200 300 400 N  
Metres  
Scale: 1:8,000 @ A3  
Coordinate System: GDA 1994 MGA Zone 56

**biosis**

Matter: 36927, Date: 05 May 2022,  
Checked by: CH, Drawn by: JB, Last edited by: amackegard  
Layout: 36927\_F1\_Locality  
Project: P:\36900s\36927\Mapping\  
36927\_FFA\_MtPenangParklands.aprx

## 2 Methods

---

### 2.1 Database and literature review

Prior to completing the field investigation, information provided by Gyde Consulting as well as other key information was reviewed, including:

- Commonwealth Department of Agriculture, Water and Environment (DAWE) Protected Matters Search Tool for matters protected by the EPBC Act.
- NSW Environment, Energy and Science (EES) BioNet Atlas of NSW Wildlife, for items listed under the BC Act.
- NSW DPI *Biosecurity Act 2015* for priority listed weeds for the Greater Sydney LLS area.
- EES Vegetation Information System (VIS) mapping, including *Greater Hunter Native Vegetation Mapping* (DPIE 2019).

The following guidelines were reviewed and adhered to throughout the assessment:

- *Flora and Fauna Guidelines* (Central Coast Council 2019).

The implications for the project were assessed in relation to key biodiversity legislation and policy including:

- *Environment Protection and Biodiversity Conservation Act 1999*.
- *Environmental Planning and Assessment Act 1979*.
- *Biodiversity Conservation Act 2016*.
- *National Parks and Wildlife Act 1974* (NPW Act).
- *Water Management Act 2000* (WM Act).
- *Biosecurity Act 2015* (Biosecurity Act).
- *Gosford Local Environmental Plan 2014*.
- *Gosford Development Control Plan 2013*.

### 2.2 Field investigation

#### 2.2.1 Flora assessment

The flora assessment was undertaken on the 23 February, 18 March and 3 May 2022 by Jake Schwebel using a combination of 20 x 20 metre quadrats, Biodiversity Assessment Methodology (BAM) (DPIE 2020) transects, spot locations and random meanders to determine the vegetation types present.

General classification of native vegetation in NSW used in this report is based on the classification system in Keith (2004) which uses three groupings of vegetation: vegetation formation, vegetation class and vegetation type, with vegetation type the finest grouping. The grouping referred to in this report is PCT as defined by the BAM.

The vegetation types were stratified into PCTs broadly based on previous vegetation mapping, and the vegetation boundaries marked with a hand-held GPS in the field. Appropriate PCTs were selected on the basis

of species composition and structure, known geographical distribution, landscape position, underlying geology, soil type, and any other diagnostic features.

A list of flora species was compiled for each vegetation type. Records of threatened flora species will be submitted to EES for incorporation into the BioNet Wildlife Atlas.

The general condition of native vegetation was observed as well as the effects of current seasonal conditions. Notes were made on specific issues such as priority weed infestations, evidence of management works, current grazing impacts and the regeneration capacity of the vegetation.

## 2.2.2 Fauna assessment

The study area was investigated on 18 February 2022 and 4 March 2022 by Dr Caragh Heenan to determine its values for fauna. These were determined primarily on the basis of the types and qualities of habitats present. All species of fauna observed during the assessment were noted and active searching for fauna was undertaken. This included direct observation, searching under rocks and logs, examination of tracks and scats and identifying calls. Particular attention was given to searching for threatened entities and their habitats. Fauna species were recorded with a view to characterising the values of the site and the investigation was not intended to provide a comprehensive survey of all fauna that has potential to utilise the site over time.

## 2.2.3 Targeted surveys

In accordance with the *Central Coast Flora and Fauna Guidelines* (Central Coast Council 2019), targeted surveys for threatened fauna were completed. Table 1 provides a list of threatened fauna considered in this assessment, each species' required survey period (DPIE 2021) and the relevant method of assessment. In addition, opportunistic aural and visual surveys for threatened frogs were completed, though no species were considered to have a moderate or greater likelihood of occurrence within the study area, and the project does not propose to have direct impacts on waterways. Further detail of the surveys undertaken are provided below.

Targeted surveys were not completed for threatened flora species. As per page three of the *Central Coast Flora and Fauna Guidelines* (Central Coast Council 2019), two hours of random meander and one BAM plot per 0.5 hectares of vegetation is considered sufficient to assess the presence of threatened flora if the site is unlikely to provide potential threatened flora habitat. Given the site primarily contains urban native/exotic vegetation, and any native vegetation was thoroughly surveyed, the completed BAM plots and random meandering was completed to assess the presence of threatened flora.

**Table 1 Fauna species subject to targeted survey**

Species name	Common name	Survey period	Method of assessment
<b>Woodland birds</b>			
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	Year-round	Targeted survey
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Year-round	Targeted survey
<i>Glossopsitta pusilla</i>	Little Lorikeet	Year-round	Targeted survey
<i>Neophema pulchella</i>	Turquoise Parrot	Year-round	Targeted survey
<i>Petroica boodang</i>	Scarlet Robin	Year-round	Targeted survey
<b>Mammals</b>			
<i>Petaurus norfolcensis</i>	Squirrel Glider	Year-round	Targeted survey

Species name	Common name	Survey period	Method of assessment
<b>Tree-hollow roosting microchiropteran</b>			
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	Year-round	Targeted survey (Opportunistic, low likelihood of occurrence)
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	Year-round	Targeted survey
<i>Miniopterus australis</i>	Little Bent-winged Bat	December-February	Targeted survey (Opportunistic, low likelihood of occurrence)
<i>Miniopterus orianae oceanensis</i>	Eastern Bent-winged Bat	December-February	Targeted survey (Opportunistic, low likelihood of occurrence)
<i>Myotis macropus</i>	Southern Myotis	October-March	Targeted survey
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tailed Bat	Year-round	Targeted survey (Opportunistic, low likelihood of occurrence)
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	Year-round	Targeted survey

Targeted threatened species surveys of the study area were undertaken in February and March 2022. Weather observations for each survey date are shown in Table 2.

**Table 2 Weather observations during targeted fauna surveys (Gosford, NSW)**

Survey undertaken	Survey date	Temperature (°C)		Rain (mm)
		Min.	Max.	
<ul style="list-style-type: none"> <li>Camera trapping</li> <li>Acoustic echolocation call detection</li> <li>Spotlight survey</li> <li>Stag watch</li> <li>Frog aural visual survey</li> </ul>	18/02/2022	18.6	28.9	16
<ul style="list-style-type: none"> <li>Camera trapping</li> <li>Acoustic echolocation call detection</li> </ul>	19/02/2022	21.5	23.8	-
	20/02/2022	16.4	29	-
	21/02/2022	21.5	30.1	0.2
	22/02/2022	20.9	22.7	-
<ul style="list-style-type: none"> <li>Camera trapping</li> <li>Acoustic echolocation call detection</li> </ul>	24/02/2022	21.8	25.9	22.8
	25/02/2022	20.2	26.3	137.6
	26/02/2022	20.1	22.2	38.6
	27/02/2022	19.5	24.4	13
	28/02/2022	19.4	24.8	10.6

Survey undertaken	Survey date	Temperature (°C)		Rain (mm)
		Min.	Max.	
	01/03/2022	19.6	23.5	19.6
	02/03/2022	20	22.5	20
	03/03/2022	20.1	24.9	20.1
<ul style="list-style-type: none"> <li>• Camera trapping</li> <li>• Acoustic echolocation call detection</li> <li>• Spotlight survey</li> <li>• Stag watch</li> <li>• Frog aural visual survey</li> </ul>	04/03/2022	20	22	10.8

Information from the Australia Government Bureau of Meteorology website.

## Threatened Fauna

Targeted surveys for threatened birds, mammals and microchiropteran bats were undertaken 18 February 2022 to 4 March 2022 by Dr Caragh Heenan (Project Zoologist) in accordance with:

- *Flora and Fauna Guidelines* (Central Coast Council 2019).
- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004).
- *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010a).
- *Survey Guidelines for Australia's Threatened Mammals* (DEWHA 2011).
- *Survey Guidelines for Australia's Threatened Bats* (DEWHA 2010).
- *'Species Credit' Threatened Bats and their Habitats: NSW Survey Guide for the Biodiversity Assessment Method* (OEH 2018).

Table 3 and Figure 2 provides a summary of the targeted fauna surveys completed.

Council's Flora and Fauna Guidelines (Central Coast Council 2019) recommends two nights of stag watching at 50 % of hollow-bearing trees present, to detect mammals and microchiropteran bats exiting at dusk. As there are 18 hollow-bearing trees within the study area, only one high quality hollow-bearing tree was subject to stag watch, as both camera trapping and acoustic echolocation call detection methods were also employed to detect species that may utilise hollows across the study area. Survey methods included deployment of two camera traps nearby hollows present on the site for the required survey period (14 days/nights), and two Songmeters were deployed for greater than the required survey period (two nights required, 14 nights deployed) (Central Coast Council 2019) (Appendix 3). Threatened birds were surveyed opportunistically, with all birds observed during the field investigation identified to species.

Council's Flora and Fauna Guidelines (Central Coast Council 2019) recommends targeted survey for threatened frogs is undertaken if there are proposed impacts to waterways. While there are two dams located within the study area, these will not be directly impacted by the proposed works. In addition, there are no threatened frogs considered to have a moderate or greater likelihood of occurrence within the study area. Despite this, threatened frogs were surveyed opportunistically concurrently with the stag watch via an aural and visual survey. Calling frogs were identified to species and a random meander adjacent to the southern dam's edge was undertaken.

**Table 3 Summary of targeted survey method and results**

Species name	Common name	Survey method	Survey results
<b>Woodland birds</b>			
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	<ul style="list-style-type: none"> <li>Opportunistic surveys and area search.</li> </ul>	Species not recorded.
<i>Daphoenositta chrysoptera</i>	Varied Sittella	<ul style="list-style-type: none"> <li>Opportunistic surveys and area search.</li> </ul>	Species not recorded.
<i>Glossopsitta pusilla</i>	Little Lorikeet	<ul style="list-style-type: none"> <li>Opportunistic surveys and area search.</li> </ul>	Species not recorded.
<i>Neophema pulchella</i>	Turquoise Parrot	<ul style="list-style-type: none"> <li>Opportunistic surveys and area search.</li> </ul>	Species not recorded.
<i>Petroica boodang</i>	Scarlet Robin	<ul style="list-style-type: none"> <li>Opportunistic surveys and area search.</li> </ul>	Species not recorded.
<b>Mammals</b>			
<i>Petaurus norfolcensis</i>	Squirrel Glider	<ul style="list-style-type: none"> <li>Two camera traps deployed (arboreal) adjacent to hollow-bearing trees for a period of 14 days/nights.</li> <li>Stag watching on two evenings.</li> <li>Spotlighting over two evenings in habitat containing hollow-bearing trees.</li> </ul>	Species not recorded.
<b>Tree-hollow roosting microchiropteran</b>			
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	<ul style="list-style-type: none"> <li>Acoustic echolocation call detection - Two Songmeters deployed for a period of 14 nights.</li> <li>Stag watching on two evenings.</li> </ul>	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or frequency, or call lacks sufficient detail (e.g. call quality) to be definite. Presence is therefore unable to be confirmed.
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	<ul style="list-style-type: none"> <li>Acoustic echolocation call detection - Two Songmeters deployed for a period of 14 nights.</li> <li>Stag watching on two evenings.</li> </ul>	Call characteristics (e.g. frequency, shape) overlap with other species or call lacks sufficient detail (e.g. call quality) making it too difficult to distinguish between species. Presence is therefore unable to be confirmed.

Species name	Common name	Survey method	Survey results
<b><i>Miniopterus australis</i></b>	Little Bent-winged Bat	<ul style="list-style-type: none"> <li>Acoustic echolocation call detection - Two Songmeters deployed for a period of 14 nights.</li> <li>Stag watching on two evenings.</li> </ul>	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or frequency, or call lacks sufficient detail (e.g. call quality) to be definite. Presence is therefore unable to be confirmed.
<b><i>Miniopterus orianae oceanensis</i></b>	Large Bent-winged Bat	<ul style="list-style-type: none"> <li>Acoustic echolocation call detection - Two Songmeters deployed for a period of 14 nights.</li> <li>Stag watching on two evenings.</li> </ul>	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or frequency, or call lacks sufficient detail (e.g. call quality) to be definite. Presence is therefore unable to be confirmed.
<b><i>Myotis macropus</i></b>	Southern Myotis	<ul style="list-style-type: none"> <li>Acoustic echolocation call detection - Two Songmeters deployed for a period of 14 nights.</li> <li>Stag watching on two evenings.</li> </ul>	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or frequency, or call lacks sufficient detail (e.g. call quality) to be definite. Presence is therefore unable to be confirmed.
<b><i>Saccolaimus flaviventris</i></b>	Yellow-bellied Sheath-tail-bat	<ul style="list-style-type: none"> <li>Acoustic echolocation call detection - Two Songmeters deployed for a period of 14 nights.</li> <li>Stag watching on two evenings.</li> </ul>	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or frequency, or call lacks sufficient detail (e.g. call quality) to be definite. Presence is therefore unable to be confirmed.

Species name	Common name	Survey method	Survey results
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	<ul style="list-style-type: none"> <li>Acoustic echolocation call detection - Two Songmeters deployed for a period of 14 nights.</li> <li>Stag watching on two evenings.</li> </ul>	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or frequency, or call lacks sufficient detail (e.g. call quality) to be definite. Presence is therefore unable to be confirmed.

#### 2.2.4 Permits and licences

The flora and fauna assessment was conducted under the terms of Biosis' Scientific Licence issued by the Environment, Energy and Science Group under the *National Parks and Wildlife Act 1974* (SL100758, expiry date 31 May 2022). Fauna survey was conducted under approval TRIM 17.892 from the NSW Animal Care and Ethics Committee (expiry date 31 January 2023).

#### 2.2.5 Limitations

Ecological surveys provide a sampling of flora and fauna at a given time and season. There are a number of reasons why not all species will be detected at a site during survey, such as 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 ecological values of a site.

The current flora and fauna assessment was conducted in February to March (summer) which is a suitable time for survey for most threatened species considered to have a medium or greater likelihood of occurrence in this assessment. All target species were surveyed during the Threatened Biodiversity Data Collection (TBDC) recommended period (DPIE 2021).

Several microchiropteran bats were considered to have a low likelihood of occurrence within the study area, however were surveyed incidentally on the basis of foraging habitat as a precautionary measure:

- Eastern False Pipistrelle *Falsistrellus tasmaniensis* (Vulnerable, BC Act).
- Large Bent-winged Bat *Miniopterus orianae oceanensis* (Vulnerable, BC Act).
- Little Bent-winged Bat *Miniopterus australis* (Vulnerable, BC Act).
- Yellow-bellied Sheath-tailed Bat *Saccolaimus flaviventris* (Vulnerable, BC Act).

Eastern False Pipistrelle, Large Bent-winged Bat, Little Bent-winged Bat and Yellow-bellied Sheath-tailed Bat were all detected within the study area (Appendix 2, Figure 2). Of these species, Large Bent-winged Bat is not hollow-dependent and is likely using the study area as foraging or transient use only. The survey effort for microbats meets the requirements under the Council survey guidelines (Central Coast Council 2019). A ToS has been prepared for hollow-dependent microbats, including those that were considered to have a low likelihood of occurrence but subsequently detected.

The Eastern Cave Bat and Greater Broad-nosed Bat may also have been recorded but reliable identification to species level was not possible due to poor data quality and/or similarity of call characteristics between species. However, due to the habitat requirements for these species, they are likely to be using the study area for foraging only.

## 3 Results

The study area is located approximately 8 kilometres from Gosford CBD, in an area comprised of a parklands, with the majority of the site being public open space. Most of study area has been cleared of native vegetation and replaced with planted urban native/exotic species. Native vegetation is limited to small patches of remnant bushland of which does not provide connectivity to vegetation in the broader community.

Regional soil landscape mapping indicates that the study area occurs on the Somersby landscape of the Gosford – lake Macquarie 1:100,000 Map Sheet Soil Landscape (Murphy 1993). The Somersby soils landscape is characterised by quartz sandstone with occasional shale caps, with a general elevation of 200 to 250 metres and a local relief to 30 metres. The landscape consists of horizontal Triassic quartz sandstone with thin conglomerates and shale ridge caps, as well as older Triassic lithic and quartz sandstones, deep yellow earths, uniform and texture-contrast soils, and loamy sand.

The study area is mapped as Gosford - Cooranbong Coastal Slopes (Gcs) Mitchell Landscape to the south and Somersby Plateau (Spp) Mitchell Landscape to the north (Mitchell 2002).

The Gosford - Cooranbong Coastal Slopes landscape is described as the coastal fall of the Sydney Basin and is characterised by rolling hills and sandstone plateau outliers of Triassic Narrabeen sandstones, extensive rock outcrop and low cliffs along ridge margins, with a general elevation to 75 metres. The landscape contains texture-contrast soils on lithic sandstones and shales, with loamy sand alluvium along creeks. Vegetation includes open forest and woodland of open forest and woodland of Smooth-barked Apple *Angophora costata*, Red Bloodwood *Corymbia gummifera*, Brown Stringybark *Eucalyptus capitellata*, Sydney Peppermint *Eucalyptus piperita*, Spotted Gum *Corymbia maculata*, Bastard Mahogany *Eucalyptus carnea*, Northern Grey Ironbark *Eucalyptus siderophloia* and Grey Gum *Eucalyptus punctata* on hills and slopes; closed forest with Turpentine *Syncarpia glomulifera*, Lilly Pilly *Acmena smithii*, Mountain Cedar Wattle *Acacia elata*, Coachwood *Ceratopetalum apetalum*, Sassafras *Doryphora sassafras* and Water Gum *Tristaniopsis laurina* in gullies under high escarpments Prickly-leaved Tea-tree *Melaleuca styphelioides* and other shrubs with Swamp Mahogany *Eucalyptus robusta*, Swamp Oak *Casuarina glauca*, sedges and common reed *Phragmites australis* on swampy creek flats.

The Somersby Plateau landscape consists of quartz sandstone with occasional shale caps, with a general elevation of 200 to 250 metres and a local relief to 30 metres. The landscape consists of horizontal Triassic quartz sandstone with thin conglomerates and shale ridge caps, as well as older Triassic lithic and quartz sandstones, deep yellow earths, uniform and texture-contrast soils, and loamy sand. Vegetation includes Sydney Blue Gum *Eucalyptus saligna*, Blackbutt *Eucalyptus pilularis*, Turpentine *Syncarpia glomulifera*, Grey Ironbark *Eucalyptus paniculata*, Sydney Peppermint *Eucalyptus piperita*, Smooth-barked apple *Angophora costata*, Scribbly Gum *Eucalyptus haemastoma*, Red Bloodwood *Corymbia gummifera*, Yellow Bloodwood *Corymbia eximia*, Coachwood *Ceratopetalum apetalum*, Water Gum *Tristaniopsis laurina*, Spotted Gum *Corymbia maculata*, Round-leaved Gum *Eucalyptus deanei*, Bangalow Palm *Archontophoenix cunninghamiana*, Forest Oak *Allocasuarina torulosa*, with diverse shrubs and patches of heath.

### 3.1 Vegetation communities

Prior to the field investigation, Biosis confirmed that various native vegetation communities including two TECs have been mapped in the broader landscape have been mapped in the broader landscape (DPIE 2019), these include:

- PCT 1642 *Scribbly Gum - Red Bloodwood - Old Man Banksia* heathy woodland of southern Central Coast, which is consistent with the TEC *Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion* (Critically Endangered Ecological Community [CEEC], BC Act).
- Urban Native and Exotic.

A key focus of the field investigation was to assess the vegetation of the study area against the final determinations for the above listed TECs to determine presence or absence.

The structure, floristic composition and condition of communities found within the study area are described in Table 4 and Figure 2.

**Table 4 Vegetation communities of the study area**

<b>PCT 1642 Scribbly Gum - Red Bloodwood - Old Man Banksia heathy woodland of southern Central Coast</b>	
<b>PCT</b>	1642 <i>Scribbly Gum - Red Bloodwood - Old Man Banksia</i> heathy woodland of southern Central Coast
<b>Extent within study area</b>	Approximately 0.38 ha of PCT 1642 was recorded within the study area.
<b>Description including fauna habitat</b>	<p>PCT 1642 typically exists as open forests to woodlands, dominated in the canopy by Eucalypts and related species, including Scribbly Gum <i>Eucalyptus haemastoma</i>, Sydney Red Gum <i>Angophora costata</i>, Silvertop Ash <i>E. sieberi</i> and, Red Bloodwood <i>Corymbia gummifera</i>. The mid-stratum is often characterised by tall Banksia and Leptospermum shrubs over a sub-stratum of smaller sclerophyllous shrubs, including Tautoon <i>Leptospermum polygalifolium</i>, Conesticks <i>Petrophile pulchella</i>, Sweet Wattle <i>Acacia suaveolens</i>, Heath-leaved Banksia <i>Banksia ericifolia</i>, Broad-leaved Geebung <i>Persoonia levis</i> and Saw Banksia <i>Banksia serrata</i>. Groundcover species generally include moisture-loving herbs and graminoids including <i>Lepyrodia scariosa</i>, Lesser Flannel Flower <i>Actinotus minor</i> and carrot Tops <i>Platysace linearifolia</i>.</p> <p>PCT 1642 within the study area was limited to isolated remnant patches containing a canopy dominated by Scribbly Gum and Sydney Red Gum with scattered occurrences of Grey Gum <i>Eucalyptus punctata</i>. The lower strata contained midstorey species such as Cheese Tree <i>Glochidion ferdinandi</i>, Black Wattle <i>Acacia decurrens</i>, Sweet Wattle and Sweet Pittosporum <i>Pittosporum undulatum</i>. The groundcover contained Spiny-head Matt-rush <i>Lomandra longifolia</i>, <i>Lomandra glauca</i>, Monkey Rope <i>Parsonsia straminea</i>, Pennywort <i>Centella asiatica</i>, Wiry Panic <i>Entolasia stricta</i> and Weeping Grass <i>Microlaena stipoides</i>. Exotic weed species found include Paddys Lucerne <i>Sida rhombifolia</i>, Blackberry-nightshade <i>Solanum nigrum</i> and Fleabane <i>Conyza bonariensis</i>.</p> <p>The PCT contains numerous hollow-bearing trees providing potential habitat for small arboreal mammals and low-lying rocky areas that may provide habitat for reptiles. In addition, there are several wood piles providing potential habitat for fauna and a drainage line/culvert to the north-east of the PCT that may provide habitat for frogs,</p>
<b>Condition</b>	The community is generally considered to be in a low condition state as it exists as isolated remnant patches with a heavily thinned lower strata.
<b>Associated soils, rainfall and landscape position</b>	PCT 1642 is associated with Dissected Sandstone Hills of the southern Central Coast hinterlands and occurs on elevations up to 350 m.
<b>Threatened ecological community</b>	<p><b>Commonwealth EPBC Act:</b> Not listed.</p> <p><b>NSW BC Act:</b> Critically Endangered.</p> <p>This community is consistent with the NSW BC Act listing for TEC <i>Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion</i>.</p>

### PCT 1642 Scribbly Gum - Red Bloodwood - Old Man Banksia heathy woodland of southern Central Coast

#### Threatened species habitat

PCT 1642 in its current condition state is not considered to provide habitat for threatened flora. However, it may provide habitat for threatened fauna including microchiropteran species, arboreal mammals (such as Squirrel Glider) and woodland birds.

#### Photo 1 PCT 1642 Scribbly Gum - Red Bloodwood - Old Man Banksia heathy woodland of southern Central Coast



### Urban Native/Exotic

#### PCT

N/A. Urban Native/Exotic

#### Vegetation description

The Urban Native/Exotic vegetation type was recorded in a variety of states ranging from mown nature strips to planted garden species and exotic weeds. Whilst native flora species were observed within this vegetation type, their presence was attributed to landscaping or amenity revegetation works only. As such, did not conform to a recognisable PCT.

Small shrubs and trees within planted garden strips primarily consisted of Camphor Laurel *Cinnamomum camphora*, Brush Box *Lophostemon confertus*, Hoop Pine *Araucaria cunninghamii*, Sweetgum *Liquidambar styraciflua* and White Poplar *Populus alba*. Areas of exotic grassland primarily contained Kikuyu *Cenchrus clandestinus*, Rhodes Grass *Chloris gayana*, and Common Couch *Cynodon dactylon*.

Priority weed species were additionally recorded within this vegetation type which included Lantana *Lantana camara*, Fireweed *Senecio madagascariensis* and Rubus *Rubus fruticosus* Blackberry.

## Urban Native/Exotic

**Photo 2 Urban native/Exotic**



### 3.2 Aquatic habitats

Two large dams occur within the study area. A third dam and one unnamed first order (Strahler) stream occur adjacent to the study area. In addition, one minor drainage line is present in the northern end of the study area, which appears to be subject to semi-regular ephemeral flows as indicated by the presence of more moisture dependent ferns. The drainage line did not contain leaf litter along the fringe and vegetation adjacent did not conform to a PCT.

### 3.3 Threatened species

Background searches identified 32 threatened flora species and 66 threatened fauna species recorded (EES 2021) or predicted to occur (Commonwealth of Australia 2021) within 5 kilometres of the study area. Previous records of threatened entities within 5 kilometres of the study area are shown in Figure 3 (flora) and Figure 4 (fauna). Those species considered most likely to have habitat within the study area based on the background research are as follows.

#### Flora

- *Darwinia glaucophylla* (Vulnerable, BC Act).
- *Grevillea shiressii* (Vulnerable, EPBC Act and BC Act).
- Spreading Guinea Flower *Hibbertia procumbens* (Endangered, BC Act).
- *Prostanthera junonis* (Endangered, EPBC Act and BC Act).
- *Tetradlea glandulosa* (Vulnerable, BC Act).

#### Fauna

- Dusky Woodswallow *Artamus cyanopterus cyanopterus* (Vulnerable, BC Act).
- Varied Sittella *Daphoenositta chrysoptera* (Vulnerable, BC Act).
- Little Lorikeet *Glossopsitta pusilla* (Vulnerable, BC Act).

- Eastern Coastal Free-tailed Bat *Micronomus norfolkensis* (Vulnerable, BC Act).
- Southern Myotis *Myotis macropus* (Vulnerable, BC Act).
- Turquoise Parrot *Neophema pulchella* (Vulnerable, BC Act).
- Squirrel Glider *Petaurus norfolcensis* (Vulnerable, BC Act).
- Scarlet Robin *Petroica boodang* (Vulnerable, BC Act).
- Greater Broad-nosed Bat *Scoteanax rueppellii* (Vulnerable, BC Act).

An assessment of the habitat values of the study area is provided below for threatened flora species and Table 5 for threatened fauna species, and discusses areas of value and potential impacts for all species with a medium or greater likelihood of occurrence, and determines the need for a Tests of Significance (ToS) for species listed under the BC Act, or Significant Impact Criteria (SIC) Assessment for species listed under the EPBC Act.

Recent records of the above listed threatened flora occur outside of the study area where large patches of undisturbed, intact native vegetation exists. Vegetation within the study area is predominantly Urban native/Exotic and any native vegetation is limited to small remnant patches which have been severely modified by garden landscaping. Nonetheless, the entirety of all areas of native vegetation within the study areas were surveyed using the random meander technique (Cropper 1993) via a series of lengthways traverses from east to west and is considered comprehensive to assess the presence of the flora species within the study area. Taking all of these factors into consideration, there is a low likelihood of occurrence for the above listed flora species.

**Table 5 Assessment of habitat for threatened fauna species**

Habitat feature	Threatened fauna association	Likelihood of occurrence or impact
<b>Feed trees</b>	Angophoras, Eucalypts and other flowering perennial species recorded in the study area may provide nectar resources suitable for a range of arboreal and flying fauna (such as gliders, Grey-headed Flying-fox and nectivorous bird species) whilst in flower.	Based on the transient nature of species reliant on foraging resources within the study area, impact to woodland nectivorous and microchiropteran species is unlikely.
<b>Hollow-bearing trees</b>	A total of 13 hollow-bearing trees Scribbly Gum <i>Eucalyptus haemastoma</i> were recorded in the study area containing small, medium, large and extra-large hollows. These tree hollows may provide potential roosting and/or nesting habitat for microbats but is unlikely to provide roosting habitat for Barking Owl and Powerful Owl due to the disturbed nature of the study area. Rainbow Lorikeets <i>Trichoglossus haematodus</i> and Common Brushtail Possums <i>Trichosurus vulpecula</i> were observed utilising hollows.	It is recommended that if possible, the hollow-bearing trees are to be retained as important habitat features in the landscape that may be used by threatened microbats, as well as providing feeding and perching habitat for other generic avifauna.

Habitat feature	Threatened fauna association	Likelihood of occurrence or impact
<b>Waterways</b>	Two large dams/ponds were recorded in the study area, however has loss of connectivity to surrounding waterways. One drainage easement was recorded within the study area.	Dams adjacent to the study area provide marginal habitat for threatened species. No threatened frogs or fish are considered likely to occur within the study area. The dams and drainage easement will not be directly impacted by the proposed works.

Based on the size of the study area, the survey effort is considered comprehensive to assess habitat presence for the species outlined in Table 5. Taking all of these factors into consideration, there is a low likelihood of impact for the above listed nomadic species.

### 3.3.1 Priority weeds

Three priority weeds for the Greater Sydney LLS region, which includes the Gosford LGA, have been recorded in the study area, and are listed in Table 6, along with their associated Biosecurity Duty in accordance with the Biosecurity Act.

The Biosecurity Act provides for the identification, classification and control of priority weeds with the purpose of determining if a biosecurity risk is likely to occur. 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.

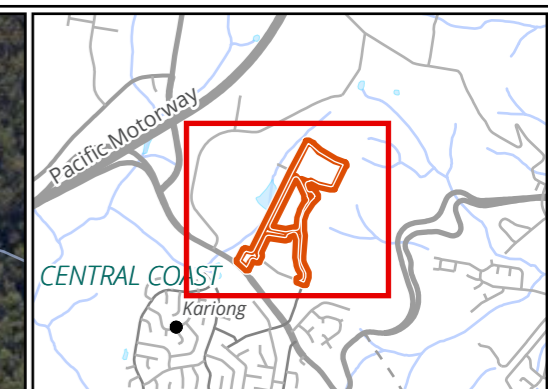
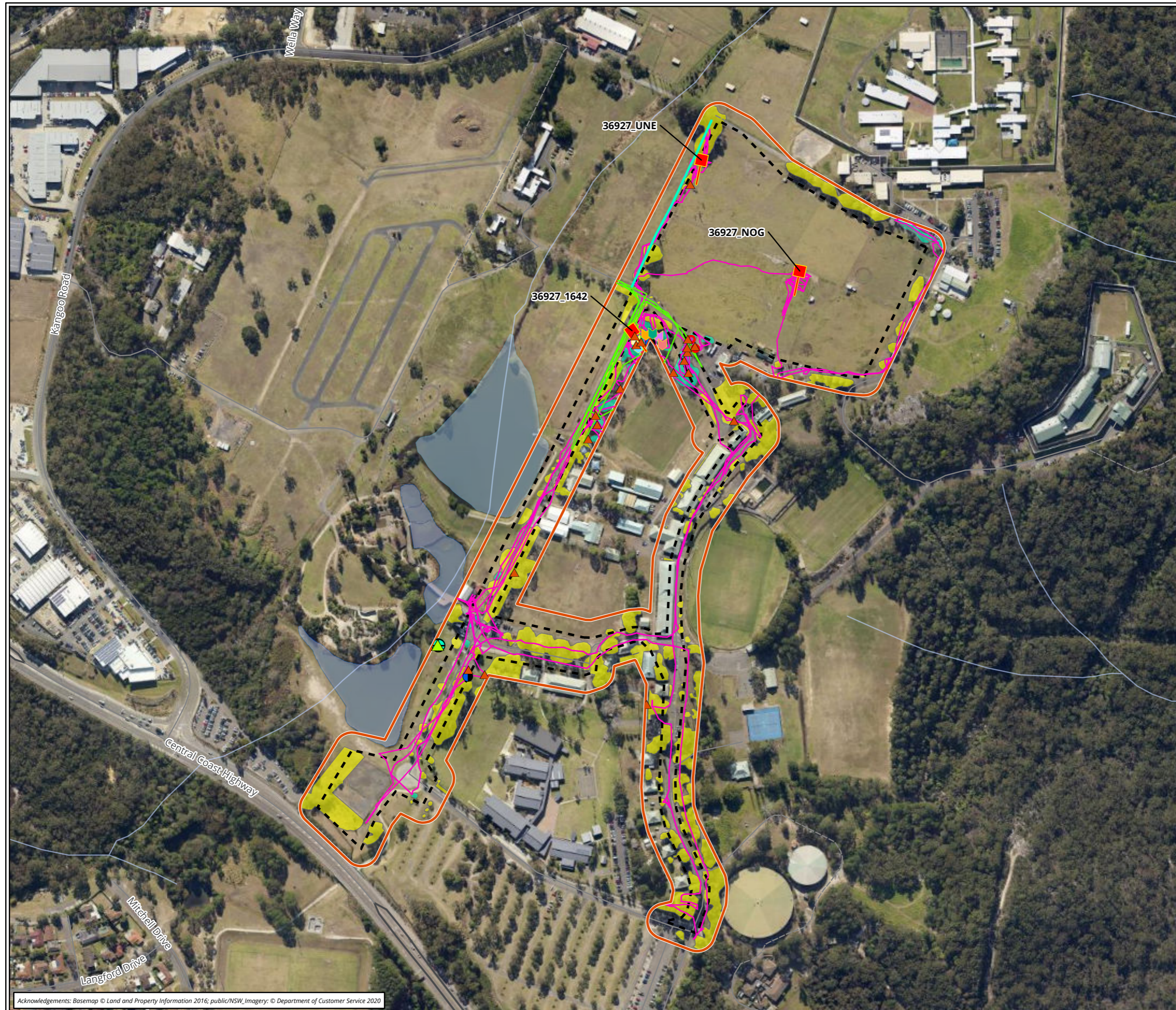
The General Biosecurity Duty as outlined in the Biosecurity Act states:

*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.*

**Table 6 Priority weeds within the study area**

Scientific name	Common name	Relevant biosecurity duty
<i>Lantana camara</i>	Lantana	No relevant biosecurity measures, general biosecurity measures apply.
<i>Rubus fruticosus</i>	Blackberry	No relevant biosecurity measures, general biosecurity measures apply.
<i>Senecio madagascariensis</i>	Fireweed	No relevant biosecurity measures, general biosecurity measures apply.

To prevent biosecurity impacts from occurring as a result of the presence of the above listed priority weeds within the study area, all practical steps should be taken to control and eradicate the weeds from the study area as per the relevant biosecurity duties outlined above, or prior to or during any future vegetation removal.



#### Legend

- Study area
- Development footprint
- Drainage easement
- Native vegetation to be removed
- BAM Plot
- Anabat
- Frog survey
- Stag watch
- Hollow-bearing tree
- Flora transect
- Spotlight survey

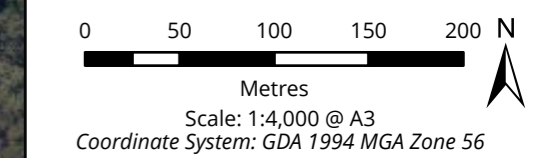
#### Threatened microbats recorded on site

- Eastern Bentwing-bat *Miniopterus orianae oceanensis*
- Eastern False Pipistrelle *Falsistrellus tasmaniensis*
- Greater Broad-nosed Bat *Scoteanax rueppellii*
- Large-footed Myotis *Myotis macropus*
- Little Bent-winged Bat *Miniopterus australis*
- Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*

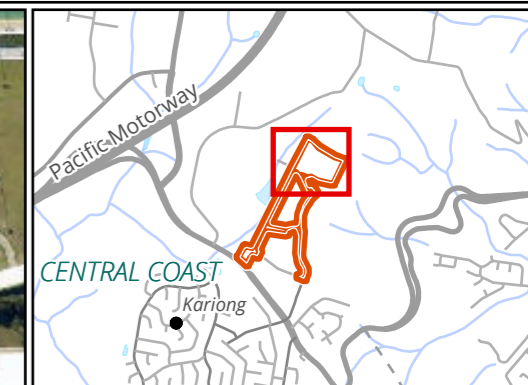
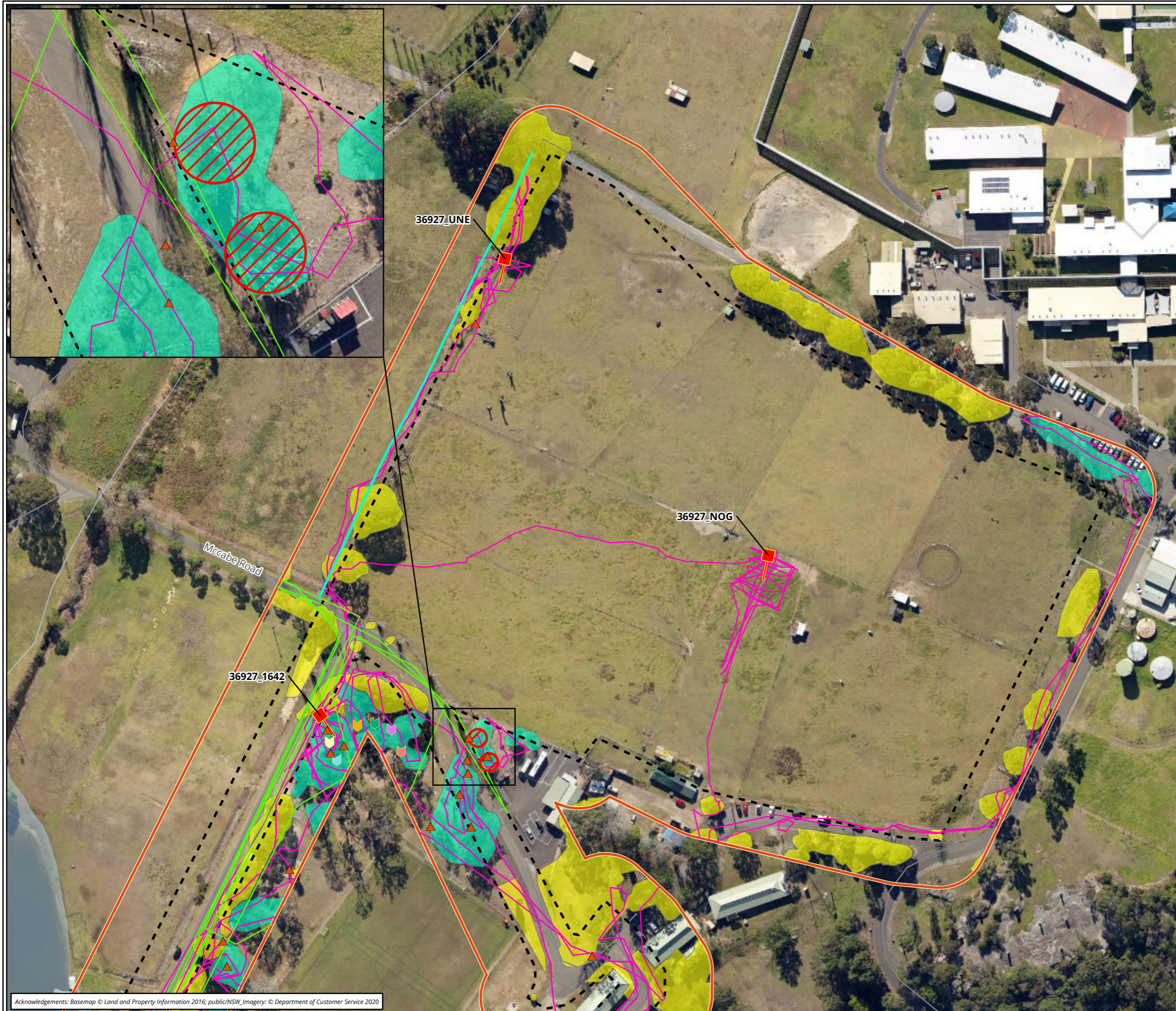
#### Plant Community Type

- Urban Native/Exotic
- 1642 - Scribbly Gum - Red
- Bloodwood - Old Man Banksia
- heathy woodland of southern Central Coast

**Figure 2 Ecological values of the study area**



Matter: 36927, Date: 09 May 2022,  
Drawn by: JB, Checked by: CH, Last edited by: amackegard  
Layout: 36927\_F2\_EcoValues  
Project: P:\36900s\36927\Mapping\  
36927\_FFA\_MtPenangParklands.aprx



#### Legend

- Study area
- Development footprint
- Drainage easement
- Native vegetation to be removed
- BAM Plot
- Hollow-bearing tree
- Flora transect
- Spotlight survey

#### Threatened microbats recorded on site

- Eastern Bentwing-bat *Miniopterus orianae oceanensis*
- Eastern False Pipistrelle *Falsistrellus tasmaniensis*
- Greater Broad-nosed Bat *Scoteanax rueppellii*
- Large-footed Myotis *Myotis macropus*
- Little Bent-winged Bat *Miniopterus australis*
- Yellow-bellied Sheath-tail-bat *Saccolaimus flaviventris*

#### Plant Community Type

- Urban Native/Exotic
- 1642 - Scribbly Gum - Red
- Bloodwood - Old Man Banksia
- heathy woodland of southern Central Coast

**Figure 2.1 Ecological values of the study area**

0 10 20 30 40

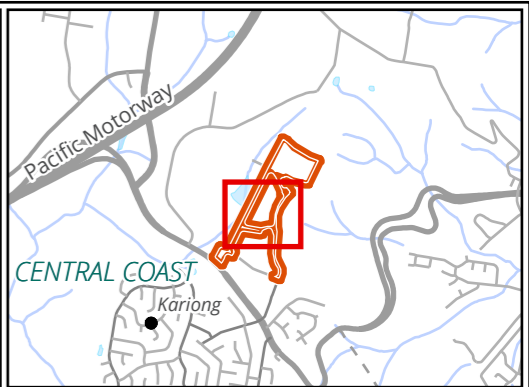
Metres

Scale: 1:1,500 @ A3

Coordinate System: GDA 1994 MGA Zone 56



Matter: 36927, Date: 09 May 2022,  
Drawn by: JB, Checked by: CH, Last edited by: amackegard  
Layout: 36927\_F2\_EcoValues  
Project: P:\36900s\36927\Mapping\  
36927\_FFA\_MtPenangParklands.aprx



**Legend**

- Study area
- Development footprint
- Anabat
- Frog survey
- Stag watch
- Hollow-bearing tree
- Flora transect
- Spotlight survey

**Plant Community Type**

- Urban Native/Exotic
- 1642 - Scribbly Gum - Red Bloodwood - Old Man Banksia heathy woodland of southern Central Coast

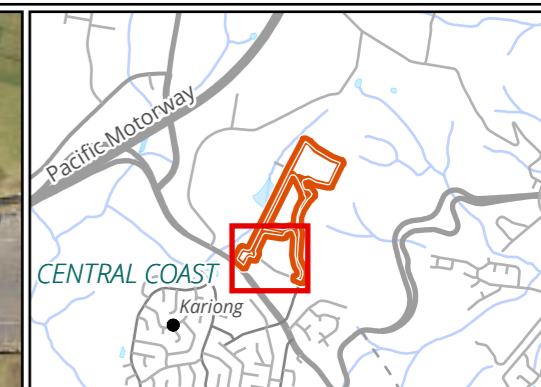
**Figure 2.2 Ecological values of the study area**

0 10 20 30 40  
Metres

Scale: 1:1,500 @ A3  
Coordinate System: GDA 1994 MGA Zone 56



Matter: 36927, Date: 09 May 2022,  
Drawn by: JB, Checked by: CH, Last edited by: amackegard  
Layout: 36927\_F2\_EcoValues  
Project: P:\36900s\36927\Mapping\36927\_FFA\_MtPenangParklands.aprx



#### Legend

- Study area
- Development footprint
- Anabat
- Frog survey
- Stag watch
- Hollow-bearing tree
- Flora transect

#### Plant Community Type

- Urban Native/Exotic
- 1642 - Scribbly Gum - Red
- Bloodwood - Old Man Banksia
- heathy woodland of southern Central Coast

**Figure 2.3 Ecological values of the study area**

0 10 20 30 40

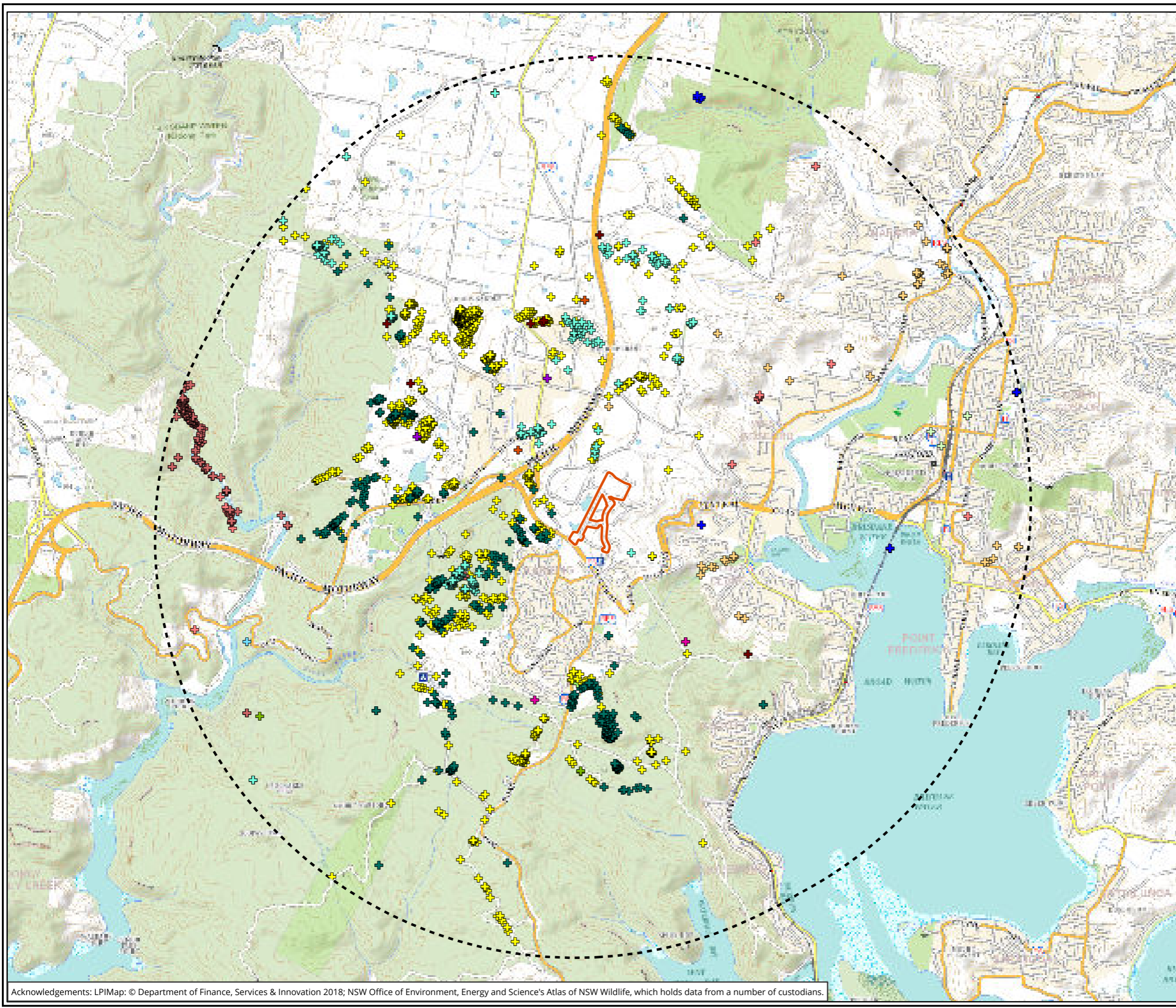
Metres

Scale: 1:1,500 @ A3

Coordinate System: GDA 1994 MGA Zone 56



Matter: 36927, Date: 09 May 2022,  
Drawn by: JB, Checked by: CH, Last edited by: amackegard  
Layout: 36927\_F2\_EcoValues  
Project: P:\36900s\36927\Mapping\  
36927\_FFA\_MtPenangParklands.aprx



**Legend**

Study area

Search area

**Threatened Flora**

- 10608 - *Baloskion longipes*
- 11422 - *Hibbertia puberula*
- 2544 - *Hibbertia procumbens*
- 4028 - *Darwinia glaucophylla*
- 4067 - *Eucalyptus camfieldii*
- 4096 - *Eucalyptus glaucina*
- 4248 - *Melaleuca deanei*
- 4283 - *Rhodamnia rubescens*
- 4284 - *Rhodomyrtus psidioides*
- 4293 - *Syzygium paniculatum*
- 4746 - *Ancistrachne maidenii*
- 5400 - *Grevillea shiressii*
- 6205 - *Tetradlea glandulosa*
- 6809 - *Melaleuca biconvexa*
- 7752 - *Epacris purpurascens* var. *purpurascens*
- 9884 - *Prostanthera junonis*
- 9885 - *Prostanthera askania*
- 4007 - *Callistemon linearifolius*\*
- 4415 - *Cryptostylis hunteriana*\*
- 4442 - *Diuris bracteata*\*
- 5458 - *Persoonia hirsuta*\*
- 6630 - *Dendrobium melaleucaphilum*\*
- 8129 - *Lindsaea fraseri*\*

\* Record is listed as sensitive under EES's Sensitive Species Data Policy and cannot be shown at this scale

**Figure 3 Threatened flora species recorded within 5 km of the study area**

0 500 1,000 1,500 2,000

Metres

Scale: 1:42,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

**biosis**

Biosis Pty Ltd

Albury, Ballarat, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 36927, Date: 09 May 2022, Checked by: CH, Drawn by: JB, Last edited by: amackegard Location: P:\36900s\36927\Mapping\36927\_FFA\_MtPenangParklands



## 4 Ecological impacts and recommendations

The proposed sewerage and road works involve the following impacts to ecological features:

- Removal of vegetation and hollow-bearing trees:
  - Approximately 1.54 ha of Urban native/Exotic vegetation.
  - Two trees (0.09 ha) containing hollows associated with the Kincumber Scribbly Gum Forest.

### 4.1 Environment Protection and Biodiversity Conservation Act 1999

An assessment of the impacts of the proposed development on Matters of National Environmental Significance (MNES), as outlined in, *Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia 2013) was prepared to determine whether referral of the project to the Commonwealth Minister for the Environment and Energy is required. MNES relevant to the project are summarised in Table 7.

**Table 7 Assessment of the project against the EPBC Act**

Matter of NES	Project specifics	Assessment against Commonwealth of Australia (2013)
<b>Threatened species (flora and fauna)</b>	No fauna or flora species listed under the EPBC Act are considered likely to occur within the study area and have the potential to be impacted by the proposed works.	Not applicable.
<b>Threatened ecological communities</b>	No EPBC Act listed TECs were mapped within the study area.	Not applicable.
<b>Migratory species</b>	The study area does not provide important habitat for an ecologically significant proportion of any migratory species.	While some of these species would be expected to use the study area on occasions, some may do so regularly and others may be resident. The study area does not provide important habitat for an ecologically significant proportion of any of these species.
<b>Wetlands of international importance (Ramsar sites)</b>	There are 12 Ramsar sites in NSW, the closest one being Hunter Estuary Wetlands, located 100 km to the north-east of the study area, and Towra Point Nature Reserve located 100 km to the south-east.	The study area does not flow directly into a Ramsar site and the development is not likely to result in a significant impact.

On the basis of criteria outlined in Commonwealth of Australia (2013) it is considered unlikely that a significant impact on a MNES would result from the project. However, applicant may choose to refer the proposed action to the Australian Government Minister for the Environment and Energy to determine whether the action requires approval under the EPBC Act.

## 4.2 Environmental Planning and Assessment Act 1979

An assessment of the project against the relevant sections of the EP&A Act is provided below.

### Test of Significance

Tests of Significance were completed for 13 species and one TEC considered to have a medium or greater likelihood of occurrence within the study area (see Appendix 4). They indicate that a significant effect is not likely to result from the project. A Species Impact Statement (SIS) or Biodiversity Development Application Report (BDAR) is therefore not required.

**Table 8 Summary of Tests of Significance**

Scientific name	Common name	1	2	3	4	5	6	7	Significant effect?
<b>TECs</b>									
<i>Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion</i>	Kincumber Scribbly Gum Forest	N	N	N	N	N	N	N	No
<b>Woodland birds</b>									
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	N	N	N	N	N	N	N	No
<i>Daphoenositta chrysoptera</i>	Varied Sittella	N	N	N	N	N	N	N	No
<i>Glossopsitta pusilla</i>	Little Lorikeet	N	N	N	N	N	N	N	No
<i>Neophema pulchella</i>	Turquoise Parrot	N	N	N	N	N	N	N	No
<i>Petroica boodang</i>	Scarlet Robin	N	N	N	N	N	N	N	No
<b>Mammals</b>									
<i>Petaurus norfolcensis</i>	Squirrel Glider	N	N	N	N	N	N	N	No
<b>Tree-hollow roosting microchiropteran</b>									
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	N	N	N	N	N	N	N	No
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	N	N	N	N	N	N	N	No
<i>Miniopterus australis</i>	Little Bent-winged Bat	N	N	N	N	N	N	N	No
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	N	N	N	N	N	N	N	No
<i>Myotis macropus</i>	Southern Myotis	N	N	N	N	N	N	N	No
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	N	N	N	N	N	N	N	No
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	N	N	N	N	N	N	N	No

### 4.3 Local Environmental Plans and Development Control Plans

Local Environmental Plans (LEPs) and Development Control Plans (DCPs) relevant to this project include:

- *Gosford Local Environmental Plan 2014.*
- *Gosford Development Control Plan 2013.*

Land within the study area is zoned SP1 (Special Activities) under the Gosford LEP and therefore any development within this zone is prohibited. However, as a public authority, HCCDC can undertake the proposed road and sewerage works under the *State Environmental Planning Policy (Transport and Infrastructure) 2021*. As such, the proposed works will be carried out in accordance with the objectives of these LEPs and DCPs.

#### Biodiversity Offsets Scheme

As the project is unlikely to result in a significant effect on threatened species, populations or communities listed under the BC Act, consideration of the BOS is not warranted.

### 4.4 Water Management Act 2000

Two large dams occur within the study area. The study area does not contain any Strahler order waterways (Strahler 1964).

As a public authority, HCCDC does not need to obtain a controlled activity approval from the Natural Resources Access Regulator for any controlled activities that it carries out in, on or under waterfront land.

### 4.5 Fisheries Management Act 1994

The FM Act provides for the protection and conservation of aquatic species and their habitat throughout NSW. Impacts to threatened species, populations and communities, and critical habitats listed under the FM Act must be assessed in accordance with Part 7A of the Act which includes an assessment of significant effect on threatened species, populations or ecological communities, or their habitats.

The study area does not contain any Strahler order waterways (Strahler 1964). Two large dams and one drainage easement that is not consistent with definitions of a waterway occur within the study area.

'Water land' is defined under the FM Act as land submerged by water: whether permanently or intermittently, or, whether forming an artificial or natural body of water, and includes wetlands and any other land prescribed by the FM Regulations as water land.

The FM Act provides for the protection and conservation of aquatic species and their habitat throughout NSW. Impacts to threatened species, populations and communities, and critical habitats listed under the FM Act must be assessed through an Assessment of Significance process (see above).

No predicted habitat for threatened aquatic species is mapped on the DPI spatial data portal within the study area. No records of threatened aquatic species have been recorded within 10 kilometres of the study area on the BioNet Atlas of NSW. The field investigation identified a degree weed ingress and point source pollution inputs (e.g. stormwater outlets). No suitable habitat for threatened aquatic species was identified. Therefore, no threatened aquatic species, populations or communities listed under the FM Act are likely to occur or be impacted by the proposed works within the study area.

The project will not result in impacts to fish passage, and assessment by NSW Fisheries is not required.

## 5 Conclusion

---

This report is an assessment of the potential impact of a residential development on ecological values within Mount Penang Parklands in accordance with the EP&A Act, Commonwealth EPBC Act and NSW BC Act.

The proposed activities that will result in impacts to ecological values including:

- Removal of vegetation and hollow-bearing trees:
  - Approximately 1.54 ha of Urban native/Exotic vegetation.
  - Two trees (0.09 ha) containing hollows associated with the Kincumber Scribbly Gum Forest TEC.

No flora species or endangered populations listed under the EPBC Act or BC Act were recorded during the field surveys in the study area.

One of the vegetation communities mapped by Biosis within the study area is consistent with the final determinations for TEC Kincumber Scribbly Gum Forest under the BC Act. A total of two trees associated with the Kincumber Scribbly Gum Forest were identified to be impacted as a result of the proposed works.

Following field investigations, no EPBC Act listed flora species were considered to have a moderate or higher likelihood of occurrence within the study area. However 13 fauna species and one TEC listed under the BC Act were considered to have a moderate or greater likelihood of occurrence in the study area. No ToS were carried out for fauna species to which the proposal was considered likely to impact on limiting foraging resources. ToS carried out for species impacted by roosting habitat concluded the proposal is unlikely to have a significant impact on any BC Act listed fauna species. Therefore an SIS or BDAR is not required,

Recommendations specific to the removal of threatened and general fauna species habitat have been included in the summary section of this report, including vegetation and habitat clearance protocols. After implementing avoidance and minimisation of all associated impacts, it is considered that the development will have a negligible impact on biodiversity values.

## References

---

- Central Coast Council 2019. *Flora and Fauna Guidelines*, Central Coast Council, NSW.
- Commonwealth of Australia 2013. Matters of National Environmental Significance: Significant impact guidelines 1.1.
- Commonwealth of Australia 2021. *Protected Matters Search Tool*, Australian Government Department of the Environment, Water, Heritage & the Arts, Canberra, <https://www.environment.gov.au/epbc/protected-matters-search-tool>.
- Crane M, Lindenmeyer D, & Cunningham R 2010. 'The use of den trees by the squirrel glider ( *Petaurus norfolcensis* ) in temperate Australian woodlands.', *Australian Journal of Zoology*, 10.
- Cropper S 1993. *Management of Endangered Plants*, CSIRO Publications Victoria, Melbourne, Victoria.
- DEC 2004. *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities (Working Draft)*, New South Wales Department of Environment and Conservation, Hurstville, NSW.
- DEWHA 2010. *Survey Guidelines for Australia's Threatened Bats: Guidelines for detecting bats listed as threatened under Environment Protection and Biodiversity Conservation Act 1999*, Department of the Environment Water Heritage and the Arts.
- DEWHA 2011. *Survey guidelines for Australia's threatened Mammals: Guidelines for detecting mammals listed as threatened under Environment Protection and Biodiversity Conservation Act 1999*, Department of the Environment Water Heritage and the Arts.
- DPE 2017a. *Dusky Woodswallow - profile*, NSW Department of Planning and Environment. Sydney, NSW, <https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20303>.
- DPE 2017b. *Squirrel Glider - profile*, NSW Department of Planning and Environment. Sydney, NSW, <https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10604>.
- DPE 2017c. *Eastern False Pipistrelle - profile*, New South Wales Government of Planning and environment. Sydney, NSW, <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10331>.
- DPE 2019. *Little Bent-winged Bat - profile*, Department of Planning and Environment. Sydney, NSW, <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10533>.
- DPE 2020. *Southern Myotis - profile*, NSW Department of Planning and Environment. Sydney, NSW, <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10549>.
- DPE 2022. *Greater Broad-nosed Bat - profile*, NSW Department of Planning and Environment. Sydney, NSW, <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10748>.
- DPIE 2019. Greater Hunter Native Vegetation Mapping v4.0. VIS ID 3855.
- DPIE 2020. *Biodiversity Assessment Method (BAM)*, Department of Planning, Industry & Environment, <https://www.environment.nsw.gov.au/research-and-publications/publications-search/biodiversity-assessment-method-2020>.

- DPIE 2021. *NSW BioNet Threatened Biodiversity Profile Data Collection*,  
<https://data.nsw.gov.au/data/dataset/9125a0e2-a575-40d4-83b0-45d985420d0e>.
- EES 2021. *BioNet the website for the Atlas of NSW Wildlife*, <http://www.bionet.nsw.gov.au/>.
- Keith D 2004. *Ocean Shores to Desert Dunes: the native vegetation of New South Wales and the ACT*, Department of Environment and Conservation, Hurstville, NSW.
- Mitchell P 2002. *NSW (Mitchell) Landscapes*, Department of Environment and Climate Change NSW, Hurstville NSW.
- Murphy CL 1993. *Soil Landscapes of the Gosford-Lake Macquarie 1:100 00 Sheet*, Department of Conservation and Land Management, Sydney.
- OEH 2018. *'Species credit' threatened bats and their habitats – NSW survey guide for the Biodiversity Assessment Method*, 1st edn, Office of Environment and Heritage, Office of Environment and Heritage, Sydney NSW 2000, 978-1-92575-453-7.
- Smith AP & Murray M 2003. 'Habitat requirements of the squirrel glider (*Petaurus norfolcensis*) and associated possums and gliders of the New South Wales central coast', *Wildlife Research*, 30: 291–301.
- Standards Australia 2009. Australian Standard 4970-2009 Protection of trees on development sites.
- Strahler A 1964. 'Quantitative geomorphology of drainage basins and channel networks' in Chow V (ed.), *Handbook of Applied Hydrology*, McGraw-Hill, New York.

## Appendices

---

## Appendix 1 Flora

### Flora species recorded from the study area

**Table A.1** Flora species recorded from the study area

Scientific name	Common name
<b>Native species</b>	
<i>Acacia decurrens</i>	Black Wattle
<i>Acacia longifolia</i>	Long-leaved Wattle
<i>Angophora costata</i>	Sydney Red Gum
<i>Calochlaena dubia</i>	Rainbow Fern
<i>Centella asiatica</i>	Indian Pennywort
<i>Commelina cyanea</i>	Native Wandering Jew
<i>Dichondra repens</i>	Kidney Weed
<i>Entolasia stricta</i>	Wiry Panic
<i>Eucalyptus haemastoma</i>	Broad-leaved Scribbly Gum
<i>Eucalyptus punctata</i>	Grey Gum
<i>Glycine clandestina</i>	Twining Glycine
<i>Glochidion ferdinandi</i>	Cheese Tree
<i>Juncus usitatus</i>	Common Rush
<i>Lomandra glauca</i>	Pale Mat-rush
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
<i>Microlaena stipoides</i>	Weeping Grass
<i>Parsonsia straminea</i>	Common Silkpod
<i>Pittosporum undulatum</i>	Sweet Pittosporum
<b>Exotic Species</b>	
<i>Acer negundo</i>	Box Elder
<i>Acetosella vulgaris</i>	Sheep Sorrel
<i>Ageratina adenophora</i>	Crofton Weed
<i>Araucaria cunninghamii</i>	Hoop Pine
<i>Callistemon citrinus</i>	Crimson Bottlebrush
<i>Cenchrus clandestinus</i>	Kikuyu Grass
<i>Chloris gayana</i>	Rhodes Grass
<i>Cinnamomum camphora</i>	Camphor Laurel

Scientific name	Common name
<i>Conyza bonariensis</i>	Flaxleaf Fleabane
<i>Cyperus eragrostis</i>	Umbrella Sedge
<i>Dietes bicolor</i>	Peacock flower
<i>Digitaria ciliaris</i>	Summer Grass
<i>Echinochloa crus-galli</i>	Barnyard Grass
<i>Ehrharta erecta</i>	Panic Veldtgrass
<i>Lagerstroemia indica</i>	Crepe Myrtle
<i>Lantana camara</i>	Lantana
<i>Ligustrum sinense</i>	Small-leaved Privet
<i>Liquidambar styraciflua</i>	Sweetgum
<i>Lophostemon confertus</i>	Brush Box
<i>Lysimachia arvensis</i>	Scarlet Pimpernel
<i>Modiola caroliniana</i>	Red-flowered Mallow
<i>Onopordum acanthium</i> subsp. <i>acanthium</i>	Scotch Thistle
<i>Phalaris aquatica</i>	Phalaris
<i>Phytolacca octandra</i>	Inkweed
<i>Populus alba</i>	White Poplar
<i>Portulaca oleracea</i>	Pigweed
<i>Richardia brasiliensis</i>	Mexican Clover
<i>Rumex obtusifolius</i>	Broadleaf Dock
<i>Senecio madagascariensis</i>	Fireweed
<i>Setaria pumila</i>	Pale Pigeon Grass
<i>Sida rhombifolia</i>	Paddy's Lucerne
<i>Solanum mauritianum</i>	Wild Tobacco
<i>Solanum nigrum</i>	Black-berry Nightshade
<i>Sonchus oleraceus</i>	Common Sowthistle
<i>Stellaria media</i>	Common Chickweed
<i>Triadica sebifera</i>	Chinese Tallowood
<i>Verbena bonariensis</i>	Purpletop

## Threatened flora species

The following table includes a list of the threatened flora species that have potential to occur within the study area. The list is based on database searches outlined in Section 2.1.

### Notes to table:

Conservation status	Most recent record
CR – Critically Endangered	# species predicted to occur by the PMST (not recorded on other databases).
EN – Endangered	
VU – Vulnerable	

Examples of criteria for determining the likelihood of occurrence for threatened biota as a guide for writing the rationale for likelihood have been listed below.

Likelihood of occurrence	Potential criteria
<b>High</b>	<ul style="list-style-type: none"> <li>Species recorded in study area during current or previous assessment/s.</li> <li>Aquatic species recorded from connected waterbodies in close proximity to the study area during current or previous assessment/s.</li> <li>Sufficient good quality habitat is present in study area or in connected waterbodies in close proximity to the study area (aquatic species).</li> <li>Study area is within species natural distributional range (if known).</li> <li>Species has been recorded within 5 km or from the relevant catchment/basin.</li> </ul>
<b>Medium</b>	<ul style="list-style-type: none"> <li>Records of terrestrial biota within 5 km of the study area or of aquatic species in the relevant basin/neighbouring basin.</li> <li>Habitat limited in its capacity to support the species due to extent, quality, or isolation.</li> </ul>
<b>Low</b>	<ul style="list-style-type: none"> <li>No records within 5 km of the study area or for aquatic species, the relevant basin/neighbouring basin.</li> <li>Marginal habitat present (low quality &amp; extent).</li> <li>Substantial loss of habitat since any previous record(s).</li> </ul>
<b>Negligible</b>	<ul style="list-style-type: none"> <li>Habitat not present in study area</li> <li>Habitat for aquatic species not present in connected waterbodies in close proximity to the study area.</li> <li>Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.</li> </ul>

**Table A.2 Threatened flora species recorded/predicted to occur within 5 kilometres of the study area**

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale for likelihood ranking
		EPBC	BC				
<i>Acacia bynoeana</i>	Bynoe's Wattle	VU	EN	#	Negligible	Semi prostrate shrub growing in central eastern NSW spanning from the Hunter District, west to the Blue Mountains and south to the Southern Highlands. Grows in a variety of communities including; Southern Tableland Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Coastal Valley Grassy Woodlands and Sydney Coastal Heaths. Prefers open, slightly disturbed sites on sandy soils.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<i>Ancistrachne maidenii</i>	-	-	VU	2001	Negligible	Scrambling perennial grass restricted to northern Sydney around the St Albans-Mt White-Maroota-Berowra regions and Shannon Creek near Grafton. Grows in transitional geology between Hawkesbury and Watagan soil landscapes in a variety of communities including South Coast Dry Sclerophyll Forests, Coastal Floodplain Wetlands, North Coast Wet Sclerophyll Forests, and Sydney Hinterland Dry Sclerophyll Forests. Grows on sandstone derived soils.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<i>Asterolasia elegans</i>	-	EN	EN	#	Negligible	Tall, thin shrub found growing north of Sydney in the Baulkham Hills, Hawkesbury and Hornsby districts. Could also occur in the Goulburn area. Grows in wet sclerophyll forest on moist hillsides in Sydney Coastal Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests and North Coast Wet Sclerophyll Forests. Grows on Hawkesbury sandstone.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<i>Baloskion longipes</i>	Dense Cord-rush	VU	VU	2003#	Negligible	Perennial rush-like herb found in the Blue Mountains National Park, Kanangra-Boyd National Park, Penrose State Forest, Morton National Park, Clyde Mountain and Ballalaba. Grows in swamps and depressions, occasionally associated	Vegetation within the study area is primarily urban native/exotic.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale for likelihood ranking
		EPBC	BC				
						with Sphagnum Moss in a variety of communities including South East Dry Sclerophyll Forests, Coastal Heath Swamps, Montane Bogs and Fens and Subalpine Woodlands. Grows in sandy alluvium.	Native vegetation was thoroughly surveyed.
<b><i>Caladenia tessellata</i></b>	Thick Lip Spider Orchid	VU	EN	#	Negligible	Small orchid recorded from the Wyong, Ulladulla and Braidwood regions with the Kiama and Queanbeyan populations believed to be extinct. Found in a wide variety of communities including Central Gorge Dry Sclerophyll Forests, Cumberland Dry Sclerophyll Forests, Coastal Floodplain Woodlands and Subalpine Woodlands. Grows on clay loam or sandy soils.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Callistemon linearifolius</i></b>	Netted Bottle Brush	-	VU	2019	Negligible	Shrub recorded from the Georges River to the Hawkesbury River, north of the Nelson Bay area and south at Coalcliff in the Illawarra region. 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.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Cryptostylis hunteriana</i></b>	Leafless Tongue Orchid	VU	VU	2008#	Negligible	Orchid with a distribution spanning from Gibraltar Range National Park southwards to the coastal area near Orbost in Victoria. 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.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Cynanchum elegans</i></b>	White-flowered Wax Plant	EN	EN	#	Negligible	Climbing vine restricted to eastern NSW from Brunswick Heads to Gerroa in the Illawarra region. Grows in rainforest gully scrub and scree slope on the edge of dry rainforests in a variety of communities including Coastal Floodplain	Vegetation within the study area is primarily urban native/exotic.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale for likelihood ranking
		EPBC	BC				
						Wetlands, Maritime Grasslands, Coastal Valley Grassy Woodlands and Northern Hinterland Wet Sclerophyll Forests.	Native vegetation was thoroughly surveyed.
<b><i>Darwinia glaucophylla</i></b>	-	-	VU	2021	Negligible	Prostrate shrub growing between Gosford and the Hawkesbury River around Calga, Kariong and Mount Karing. Associated with rock platforms or hanging swamps in Sydney Coastal Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Coastal Heath Swamps and Sydney Coastal Heaths. Grows in friable, shallow sandstone soils.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Dendrobium melaleucaphilum</i></b>	Spider orchid	-	EN	1935	Negligible	Epiphytic Orchid with a distribution confined to the coastal districts extending from Queensland down to the lower Blue Mountains. Grows on Prickly Paperbark trees <i>Melaleuca styphelioides</i> and occasionally on rainforest trees or on rocks in Coastal Floodplain Wetlands, Coastal Swamp Forests and Coastal Valley Grassy Woodlands.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Diuris bracteata</i></b>	-	EX	EN	1996	Negligible	Terrestrial orchid believed extinct for over 100 years until its rediscovery north-west of Gosford. Grows in Sydney Coastal Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Sydney Coastal Heaths and Southern Lowland Wet Sclerophyll Forests. Grows in clay soil	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Epacris purpurascens</i> var. <i>purpurascens</i></b>	-	-	VU	2019	Negligible	Erect shrub distributed from Gosford in the north, Silverdale to the west, Narrabeen in the east and Avon Dam in the south. Grows in scrubs and swamps in a variety of communities including Cumberland Dry, Sydney Hinterland Dry, Northern Hinterland Wet, and Southern Tableland Wet Sclerophyll Forests, Eastern Riverine Forests, and Coastal Valley Grassy Woodlands. Grows in soils with a strong shale influence on sandstone substrates.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale for likelihood ranking
		EPBC	BC				
<b><i>Eucalyptus camfieldii</i></b>	Camfield's Stringybark	VU	VU	2017#	Negligible	Mallee tree restricted to a narrow band stretching from Raymond Terrace to the north and Waterfall in the south. Grows in scattered, localised distributions including sites at Norah Head, Terrey Hills, North Head, Menai, Mt Colah, Peats Ridge and Elvina Bay Trail. Grows in scattered stands near the boundaries of tall coastal heath and low open woodland in a variety of communities including Sydney Coastal Dry Sclerophyll Forests, Eastern Riverine Forests, Sydney Coastal Heaths and Wallum Sand Heaths. Grows in sandy soils on Hawkesbury sandstone.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Eucalyptus glaucina</i></b>	Slaty Red Gum	VU	VU	1955	Negligible	Medium sized tree, confined to the north coast of NSW at Casino as well as Taree to Broke, west of Maitland. Grows in a variety of communities including Hunter - Macleay Dry Sclerophyll Forests, Coastal Floodplain Wetlands, Northern Hinterland Wet Sclerophyll Forests and Coastal Valley Grassy Woodlands. Grows on deep, moderately fertile, well-watered soils.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Genoplesium baueri</i></b>	Bauer's Midge Orchid	EN	EN	#	Negligible	Terrestrial orchid with 13 populations totalling 200 plants distributed between Ulladulla and Port Stephens. Grows on moss gardens in a variety of communities including Sydney Coastal Dry sclerophyll Forests, Sydney Coastal Heaths, Sydney Montane Heaths, Southern Lowland Wet Sclerophyll Forests and Sydney Hinterland Dry Sclerophyll Forests. Grows on sandstone substrates	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Grevillea shiressii</i></b>	-	VU	VU	2021#	Negligible	Tall shrub confined to two populations growing near Gosford on Mooney Mooney Creek and Mullet Creek, both tributaries of the lower Hawkesbury River. Grows adjacent to creek banks in Sydney Coastal Dry Sclerophyll Forests, Eastern	Vegetation within the study area is primarily urban native/exotic.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale for likelihood ranking
		EPBC	BC				
						Riverine Forests and North Coast Wet Sclerophyll Forests. Grows on Hawkesbury Sandstone in alluvial or sandy soils.	Native vegetation was thoroughly surveyed.
<b><i>Haloragis exalata</i> subsp. <i>exalata</i></b>	Square Raspwort	VU	VU	#	Negligible	Small to medium sized shrub found growing in four widely scattered locations in eastern NSW including the central coast, south coast and north western slopes. Grows in damp, protected and shaded areas in riparian zones in a variety of communities including South East Dry Sclerophyll Forests, Coastal Floodplain Wetlands, Montane Bogs and Fens and Northern Warm Temperate Rainforests.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Hibbertia procumbens</i></b>	Spreading Guinea Flower	-	EN	2021	Negligible	Prostrate, spreading shrub restricted to seven locations in Gosford and Wyong including Bumble Hill near Yarramalong, Kulnura, Strickland State Forest, Mangrove Mountain, Somersby, Calga/Mount White, Peats Ridge and near Mogo Creek to the west of Mangrove Creek Dam. Associated with scrub/heath and hanging swamp communities including Sydney Coastal Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Coastal Heath Swamps, and Sydney Coastal Heaths. Grows on skeletal sandy soils.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Hibbertia puberula</i></b>	-	-	EN	2019	Negligible	Shrublet with a distribution extending from Wollemi National Park south to Morton National Park and the south coast near Nowra. Grows in a variety of communities including Southern Tableland Dry Sclerophyll Forests, Sydney Coastal Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Coastal Heath Swamps, Coastal Valley Grassy Woodlands and Sydney Coastal Heaths. Grows on sandy soils, occasionally on clay soils.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale for likelihood ranking
		EPBC	BC				
<b><i>Lindsaea fraseri</i></b>	Fraser's Screw Fern	-	EN	1955	Negligible	Small lithophytic fern restricted to two locations in NSW, near Hastings Point on the Tweed Coast and in the Pillar Valley, east of Grafton. Grows in swamp forest and open forest in a variety of communities including Clarence Dry Sclerophyll Forests, North Coast Dry Sclerophyll Forests, Coastal Floodplain Wetlands, Coastal Swamp Forests, Wallum Sand Heaths and North Coast Wet Sclerophyll Forests. Grows in poorly drained, infertile soils.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Melaleuca biconvexa</i></b>	Biconvex Paperbark	VU	VU	2019#	Negligible	Large shrub or small tree confined to NSW with scattered, widely dispersed populations around the Jervis Bay area in the south and the Gosford-Wyong area to the north. Grows in damp places, often near streams or low lying areas on low slopes or sheltered aspects in a variety of communities including Hunter-Macleay Dry Sclerophyll Forests, Coastal Swamp Forests, Coastal Floodplain Wetlands, Coastal Freshwater Lagoon and North Coast Wet Sclerophyll Forests. Grows in alluvial soils.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Melaleuca deanei</i></b>	Deane's Paperbark	VU	VU	2007#	Negligible	Medium sized shrub found growing in two distinct populations in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas along with a few outliers at Springwood and in the Wollemi National Park, Yalwal and the Central Coast regions. Grows in ridgetop woodland in a variety of communities including Sydney Coastal Dry Sclerophyll Forests, South East Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Coastal Valley Grassy Woodlands, Sydney Coastal Heaths. Grows on sandstone substrates in alluvial soils.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale for likelihood ranking
		EPBC	BC				
<b><i>Persoonia hirsuta</i></b>	Hairy Geebung	EN	EN	1903#	Negligible	Spreading, hairy shrub with a scattered distribution throughout Sydney from Singleton to the north, the east coast of Bargo to the south and the Blue Mountains to the west. Grows at elevations between 350 - 600 metres in a variety of communities including Southern Tableland Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Western Slopes Dry Sclerophyll Forests, Coastal Valley Grassy Woodlands, Sydney Coastal Heaths and Southern Escarpment Wet Sclerophyll Forests. Grows in sandy soils on sandstone substrates.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Pimelea curviflora</i> var. <i>curviflora</i></b>	-	VU	VU	#	Negligible	Small to medium sized shrub restricted to the coastal areas of Sydney between northern Sydney and Maroota with an outlying population at Croom Reserve near Albion Park in the Illawarra region. Grows on ridgetops and upper slopes amongst grasses and sedges in a variety of communities including Cumberland Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Coastal Valley Grassy Woodlands, Sydney Coastal Heaths and Northern Hinterland Wet Sclerophyll Forests. Can be inconspicuous amongst grasses and sedges although easier to find in October to May when flowering. Grows on sandstone substrates in shale/lateritic soils and shale/sandstone transition soils.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Prostanthera askania</i></b>	Tranquility Mintbush	EN	EN	2003#	Negligible	Medium sized spreading shrub with ten populations restricted to an area of ~12 km in the upper reaches of creeks that flow into Tuggerah Lake or Brisbane Water in the Wyong and Gosford Local Government Areas. Found growing adjacent to drainage lines on flat to moderately steep slopes in Sydney Coastal Dry Sclerophyll Forests, Northern	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale for likelihood ranking
		EPBC	BC				
						Hinterland Wet Sclerophyll Forests and North Coast Wet Sclerophyll Forests. Grows in alluvial soils over Narabeen Sandstone.	
<b><i>Prostanthera junonis</i></b>	Somersby Mintbush	EN	EN	2020#	Negligible	Small spreading shrub restricted to a north-south distribution on the Somersby Plateau in the Gosford and Wyong Local Government Areas. Found growing on disturbed and undisturbed sites near the coast on gently undulating landscapes in Sydney Coastal Dry Sclerophyll Forests, Sydney Coastal Heaths, Coastal Heath Swamps, Southern Lowland Wet Sclerophyll Forests. Grows in sandy soils over Hawkesbury Sandstone on both the Somersby and Sydney Town soil landscapes.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Rhizanthella slateri</i></b>	Eastern Australian Underground Orchid	EN	VU	#	Negligible	Terrestrial orchid with a distribution spanning from south-east NSW to south-east Queensland. Recorded in ten populations in NSW including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wisemans Ferry Area, Agnes Banks and near Nowra. A cryptic species which grows beneath the soil surface with flowers being the only part of the plant to occur aboveground in Sydney Sand Flats Dry Sclerophyll Forests, Eastern Riverine Forests, Northern Warm Temperate Rainforests, North Coast Wet Sclerophyll Forests, Northern Hinterland Wet Sclerophyll Forests and Southern Lowland Wet Sclerophyll Forests. Grows in deep loam soils.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Rhodamnia rubescens</i></b>	Scrub Turpentine	-	CR	2020	Negligible	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	Vegetation within the study area is primarily urban native/exotic.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale for likelihood ranking
		EPBC	BC				
							Native vegetation was thoroughly surveyed.
<b><i>Rhodomyrtus psidioides</i></b>	Native Guava	-	CR	1900	Negligible	A shrub or small tree occurring from Broken Bay, approximately 90 km north of Sydney to Maryborough. Populations are typically restricted to coastal and sub-coastal areas of low elevation however the species does occur up to c. 120 km inland in the Hunter and Clarence River catchments and along the Border Ranges in NSW. The species is a pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Syzygium paniculatum</i></b>	Magenta Lilly Pilly	VU	EN	2017#	Negligible	Small to medium sized rainforest tree restricted to a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. Found growing on stabilized dunes near the sea in South Coast Sands Dry Sclerophyll Forests, Coastal Swamp Forests, Coastal Headland Heaths, Littoral Rainforests, Northern Hinterland Wet Sclerophyll Forests and Southern Lowland Wet Sclerophyll Forests. Grows on grey sandy, gravelly, silty or clay soils over sandstone substrates.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.
<b><i>Tetratheca glandulosa</i></b>	-	-	VU	2010	Negligible	Small, spreading shrub with 150 populations confined to the Baulkham Hills, Gosford, Hawkesbury, Ku-ring-gai, Pittwater, Ryde and Wyong Local Government Areas. Found growing in a variety of communities including Sydney Sandstone Ridgetop Woodland, Sydney Coastal Dry Sclerophyll Forests, Eastern Riverine Forests, Coastal Valley Grassy Woodlands, Sydney Montane Heaths and North Coast Wet Sclerophyll Forests. Grows in the shallow, yellow clay/sandy loams that are typical of shale/sandstone transition soils where shale	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale for likelihood ranking
		EPBC	BC				
						caps occur over sandstone substrates such as the Lucas Heights, Gympie, Lambert and Faulconbridge soil landscapes.	
<b><i>Thesium australe</i></b>	Austral Toadflax	VU	VU	#	Negligible	Small, straggling herb with a distribution comprising of small populations scattered along the coast of eastern NSW including the Northern and Southern Tablelands, Tasmania, Queensland and eastern Asia. A root parasite found growing on damp sites in grassland, grassy woodlands and coastal headlands often in association with Kangaroo Grass <i>Themeda triandra</i> in a variety of communities including New England Dry Sclerophyll Forests, Western Slopes Grasslands, Northern Tableland Wet Sclerophyll Forests, Brigalow Clay Plain Woodlands, Subalpine Woodlands and Maritime Grasslands.	Vegetation within the study area is primarily urban native/exotic. Native vegetation was thoroughly surveyed.

\* Habitat descriptions have been adapted by qualified ecologists from the DEE Species Profile and Threats (SPRAT) Database, OEH Threatened Species online profiles and the NSW Scientific Committee final determinations for listed species, references within the above table are provided within the report reference list.

## Appendix 2 Fauna

### Fauna species recorded from the study area

Below is a list of fauna species recorded from the study area during the present assessment.

Fauna species in these tables are listed in alphabetical order within their taxonomic group.

#### Notes to table:

##### Conservation status

V – Vulnerable

**Table A.3 Vertebrate fauna recorded from the study area (current assessment)**

Scientific name	Common name	Commonwealth status	NSW status
<b>Birds</b>			
<i>Anas superciliosa</i>	Pacific Black Duck	-	-
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	-	-
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo	-	-
<i>Chenonetta jubata</i>	Australian Wood Duck	-	-
<i>Cracticus tibicen</i>	Australian Magpie	-	-
<i>Cracticus torquatus</i>	Grey Butcherbird	-	-
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	-	-
<i>Egretta novaehollandiae</i>	White-faced Heron	-	-
<i>Gallinula tenebrosa</i>	Dusky Moorhen	-	-
<i>Grallina cyanoleuca</i>	Magpie-lark	-	-
<i>Hirundo neoxena</i>	Welcome Swallow	-	-
<i>Manorina melanocephala</i>	Noisy Miner	-	-
<i>Ocyphaps lophotes</i>	Crested Pigeon	-	-
<i>Oriolus sagittatus</i>	Olive-backed Oriole	-	-
<i>Platycercus eximius</i>	Eastern Rosella	-	-
<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird	-	-
<i>Rhipidura leucophrys</i>	Willie Wagtail	-	-
<i>Sphecotheres vieilloti</i>	Australasian Figbird	-	-
<i>Sturnus tristis</i>	Common Myna	-	-
<i>Threskiornis spinicollis</i>	Straw-necked Ibis	-	-
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	-	-

Scientific name	Common name	Commonwealth status	NSW status
<i>Turdus merula</i>	Eurasian Blackbird	-	-
<i>Tyto javanica</i>	Eastern Barn Owl	-	-
<i>Vanellus miles</i>	Masked Lapwing	-	-
<b>Mammals</b>			
<i>Oryctolagus cuniculus</i>	Rabbit	-	-
<i>Rattus rattus</i>	Black Rat	-	-
<i>Trichosurus vulpecula</i>	Common Brushtail Possum	-	-
<i>Auromomus australis</i>	White-striped Free-tailed Bat	-	-
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	-	-
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	-	-
<i>Falsistrellus tasmaniensis</i> *	Eastern False Pipistrelle	V	-
<i>Micronomus</i> sp.	Unidentified Free-tailed Bat	#	#
<i>Miniopterus australis</i> *	Little Bent-winged Bat	V	-
<i>Miniopterus orianae oceanensis</i> *	Large Bent-winged Bat	V	-
<i>Myotis macropus</i> *	Southern Myotis	V	-
<i>Nyctophilus</i> sp.	Unidentified long-eared bat	#	#
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	-	-
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat	-	-
<i>Saccolaimus flaviventris</i> *	Yellow-bellied Sheath-tailed Bat	V	-
<i>Scoteanax rueppellii</i> *	Greater Broad-nosed Bat	V	-
<i>Scotorepens</i> sp.	Unidentified broad-nosed Bat	#	#
<i>Vespadelus</i> sp.	Unidentified Eptesicus <i>Vespadelus</i> sp.	#	#
<b>Frogs</b>			
<i>Limnodynastes peronii</i>	Brown-striped Frog	-	-
<b>Fish</b>			
<i>Gambusia holbrooki</i>	Mosquito Fish	-	-
<b>Crustaceans</b>			
<i>Cherax destructor</i>	Dam Yabby	-	-

\* Probable detection (see Appendix 3).

# Species complex that may contain threatened species (see Appendix 3).

## Threatened fauna species

The following table includes a list of the threatened fauna species that have potential to occur within the study area. The list is based on database searches outlined in Section 2.1.

### Notes to table:

Conservation status	Most recent record
CR – Critically Endangered	# species predicted to occur by the PMST (not recorded on other databases).
EN – Endangered	## species predicted to occur based on natural distributional range and suitable habitat despite lack of records in the databases searched.
VU – Vulnerable	

Examples of criteria for determining the likelihood of occurrence for threatened entities as a guide for writing the rationale for likelihood have been listed below.

Likelihood of occurrence	Potential criteria
<b>High</b>	<ul style="list-style-type: none"> <li>Species recorded in study area during current or previous assessment/s.</li> <li>Aquatic species recorded from connected waterbodies in close proximity to the study area during current or previous assessment/s.</li> <li>Sufficient good quality habitat is present in study area or in connected waterbodies in close proximity to the study area (aquatic species).</li> <li>Study area is within species natural distributional range (if known).</li> <li>Species has been recorded within 5 kilometres or from the relevant catchment/basin.</li> </ul>
<b>Medium</b>	<ul style="list-style-type: none"> <li>Records of terrestrial species within 5 kilometres of the study area or of aquatic species in the relevant basin/neighbouring basin.</li> <li>Habitat limited in its capacity to support the species due to extent, quality, or isolation.</li> </ul>
<b>Low</b>	<ul style="list-style-type: none"> <li>No records within 5 kilometres of the study area or for aquatic species, the relevant basin/neighbouring basin.</li> <li>Marginal habitat present (low quality and extent).</li> <li>Substantial loss of habitat since any previous record(s).</li> </ul>
<b>Negligible</b>	<ul style="list-style-type: none"> <li>Habitat not present in study area</li> <li>Habitat for aquatic species not present in connected waterbodies in close proximity to the study area.</li> <li>Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.</li> </ul>
<b>Transient/ Nomadic</b>	<ul style="list-style-type: none"> <li>Migratory or nomadic fauna species/individuals that may occur in the study area from time to time, but are not considered resident.</li> </ul>

**Table A.4 Threatened fauna species recorded, or predicted to occur, within 5 kilometres of the study area**

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
Birds							
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE	2002#	Low	Regent Honeyeaters are semi-nomadic, occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests. Nectar and fruit from mistletoes are also eaten. This species usually nest in tall mature eucalypts and sheoaks.	The study area is not included on the Important Areas map for the species.
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	-	VU	2009	Medium	Primarily inhabits dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland.	Dry, open forests and woodlands are present in the study area. Though there has been some disturbance to habitat, the study area may be utilised by the species and provides marginal habitat.
<i>Botaurus poiciloptilus</i>	Australasian Bittern	EN	EN	2017#	Low	The Australasian Bittern is distributed across south-eastern Australia. Often found in terrestrial and estuarine wetlands, generally where there is permanent water with tall, dense vegetation including <i>Typha</i> spp. and <i>Eleocharis</i> spp.. Typically this bird forages at night on frogs, fish and invertebrates, and remains inconspicuous during the day. The breeding season extends from October to January with nests being built amongst dense	The habitat for this species is not present in the study area, as it does not contain terrestrial or estuarine wetlands. While there are waterways present in the study area in the form of a first order waterway and ponds adjacent to the study area, observations are generally from

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						vegetation on a flattened platform of reeds.	wetlands.
<b><i>Burhinus grallarius</i></b>	Bush Stone-curlew	-	EN	2017	Low	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Occurs in lightly timbered open forest and woodland, or partly cleared farmland with remnants of woodland, with a ground cover of short sparse grass and few or no shrubs where fallen branches and leaf litter are present.	This species depends on vegetation with an open understorey and suitable fallen debris for cover and foraging (such as dead timber and logs). There is a minimal fallen debris present in the study area and it is highly disturbed. The species was not observed during field investigations.
<b><i>Calidris canutus</i></b>	Red Knot	EN	-	#	Negligible	Typically located within intertidal mudflats, sandflats and sandy beaches of sheltered coasts. Occasionally found on sandy open beaches or shallow pools, or in saline wetlands close to the coast.	This species is a non-breeding migratory visitor from Arctic regions of Siberia. This species has not been observed within 5 km of the study area.
<b><i>Calidris ferruginea</i></b>	Curlew Sandpiper	CE	EN	#	Negligible	Inhabits sheltered intertidal mudflats. Also non-tidal swamps, lagoons and lakes near the coast. Infrequently recorded inland.	The habitat for this species is not present in the study area, as it is over 5 km from coastal waterbodies. While there are large ponds and a waterway present in the study area, observations are generally from high quality freshwater wetlands. This species has not been observed within 5 km of the study

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
							area.
<b><i>Callocephalon fimbriatum</i></b>	Gang-gang Cockatoo	-	VU	2013	Low	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.	Old growth forests and woodland habitats preferred by the species are not present in the study area. Suitable hollows are available in the study area but subjected to disturbance. Presence is likely to be limited to transient movements.
<b><i>Calyptrorhynchus lathamii</i></b>	Glossy Black-Cockatoo	-	VU	2017	Low	Inhabits forest with low nutrients, characteristically with key Allocasuarina species. Tends to prefer drier forest types. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead.	Breeding habitat for the species consists of large hollow-bearing eucalyptus trees with a minimum diameter of 15 cm that are greater than 8 m above ground. While there was some hollows on site that are suitable for the species, the study area is subject to ongoing disturbance. Foraging habitat in the form of Allocasuarina and Casuarina spp. are not present within the study area, therefore presence is likely to be limited to transient movements.
<b><i>Charadrius leschenaultii</i></b>	Greater Sand-plover	VU	VU	2018	Negligible	Entirely coastal in NSW, foraging on intertidal sand and mudflats in estuaries and roosting during high	The habitat for this species in the form of intertidal sand and

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						tide on sandy beaches or rocky shores. Individuals have been recorded on inshore reefs, rock platforms, small rocky islands and sand cays on coral reefs, within Australia. Occasional sightings have also occurred on near-coast salt lakes, brackish swamps, shallow freshwater wetlands and grassed paddocks.	mudflats, and sandy beaches is not present in the study area. The study area is not included on the Important Areas map for the species.
<b><i>Circus assimilis</i></b>	Spotted Harrier	-	VU	2013	Low	The Spotted Harrier is found throughout Australia but rarely in densely forested and wooded habitat of the escarpment and coast. Preferred habitat consists of open and wooded country with grassland nearby for hunting. Habitat types include open grasslands, acacia and mallee remnants, spinifex, open shrublands, saltbush, very open woodlands, crops and similar low vegetation. The Spotted Harrier is more common in drier inland areas, nomadic part migratory and dispersive, with movements linked to the abundance of prey species. Nesting occurs in open or remnant woodland and unlike other harriers, the Spotted Harrier nests in trees.	Habitat suitable for the species is absent in the study area and the species is uncommon in coastal areas.
<b><i>Daphoenositta chrysoptera</i></b>	Varied Sittella	-	VU	2019	Medium	The Varied Sittella is a sedentary species which inhabits a wide variety of dry eucalypt forests and woodlands, usually with either shrubby understorey or grassy ground cover or both, in all climatic zones of Australia. Usually inhabit areas with rough-barked trees, such as stringybarks or ironbarks, but also in mallee and acacia woodlands, paperbarks or mature	Eucalypt forests and woodlands are present in the study area but highly fragmented and subject to ongoing disturbance. Though there has been some disturbance to habitat, the study area may be utilised by the species.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						Eucalypts. The Varied Sittella feeds on arthropods gleaned from bark, small branches and twigs. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	
<b><i>Dasyornis brachypterus</i></b>	Eastern Bristlebird	EN	EN	#	Negligible	Found in coastal woodlands, dense scrub and heathlands, particularly where it borders taller woodlands.	Habitat within the study area does not constitute preferred habitat for this species, as it does not include a healthy understorey. This species has not been recorded within 5 km of the study area.
<b><i>Glossopsitta pusilla</i></b>	Little Lorikeet	-	VU	2016	Medium	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.	Dry and open eucalypt forests and woodlands, including hollow-bearing trees and foraging resources in the form of flowering shrubs and trees, are present within the study area but subjected to lots of disturbance. The species was not recorded during field investigations.
<b><i>Haematopus longirostris</i></b>	Pied Oystercatcher	-	EN	1995	Negligible	An intertidal forager found on undisturbed sandy beaches and spits, tidal mudflats and estuaries. Its food supply (beach macroinvertebrates) have been negatively affected by human impacts. The Pied	The habitat for this species in the form of intertidal sand and mudflats, and sandy beaches is not present in the study area.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						Oystercatcher is restricted to the littoral zone of beaches and estuaries, nesting on the ground above the tideline. A pair will re-nest in the same spot each year, rarely shifting their territory. Occasionally the Pied Oystercatcher is found in paddocks near the coast.	
<b><i>Haliaeetus leucogaster</i></b>	White-bellied Sea-Eagle	-	VU	2018	Low	A migratory species that is generally sedentary in Australia, although immature individuals and some adults are dispersive. Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and saltmarshes. It hunts over open terrestrial habitats. Feeds on birds, reptiles, fish, mammals, crustaceans and carrion. Roosts and makes nest in trees.	This species nests on cliff ledges, headlands or at the top of large trees near coasts or rivers. Nests are usually in sight of large waterbodies. The breeding habitat for this species is not present in the study area as it does not contain mature tall open forest. There are several ponds present adjacent to the study area, but these do not constitute sufficient breeding habitat as they are not flanked with large nesting trees. No nests or evidence of breeding were observed during the field investigations.
<b><i>Hamirostra melanosternon</i></b>	Black-breasted Buzzard	-	VU	1984	Low	Occur in woodland and open country of tropical and temperate Australian. They prefer tree-lined watercourses, billabongs, ephemeral lakes and floodplains. Have been recorded in areas where Melaleuca dominate the vegetation. Nest in dead or partly dead trees usually near watercourses.	Habitat in the form of waterbodies and land within 40 metres of timbered watercourses is present as marginal habitat adjacent to the study area but not within the study area. No nests or

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
							evidence of breeding was observed during field investigations.
<b><i>Hieraaetus morphnoides</i></b>	Little Eagle	-	VU	2009	Low	The Little Eagle is most abundant in lightly timbered areas with open areas nearby providing an abundance of prey species. It has often been recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. The Little Eagle nests in tall living trees within farmland, woodland and forests.	This species nests in tall living trees within a remnant patch of open eucalypt forest, which is present as habitat in the study area, however it is of poor quality, highly fragmented and no nests or evidence of breeding was observed during the field investigations.
<b><i>Hirundapus caudacutus</i></b>	White-throated Needletail	VU	-	2018#	Transient	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Breeds in Asia.	The species has been recorded roosting in trees in forests and woodlands, though little is known about the species. The species does not breed in Australia and nearby sightings are likely vagrants.
<b><i>Ixobrychus flavicollis</i></b>	Black Bittern	-	VU	2015	Low	The Black Bittern is found along the coastal plains within NSW, although individuals have rarely being recorded south of Sydney or inland. It inhabits terrestrial and estuarine wetlands such as flooded grasslands, forests, woodlands, rainforests and mangroves with permanent water and dense waterside vegetation. The Black Bittern typically roosts on the ground or in trees during the day and	The habitat for this species is not present in the study area, as it does not contain terrestrial or estuarine wetlands. While there are waterways present in the study area, observations are generally from wetlands.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						forages at night on frogs, reptiles, fish and invertebrates. The breeding season extends from December to March. Nests are constructed of reeds and sticks in branches overhanging the water.	
<b><i>Lathamus discolor</i></b>	Swift Parrot	CE	EN	2016#	Low	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. Favoured feed trees include winter flowering species such as Swamp Mahogany <i>Eucalyptus robusta</i> , Spotted Gum <i>Corymbia maculata</i> , Red Bloodwood <i>C. gummifera</i> , Mugga Ironbark <i>E. sideroxylon</i> , and White Box <i>E. albens</i> . Commonly used lerp infested trees include Grey Box <i>E. microcarpa</i> , Grey Box <i>E. moluccana</i> and Blackbutt <i>E. pilularis</i> . This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	The study area is not included on the Important Areas map for the species.
<b><i>Limosa lapponica baueri</i></b>	Bar-tailed Godwit ( <i>baueri</i> )	VU	-	#	Negligible	The bar-tailed godwit (western Alaskan) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It has also been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats.	The habitat for this species in the form of sandflats, mudflats, and estuarine areas are not present in the study area. The study area is not included on the Important Areas map for the species. This species has not been recorded within 5 km of the study area.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
<b><i>Limosa lapponica menzbieri</i></b>	Bar-tailed Godwit	CE	-	#	Negligible	The bar-tailed godwit (northern Siberian) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It has also been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats.	The habitat for this species in the form of sandflats, mudflats, and estuarine areas are not present in the study area. This species has not been recorded within 5 km of the study area.
<b><i>Lophoictinia isura</i></b>	Square-tailed Kite	-	VU	2013	Low	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by <i>Eucalyptus longifolia</i> , <i>Corymbia maculata</i> , <i>E. elata</i> , or <i>E. smithii</i> . Individuals appear to occupy large hunting ranges of more than 100 km <sup>2</sup> . They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	Breeding habitat for this species includes large eucalypts in preferred vegetation types located along or near watercourses. There is a first order waterway within the study area but it is not heavily timbered and subject to degradation. No nests or evidence of breeding were observed during the field investigations.
<b><i>Neophema pulchella</i></b>	Turquoise Parrot	-	VU	2007	Medium	Occurs in open woodlands and eucalypt forests with a ground cover of grasses and understorey of low shrubs. Generally found in the foothills of the Great Divide, including steep rocky ridges and gullies. Nest in hollow-bearing trees, either dead or alive; also in hollows in tree stumps. Prefer to breed in open grassy forests and woodlands, and gullies that are moist.	Open woodlands, though fragmented and disturbed, and subjected to disturbance, are present in the study area and includes hollow-bearing trees.
<b><i>Ninox strenua</i></b>	Powerful Owl	-	VU	2018	Low	The Powerful Owl occupies wet and dry eucalypt	The species requires living or

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						forests and rainforests. It may inhabit both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm. It has a large home range of between 450 and 1450 ha.	dead trees with hollows greater than 20 cm diameter for breeding habitat. Suitable hollow-bearing trees are present though are present in a highly fragmented and disturbed landscape.
<b><i>Numenius madagascariensis</i></b>	Eastern Curlew	CE	-	2002#	Negligible	Occurs in sheltered coasts, especially estuaries, embayments, harbours, inlets and coastal lagoons with large intertidal mudflats or sandflats often with beds of seagrass.	The breeding habitat in the form of coastal areas or intertidal mudflats/sandflats is not present in the study area.
<b><i>Pandion cristatus</i></b>	Eastern Osprey	-	VU	2019#	Low	Found in coastal waters, inlets, estuaries and offshore islands. Occasionally found 100 km inland along larger rivers. It is water-dependent, hunting for fish in clear, open water. The Osprey occurs in terrestrial wetlands, coastal lands and offshore islands. It is a predominantly coastal species, generally using marine cliffs as nesting and roosting sites. Nests can also be made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.	Breeding habitat for this species consists of dead trees or artificial structures that are located within 100 m of a floodplain, with a preference for coastline, therefore the habitat is absent in the study area. No nests or evidence of breeding were found during the field investigations.
<b><i>Petroica boodang</i></b>	Scarlet Robin	-	VU	1986	Medium	The Scarlet Robin inhabits dry eucalypt forests and	Dry forests and woodlands with

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						woodlands. The understorey is usually open and grassy with few scattered shrubs. During autumn and winter it moves to more open and cleared areas. The Scarlet Robin forages amongst logs and woody debris for insects. The nest is an open cup of plant fibres and cobwebs, sited in the fork of a tree.	an open and grassy understorey is present in the study area. Though there has been some disturbance to habitat, the study area may provide marginal habitat.
<b><i>Rostratula australis</i></b>	Australian Painted Snipe	EN	EN	#	Negligible	Usually found in shallow inland wetlands including farm dams, lakes, rice crops, swamps and waterlogged grassland. They prefer freshwater wetlands, but have been recorded in brackish waters. Forages on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter.	The habitat for this species is not present in the study area, as it does not contain shallow inland wetlands. While there are waterways present in the study area, observations are generally from wetlands. This species has not been observed within 5 km of the study area.
<b><i>Thinornis rubricollis rubricollis</i></b>	Eastern Hooded Plover	VU	-	#	Low	In south-eastern Australia Hooded Plovers prefer sandy ocean beaches, especially those that are broad and flat, with a wide wave-wash zone for feeding, much beachcast seaweed, and backed by sparsely vegetated sand-dunes for shelter and nesting. Occasionally Hooded Plovers are found on tidal bays and estuaries, rock platforms and rocky or sand-covered reefs near sandy beaches, and small beaches in lines of cliffs. They regularly use near-coastal saline and freshwater lakes and lagoons, often with saltmarsh. They forage in sand at all levels of the zone of wave-wash during low and mid-tide or among seaweed at high-tide, and occasionally in	The habitat for this species in the form of sandy beaches and estuaries is not present in the study area, however freshwater waterways are present, though limited to large ponds and a first order waterway. The study area is not included on the Important Areas map for the species. This species has not been observed within 5 km of the study area.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						dune blowouts after rain. At night they favour the upper zones of beaches for roosting. When on rocks they forage in crevices in the wave-wash or spray zone, avoiding elevated rocky areas and boulder fields. In coastal lagoons they forage in damp or dry substrates and in shallow water, depending on the season and water levels.	
<b><i>Turnix maculosus</i></b>	Red-backed Button-quail	-	VU	2019	Low	Red-backed Button-quail inhabit grasslands, woodlands and cropped lands of warm temperate areas that annually receive 400 mm or more of summer rain. The species prefers sites near water, including grasslands and sedgeland near creeks, swamps and springs, and wetlands.	This species usually inhabits grasslands and breeds in dense grass near water, therefore there is no potential for habitat within the study area, as grassy areas are regularly mown and subjected to disturbance.
<b><i>Tyto novaehollandiae</i></b>	Masked Owl	-	VU	2011	Low	The Masked Owl is found in range of wooded habitats that provide tall or dense mature trees with hollows suitable for nesting and roosting. It is mostly seen in open forests and woodlands adjacent to cleared lands. Prey includes hollow-dependent arboreal marsupials and terrestrial mammals.	This species breeds in moist eucalypt forests and woodlands, and the species relies on medium sized hollows with close proximity to open habitat. Suitable hollow-bearing trees are present but in a highly fragmented landscape that is subjected to ongoing disturbance.
<b><i>Tyto tenebricosa</i></b>	Sooty Owl	-	VU	2019	Low	The Sooty Owl is often found in tall old-growth forests, including temperate and subtropical rainforests. It is mostly found on escarpments with a mean altitude <500 m. This species nests and roosts	This species prefers rainforests and moist eucalyptus forests. It also requires very large hollows for nesting. Suitable hollow-

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						in hollows of emergent trees, mainly eucalypts often located in gullies.	bearing trees are present but in a highly fragmented landscape that is subjected to ongoing disturbance.
<b>Mammals</b>							
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	-	VU	2021	Low	Patchily distributed from the coast to the Great Dividing Range, and as far as Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes. Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Soft fruits are eaten when flowers are unavailable and it also feeds on insects. Will often nest in tree hollows, but can also construct its own nest. Because of its small size it is able to utilise a range of hollow sizes including very small hollows. Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5 ha area over a 5 month period.	Habitat in the form of woodland with hollow-bearing trees is present within the study area but lacks suitable foraging habitat, is highly fragmented and subjected to ongoing disturbance.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	VU	VU	2018#	Low	Occurs from the Queensland border to Ulladulla, with largest numbers from the sandstone escarpment country in the Sydney Basin and Hunter Valley. Primarily found in dry sclerophyll forests and woodlands, but also found in rainforest fringes and subalpine woodlands. Forages on small, flying insects below the forest canopy. Roosts in colonies of between three and 80 in caves, Fairy Martin nests	The study area has low topographic relief and there are no rocky areas containing caves within 2 km of the study area, therefore it is not considered to contain breeding habitat for the species. They forage in well-timbered areas containing gullies,

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						and mines, and beneath rock overhangs, but usually less than 10 individuals. Likely that it hibernates during the cooler months. The only known existing maternity roost is in a sandstone cave near Coonabarabran.	under the forest canopy, therefore there is unlikely to be any suitable foraging habitat in the study area. Targeted survey was undertaken and the species was not detected.
<b><i>Dasyurus maculatus</i></b>	Spotted-tailed Quoll	EN	VU	2020	Low	Occurs along the east coast of Australia and the Great Dividing Range. Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests. Occasional sightings have been made in open country, grazing lands, rocky outcrops and other treeless areas. Habitat requirements include suitable den sites, including hollow logs, rock crevices and caves, an abundance of food and an area of intact vegetation in which to forage. Seventy per cent of the diet is medium-sized mammals, and also feeds on invertebrates, reptiles and birds. Individuals require large areas of relatively intact vegetation through which to forage. The home range of a female is between 180 and 1000 ha, while males have larger home ranges of between 2000 and 5000 ha. Breeding occurs from May to August.	Woody debris and rock outcrops were absent from the study area, though some hollow-bearing trees were present. No evidence of latrines were recorded during the field survey.
<b><i>Falsistrellus tasmaniensis</i></b>	Eastern False Pipistrelle	-	VU	2020	High	Distribution extending east of the Great Dividing Range throughout the coastal regions of NSW, from the Queensland border to the Victorian border. Prefers wet high-altitude sclerophyll and coastal mallee habitat, preferring wet forests with a dense understorey but being found in open forests at	There are some hollow-bearing trees within the study area, however habitat in the form of wet, high-altitude forests are absent. Targeted survey was undertaken and the species was

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						lower altitudes. Apparently hibernates in winter. Roosts in tree hollows and sometimes in buildings in colonies of between 3 and 80 individuals. Often change roosts every night. Forages for beetles, bugs and moths below or near the canopy in forests with an open structure, or along trails. Has a large foraging range, up to 136 ha. Records show movements of up to 12 km between roosting and foraging sites.	recorded.
<b><i>Micronomus norfolkensis</i></b>	Eastern Coastal Free-tailed Bat	-	VU	2019	Medium	Distribution extends east of the Great Dividing Range from southern Queensland to south of Sydney. Most records are from dry eucalypt forests and woodland. Individuals tend to forage in natural and artificial openings in forests, although it has also been caught foraging low over a rocky river within rainforest and wet sclerophyll forest habitats. The species generally roosts in hollow spouts of large mature eucalypts (including paddock trees), although individuals have been recorded roosting in the roof of a hut, in wall cavities, and under metal caps of telegraph poles. Foraging generally occurs within a few kilometres of roosting sites.	Habitat in the form of hollow-bearing trees within dry eucalypt forest and woodland are present in the study area. Targeted survey was undertaken and the species was not recorded with any certainty.
<b><i>Miniopterus australis</i></b>	Little Bent-winged Bat	-	VU	2020	High	Occurs from Northern Queensland to the Hawkesbury River near Sydney. Roost sites encompass a range of structures including caves, tunnels and stormwater drains. Young are raised by the females in large maternity colonies in caves in summer. Shows a preference for well timbered	The study area does not contain habitat features suitable for roosting or breeding (i.e. caves, mines or tunnels). Targeted survey for the species was conducted and the species was

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests. The Little Bentwing bat forages for small insects (such as moths, wasps and ants) beneath the canopy of densely vegetated habitats.	recorded.
<b><i>Miniopterus orianae oceanensis</i></b>	Large Bent-winged Bat	-	VU	2021	High	Occurs from Victoria to Queensland, on both sides of the Great Dividing Range. Forms large maternity roosts (up to 100,000 individuals) in caves and mines in spring and summer. Individuals may fly several hundred kilometres to their wintering sites, where they roost in caves, culverts, buildings, and bridges. They occur in a broad range of habitats including rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands. Has a fast, direct flight and forages for flying insects (particularly moths) above the tree canopy and along waterways.	The study area does not contain habitat features suitable for roosting or breeding (i.e. caves, mines or tunnels). Targeted survey for the species was conducted and the species was recorded.
<b><i>Myotis macropus</i></b>	Southern Myotis	-	VU	2019	High	Scattered, mainly coastal distribution extending to South Australia along the Murray River. Roosts in caves, mines or tunnels, under bridges, in buildings, tree hollows, and even in dense foliage. Colonies occur close to water bodies, ranging from rainforest streams to large lakes and reservoirs. They catch aquatic insects and small fish with their large hind claws, and also catch flying insects.	Breeding and foraging habitat was considered to be present within the study area due to the presence of hollow-bearing trees within 200 m of the adjacent ponds. Targeted survey for the species was conducted and the species was recorded.
<b><i>Petauroides volans</i></b>	Greater Glider	VU	-	#	Low	The distribution of the Greater Glider includes the ranges and coastal plain of eastern Australia, where it inhabits a variety of eucalypt forests and	Habitat in the form of hollow-bearing trees are present in the study area, however subject to

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						woodlands. Presence and density of Greater Gliders is related to soil fertility, eucalypt tree species, disturbance history and density of suitable tree hollows. Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe.	regular disturbance. This species has not been observed within 5 km of the study area.
<b><i>Petaurus norfolcensis</i></b>	Squirrel Glider	-	VU, E2	1996	Medium	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range. Requires abundant hollow-bearing trees and a mix of eucalypts, banksias and acacias. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked.	This species prefers Blackbutt-Bloodwood forest with a heath understorey and an Acacia midstorey, which is absent from the study area. The species requires hollow-abundant vegetation for refuge or breeding sites, which is present within the study area. Targeted survey was undertaken and the species was not recorded.
<b><i>Petrogale penicillata</i></b>	Brush-tailed Rock-wallaby	VU	EN	#	Negligible	Occurs along the Great Dividing Range south to the Shoalhaven, and also occurs in the Warrumbungles and Mt Kaputar. Habitats range from rainforest to open woodland. It is found in areas with numerous ledges, caves and crevices particularly with northern aspects. The species forages on grasses and forbs.	Natural rocky escarpments, outcrops and cliffs, which are key habitat areas for this species, are absent from the study area. This species has not been observed within 5 km of the study area.
<b><i>Phascolarctos cinereus</i></b>	Koala	VU	VU	2018#	Low	In NSW the Koala mainly occurs on the central and north coasts with some populations in the western region. Koalas feed almost exclusively on eucalypt foliage, and their preferences vary regionally. Primary feed trees include <i>Eucalyptus robusta</i> , <i>E.</i>	Native vegetation containing Koala food trees are of poor quality, being heavily degraded by past disturbance and clearance. It is unlikely that the study area is

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						<i>tereticornis</i> , <i>E. punctata</i> , <i>E. haemostoma</i> and <i>E. signata</i> . They are solitary with varying home ranges.	used by individuals for foraging habitat due to the poor-quality and highly fragmented nature of the vegetation.
<b><i>Potorous tridactylus</i></b>	Long-nosed Potoroo	VU	VU	2000	Low	Usually found within 50 km of the coast. Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy. Known to eat fungi, arthropods, fleshy fruit, seeds and plant tissue.	Habitat in the form of coastal heath of wet/dry sclerophyll forest is absent from the study area. This species has not been observed within 5 km of the study area.
<b><i>Pseudomys gracilicaudatus</i></b>	Eastern Chestnut Mouse	-	VU	2007	Low	The Eastern Chestnut Mouse is most common in dense, wet heath and swamps, but also occurs in open woodlands and dry sclerophyll forests with a grassy understorey. Density of the ground layer is a determining factor. It relies on a variety of food sources, including fungi, seeds, insects and stems.	Habitat in the form of dense, wet, vigorously regenerating heath is absent from the study area.
<b><i>Pseudomys novaehollandiae</i></b>	New Holland Mouse	VU	-	#	Negligible	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. The home range of the New Holland Mouse can range from 0.44 ha to 1.4 ha. The New Holland Mouse is a social animal, living predominantly in burrows shared with other individuals. The species is nocturnal and omnivorous, feeding on seeds,	Suitable habitat in the form of heathland understorey and vegetated sand dunes is absent from the study area. This species has not been observed within 5 km of the study area.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						insects, leaves, flowers and fungi, and is therefore likely to play an important role in seed dispersal and fungal spore dispersal. It is likely that the species spends considerable time foraging above-ground for food, predisposing it to predation by native predators and introduced species. Breeding typically occurs between August and January, but can extend into autumn.	
<b><i>Pteropus poliocephalus</i></b>	Grey-headed Flying-fox	VU	VU	2021#	Transient	Occurs along the NSW coast, extending further inland in the north. This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Roosts in large colonies, commonly in dense riparian vegetation.	No camps (communal breeding/roosting sites) were identified within the study area during the field investigations. Presence may be limited to transient foraging.
<b><i>Scoteanax rueppellii</i></b>	Greater Broad-nosed Bat	-	VU	2020	High	Occurs along the Great Dividing Range and in coastal areas. Occurs in woodland and rainforest, preferring open habitats or openings in wetter forests. Often hunts along creeks or river corridors. Preys upon beetles and other large, flying insects, other bats and spiders. Roosts in hollow tree trunks and branches.	Habitat in the form of hollow-bearing trees within forest and woodland are present in the study area. Targeted survey was undertaken and the species was recorded.
<b><i>Vespadelus troughtoni</i></b>	Eastern Cave Bat	-	VU	2017	Low	Found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. It roosts in small groups, often in well-lit overhangs and caves, mine tunnels, road culverts, and occasionally in buildings.	The study area does not contain habitat features suitable for roosting or breeding (i.e. caves, mines or tunnels). Targeted survey was undertaken and the species was not recorded with any certainty.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
Reptiles							
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	VU	EN	#	Negligible	Mainly occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer.	Habitat in for the form of rock crevices within close proximity to hollow-bearing trees is not present within the study area/study area. This species has not been observed within 5 km of the study area/study area.
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	-	VU	2004	Low	This species is a Hawkesbury/Narrabeen sandstone outcrop specialist. Occurs in coastal heaths, humid woodlands and both wet and dry sclerophyll forests. Termite mounds are a critical habitat component.	Habitat in the form of sandstone outcrops is absent within the study area.
Frogs							
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	VU	VU	2021#	Low	Prefers hanging swamps on sandstone shelves adjacent to perennial non-flooding creeks. Can also occur within shale outcrops within sandstone formations. Known from wet and dry forests and montane woodland in the southern part range. Individuals can be found around sandy creek banks or foraging along ridge-tops during or directly after heavy rain. Males often call from burrows located in sandy banks next to water. Spends the majority of its time in non-breeding habitat 20-250m from breeding sites.	This species is not known to occur within previously disturbed areas. It has also been reported as being potentially unwilling or unable to burrow into soil covered by grasses and crops (Penman & Mahony 2004). The species spends most of its time in heath, woodland and dry sclerophyll forest areas, within 300 m of breeding sites (DPIE 2019d). There are large ponds adjacent to the study area and one waterway,

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
							however the disturbance to the area makes it unlikely habitat. Opportunistic survey was undertaken and the species was not detected.
<b><i>Litoria aurea</i></b>	Green and Golden Bell Frog	VU	EN	#	Negligible	Most existing locations for the species occur as small, coastal, or near coastal populations, with records occurring between south of Grafton and northern VIC. The species is found in marshes, dams and stream sides, particularly those containing bullrushes or spikerushes. Preferred habitat contains water bodies that are unshaded, are free of predatory fish, have a grassy area nearby and have diurnal sheltering sites nearby such as vegetation or rocks, although the species has also been recorded from highly disturbed areas including disused industrial sites, brick pits, landfill areas and cleared land. Breeding usually occurs in summer. Tadpoles, which take approximately 10-12 weeks to develop, feed on algae and other vegetative matter. Adults eat insects as well as other frogs, including juveniles of their own species.	Semi-permanent wet areas associated with a first order creekline are considered potential habitat for the species. There are several large ponds adjacent to the study area and one small waterway. This species has not been observed within 5 km of the study area. Opportunistic survey was undertaken and the species was not detected.
<b><i>Litoria littlejohni</i></b>	Littlejohn's Tree Frog	VU	VU	#	Negligible	The species is distributed along the eastern slopes of the Great Dividing Range from Watagan State Forest near Wyong, south to Buchan in north-eastern VIC. It is not known from coastal habitats. Occurs in wet and dry sclerophyll forests and heath communities associated with sandstone outcrops between 280	Habitat in the form of heath-based forests and woodlands are absent from the study area. This species has not been observed within 5 km of the study area. Opportunistic survey was

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
						and 1000 m. Littlejohn's Tree Frog prefers permanent and semi-permanent rock flowing streams, but individuals have also been collected from semi-permanent dams with some emergent vegetation. Forages both in the tree canopy and on the ground, and has been observed sheltering under rocks on high exposed ridges during summer. The species breeds in autumn but will also breed after heavy rainfall in spring and summer. The species has been recorded calling in all seasons with variously reported peak calling periods. Eggs are laid in loose gelatinous masses attached to submerged twigs; eggs and tadpoles are most often recorded in slow-flowing pools that receive extended exposure to sunlight.	undertaken and the species was not detected.
<b><i>Mixophyes balbus</i></b>	Stuttering Frog	VU	EN	#	Negligible	This species is usually associated with mountain streams, wet mountain forests and rainforests. It rarely moves very far from the banks of permanent forest streams, although it will forage on nearby forest floors. Eggs are deposited in leaf litter on the banks of streams and are washed into the water during heavy rains.	Breeding habitat for the species (i.e. stream and watercourses with rock shelves or shallow riffles) were not present within the study area. The vegetation within the study area is not considered suitable as foraging habitat due to the high level of exotic grasses and herbaceous annuals within the understorey stratum. This species has not been observed within 5 km of the study area. Opportunistic survey was

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
							undertaken and the species was not detected.
<b><i>Mixophyes iteratus</i></b>	Giant Barred Frog	EN	EN	#	Negligible	Occurs along coast and ranges from south-eastern Queensland to the Hawkesbury River in NSW. Found in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m, often hiding in leaf litter near permanent fast-flowing streams. Females lay eggs onto moist creek banks or rocks above water level, from where tadpoles drop into the water when hatched. When not breeding the frogs disperse hundreds of metres away from streams.	Breeding habitat in the form of a creek with a bank and fast-flowing water is absent in the study area, as the first order creek present is not permanent and lacks structure. Some non-breeding habitat in the form of dams and open eucalypt woodland is present, however of poor quality. This species has not been observed within 5 km of the study area. Opportunistic survey was undertaken and the species was not detected.
<b><i>Pseudophryne australis</i></b>	Red-crowned Toadlet	-	VU	2022	Low	Occurs on wetter ridge tops and upper slopes of sandstone formations on which the predominant vegetation is dry open forests and heaths. This species typically breeds within small ephemeral creeks characterised by a series of shallow pools that feed into larger semi-perennial streams.	The study area has low topographic relief and there are no sandstone formations in the study area. There are two large dams and a drainage easement within the study area that provide poor connectivity to suitable habitat and lack leaf litter required for sheltering by the species. The dams and drainage easement may provide marginal dispersal habitat within the study

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Habitat description*	Rationale*
		EPBC	BC				
							area for the species, which will not be impacted by the proposed works. Opportunistic survey during optimal conditions was undertaken and the species was not detected.
<b>Fish</b>							
<b><i>Macquaria australasica</i></b>	Macquarie Perch	EN	-	#	Negligible	Macquarie Perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury and Shoalhaven catchments. Macquarie perch are found in both river and lake habitats, especially the upper reaches of rivers and their tributaries	Key habitat for this species is not present within the study area. This species has not been observed within 5 km of the study area.
<b><i>Prototroctes maraena</i></b>	Australian Grayling	EN	EN	#	Negligible	The Australian Grayling occurs in streams and rivers on the eastern and southern flanks of the Great Dividing Range from Sydney southwards to the Otway Ranges in Victoria, and Tasmania. Australian grayling do not occur in the inland Murray-Darling Basin system. Grayling is a diadromous species; migrating between freshwater streams and the ocean. This species has been found in clear, gravel-bottomed streams with alternating pools and riffles, and granite outcrops, and also in muddy-bottomed, heavily silted habitats.	Key habitat for this species is not present within the study area. This species has not been observed within 5 km of the study area.

## Migratory species (EPBC Act listed)

The following table includes a list of migratory species that have potential to occur within the study area. The list is based on database searches outlined in Section 2.1.

Bold denotes species recorded in the study area during the current assessment.

### Notes to table:

#### Most recent record

# species predicted to occur by the PMST (not recorded on other databases).

**Table A.5 Migratory fauna species recorded or predicted to occur within 5 kilometres of the study area**

Scientific name	Common name	Most recent record
<i>Actitis hypoleucos</i>	Common Sandpiper	#
<i>Apus pacificus</i>	Fork-tailed Swift	2006#
<i>Ardenna tenuirostris</i>	Short-tailed Shearwater	2013
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	#
<i>Calidris canutus</i>	Red Knot	#
<i>Calidris ferruginea</i>	Curlew Sandpiper	#
<i>Calidris melanotos</i>	Pectoral Sandpiper	#
<i>Charadrius leschenaultii</i>	Greater Sand-plover	2018
<i>Gallinago hardwickii</i>	Latham's Snipe	2013#
<i>Hirundapus caudacutus</i>	White-throated Needletail	2018#
<i>Hydroprogne caspia</i>	Caspian Tern	2006
<i>Limosa lapponica</i>	Bar-tailed Godwit	#
<i>Limosa lapponica baueri</i>	Bar-tailed Godwit (baueri)	#
<i>Limosa lapponica menzbieri</i>	Northern Siberian Bar-tailed Godwit	#
<i>Motacilla flava</i>	Yellow Wagtail	#
<i>Numenius madagascariensis</i>	Eastern Curlew	2002#
<i>Numenius phaeopus</i>	Whimbrel	1970
<i>Pandion cristatus</i>	Eastern Osprey	2019#
<i>Pluvialis fulva</i>	Pacific Golden Plover	2007
<i>Pluvialis squatarola</i>	Grey Plover	2012
<i>Tringa nebularia</i>	Common Greenshank	1995#

## Appendix 3 Microbat call analysis

---

### Survey method and effort

Data was collected over fourteen nights from 18 February 2022 to 3 March 2022. Calls were recorded from dusk until dawn using two Wildlife Acoustics Songmeter SM4 acoustic recorders fitted with omnidirectional microphones. Default settings for trigger, sensitivity, sampling rate and minimum / maximum frequency were used. Units were deployed at two locations within the study area.

Both units were located in an open parkland with minimal native vegetation but with a large number of hollows. Both units were located facing large, hollow-bearing stags with multiple hollows of various sizes. One unit was located in native vegetation and one was located in urban native / exotic vegetation.

Units were located to allow space in front and around the microphone so as to minimize echoes from hard surfaces, call attenuation from surrounding vegetation, and ensure adequate flight space around the microphone.

Files were recorded in zero-crossing format. Data was downloaded and viewed using Anabat Insight (version 2.0.1 (licensed), Titley Scientific).

### Reference library

No reference calls were collected during the survey. Call identification was assisted by the following resources:

- *Bat calls of NSW* (Pennay, Law, & Reinhold 2004) including sample call files downloaded from <https://www.environment.nsw.gov.au/topics/animals-and-plants/surveys-monitoring-and-records/bat-calls-of-nsw>.
- *Key to the bat calls of south-east Queensland and north-east New South Wales* (Reinhold et al. 2001).
- *Geographic variation in the echolocation calls of *Vespadelus* spp. (Vespertilionidae) from New South Wales and Queensland, Australia* (Law, Reinhold, & Pennay 2002).

Species nomenclature used in this report follows *A current taxonomic list of Australian Chiroptera* (Armstrong, Reardon, & Jackson 2020).

### Call identification

A total of 12,757 call files were recorded at the two sites over fourteen nights.

Species identification was first refined by using known species geographic distributions (Churchill 2008, Australasian Bat Society 2022) to generate a list of species with potential to occur at the site.

Files not containing bat calls (noise files) were filtered out using a standard “allbats” filter in Anabat Insight. Remaining files were then manually reviewed and identified to species level where possible based on characteristic call parameters, with a focus on species-credit threatened species.

Calls recorded during the field survey were identified by visually comparing the spectrogram and call characteristics (e.g. characteristic frequency and call shape) with reference calls and descriptions from available reference materials (Reinhold et al. 2001, Pennay, Law, & Reinhold 2004). A call (pass) was defined as

a sequence of three or more consecutive pulses of similar frequency and shape. Sequences with less than three defined consecutive pulses were not identified to species.

The focus of call analysis was to generate a list of species present, with a focus on threatened species, rather than analyse species activity. Species identification was therefore not attempted for all files recorded.

Due to variability in the quality of calls and difficulty in distinguishing some species a conservative approach was taken when analysing calls and assigning an identification. The identification of each call was assigned a confidence rating (Duffy et al. 2000) as summarised in Table A.6 below.

**Table A.6 Confidence ratings of call identification**

Identification	Description
<b>D – Definite</b>	Species identification not in doubt. Call characteristics diagnostic, matching those described in reference material, including species reference calls. Call sequence contains three or more consecutive pulses of similar frequency and shape.
<b>PR – Probable</b>	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or frequency, or call lacks sufficient detail (e.g call quality) to be definite.
<b>SG – Species Group</b>	Call characteristics (e.g frequency, shape) overlap with other species or call lacks sufficient detail (e.g. call quality) making it too difficult to distinguish between species.
<b>X – Not Detected</b>	Of the data analysed, no calls were attributable to this species.

## Summary of results and survey effort

Bat activity at the site was relatively high, with a maximum activity per night of 1218 calls and a minimum activity per night of three calls. Average bat activity across the two units was 635 calls per night.

Twelve species were positively identified (Definite or Probable) of the 21 species that are known to occur within 10 km of Mount Penang Parklands (Australasian Bat Society 2022). Up to seven additional species may also have been recorded however reliable identification to species level was not possible due to poor data quality and/or similarity of call characteristics between species. Three species known to occur in the locality were not detected by acoustic analysis.

Table A.7 provides a list of all species known to occur in the study area, their conservation status, and identification following call analysis.

**Table A.7 Bat call analysis results**

Species name	Common name	BC Act status	EPBC Act status	Identification
<i>Austronomus australis</i>	White-striped Free-tailed Bat	-	-	D
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	X
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	-	-	D
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	-	-	D
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	PR
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	V	-	SG

Species name	Common name	BC Act status	EPBC Act status	Identification
<i>Miniopterus australis</i>	Little Bent-winged Bat	V	-	PR
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	-	PR
<i>Myotis macropus</i>	Southern Myotis	V	-	PR
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	-	-	SG
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat	-	-	SG
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	-	-	D
<i>Phoniscus papuensis</i>	Golden-tipped Bat	V	-	X
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat	-	-	D
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tailed Bat	V	-	PR
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	PR
<i>Scotorepens orion</i>	Eastern Broad-nosed Bat	-	-	SG
<i>Vespadelus darlingtoni</i>	Large Forest Bat	-	-	PR
<i>Vespadelus pumilus</i>	Eastern Forest Bat	-	-	SG
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V	-	SG
<i>Vespadelus vulturnus</i>	Little Forest Bat	-	-	SG

### Threatened species summary

Six threatened species were identified to species level (probable or definite):

- Eastern False Pipistrelle *Falsistrellus tasmaniensis* (Vulnerable, BC Act).
- Large Bent-winged Bat *Miniopterus orianae oceanensis* (Vulnerable, BC Act).
- Greater Broad-nosed Bat *Scoteanax rueppellii* (Vulnerable, BC Act).
- Southern Myotis *Myotis macropus* (Vulnerable, BC Act).
- Little Bent-winged Bat *Miniopterus australis* (Vulnerable, BC Act).
- Yellow-bellied Sheath-tailed Bat *Saccolaimus flaviventris* (Vulnerable, BC Act).

A further two threatened species may also have been recorded but reliable identification to species level was not possible due to poor data quality and / or similarity of call characteristics between species. These species were identified within species groups containing two or more species with overlapping call characteristics:

- Eastern Cave Bat *Vespadelus troughtoni*.
- Eastern Coastal Free-tailed Bat *Micronomus norfolkensis*.

### Call characteristics used to differentiate overlapping species

The calls of Little Bent-winged Bat were distinguished from Eastern Forest Bat *Vespadelus pumilus* in good quality sequences by the presence of a down-sweeping tail.

Calls from Eastern Forest Bat, Eastern Cave Bat and Little Forest Bat *Vespadelus vulturnus* could not be reliably separated based on call characteristics from potential calls recorded. These species were combined in a species group.

Large Bent-winged Bat calls were separated from Large Forest Bat *Vespadelus darlingtoni* based on frequency, the presence of a downsweeping tail and uneven consecutive pulses.

Free-tailed Bat calls were identified by the presence of mostly flat pulses. Ride's Free-tailed Bat *Ozimops ridei* was differentiated from Eastern Coastal Free-tailed Bat using long sequences with few alternating pulses.

Gould's Wattled Bat *Chalinolobus gouldii* was differentiated from other species by the presence of curved pulses showing alternation in longer sequences.

Large-footed Myotis was separated from Lesser Long-eared Bat and Gould's Long-eared Bat *Nyctophilus* spp. due to the length of sequences recorded, pulse intervals of <75ms, initial slope of greater than 400 OPS on sequences where the initial section of the call was captured and calls of reduced slope scattered amongst steeper calls.

Greater Broad-nosed Bat was differentiated from Eastern False Pipistrelle and Eastern Broad-nosed Bat *Scotorepens orion* in calls where a drop in the pre-characteristic section was >3 kHz, the pre-characteristic section was long and gently curved and the frequency of the knee was >37kHz. Where these features were absent, calls were attributed to a species group. These species are difficult to separate, and these calls were identified as 'probable' for this reason.

Calls attributed to Eastern False Pipistrelle had a drop in the pre-characteristic section of >3kHz, were steep and had an occasional downsweeping tail which suggested they were less likely to be Greater Broad-nosed Bat. These species are difficult to separate, and these calls were identified as 'probable' for this reason.

### Limitations and assumptions

Acoustic sampling is associated with a number of limitations. Detectability of bats relates to the intensity of their calls, their flight characteristics and the structure of the surrounding vegetation, all of which influence the distance over which a bat can be detected. Differences in the probability of detection may result in reduced likelihood of recording and therefore positively identifying some species as present within a site.

Manual call analysis is also associated with limitations including the sometimes arbitrary selection of useable calls and subjectivity of the observer. Definitions as to which calls are assigned to each species have been provided to improve the consistency at which calls were attributed to a species.

It was assumed that individuals would have access to a site for foraging even if they could not roost there.

### Qualifications

Call analysis was undertaken by Felicity Williams. Felicity is experienced in acoustic call analysis having used it to complete her Honours thesis titled "The influence of fire on the foraging activity of insectivorous bats in the Victorian Mallee" in 2009 under the supervision of Lindy Lumsden (Arthur Rylah Institute for Environmental Research, Victorian Government Department of Land, Environment, Water and Planning). Felicity has since used skills in acoustic call detection and analysis for impact assessments on microbats in both Victoria and NSW.

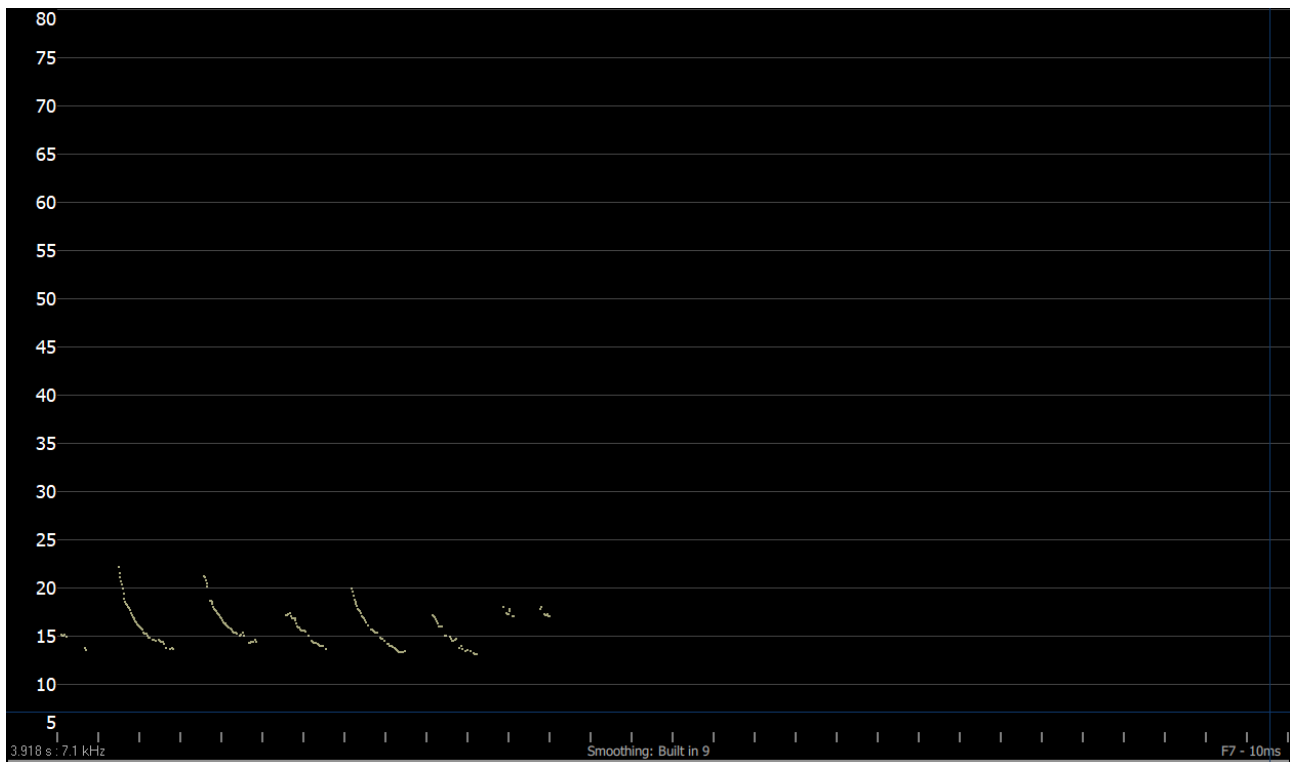
Felicity has completed the following training courses with regard to ultrasonic call recording and analysis:

- Anabat system training course (December 2010) – Titley Scientific.
- Bats of Gluepot Reserve (2011) – Survey techniques and identification.
- Micro-workshop: Basics of Bat Calls (February 2022) – Titley Scientific.

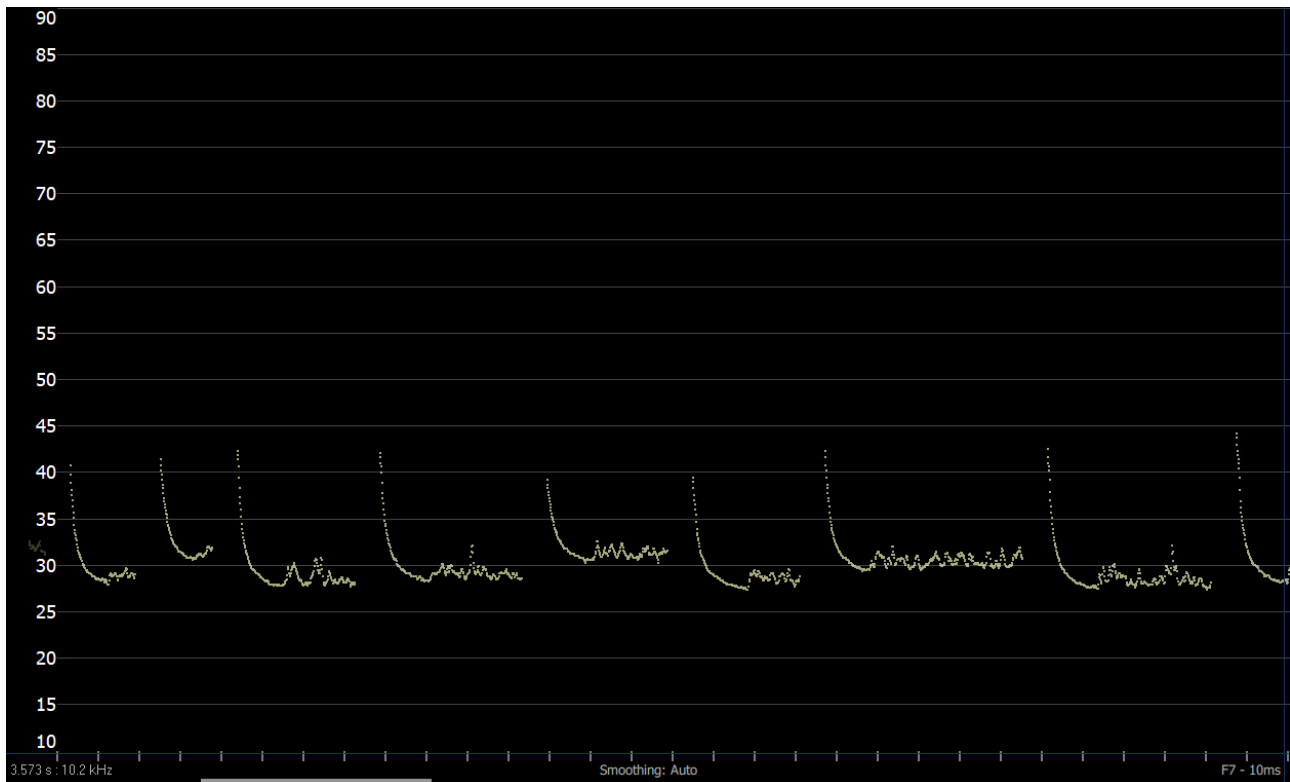
- Micro-workshop: Deployment Techniques for Bat Detectors (March 2022) – Titley Scientific.
- Anabat Insight Advanced Skills Workshop (March 2022) – Titley Scientific.

## Example time versus frequency graphs

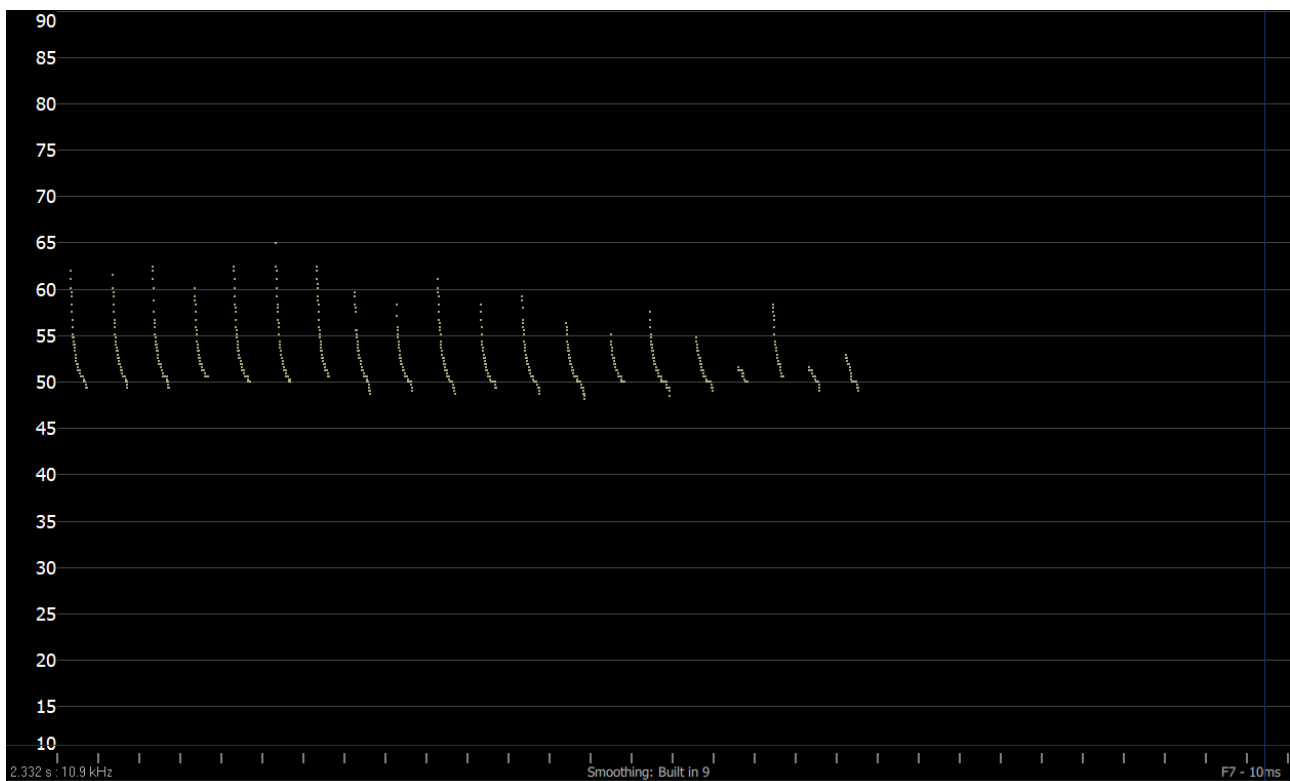
Example time versus frequency graphs for each species given a 'probable' or 'definite' identification are shown in F7, compressed mode unless otherwise stated.



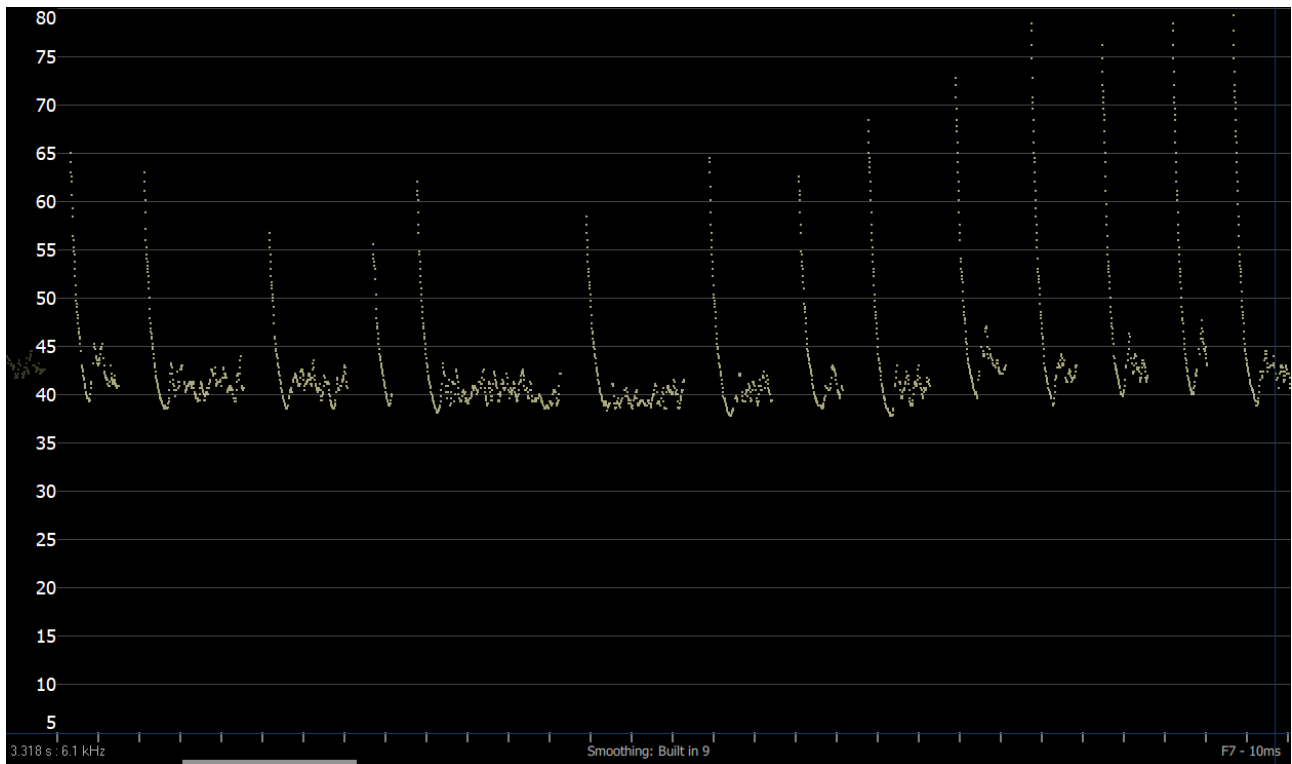
**Plate 1 White-striped Free-tailed Bat *Austrostromus australis***



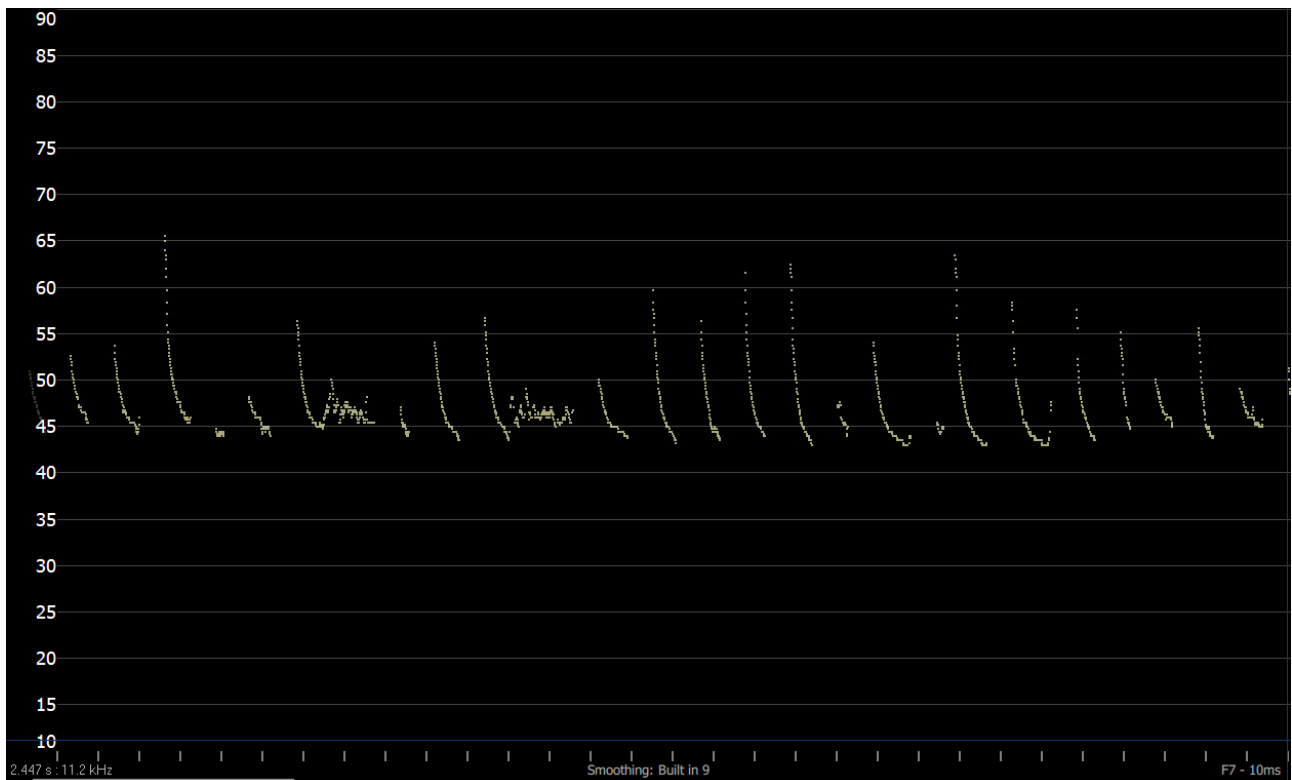
**Plate 2 Gould's Wattled Bat *Chalinolobus gouldii***



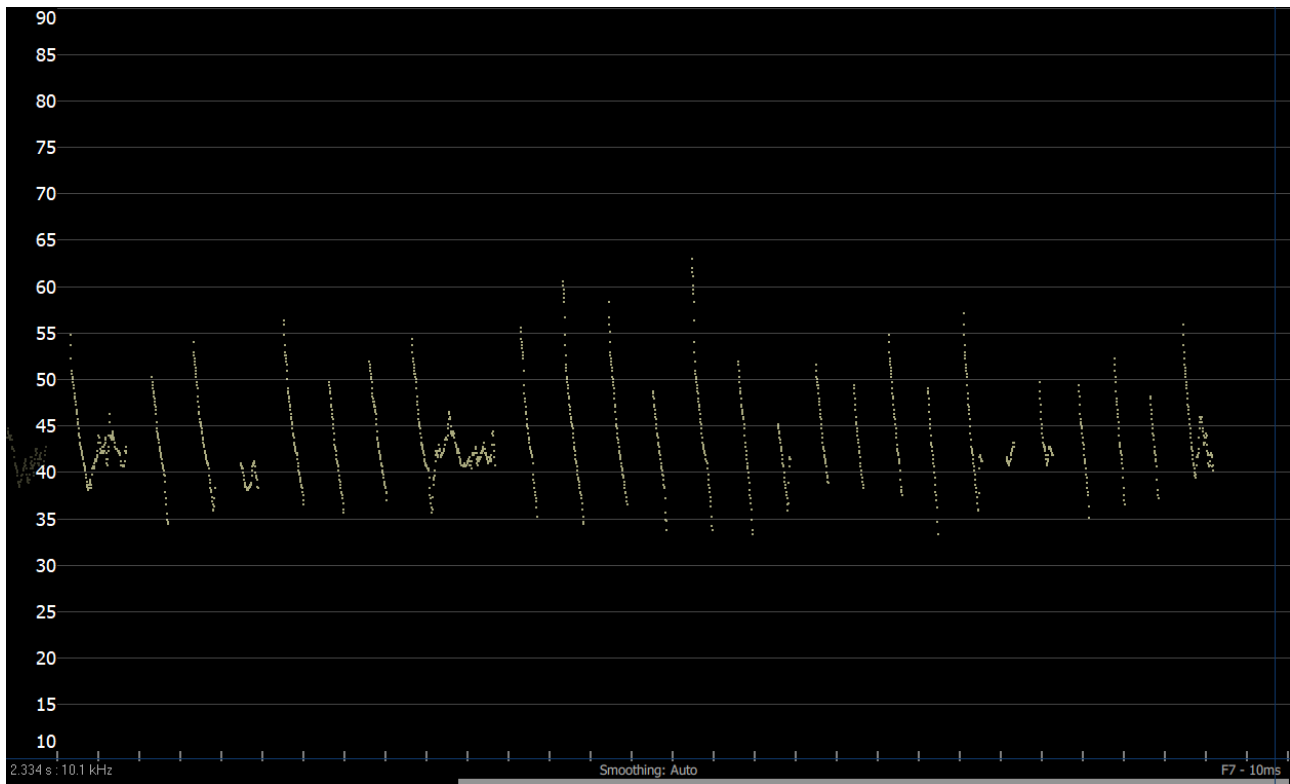
**Plate 3 Chocolate Wattled Bat *Chalinolobus morio***



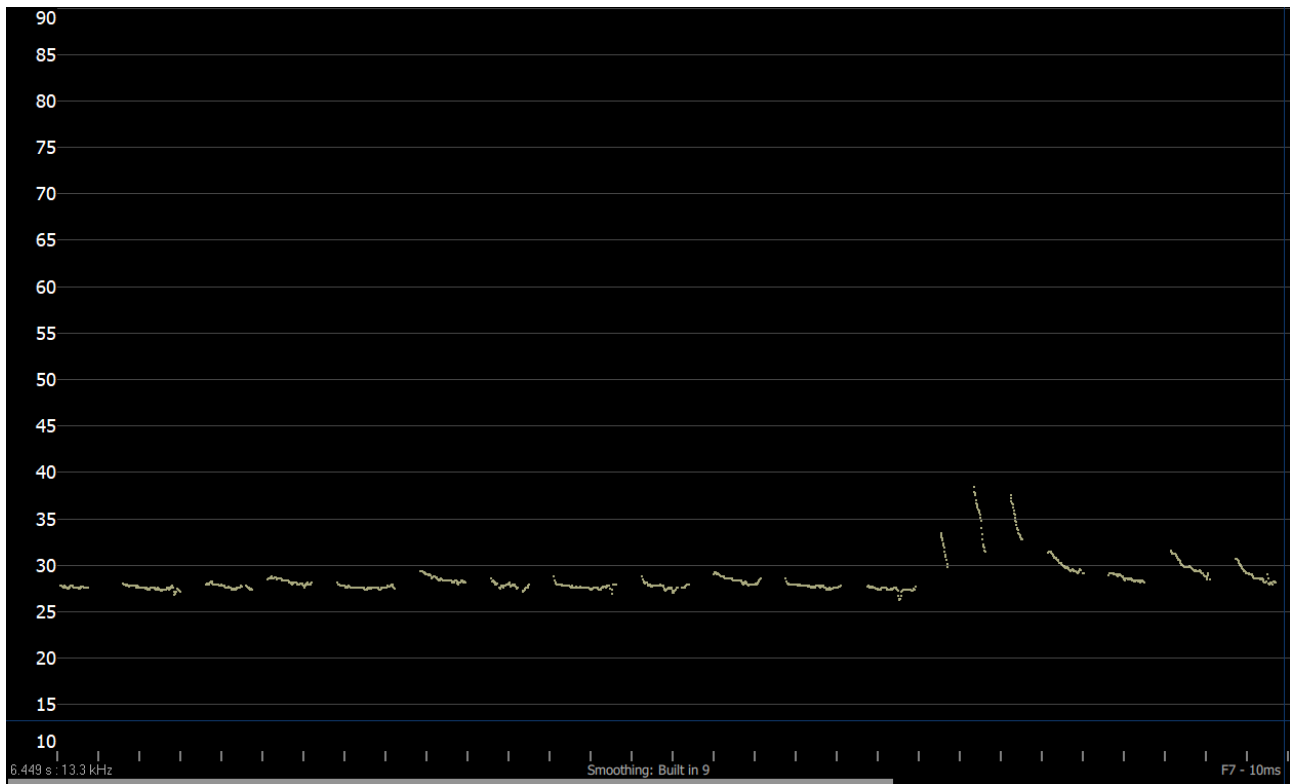
**Plate 4 Eastern Falsistrelle *Falsistrellus tasmaniensis***



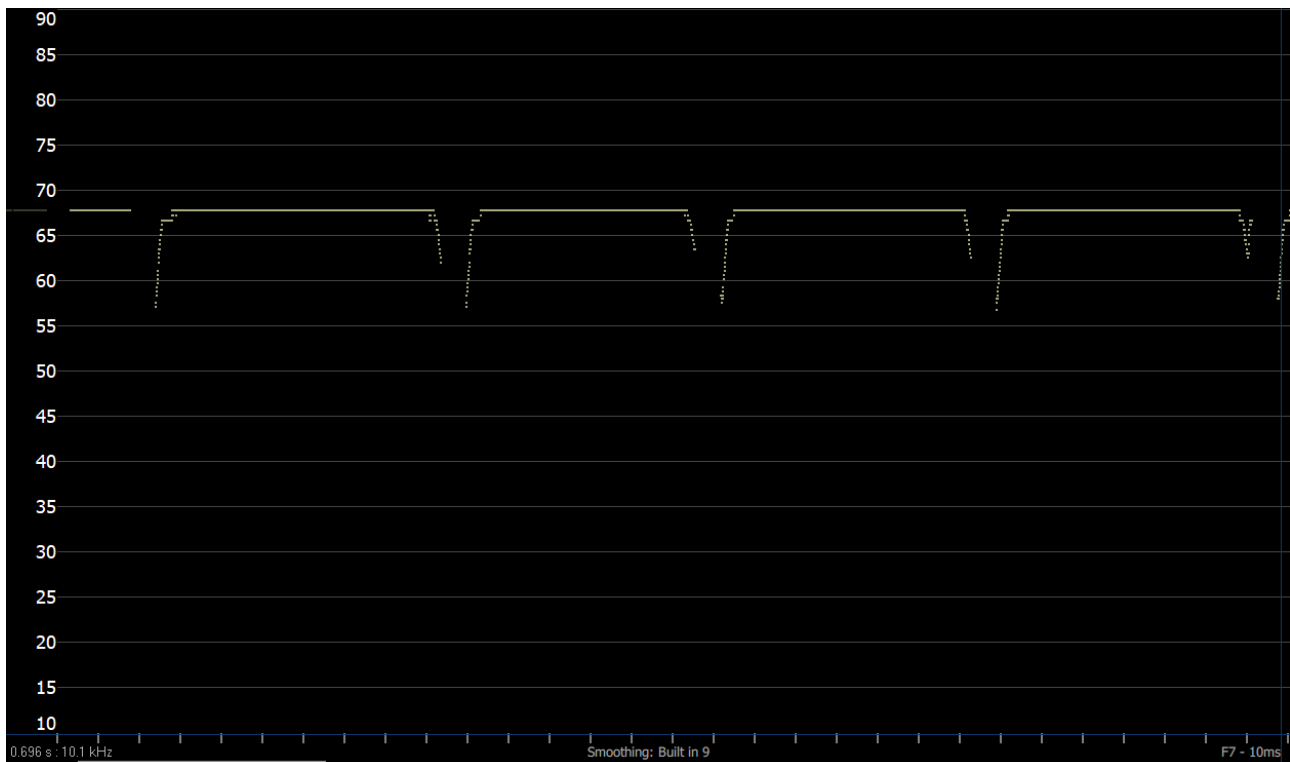
**Plate 5 Large Bent-winged Bat *Miniopterus orianae oceanensis***



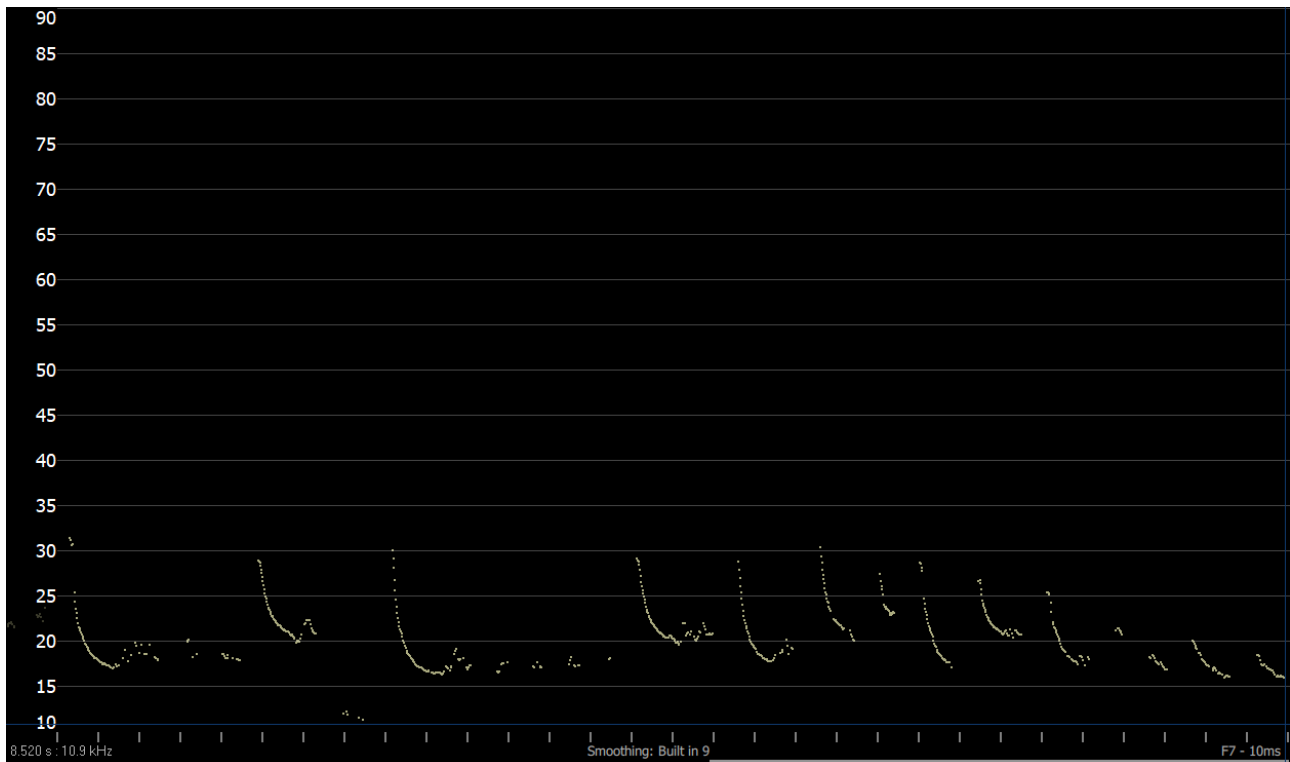
**Plate 6 Southern Myotis *Myotis macropus***



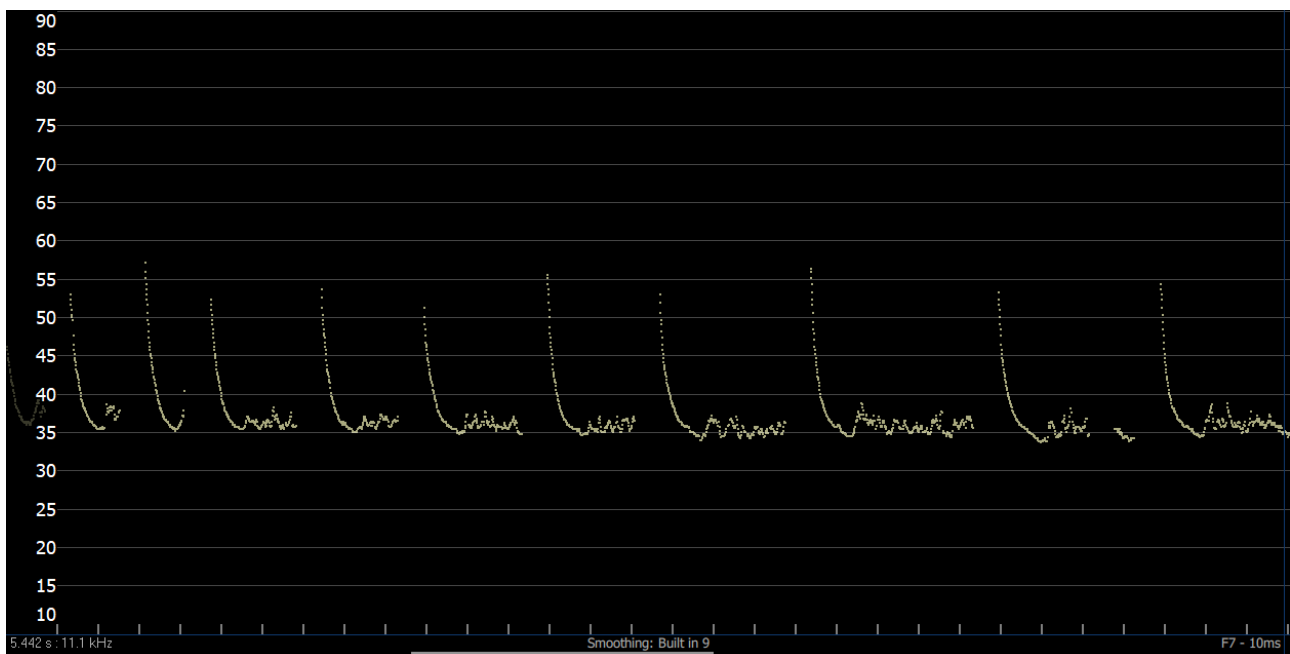
**Plate 7 Ride's Free-tailed Bat *Ozimops ridei***



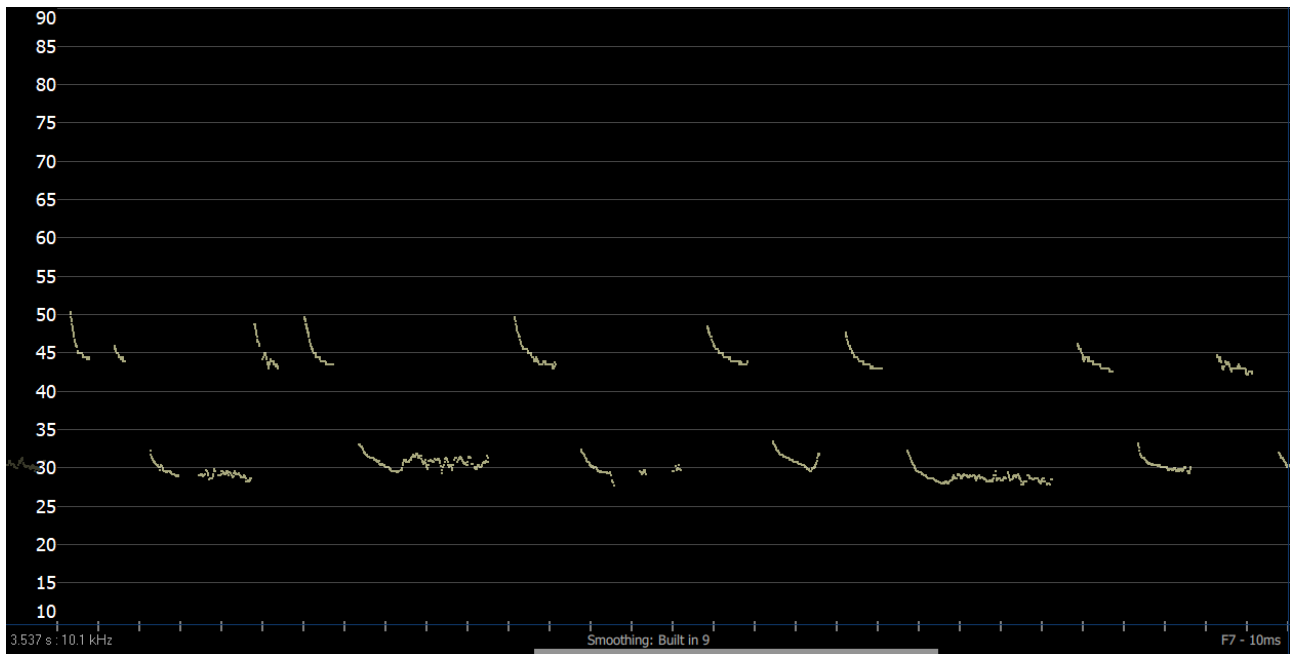
**Plate 8 Eastern Horseshoe Bat *Rhinolophus megaphyllus***



**Plate 9 Yellow-bellied Sheath-tailed Bat *Saccolaimus flaviventris***



**Plate 10 Greater Broad-nosed Bat *Scoteanax rueppellii***



**Plate 11 Large Forest Bat *Vespadelus darlingtoni***

## Appendix 4 Tests of Significance

### Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion

#### Community background

*Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion* is listed as a Critically Endangered Ecological Community under the BC Act. The dominant canopy trees include Scribbly Gum *Eucalyptus racemosa*, Smooth-barked Apple *Angophora costata*, Red Bloodwood *Corymbia gummifera*, Turpentine *Syncarpia glomulifera* and Sydney Peppermint *Eucalyptus piperita*. Black She-oak *Allocasuarina littoralis* and Cheese Tree *Glochidion ferdinandi* are generally present in the midstorey. The understorey supports species such as Apple Berry *Billardiera scandens*, *Cassytha glabella*, Blue-flax Lily *Dianella caerulea*, Wiry Panic *Entolasia stricta*, *Lepidosperma laterale*, Bracken Fern *Pteridium esculentum*, and Sweet Sarsparilla *Smilax glyciophylla*.

Kincumber Scribbly Gum Forest is restricted to a small area on the Bouddi Peninsula on the NSW Central Coast south of Kincumber. It occurs in the Gosford LGA. The total remaining area of Kincumber Scribbly Gum Forest is thought to be less than 100 hectares.

Clearing for urban development and subsequent impact from fragmentation is the greatest threat to Kincumber Scribbly Gum Forest. Given it only persists in fragments, the community is vulnerable to disturbances such as habitat degradation by rubbish dumping, weed invasion facilitated by urban runoff, inappropriate fire regimes, unauthorised horse riding activities and access by people, trail bikes, and other vehicles.

**Table A.8 Test of Significance for Kincumber Scribbly Gum Forest Ecological Community in the Sydney Basin Bioregion**

Test of Significance for Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion
<b>In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</b>
Not applicable – Kincumber Scribbly Gum Forest is not a threatened species.
<b>In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</b>
<b>(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</b>
<b>(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</b>
The local occurrence of Kincumber Scribbly Gum Forest is defined as the patch of the community that occurs within the study area and extends into adjacent areas in a contiguous manner without major breaks in connectivity. In the case of the current assessment, the local occurrence exists as a moderately sized remnant patch equating to approximately 0.43 ha. The proposed works require the removal of two individual trees within this patch. Whilst this immediate removal will reduce the local occurrence of Kincumber Scribbly Gum Forest, trees removed are to be replanted following the completion of construction works. Further to this, vegetation to be retained will be protected in accordance with the requirements of Australian Standard 4970-2009 for the Protection of Trees on Development Sites (Standards Australia 2009). As such, this level of impact is considered negligible and will not lead to the local occurrence of Kincumber Scribbly Gum Forest being placed at risk of extinction.

## Test of Significance for Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion

### In relation to the habitat of a threatened species or ecological community:

- (i) The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
- (ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
- (iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

#### Interpretation of key terms:

- Habitat: the area occupied, or periodically or occasionally occupied, by any threatened species, population or ecological community and includes all the different aspects (both biotic and abiotic) used by species during the different stages of their life cycles.
- Extent: the physical area removed and/or to the compositional components of the habitat and the degree to which each is affected.
- Importance: related to the stages of the species' life cycles and how reproductive success may be affected.
- Locality: the same meaning as ascribed to local population of a species or local occurrence of an ecological community.

The proposed works will remove two individual trees within a patch with an approximate size of 0.45 ha. Whilst this removal will initially cause minor fragmentation, trees being removed will be replanted following the completion of construction works. Therefore, the nature of this impact is unlikely to substantially reduce the habitat available to the CEEC in the locality, nor will it result in isolation or fragmentation of habitats.

Given the restricted nature of the Kincumber Scribbly Gum Forest, the small area of forest remaining, and the existing threats to the community, all habitats in which this community occurs are considered important to the long term survival of the ecological community.

### Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).

The proposed works will not have an adverse effect on any declared areas of outstanding biodiversity value.

### Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

#### Key threatening processes relevant to this community include:

- Land clearance / Clearing of native vegetation.
- Loss of hollow-bearing trees.

However the degree to which the above key threatened process will be enacted as a result of the proposed works is minor and not considered likely to result in a significant impact to this community. The impacts to two trees which will be replanted after construction works is not considered to significantly exacerbate key threatening processes to the community.

### Conclusion.

In consideration of the above five factors, the proposed activity is not likely to significantly impact this TEC within the study area or wider locality, as:

- The proposed works will only result in impacts to two trees which will be replanted following works.
- The proposed works do not significantly contribute to a KTP for Kincumber Scribbly Gum Forest.

As such further assessment of impacts in the form of the application of the BOS or preparation of a SIS is therefore not required.

## Woodland bird species

The following woodland bird species have previously been recorded within a 5 kilometre radius of the study area and have a moderate or greater likelihood of occurrence within the study area:

- Dusky Woodswallow *Artamus cyanopterus cyanopterus* (Vulnerable, BC Act).
- Varied Sittella *Daphoenositta chrysoptera* (Vulnerable, BC Act).
- Little Lorikeet *Glossopsitta pusilla* (Vulnerable, BC Act).
- Turquoise Parrot *Neophema pulchella* (Vulnerable, BC Act).
- Scarlet Robin *Petroica boodang* (Vulnerable, BC Act).

### Species background

Dusky Woodswallow are found over a broad range of habitats, primarily inhabiting dry open Eucalypt forests and woodland, yet can be found in moist forest or rainforest. The species can be resident or migratory birds depending on location. Populations in NSW migrate to south-eastern Queensland after breeding in Spring. Dusky Woodswallow nest in open cup shaped nests, generally occurring in shrubs or low trees. Dusky Woodswallow primarily eat insects whilst flying high but can also forage under canopy over leaf litter or dead timber (DPE 2017a).

The Varied Sittella is a sedentary species which inhabits a wide variety of dry eucalypt forests and woodlands, usually with either shrubby understorey or grassy ground cover or both, in all climatic zones of Australia. The species usually inhabit areas with rough-barked trees, such as stringybarks or ironbarks, but also in mallee and acacia woodlands, paperbarks or mature Eucalypts. The Varied Sittella feeds on arthropods gleaned from bark, small branches and twigs. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.

Little Lorikeet is distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 metres and 15 metres, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.

The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. The species lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Nests in tree hollows, logs or posts, from August to December.

Scarlet Robin is found from south east Queensland to south east South Australia and also in Tasmania and south west Western Australia. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter. The species lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation that usually contains abundant logs and fallen timber, which are important components of its habitat. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps.

### Woodland bird species within the study area

A number of records of the above woodland bird species occur within 5 kilometres of the study area.

The proposed works will result in the removal of up to two hollow-bearing trees providing potential habitat for these species. An assessment of whether the proposed project is likely to lead to a significant impact on the woodland bird species is provided below.

**Table A.9 Test of Significance for woodland bird species**

Test of Significance for woodland bird species
<p><b><i>In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</i></b></p>
<p>Woodland birds move freely between the study area and adjacent woodland habitats adjacent to the study area and more broadly in the locality. Impacts from the project that have potential to adversely affect the life cycle of threatened woodland birds include direct mortality during construction and loss of nesting, perching and sheltering habitat. Indirect impacts including clutch failure due to noise disturbance, mortality through vehicle strikes, increased edge effects and competition from Noisy Miners.</p> <p>The bird species considered here may use a range of PCTs therefore the total permanent habitat removal/disturbance area is considered to be the likely extent of long term impacts on woodland vegetation although not all species would utilise all vegetation in the same manner. In addition to this total, woodland birds are likely to utilise planted indigenous and non-indigenous vegetation that does not align with a PCT. The habitat to be removed two hollow-bearing trees that may be used as a nesting resource. It is likely that if these species use the study area for nesting and breeding then the local populations would be reasonably expected to use the entire patches of contiguous habitat within the road reserves and adjacent native vegetation that is contiguous with vegetation within the study area. Removal of vegetation in the context of the available habitat adjacent to the development will not adversely affect the life cycle of threatened woodland bird species such that local populations would be placed at risk of extinction given the quantity of suitable breeding and nesting habitat immediately adjacent to the development, the dispersal ability of these mobile avian species and the abundance of these species in the local area.</p>
<p><b><i>In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</i></b></p> <p><b><i>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</i></b></p> <p><b><i>(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</i></b></p>
<p>Not applicable, not an ecological community.</p>
<p><b><i>In relation to the habitat of a threatened species or ecological community:</i></b></p> <p><b><i>(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</i></b></p> <p><b><i>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and</i></b></p> <p><b><i>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.</i></b></p>
<p>The project will remove two hollow-bearing trees that may provide potential habitat for threatened woodland birds throughout the study area. Recommendations contained within this report aim to minimise indirect impact from construction and operation of the proposal.</p> <p>The threatened woodland bird habitat in the area is fragmented and in poor condition, however some woodland birds</p>

## Test of Significance for woodland bird species

are more susceptible to fragmentation and are generally more sedentary, the development will not act as a barrier such that the habitat would become isolated or local population should become genetically isolated.

In a broader sense, the potential habitat to be removed within the study area is considered marginal habitat for these species. However, the quantity of permanent vegetation removal/disturbance required for the development will not jeopardise the long term survival of these species in the locality given the quantity of similar contiguous habitat immediately adjacent to the development. The cumulative impacts of incremental habitat loss is a key concern for woodland bird species but given the type of impact in the context of the available habitat at the location, this is not seen as a significant issue in this case. Habitat removal of this type and extent will not adversely influence the long term survival of any threatened woodland birds given the quantity of similar habitat immediately adjacent to the development.

***Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).***

To date no AOBVs have been declared within the project's study area.

***Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.***

Key threatening processes relevant to the woodland bird species identified on the Schedule 4 of the BC Act that may be exacerbated by the proposed slope works include:

- Loss of hollow-bearing trees.

The removal of two hollow-bearing trees providing potential roosting habitat will contribute to these KTPs, but is unlikely to significantly impact any threatened woodland birds within the locality.

### Conclusion.

In consideration of the above five factors, the proposed activity is not likely to significantly impact threatened woodland birds within the study area or broader locality, as:

- The proposal will remove two hollow-bearing trees providing potential habitat that may represent a dispersal, nesting or foraging resource from within an area containing patches of similar habitat.
- The extent of the vegetation removal in the context of the broader area will not significantly disrupt the lifecycle of threatened woodland birds as large areas of similar habitat will still be available for critical activities to occur in post construction adjacent to the study area. Some of the species considered here readily move through the landscape and undertake seasonal migration while others are sedentary but capable of short distance dispersal.
- While the habitat to be removed is considered important to these species, the type of the removal within the area is not considered important to the survival or recovery of any of these species.
- The proposal does not significantly contribute to a KTP for these species.

As such further assessment of impacts in the form of the application of the BOS or preparation of a SIS is therefore not required.

## Squirrel Glider *Petaurus norfolcensis*

### Species background

Squirrel Glider, listed as Vulnerable under the BC Act, is a small arboreal mammal with a head and body length of approximately 20 centimetres. Squirrel Gliders can be told apart from Sugar Gliders by their larger size (up to twice that of Sugar Gliders), as well as their distinctive facial markings. The species has a wide, although sparse, distribution throughout eastern Australia extending from northern Queensland to western Victoria.

Squirrel Glider inhabits mature of old growth Box, Box-Ironbark woodlands, and River Red Gum forest west of the Great Dividing Range, as well as Blackbutt-Bloodwood forest with a heath understorey in coastal areas. The species feeds on the gum produced by *Acacia* shrubs, as well as *Eucalyptus* sap and nectar, honeydew and manna, as well as some invertebrates and pollen. The species shelters and breeds in tree hollows (DPE 2017b, Smith & Murray 2003).

### Squirrel Glider within the study area

A number of records of the above mammal species occur within 5 kilometres of the study area.

The study area includes *Eucalyptus* spp. and *Acacia* spp. trees and shrubs that represent potential foraging resources for Squirrel Glider species. The proposed works will result in the removal of two hollow-bearing trees that may potential habitat for these species. As the Squirrel Glider is listed under the BC Act, a test for determining whether the proposed works are likely to significantly affect the species in accordance with section 7.3 of the BC Act is required and has been undertaken below.

**Table A.10 Test of Significance for Squirrel Glider**

Test of Significance for Squirrel Glider
<p><b>In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</b></p>
<p>Impacts likely to have an adverse effect on the life cycle of Squirrel Gliders include loss, modification and fragmentation of habitat through clearing of vegetation, loss of understorey food resources, and loss of hollow-bearing tree nest sites. The proposed works will result in the potential impacts to two hollow-bearing trees that may provide sheltering and breeding habitat for these this species. The removal of this vegetation will reduce the availability of resources within the immediate area. However, Squirrel Glider utilise up to 12 den trees simultaneously and move between them (Crane, Lindenmeyer, &amp; Cunningham 2010). In addition, hollows are abundant in the surrounding area and trees removed will be replanted following construction works. Recommendations for the staged removal of these habitat trees under ecological supervision will further ensure the impacts to Squirrel Glider are minimised.</p> <p>Given the small scale of impact associated with the proposed works, the wide availability of suitable high-quality resources within the locality, and mitigation measures provided, it is unlikely that the proposed works will have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.</p>
<p><b>In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</b></p> <p><b>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</b></p> <p><b>(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</b></p>
<p>Not applicable – neither species is an ecological community.</p>
<p><b>In relation to the habitat of a threatened species or ecological community:</b></p> <p><b>(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</b></p> <p><b>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and</b></p> <p><b>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.</b></p>

## Test of Significance for Squirrel Glider

The proposed works include the removal of two hollow-bearing trees containing small to medium hollows (<10 cm) representing potential sheltering and breeding habitat, for Squirrel Gliders.

Fragmentation is evident within the study area due to previous vegetation clearing undertaken to allow for the construction of buildings and associated road infrastructure. However connectivity with the surrounding vegetation is high due to the high retention of canopy trees containing hollows. The proposed works are unlikely to result in further fragmentation or significantly reduce habitat connectivity across the study area due to the small scale of disturbance associated with the proposed works. As such the resources to be impacted by the proposed works represent marginal sheltering resources only and are unlikely to be relied upon by this species.

Given the wide availability of suitable high-quality resources providing similar foraging and dispersal habitat immediately adjacent to the proposed works, the low risk of habitat fragmentation and high connectivity with vegetation in the locality, the proposed scope of works are not considered to constitute a significant impact to the long term survival Squirrel Gliders within the locality.

The habitat to be removed within the study area is not considered important to the Squirrel Glider given that the species utilise up to 12 den trees simultaneously and move between them (Crane, Lindenmeyer, & Cunningham 2010). In addition, hollows are abundant in the surrounding area and trees removed will be replanted following construction works. Therefore, removal of two trees containing potentially suitable hollows is not considered likely to result in a significant impact to the long-term survival of the species.

### **Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).**

The proposed works will not have an adverse effect on any declared areas of outstanding biodiversity value.

### **Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.**

Key threatening processes relevant to Squirrel Gliders include clearing of native vegetation, loss of hollow-bearing trees, forest eucalypt dieback associated with over-abundant psyllids and Bell Miners *Manorina melanophrys*, high frequency fire resulting in the disruption of life cycle processes in plants and animals, loss of vegetation structure and composition, and predation by European Red Fox *Vulpes vulpes* and Feral Cat *Felis catus*.

Of these threatening process, clearing of native vegetation and removal of hollow-bearing trees are relevant to the proposed works. The removal of these trees will reduce the availability of sheltering/breeding resources within the immediate study area. However, Squirrel Glider utilise up to 12 den trees simultaneously and move between them (Crane, Lindenmeyer, & Cunningham 2010). In addition, hollows are abundant in the surrounding area and trees removed will be replanted following construction works. Therefore, removal of two trees containing potentially suitable hollows is not considered to significantly exacerbate key threatening processes to either of these species.

### **Conclusion.**

In consideration of the above five factors, the proposed activity is not likely to significantly impact Squirrel Glider within the study area or wider locality, as:

- The proposed works will only result in impacts to two hollow-bearing trees, of which are surrounded by numerous other hollows.
- The proposed works do not significantly contribute to a KTP for Squirrel Gliders.

As such further assessment of impact in the form of the application of the BOS or preparation of a SIS is therefore not required.

## Tree-hollow roosting microchiropteran bats

The following tree-hollow roosting microchiropteran species have previously been recorded within a 5 kilometre radius of the study area:

- Eastern False Pipistrelle *Falsistrellus tasmaniensis* (Vulnerable, BC Act).
- Eastern Coastal Free-tailed Bat *Micronomus norfolkensis* (Vulnerable, BC Act).
- Little Bent-winged Bat *Miniopterus australis* (Vulnerable, BC Act).
- Southern Myotis *Myotis macropus* (Vulnerable, BC Act).
- Greater Broad-nosed Bat *Scoteanax rueppellii* (Vulnerable, BC Act).

In addition, Yellow-bellied Sheath-tailed Bat *Saccolaimus flaviventris* (Vulnerable, BC Act) was detected during the current assessment.

### Species background

The Eastern False Pipistrelle occurs in moist habitats with trees taller than 20 metres (DPE 2017c). The species generally roosts in eucalypt hollows and occasionally under loose bark on trees or in buildings. It is insectivorous, feeding on beetles, moths, weevils and other flying insects above or just below the tree canopy.

The Eastern Coastal Free-tailed Bat is found along the east coast from south Queensland to southern NSW in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. The species generally roosts in tree hollows but will also roost under bark or in man-made structures. It is solitary but also recorded roosting communally. It is insectivorous.

The Little Bent-winged Bat occurs on the east coast of Australia, ranging from Cape York in Queensland to Wollongong in NSW (DPE 2019). It is a cave dwelling bat, however it is known to roost in caves, abandoned mines, tunnels, stormwater drains, tree hollows and occasionally buildings. It is insectivorous, feeding primarily on beetles, moths and flies, but is also known to frequently consume spiders.

Southern Myotis has a wide distribution within the coastal band (i.e. less than 100 kilometres inland), occurring from north-west Australia, across the top-end and south to western Victoria (DPE 2020). The species generally roosts in groups of 10 to 15 individuals, preferably close to water in a number of different habitat structures including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, bridges and in dense foliage.

Yellow-bellied Sheath-tail-bat is found throughout NSW in habitats including wet and dry sclerophyll forest, open woodland, acacia shrubland, mallee, grasslands and desert. They roost in tree hollows in colonies and have also been observed roosting in animal burrows, abandoned Sugar Glider nests, cracks in dry clay, hanging from buildings and under slabs of rock. The species forages for insects above the canopy in forests.

Greater Broad-nosed Bat occurs in gullies and river systems that drain the Great Dividing Range and ranges from north-eastern Victoria up to the Gold Coast in Queensland (DPE 2022). The species utilises a variety of habitats including woodland, moist and dry Eucalyptus forests and rainforest, however it is most commonly found in tall wet forests. It generally roosts in tree hollows however it is also known to utilise man-made structures.

### Tree-hollow roosting microbat species within the study area

A number of records of the above microbat species occur within 5 kilometres of the study area. Only Southern Myotis, Eastern Coastal Free-Tailed Bat and Greater Broad-nosed Bat are considered to have a medium likelihood of occurrence in the study area. The remaining species were considered to have a low

likelihood of occurrence but were detected during targeted survey and therefore their likelihood of occurrence was revised to high.

Six threatened species were identified to species level within the study area (probable or definite):

- Eastern False Pipistrelle *Falsistrellus tasmaniensis* (Vulnerable, BC Act).
- Large Bent-winged Bat *Miniopterus orianae oceanensis* (Vulnerable, BC Act).
- Southern Myotis *Myotis macropus* (Vulnerable, BC Act).
- Little Bent-winged Bat *Miniopterus australis* (Vulnerable, BC Act).
- Yellow-bellied Sheath-tailed Bat *Saccolaimus flaviventris* (Vulnerable, BC Act).
- Greater Broad-nosed Bat *Scoteanax rueppellii* (Vulnerable, BC Act).

The project will result in the removal of two hollow-bearing trees proving potential habitat for the species. An assessment of whether the proposed project is likely to lead to a significant impact on the microbat species is provided below.

**Table A.11 Test of Significance for tree-hollow roosting microchiropteran bats**

Test of Significance for tree-hollow roosting microchiropteran
<p><b><i>In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</i></b></p>
<p>Impacts from the project which have potential to have an adverse effect on the life cycle of threatened microbats include disturbance to roosting and breeding sites, loss of roosting habitat (primarily hollow-bearing eucalypts and indirect impacts including noise disturbance and mortality through vehicle strikes.</p> <p>These tree-hollow dependent microbats may occupy woodland habitats, planted vegetation, farm houses, sheds and culverts, bridges and underpasses within and adjacent to the alignment. The development will permanently remove two hollow-bearing trees. This level of disturbance, whilst significant, is unlikely to affect foraging, dispersal or gene flow of threatened microbats given their dispersal ability and large home ranges to the extent that local populations are put at risk of extinction.</p> <p>Recommendations for the staged removal of these habitat trees under ecological supervision will further ensure the impacts to any roosting microbats are minimised.</p> <p>As such the development is unlikely to have a significant adverse effect on the life cycle of local populations of microbats to the point that the broader population should significantly decline.</p>
<p><b><i>In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</i></b></p> <p><b><i>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</i></b></p> <p><b><i>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</i></b></p>
<p>Not applicable, not an ecological community.</p>

## Test of Significance for tree-hollow roosting microchiropteran

### ***In relation to the habitat of a threatened species or ecological community:***

***(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and***

***(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and***

***(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.***

The project will remove two hollow-bearing trees that may be used by threatened microbat species. The proposed works also have the potential to modify adjoining native vegetation by increased edge effects, sedimentation and accidental modification by workers during construction.

Given the dispersal ability of these species, any fragmentation that may occur from the current proposal is unlikely to act as a barrier to dispersal such that two populations would become isolated.

The hollow-bearing trees to be removed for the proposed works is important habitat for these species, however, the extent of removal required for the development will not jeopardise the long term survival of these species in the locality given the quantity of similar quality habitat in the broader landscape.

### ***Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).***

To date no AOBVs have been declared within the project's study area.

### ***Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.***

The proposed works have the potential to result in the following key threatening processes, which are listed under the Schedule 4 of the BC Act and which are considered relevant to these species:

- Removal of hollow-bearing trees.

The project will result in the removal of two hollow-bearing trees for tree-hollow dependent microbats. Given the location of the study area within a disturbed and developed semi-urban environment it is considered unlikely that the removal of this vegetation would exacerbate the impacts of these key threatening processes on the microbat species.

### **Conclusion.**

In consideration of the above five factors, the proposed activity is not likely to significantly impact threatened microbats within the study area or broader locality, as:

- The proposal will permanently remove or disturb woodland vegetation that may represent a foraging resource from within an area containing large contiguous patches of similar habitat.
- The extent of the vegetation removal in the context of the broader landscape will not significantly disrupt the lifecycles of threatened microbats as large areas of similar habitat will still be available for critical activities to occur in post construction.
- Recommendations for the staged removal of these habitat trees under ecological supervision will further ensure the impacts to threatened microbats are minimised.
- No BC Act listed microbats were detected during targeted surveys.

As such further assessment of impacts in the form of the application of the BOS or preparation of a SIS is therefore not required.