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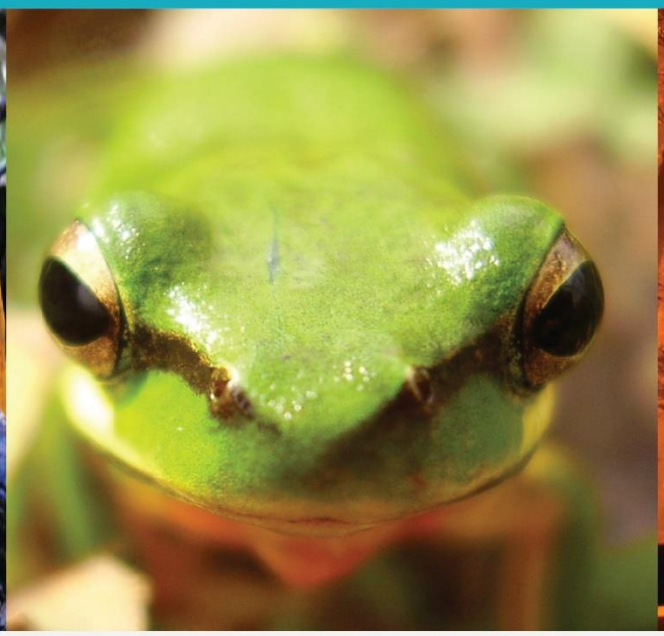


BIODIVERSITY CERTIFICATION ASSESSMENT REPORT

Proposed Development

Lots 3 and 4 DP26902

10 and 12 Boondah Road

Warriewood

16 September 2022

(REF: 18HEN03.2)

BIODIVERSITY CERTIFICATION ASSESSMENT REPORT

Proposed Development

Lots 3 and 4 DP26902, 10 and 12 Boondah Road, Warriewood

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Date:	16/09/22
File:	18HEN03.2

Request an online quote 24/7

EXECUTIVE SUMMARY

Travers bushfire & ecology has been engaged to prepare a biodiversity certification assessment report (BCAR) for the proposed re-zoning and townhouse development at 10 and 12 Boondah Road, Warriewood. The entire area bounded by Lots 3 and 4, DP26902 has been subject to detailed survey effort and will hereafter be referred to as the 'study area'.

The area of direct impact from the development will hereafter be referred to as the 'development footprint'.

Development/Planning proposal

The proposal is to re-zone the existing lots from RU2 to a combination of R2 – low density residential and C2 – environmental conservation. The proposed R2 land will permit development of approximately 42 terrace-style dwellings arranged in six rows along linked internal roads accessed at three (3) locations along the site's frontage to Boondah Rd. Open space areas are in the southern and western parts of the site, associated with bushfire asset protection zones, a children's playground, and vegetation and riparian corridors. The C2-zoned land will allow for protection and conservation of retained Swamp Oak Forest vegetation.

Recorded biodiversity

Ecological survey and assessment has been undertaken in accordance with the *Biodiversity Assessment Methodology* 2020 (BAM) as well as relevant legislation including the *Environmental Planning and Assessment Act 1979* (*EP&A Act*), the *Biodiversity Conservation Act 2016* (*BC Act*), the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) and the *Fisheries Management Act 1994* (*FM Act*). Compliant survey and limitations for candidate species are explained in Section 2.5, Section 4.2.2 (flora) and Section 4.3.4 (fauna).

In respect of matters required to be considered under the *EP&A Act* and relating to the species / provisions of the *BC Act*, six (6) threatened fauna species Grey-headed Flying-fox (*Pteropus poliocephalus*), Southern Myotis (*Myotis macropus*), Little Bent-winged Bat (Miniopterus australis), Large Bent-winged Bat (*Miniopterus orianae oceanensis),* Eastern Cave Bat *(Vespadelus troughtoni)* and Powerful Owl (*Ninox strenua*), no migratory bird species, no threatened flora species and two (2) Threatened Ecological Communities (TECs), Swamp Oak Floodplain Forest (SOFF) and Bangalay Sand Forest of the Sydney Basin (BSF) were recorded within the development footprint.

In respect of matters required to be considered under the *EPBC Act*, one (1) threatened fauna species Grey-headed Flying-fox (*Pteropus poliocephalus*), no threatened flora species, and one (1) TEC, *Coastal Swamp Oak Forest,* was recorded within the development footprint.

In respect of matters relative to the *FM Act*, no suitable habitat for threatened marine or aquatic species was observed within the development footprint.

Impact assessment

Avoidance actions are outlined in Section 5.3. The resultant direct, indirect and cumulative ecological impacts of the proposal have been carefully considered in Section 5.5. Further

recommended mitigation measures to minimise/offset these impacts, to address threatening processes and to create a more positive ecological outcome for threatened biodiversity have been outlined within Section 5.4.

The Development Proposal will see the impact of 1.26 ha of vegetation, which includes impacts to five different vegetation units including the following (PCT below refers to Plant Community Type):

- Zone1: PCT 1232 – Swamp Oak floodplain swamp forest (TEC SOFF) – 0.18 ha impacted
- Zone 2: PCT 1793 – Smooth-barked Apple - Bangalay / Tuckeroo - Cheese Tree open forest (TEC BSF) – 0.23 ha impacted
- Zone 3: Planted and derived exotic vegetation – 0.27 ha impacted
- Zone 4: Pasture and weeds – 0.48 ha impacted
- Planted native vegetation – 0.10 ha impacted

There will be no significant impact on matters listed under the *FM Act*.

Biodiversity Offsets Scheme (BOS) – Threshold Assessment

The BOS applies to all biodiversity certification assessments. Subsequently the three (3) elements to the BOS threshold test – an area trigger, a Biodiversity Values Land Map trigger and the Test of Significance – do not apply.

BAM Calculator results

The BAM Calculator provides a means of objectively determining the loss of biodiversity as a result of a proposed development. The credits required (Table A & B) are the number of credits needed to be 'retired' to offset residual impacts.

A – Requirement for ecosystem credits

Zone	Veg. zone name	Veg. integrity loss	Area (ha)	Sensitivity to gain	Biodiversity risk weighting	Potential SAII	Ecosystem credits
1	1232_poor	38.6	0.18	High	2	no	3
2	1793_poor	25.9	0.23	High	2	no	3
3	1232_derived_exotic	1.3	0.27	High	2.5	no	0
4	1232_pasture_weeds	3.1	0.48	High	2.5	no	0
							Total: 6

Table B – Requirement for species credits

Veg. zone name	Veg. integrity loss	Area (ha) / count	Biodiversity risk weighting	Potential SAII	Species credits
***Cercartetus nanus* / Eastern Pygmy-possum (Fauna)**					
1232_poor	38.6	0.18	2	False	3
1793_poor	25.9	0.23	2	False	3
					Subtotal: 6
***Myotis macropus* / Southern Myotis (Fauna)**					
1232_derived_exotic	1.3	0.27	2	False	1
1232_pasture_weeds	3.1	0.48	2	False	1
1232_poor	38.6	0.18	2	False	3
1793_poor	25.9	0.23	2	False	3
					Subtotal: 8
***Vespadelus troughtoni* / Eastern Cave Bat (Fauna)**					
1232_derived_exotic	1.3	0.27	3	True	1
1232_pasture_weeds	3.1	0.48	3	True	1
1232_poor	38.6	0.18	3	True	5
1793_poor	25.9	0.23	3	True	4
					Subtotal: 11

The pricing of credits can vary greatly over time and it is advised that the proponent use the online Biodiversity Offset Payment Calculator tool to determine the current pricing of credits (https://www.lmbc.nsw.gov.au/offsetpaycalc).

LIST OF ABBREVIATIONS

APZ	asset protection zone
BAM	Biodiversity Assessment Method (2020)
BAR	Biodiversity Assessment Report
BC Act	*Biodiversity Conservation Act (2016)*
BC Reg	*Biodiversity Conservation Regulation (2017)*
BCAR	Biodiversity Certification Assessment Report
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offset Scheme
BPA	bushfire protection assessment
BSSAR	Biodiversity Stewardship Site Assessment Report
CEEC	Critically endangered ecological community
CM Act	*Coastal Management Act 2016*
DAWE	Department of Agriculture, Water and the Environment.
DCP	development control plan
DEC	NSW Department of Environment and Conservation (superseded by DECC from April 2007)
DECC	NSW Department of Environment and Climate Change (superseded by DECCW from October 2009)
DECCW	NSW Department of Environment, Climate Change and Water (superseded by OEH from April 2011)
DEWHA	Commonwealth Department of Environment, Water, Heritage & the Arts (superseded by SEWPAC)
DOEE	Commonwealth Department of Environment & Energy (superseded by DAWE)
DPE	NSW Department of Planning and Environment
DPIE	NSW Department of Planning, Industry and Environment (superseded by DPE Nov 2021)
EEC	endangered ecological community
EHG	Environment and Heritage Group (DPE)
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act (1979)*
EPBC Act	*Environment Protection and Biodiversity Conservation Act (1999)*
FM Act	Fisheries Management Act
IBRA	Interim Biogeographic Regionalisation for Australia
LEP	local environmental plan
LGA	local government area
LLS Act	*Local Land Services Act (2013)*
NES	national environmental significance
NPW Act	*National Parks and Wildlife Act (1974)*
NRAR	Natural Resources Access Regulator (NSW)
NSW DPI	NSW Department of Industry and Investment
OEH	Office of Environment and Heritage (superseded by DPIE from August 2019)
PCT	plant community type
PFC	projected foliage cover
RFS	NSW Rural Fire Service
ROTAP	rare or threatened Australian plants
SAII	Serious And Irreversible Impacts
SEPP	State Environmental Planning Policy
SEWPAC	Commonwealth Dept. of Sustainability, Environment, Water, Population & Communities (superseded by DOEE)
SIS	species impact statement
SULE	safe useful life expectancy
TEC	threatened ecological community
TPZ	tree preservation zone
TSC Act	*Threatened Species Conservation Act (1995)* – superseded by the *Biodiversity Conservation Act (2016)*
VMP	vegetation management plan

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1. INTRODUCTION

Travers bushfire & ecology has been engaged to undertake a biodiversity certification assessment within Lots 3 and 4 DP26902, at 10 and 12 Boondah Road, Warriewood within the Northern Beaches local government area (LGA). The extent of these lots is shown in Figure 1.1 below. These lots are subject to a planning proposal application and will hereafter be referred to as the 'study area'.

The area containing the proposed development, APZs and all associated impact on habitat features is hereafter referred to as the 'subject land' (refer to Figure 1.3).

The proposal shall be assessed under the *Biodiversity Conservation Act* (*BC Act*), 2016.

Figure 1.1 – Subject lots (red) and subject land / biodiversity certification area (yellow)

1.1 Purpose

The purpose of this Biodiversity Certification Assessment Report (BCAR) is to undertake assessment of impact on biodiversity, including threatened species, populations and ecological communities. Consequently, the following tasks have been completed:

- Undertake botanical survey to describe the vegetation communities and their conditions
- Undertake fauna habitat survey for the detection and assessment of fauna and their potential habitats
- Complete targeted surveys for threatened species, populations and ecological communities
- Prepare a BCAR in accordance with the requirements of the:
    a) *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act),*
    b) *Biodiversity Conservation Act 2016 (BC Act),*
    c) *Biodiversity Conservation Regulation 2017 (BC Reg.),*
    d) *Fisheries Management Act 1994 (FM Act)*, and
- Prepare a BCAR in accordance with the Biodiversity Assessment Methodology (BAM) 2020

1.1.1 Certification of BAM compliance

Section 6.15 of the *BC Act* regarding the currency of a BCAR requires:

(1) A biodiversity assessment report cannot be submitted in connection with a relevant application unless the accredited person certifies in the report that the report has been prepared on the basis of the requirements of (and information provided under) the biodiversity assessment method as at a specified date and that date is within 14 days of the date the report is so submitted.

(2) A relevant application is an application for planning approval, for vegetation clearing approval, for biodiversity certification or in respect of a biodiversity stewardship agreement.

George Plunkett (BAAS 19010) is an accredited person under the *BC Act.* I, George Plunkett, certify here that the report has been prepared on the basis of the requirements of (and information provided under) the BAM on 16 September 2022, and that date is within 14 days of the date the report is so submitted.

1.1.2 Terminology

Throughout this report the terms development footprint and study area are used. It is important to have a thorough understanding of these terms as they apply to the assessment.

Development footprint means the area directly affected by the proposal. It has the same meaning as “subject land” defined below.

Study area is the portion of land that encompasses all surveys undertaken and is usually all land contained within the designated property boundary. The study area extends as far as is necessary to assess all important biodiversity values known and likely to occur within the subject land and includes the development footprint and any additional areas which are likely to be affected by the proposal, either directly or indirectly.

Subject land is land to which the BAM is applied in Stage 1 to assess the biodiversity values. It includes land that may be a development site, clearing site, proposed for biodiversity certification or land that is proposed for a biodiversity stewardship agreement. In this case, it

refers to the area designated as the development footprint, and has the same meaning for the purposes of this report. The terms “subject land” and “development” are interchangeable in this regard.

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

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

1.2 Site description

1.2.1 Site overview

Table 1.1 provides an overview the planning, cadastral and topographical details of the study area and an overview of the site and surrounds is shown on Figure 1.4 and Figure 1.5 (site and location maps).

Table 1.1 – Site features

Location	Lots 3 and 4 DP26902 at 10 and 12 Boondah Road, Warriewood
Location description	The site is located approximately on the eastern edge of Warriewood Wetlands and approximately 210 m north of the Warriewood Square shopping centre. The site is surrounded on the western and southern edge by riparian vegetation and urban and rural lands to the north and east.
Area	Approximately 2 ha
Local government area	Northern Beaches (formerly Pittwater)
Zoning	RU2 – Rural Landscape
Grid reference MGA-56	342213E 6270482S
Elevation	Approximately 6-3m ASL
Topography	The site is relatively flat across both lots. There is a slight incline across the site which faces a south westerly direction.
Catchment and drainage	The site contains no drainage lines but is on a slight incline to the south west. Water entering the site would flow directly into the Warriewood Wetlands.
Existing land use	Residential and vacant land.

1.2.2 Landscape features

Table 1.2 examines the landscape features of the proposed development site in accordance with the BAM.

Table 1.2 – Landscape features

Patch size	>100 ha
IBRA bioregions and subregions	Sydney Basin bioregion – Pittwater subregion (Figure 1.4 and Figure 1.5)
NSW landscape region and area (ha)	Sydney - Newcastle Barriers and Beaches
Native vegetation extent in the buffer area (1500 m)	187.47 ha approx. and 23.53% Cover class: 10–30%
Cleared areas	Approximately 55% / 1.03 ha of land within the study area is cleared
Evidence to support differences between mapped vegetation extent and aerial imagery	Mapped vegetation closely matches aerial imagery.
Rivers and streams classified according to stream order	The site map (Figure 1.4) shows the study area with first, second and third order streams
Wetlands within, adjacent to and downstream of the site, including important wetlands	The southern portion of the study area forms part of Warriewood Wetlands, which also extends off site to the west.
Connectivity features	The subject lots contributes to local connectivity in two ways but neither of these are of local significance or sufficient to contribute to local or regional 'corridors'. This is particularly given that the creekline connectivity that does extend to the east does not link up with any other major area of natural habitat, but rather loops around to return to the same connective forest areas surrounding Warriewood Wetlands and the Warriewood Escarpment. One connectivity link through the subject lots occurs along the western boundary and crossing Boondah Road to the south. The second and more direct passage across the northern portions of the site is currently limited to fragmented canopy trees for birds and common arboreal mammals. The location map (Figure 1.5) shows an overview of the extent of native vegetation in the locality.
Geology and soils	Quaternary silty to peaty quartz sand, silt, and clay. Ferruginous and humic cementation in places. Common shell layers. The soil landscape within the site is mapped as "Disturbed Terrain".
Identification of method applied (i.e. linear or site-based)	Site based assessment

Figure 1.2 – Zoning

(Source: Planning Portal, 2022)

1.3 Proposed development

The proposal is to re-zone the existing lots from RU2 to a combination of R2 – low density residential and C2 – environmental conservation. The proposed R2 land will permit development of approximately 42 terrace-style dwellings arranged in six rows along linked internal roads accessed at three (3) locations along the site's frontage to Boondah Rd. Open space areas are in the southern and western parts of the site, associated with bushfire asset protection zones, a children's playground, and vegetation and riparian corridors (Figure 1.3). The C2-zoned land will allow for protection and conservation of retained Swamp Oak Forest vegetation.

1.3.1 Identification of development site footprint

1.26 ha of vegetation will be directly impacted through the construction dwellings, internal roads / driveways, asset protection zones (APZs), landscaping, services and other infrastructure. For the purposes of this assessment, it is assumed that all vegetation within the biodiversity certification area will be removed.

Figure 1.3 – Concept masterplan

(Source: Buchan, June 2021)

1.4 Statutory assessment requirements

1.4.1 Environmental Planning and Assessment Act 1979 (EP&A Act)

Prior to any development taking place in New South Wales a formal assessment needs to be made of the proposed work to ensure it complies with relevant planning controls and, according to its nature and scale, confirm that it is environmentally and socially sustainable. State, regional and local planning legislation indicates the level of assessment required, and outlines who is responsible for assessing the development. The development assessment and consent system is outlined in Part 4 and the infrastructure and environmental impact assessment system is outlined in Part 5 of the *EP&A Act*.

1.4.2 Biodiversity Conservation Act 2016 (BC Act)

The *BC Act* repeals the *Threatened Species Conservation Act 1995*, the *Nature Conservation Trust Act 2001* and the animal and plant provisions of the *National Parks and Wildlife Act 1974*.

The *BC Act* and the *BC Reg* establishes a regulatory framework for assessing and offsetting impacts on biodiversity values due to proposed developments and clearing. It establishes a framework to avoid, minimise and offset impacts on biodiversity from development through the Biodiversity Offsets Scheme. Where development consent is granted, the authority may impose as a condition of consent an obligation to retire a number and type of biodiversity credits determined under the new Biodiversity Assessment Method (BAM).

The BOS applies to:

- local development (assessed under Part 4 of the *Environmental Planning and Assessment Act 1979*) that triggers a BOS threshold or is likely to significantly affect threatened species based on the test of significance in section 7.3 of the *Biodiversity Conservation Act 2016*
- state significant development and state significant infrastructure projects, unless the Secretary of the Department of Planning, Industry and Environment and the environment agency head determine that the project is not likely to have a significant impact
- biodiversity certification proposals
- clearing of native vegetation in urban areas and areas zoned for environmental conservation that exceeds a BOS threshold and does not require development consent
- clearing of native vegetation that requires approval by the Native Vegetation Panel under the *Local Land Services Act 2013*
- activities assessed and determined under Part 5 of the *Environmental Planning and Assessment Act 1979* (generally, proposals by government entities) if proponents choose to 'opt in' to the Scheme.

Proponents will need to supply evidence relating to the triggers for the BOS thresholds and the test of significance (where relevant) when submitting their application to the consent authority.

Development consent cannot be granted for non-State significant development under Part 4 of the *EP&A Act* if the consent authority is of the opinion it is likely to have serious and irreversible impacts (SAII) on biodiversity values. The determination of SAII is to be made in accordance with principles prescribed section 6.7 of the *BC Regulation 2017*. The principles have been designed to capture those impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in New South Wales.

The threatened species test of significance is used to determine if a development or activity is likely to significantly affect threatened species or ecological communities, or their habitats. It is applied as part of the Biodiversity Offsets Scheme entry requirements and for Part 5 activities under the *Environmental Planning and Assessment Act* (*EP&A Act*), 1979.

The test of significance is set out in s.7.3 of the *BC Act.* If the activity is likely to have a significant impact, or will be carried out in a declared area of outstanding biodiversity value, the proponent must either apply the Biodiversity Offsets Scheme or prepare a species impact statement (SIS).

The environmental impact of activities that will not have a significant impact on threatened species will continue to be assessed under s.111 of the *EP&A Act*

1.4.3 Fisheries Management Act 1994 (FM Act)

The *FM Act* provides a list of threatened aquatic species that require consideration when addressing the potential impacts of a proposed development. Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, an SIS is required to be prepared.

1.4.4 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The *EPBC Act* requires that Commonwealth approval be obtained for certain actions. It provides an assessment and approvals system for actions that have a significant impact on matters of *national environmental significance* (NES). These may include:

- World Heritage Properties and National Heritage Places
- Wetlands of International Importance protected by international treaty
- Nationally listed threatened species and ecological communities
- Nationally listed migratory species
- Commonwealth marine environment

Actions are projects, developments, undertakings, activities, and series of activities or alteration of any of these. An action that needs Commonwealth approval is known as a controlled action. A controlled action needs approval where the Commonwealth decides the action would have a significant effect on an NES matter.

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, then the matter needs to be referred to the Commonwealth Department of Agriculture, Water and the Environment (DAWE) for assessment. In the case where no listed federal species are located on site then no referral is required. The onus is on the proponent to make the application and not the Council to make any referral.

A threshold criterion applies to specific NES matters which may determine whether a referral is or is not required, such as for the *EPBC*-listed ecological communities Cumberland Plain Woodland and Shale-Gravel transition Forest. Consultation with DOEE may be required to determine whether a referral is or is not required. If there is any doubt as to the significance of impact or whether a referral is required, a referral is generally recommended to provide a definite decision under the *EPBC Act* thereby removing any further obligations in the case of 'not controlled' actions.

A significant impact is regarded as being:

> *important, notable, or of consequence, having regard to its context or intensity and depends upon the sensitivity, value, and quality of the environment which is impacted and upon the duration, magnitude, and geographical extent of the impacts. A significant impact is likely when it is a real or not a remote chance or possibility.*

Source: EPBC Policy Statement

Guidelines on the correct interpretation of the actions and assessment of significance are located on the department's web site http://www.environment.gov.au/epbc/publications.

1.4.5 Coastal Management Act 2016 (CM Act)

The *Coastal Management Act* (*CM Act,* 2016) establishes the framework and overarching objects for coastal management in New South Wales. The Act commenced on 29 June 2018 and replaces the previous *Coastal Protection Act* (1979).

The purpose of the *CM Act* is to manage the use and development of the coastal environment in an ecologically sustainable way, for the social, cultural and economic well-being of the people of New South Wales.

The *CM Act* also supports the aims of the *Marine Estate Management Act 2014*, as the coastal zone forms part of the marine estate.

The *CM Act* defines the coastal zone, comprising four (4) coastal management areas:

1. coastal wetlands and littoral rainforests area; areas which display the characteristics of coastal wetlands or littoral rainforests that were previously protected by SEPP 14 and SEPP 26
2. coastal vulnerability area; areas subject to coastal hazards such as coastal erosion and tidal inundation
3. coastal environment area; areas that are characterised by natural coastal features such as beaches, rock platforms, coastal lakes and lagoons and undeveloped headlands. Marine and estuarine waters are also included
4. coastal use area; land adjacent to coastal waters, estuaries and coastal lakes and lagoons.

The *CM Act* establishes management objectives specific to each of these management areas, reflecting their different values to coastal communities.

1.4.6 Licences

Individual staff members of *Travers bushfire & ecology* are licensed under Clause 20 of the *National Parks and Wildlife (Land Management) Regulation 1995* and Sections 120 & 131 of the *National Parks and Wildlife Act 1974* to conduct flora and fauna surveys within service and non-service areas. NPWS Scientific Licence Numbers: SL100848.

Travers bushfire & ecology staff are licensed under an Animal Research Authority issued by the NSW Department of Primary Industries. This authority allows *Travers bushfire & ecology* staff to conduct various fauna surveys of native and introduced fauna for the purposes of environmental consulting throughout New South Wales.

Figure 1.4 – Site map

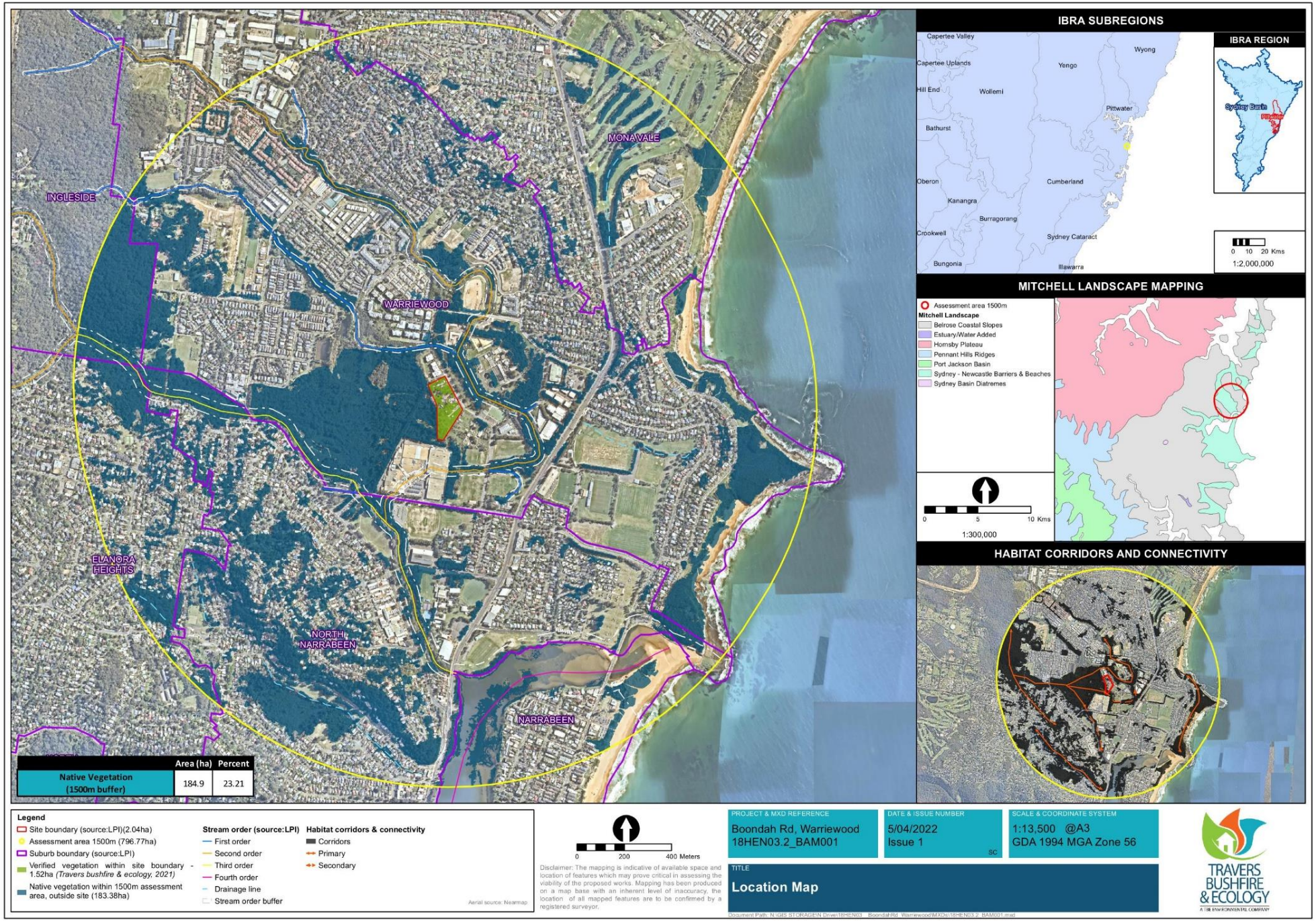

Figure 1.5 – Location map

2. SURVEY METHODOLOGY

2.1 Presurvey information collation & resources

Documents reviewed:

The following documents, reports and information sources were utilised in the preparation of this report:

- Correspondence from Henroth outlining the proposal
- Conceptual Masterplan prepared by *Buchan* (2022)
- Bushfire Review prepared by *Travers bushfire and ecology* (2021).
- Water Management Report prepared by *Calibre* (2022)
- Flora & Fauna Assessment, Planning Proposal, Lots 3 & 4 DP 26902 & Lot 9 DP 806132, 10 & 12 Boondah Road & 6 Jacksons Road prepared by *Travers bushfire and ecology* (2016)
- Biological Constraints Assessment prepared by *Travers bushfire & ecology* (2019)

Technical resources utilised:

Legislation

- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*
- *Biodiversity Conservation Act 2016 (BC Act)*
- *Biodiversity Conservation Regulation 2017 (BC Reg.)*
- *Fisheries Management Act 1994 (FM Act)*

Survey Guidelines

- NSW Survey Guide for Threatened Frogs (DPIE 2020)
- Koala (Phascolarctos cinereus) Biodiversity Assessment Method Survey Guide (DPE 2022)
- 'Species credit' threatened bats and their habitats (DPIE 2018)
- Survey guidelines for Australia's threatened birds (DEWHA 2010)
- Survey guidelines for Australia's threatened mammals (DEWHA 2011)
- Matters of National Environmental Significance (Commonwealth of Australia 2013)
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities 2004 (working draft), Department of Environment and Conservation (DEC)
- Hygiene Protocol for the Control of Diseases in Frogs (DECC 2008)
- Region based guide to the echolocation calls of Microchiropteran bats (DEC 2004)
- Field survey methods: Best practice field survey methods for environmental consultants and surveyors when assessing proposed development sites or other activities on sites containing threatened species, populations or ecological communities (OEH 2004)
- NSW Guide to Surveying Threatened Plants (DPIE 2016)
- Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method (DPIE 2020)

Mapping resources

- Aerial photographs (Google Earth Pro / Spatial Information Exchange / NearMap)
- Topographical maps (scale 1:25,000)

Threatened species records

- BioNet database which holds data from a number of custodians (2022)
- Birdata (Birdlife Australia 2017)
- EPBC Protected Matters Search Tool - DAWE (2022)

Vegetation mapping/resources:

- BioNet Vegetation Classification System
- Native Vegetation of the Sydney Metropolitan Area (OEH 2016).

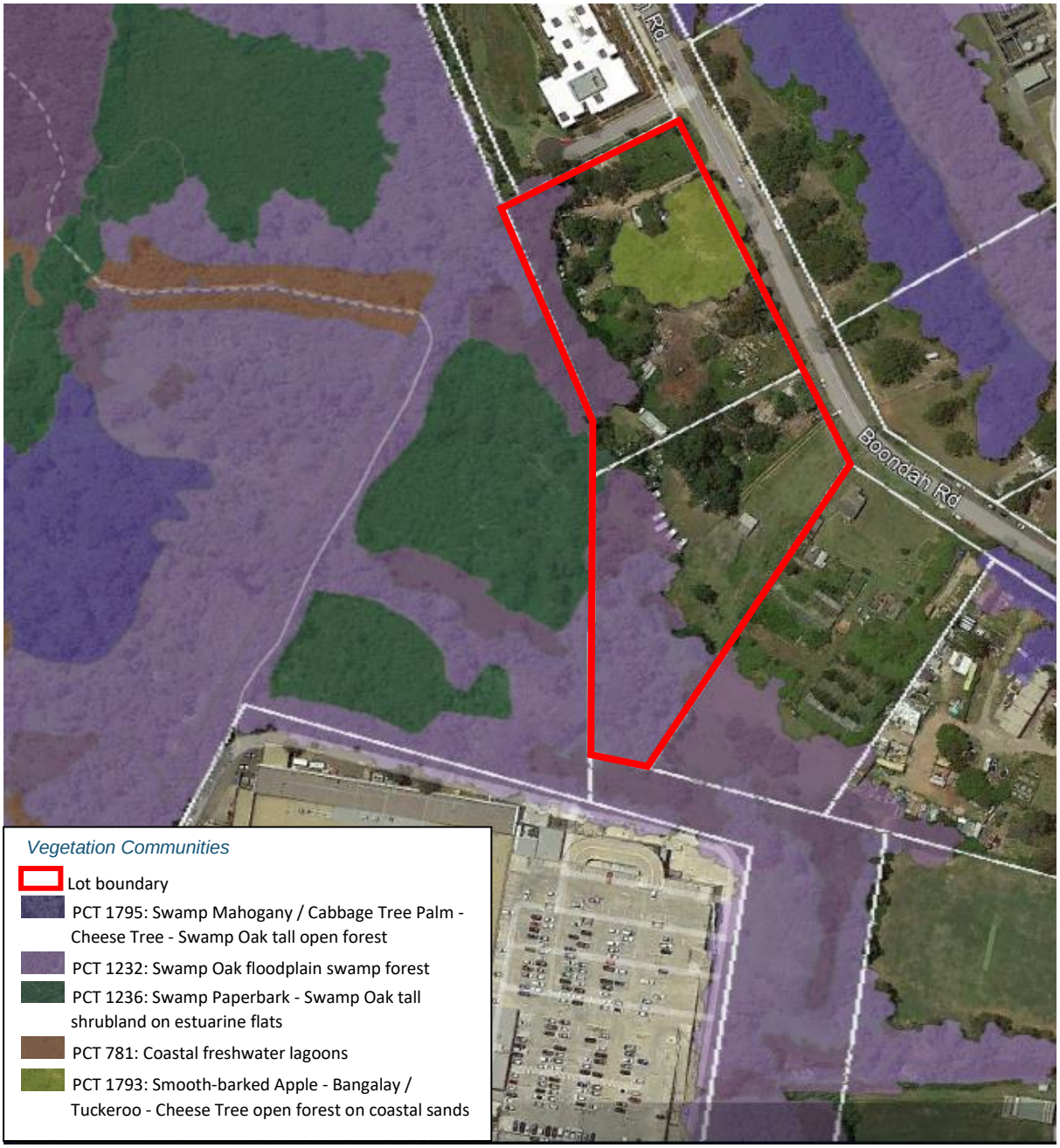

Figure 2.1 – The Native Vegetation of the Sydney Metropolitan Area (OEH 2016)

The Native Vegetation of the Sydney Metropolitan Area (OEH 2016) is shown in Figure 2.1. This mapping identifies the following communities within the study area:

- PCT 1232: Swamp Oak floodplain swamp forest
- PCT 1236: Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats

- PCT 1793: Smooth-barked Apple - Bangalay / Tuckeroo - Cheese Tree open forest on coastal sands

Previous ecological reports:

Flora & Fauna Assessment, Planning Proposal, Lots 3 & 4 DP 26902 & Lot 9 DP 806132, 10 & 12 Boondah Road & 6 Jacksons Road prepared by Travers bushfire and ecology (2016)

Flora survey involving 14 20 m x 20 m floristic quadrats was undertaken on 15 May 2012 and 13 April 2013.

Fauna survey involving diurnal bird sensus, nocturnal call-playback, spotlighting, detailed habitat tree survey, passive overnight ultrasonic microbat monitoring, pportunistic bird survey was undertaken on 8 & 9 April 2013 and 5 Dec 2016.

Two (2) state listed threatened fauna species including Large Bentwing-bat (*Miniopterus orianae oceanensis*) and Grey-headed Flying-fox (*Pteropus poliocephalus*) were recorded present during 2013 surveys. One (1) additional threatened fauna species the Southern Myotis (*Myotis macropus*) was recorded only to a 'possible' level of certainty during updated 2016 survey. No threatened flora species were recorded.

The TECs Swamp Oak Floodplain Forest and Freshwater Wetlands on Coastal Floodplains have been recorded within the development site boundary or immediately adjacent. Bangalay / Apple Open Forest was recorded but was not considered commensurate with the TEC Bangalay Sand Forest.

Although not used for species credit assessment as part of this BCAR, the threatened fauna recorded as part of this assessment are displayed on Figure 3.3.

Biological Constraints Assessment prepared by Travers bushfire & ecology (2019)

Botanical survey was undertaken on 19 June and 8 August 2019 involving a random meander in accordance with *Cropper* (1993) to gain a full species list of the plants within the site, and then four (4) 20 m x 20 m flora quadrats were undertaken within remnant native vegetation.

Fauna survey was undertaken on the 25/7/19 and included:

- *Opportunistic bird call and activity survey,*
- *Mammal activity searches (scats, scratches, diggings, burrows, etc)*
- *Habitat tree survey.*
- *Culvert bat roosting habitat searches.* This involved wading through the first 20m of the two large box culverts that commence on the edge of the subject lots and run under the adjacent shopping centre, looking in the ceiling crevices for microbats at roost.
- *Spotlighting,*
- *Ultrasonic microbat recording (x2 passive recording stations),*
- *Frog call identification,*
- *Owl call-playback (Powerful Owl, Masked Owl, Sooty Owl & Barking Owl),*
- *Bush Stone-curlew, Black Bittern & Australasian Bittern call-playback,*
- *Nocturnal mammal call-playback (Koala & Squirrel Glider)*

The following vegetation communities were recorded within the study area:

- PCT 1232 – Swamp Oak floodplain swamp forest
- PCT 1793 – Smooth-barked Apple - Bangalay / Tuckeroo - Cheese Tree open forest
- Planted native vegetation
- Cleared or exotic vegetation with occasional remnant trees

No threatened flora species were observed or considered likely to occur in a natural state.

Two TECs were recorded within the study area: Swamp Oak Forest and Bangalay Sand Forest.

Three threatened fauna species were recorded within the subject lots: Little Bentwing-bat, Large Bentwing-bat and Southern Myotis. The Sothern Myotis was recorded roosting in the culvert under the nearby neighbouring shopping complex outside of the subject land.

As the 2019 survey was conducted within 5 years of the current proposal, it has been utilised for the purposes of threatened species credit assessment in this BCAR in accordance with the BAM. Threatened fauna recorded as part of this assessment are displayed on Figure 3.3.

2.2 Flora survey methodology

2019

Initial survey was undertaken on 19 June and 8 August 2019 over a total time frame of approximately 5 hrs, for the purposes of constraints assessment.

Botanical survey included a random meander in accordance with *Cropper* (1993) to gain a full species list of the plants within the site, and then four (4) 20 m x 20 m flora quadrats were undertaken within remnant native vegetation. A review of the *Atlas of NSW Wildlife* (OEH 2019) was undertaken prior to the site visit to determine threatened species previously recorded within 10 km of the subject lots, and opportunistic searches were undertaken during the random meander and stratified survey.

2021/22

Flora survey was undertaken on 13 December 2021.

Stratified survey using the BAM was undertaken. The following information was collected at each of four (4) BAM plots:

- Native overstorey, mid-storey and ground cover recorded for all observed species and an estimate of stems (20 m x 20 m, 10 m x 40 m).
- Stratum (and layer): stratum and layer in which each species occurs (20 m x 20 m)
- Growth form: growth form for each recorded species (20 m x 20 m
- Species name: scientific name and common name (20 m x 20 m)
- Percent projected foliage cover of the understorey strata and exotic vegetation (20 m x 20 m
- Number of trees with hollows visible from the ground (20 m x 50 m)
- The total length of fallen logs >10 cm in diameter (20 m x 50 m)
- The proportion of regenerating overstorey species (20 m x 50 m)
- Number of large trees (20 m x 50 m)
- Estimates of leaf litter cover, bare ground, cryptograms and rocks in 1 m x 1 m subplots at five (5) locations along the central transect (20 m x 50 m)

All plot sheets utilised for the BAM calculator are provided in Appendix 1.

2.3 Fauna survey methodology

Site survey effort accounting for techniques deployed, duration, and weather conditions are outlined in Table 2.1 and are depicted on Figure 3.2.

Diurnal birds

Two diurnal bird census points were undertaken within the subject site in 2021 survey. A third census point was conducted to the south of the subject land. A minimum of 15 minutes of survey was undertaken at each census point in an area radiating out to between 30–50 m.

Bird census points were selected to give an even spread and representation across the site and its communities (see Figure 3.2). Census points were also commenced in locations where bird activity was apparent, as often different small bird species are found foraging together. Opportunistic diurnal bird survey was conducted between census points and whilst undertaking other diurnal surveys. Raptor nest searches were undertaken during all diurnal survey in 2021.

Given the suitability of foraging habitat present, Glossy Black Cockatoo, foraging evidence was surveyed around the base of *Casuarina* trees existing within the development footprint. Nuts were inspected under *Casuarina* trees to find evidence of chew marks synonymous with these species of cockatoo.

Nocturnal birds

Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Black Bittern (*Ixobrychus flavicollis*), Australian Bittern (*Botaurus poiciloptilus*) and Bush Stone-curlew (*Burhinus grallarius*) were targeted by call-playback techniques across six (6) nights during 2019, 2021 and 2022 survey. Call-playback survey was undertaken during spotlighting activities.

Diurnal survey included searches for any signs of threatened Owl roosting activity. This was undertaken where dense mid-storey foliage was present, typically in the south western portions of the site.

Arboreal and terrestrial mammals

Given the suitability of habitat present, Squirrel Glider (*Petaurus norfolcensis*) was targeted by call-playback techniques across nine (9) nights during 2021 survey whilst spotlight survey was undertaken.

Following correspondence with the EGH, approval was granted for the use of infra-red remote camera trapping as an alternative to typical Elliott B / cage trapping for Squirrel Glider. Target survey was undertaken using three cameras per PCT equating to six cameras in total for the subject land. Each camera trap was baited with standard bait mix containing honey, peanut butter and oats and trees were sprayed with honey to act as further attractant for Squirrel Gliders. Each trap was deployed for two weeks.

The study site contains five Koala use tree species listed under the Central Coast Koala modelling region it is therefore considered that the subject site contains suitable habitat for Koala. These Koala use tree species include: Sydney Red Gum (*Angophora costata*) Swamp Oak (*Casuarina glauca)*, Bangalay (*Eucalyptus botryoides*), planted Tallowwood (*Eucalyptus microcorys*) and Turpentine (*Syncarpia glomulifera*).

A single Spot Assessment Technique (SAT) described by *Phillips & Callaghan* (2008) was undertaken within the subject lot during survey undertaken in 2021.

Additional survey for Koala was undertaken in 2022 utilising methods outlined in the recently published guide, *The Koala (Phascolarctos cinereus): Biodiversity Assessment Method Survey Guide* (DPE 2022). This involved a spotlighting transect over two nights, encompassing all trees within the subject land. Two additional SAT points were conducted. Due to the small size of the site, the standard 150 m grid method was not possible. Instead, each potential Koala tree within the subject land was surveyed for Koala scats to within 1 m of the base in accordance with the SAT.

Targeted survey was undertaken for Southern Brown Bandicoot (*Isoodon obesulus*). Camera trapping was undertaken across the site and was accompanied with a hair tube trapping effort amounted to a total of sixty-four (64) camera nights and sixty-four (64) hair tube trapping nights. See Figure 3.2 for camera and hair tube transect locations.

Bats

Mega-chiropteran bat species, such as Grey-headed Flying-fox, are surveyed by targeting flowering/fruiting trees during spotlighting activities and by listening to distinctive vocalisations. Suitable roosting habitat is searched for presence of small or large established camps during diurnal survey periods.

Micro-chiropteran bats are surveyed by echolocation using ultrasonic recording detectors. Passive recording was undertaken through the deployment of ultrasonic recorders that were positioned to target species preferred roosting and foraging habitat. Passive recorders were then repositioned during additional survey periods at the waterfront and in areas considered to be potential flightpaths to gain comprehensive data of microbat species diversity over the entire site.

Diurnal roost searches investigating potential micro-chiropteran bat roosting sites were undertaken in 2019 survey and followed up in 2021, following the *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method* (OEH 2018). Searches included the inspection of openings within man-made structures and trees exhibiting trunk hollows, looking for bats or signs of bats (urine stains, droppings, remains, and bat fly casings) in suitable roost habitat during the daytime. Roost searches used a torch (Ledlenser H15R Core Headlamp) to shine in holes, cracks and crevices, and a handheld bat detector to locate (and identify) bats that may call. A Southern Myotis was recorded during 2019 survey roosting in the culvert to the south of the subject site running under the adjacent shopping centre. The culvert was reinspected on the 16th November 2021 with no microbats recorded roosting at the time.

The existing Grey-headed Flying-fox (*Pteropus poliocephalus*) camp south west of the subject site was inspected across three (3) separate occasions during survey conducted in 2021 and 2022 to observe potential shifting or swelling of the population.

Amphibians

Candidate species Green and Golden Bell Frog (*Litoria aurea*) and Green-thighed Frog (*Litoria brevipalmata*) were targeted during survey as the subject land contains the habitat constraints as defined by the TBDC:

- *Green and Golden Bell Frog:* Subject site within 1 km of wet areas including swamps, permanent and ephemeral wet areas (i.e. the entire site).
- *Green-thighed Frog:* Subject site within 100 m top of bank of semi-permanent, ephemeral wet areas, swamps and waterbodies

Compliant survey for these species is required in potential breeding habitat only, which are defined by *The NSW Survey Guide for Threatened Frogs - A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method* (DPIE 2020) as follows:

- *Green and Golden Bell Frog:* any waterbody with emergent aquatic vegetation and without the plague minnow (*Gambusia holbrooki*).
- *Green-thighed Frog:* any semi-permanent or ephemeral waterbody of >25 square metres in surface area located within native vegetation or immediately adjacent to or within 10 metres of native vegetation.

For both of these species potential breeding habitat requiring survey is largely contained within Warriewood Wetlands to the west of the subject land, with only a very small portion of the subject land containing suitable habitat – this is shown on Figures 3.2 and 3.3. Target surveys were undertaken in line with the NSW Survey Guide for Threatened Frogs (DPIE 2020).

The closest reference sites available were utilised for each species and survey within the study area was only undertaken when species activity was recorded as the corresponding reference site. These sites were Sydney Olympic Park (Green and Golden Bell Frog) and Ourimbah State Forest (Green-thighed Frog), and were chosen because they were the two closest known reference sites for those species. We are unaware of any closer reference sites. Weather variables such as rainfall, wind, and temperature at the reference sites and within the study area prior to survey are presented in Table 2.1 which shows that weather conditions were very similar, adding to their reliability. The *NSW Survey Guide for Threatened Frogs A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method* (DPIE 2020) states:

> *"The use of reference sites is strongly recommended, but it is recognised there will not always be a reference site known or readily available. In such cases the determination of occupancy needs be based on standard field surveys, or habitat assessment and the decision on presence/absence justified in the BAR."*

Our decision to use the Sydney Olympic Park and Mardi reference sites was an optional addition to the survey to increase detection probability rather than an action that invalidates our surveys. Further, the detection of the target frog species at both reference sites indicates that the species were active during the survey period, and that the survey techniques deployed were successful in detecting both species where present. Thus, the inability to detect any recorded Green and Golden Bell Frog or Green-thighed Frog within the subject land is a reliable indication that both species are absent from the subject land.

Survey was undertaken during suitable weather events required for each species and involved aural-visual searches, call-playback transects and tadpole sweep netting and metamorph searches. Dates and weather data is provided in Table 2.1 below. The survey techniques were undertaken according to the *NSW Survey Guide for Threatened Frogs - A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method* (DPIE 2020), and are described as follows:

- Aural-visual searches and spotlighting: a combination of listening for the calls of frogs and searching for individuals along a transect. One survey night requires 2 hrs minimum of listening for calling frogs and conducting a visual search along a 500 metre transect in breeding habitat along, around or through a suitable waterbody. Where there is insufficient habitat to accommodate a 500 metre transect a pro-rata effort is to be applied with all available habitat being searched. The search commences with 5 min of listening in silence and darkness, followed by visual spotlighting searches for 5 min using a headlamp with a minimum of 200 lumens brightness. This process is repeated every 50 m along the required 500 m transect.

- Call-playback: a loudspeaker is used to broadcast the advertisement calls of target threatened frogs to elicit either an advertisement or territorial response call. The call is broadcast continuously through the speaker for a period of no less than two minutes. This is followed by a two-minute listening period to detect any responses.

- Tadpole searches: undertaken by sweeping a fine meshed net backwards and forwards through the water for 10 minutes per 50 m^2 of waterbody surface area, covering all parts of the water column up to a minimum of two metres from the bank. Sweeping includes areas of vegetation and cover areas of the waterbody suitable for the target species. Sweeps are made at about one metre per second.

Amphibian survey was undertaken in accordance with the *Hygiene Protocol for the Control of Diseases in Frogs* (DECC 2008).

Reptiles

There is habitat considered suitable for threatened reptiles within or surrounding the subject lot. However, opportunistic habitat searches were undertaken during other diurnal surveys.

Invertebrates

Opportunistic snail searches were undertaken where native understory vegetation persisted during 2021 survey.

Given the presence of human-made structures, pile and refuse within the subject site, target searches for Maroubra Woodland Snail *(Meridolum maryae*) were undertaken during 2022 survey. This involved searching among leaf litter, shrubs, ground covers, weeds and artificial debris for living and dead snails. Note for the purpose of survey, the presence of shells equals the presence of this species (TBDC). As such, the presence or absence of this species can be extrapolated from the presence or absence of snail shells, and it is not necessary to search for live individuals. Locations of target searches are shown in Figure 3.2.

Habitat trees

Hollow-bearing trees were identified and recorded within the development footprint on a *Trimble* handheld GPS unit during surveys. All data such as hollow types, hollow size, tree species, diameter at breast height, canopy spread and overall height were collected and a metal tag with the tree number placed on the trunk for field relocation purposes. Other habitat features such as nests and significant sized mistletoe for foraging were also noted.

Significant habitat trees

Significant habitat trees are defined as trees containing large hollows suitable for use by owls and/or containing a number of good quality hollows typically consisting of more than one medium (10–30 cm) sized hollow. A tree may also be considered significant where evidence of use by select fauna is found such as glider sap feed tree, raptor nest, or owl roost.

Data such as the number of hollows present in each size category (or other reason for selection), tree species, diameter at breast height, canopy spread and overall height were collected. A summary of significant habitat tree results is provided in Table 3.8.

Equipment specifications

<u>Spotlight</u>

- Make and model: Ledlenser H15R Core Headlamp

- Light intensity: 20–2500 lm

- Light range: 20–250 m

<u>Animal vocalisation broadcasting</u>

- Make and model: Faunatech Toa megaphone

- Size: 15 watt (23 W max)

2.4 Field survey effort

Table 2.1 and Table 2.2 below detail the flora and fauna survey effort undertaken for the development footprint.

Table 2.1 – Fauna survey effort

Fauna group	Date	Weather conditions	Survey technique(s)	Time effort (24hr)
Diurnal birds	13/8/19	0/8 cloud, light W wind, no rain, 15ºC - 12°C	Diurnal survey	4hr 45min 1245 - 1730
	16/11/21	1/8 cloud, 15km/h SE winds, no rain, 19°C	Census points x2 / Diurnal survey	4hr 45min 1445-1930
			Raptor nest search	3hrs 1400-1700
	24/11/21	6/8 cloud, no wind, 1.2mm rain. 23-23°C	Diurnal opportunistic, target survey, Raptor nest search	1hr 30min 1900-2030
	2/12/21	1/8 cloud, no winds, no rain, 19-22°C	Diurnal opportunistic, target survey, Raptor nest search	3hrs 0830-1130
	9/12/21		Diurnal target survey	1hr 30min 1900-2030
Nocturnal birds	13/8/19	0/8 cloud, no wind, no rain, 11-8°C	Spotlighting	2hr 15min 1730 - 1945
			Call playback (MO/PO/BO/BSC)	Commenced @1850
	16/11/21	1/8 cloud, 15km/h SE winds, no rain, 19°C	Roost search	4hr 45min 1445-1930
		2/8 cloud, wind 19 km/h, 50mm rain within 7 days (11/11/21), 15°C	Spotlighting	2hrs 1930 - 2030
			Call-playback (MO/PO/BO)	Commenced @ 1945
	21/11/21	8/8 cloud, no wind, 14mm rain, 19°C	Spotlighting	2hrs 2145–2345
			Call-playback (MO/PO/BO/BSC)	Commenced @ 2145
	22/11/21	8/8 cloud, no wind, 38 mm rain previous, 19°C	Spotlighting	2hrs 2100–2300
			Call-playback (MO/PO/BO/BSC)	Commenced @ 2130
	7/12/21	8/8 cloud, 26.3°C, light W, thunder storms with no rain, ¼ moon	Spotlighting	1hr 1930-2030
	8/12/21	8/8 cloud, 20°C, no wind, thunder storm 2.4mm rain, ¼ moon	Spotlighting	1hr 1930-2030
	9/12/21	8/8 cloud, 26°C , no wind, thunder storm 10.8mm rain, ¼ moon	Spotlighting	1hr 1930-2030
	11/08/2022	7/8 cloud, 15-16ºC, no wind, no rain	Call-playback (MO/PO)	Commenced @ 1840
	18/08/2022	1/8 cloud, 18.3-17.4°C, no wind, no rain	Hollow searches within 100m	3.5hrs 1300-1630
	18/08/2022	1/8 cloud, 16.3-16°C, no wind, no rain	Call-playback (MO/PO)	Commenced @ 1840
Arboreal mammals	13/8/19	0/8 cloud, no wind, no rain, 11-8ºC	Spotlighting	2hr 15min 1730 - 1945
			Call playback (Koala / Squirrel Glider)	Commenced @1915
	16/11/21	1/8 cloud, 15km/h SE winds, no rain, 19°C	Koala SAT x1	2hr 1445-1645
		2/8 cloud, wind 19 km/h, 50mm rain within 7 days (11/11/21), 15°C	Spotlighting	2hr 2000 - 2200
			Call-playback (Koala / Squirrel Glider)	Commenced @ 1945
	21/11/21	8/8 cloud, no wind, 14mm rain, 19°C	Spotlighting	2hrs 2145–2345

Fauna group	Date	Weather conditions	Survey technique(s)	Time effort (24hr)
			Call-playback (Koala / Squirrel Glider)	Commenced @ 2145
	7/12/21	8/8 cloud, 26.3°C, light W, thunder storms with no rain, ¼ moon	Spotlighting	1hr 1930-2030
			Call-playback (Koala / Squirrel Glider)	Commenced @ 1800
	8/12/21	8/8 cloud, 20°C, no wind, thunder storm 2.4mm rain, ¼ moon	Spotlighting	1hr 1930-2030
			Call-playback (Koala / Squirrel Glider)	Commenced @ 1945
	9/12/21	8/8 cloud, 26°C, no wind, thunder storm 10.8mm rain, ¼ moon	Spotlighting	1hr 1930-2030
			Call-playback (Koala / Squirrel Glider)	Commenced @ 1930
	11/08/2022	4/8 cloud, 15-16ºC, no wind, no rain	1 x spotlighting transect targeting Koala. Survey effort as defined by DPE 2022.	30 mins 1830-1900
	18/08/2022	1/8 cloud, 18.3-17.4°C, no wind, no rain	Koala scat searches equivalent to 2 x Koala SAT. Survey effort as defined by DPE 2022.	5 hr 1230-1730
		1/8 cloud, 16.3-16°C, no wind, no rain	1 x spotlighting transect targeting koala survey effort as defined by DPE 2022.	30 mins 1830-1900
	25/08/2022	6/8 cloud, 16.2-14.4°C, no wind, no rain	Koala scat searches equivalent to 1 x Koala SAT. Survey effort as defined by DPE 2022.	1hr 1345-1445
	11/08/22-25/08/22	Variable weather conditions	6x Surveillance cameras (targeting Squirrel Glider)	84 trapping nights
Terrestrial mammals	13/8/19	0/8 cloud, no wind, no rain, 11-8ºC	Spotlighting	2hr 15min 1730 - 1945
	16/11/21	2/8 cloud, wind 19 km/h, 50mm rain within 7 days (11/11/21), 15°C	Spotlighting	2hrs 2000 - 2200
	16/11-2/12/21	Mostly fine	Surveillance cameras (targeting Southern Brown Bandicoot) x4	64 camera nights
			Hair tubes (targeting Southern Brown Bandicoot) x4	64 trapping nights
	21/11/21	8/8 cloud, no wind, 14mm, 19˚C	Spotlighting	2hrs 2145–2345
	7/12/21	8/8 cloud, 26.3˚C, light W, thunder storms with no rain, ¼ moon	Spotlighting	1hr 1930-2030
	8/12/21	8/8 cloud, 20˚C, no wind, thunder storm 2.4mm rain, ¼ moon	Spotlighting	1hr 1930-2030
	9/12/21	8/8 cloud, 26°C, no wind, thunder storm 10.8mm rain, ¼ moon	Spotlighting	1hr 1930-2030
Bats	13/8/19	0/8 cloud, no wind, no rain, 11-8˚C	Spotlighting	2hr 15min 1730 - 1945
			Anabat x2 (passive monitoring)	2hr 10min 1735 - 1945
	16/11/21	1/8 cloud, 15km/h SE winds, no rain, 19˚C	Microbat roost habitat search	2hr 1645-1845
			Grey-headed Flying-fox camp survey	2hr 1445-1645
	16/11/21	2/8 cloud, wind 19 km/h, 50mm rain within 7 days (11/11/21), 15°C	Spotlighting	2hrs 2000 - 2200
	16/11-2/12/21	Mostly fine	Ultrasonic frequency recorders x 2 (passive monitoring)	32 recording nights
	21/11/21	8/8 cloud, no wind, 14mm rain, 19°C	Spotlighting	2hrs 2145–2345
	2/12/21	1/8 cloud, no winds, no rain, 19-22°C	Grey-headed Flying-fox camp survey	3hrs 0830-1100
	7/12/21	8/8 cloud, 26.3°C, light W, thunder storms with no rain, ¼ moon	Spotlighting	1hr 1930-2030

Fauna group	Date	Weather conditions	Survey technique(s)	Time effort (24hr)
	9/12/21	8/8 cloud, 26°C, no wind, thunder storm 10.8mm rain, ¼ moon	Spotlighting	1hr 1930-2030
	11/08/2022	7/8 cloud, 16-15°C, no wind, no rain	Opportunistic Grey-headed Flying-fox camp survey	2hr 1520-1720
	18/08/2022	1/8 cloud, 18.3-17.4°C, no wind, no rain	Grey-headed Flying-fox camp survey	2hr 1300-1500
	25/08/2022	6/8 cloud, 16.2-14.4°C, no wind, no rain	Opportunistic Grey-headed Flying-fox camp survey	1hr 1345-1445
Reptiles	2/12/21	1/8 cloud, no winds, no rain, 19-22°C	Opportunistic habitat searches	Commenced @ 830
	13/8/19	0/8 cloud, no wind, no rain, 11-8°C	Spotlighting / call identification	2hr 15min 1730 - 1945
Amphibians	16/11/21	1/8 cloud, 15km/h SE winds, no rain, 19°C	Opportunistic habitat search	2hr 1445-1645
		2/8 cloud, wind 19 km/h, 50mm rain within 7 days (11/11/21), 15°C	Aural-visual searches and spotlighting (Green and Golden Bell Frog and Green-thighed Frog)	2hrs 2000 - 2200
			Tadpole searches (Green and Golden Bell Frog)	15mins 2030 - 2045
	21/11/21	8/8 cloud, no wind, 14mm rain (areas of suitable habitat inundated), 19°C	Aural-visual searches, spotlighting and call-playback (Green and Golden Bell Frog, and Green-thighed Frog)	2hrs 2145–2345
			Tadpole searches (Green and Golden Bell Frog)	15mins 2315–2330
		8/8 cloud, no wind, 10.8mm rain, 18.6°C	Sydney Olympic Park reference site for Green and Golden Bell Frog (active foraging recorded)	15mins 2000–2015
		8/8 cloud, no wind, 14mm rain (areas of suitable habitat inundated), 19°C	Mardi reference site for Green-thighed Frog (calling males recorded)	15mins 2000-2015
	22/11/21	8/8 cloud, no wind, previous day 14mm, 24mm rain (areas of suitable habitat inundated), 19°C	Aural-visual searches, spotlighting and call-playback (Green and Golden Bell Frog and Green-thighed Frog)	2hrs 2100–2300
			Tadpole searches (Green and Golden Bell Frog)	15mins 2330 - 2345
		8/8 cloud, no wind, previous day 10.8mm plus 18.4mm rain (areas of suitable habitat inundated), 21.5°C	Sydney Olympic Park reference site for Green and Golden Bell Frog (active foraging recorded)	15mins 2000-2015
		7/8 cloud, no wind, 5mm rain (areas of suitable habitat inundated), 21°C	Mardi reference site for Green-thighed Frog (calling males recorded)	30mins 2100-2130
	24/11/21	6/8 cloud, 23°C, no wind, 1.2mm rain, ½ moon	Aural-visual searches, spotlighting and call-playback (Green and Golden Bell Frog & Green and Golden Bell Frog	2hrs 1930–2130
			Tadpole searches (Green and Golden Bell Frog)	15mins 2330 - 2345
		7/8 cloud, no wind, 0.8mm rain and thunders storms, 27.1°C, ½ moon	Sydney Olympic Park reference site for Green and Golden Bell Frog (calling males recorded)	15mins 1930-1945
	25/11/21	6/8 cloud, no wind, thunder storm 15.8mm (areas of suitable habitat inundated), 24.1°C, 1/3 moon	Aural-visual searches, spotlighting and call-playback (Green and Golden Bell Frog)	2hrs 1930–2130
			Tadpole searches (Green and Golden Bell Frog)	15mins 2330 - 2345
		5/8 cloud, light wind, 5.8mm rain, 26.2°, 1/3 moon	Sydney Olympic Park reference site for Green and Golden Bell Frog (calling males recorded)	15mins 1930-1945

Fauna group	Date	Weather conditions	Survey technique(s)	Time effort (24hr)
	26/11/21	8/8 cloud, 17°C, no wind, thunder storms with 25.4mm rain, 1/3 moon	Aural-visual searches, spotlighting and call-playback (Green and Golden Bell Frog)	2hrs 1930–2130
			Tadpole searches (Green and Golden Bell Frog)	15mins 2330 - 2345
		8/8 cloud, no wind, 30.2mm rain (areas of suitable habitat inundated), 26.2°C	Sydney Olympic Park reference site for Green and Golden Bell Frog (calling males recorded)	15mins 1930-1945
	7/12/21	8/8 cloud, 26.3°C, light W, thunder storms with no rain, ¼ moon	Aural-visual searches, spotlighting and call-playback (Green and Golden Bell Frog)	1hr 1930-2030
			Tadpole searches (Green and Golden Bell Frog)	30mins 2030-2100
	8/12/21	8/8 cloud, 20°C, no wind, thunder storm 2.4mm rain, ¼ moon	Aural-visual searches, spotlighting and call-playback (Green and Golden Bell Frog)	1hr 1930-2030
			Tadpole searches (Green and Golden Bell Frog)	15mins 2045-2100
	9/12/21	8/8 cloud, 26°C , no wind, thunder storm 10.8mm rain, ¼ moon	Tadpole searches (Green and Golden Bell Frog)	1hr 1930-2030
	5/01/22	8/8 cloud, light wind, thunderstorms with 5.8mm rain, 24.2°C	Tadpole/ metamorph searches (Green-thighed Frog)	30mins 1730-1800
	6/01/22	8/8 cloud, light wind, thunderstorms with 5.8mm rain, 24.2°C	Tadpole/ metamorph searches (Green-thighed Frog)	30mins 1730-1800
Molluscs	16/11/21	1/8 cloud, 15km/h SE winds, no rain, 19°C	Opportunistic habitat search	2hr 1445-1645
	2/12/21	1/8 cloud, no winds, no rain, 19-22°C	Opportunistic habitat search	3hrs 0830-1130
	18/08/2022	1/8 cloud, 18.3-17.4°C, no wind, no rain	2x targeted searches for Maroubra Land Snail within suitable habitat including pile, refuse, tarpaulins and pasture	5hr 1230-1730
	25/08/2022	6/8 cloud, 16.2-14.4°C, no wind, no rain	1x targeted searches for Maroubra Land Snail within suitable habitat including pile, refuse, tarpaulins and pasture	1hr 1345-1445

Table 2.2 – Flora survey effort

Flora survey	Survey technique(s)	Dates
Vegetation communities	Survey of the boundaries of all communities – field verification, determining vegetation boundaries Opportunistic observations of flora species during all on-foot traverses of the development footprint	19 June, 8 Aug 2019 13 Dec 2021
Stratified sampling	Four (4) 20 m x 20 m flora quadrats Four (4) 20 m x 50 m BAM plots within the subject land	19 June, 8 Aug 2019 13 Dec 2021

Flora survey	Survey technique(s)	Dates
Targeted searches	Targeted searches across the whole subject land	13 Dec 2021

Table 2.3 – Plot and transect survey effort – development footprint

Veg zone no.	PCT	Condition	Area (Ha)	Minimum plots required	Plot sampled	Plot identifier	Plot size	Easting at 0 m	Northing at 0 m	Bearing
1	1232	Poor	0.18	1	1	Plot 2	20 m x 50 m	342177	6270452	165
2	1793	Poor	0.23	1	1	Plot 1	20 m x 50 m	342180	6270599	99
3	1232	derived exotic	0.27	1	1	Plot 4	20 m x 50 m	342220	6270495	36
4	1232	pasture weeds	0.48	1	1	Plot 3	20 m x 50 m	342232	6270490	56

2.5 Survey limitations

It is important to note that field survey data collected during the survey period is representative of species occurring within the development footprint for that occasion. Due to effects of fire, breeding cycles, migratory patterns, camouflage, weather conditions, time of day, visibility, predatory and / or feeding patterns, increased species frequency or richness may be observed within the development footprint outside the nominated survey period. Habitat assessments based on the identification of micro-habitat features for various species of interest, including regionally significant and threatened species, have been used to minimise the implications of this survey limitation.

Given the limited potential for threatened species to occur on site because of the heavily disturbed (and removed understorey), together with long-term and ongoing management of the surrounding managed lands, it is unlikely that there are any significant limitations of this study.

Flora survey limitations

It is not expected that there are any limitations to threatened flora species survey which could change the outcomes of credit assessment as survey has been undertaken at a time when all candidate flora species are able to be detected.

Table 2.4 – Survey adequacy for confirmed candidate species (flora)

Common name	*BC Act*	Potential SAII species	Defined survey period (DPIE)	Actual survey period	Survey sufficient to rule out presence
Melaleuca biconvexa	V	no	All months	Oct	yes

Fauna survey limitations

Table 2.5 – Survey adequacy for confirmed candidate species (fauna)

Common name	*BC Act*	Potential SAII species	Defined survey period (DPIE)	Actual survey period	Survey sufficient to rule out presence
Bush Stone-curlew	E	no	All	Aug, Nov, Dec	yes
Eastern Pygmy Possum	V	no	Oct-March	n/a	no
Glossy Black-Cockatoo (breeding)	V	no	Mar-Aug	Aug	yes
Green and Golden Bell Frog	E	no	Nov-Mar	Nov, Dec	yes
Green-thighed Frog	V	no	Sep-Apr	Nov, Dec, Jan	yes
Large-eared Pied Bat	V	yes	Nov-Jan	Nov-Dec	yes
Maroubra Woodland Snail	E	no	Jan-Dec	Nov-Dec	yes

Common name	*BC Act*	Potential SAII species	Defined survey period (DPIE)	Actual survey period	Survey sufficient to rule out presence
Southern Brown Bandicoot	E	no	Jan-Dec	Nov-Dec	yes
Little Eagle (breeding)	V	no	Aug-Oct	Aug, Nov, Dec	yes
Square-tailed Kite (breeding)	V	no	Sept–Jan	Aug, Nov, Dec	yes
White-bellied Sea Eagle (breeding)	V	no	July-Dec	Aug, Nov, Dec	yes
Koala	E	no	All	Aug	yes
Squirrel Glider (species)	V	no	March–Aug	Aug	yes

Whilst considered with lower potential to occur the, Eastern Pygmy Possum was included because there has not been sufficient survey for the species. Denning tubes are required for this species to assess presence / absence.

2.6 Accuracy of identification

Hair samples collected from hair tubes were sent to Robyn Carter for identification. Robyn has is qualified with a Bachelor of Science majoring in Zoology. She was trained in 2005 by Barbara Triggs, Australia's most recognised authority in mammalian hair identification. Robyn has consistently worked in the field of hair identification for the last 17 years, regularly consulting Barbara to confirm identifications when necessary.

3. SURVEY RESULTS

3.1 Flora results

3.1.1 Native vegetation extent

The vegetation extent within the study area has been ground-truthed and is mapped on Figure 3.1. The subject lot contains 1.52 ha of vegetation, which includes remnant native vegetation and derived vegetation with a mix of native and exotic species.

The total vegetation to be impacted measures 1.28 ha. This is through a combination of impacts from roads, construction and APZ.

3.1.2 Flora species

The plants observed within the vegetation communities of the study area are listed in the Table 3.1 below.

Table 3.1 – Flora observations within the study area and surrounds

Family	Scientific name	Common name
TREES		
Fabaceae	*Acacia parramattensis*	Sydney Green Wattle
Myrtaceae	*Angophora costata*	Smooth-barked Apple
Arecaceae	*Archontophoenix alexandrae**	Alexandra Palm
Sterculiaceae	*Brachychiton populneus*	Kurrajong
Casuarinaceae	*Casuarina glauca*	Swamp Oak
Lauraceae	*Cinnamomum camphora**	Camphor Laurel
Fabaceae	*Erythrina sykesii**	Coral Tree
Myrtaceae	*Eucalyptus botryoides*	Bangalay / Southern Mahogany
Myrtaceae	*Eucalyptus microcorys*	Tallowwood
Euphorbiaceae	*Glochidion ferdinandi*	Cheese Tree
Moraceae	*Morus alba**	Mulberry
Oleaceae	*Olea europaea* subsp. *cuspidata**	African Olive
Arecaceae	*Phoenix canariensis**	Canary Island Date Palm
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum
Salicaceae	*Populus nigra**	Black Poplar
Salicaceae	*Salix babylonica**	Weeping Willow
Arecaceae	*Syagrus romanzoffiana**	Cocos Palm
Myrtaceae	*Syncarpia glomulifera*	Turpentine
SHRUBS		
Fabaceae	*Acacia elongate*	Swamp Wattle
Fabaceae	*Acacia longifolia* var. *longifolia*	Sydney Golden Wattle
Fabaceae	*Acacia saligna*	Orange Wattle

Family	Scientific name	Common name
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush
Solanaceae	*Cestrum parqui**	Chilean Cestrum
Apocnynaceae	*Gomphocarpus fruiticosus**	Narrow Leaf Cotton Bush
Proteaceae	*Hakea salicifolia*	Willow Hakea
Euphorbiaceae	*Homalanthus populifolius*	Bleeding Heart
Myrtaceae	*Kunzea ambigua*	Tick Bush
Verbenaceae	*Lantana camara**	Lantana
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet
Oleaceae	*Ligustrum sinense**	Small-leaved Privet
Celastraceae	*Maytenus silvestris*	-
Myrtaceae	*Melaleuca armillaris*	Bracelet Honey Myrtle
Myrtaceae	*Melaleuca ericifolia*	Swamp Paperbark
Ochnaceae	*Ochna serrulata**	Mickey Mouse Plant
Asteraceae	*Osteospermum fruticosum**	Shrubby Daisy-bush
Pittosporaceae	*Pittosporum revolutum*	Yellow Pittosporum
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax
Euphorbiaceae	*Ricinus communis**	Castor Oil Plant
Rosaceae	*Rubus fruticosus* sp. agg.*	Blackberry Complex
Fabaceae	*Senna pendula* var. *glabrata**	-
Solanaceae	*Solanum mauritianum**	Wild Tobacco
GROUNDCOVERS		
Polygonaceae	*Acetosa sagittata**	Turkey Rhubarb
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair
Asteraceae	*Ageratina adenophorum**	Crofton Weed
Alismataceae	*Alisma plantago-aquatica*	Water Plantain
Amaranthaceae	*Alternanthera denticulate*	Lesser Joyweed
Myrsinaceae	*Anagallis arvensis**	Scarlet Pimpernel
Poaceae	*Andropogon virginicus**	Whisky Grass
Poaceae	*Arundo donax**	Giant Reed
Asparagaceae	*Asparagus aethiopicus**	Asparagus Fern
Aspleniaceae	*Asplenium australasicum*	Birds Nest Fern
Poaceae	*Axonopus fissifolius**	Narrow-leaf Carpet Grass
Azollaceae	*Azolla pinnata*	Ferny Azolla
Restionaceae	*Baloskion tetraphyllum*	-
Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern
Cyperaceae	*Bolboschoenus fluviatilis*	Marsh Club-rush
Dicksoniaceae	*Calochlaena dubia*	False Bracken
Brassicaceae	*Capsella bursa-pastoris**	Shepherds purse
Cyperaceae	*Carex appressa*	Tall Sedge
Poaceae	*Cenchrus clandestinum**	Kikuyu
Apiaceae	*Centella asiatica*	Swamp Pennywort
Carophyllaceae	*Cerastium glomeratum**	Mouse-ear Chickweed
Solanaceae	*Cestrum parqui**	Green Cestrum

Family	Scientific name	Common name
Chenopodiaceae	*Chenopodium album*f*	Fat Hen
Liliaceae	*Chlorophytum comosum**	Spider Plant
Asteraceae	*Cirsium vulgare**	Spear Thistle
Commelinaceae	*Commelina cyanea*	Scurvy Weed
Asteraceae	*Conyza sumatrensis**	Fleabane
Poaceae	*Cortaderia selloana**	Pampas Grass
Asteraceae	*Cotula australis*	Common Cotula, Carrot Weed
Apiaceae	*Cyclospermum leptophyllum**	Slender Celery
Poaceae	*Cynodon dactylon*	Common Couch
Cyperaceae	*Cyperus brevifolius**	Mullumbimby Couch
Cyperaceae	*Cyperus eragrostis**	-
Cyperaceae	*Cyperus gracilis*	-
Cyperaceae	*Cyperus polystachyos*	-
Cyperaceae	*Cyperus rotundatus**	-
Phormiaceae	*Dianella caerulea*	Flax Lily
Convolvulaceae	*Dichondra repens*	Kidney Weed
Iridaceae	*Dietes grandiflora*	Wild Iris
Poaceae	*Ehrharta erecta**	Panic Veldtgrass
Pontederiaceae	*Eichhornia crassipes**	Water Hyacinth
Cyperaceae	*Eleocharis sphacelata*	Tall Spike-rush
Poaceae	*Entolasia stricta*	Wiry Panic
Asteraceae	*Erechtites valerianifolia**	Brazilian Fireweed
Euphorbiaceae	*Euphorbia peplus**	Spurge
Cyperaceae	*Ficinia nodosa*	-
Apiaceae	*Foeniculum vulgare**	Fennel
Cyperaceae	*Gahnia clarkei*	Tall Saw-sedge
Cyperaceae	*Gahnia sieberiana*	Red-fruited Saw-sedge
Geraniaceae	*Geranium homeanum*	Northern Cranesbill
Iridaceae	*Gladiolus* sp.*	-
Zingiberaceae	*Hedychium gardnerianum**	Ginger Lily
Apiaceae	*Hydrocotyle bonariensis**	Kurnell Curse / Pennywort
Apiaceae	*Hydrocotyle sibthorpioides*	Pennywort
Clusiaceae	*Hypericum perforatum**	St John's Wort
Asteraceae	*Hypochaeris glabra**	Smooth Catsear
Asteraceae	*Hypochaeris radicata**	Flatweed
Dennstaedtiaceae	*Hypolepis muelleri*	Harsh Ground Fern
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass
Juncaceae	*Juncus usitatus*	Common Rush
Liliaceae	*Lilium formosanum**	Formosan Lily
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Onagraceae	*Ludwigia peruviana**	Water Primrose
Cyperaceae	*Machaerina articulata*	Jointed twig-rush
Cyperaceae	*Machaerina juncea*	Bare Twig-rush
Lamiaceae	*Mentha* sp.*	Mint

Family	Scientific name	Common name
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Rice Grass
Malvaceae	*Modiola caroliniana**	Red-flowered Mallow
Poaceae	*Oplismenus aemulus*	Basket Grass
Poaceae	*Oplismenus imbecillis*	Basket Grass
Oxalidaceae	*Oxalis corniculata**	Yellow Wood Sorrel
Urticaceae	*Parietaria judaica**	Wall pellitory
Poaceae	*Paspalum dilatatum**	Paspalum
Poaceae	*Paspalum urvillei**	Vasey Grass
Polygonaceae	*Persicaria decipiens*	Slender Knotweed
Polygonaceae	*Persicaria strigosa*	-
Poaceae	*Phragmites australis*	Common Reed
Phytolaccaceae	*Phytolacca octandra**	Inkweed
Plantaginaceae	*Plantago lanceolata**	Ribwort
Poaceae	*Poa annua**	Winter Grass
Caryophyllaceae	*Polycarpon tetraphyllum*	Allseed
Portulacaceae	*Portulaca oleracea*	Purslane
Lobeliaceae	*Pratia purpurascens*	Whiteroot
Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Ranunculaceae	*Ranunculus plebeius*	Forest Buttercup
Ranunculaceae	*Ranunculus repens**	Creeping Buttercup
Polygonaceae	*Rumex brownii*	Swamp Dock
Polygonaceae	*Rumex crispus**	Curled Dock
Cyperaceae	*Schoenoplectus validus*	River Club-rush
Cyperaceae	*Schoenus brevifolius*	Bog-rush
Asteraceae	*Senecio madagascariensis**	Fireweed
Poaceae	*Setaria parviflora**	-
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Solanaceae	*Solanum americanum*	Glossy Nightshade
Solanaceae	*Solanum chenopodioides**	Whitetip Nightshade
Solanaceae	*Solanum nigrum**	Black Nightshade
Asteraceae	*Soliva sessilis**	Jojo
Asteraceae	*Sonchus asper* subsp. *asper**	Prickly Sowthistle
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle
Poaceae	*Sporobolus africanus**	Parramatta Grass
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass
Strelitzeaceae	*Strelitzea juncea**	Bird of Paradise
Asteraceae	*Tagetes minuta**	Stinking Roger
Asteraceae	*Taraxacum officinale**	Dandelion
Blechnaceae	*Telmatoblechnum indicum*	Swamp Water Fern
Aizoaceae	*Tetragonia tetragonioides*	New Zealand Spinach
Commelinaceae	*Tradescantia albiflora**	Wandering Jew
Fabaceae	*Trifolium repens**	White Clover
Juncaginaceae	*Triglochin microtuberosum*	Water Ribbons

Family	Scientific name	Common name
Typhaceae	*Typha orientalis*	Cumbungi
Urticaceae	*Urtica incisa*	Stinging Nettle
Scrophulariaceae	*Verbascum virgatum**	Twiggy Mullein
Verbenaceae	*Verbena bonariensis**	Purpletop
Verbenaceae	*Verbena litoralis**	Coastal Verbena
Violaceae	*Viola hederacea*	Ivy-leaved Violet
Violaceae	*Viola odorata**	Sweet Violet
Iridaceae	*Watsonia meriana**	Wild Watsonia
Araeceae	*Zantedeschia aethiopica**	White Arum Lily
EPYHPITES		
Polypodiaceae	*Pyrrosia rupestris*	Rock Felt Fern
Araceae	*Monstera deliciosa**	Fruit-salad Plant
VINES		
Basellaceae	*Anredera cordifolia**	Madiera Vine
Apocnyaceae	*Araujia sericifolia**	Mothvine
Sapindaceae	*Cardiospermum grandiflorum**	Balloon Vine, Love in a Puff
Lauraceae	*Cassytha glabella*	
Vitaceae	*Cayratia clematidea*	Slender Grape
Dioscoreaceae	*Dioscorea transversa*	Native Yam
Convolvulaceae	*Ipomoea indica**	Coastal Morning Glory
Caprifoliaceae	*Lonicera japonica**	Japanese Honeysuckle
Apocynaceae	*Parsonsia straminea*	Common Silkpod
Passifloraceae	*Passiflora edulis**	Common Passionfruit
Menispermiaceae	*Stephania japonica* var. *discolor**	Snake Vine
Fabaceae	*Vicia sativa* subsp. *sativa**	Common Vetch
* denotes exotic species TS denotes threatened species		

3.1.3 Plant community types (PCTs)

Evidence used to identify a PCT

Evidence used to identify the PCTs within the site: the entire list of PTCs was exported from the online BioNet Vegetation Classification Tool. Dominant canopy species, mid-stratum species, ground cover species, and Interim Biogeographic Regionalisation for Australia (IBRA) region and sub-region (Pittwater) information were utilised to produce a short list of potential PCTs (Table 3.2). Final PCTs were then chosen based on species composition and presence, and similarity to descriptive attributes and distributional information provided in the BioNet Vegetation Classification Tool. Justification for inclusion or exclusion of each shortlisted PCT is provided in Table 3.2.

Table 3.3 provides a summary of the PCT occurring within the development site, including vegetation formation, percent cleared within and extent within the development site.

All plot sheets utilised for the BAM calculator are in Appendix 1.

Table 3.2 – PCT shortlist and justification

Zone	Shortlisted PCTs	PCT name	Match	Justification
1	**1232**	**Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion**	**x**	**Correct landscape position and freshwater influence. Dominated by *C. glauca.***
	1234	Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	x	Wrong landscape position: vegetation does not fringe the margins of saline waterbodies
	1236	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	x	Wrong landscape position: dissected sandstone hills. Absence of B. spinulosa in mid strata diagnostics
	1717	Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast	x	Zone not dominated by *Melaleuca*
	1722	Swamp Mahogany - Paperbarks - Harsh Ground Fern swamp forest of the Central Coast	x	Zone not dominated by Eucalypts
	1727	Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast	x	Distribution (Hunter) does not extend to the study area. Wrong landscape position: vegetation does not occur on margins of brackish water bodies
	1728	Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast	x	Distribution (East Gosford north to Tuncurry) does not extend to the study area
	1729	Swamp Oak swamp forest on coastal lowlands of the Central Coast and Lower North Coast	x	Distribution (Tuggerah to Nabiac) does not extend to the study area. Wrong landscape position: vegetation does not occur on margins of brackish water bodies
	1730	Swamp paperbark - Baumea juncea swamp shrubland on coastal lowlands of the Central Coast and Lower North Coast	x	Distribution (Empire Bay to Black Head) does not extend to the study area.
2	661	Bangalay - Smooth-barked Apple - Swamp Mahogany low open forest of southern Sydney, Sydney Basin Bioregion	x	Site is not within southern Sydney
	1778	Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney	x	Wrong landscape position: sheltered sandstone slopes along the foreshores of Sydney's major waterways and coastal escarpments
	1793	**Smooth-barked Apple - Bangalay / Tuckeroo - Cheese Tree open forest on coastal sands of the Sydney basin**	✓	**Correct landscape position and substrate: flat, low-lying coastal marine sand deposits**

Zone	Shortlisted PCTs	PCT name	Match	Justification
	1794	Bangalay - Smooth-barked Apple / She-oak open forest on sandy alluvium in coastal parts of the Sydney region	x	Wrong landscape position and substrate: low-lying alluvial deposits associated with stream banks and inlets
	1841	Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region	x	Wrong landscape position and substrate: sandstone gullies and sheltered slopes enriched by clay material
	1915	Blue Gum-Bangalay - Turpentine / Cheese Tree - Lilly Pilly tall moist forest on coastal flats of the northern Sydney basin	x	Potential match but lack of *E. saligna* and forest is not tall

Zone 1:

The identification of the most suitable PCT was based upon filtering for Freshwater Wetland PCTs with *Casuarina glauca* as an upper strata species within the Pittwater IBRA sub-region. This produced a shortlist of nine PCTs: 1232, 1234, 1236, 1717, 1722, 1727, 1728, 1729 and 1730. PCTs 1236, 1717 and 1722 can be excluded as the descriptions for each state that the canopy is dominated by *Melaleuca* or Eucalypt species. PCT 1234 fringes the margins of saline waterbodies just above tidal influence – Zone 1 occurs outside of saline influence and thus this PCT can also be excluded. PCTs 1727, 1728, 1729 and 1730 can also be excluded as the distribution of these PCTs does not extend to the study area. Further, PCTs 1727 and 1729 occur on margins of brackish water bodies – Zone 1 occurs outside of saline or brackish influence. The remaining PCT 1232 is correctly dominated by *C. glauca*, occurs under freshwater inundation, and is known to occur within the Sydney metropolitan area. This designation is consistent with the Native Vegetation of the Sydney Metropolitan Area (OEH 2016) mapping (Figure 2.1).

Note that PCT 1232 is now decommissioned and is split into several new Eastern NSW PCTs. The most likely is PCT 4028 - Estuarine Swamp Oak Twig-rush Forest. Despites this, PCT 1232 is still used by the BAM-C, whereas PCT 4028 cannot yet be used.

Zone 2:

The identification of the most suitable PCT was based upon filtering for PCTs within the Pittwater IBRA sub-region with *Eucalyptus botryoides* and *Angophora costata* in the upper strata, and *Glochidion ferdinandi* in the mid strata. This produced shortlist of six PCTs: 661, 1778, 1793, 1794, 1841 and 1915. PCT 661 can be excluded as it is restricted to southern Sydney, while Zone 2 is in the wrong landscape position and substrate for PCTs 1778, 1794 and 1841 (Table 3.2). Both PCTs 1793 and 1915 are a potential match, and the depauperate nature of the vegetation present prevents accurate delineation based on floristic data. Ultimately, the landscape position and substrate are correct for PCT 1793, while the lack of *E. saligna* and the shorter height of the vegetation suggests that PCT 1915 is not the best match. PCT 1793 is consistent with the Native Vegetation of the Sydney Metropolitan Area (OEH 2016) mapping (Figure 2.1).

Note that PCT 1793 is now decommissioned and is amalgamated into the new Eastern NSW PCT 3638 - South Coast Sands Bangalay Forest within the Sydney metropolitan area. Despites this, PCT 1793 is still used by the BAM-C, whereas PCT 3638 cannot yet be used.

Zones 3 & 4:

Zones 3 and 4 contain a mix of derived, planted and naturalised species largely dominated by exotics. Native species richness is very low and, being comprised of widespread and common forbs and grasses, is not sufficient to assign a PCT based on floristics. As such, we must determine an acceptable PCT based on what would have originally occurred in that position. As the majority of Zones 3 and 4 occur toward the southern end of the subject land, it is appropriate to assign PCT 1232 to these Zones.

Table 3.3 – PCTs

PCT code	PCT name	Species relied upon	Vegetation formation	Vegetation class	% Cleared	Area within development site (ha)	TEC status
1232	Coastal freshwater swamp forest	*Casuarina glauca*	Forested Wetlands	Coastal Swamp Forests	95	0.44 on site, 0.18 to be impacted	Swamp Oak Floodplain Forest
1793	Coastal Sand Bangalay Forest	*A. costata E. botryoides Glochidion ferdinandi*	Dry Sclerophyll Forests (Shrubby sub-formation);	South Coast Sands Dry Sclerophyll Forests;	40	0.23 on site, all to be impacted	Bangalay Sand Forest

3.1.4 Vegetation descriptions of observed communities

The following vegetation communities were recorded within the study area:

- Zone1: PCT 1793 – Smooth-barked Apple - Bangalay / Tuckeroo - Cheese Tree open forest
- Zone 2: PCT 1232 – Swamp Oak floodplain swamp forest
- Zone 3: Planted and derived exotic vegetation
- Zone 4: Pasture and weeds
- Planted native vegetation

Zone 1: PCT 1793 – Smooth-barked Apple - Bangalay / Tuckeroo - Cheese Tree open forest

Canopy:

Eucalyptus botryoides, *Angophora costata, Glochidion ferdinandi* and *Syncarpia glomulifera* to a height of 15–20 m provide a PFC of 25–35%.

Mid-storey:

The majority of the native mid-storey is absent. Naturalised exotic species such as *Cestrum parqui*, *Lantana camara* and *Senna pendula* are abundant.

Ground layer:

The ground layer contains limited native species but includes *Dichondra repens, Commelina cyanea, Hydrocotyle sibthorpioides, Oplismenus aemulus, Solanum americanum, Calochlaena dubia* and *Geranium homeanum*.

Classification:

This vegetation community is commensurate with *Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions*, which is listed as an endangered ecological community (EEC) under the NSW *BC Act 2016*. This community is not listed under the *EPBC Act.*

Photo 3.1 – Disturbed PCT 1793 Smooth-barked Apple - Bangalay / Tuckeroo - Cheese Tree open forest in the northern portion of the subject land

Photo 3.2 – Disturbed PCT 1793 Smooth-barked Apple - Bangalay / Tuckeroo - Cheese Tree open forest in the northern portion of the subject land

Zone 2: PCT 1232 – Swamp Oak floodplain swamp forest

Canopy:

Canopy consists of *Casuarina glauca* to a height of 15–22 m and a projected foliage cover (PFC) of 20–75%. Occasional *E. botryoides* are present at the edges of this vegetation. Naturalised exotic species such as *Erythrina sykesii* and *Cinnamomum camphora* are abundant in some areas and provide up to 25% PFC.

Mid-storey:

The mid-storey is largely devoid of native vegetation; however, occasional small trees, palms and shrubs are present such as *Melaleuca linearifolia, Melaleuca ericifolia, Glochidion ferdinandi, Parsonsia straminea* and *Livistona australis* providing up to 10% PFC. The mid-storey contains a high abundance of naturalised exotics such as *Lantana camara* (up to 80% PFC)*, Senna pendula, Ipomoea indica, Arundo donax, Anredera cordifolia* and *Lonicera japonica*.

Ground layer:

The ground layer contains a number of sedges, herbs and ferns including *Gahnia clarkei, Hypolepis muelleri, Centella asiatica, Carex appressa, Calochlaena dubia, Persicaria hydropiper, Ranunculus plebeius, Oplismenus* spp.*, Commelina cyanea, Centella asiatica, Blechnum cartilagineum* and *Viola hederacea* providing up to 30% PFC. Exotic species are sparse and include *Tradescantia fluminensis* and *Cenchrus clandestinus*.

Photo 3.3 – PCT 1232 – Swamp Oak floodplain swamp forest in the southern portion of the subject land

Classification:

This vegetation community is commensurate with *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* which is listed as an endangered ecological community (EEC) under the NSW *BC Act 2016*. This community is also commensurate with *Coastal Swamp Oak Forest* which is listed under the *EPBC Act* as an EEC.

Photo 3.4 – PCT 1232 – Swamp Oak floodplain swamp forest within Plot 2

Zone 3: Planted and derived exotic vegetation

This vegetation occurs in patches within the centre of the subject land. It is comprised of planted trees and garden plants including *Populus nigra, Syagrus romanzoffiana, Phoenix canariensis* and *Schefflera actinophylla* along with naturalised species such as *Erythrina x. sykesii, Solanum mauritianum, Conyza bonariensis, Acetosa sagittata, Lantana camara, Sonchus oleraceus, Lolium perenne, Solanum nigrum, Cenchrus clandestinus,* and *Ricinus communis.* Although dominated by exotic species, this vegetation contains some native groundcover species, including *Commelina cyanea, Cotula australis, Oplismenus aemulus, Juncus usitatus* and *Rumex brownii,* and as such has been allocated a separate vegetation zone for assessment according to the BAM.

Planted native vegetation

Planted *E. microcorys* are scattered throughout the northern portions of the subject land. This species has a natural southern limit at Cooranbong (PlantNet) and would not naturally occur on the Northern Beaches. Where individuals of *E. microcorys* are intermingled with remnant, locally-indigenous species, they have been included within either Zone 1 or Zone 2. Where they are distinct and not part of a mosaic they have been mapped as a separate vegetation community (Figure 3.1). Appendix D of the BAM can be applied to this vegetation and, as such, Chapters 4 and 5 of the BAM (i.e. plot-based survey and assessment for ecosystem and

species credits) are not required to be applied to the planted native vegetation, and it will only need to be assessed for use by threatened fauna. No offsets will be required for impacts on this planted native vegetation. See Section 5.2.1 for additional detail.

3.1.5 Vegetation integrity assessment

A vegetation integrity assessment is an assessment on the site's condition. Vegetation patches are broken into zones of roughly equal quality and then surveyed by transect plots. The number of required transect plots is dependent upon the size of the zone.

Vegetation zone area (ha)	Minimum number of plots/transects
<2	1 plot/transect
>2–5	2 plots/transects
>5–20	3 plots /transects
>20–50	4 plots/transects
>50–100	5 plots/transects
>100–250	6 plots/transects
>250–1000	7 plots/transects; more plots may be needed if the condition of the vegetation is variable across the zone
>1000	8 plots/transects; more plots may be needed if the condition of the vegetation is variable across the zone

Once data from the transect plot has been collected, the composition of native plant species per growth form is assessed, along with numbers of stems, percentages of exotic or high threat exotic species present, number and sizes of native tree stems, litter cover, rock cover, cryptogram cover, hollows and fallen logs. Therefore, the vegetation integrity assessment is a measure of composition, structure and function.

The breakdown of PCTs and zones is shown on Figure 3.1. Impacted areas (the development footprint) are shown cross-hatched. Figure 3.1 shows the location of the plots in relation to the impacted areas.

The vegetation integrity score is obtained using equations and weightings based upon a number of entities to calculate scores for composition, structure and function, for an overall current vegetation integrity score.

Table 3.4 – Current vegetation integrity score

Zone no.	Vegetation zone name	Area (ha)	Composition condition score	Structure condition score	Function condition score	Current vegetation integrity score
1	1232_poor	0.18	38.3	24	62.5	38.6
2	1793_poor	0.23	15.2	25.9	44.2	25.9
3	1232_derived_exotic	0.27	14.1	1.2	0.1	1.3
4	1232_pasture_weeds	0.48	14.1	24	0.1	3.1

The future vegetation integrity score is measured assuming there will be no vegetation retained within the subject land. As such, the future vegetation integrity score for all Zones will be 0 as indicated in Table 3.5.

Table 3.5 – Future vegetation integrity score

Zone no.	Vegetation zone name	Area (ha)	Composition condition score	Structure condition score	Function condition score	Current vegetation integrity score
1	1232_poor	0.18	0	0	0	0
2	1793_poor	0.23	0	0	0	0
3	1232_derived_exotic	0.27	0	0	0	0
4	1232_pasture_weeds	0.48	0	0	0	0

3.2 Fauna results

Fauna species observed throughout the duration of fauna surveys are listed below.

Table 3.6 – Fauna recorded within the study area

Common name	Scientific name	Method observed		
Birds		Apr 2013 / Dec 2016	Aug 2019	Nov/ Dec 2021
Australian Brush-turkey	*Alectura lathami*	O		
Australian Magpie	*Gymnorhina tibicen*	O W	O W	OW
Australian Raven	*Corvus coronoides*	O W	O	OW
Australian White Ibis	*Threskiornis moluccus*		O	
Brown Thornbill	*Acanthiza pulsilla*	W	W	OW
Channel-billed Cuckoo	*Scythrops novaehollandiae*			W
Chestnut Teal	*Anas castanea*	O W		
Common Bronzewing	*Phaps chalcoptera*	O		
Common Koel	*Eudynamys scolopacea*	O W		W
Common Myna *	*Acridotheres tristis*	W	W	OW
Long-billed Corella	*Cacatua tenuirostris*		O W	OW
Eastern Spinebill	*Acanthorhynchus tenuirostris*	O W	W	OW
Eastern Whipbird	*Psophodes olivaceus*	W	O W	W
Eastern Yellow Robin	*Eopsaltria australis*		W	
Figbird	*Sphecotheres vieilloti*		W	W
Galah	*Cacatua roseicapilla*	O W	W	OW
Golden Whistler	*Pachycephala pectoralis*	O W	W	OW
Grey Butcherbird	*Cracticus torquatus*	W	W	OW
Grey Fantail	*Rhipidura fuliginosa*	O W	W	OW
Laughing Kookaburra	*Dacelo novaeguineae*	O W	O W	W
Magpie-lark	*Grallina cyanoleuca*	O	O	OW
Masked Lapwing	*Vanellus miles*	O W	O W	OW
Musk Lorikeet	*Glossopsitta concinna*	O W	W	W
Nankeen Kestrel	*Falco cenchroides*			
Noisy Miner	*Manorina melanocephala*	W	O W	OW
Olive-backed Oriole	*Oriolus sagittatus*	O W		OW
Pacific Black Duck	*Anas superciliosa*	O		OW
Pied Currawong	*Strepera graculina*	O W	O W	OW
Powerful Owl TS	*Ninox strenua*			OW
Purple Swamphen	*Porphyrio porphyrio*	O W	O W	OWQ
Rainbow Lorikeet	*Trichoglossus haematodus*	O W	O W	OW
Red-browed Finch	*Neochmia temporalis*		O W	
Red Junglefowl *	*Gallus gallus*	O W		OW

Common name	Scientific name	Method observed		
Red Wattlebird	*Anthochaera carunculata*	W	O W	OW
Red-whiskered Bulbul *	*Pycnonotus jocosus*	O W	W	
Rufous Whistler	*Pachycephala rufiventris*		W	
Silvereye	*Zosterops lateralis*	O W		OW
Spotted Pardalote	*Pardalotus punctatus*	W		
Spotted Turtle-Dove *	*Streptopelia chinensis*	O	O W	OW
Sulphur Crested Cockatoo	*Cacatua galerita*	O W	W	OW
Superb Fairy-wren	*Malurus cyaneus*	O W	O W	OW
Tawny Frogmouth	*Podargus strigoides*	O		
Variegated Fairy-wren	*Malurus lamberti*	O W	O W	OW
White-browed Scrubwren	*Sericornis frontalis*	O W		OW
White-cheeked Honeyeater	*Phylidonyris nigra*	W	W	OW
Willie Wagtail	*Rhipidura leucophrys*	O W	O W	
Yellow Thornbill	*Acanthiza nana*	O W		
Mammals				
Black Rat *	*Rattus rattus*	T	O	O
Chocolate Wattled Bat	*Chalinolobus morio*			U PO
Common Brushtail Possum	*Trichosurus vulpecula*	P	O	O
Common Ringtail Possum	*Pseudocheirus peregrinus*	P	O	O
Domesticated Dog *	*Canis familiaris*	O	O	W
Large Bent-winged Bat TS	*Miniopterus orianae oceansis*	U	U	U
Eastern Freetail-bat	*Mormopterus ridei*	U PO		
Eastern Cave Bat	*Vespadelus troughtoni*			U PO
Gould's Wattled Bat	*Chalinolobus gouldii*	U		
Grey-headed Flying-fox TS	*Pteropus poliocephalus*	S		OW
Horse *	*Equus caballus*	O	O	O
Southern MyotisTS	*Myotis macropus*	U PO	O PR U PO	
Little Forest Bat	*Vespadelus vulturnus*	U		
Little Bent-winged Bat TS	*Miniopterus australis*		U	U
Long-nosed Bandicoot	*Perameles nasuta*		O W	OW
Rabbit *	*Oryctolagus cuniculus*	P	O	O
Swamp Wallaby	*Wallabia bicolor*		O	OQ
Reptiles				
Delicate Skink	*Lampropholis delicata*	O		O
Eastern Water Dragon	*Intellagama lesueurii*	O		O
Eastern Water Skink	*Eulamprus quoyii*	O		O
Red-Bellied Black Snake	*Pseudechis porphyriacus*	O		
Amphibians				
Common Eastern Froglet	*Crinia signifera*	W	W	OW
Dwarf Tree Frog	*Litoria fallax*	W		OW
Graceful Tree Frog	*Litoria gracilenta*			OW
Peron's Tree Frog	*Litoria peronii*		W	OW
Striped Marsh Frog	*Limnodynastes peronii*	W		OW
Mollusc				
Brown Garden Snail *	Cornu aspersum			O
Asian Tramp Snail *	Bradybaena similaris			O

Note: * indicates introduced species
TS indicates threatened species
MS indicates Migratory species

All species listed are identified to a high level of certainty unless otherwise noted as:

PR indicates species identified to a 'probable' level of certainty – more likely than not
PO indicates species identified to a 'possible' level of certainty – low-moderate level of confidence

Common name	Scientific name	Method observed	
AR - Acoustic Recording E - Nest/roost F- Tracks/scratchings FB - Burrow G - Crushed cones	H - Hair/feathers/skin K- Dead O - Observed OW- Obs & heard call	P - Scat Q- Camera T - Trapped/netted U- Anabat/ultrasound	W - Heard call X- In scat Y - Bone/teeth/shell Z- In raptor/owl pellet

3.3 Habitat results

3.3.1 *Fauna habitat observations*

The fauna habitats present within the site are identified within the following table.

Table 3.7 – Observed fauna habitat

Topography				
Flat ✓	Gentle ✓	Moderate	Steep	Drop-offs
Vegetation structure				
Closed Forest	Open Forest ✓	Woodland ✓	Heath	Grassland ✓
Disturbance history				
Fire ✓	Under-scrubbing ✓	Cut and fill works ✓		
Tree clearing ✓	Grazing ✓			
Soil landscape				
DEPTH:	Deep	Moderate ✓	Shallow ✓	Skeletal
TYPE:	Clay ✓	Loam ✓	Sand ✓	Organic ✓
VALUE:	Surface foraging ✓	Sub-surface foraging ✓	Denning/burrowing ✓	
WATER RETENTION:	Well Drained ✓	Damp / Moist ✓	Water logged ✓	Swamp / Soak ✓
Rock habitat				
CAVES: CREVICES: ESCARPMENTS: OUTCROPS:	No caves, crevices, escarpments or outcrops recorded within the subject site			
SCATTERED / ISOLATED:	High Surface Area Hides	Med. Surface Area Hides	Low Surface Area Hides ✓	
Feed resources				
FLOWERING TREES:	Eucalypts ✓	Corymbias ✓	Melaleucas	
	Banksias	Acacias		
SEEDING TREES:	Allocasuarinas	Conifers		
WINTER FLOWERING EUCALYPTS:	C. maculata ✓	E. crebra	E. globoidea	E. sideroxylon
	E. squamosa	E. grandis	E. multicaulis	E. scias
	E. robusta ✓	E. tereticornis	E. agglomerata	E. siderophloia
FLOWERING PERIODS:	Autumn ✓	Winter ✓	Spring ✓	Summer ✓
OTHER:	Mistletoe	Figs / Fruit	Sap / Manna ✓	Termites ✓
Foliage protection				
UPPER STRATA:	Dense	Moderate ✓	Sparse ✓	
MID STRATA:	Dense ✓	Moderate ✓	Sparse ✓	
PLANT / SHRUB LAYER:	Dense ✓	Moderate ✓	Sparse ✓	
GROUNDCOVERS:	Dense	Moderate ✓	Sparse ✓	
Hollows / logs				
TREE HOLLOWS:	Large(>15 cm)	Medium (10-15 cm) ✓	Small (5-10 cm) ✓	
TREE HOLLOW TYPES	Spouts / branch ✓	Trunk ✓	Broken Trunk	Basal Cavities	Stags
GROUND HOLLOWS:	Large	Medium	Small	
Vegetation debris				
FALLEN TREES:	Large	Medium	Small ✓	
FALLEN BRANCHES:	Large	Medium ✓	Small ✓	

Topography						
LITTER:	Deep ✓		Moderate ✓		Shallow ✓	
HUMUS:	Deep ✓		Moderate ✓		Shallow ✓	
Drainage catchment						
WATER BODIES	Wetland(s) ✓	Soak(s) ✓	Dam(s)	Drainage line(s) ✓	Creek(s)	River(s)
RATE OF FLOW:	Still ✓		Slow		Rapid	
CONSISTENCY:	Permanent ✓		Perennial ✓		Ephemeral ✓	
RUNOFF SOURCE:	Urban / Industrial	Parkland		Grazing ✓	Natural ✓	
RIPARIAN HABITAT:	High quality	Moderate quality ✓		Low quality ✓	Poor quality	
Artificial habitat						
STRUCTURES:	Sheds ✓		Infrastructure ✓		Equipment ✓	
SUB-SURFACE	Pipe / culvert(s) ✓		Tunnel(s)		Shaft(s)	
FOREIGN MATERIALS:	Sheet ✓		Pile / refuse ✓			

3.3.2 Habitat tree data

Hollow-bearing trees were surveyed within the subject lots during the recent 2019 and 2021 fauna survey. Hollow-bearing tree data for the subject lots is provided in Table 3. None of these hollows are considered suitable for threatened large forest owls or cockatoos. No such suitable hollows for nesting will also be indirectly impacted nearby. The majority of hollows recorded present were located within exotic Poplar trees, one of these HT3 observed to be used by Common Brushtail Possum during survey.

The recorded hollows may be suitable for hollow-dependent threatened species with considered potential to occur including; Little Lorikeet, East-coast Freetail Bat, Southern Myotis, Eastern False Pipistrelle, Greater Broad-nosed Bat and Squirrel Glider. Of these species, the Southern Myotis has been recorded during surveys to date, however this species has been recorded utilising the adjacent culverts which are likely preferred over the recorded hollows. The presence of hollows within the proposed development area is considered unlikely to constrain development. The assessment for hollow-dependent species will recommend retention of hollows where possible and otherwise relocation / replacement to adjacent habitat.

Table 3.8 – Habitat tree data

Tree No	Scientific Name	Common Name	DBH (cm)	Height (m)	Spread (m)	Vigour (%)	Hollows & Other Habitat Features Recorded
HT1	*Casuarina glauca*	Swamp Oak	45	13	6	60	1x 5-10cm trunk split
HT2	*Populus nigra*	Black Poplar	34	28	11	75	1x 0-5cm trunk, 1x 5-10cm trunk
HT3	*Populus nigra*	Black Poplar	56	20	11	75	1x 10-15cm broken trunk (Common Brushtail Possum)
HT4	*Populus nigra*	Black Poplar	90	29	17	75	1x 5-10cm trunk, 1x 5-10cm broken trunk
HT5	*Populus nigra*	Black Poplar	40	21	8	75	1x 0-5cm trunk split
HT6	*Populus nigra*	Black Poplar	30	20	8	75	1x 5-10cm trunk
HT7	*Populus nigra*	Black Poplar	41	35	10	75	1x 0-5cm trunk, 1x 0-5cm trunk split
HT8	*Populus nigra*	Black Poplar	40	26	11	75	1x 5-10cm broken trunk
HT9	*Populus nigra*	Black Poplar	37	38	10	75	1x 5-10cm trunk split
HT10	*Populus nigra*	Black Poplar	54	45	20	75	1x 0-5cm trunk

Figure 3.1 – Flora survey effort and results

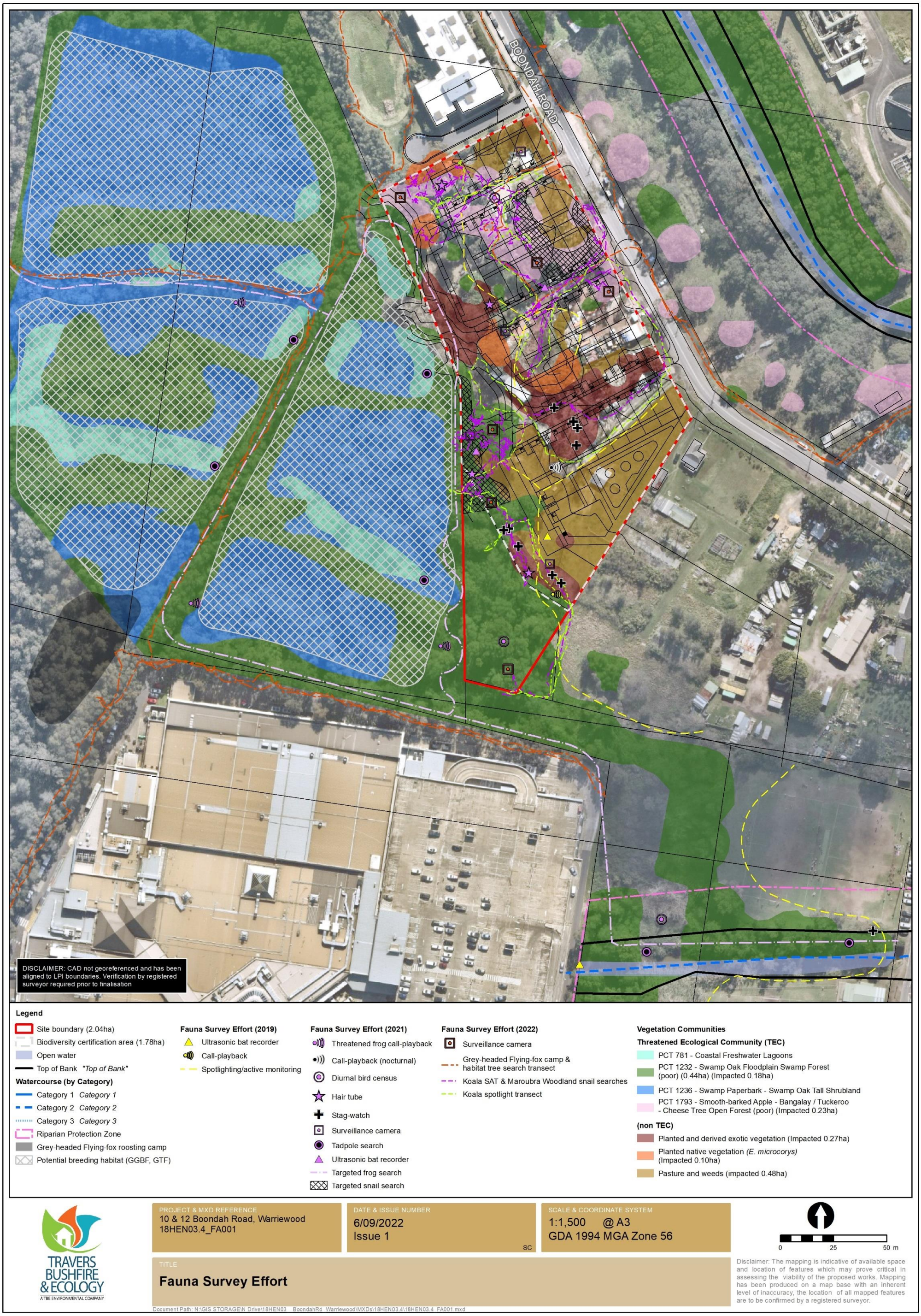

Figure 3.2 – Fauna survey effort

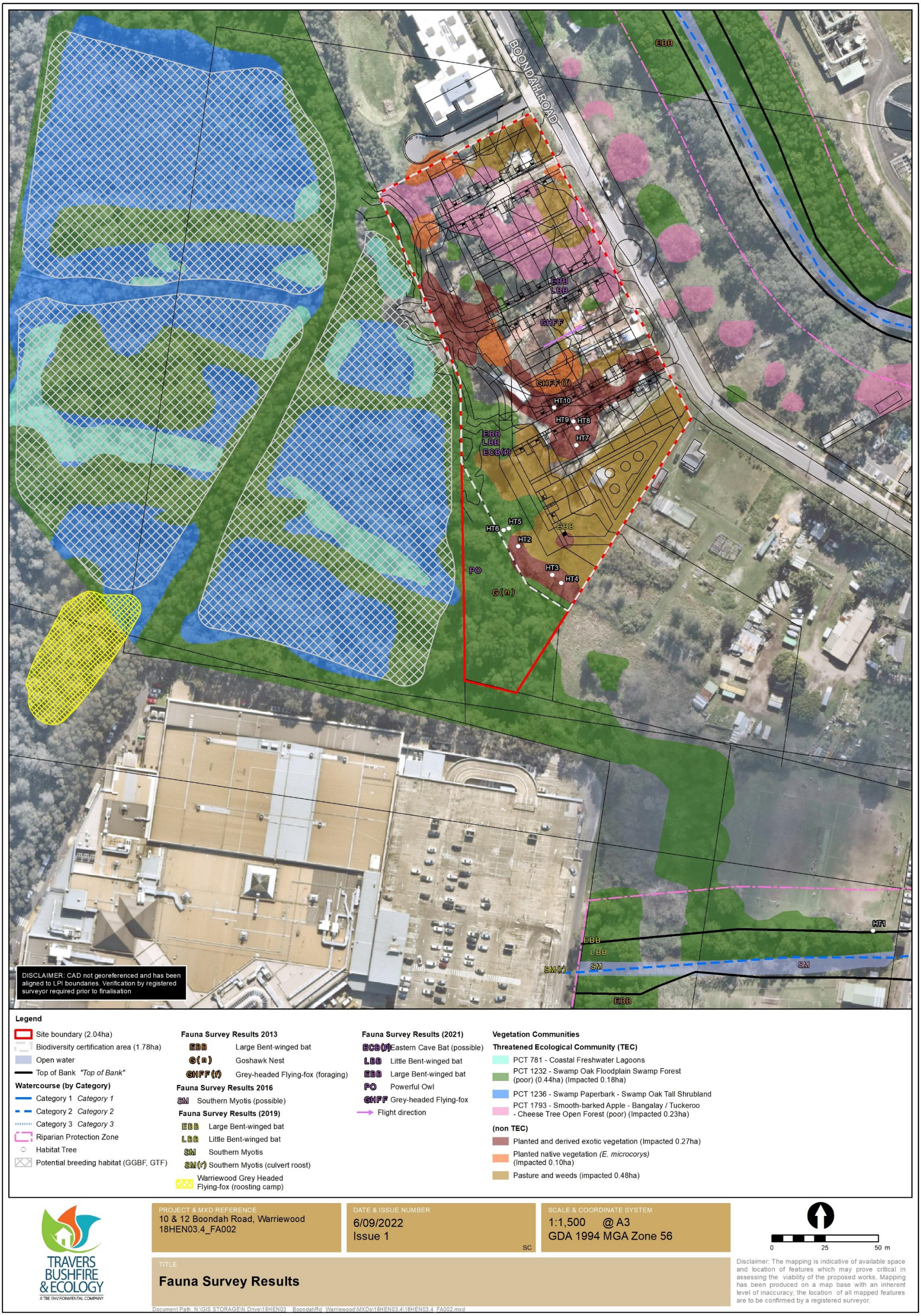

Figure 3.3 – Fauna survey results

4. BIODIVERSITY ASSESSMENT

4.1 Flora

4.1.1 State legislative flora matters

(a) Threatened flora species and populations (NSW)

BC Act – No state listed threatened flora species were observed during the survey undertaken.

There are no endangered flora populations within the former Pittwater LGA nor the current Northern Beaches LGA.

(b) Threatened ecological communities (NSW)

Two (2) threatened ecological communities (TECs) occur within the study area:

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (SOFF):

This TEC occurs in the western and southern portions of the subject land in association with PCT 1232 – Swamp Oak floodplain swamp forest and is listed as an endangered ecological community (EEC) under the NSW *BC Act 2016*. This community is equivalent to *Coastal Swamp Oak Forest* which is listed under the *EPBC Act* as an EEC.

Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions (BSF):

This TEC occurs in the north of the subject land in association with PCT 1793 Smooth-barked Apple - Bangalay / Tuckeroo - Cheese Tree open forest and is listed as an endangered ecological community (EEC) under the NSW *BC Act 2016*. This community is not listed under the *EPBC Act.*

(c) Ecosystem credit species

The BAM calculator does not predict any threatened flora species as ecosystem credit species.

(d) Species credit species

Based upon the BAM calculator and field surveys to date, the following predicted threatened species were considered as candidate species for species credit calculation:

Table 4.1 – Species credit species (flora)

Scientific name	*BC Act*	Associated PCTs	Potential to occur (presence status)	Confirmed candidate species	Survey Adequacy			Presence
					Preferred Survey period (TBDC)	Actual Survey period	Survey Compliant (Yes/ No)	
Chamaesyce psammogeton	E1		no - microhabitats absent	no	n/a	n/a	n/a	Absent (absence of microhabitats absent)
Melaleuca biconvexa	V	1232	unlikely	yes	All months	Oct	yes	Absent (survey)
Senecio spathulatus	V		no - habitat constraint absent	no	n/a	n/a	n/a	Absent (habitat constraints)
Syzygium paniculatum	E1		no - microhabitats absent	no	n/a	n/a	n/a	Absent (absence of microhabitats absent)

Exclusions based on habitat features / survey

Exclusion of species from consideration as candidate species follows Section 5.2 of the BAM. Candidate species can be excluded from further consideration if:

- The distribution of the species does not include the IBRA subregion within which the subject land is located
- the subject land is outside any geographic limitations of the species distribution based on information from the threatened biodiversity profile search webpage. If no geographic limitations are listed for the species, then this step is not applicable
- none of the habitat constraints for the species as provided in the TBDC are present in a vegetation zone or subject land.
- the species is a vagrant in the IBRA subregion.

After carrying out a field assessment, a candidate species can also be excluded if:

- the microhabitats required by a species are absent from the subject land (or specific vegetation zone).
- the habitat constraints or microhabitats are degraded to the point that the species is unlikely to use the subject land (or specific vegetation zones).

If a candidate species cannot be excluded based on the above criteria, targeted survey must be undertaken, the species assumed present or an expert report obtained that states that the species is unlikely to be present on the subject land or specific vegetation zones.

Excluded species are mentioned below:

Chamaesyce psammogeton

The TBDC states that this species “grows on fore-dunes, pebbly strandlines and exposed headlands”. These landscape features are absent from the subject land and the species can be excluded as a candidate species due to absence of suitable microhabitat.

Senecio spathulatus

The TBDC lists one habitat constraint for this species: Headlands within 500 m of the coast. The subject land contains no headland, being more or less flat, and is just over 1 km from the coast. Thus, this habitat constraint is absent from the subject land and the species can be excluded as a candidate species.

Syzygium paniculatum

The TBDC states that this species occurs in “riverside gallery rainforests and remnant littoral rainforest communities”. As these vegetation communities are absent from the subject land, the species can be excluded as a candidate species due to absence of suitable microhabitat.

4.2 Fauna

All fauna species recorded during 2012, 2014, 2019, 2021 and 2022 surveys, key fauna habitat observations and habitat tree data are provided in Section 3.

4.2.1 Key fauna habitat

Most notable habitat features for threatened fauna species considered with most potential to occur include:

- Small hollows (<10cm)
- Diverse seasonal flowering opportunities for nectivorous species.
- Winter flowering trees
- Open water large adjacent river, smaller dams and wetland habitat
- Fringing wetland vegetation
- Terrestrial infrastructure and pile refuges

A complete assessment of the location of habitat trees and the size of hollows within was undertaken as part of surveys. Hollow-bearing trees were surveyed within the subject lots during the recent 2019 and 2021 fauna survey. Hollow-bearing tree data for the subject lots is provided in Table 3. None of these hollows are considered suitable for threatened large forest owls or cockatoos. No such suitable hollows for nesting will also be indirectly impacted nearby. The majority of hollows recorded present were located within exotic Poplar trees, one of these HT3 observed to be used by Common Brushtail Possum during survey.

The recorded hollows may be suitable for hollow-dependent threatened species with considered potential to occur including; Little Lorikeet, East-coast Freetail Bat, Southern Myotis, Eastern False Pipistrelle, Greater Broad-nosed Bat and Squirrel Glider. Of these species, the Southern Myotis has been recorded during surveys to date, however this species has been recorded utilising the adjacent culverts which are likely preferred over the recorded hollows. The presence of hollows within the proposed development area is considered unlikely to constrain development. The assessment for hollow-dependent species will recommend retention of hollows where possible and otherwise relocation / replacement to adjacent habitat.

Table 3.8 below provides hollow-bearing tree data and other habitat features recorded. Figure 3.3 provides locations of habitat trees.

All hollow-dependent threatened fauna species recorded during previous or recent surveys include the Powerful Owl (*Ninox strenua*) and Southern Myotis (*Myotis macropus*).

Other notable hollow-dependent fauna species recorded during surveys include the Rainbow Lorikeet, Spotted Pardalote, Sulphur Crested Cockatoo, Common Ringtail Possum, Common Brushtail Possum, Gould's Wattled Bat, Chocolate Wattled Bat, Eastern Freetail-bat, Eastern Broad-nosed Bat, Little Forest Bat, Dwarf Tree Frog and Peron's Tree Frog.

Two hollow-dependent threatened fauna species were recorded present during survey including the Southern Myotis and the Powerful Owl. Hollows recorded present may support roosting/breeding habitat for the recorded hollow-dependent threatened Southern Myotis, however, no large hollows suitable for threatened owls were recorded present within the habitat tree survey area or along the adjacent Warriewood wetlands and Narrabeen Creek.

Nine hollow-bearing trees will be removed by the proposal. A strict removal of hollows process is recommended in Section 5.4 to prevent impacts on hollow-dependent fauna. This includes the initial identification of all hollows, supervision of their removal to effectively recover fauna and the relocation of hollows (or replacement with nest boxes) within the conservation areas of the site.

4.2.2 State legislative fauna matters

(a) Threatened fauna species and populations (NSW)

BC Act – Six (6) state listed threatened fauna species – Grey-headed Flying-fox (*Pteropus poliocephalus*), Large Bent-winged Bat (*Miniopterus orianae oceanensis*), Eastern Cave Bat (*Vespadelus troughtoni*), Southern Myotis (*Myotis* macropus), Little Bent-winged Bat (*Miniopterus australis*) and Powerful Owl (*Ninox strenua*) – were recorded within the development footprint during surveys.

FM Act – No habitats suitable for threatened aquatic species were observed within the development footprint and as such the provisions of this act do not require any further consideration.

(b) State Environmental Planning Policy (Biodiversity and Conservation) 2021 – Koala Habitat Protection

Chapter 4 of State Environmental Planning Policy (Biodiversity and Conservation) 2021 (Koala Habitat Protection) applies to land within LGAs listed under Schedule 2 of the Policy. As the study area falls under the Pittwater LGA, which is not listed under Schedule 2, it is considered that Koala SEPP 2021 does not apply to this development proposal. However, the population in the Pittwater LGA is listed as an endangered population under the *BC Act.* Therefore, the overarching legislative document relating to Koalas at this locations will be Schedule 1, Part 2, Division 4 of the *BC Act*.

As of February 2022, the nearest Koala records to the study area within the last 18 years were two observations dated in 2020, one of these observations was recorded in Kuring-Gai National Park approximately 10.5 km north west of the study site, while another individual in 2020 was observed in Wakehurst Parkway approximately 10.2 km to the south west. However, within a 10 km radius, Koala populations are highly sporadic and only contain observations dated between 1949 and 1971.

The Department of Planning, Industry and Environment (DPIE) list seven Koala Management Areas (KMAs) which provide regional divisions across New South Wales, partly based on the distribution of preferred koala food trees and partly on local council boundaries to make management of resources easier. As the study area falls under the Pittwater LGA, the Central Coast/Sydney Basin KMA applies with regard to Koala use tree species. Three tree species were recorded in the study area which are considered to be Koala use tree species within this KMA. Of these species, one is considered high preferred use (*Eucalyptus microcorys*) and two are considered significant use (*Angophora costata* and *Eucalyptus botryoides*). No evidence of Koala activity was recorded during the Spot Assessment Technique (SAT) and spotlighting survey.

(c) Ecosystem credit species

Based upon the BAM calculator and field surveys to date, the following threatened fauna species were considered as predicted species for ecosystem credit calculation:

Table 4.2 – Ecosystem credit species (fauna)

Common name	*BC Act*	Confirmed predicted species	Associated PCT
Australasian Bittern	E	✓	1232
Barking Owl (foraging)	V	✓	1232
Black Bittern	V	✓	1232
Dusky Woodswallow	V	✓	1232/1793
Eastern Coastal Free-tailed Bat	V	✓	1232/1793
Glossy Black-Cockatoo (foraging)	V	✓	1232
Grey-headed Flying-fox (foraging)	V	✓	1232/1793
Large Bent-winged Bat (foraging)	V	✓	1232
Little Bent-winged Bat (foraging)	V	✓	1232/1793
Little Eagle (foraging)	V	✓	1232/1793
Little Lorikeet	V	✓	1232/1793
Masked Owl (foraging)	V	✓	1232/1793
New Holland Mouse	V	✓	1232/1793

Common name	*BC Act*	Confirmed predicted species	Associated PCT
Osprey (foraging)	V	✓	1232/1793
Painted Snipe	E	✓	1232
Powerful Owl (foraging)	V	✓	1232/1793
Regent Honeyeater (foraging)	E4A	✓	1232/1793
Rosenberg's Goanna	V	✓	1232/1793
Spotted Harrier	V	✓	1232
Spotted-tailed Quoll	V	✓	1232/1793
Square-tailed Kite (foraging)	V	✓	1232
Swift Parrot (foraging)	E	✓	1232/1793
Varied Sittella	V	✓	1232/1793
White-bellied Sea Eagle (foraging)	V	✓	1232
White-throated Needletail	V	✓	1232/1793
Yellow-bellied Sheathtail-bat	V	✓	1232/1793

(d) Species credit species

Based upon the BAM calculator and field surveys to date, the following predicted threatened fauna species were considered as candidate species for species credit calculation:

Table 4.3 – Species credit species (fauna)

Common name	*BC Act*	Associated PCTs	Confirmed candidate species	Survey adequacy			Presence
				Defined survey months (TBDC)	Actual survey period	Survey compliant (yes/ no)	
Barking Owl (breeding)	V	1232/1793	no – habitat constrains absent	n/a	n/a	n/a	absent (no breeding habitat)
Bush Stone-curlew	E	1232	yes	All	Aug, Nov, Dec	yes	absent (survey)
Eastern Pygmy Possum	V	1232/1793	yes	Oct-March	n/a	no	present (assumed)
Glossy Black-Cockatoo (breeding)	V	1232	no – habitat constrains absent	n/a	n/a	n/a	absent (no breeding habitat)
Green and Golden Bell Frog	E	1232	yes	Nov-Mar	Nov, Dec	yes	absent (survey)
Green-thighed Frog	V	1232	yes	Sep-Apr	Nov, Dec, Jan	yes	absent (survey)
Grey-headed Flying-fox (breeding)	V	1232/1793	no	n/a	n/a	n/a	absent (no breeding habitat)
Large Bent-winged Bat (breeding)	V	1232	no	n/a	n/a	n/a	absent (no breeding habitat)
Large-eared Pied Bat	V	1232	yes	Nov-Jan	Nov-Dec	yes	absent (survey)
Masked Owl (breeding)	V	1232/1793	no – habitat constrains absent	n/a	n/a	n/a	absent (no breeding habitat)
Maroubra Woodland Snail	E	1232/1793	yes	All	Aug, Nov-Dec	yes	absent (survey)
Southern Brown Bandicoot	E	1232	yes	Jan-Dec	Nov-Dec	yes	absent (survey)
Southern Myotis	V	1232/1793	yes – recorded	n/a	n/a	n/a	present (recorded)
Little Bent-winged Bat (breeding)	V	1232/1793	no	n/a	n/a	n/a	absent (no breeding habitat)
Little Eagle (breeding)	V	1232/1793	yes	Aug-Oct	Aug, Nov, Dec	yes	absent (survey)
Square-tailed Kite (breeding)	V	1232/1793	yes	Sept–Jan	Aug, Nov, Dec	yes	absent (survey)
Osprey (breeding)	V	1232/1793	no	n/a	n/a	n/a	absent (no breeding habitat)
Squirrel Glider - endangered population	E2	1232/1793	no – geographic constraints	n/a	n/a	n/a	absent (geographic constraints)
Squirrel Glider (species)	V	1232/1793	yes – manually added	Mar–Aug	Aug 2022	yes	absent (survey)

Common name	*BC Act*	Associated PCTs	Confirmed candidate species	Survey adequacy			Presence
				Defined survey months (TBDC)	Actual survey period	Survey compliant (yes/ no)	
Powerful Owl (breeding)	V	1232/1793	no – habitat constrains absent	n/a	n/a	n/a	absent (no breeding habitat)
Regent Honeyeater (breeding)	E4A	1232/1793	no	n/a	n/a	n/a	absent (no mapped imp. areas)
Swift Parrot (breeding)	E	1232/1793	no	n/a	n/a	n/a	absent (no mapped imp. areas)
White-bellied Sea Eagle (breeding)	V	1232	yes	July-Dec	Aug, Nov, Dec	yes	absent (survey)
Eastern Cave Bat	V	1232/1793	yes – recorded	n/a	n/a	n/a	present (recorded)
Koala	E	1232/1793	yes – manually added	All months	Aug	yes	absent (survey)

Excluded species based on the absence of breeding habitat:

- *Grey-headed Flying Fox (breeding)*

  Breeding habitat is the same as roosting habitat typically located in dense shelter foliage close to water in lower depressions. Such habitat is not present within the development footprint and the nearby drainages have not recorded roosting use.

- *Large Bent-winged Bat and Little Bent-winged Bat (breeding)*

  The TBDC identifies the breeding habitat constraints for these species as *cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding*; *with numbers of individuals >500; or from the scientific literature*. Whilst both of these species were recorded, there are no such potential breeding habitat present in the study area that may be utilised by either species.

- *Powerful Owl, Masked Owl, Barking Owl (breeding)*

  The TBDC identifies the breeding habitat constraint for this species as *living or dead trees with hollow greater than 20 cm diameter.* Whilst the Powerful Owl was recorded, there are no large hollows greater than 20 cm within the subject site (Table 3.8), and this species can be excluded as a candidate species due to absence of habitat constraints.

- *Glossy Black-Cockatoo (breeding)*

  The TBDC identifies the breeding habitat constraint for this species as *living or dead tree with hollows greater than 15cm diameter and greater than 8m above ground*. There are no large hollows greater than 15 cm (Table 3.8), and this species can be excluded as a candidate species due to absence of habitat constraints

- *Osprey (breeding)*

  The TBDC identifies the breeding habitat constraint for this species as *Presence of stick-nests in living and dead trees (>15 m) or artificial structures within 100 m of a floodplain for nesting.* No stick-nests or artificial structures were observed within or nearby the subject land, and this species can be excluded as a candidate species due to absence of habitat constraints.

Excluded species based on the absence of important mapped habitat:

- *Swift Parrot*

  The site is not mapped as containing important habitat for this species on the BAM - Important Areas (DPIE) mapping.

- *Regent Honeyeater*

  The site is not mapped as containing important habitat for this species on the BAM - Important Areas (DPIE) mapping.

Excluded species due to geographic constraints

- *Squirrel Glider endangered population on Barrenjoey Peninsula, north of Bushrangers Hill*

  This endangered population is restricted to Barrenjoey Peninsula, north of Bushranger Hill. As such, the subject land is outside of the geographic range of this population.

Inclusions based on inadequacy of survey

- *Eastern Pygmy Possum*

  Whilst considered with lower potential to occur the Eastern Pygmy Possum was included because there has not been sufficient survey for the species. Denning tubes are required for this species to assess presence / absence.

Inclusions due to recorded presence

- *Eastern cave-bat*

  Although not listed as a potential candidate species associated with PCTs 1232 and 1793, this species was detected during survey in Nov–Dec 2021. In accordance with the BAM, this species has been included as a candidate species and assessed as present for the purposes of species credit calculation.

Inclusions due to potential habitat

- *Koala*

  Although not listed as a potential candidate species associated with PCTs 1232 and 1793, Koala has been added as a candidate species. This was due to the suitability of habitat for this species, particularly the presence of three (3) tree species which are considered to be Koala use tree species. Targeted survey was undertaken in August 2022 in accordance with *The Koala (Phascolarctos cinereus): Biodiversity Assessment Method Survey Guide* (DPE 2022). This survey did not detect Koala, and it can be treated as absent for the purposes of this BCAR.

- *Squirrel Glider (species)*

  Although not listed as a potential candidate species associated with PCTs 1232 and 1793, Squirrel Glider has been added as a candidate species. This was due to the suitability of habitat for this species and close records nearby. Survey was conducted in August as detailed in Section 2.3 of this BCAR. No Squirrel Glider were detected and this species can be treated as absent for the purposes of this BCAR.

Creation of species polygons

Following assessment and survey in accordance with the BAM, the following species are considered present for the purposes of credit assessment. Eastern Cave Bat and Southern Myotis have been recorded within the subject land, while Eastern Pygmy Possum is assumed present due to insufficient survey. The TBDC and OEH (2018a) were used to create species polygon maps for these species as follows:

- Eastern Cave Bat

  Species polygon aligns with PCTs on the subject land to which the species is associated that are within 2km of identified potential roost habitat features (TBDC). This equates to all vegetation zones within the subject land (Figure 5.4).

- Southern Myotis

  Species polygon boundaries align with PCTs on the subject land to which the species is associated that are within 200 m of waterbodies with pools or stretches 3 m or wider. A 200 m buffer was applied to the closest suitable waterbody (Figure 5.4), which includes the whole extent of all vegetation zones within the subject land.

- Eastern Pygmy Possum

  Species polygon has been mapped for all PCTs to which the species is associated with within the subject land. This species is associated with PCT 1793 but not PCT 1232. Eastern Pygmy Possum is, however, associated with new eastern NSW PCTs associated with the now-decommissioned PCT 1232.

  The TBDC states that this species feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes, and that the presence of eucalypts alone is sufficient to support populations. Within Zones 3 and 4 there are no eucalypts or other flowering trees or shrubs. Therefore, the species polygon for this species includes Zones 1 and 2 (Figure 5.4).

4.3 Watercourses, GDEs & Wetlands

4.3.1 Endangered wetland communities

A number of wetland communities have been listed as TECs under the *BC Act*. We note that 'wetlands' are included in the definition of 'waterfront lands' in accordance with the *Water Management Act 2000* (*WM Act*) due to their inclusion in the definition of a 'lake' under the same Act. TECs that are considered to be an endangered protected wetland are as follows:

- Artesian springs ecological community
- Castlereagh Swamp Woodland Community
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions
- Coastal Upland Swamp in the Sydney Basin bioregion
- Coolibah–Black Box woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands bioregions
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions
- Kurri sand swamp woodland in the Sydney Basin Bioregion
- Lagunaria swamp forest on Lord Howe Island
- Maroota Sands swamp forest
- Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion
- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions
- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions
- The shorebird community occurring on the relict tidal delta sands at Taren Point
- Upland wetlands of the drainage divide of the New England Tableland Bioregion
- Wingecarribee Swamp

Swamp Oak Floodplain Forest (SOFF) is present within the western and southern portions of the study area, which is a TEC as listed under the *BC Act* and *EPBC Act*. SOFF is an endangered wetland community as listed above.

- *Impact on the extent of wetland vegetation*

  The proposal will impact on 0.18 ha of this endangered wetland community.

- *Impact on acid sulfate soils*

  The majority of the subject land is identified as containing Class 3 acid sulfate soils, with a very small portion near the western boundary mapped as Class 2 acid sulphate soils (Figure 4.1). It is expected that an acid sulfate soils management plan is to be prepared for the proposal.

- *Indirect impacts of wetlands*

  Indirect impacts may include pedestrian usage and trampling of soils, dumping of rubbish and garden waste, accidental spillages post development.

  As part of the proposal a Vegetation Management Plan (VMP) is to be prepared to protect, and mitigate impacts on, the SOFF.

- *Impacts due to storm water quality or quantity*

  It is expected that an appropriate storm water management plan will be prepared to avoid these impacts on the TEC.

- *Impacts on groundwater*

  The proposal is not expected to impact on groundwater resources.

- *Proposed mitigation measures*

  1. Appropriate design of construction of any works e.g. storm water outlets.
  2. Manage access to the area.
  3. Undertake pest animal and weed control.
  4. Preparation of a VMP to improve and maintain sensitive ecological landscapes, sediment and erosion control measures.

- Watercourses and waterfront lands

  There are no riparian streams or zones throughout the development footprint. The site drains directly into Warriewood Wetlands to the west. The area of SOFF is classed as an endangered protected wetland and is a 'lake' as defined under the *WM Act* therefore it is deemed as 'waterfront land'.

In accordance with the *WM Act*, endangered wetland communities are through the definition of 'lakes' potentially classed as waterfront land. Referral to NSW Natural Resources Access Regulator (NRAR) may be required for determination under the *WM Act* as a controlled activity.

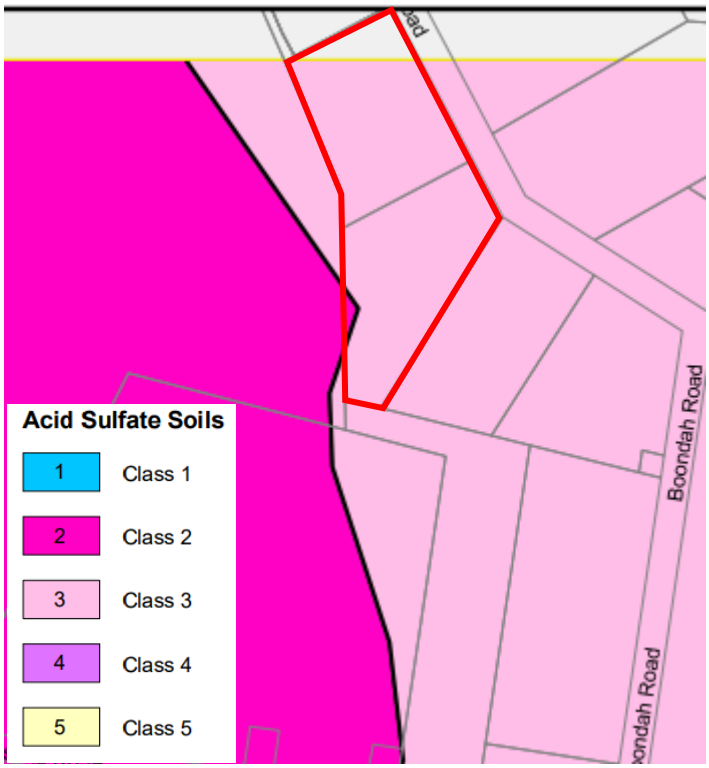

Figure 4.1 – Acid sulfate soils

4.3.2 Groundwater dependent ecosystems (GDEs)

Groundwater dependent ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater. Some examples of ecosystems which depend on groundwater are:

- wetlands;
- red gum forests, vegetation on coastal sand dunes and other terrestrial vegetation;
- ecosystems in streams fed by groundwater;
- limestone cave systems;
- springs; and
- hanging valleys and swamps.

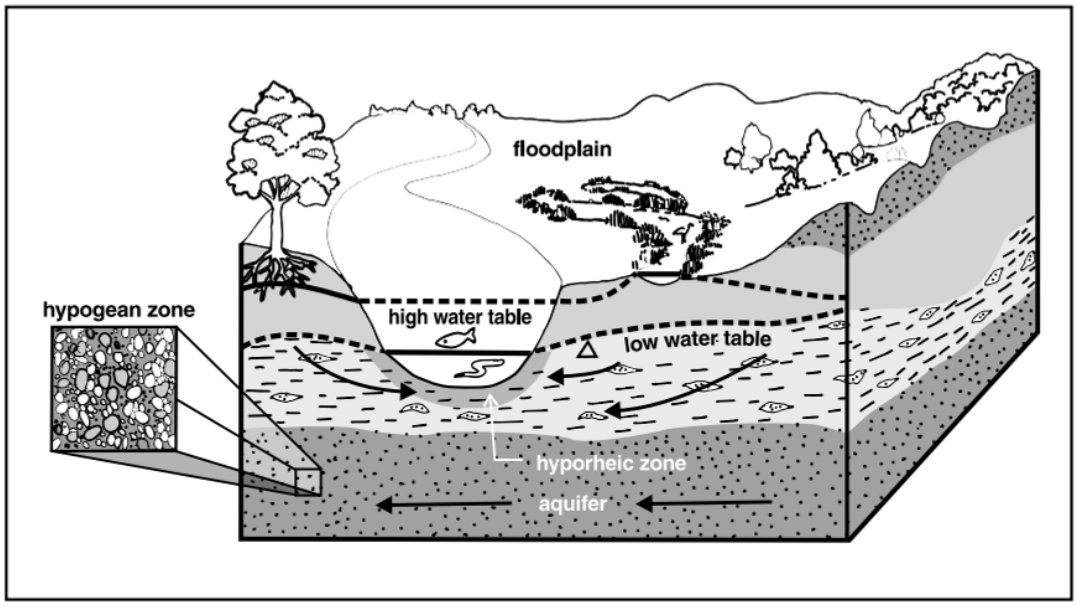

Figure 4.2 – Alluvial groundwater system discharging into a river

GDEs are therefore ecosystems which have their species composition and their natural ecological processes determined by groundwater (NSW State Groundwater Dependent Ecosystems Policy April 2002).

Swamp Oak Forest is considered to be a wetland community and, in the context of the landscape is classed as a GDE. To assist in protecting this in the future, this community is to be conserved and managed in accordance with the VMP.

4.3.3 Watercourses

No watercourses occur within the subject land, as shown on hydroline mapping by Water Management (General) Regulation 2018 (Figure 1.4). A referral to NRAR is not required in this respect for impacts on waterfront land but see Section 4.3.1 above for assessment of Endangered Wetland Communities.

Figure 4.3 – Mapped hydrolines

(Source: https://trade.maps.arcgis.com/apps/webappviewer/index.html?id=07b967fd0bdc4b0099fc5be45b6d1392)

4.3.4 State Environmental Planning Policy (Coastal Management) 2018

State Environmental Planning Policy (Coastal Management) 2018 updates and consolidates into one integrated policy SEPP 14 (Coastal Wetlands), SEPP 26 (Littoral Rainforests) and SEPP 71 (Coastal Protection), including clause 5.5. of the Standard Instrument – Principal Local Environmental Plan. These policies are now repealed.

The Coastal Management SEPP gives effect to the objectives of the *CM Act* from a land use planning perspective, by specifying how development proposals are to be assessed if they fall within the coastal zone.

An integrated and coordinated approach to land use planning is promoted by the new SEPP. It defines the four coastal management areas in the Act through detailed mapping and specifies assessment criteria that are tailored for each coastal management area. Councils and other consent authorities must apply these criteria when assessing proposals for development that fall within one or more of the mapped areas. The Coastal Management SEPP identifies development controls for consent authorities to apply to each coastal management area to achieve the objectives of the *CM Act*.

The Coastal Management SEPP establishes the approval pathway for coastal protection works.

Wetlands on site or adjacent

Coastal Wetlands are mapped within the southern portion of the study area, and just within the north-western boundary (Figure 4.4), apparently in association with Swamp Oak Floodplain Forest vegetation, which is an Endangered Ecological Community (EEC, see Section 4.1.1(b)of this report). A Proximity Area for Coastal Wetlands is mapped across the remainder of the study area.

To the east of the study area there is more SOFF in addition to vegetation that is part of the EEC Freshwater Wetlands on Coastal Floodplains. No quadrats or other stratified survey have been undertaken within this vegetation community by *Travers bushfire & ecology.* Some species observed by random meander in 2019 include *Melaleuca ericifolia, Persicaria* spp., *Azolla pinnata, Schoenoplectus* sp., *Eleocharis sphacelata, Casuarina glauca, Juncus* spp., and *Phragmites australis.*

As stated in the *State Environmental Planning Policy (Coastal Management) 2018*, development consent is required for any development within these areas and must not be given unless the consent authority is satisfied that sufficient measures have been, or will be, taken to protect, and where possible enhance, the biophysical, hydrological and ecological integrity of the coastal wetland. Additionally, within the “proximity area for coastal wetlands” area, development consent must not be given unless the consent authority is satisfied that the proposed development will not significantly impact on the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland. Potential impacts to the wetland and SOFF vegetation are considered in Section 5.5 of this BCAR. Avoidance and minimisation actions are provided in Section 5.3 while mitigation measures are provided in Section 5.4.

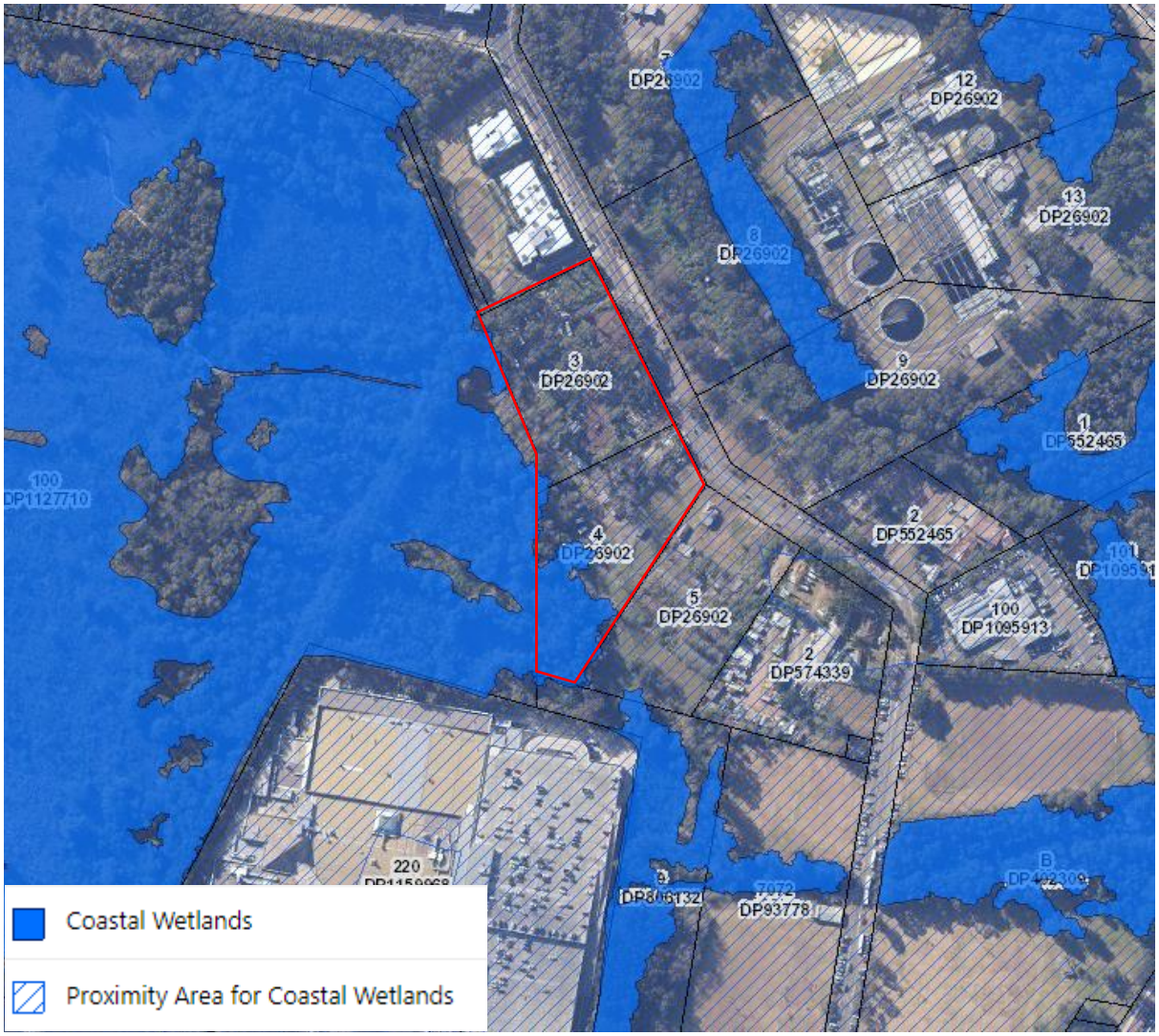

Figure 4.4 – Coastal wetlands area map

5. IMPACT ASSESSMENT

5.1 BOS thresholds

The BOS appies to all biodiversity certification assessments. Subsequently the three (3) elements to the BOS threshold test – an area trigger, a Biodiversity Values Land Map trigger and the Test of Significance – do not apply.

5.2 Streamlined assessment modules

The BAM contains three streamlined assessment modules that are set out in Appendices B, C and D of the BAM. The streamlined assessment modules include specific requirements to assess the impacts on biodiversity values for the purpose of preparing a BCAR. These streamlined assessment modules may be used where the proposal impacts on:

a) scattered trees (Appendix B)

b) a small area (Appendix C)

c) planted native vegetation, where the planted native vegetation was planted for purposes such as street trees and other roadside plantings, windbreaks, landscaping in parks and gardens, and revegetation for environmental rehabilitation (Appendix D)

Appendices B, C and D of the BAM set out the circumstances where each of the streamlined assessment modules can be used to assess a proposal and the specific assessment requirements.

The streamlined assessment modules for scattered trees and planted native vegetation may be used in conjunction with the full BAM to assess particular parts of the subject land under a single BCAR.

Table 5.1 – Streamlined assessment modules

Streamlined assessment module	Criteria for application	Does the impacted vegetation meet this criterion?	Can this module be applied?
Scattered trees	Scattered trees are defined as species listed in the tree growth form group that: **a.** have a percent foliage cover that is less than 25% of the benchmark for tree cover for the most likely plant community type and are on category 2-regulated land and surrounded by category 1-exempt land on the Native Vegetation Regulatory Map under the LLS Act, or	no	no

Streamlined assessment module	Criteria for application	Does the impacted vegetation meet this criterion?	Can this module be applied?
	b. have a DBH of greater than or equal to 5 cm and are located more than 50 m away from any living tree that is greater than or equal to 5 cm DBH, and the land between the scattered trees is comprised of vegetation that are all ground cover species on the widely cultivated native species list, or exotic species or human-made surfaces or bare ground, or	no	
	c. are three or fewer trees that have a DBH of greater than or equal to 5 cm and are within a distance of 50 m of each other, that in turn, are greater than 50 m away from the nearest living tree that is greater than or equal to 5 cm DBH, and the land between the scattered trees is comprised of vegetation that are all ground cover species on the widely cultivated native species list, or exotic species or human-made surfaces or bare ground.	no	
Small area	Is the area of native vegetation clearing less than or equal to the thresholds as shown in Table 5.2 (BAM Table 12)? This depends on minimum or actual lot size: • **For lot size <1 ha, threshold is ≤1 ha** • For lot size 1–40 ha, threshold is ha ≤2 ha • For lot size 40–1000 ha, threshold is ≤3 ha • For lots size 1000 ha, threshold is ≤5 ha	no: clearing exceeds 1 ha	no
Planted native vegetation	**Is any planted native vegetation impacted?**	**Yes**	**Yes**

Table 5.2 – Area clearing limits for application of the small area development module

Minimum lot size associated with the property *	Maximum area clearing limit for application of the small area development module
Less than 1 ha	≤1 ha
Less than 40 ha but not less than 1 ha	≤2 ha
Less than 1000 ha but not less than 40 ha	≤3 ha
1000 ha or more	≤5 ha

*shown in the lot size maps made under the relevant local environmental plan (LEP), or actual lot size (where there is no minimum lot size provided for the relevant land under the LEP

5.2.1 Streamlined assessment module - planted native vegetation

Planted native vegetation occurs in the northern and central portions of the study area in the form of *E. microcorys* trees. Appendix D of the BAM can be applied to this vegetation. In this case, assessment of the planted native vegetation answers yes to question 5 of the *D.1 Decision-making key*:

> *"Is the native vegetation (including individuals of a threatened flora species) planted for functional, aesthetic, horticultural or plantation forestry purposes? This includes examples such as: windbreaks in agricultural landscapes, roadside plantings (including street trees, median strips, roadside batters), landscaping in parks, gardens and sport fields/complexes, macadamia plantations or teatree farms?"*

As such, Chapters 4 and 5 of the BAM (i.e. plot-based survey and assessment for ecosystem and species credits) are not required to be applied to the planted native vegetation, and it will only need to be assessed for use by threatened fauna. No offsets will be required for impacts on the planted native vegetation.

5.3 Avoidance and minimisation actions

The proposal has been located and designed to avoid or minimise direct and indirect impacts on native vegetation, threatened species, threatened ecological communities and their habitat by:

- The proposed layout has been modified to minimise impacts on SOF. The preliminary layout is shown on Figure 5.1, the outer extent of which has been overlaid on the current, proposed layout on Figure 5.2. This modification has reduced the proposed impacts on SOF from 0.26 ha (59.1%) to 0.18 ha (40.9%).
- Avoidance of direct impacts on 0.26 ha of SOF within the subject lots, which equates to 59.1% of the total SOF present within those lots. All retained SOF is to be protected and conserved under a VMP
- Subsequent avoidance of 0.26 ha foraging habitat for recorded Southern Myotis, Little Bent-winged Bat, Large Bent-winged Bat, Eastern Cave Bat and Powerful Owl, and assumed present Eastern Pygmy Possum.
- Implementation of a stormwater management plan, which will avoid impacts caused by changes in hydrology or increases in pollution, nutrient or sediment inputs into the SOF
- Development has been located taking advantage of the existing cleared and disturbed potions of the subject lots and within vegetation in the poorest condition (i.e. areas with the lowest vegetation integrity scores)
- Avoidance of the majority of mapped biodiversity values within the subject lots
- Avoidance of the majority of mapped Coastal Wetland within the subject lots
- Preparation and implementation of a VMP to assist with rehabilitation, ecological restoration and ongoing maintenance of retained SOF vegetation and threatened species habitat

Figure 5.1 – Preliminary masterplan
(Source: Buchan, June 2021)

Figure 5.2 – Proposed site plan (outer extent of preliminary impact area shown as blue line)
(Source: Buchan, March 2022)

5.4 Mitigation measures

The following mitigation measures are recommended to avoid, minimise or ameliorate the above potential ecological impacts, address threatening processes and to guide a more positive ecological outcome for threatened species and their associated habitats.

Table 5.3 – Measures to mitigate & manage impacts

Action / Technique	*Outcome*	*Timing / Frequency*	*Responsibility*	*Risk of failure*	*Impacts likely to remain after action and consequence*
Prepare a **Conservation Measures Implementation Plan (CMIP)** with included **Vegetation Management Plan (VMP)** to identify mitigation actions and establish a C2 conservation zone within the site:					
(a) Protection and conservation of SOF to the west and south west of the development footprint. • Limit access to the proposed C2-zoned vegetation by placement of permanent fencing. This fencing is to be constructed of light-blocking material (e.g. Colourbond) to reduce lighting spill-over into the C2 area and adjacent vegetation. • Prioritised weed control – consideration to be given to extend VMP area into adjacent Warriewood Wetlands with consent of landholder. • Standard *Phytophthora cinnamomi* protocol applies to the cleaning of all plant, equipment, hand tools and work boots prior to delivery onsite to ensure that there is no loose soil or vegetation material caught under or on the equipment and within the tread of vehicle tyres. Any equipment onsite found to contain soil or vegetation material is to be cleaned in a quarantined work area or wash station and treated with fungicides.	Prevent indirect impacts on C2 conserved habitats Fencing to reduce chance of vehicle strike by owls, and lighting spill-over	Prior to any clearing works. During construction and ongoing	Project Ecologist as guided by the CMIP	Low	None anticipated

Action / Technique	*Outcome*	*Timing / Frequency*	*Responsibility*	*Risk of failure*	*Impacts likely to remain after action and consequence*
(b) Sediment and erosion control measures in accordance with Managing Urban Stormwater: Soils and Construction (Landcom 2004) to minimise impact of possible sedimentation to local drainage lines.	Maintain integrity of C2 habitat and natural topsoil soil by preventing deposition	Prior to any clearing works. Ongoing during all exposed soil stages until landscaping is completed	Project Ecologist / Contractors	Low	None anticipated
(c) Temporary fencing: where it adjoins the development areas, the boundary of the conservation area shall be clearly marked out on-site to ensure their protection. All areas of natural vegetation retention shall be protected by fencing, prior to construction, to ensure that these areas are not damaged during the construction phase.	Maintain integrity of C2 habitat Fencing to reduce chance of vehicle strike by owls	Prior to Construction / habitat clearance	Project Ecologist / Contractors	Low	None anticipated
(d) Construction activities are to be intermittently supervised on-site and monitored. All staff involved with the development shall undergo an induction and training program to reinforce the ecological and environmental objectives of the development.	Ensure that the recommendations of the BCAR are implemented.	Prior to and during habitat clearance and construction of services	Project Ecologist	Low–moderate	Contractors not implementing measures correctly. Strict supervision required.

Action / Technique	*Outcome*	*Timing / Frequency*	*Responsibility*	*Risk of failure*	*Impacts likely to remain after action and consequence*
(a) Undertake water quality testing within Warriewood Wetlands to monitor for any increase in nutrient or sediment. Benchmark water quality data is collected prior the development with Warriewood wetlands as close to stormwater discharge points. Water quality is monitored during and post construction for a period of 2 years to ensure that the water being discharged meets the receiving water quality in the Warriewood Wetlands. In the event it does not meet it extra treatment is to be undertaken within the development e.g. sedimentation removal. (b) Practices such as lawn fertilising and dumping of waste adjoining the wetlands are to be prohibited and all exposed soils to be fully stabilised.	Ensure no indirect impacts on adjacent water quality or quantity	Prior to and during habitat clearance and construction	Project Ecologist	Low	None anticipated
(c) Prior to any habitat removal, including human-made structures and non-native vegetation, a comprehensive search for fauna and habitat is to be undertaken to relocate any terrestrial individuals and identify any important nesting to be protected until fledging. Pre-clearance protocol is be undertaken by experienced and qualified ecologists in accordance with the "Biodiversity Guidelines" (RTA 2011) which are considered as 'best practice'	Reduce potential for impact on native species	Immediately prior to land clearance	Project Ecologist	Low–moderate	Potential unintended injury or death of undetected native species

Action / Technique	*Outcome*	*Timing / Frequency*	*Responsibility*	*Risk of failure*	*Impacts likely to remain after action and consequence*
(d) Clearing of vegetation is to be staged to allow resident fauna ample opportunity to disperse, while also providing shelter habitat. Timing recommended in April / May or September to avoid critical life cycle events such as breeding or torpor for threatened species recorded or assumed present: • Eastern Pygmy Possum: breeding Oct–March, torpor mostly winter • Little and Large Bent-winged Bats: no breeding habitat, torpor mostly winter • Eastern Cave Bat: breeding Nov–Jan (but breeding unlikely), torpor mostly winter	Reduce potential for impact on native species	Immediately prior to land clearance	Project Ecologist	Low–moderate	Potential unintended injury or death of undetected native species
(e) Management of hollows and hollow-dependent fauna: • The felling of hollow-bearing trees is to be conducted under the supervision of a fauna ecologist to ensure appropriate animal welfare procedures are taken, particularly for threatened species. Hollows of high quality or with fauna recorded residing within should be dismantled for relocation and all hollows should be inspected for occupation, signs of previous activity and potential for reuse.	Protection of hollow-dependent wildlife	At time of removal	Project Ecologist	Low	Potential unintended injury or death of undetected native species

Action / Technique	*Outcome*	*Timing / Frequency*	*Responsibility*	*Risk of failure*	*Impacts likely to remain after action and consequence*
• Subsequent hollows of retention value are to be relocated to nearby conservation areas. If these are placed as on ground habitat and are not reattached to a new recipient tree then they are to be replaced with appropriately sized nest boxes affixed to a retained tree.	Maintain quality denning / hollow shelter opportunities	At time of removal	Project Ecologist	Low–moderate	None anticipated
• Constructed nest boxes should as priority target recorded hollow-dependent threatened species (and their prey species). Boxes should be constructed all of weatherproof timber (marine ply), fasteners and external paint and appropriately affixed to a recipient tree under the guidance of a fauna ecologist.	Protection of hollow-dependent wildlife	Prior to hollow removal	Project Ecologist	Low	None anticipated
• If a threatened species is found to be occupying the hollow at the time of removal, then this hollow section is to be reattached to a recipient tree within the nearby conservation areas as selected and directed by the fauna ecologist. The welfare and temporary holding of the residing animal(s) is at the discretion of the fauna ecologist.	Priority protection of hollow-dependent threatened species	At time of removal	Project Ecologist	Low	None anticipated
• The relocated hollow section and nest boxes should be well secured in the recipient tree in a manner that will not compromise the current or future health of that tree.	Ensure hollow integrity is maintained	Time of installation	Project Ecologist	Low	None anticipated

Action / Technique	*Outcome*	*Timing / Frequency*	*Responsibility*	*Risk of failure*	*Impacts likely to remain after action and consequence*
• A hollow and nest box monitoring and management strategy is to be prepared to enable the number, size, location, construction, installation, monitoring and replacement of hollows to be planned for the ongoing maintenance and replacement of artificial and salvaged hollows. The strategy is also to assess unintended impacts such as providing pest species habitat.	Ensure hollow integrity is maintained	Each year for 5 years	Project Ecologist	Low	None anticipated
(f) Management of any other displaced fauna	Prevent direct impacts on nesting and terrestrial native fauna species	Prior to and during habitat removal / Adaptive management required	Project Ecologist	Low	None anticipated
(g) If any fauna species, a nest or roost is located during development works, then works should cease until safe relocation can be advised by a contact fauna ecologist	Prevent direct impacts on nesting and terrestrial native fauna species	At time of removal / Adaptive management required	Project Ecologist / contractors	Low	None anticipated
Additional mitigation measures					
(h) Vehicle speed restriction of 10 kph should be imposed on the internal roads during construction and operation	Prevent vehicle collision	Construction and ongoing	Proponent / contractors	Low	None anticipated
(i) Lighting baffles on lights used during construction and road lights to direct light down and away	Reduce lighting spill-over into C2 area and adjacent vegetation	Construction and ongoing	Proponent / contractors	Low–moderate	Slight increase in disturbance of local fauna

5.5 Potential ecological impacts

The direct, indirect and cumulative ecological impacts have been considered in respect to recorded biodiversity, threatening processes and extent of impact as a result of the proposed works:

5.5.1 Prescribed impacts

In accordance with Section 6 of the BAM, Table 5.4 identifies potential 'prescribed' impacts on biodiversity.

Table 5.4 – Potential prescribed impacts

Feature	Present (yes / no)	Description of feature characteristics and location	Potential impact	Threatened species or community using or dependent on feature	Section of the BCAR where prescribed impact is addressed
Karst, caves, crevices, cliffs, rocks or other geological features of significance	no	n/a	n/a	n/a	n/a
Human-made structures	yes	existing dwelling	demolition	existing building provides potential roosting habitat for threatened species such as Southern Myotis, Large Bentwing-bat, & Little Bent-wing Bat	5.5.1
Non-native vegetation	yes	planted and naturalised exotic vegetation providing foraging habitat and hollow-bearing trees (see Section 3.1.3)	removal of vegetation	no threatened species recorded using habitat, but may be used sporadically by, East-coast Freetail Bat, Southern Myotis, Eastern Falsistrelle, Green and Golden Bell Frog. Grey-headed Flying Fox may forage on fruiting trees	5.5.1
Habitat connectivity	yes	minor local connectivity	very slight reduction in cross-site connectivity	none	5.6
Waterbodies, water quality and hydrological processes	yes	hydrological processes: wetland vegetation	indirect impacts	Swamp Oak Forest	5.5.1

Feature	Present (yes / no)	Description of feature characteristics and location	Potential impact	Threatened species or community using or dependent on feature	Section of the BCAR where prescribed impact is addressed
Wind farm development	no	n/a	n/a	n/a	n/a
Vehicle strikes	yes	internal roads	On terrestrial mammals and frogs as well as birds in flight.	n/a	5.5.1

The following potential impacts on biodiversity values as a result of the proposal are prescribed (as per clause 6.1 of the *BC Reg*. and Section 8.3 of the BAM) as biodiversity impacts to be assessed under the biodiversity offsets scheme:

- *Human-made structures and non-native vegetation*

  Human-made structures

  The existing dwelling may provide potential roosting habitat within wall or ceiling cavities that have small openings to external foraging airspace. This habitat is not likely to support breeding habitat for threatened microbat species and roosting habitat in other structures is expected through the local landscape.

  Roosting and breeding habits for each species are stated in species profiles (*OEH*) and the TBDC (*BioNet*). Based on these profiles, the removal of human made structures from the site is not expected to have a significant impact on any entity being assessed under the BAM for roosting.

  Non-native vegetation

  Non-native vegetation on site includes hollow-bearing *Erythrina x. sykesii* (Corral Trees) and *Populus nigra* (Poplar) trees, and some fruiting *Syagrus romanzoffiana* (Cocos Palms). The hollows may be used as roosting habitat by threatened species, including Little Lorikeet, East-coast Freetail Bat, Southern Myotis, Eastern Falsistrelle, Greater Broad-nosed Bat and Squirrel Glider.

  Grey-headed Flying Fox are known to feed on *S. romanzoffiana* fruits, but can also be killed by entanglement in the fronds, or through choking on the fruits. Considering this, the removal of these palms would be a positive outcome for the local population of Grey-headed Flying Fox.

- *Water bodies, water quality and hydrological processes.*

  This has been assessed in detail according to the criteria outlined in Sections 6.1.4 and 8.3.4 of the BAM, and with consideration to avoidance and minimisation of impacts as outlined in Section 7.2 of the BAM:

  Potential hydrological and water quality of overland flow south to Swamp Oak Forest vegetation may be impacted by the proposal. As the proposal will not require substantial excavation the groundwater will not be impacted.

Swamp Oak Floodplain Forest is dependent on soil that is waterlogged or periodically inundated. As such, all hydrological inputs into the EEC, relating to flooding regime and overland flow, are likely to influence its current distribution within the site. The BioNet TBDC lists the key threats to Swamp Oak Floodplain Forest and includes changes to hydrological regimes such as increased and decreased periods of inundation and changes to salinity, which may result from draining associated with ditching, levees and dykes; infill, and altered inundation conditions. Given the largely flat nature of the site and restriction of the majority of the EEC to areas mapped as high-risk flood in the Pittwater DCP, it is reasonable to infer that the extent of the flood plain and the local flooding regime is of most importance for the persistence of the EEC vegetation within the site. The proposal will result in earthworks causing a raising of the ground level, but this is concentrated in the northern half of the subject land, which is in keeping with the natural conditions. No earthworks are proposed in the retained EEC vegetation. Modelling in the Water Management Report prepared by Calibre Group (Feb 2022) shows that the proposal will have no or negligible impacts on flood afflux and velocity within the subject land at Annual Exceedance Probability (AEP) between 1 and 50 %, particularly within the area of the retained EEC. Based on this modelling, it is unlikely that the proposal will impact the flood regime such that it leads to a reduction in the extent of the retained Swamp Oak Floodplain Forest.

Overland flow from rain runoff is of less importance to the EEC than flooding regime, but may be impacted by the proposal through increased volume and velocity of runoff, and higher sediment, pollution and nutrient loads. The proposed approach to avoiding these impacts is through design and implementation of a Stormwater management Plan, with the intent of connecting to the council system to divert stormwater off site. The Water Management Report (Calibre Group 2022) provides a Stormwater Quality Strategy and a Stormwater Quantity Strategy that summarise additional on-site measures to avoid or minimise changes in runoff if connection to the existing council system is not possible. These are:

- Detention measures:
  - On-site detention systems on a lot-by-lot basis for the short duration storms
  - Detention basins (either local groupings of lots or larger-scale basins)
  - Additional storage in Water Quality Control Ponds.
- Retention measures:
  - Seepage techniques
  - Stormwater Reuse
- Controls for water quality treatment may be provided within individual lots, private property, or public land. Such controls include, but are not limited to:
  - Ponds/wetlands
  - Filter strips
  - Devices

More specifically, the Water Management Report suggests the following measures to reduce stormwater changes:

- Temporary pond or wetland which may be located within any required detention basin and above the 20% AEP storm event, and hence would only

be impacted by major storms. This would be subject to further investigation in the DA process.

- On Site Detention (OSD) systems via underground tanks and rainwater tanks would seem appropriate for this development. They may be situated within the extents of the townhouses, which are placed above the 1% AEP at the FPL. These may cater to the higher impervious areas associated with the housing and road paving. The rainwater tanks may also serve as retention structures to recycle stormwater runoff for laundry, toilet, and landscaping uses.
- Where the stormwater is diverted into the existing water quality devices placed within the stormwater network. Gross pollutant traps (GPTs) or baskets for the screening of rubbish could be placed within the pits, and treatment devices for other pollutants could be placed within tanks underneath the townhouse driveways. These treatment devices may also fit within the OSD tanks for the detention strategy. Such devices would be well placed to capture pollutant runoff from the urbanised region of the development. For the play area, filter strips may be planted for treatment and decoration.

If unmitigated, the proposal could lead to a long-term increase in volume and velocity of water entering the EEC indefinitely. This would be caused by the construction of hard surfaces including internal roads, driveways and buildings that would create more surface runoff during rainfall events. It is expected that these impacts will be avoided through appropriate stormwater management that will divert stormwater into existing stormwater infrastructure, such that hydrological process in the Swamp Oak Floodplain Forest may persist under natural scenarios.

If unmitigated, the proposal could lead to a short-term increase in sediment and nutrient loads during the construction phase through exposure and disturbance of soil through vegetation clearance and excavation. This could lead to higher weed abundance in the EEC. Appropriate erosion and sediment control measures are to be undertaken to avoid these impacts. The additional water management options will further prevent sediment and nutrient loads entering the EEC. Implementation of the VMP in the conservation areas will allow the control of weed species.

- *Vehicle strikes*

Figure 1.3 shows the current proposed concept masterplan layout associated with the development of approximately 42 townhouses. The proposed internal road network includes 3 roads each accessed via Boondah Rd and further linked by a main arterial road to the western aspect of the development. Considerations to the presence of potential Masked Owl breeding area nearby within the Swamp Oak Floodplain Forest lands, and the presence of recorded Powerful Owl has prompted a need for roadside fencing along the southern boundary.

As Masked Owls are specialist hunters of terrestrial prey and forage off the ground they have been identified in the Recovery Plan for Large Forest Owls (DEC 2006) as being susceptible to vehicle collisions in some areas. Likewise, for the recorded Powerful Owl, The Powerful Owl Project (2014) has also identified that car strikes are one of the main causes of Powerful Owl injuries and mortalities. A vehicle speed restriction of 10 kph should be imposed on the internal roads and therefore collision is not an expected impact of high concern. The fencing will however reduce this potential for both the Masked and Powerful Owls, and other birds.

In summary, the implementation of fencing not only serves to reduce vehicle collision potential, but also as a conservation mechanism by directing the movements of threatened fauna recorded and with the potential to occur away from the road. However, consequences of any increase in vehicle collision potential along this road is also not considered likely to reduce the viability of any local breeding populations.

5.5.2 Direct impacts

The other direct impacts of the proposal within the development footprint are considered as:

Table 5.5 – Direct impact assessment

Direct impact	*BC Act* status	SAII entity	Project phase/timing of impact	Extent (ha, number of individuals)
Removal of PCT 1232_poor (Swamp Oak Floodplain Swamp Forest)	EEC	No	Demolition / clearing	0.18 ha
Removal of PCT 1793_poor (Smooth-barked Apple – Bangalay / Tuckeroo – Chinese Tree Open Forest)	EEC	No	Demolition / clearing	0.23 ha
Removal of planted *Eucalyptus microcorys*	No	No	Demolition / clearing	0.10 ha
Removal of derived exotic-dominated vegetation	No	No	Demolition / clearing	0.75 ha
Removal of nine hollow bearing trees, some containing hollows suitable for threatened species including the recorded Southern Myotis	Various	No	Demolition / clearing	nine hollow-bearing trees
Removal of threatened fauna species foraging habitat including: (a) Seasonal flowering resources for Little Lorikeet and Grey-headed Flying-fox. (b) Air space and prey species habitat for recorded Powerful Owl, Large Bent-winged Bat, Little Bent-winged Bat and Eastern Cave Bat	Various	Yes (LaBB, LiBB, ECB) – but no breeding habitat	Demolition / clearing	1.26 ha (all vegetation)
Direct impact on habitat for species credit species Southern Myotis and Eastern Cave Bat	V	Yes (ECB) – but no breeding habitat	Demolition / clearing	1.16 ha (BAM-C rounds this to 1.2 ha)
Assumed direct impact on habitat for species credit species Eastern Pygmy Possum.	V	No	Demolition / clearing	0.41 ha

Direct impact	*BC Act* status	SAII entity	Project phase/timing of impact	Extent (ha, number of individuals)
Removal of foraging resources for ecosystem species Australasian Bittern, Barking Owl (foraging), Black Bittern, Dusky Woodswallow, Eastern Coastal Free-tailed Bat, Glossy Black-Cockatoo (foraging), Grey-headed Flying-fox (foraging), Large Bent-winged Bat (foraging), Little Bent-winged Bat (foraging), Little Eagle (foraging), Little Lorikeet, Masked Owl (foraging), New Holland Mouse, Osprey (foraging), Painted Snipe, Powerful Owl (foraging), Regent Honeyeater (foraging), Rosenberg's Goanna, Spotted Harrier, Spotted-tailed Quoll, Square-tailed Kite (foraging), Swift Parrot (foraging), Varied Sittella, White-bellied Sea Eagle (foraging), White-throated Needletail, Yellow-bellied Sheathtail-bat	Various	No	Demolition / clearing	1.16 ha (BAM-C rounds this to 1.2 ha)

5.5.3 Indirect impacts

The potential indirect impacts of the proposal are considered below. The likelihood of these impacts are considered following implementation of mitigation measures detailed in Section 5.4.

Table 5.6 – Indirect impact assessment

Indirect impact description	Impacted entities (PCT, species, TEC)	Frequency	Duration	Project phase/ timing of impact	Consequences (likelihood)
Spill-over from noise, activity, scent and lighting effects	All retained vegetation within c. 10 m of development	Constant	Lifetime of development	Clearing, construction and ongoing	• Disturbance of local fauna (moderate likelihood)

Indirect impact description	Impacted entities (PCT, species, TEC)	Frequency	Duration	Project phase/ timing of impact	Consequences (likelihood)
Concentrated stormwater runoff from solid surfaces and subsequent increased flows	All retained vegetation, watercourses and habitat downslope of the development	During rainfall events	Lifetime of development	Clearing, construction and ongoing	• Potential increased flow, nutrient and sediment loads that may provide further opportunities for weeds within retained vegetation (unlikely) • Potential increased flow, nutrient and sediment loads into adjacent wetland (unlikely)
Reduced inter-site connectivity	Small bird species, arboreal mammals	Once	Lifetime of development	Clearing, construction	• Reduced cross-site movements by local and transient fauna (high)

5.5.4 Serious & Irreversible Impacts (SAIIs)

An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community most at risk of extinction. Threatened species and communities that are potential for serious and irreversible impacts are outlined in Appendix 2 of *Guidance to assist a decision-maker to determine a serious and irreversible impact* (DPIE 2017). The principles for determining serious and irreversible impacts are set out under Section 6.7.2 of the *BC Reg*.

SAII entities recorded or with potential to occur within the study area include:

Table 5.7 – SAII species recorded or with potential to occur

Species / TEC (Scientific Name)	Species (Common Name)	*BC Act*	Species potential to occur	SAII threshold potential
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	recorded	no
Miniopterus australis	Little Bent-winged Bat	V	recorded	no
Vespadelus troughtoni	Eastern cave bat	V	recorded (probable)	no

Species:

For the Large Bent-winged Bat, Little Bent-winged Bat and Eastern cave bat, consideration of potential SAII only applies where there is a likely impact to breeding habitat. For each of these species, breeding habitat is highly specific and is defined by the TBDC as any "*cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature*". As none of these features are present within the subject land or nearby the proposal will not impact on breeding habitat. Therefore, further consideration of SAII on these species is not required under the BAM.

For Eastern Cave bat, the SAII threshold is potential breeding habitat, which is defined by the as "*the PCTs associated with the species within 100 m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within the potential habitat"*. As none of these features are present within the subject land or nearby the proposal will not impact on breeding habitat. Therefore, further consideration of SAII on these species is not required under the BAM.

5.6 Vegetation connectivity and habitat corridors

The subject lots contribute to local connectivity in two ways but neither of these are of local significance or sufficient to contribute to local or regional 'corridors'. This is particularly given that the creek line connectivity to the south that does extend to the east does not link up with any other major area of natural habitat, but rather loops around to return to the same connective forest areas surrounding Warriewood Wetlands and the Warriewood Escarpment.

One connectivity link through the subject lots occurs along the western boundary and crossing Boondah Road to the south. The second and more direct passage across the northern portions of the site is currently limited to fragmented canopy trees for birds and common arboreal mammals.

The only threatened species records that exist in the immediate area are highly mobile flying species (incl. flying-foxes, diurnal birds, owls and microbats). The removal of the fragmented cross-site connectivity across the northern portions of the subject lots is not likely to affect

important habitat or local movements of any of these species. The current proposal maintains the existing southern connectivity along the core riparian zone subsequently reducing further impacts to other locally occurring native biodiversity. Southern Myotis has been recorded roosting immediately adjacent and foraging along this channel. Such habitat use will be maintained and may be improved via riparian habitat restoration efforts.

The subject lots are shown on Figure 5.3 – Local connectivity in orange, with the local habitat connectivity shown in yellow. Connectivity is fragmented in places where roads bisect the free passage for terrestrial species or where the linkages narrow down due to fragmentation.

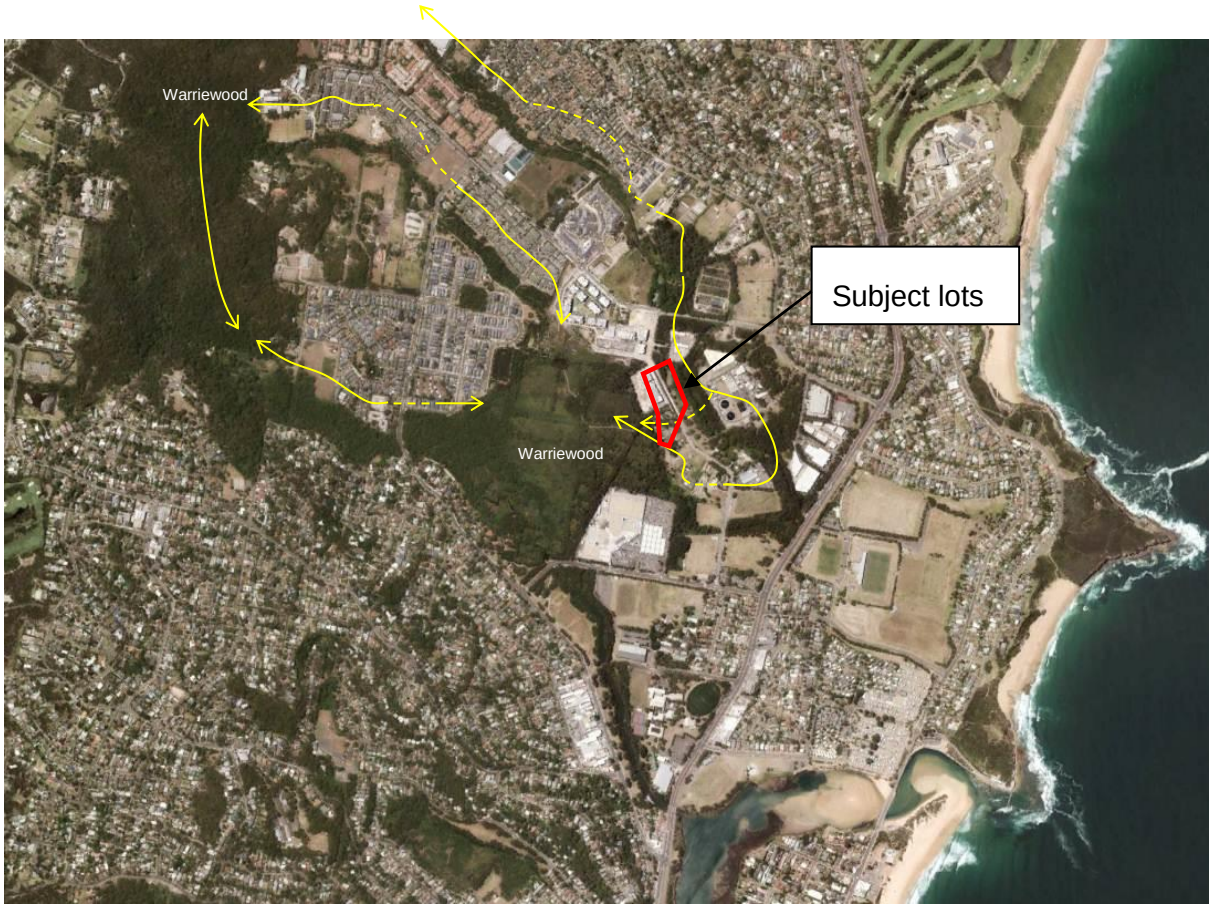

Figure 5.3 – Local connectivity

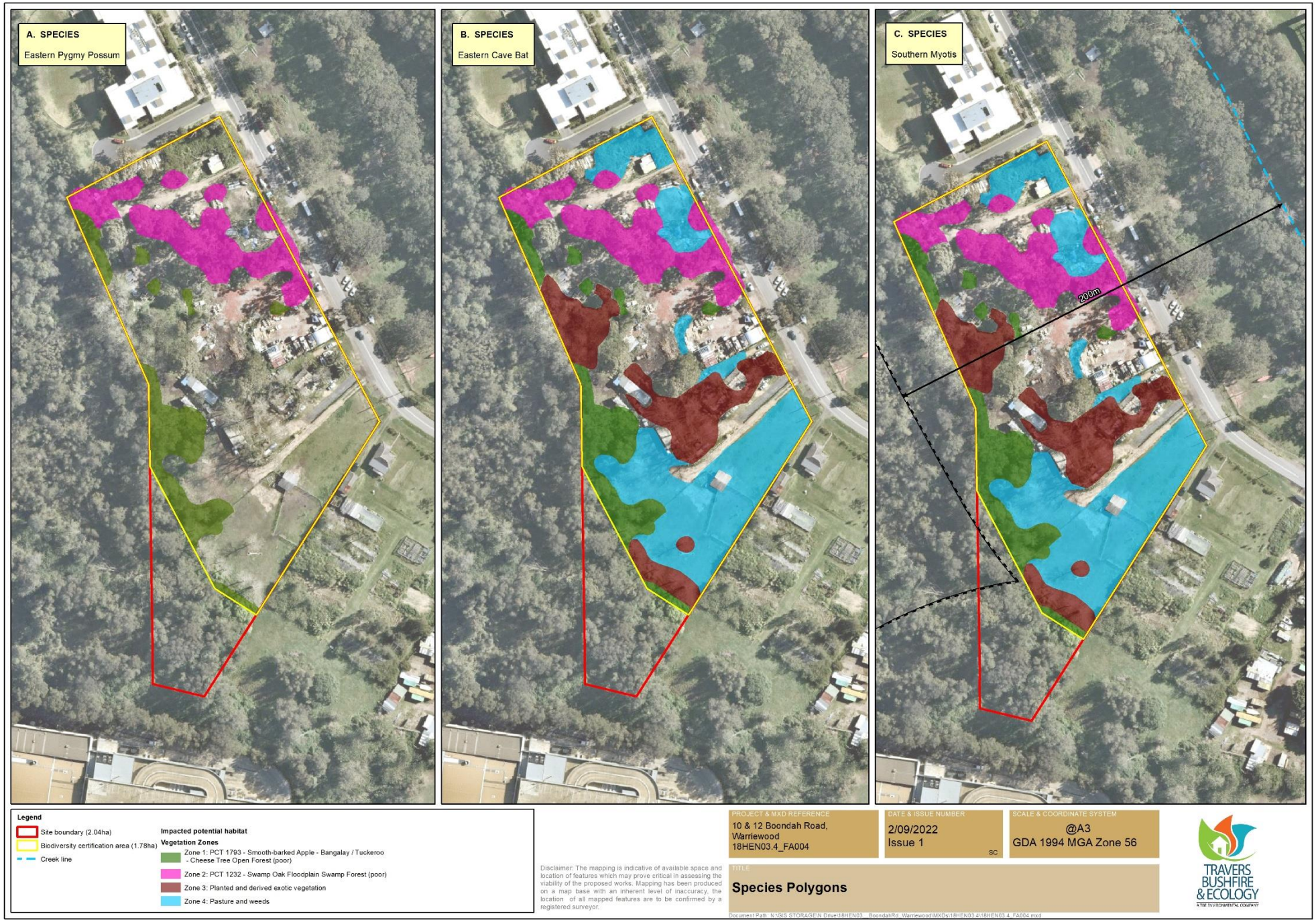

Figure 5.4 – Species credit species polygons

6. CONCLUSION

Travers bushfire & ecology has been engaged to undertake Biodiversity Development Assessment Report within Lots 3 and 4 DP26902, 10 and 12 Boondah Road, Warriewood.

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the *Environmental Planning and Assessment Act 1979*, the *Biodiversity Conservation Act 2016*, the commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the *Fisheries Management Act 1994*.

6.1 Legislative compliance

In respect of matters required to be considered under the *Environmental Planning and Assessment Act 1979* and relating to the species / provisions of the *Biodiversity Conservation Act 2016*, Six (6) threatened fauna species Grey-headed Flying-fox (Pteropus poliocephalus), Large Bent-winged Bat (Miniopterus orianae oceanensis), Eastern Cave Bat (Vespadelus troughtoni with “probable” certainty), Southern Myotis (Myotis macropus), Little Bent-winged Bat (Miniopterus australis) and Powerful Owl (*Ninox strenua*), no threatened flora species, and two (2) TECs, Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions (BSF) and Swamp Oak Floodplain Forest (SOFF), were recorded within the study area.

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act 1999*, one threatened fauna species Grey-headed Flying-fox (*Pteropus poliocephalus*), no protected migratory bird species and no threatened flora species, and two (2) TECs listed under this Act were recorded within the study area.

The proposal was not considered to have a significant impact on or be constrained by matters of national environmental significance. As such a referral to Department of Agriculture, Water and the Environment is not required.

In respect of matters relative to the *Fisheries Management Act 1994*, no suitable habitat for threatened marine or aquatic species was observed within the development footprint and there are no matters requiring further consideration under this Act.

6.2 Biodiversity credit requirements

6.2.1 Impacts requiring offset

The following impacts will require offsetting:

- 0.18 ha of PCT 1232 Swamp Oak Forest
- 0.23 ha of PCT 1793 Bangalay Sand Forest
- loss of habitat for threatened species, including species credits for Southern Myotis, Eastern Cave Bat and Eastern Pygmy Possum.

Locations of the abovementioned communities within the subject land are shown on Figure 3.1.

6.2.2 Impacts not requiring offset

The following impacts do not require offset:

- Impacts on non-native vegetation

- Impacts on planted native vegetation (see Section 5.2.1)
- Indirect impacts on remaining native vegetation areas as outlined in Section 5.5.3.

6.2.3 Areas not requiring assessment

Native vegetation that has not been directly impacted by this proposal, both within the study area and beyond, do not require credit assessment.

7. BAM CREDIT RESULTS

7.1 Ecosystem credits and species credits

Ecosystem credits and species credits that measure the impact of the development on biodiversity values have been calculated, assuming full removal of vegetation within the subject land.

Habitat suitability for threatened species has been considered in Section 4. Some species are considered for species credits, particularly in this case if recorded or assumed present.

Ecosystem credits for PCTs, ecological communities and threatened species habitat is shown below in Table 7.1. Species credits for threatened species are shown in Table 7.2

Table 7.1 – Requirement for ecosystem credits

Zone	Veg. zone name	Veg. integrity loss	Area (ha)	Sensitivity to gain	Biodiversity risk weighting	Potential SAII	Ecosystem credits
1	1232_poor	38.6	0.18	High	2	no	3
2	1793_poor	25.9	0.23	High	2	no	3
3	1232_derived_exotic	1.3	0.27	High	2.5	no	0
4	1232_pasture_weeds	3.1	0.48	High	2.5	no	0
							Total: 6

Table 7.2 – Requirement for species credits

Veg. zone name	Veg. integrity loss	Area (ha) / count	Biodiversity risk weighting	Potential SAII	Species credits
***Cercartetus nanus* / Eastern Pygmy-possum (Fauna)**					
1232_poor	38.6	0.18	2	False	3
1793_poor	25.9	0.23	2	False	3
					Subtotal: 6
***Myotis macropus* / Southern Myotis (Fauna)**					
1232_derived_exotic	1.3	0.27	2	False	1
1232_pasture_weeds	3.1	0.48	2	False	1
1232_poor	38.6	0.18	2	False	3
1793_poor	25.9	0.23	2	False	3
					Subtotal: 8
***Vespadelus troughtoni* / Eastern Cave Bat (Fauna)**					
1232_derived_exotic	1.3	0.27	3	True	1
1232_pasture_weeds	3.1	0.48	3	True	1
1232_poor	38.6	0.18	3	True	5
1793_poor	25.9	0.23	3	True	4
					Subtotal: 11

7.2 Ecosystem credit classes

Table 7.3 – Ecosystem credit summary

PCT	TEC	Area (ha)	HBT credits	non-HBT credits	Credits
1232-Coastal freshwater swamp forest	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.18	3	0	3
1232-Coastal freshwater swamp forest	Not a TEC	0.75	0	0	0
1793-Coastal Sand Bangalay Forest	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions	0.23	3	0	3

Table 7.4 – Credit classes for PCT 877 and 1395 - Like for like options

PCT	TEC	Containing hollow-bearing trees?	Credits
1232	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCTs: 915, 916, 917, 918, 1125, 1232, 1234, 1726, 1727, 1728, 1731, 1808	Yes	Pittwater , Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1793	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions This includes PCTs: 1794	Yes	Pittwater , Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

7.3 Species credit classes

Table 7.5 – Species credit summary

Species	Veg. zones	Area (ha)	Credits
Cercartetus nanus / Eastern Pygmy-possum	1793_poor	0.41	6
Myotis macropus / Southern Myotis	1232_poor, 1793_poor, 1232_derived_exotic, 1232_pasture_weeds	1.2	8
Vespadelus troughtoni / Eastern Cave Bat	1232_poor, 1793_poor, 1232_derived_exotic, 1232_pasture_weeds	1.2	11

All above-listed species need to be offset with the same species but anywhere in NSW.

The pricing of credits can vary greatly over time and it is advised that the proponent use the online Biodiversity Offset Payment Calculator tool to determine the current pricing of credits (https://www.lmbc.nsw.gov.au/offsetpaycalc).

7.4 Credit offset strategy

All credit offset obligations are to be satisfied by payment into the Biodiversity Conservation Fund.

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Appendix 1. Plot datasheets

BAM Site – Field Survey Form

Site Sheet no: 1 of

Date	13/12/21	Survey Name	18HEN03.2 Warrieweed	Zone ID		Recorders	CP		
Zone	Datum	Plot ID	P1			Plot dimensions	20x50m	Photo #	✓
Easting	Northing	IBRA region		In m		Midline bearing from 0 m		Magnetic °	
Vegetation Class								Confidence: H M L	
Plant Community Type						EEC: tick		Confidence: H M L	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
Sum of Cover of native vascular plants by growth form group	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
High Threat Weed cover		

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	✓	✓
50 – 79 cm	/	/
30 – 49 cm	✓	
20 – 29 cm		
10 – 19 cm		
5 – 9 cm		
< 5 cm		n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	Tally space	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	95	5	10	30	75	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots																				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400m² plot: Sheet 2 of 2 | Survey Name: ISHEDO3 Waterwood | Plot Identifier: P1 | Recorders: GP

Date: 13/12/21

GF		Top 3 natives in each GF: Full species name mandatory. All others where practicable	N	E	HTE	Cover %	Abund	voucher
	1	Eucalyptus botryoides	✓			15	3	
	2	Angophora costata	✓			5	2	
	3	Brachychiton acer.	✓			2	1	
	4	Lantana camara			✓	5	20	
	5	Ipomoea indica			✓	10	20	
	6	Senna pendula			✓	1	5	
	7	Ageratina adenophora			✓	2	100	
	8	Ehrharta erecta			✓	0.5	50	
	9	Commelina cyanea	✓			1	20	
	10	Anagallis arvensis		✓		<0.1	30	
	11	Cirsium vulgare		✓		0.1	10	
	12	Paspalum urvillei		✓		5	20	
	13	Cenchrus clandestinus			✓	0.1	10	
	14	Cyperus eragrostis		✓		0.1	5	
	15	Solanum oleraceus		✓		0.1	10	
	16	Solanum nigrum		✓		4	20	
	17	Solanum americanum	✓			2	10	
	18	Solanum chenopodioides		✓		1	5	
	19	Conyza bonariensis		✓		3	20	
	20	Cestrum parqui			✓	0.1	5	
	21	Chenopodium album		✓		0.1	5	
	22	Gamochaeta sp		✓		0.1	5	
	23	Sida rhombifolia		✓		0.1	10	
	24	Senecio madagascariensis			✓	0.1	10	
	25	Inkweed - Phytolacca octandra		✓		0.1	3	
	26	Cinnamomum camphora			✓	2	1	
	27	Glochidion ferdinandi	✓			5	1	
	28							
	29							
	30							
	31							
	32							
	33							
	34							
	35							
	36							
	37							
	38							
	39							
	40							
	41							
	42							
	43							
	44							
	45							
	46							
	47							

GF Code: see growth form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code of 'top 3'

Cover: 0.1, 0.2, 0.3..... 1, 2, 3 ..... 10, 15, 20, 25 .....100% (foliage cover): ***Note:*** *0.1% cover = 63 x 63 cm or a circle 71 cm across, 0.5% cover = 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10m.* **Abundance:** 1, 2, 3...10, 20, 30....100, 200...1000...

BAM Site – Field Survey Form

Site Sheet no: 1 of

Survey Name	Zone ID	Recorders
1YHEND3.2 Warrigwood		GP

Date	13/12/21	Plot ID	P2	Plot dimensions	20x50m	Photo #	✓
Zone	Datum						
Easting	Northing	IBRA region	In m	Midline bearing from 0 m	Magnetic °		

Vegetation Class		Confidence: H M L
Plant Community Type	**EEC:**	Confidence: H M L

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0 04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of **Native Richness**	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
Sum of **Cover** of native vascular plants by growth form group	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
High Threat Weed cover		

BAM Attribute (1000 m² plot)		
DBH	**# Tree Stems Count**	**# Stems with Hollows**
80 + cm		
50 – 79 cm	II	
30 – 49 cm	✓	II
20 – 29 cm	✓	
10 – 19 cm	✓	
5 – 9 cm		
< 5 cm		n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	40 Tally space	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30…, 100, 200, 300…). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Subplot score (% in each)	50	60	75	85	75															
Average of the 5 subplots																				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400m² plot: Sheet 2 of 2	Survey Name	Plot Identifier	Recorders
Date 13/12/21	IBHEN03 Warrewood	P2	GP

GF	Top 3 natives in each GF: Full species name mandatory. All others where practicable	N	E	HTE	Cover %	Abund	voucher
	1 Casuarina glauca	✓			10	6	
	2 Hydrocotyle tripartita	✓			15	100	
	3 Lantana camara			✓	80	200	
	4 Ipomoea indica			✓	10	50	
	5 Ligustrum sinense			✓	5	20	
	6 Senna pendula			✓	1	10	
	7 Poplar		✓	✓	5	3	
	8 Gahnia clarkei	✓		✓	2	10	
	9 Ligustrum sinense			✓	2	10	
	10 Pteridium esculentum	✓			1	5	
	11 Spirodela punctata	✓			5	thousands	
	12 Cassytha pubescens	✓			1	10	
	13 Pyrrosia rupestris	✓			0.1	10	
	14 Carex appressa	✓			0.5	10	
	15 Eucalyptus botryoides	✓			5	2	
	16 Crows nest - Asplenium australasicum	✓			0.5	1	
	17 Polystichum aculeatum	✓			2	100	
	18 Hydrocotyle bonariensis		✓		1	20	
	19 Persicaria hydropiper	✓			0.1	10	
	20 Solanum nigrum		✓		0.1	3	
	21 Arum lily		✓		2	10	
	22 Commelina cyanea	✓			1	20	
	23 Centella asiatica	✓			1	50	
	24 Tradescantia fluminensis			✓	1	50	
	25 Ranunculus plebeius	✓			0.1	3	
	26 Cenchrus clandestinus			✓	0.1	3	
	27 Cestrum parqui			✓	0.1	3	
	28						
	29						
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	47						

GF Code: see growth form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code of 'top 3'
Cover: 0.1, 0.2, 0.3..... 1, 2, 3 ..... 10, 15, 20, 25 .....100% (foliage cover): ***Note:*** *0.1% cover = 63 x 63 cm or a circle 71 cm across, 0.5% cover = 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10m.* **Abundance:** 1, 2, 3…10, 20, 30….100, 200…1000…

BAM Site – Field Survey Form

Site Sheet no: 1 of 1

		Survey Name	Zone ID	Recorders GP			
Date	13 12 21	ISHENO3.2 Charlestwood					
Zone	Datum	Plot ID	P3	Plot dimensions	20x50m	Photo #	✓
Easting	Northing	IBRA region	In m	Midline bearing from 0 m		Magnetic °	

Vegetation Class			Confidence: H M L
Plant Community Type		EEC:	Confidence: H M L

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
Sum of Cover of native vascular plants by growth form group	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
High Threat Weed cover		

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm		
50 – 79 cm		
30 – 49 cm		
20 – 29 cm		
10 – 19 cm		
5 – 9 cm		
< 5 cm		n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	Tally space	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	5	3	2	2	3	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots																				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400m² plot: Sheet 2 of 2 | Survey Name: 18HEN03 Woolenwood | Plot Identifier: P3 | Recorders: ap

Date: 13/12/24

GF	Top 3 natives in each GF: Full species name mandatory. All others where practicable	N	E	HTE	Cover %	Abund	voucher
	1 Cynodon dactylon	✓			60	2000	
	2 Modiola caroliniana		✓		0.1	5	
	3 Conyza bonariensis		✓		0.1	5	
	4 Gamochaeta sp		✓		0.1	10	
	5 Juncus usitatus	✓			5	200	
	6 Buffalo grass			✓	1	50	
	7 Centaurium spicatum		✓		0.1	10	
	8 Hydrocotyle bonariensis				0.1	5	
	9 Anagallis arvensis		✓		0.1	10	
	10 Trifolium repens		✓		2	100	
	11 grass 1 - Eleusine tristachya		✓		1	50	✓
	12 Cenchrus clandestinus			✓	25	1000	
	13 Notoscordum		✓		0.5	20	
	14 Mouse-ear		✓		0.1	5	
	15 Oxalis perennans	✓			0.1	5	
	16 Plantago major		✓		0.1	5	
	17 Soliva sessilis		✓	✓	0.1	10	
	18 white-flowered onion		✓		0.1	3	
	19 sorell - Rumex crispus		✓		0.1	5	
	20 Commelina cyanea	✓			0.1	5	
	21 Conyza sumatrensis		✓		0.1	10	
	22 Cyperus eragrostis		✓		0.1	10	
	23 Sida rhombifolia		✓		0.1	20	
	24 Foto 1		✓		0.1	10	
	25 Hydrocotyle sibthorpioides	✓			0.5	100	
	26						
	27						
	28						
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	45						
	46						
	47						

GF Code: see growth form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code of 'top 3'
Cover: 0.1, 0.2, 0.3..... 1, 2, 3 .... 10, 15, 20, 25 ......100% (foliage cover): ***Note:*** *0.1% cover = 63 x 63 cm or a circle 71 cm across, 0.5% cover = 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10m.* **Abundance:** 1, 2, 3...10, 20, 30....100, 200...1000...

BAM Site – Field Survey Form

Site Sheet no: 1 of 1

Survey Name	Zone ID	Recorders
18HEN02.3 Woodlawn1		GP

Date	13/12/21	Plot ID	P4	Plot dimensions	20 x 50m	Photo #	✓
Zone	Datum						
Easting	Northing	IBRA region	In m	Midline bearing from 0 m		Magnetic ?	

Vegetation Class		Confidence: H M L
Plant Community Type	EEC:	Confidence: H M L

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
Sum of Cover of native vascular plants by growth form group	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
High Threat Weed cover		

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm		
50 – 79 cm		
30 – 49 cm		IIII (Poplars)
20 – 29 cm		
10 – 19 cm		
5 – 9 cm		
< 5 cm		n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	Tally space	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	2 5 3 6 1	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots																

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400m² plot: Sheet 2 of 2	Survey Name	Plot Identifier	Recorders
Date 13/12/21	18KEN03 Woodcrest	P4	GP

GF		Top 3 natives in each GF: Full species name mandatory. All others where practicable	N	E	HTE	Cover %	Abund	voucher
	1	Populus		✓	✓	60	7	
	2	Solanum mauritianum		✓		4	1	
	3	Conyza bonariensis		✓		4	20	
	4	Turkey rhubarb – Acetosa sagittata		✓	✓	3	10	
	5	Tagetes erecta		✓		2	20	
	6	Eichhornia crassa			✓	1	20	
	7	Commelina cyanea	✓			1	20	
	8	Lantana camara			✓	0.1	3	
	9	Sonchus oleraceus		✓		0.1	10	
	10	daisy – Cotula australis	✓			0.1	10	1
	11	Lolium perene		✓		1	50	
	12	Chenopodium album		✓		0.1	5	
	13	Gamochaeta sp.		✓		0.1	20	
	14	Euphorbia peplus		✓		0.1	5	
	15	Oplismenus aemulus	✓			2	100	
	16	Cyperus esculentus		✓		0.1	10	
	17	Solanum nigrum		✓		3	20	
	18	Juncus usitatus	✓			0.2	20	
	19	Cenchrus clandestinus			✓	4	100	
	20	Daucus carota		✓		0.1	10	
	21	Verbena bonariensis		✓		0.1	10	
	22	Plantago major		✓		0.1	10	
	23	Rumex brownii	✓		✓	0.1	5	
	24	Modiola caroliniana		✓		0.1	5	
	25	Setaria parviflora		✓		0.5	10	
	26	Sporobolus africanus ~~pyramidalis~~		✓		0.1	3	
	27	Capsella		✓		0.1	5	
	28	Castor oil plant – Ricinus communis			✓	0.5	1	
	29	All seed = Polycarpon tetraphyllum		✓		0.1	20	
	30							
	31							
	32							
	33							
	34							
	35							
	36							
	37							
	38							
	39							
	40							
	41							
	42							
	43							
	44							
	45							
	46							
	47							

GF Code: see growth form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code of 'top 3'
Cover: 0.1, 0.2, 0.3..... 1, 2, 3 ..... 10, 15, 20, 25 .....100% (foliage cover): ***Note:*** *0.1% cover = 63 x 63 cm or a circle 71 cm across, 0.5% cover = 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10m.* **Abundance:** 1, 2, 3...10, 20, 30....100, 200...1000...

Appendix 2. MICROBAT CALL ANALYSIS

Client Name: **Dan Maurici**	Project Name: **Warriewood Biodiversity Certification Assessment Report**
Client Contact: **dan@henroth.com.au**	TBE Quote Ref No: **18HEN03.2**
Client Address: **10-12 Boondah Road, Warriewood, 2102**	Detector Location: **-33.693204 S, 151.297509 E -33.693878 S, 151.297174 E**
	Date of Survey: **16th November – 1st December 2021**

SUMMARY OF RESULTS			
ID Method	**Result**	**Threatened**	**Confidence (Probability low to high)**
Characteristic frequency, alternating pulses	*Chalinolobus gouldii*	No	High
Characteristic frequency, down-sweeping tail	*Chalinolobus morio*	No	High
Characteristic frequency, down-sweeping tail	*Miniopterus australis*	Yes	High
Characteristic frequency, down-sweeping tail	*Miniopterus orianae oceanensis*	Yes	Medium
Characteristic frequency, call shape	*Vespadelus sp.*	Yes (*Vespadelus troughtoni* only)	Medium

HABITAT & SURVEY CONDITIONS

Survey was conducted in an open habitat with no rain, no wind, almost no cloud cover and the temperature was 23°C.

METHOD DESCRIPTION

An Anabat Swift (full-spectrum) with an omnidirectional microphone was used to record bat calls. All recorded files were run through a decision tree in Anabat Insight which filtered out non-bat files and labelled bat files with either a species or species complex. Each automatically labelled file was then manually verified. The call from each species/species complex that was most confidently identified was selected to be used as the image in the "Results" section of this report. All images were taken from within Anabat Insight and shown in either compressed or uncompressed mode, depending on which image best highlights diagnostic features. All full-spectrum recordings are shown in full-spectrum with a zero-crossing overlay.

CALL REFERENCE LIBRARY

Calls were identified using the "Bat Calls of NSW" by Pennay *et al*. (2004) regional guide, the "Key to the bat calls of south-east Queensland and north-east New South Wales" by Reinhold *et al*. (2001), and the "Bat Calls of Central Eastern NSW" by Titley Scientific (2009). Additional call metrics were also been collected for specific bat species from discussions with recognised bat experts including Michael Pennay, Brad Law and Greg Ford.

RESULTS

The calls of three species and two species complexes were identified from the Lugarno recordings. One threatened species (*Miniopterus schreibersii oceanensis*), one genus (*Vespadelus*) that contains another threatened species (*Vespadelus troughtoni*), and one species complex (Broad-nosed Bats) that contains another threatened species (*Scoteanax rueppellii)* was identified.

Figure 1: Gould's Wattle Bat (*Chalinolobus gouldii*.) in uncompressed mode.

This sequence was identified as *C. gouldii* call due to the alternating characteristic frequency, long frequency sweep and down-sweeping tail.

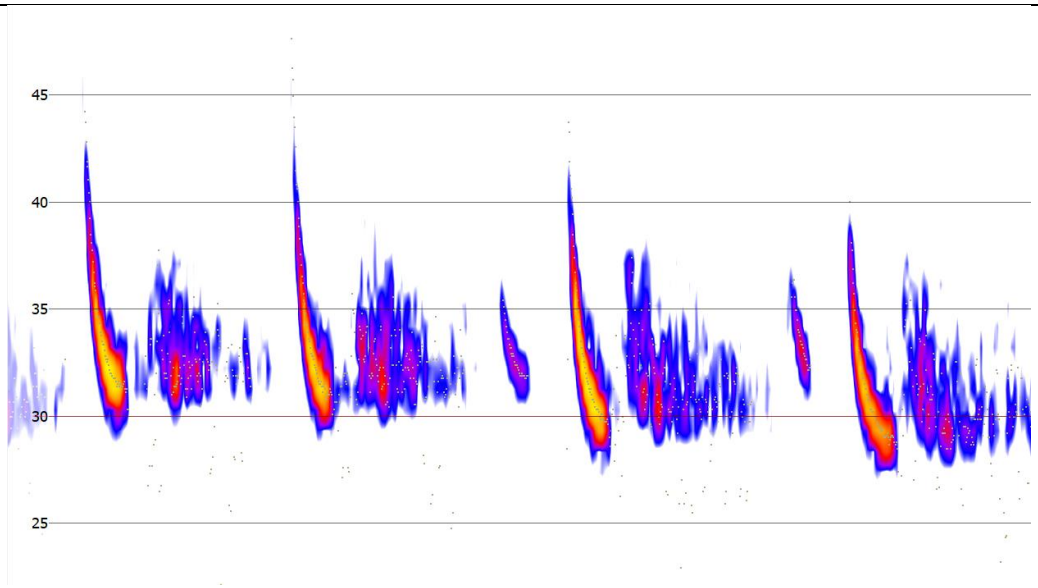


Figure 2: Large bent-winged Bat (*Miniopterus orianae oceansis*) in uncompressed mode.

This sequence was identified as *M. o. oceansis* call due to the majority of pulses having a down-sweeping tail and time between calls is irregular.

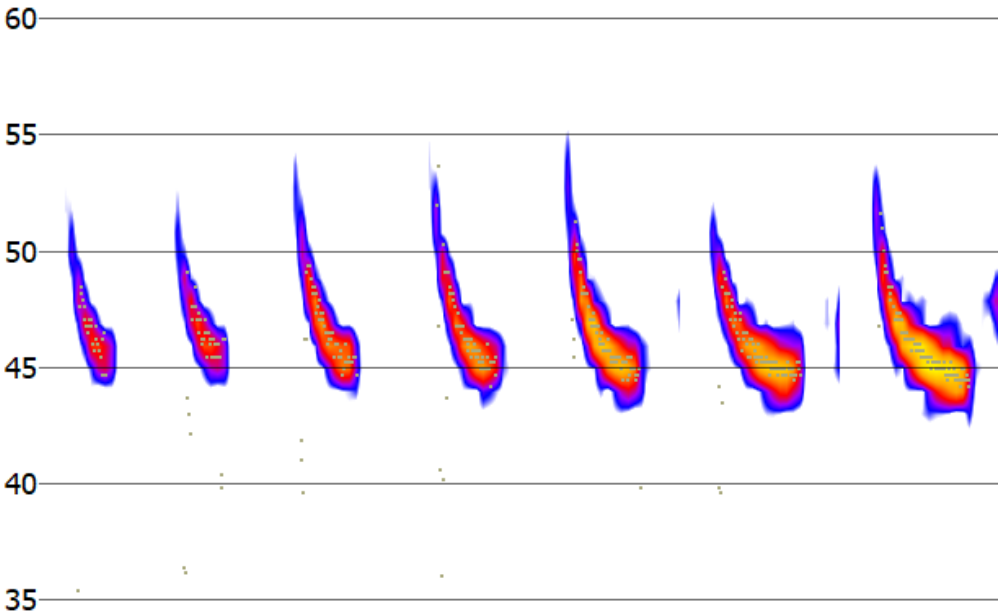


Figure 3: *Vespadelus* sp. in compressed mode.

This sequence was identified as a *Vespadelus* call due to the characteristic frequency and majority of pulses having an up-sweeping tail. The call could not be identified to species due to the end frequency of 50.1kHz.

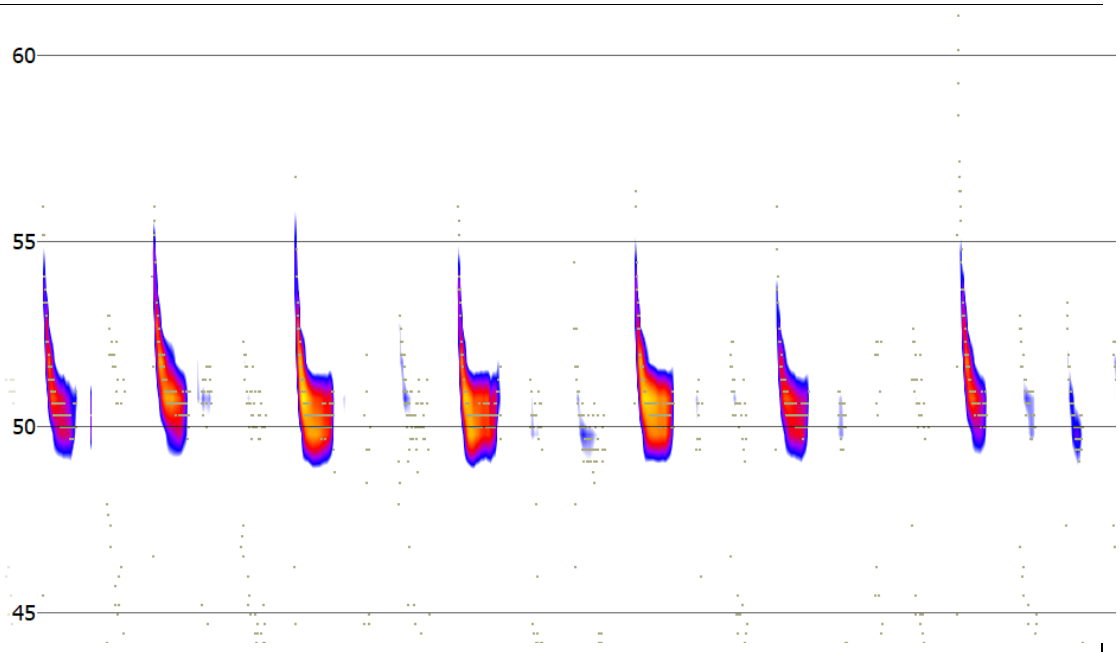


Figure 4: Little Bent-winged Bat (*Miniopterus australis*) in compressed mode.

This sequence identified based on the characteristic frequency and prominent down-sweeping tail.

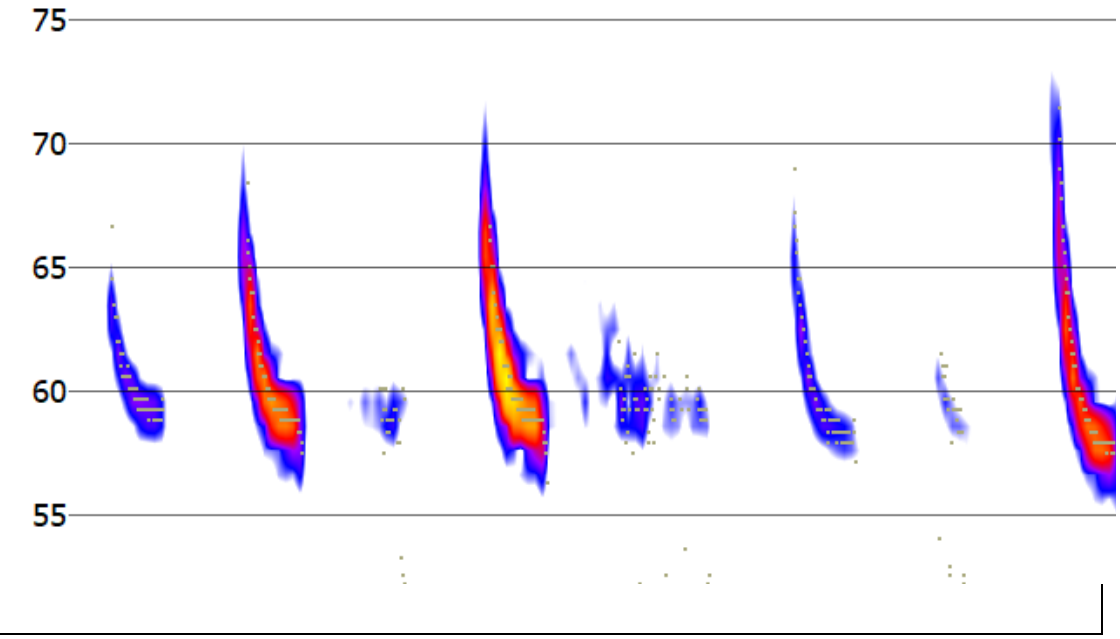
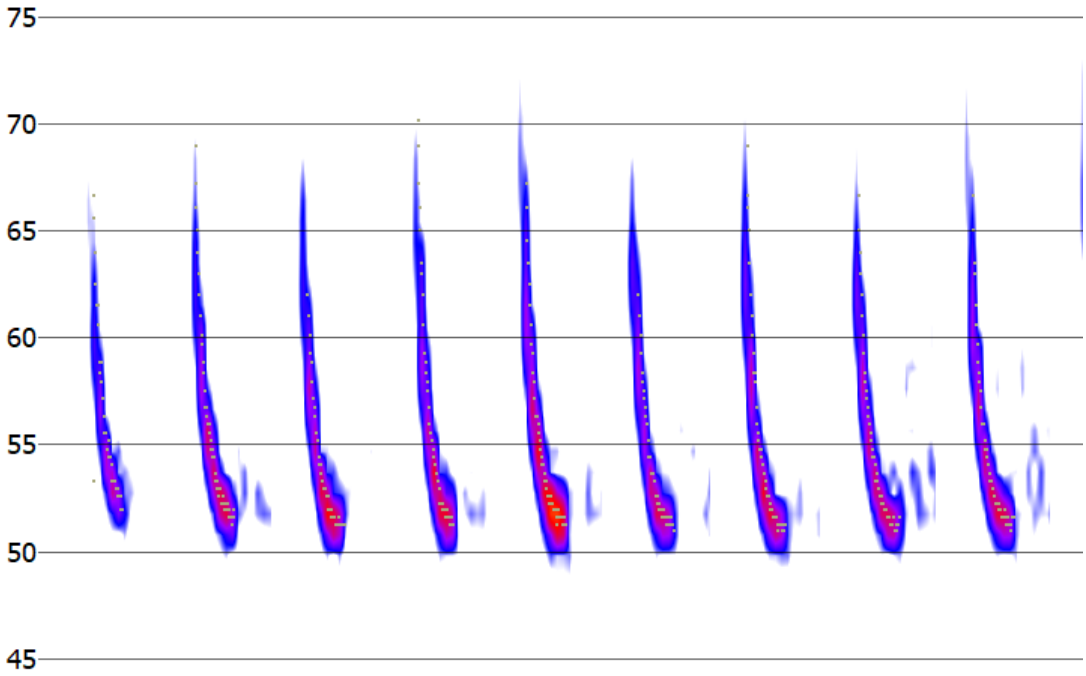


Figure 5: Chocolate Wattled Bat (*Chalinolobus morio*) in compressed mode. This sequence was identified as *C. morio* due to the characteristic frequency and down-sweeping tail.	

Assessing officer: **Nathan Stewart** Date**: 09/12/2021**

Scientific Licence: **SL100848**

Appendix 3. Staff qualifications and experience

Team member (role)	Accreditations and qualifications	Experience	Employment history	Skills and expertise
George Plunkett (Botanist)	• Biodiversity Assessment Method (BAM) Assessor (Accredited Assessor no. BAAS19010) • PhD – Plant systematics, ecology and evolution • Bachelor of Science (Honours) – Ecology / Botany, University of New England (UNE), NSW • Four-wheel drive vehicle operation • Senior First Aid Certificate	George has 12 years of experience as a plant taxonomist, flora ecologist and botanist, including a PhD in plant systematics, ecology and evolution, and has a very well-developed understanding of the Australian flora.	• 2017-Current: Botanist, Travers bushfire & ecology • 2016-2017: Research Botanist, UNE • 2010-2011: Research Botanist, UNE • 2008-2009: Plant Ecologist, Ecotone Flora Fauna Consultants	• High-quality report writing • Application of the BAM and BOS • Highly experienced in botanical survey and ecological analysis • Plant identification and taxonomy • Flora and fauna assessment • Threatened species, ecological communities and endangered population surveys and analysis • Habitat tree analysis and assessment • Noxious weed identification • Tree assessment
Lindsay Holmes (Manager of Ecology)	• Bachelor of Science – Biology, James Cook University, Qld • Bush Regeneration II Certificate, Ourimbah TAFE • NSW WorkCover OHS Construction Induction • Senior First Aid Certificate • BioBanking Assessor (No. 199) • Biodiversity Assessment Method (BAM) Assessor (BAAS17032)	Lindsay has 21 years of experience as a flora ecologist and bushland regeneration supervisor and has expertise in botanical survey, ecological analysis, maintain and improve analysis, biometric analysis and geo-plotting of ecological data.	• 2007-Current: Senior Botanist, Travers bushfire & ecology • 2006-2007: Ecologist, Conacher Travers Pty Ltd • 1999-2006: Field Operations Manager, Microclimate	• Highly experienced in botanical survey and ecological analysis • Vegetation management planning • Flora and fauna assessment • Species impact statement • Threatened species, ecological communities and endangered population surveys and analysis • Preparation of BioBanking and Biodiversity Development Assessment Reports • Riparian, bushland and wetland restoration • Habitat tree analysis and assessment • Noxious weed identification and control • SULE assessment

Team member (role)	Accreditations and qualifications	Experience	Employment history	Skills and expertise
Michael Sheather-Reid (Managing Director)	• Bachelor of Natural Resources (Hons), University of New England • BioBanking Assessor • Engineering Assistant – CAD Drafting • MUSIC Modelling – Stormwater quality and quantity modelling (RMIT) • Bush Regeneration II Certificate, Ryde TAFE • NSW WorkCover OHS Construction Induction • Chemical Handling Certificate, Ryde TAFE	Michael has a wealth of experience in environmental consulting and on ground management of bushland, wetland and riparian habitats having undertaken environmental assessment, ecological consultancy and restoration in both the private and public sectors for over 22 years.	• 2007- Current: Senior Ecologist, Travers bushfire & ecology • 2004 -2007: Senior Ecologist, Conacher Travers Pty Ltd • 2002-2004: Project Manager, Urban Bushland Management Projects Pty Ltd • 1999-2002: Project Manager Sustainable Vegetation Management Pty Ltd • 1995-1999: Managing Director Sheather-Reid & Associates Pty Ltd • 1996-1997: NSW Landcare Liaison Officer, Australian Conservation Foundation • 1992-1995: Environmental Officer, Dept. Land & Water Conservation • 1990-1992: Scientific Officer Dept. of Water Resources	• Ecological assessment • Rezoning studies • Biodiversity offset planning • Restoration management and coordination • Biotic and soil translocation • Watercourse assessment • Project ecologist services • *EPBC Act* referrals • Controlled Activity Approvals • Vegetation management plans
Sandy Cardow (GIS officer)	• Bachelor of Science (Biological Sciences) (Macquarie University)	Sandy has over twenty years of experience in Spatial Information (Geographic Information Systems (GIS)), which includes preparation of mapping in local government roles and has completed a Bachelor of Science (Biological Sciences).	• 2017 – Current: GIS Officer, Travers bushfire & ecology • 2014 – 2017: GIS Consultant, Forestry Corp. NSW • 2005 – 2011: GIS Analyst, Forests NSW • 2002 – 2005: GIS Data Librarian, Forests NSW • 2000 – 2002: GIS Operator, Forests NSW • 2000 – 2002: GIS Data Import / Export Officer, Forests NSW • 1999 2000: GIS Project Officer DECC • 1998 – 1999: GIS Support Officer DECC • 1998 – 1999: Wildlife Atlas Data Entry Officer DECC	• Geographic Information Systems • Data management and analysis • Spatial databases and database administration • GPS • Cartography • Natural resource management • Client liaison
Corrine Edwards (Fauna Ecologist)	• Bachelor of Environmental Science and Management. (Hons) (University of New South Wales) (2016-2020)	Corrine has over 10 years' experience in fauna survey techniques, researching ecological interactions and identification of vertebrate fauna within a magnitude of Australian habitats. She is experienced in leading research projects, experimental design, data collection, data analysis and report writing.	• 2021 – Current: Fauna Ecologist, Travers Bushfire and Ecology • 2019 – 2020: Research scholarship fellow at the Fowlers Gap Research Station • 2019 – Research assistant at University of NSW • 2015-2016 – Reptile Research Assistant, Adelaide Museum • 2014 – 2015 Amphibian Research Assistant, University of Western Australia • 2012-14 – Reptile Zookeeper – Australian Reptile Park	• Survey techniques for all major vertebrate fauna groups (including threatened species target searches) • Fauna identification, ecological association and behaviour • Fauna field assessment • Microhabitat identification • Project ecology • Experimental design and statistical analysis • Scientific report writing

Team member (role)	Accreditations and qualifications	Experience	Employment history	Skills and expertise
Lachlan McRae (Fauna ecologist)	• Bachelor of Environmental Science and Management (majoring in Biodiversity and Ecosystems) • Bachelor of Environmental Science and Management HONOURS – 1st Class • Anabat Insight Advanced Workshop – Titley Scientific • Kaleidoscope Pro Advanced Training – Wildlife Acoustics • Drive and Recover a 4WD – Out of Town 4WD • Provide First Aid – St John Ambulance • Trim and Cut Felled Trees and Maintain Chainsaws – Chainsaw Accreditation and Safety • Mammal & Amphibian Handling & Microchipping Training – University of Newcastle and Australian Wildlife Conservancy • Advanced Reptile Keepers Licence	Lachlan has more than 5 years' experience in fauna survey techniques, threatened species target surveys, acoustic data analysis, and active call identification of vertebrate fauna within coastal habitats of NSW. He has specialist bat identification skills and experience leading threatened species field surveys in NSW, SA, & NT.	• 2017: Koala research assist – NSW National Parks and Wildlife Service • 2019 – 2021: Amphibian Research Assistant - University of Newcastle • 2020: Botanical Intern - Canberra National Herbarium • 2021: Ecology and Conservation Intern - Australian Wildlife Conservancy • 2020 – Current: Fauna Ecologist - Travers bushfire & ecology	• Threatened fauna target surveys & assessment • Flora and fauna species identification • Report writing to a high scientific standard • Bioacoustic analysis for all fauna groups • Microbat identification, harp trapping, and reference call collection • Pitfall and radiotracking surveys targeting threatened mammal species • Thorough knowledge of experimental design and statistical analysis

Appendix 4. BAM-C outputs

BAM Credit Summary Report

Proposal Details

Assessment Id 00030258/BAAS19010/21/00030259	Proposal Name	BAM data last updated * 16/06/2022
Assessor Name George Thomas Plunkett	Report Created 16/09/2022	BAM Data version * 54
Assessor Number BAAS19010	BAM Case Status Finalised	Date Finalised 16/09/2022
Assessment Revision 5	Assessment Type Biocertification	

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

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

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

Coastal freshwater swamp forest												
1	1232_poor	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	38.6	38.6	0.18	PCT Cleared - 95%	High Sensitivity to Gain	Endangered Ecological Community	Endangered	2.00		3
											Subtotal	**3**
Coastal freshwater swamp forest												
3	1232_derived_exotic	Not a TEC	1.3	1.3	0.27	PCT Cleared - 95%	High Sensitivity to Gain			2.50		0
4	1232_pasture_weeds	Not a TEC	3.1	3.1	0.48	PCT Cleared - 95%	High Sensitivity to Gain			2.50		0
											Subtotal	**0**

Coastal Sand Bangalay Forest											
2	1793_poor	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions	25.9	25.9	0.23	PCT Cleared - 40%	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	3
										Subtotal	**3**
										Total	**6**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits
Cercartetus nanus / Eastern Pygmy-possum (Fauna)									
1232_poor	38.6	38.6	0.18			Vulnerable	Not Listed	False	3
1793_poor	25.9	25.9	0.23			Vulnerable	Not Listed	False	3
								Subtotal	**6**
Myotis macropus / Southern Myotis (Fauna)									
1232_poor	38.6	38.6	0.18			Vulnerable	Not Listed	False	3
1793_poor	25.9	25.9	0.23			Vulnerable	Not Listed	False	3
1232_derived_exotic	1.3	1.3	0.27			Vulnerable	Not Listed	False	1

1232_pasture_weeds	3.1	3.1	0.48			Vulnerable	Not Listed	False	1
								Subtotal	**8**
Vespadelus troughtoni / Eastern Cave Bat (Fauna)									
1232_poor	38.6	38.6	0.18			Vulnerable	Not Listed	True	5
1793_poor	25.9	25.9	0.23			Vulnerable	Not Listed	True	4
1232_derived_exotic	1.3	1.3	0.27			Vulnerable	Not Listed	True	1
1232_pasture_weeds	3.1	3.1	0.48			Vulnerable	Not Listed	True	1
								Subtotal	**11**

BAM Vegetation Zones Report

Proposal Details

Assessment Id
00030258/BAAS19010/21/00030259

Assessment name

BAM data last updated *
16/06/2022

Assessor Name
George Thomas Plunkett

Report Created
16/09/2022

BAM Data version *
54

Assessor Number
BAAS19010

Assessment Type
Biocertification

BAM Case Status
Finalised

Assessment Revision
5

Date Finalised
16/09/2022

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

Vegetation Zones

#	Name	PCT	Condition	Area	Minimum number of plots	Management zones
1	1232_poor	1232-Coastal freshwater swamp forest	poor	0.18	1	
2	1793_poor	1793-Coastal Sand Bangalay Forest	poor	0.23	1	

3	1232_derived_exotic	1232-Coastal freshwater swamp forest	derived_exotic	0.27	1	
4	1232_pasture_weeds	1232-Coastal freshwater swamp forest	pasture_weeds	0.48	1	

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00030258/BAAS19010/21/00030259		16/06/2022
Assessor Name	**Report Created**	**BAM Data version ***
George Thomas Plunkett	16/09/2022	54
Assessor Number	**Assessment Type**	**BAM Case Status**
BAAS19010	Biocertification	Finalised
Assessment Revision		**Date Finalised**
5		16/09/2022

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

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Australasian Bittern	Botaurus poiciloptilus	1232-Coastal freshwater swamp forest
Australian Painted Snipe	Rostratula australis	1232-Coastal freshwater swamp forest
Barking Owl	Ninox connivens	1232-Coastal freshwater swamp forest
Black Bittern	Ixobrychus flavicollis	1232-Coastal freshwater swamp forest
Dusky Woodswallow	Artamus cyanopterus cyanopterus	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
Eastern Osprey	Pandion cristatus	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
Glossy Black-Cockatoo	Calyptorhynchus lathami	1232-Coastal freshwater swamp forest
Grey-headed Flying-fox	Pteropus poliocephalus	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
Large Bent-winged Bat	Miniopterus orianae oceanensis	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest

Little Bent-winged Bat	Miniopterus australis	1232-Coastal freshwater swamp forest
Little Eagle	Hieraaetus morphnoides	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
Little Lorikeet	Glossopsitta pusilla	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
Masked Owl	Tyto novaehollandiae	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
New Holland Mouse	Pseudomys novaehollandiae	1793-Coastal Sand Bangalay Forest
Powerful Owl	Ninox strenua	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
Regent Honeyeater	Anthochaera phrygia	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
Rosenberg's Goanna	Varanus rosenbergi	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
Spotted Harrier	Circus assimilis	1232-Coastal freshwater swamp forest
Spotted-tailed Quoll	Dasyurus maculatus	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
Square-tailed Kite	Lophoictinia isura	1232-Coastal freshwater swamp forest
Swift Parrot	Lathamus discolor	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
Varied Sittella	Daphoenositta chrysoptera	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
White-bellied Sea-Eagle	Haliaeetus leucogaster	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
White-throated Needletail	Hirundapus caudacutus	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	1232-Coastal freshwater swamp forest
		1793-Coastal Sand Bangalay Forest

Threatened species Manually Added

None added

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Refer to BAR for detailed justification

BAM Predicted Species Report

Common Name	Scientific Name	Justification in the BAM-C

BAM Candidate Species Report

Proposal Details

Assessment Id 00030258/BAAS19010/21/00030259	Proposal Name	BAM data last updated * 16/06/2022
Assessor Name George Thomas Plunkett	Report Created 16/09/2022	BAM Data version * 54
Assessor Number BAAS19010	Assessment Type Biocertification	BAM Case Status Finalised
Assessment Revision 5	Date Finalised 16/09/2022	

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

List of Species Requiring Survey

Name	Presence	Survey Months
Burhinus grallarius Bush Stone-curlew	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☑ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?
Cercartetus nanus Eastern Pygmy-possum	Yes (assumed present)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Chalinolobus dwyeri Large-eared Pied Bat	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?

Haliaeetus leucogaster White-bellied Sea-Eagle	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☑ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?
Hieraaetus morphnoides Little Eagle	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☑ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern)	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?
Litoria aurea Green and Golden Bell Frog	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?
Litoria brevipalmata Green-thighed Frog	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?
Lophoictinia isura Square-tailed Kite	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☑ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?

Melaleuca biconvexa Biconvex Paperbark	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Meridolum maryae Maroubra Woodland Snail	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☑ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?
Myotis macropus Southern Myotis	Yes (surveyed)	☐ Jan ☐ Feb ☑ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Phascolarctos cinereus Koala	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☑ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Vespadelus troughtoni Eastern Cave Bat	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☑ Dec ☐ Survey month outside the specified months?

Threatened species Manually Added

Common Name	Scientific Name
Eastern Cave Bat	Vespadelus troughtoni

Threatened species assessed as not on site

Refer to BAR for detailed justification

BAM Candidate Species Report

Common name	Scientific name	Justification in the BAM-C
Barking Owl	Ninox connivens	Habitat constraints
Coast Groundsel	Senecio spathulatus	Habitat constraints
Eastern Osprey	Pandion cristatus	Habitat constraints
Glossy Black-Cockatoo	Calyptorhynchus lathami	Habitat constraints
Grey-headed Flying-fox	Pteropus poliocephalus	Habitat constraints
Large Bent-winged Bat	Miniopterus orianae oceanensis	Habitat constraints
Little Bent-winged Bat	Miniopterus australis	Habitat constraints
Magenta Lilly Pilly	Syzygium paniculatum	Refer to BAR
Masked Owl	Tyto novaehollandiae	Habitat constraints
Powerful Owl	Ninox strenua	Habitat constraints
Regent Honeyeater	Anthochaera phrygia	Habitat constraints
Sand Spurge	Chamaesyce psammogeton	Refer to BAR
Squirrel Glider on Barrenjoey Peninsula, north of Bushrangers Hill	Petaurus norfolcensis - endangered population	Refer to BAR
Swift Parrot	Lathamus discolor	Habitat constraints

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00030258/BAAS19010/21/00030259

Proposal Name

BAM data last updated *
16/06/2022

Assessor Name
George Thomas Plunkett

Assessor Number
BAAS19010

BAM Data version *
54

Proponent Names

Report Created
16/09/2022

BAM Case Status
Finalised

Assessment Revision
5

Assessment Type
Biocertification

Date Finalised
16/09/2022

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

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Vespadelus troughtoni / Eastern Cave Bat

Additional Information for Approval

PCT Outside Ibra Added

BAM Biodiversity Credit Report (Like for like)

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1232-Coastal freshwater swamp forest	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.2	3	0	3
1793-Coastal Sand Bangalay Forest	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions	0.2	3	0	3
1232-Coastal freshwater swamp forest	Not a TEC	0.8	0	0	0

1232-Coastal freshwater swamp forest	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 915, 916, 917, 918, 919, 1125, 1230, 1232, 1234, 1235, 1236, 1726, 1727, 1728, 1729, 1731, 1800, 1808	-	1232_poor	Yes	3	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1232-Coastal freshwater swamp forest	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Coastal Swamp Forests This includes PCT's: 1232, 1723	Coastal Swamp Forests >=90%	1232_derived_exotic	Yes	0	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Coastal Swamp Forests This includes PCT's: 1232, 1723	Coastal Swamp Forests >=90%	1232_pasture_ weeds	No	0	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1793-Coastal Sand Bangalay Forest	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions This includes PCT's: 659, 1793, 1794	-	1793_poor	Yes	3	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

BAM Biodiversity Credit Report (Like for like)

Species	Vegetation Zone/s	Area / Count	Credits
Cercartetus nanus / Eastern Pygmy-possum	**1232_poor, 1793_poor**	0.4	6.00
Myotis macropus / Southern Myotis	**1232_poor, 1793_poor, 1232_derived_exotic, 1232_pasture_weeds**	1.2	8.00
Vespadelus troughtoni / Eastern Cave Bat	**1232_poor, 1793_poor, 1232_derived_exotic, 1232_pasture_weeds**	1.2	11.00

Credit Retirement Options

Like-for-like credit retirement options

Cercartetus nanus / Eastern Pygmy-possum	Spp	IBRA subregion
	Cercartetus nanus / Eastern Pygmy-possum	Any in NSW
Myotis macropus / Southern Myotis	Spp	IBRA subregion
	Myotis macropus / Southern Myotis	Any in NSW
Vespadelus troughtoni / Eastern Cave Bat	Spp	IBRA subregion
	Vespadelus troughtoni / Eastern Cave Bat	Any in NSW

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id

00030258/BAAS19010/21/00030259

Proposal Name

BAM data last updated *

16/06/2022

Assessor Name

George Thomas Plunkett

Assessor Number

BAAS19010

BAM Data version *

54

Proponent Name(s)

Report Created

16/09/2022

BAM Case Status

Finalised

Assessment Revision

5

Assessment Type

Biocertification

Date Finalised

16/09/2022

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Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Vespadelus troughtoni / Eastern Cave Bat

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1232-Coastal freshwater swamp forest	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.2	3	0	3.00
1793-Coastal Sand Bangalay Forest	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions	0.2	3	0	3.00
1232-Coastal freshwater swamp forest	Not a TEC	0.8	0	0	0.00

1232-Coastal freshwater swamp forest

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region

	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 915, 916, 917, 918, 919, 1125, 1230, 1232, 1234, 1235, 1236, 1726, 1727, 1728, 1729, 1731, 1800, 1808	-	1232_poor	Yes	3	Pittwater,Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Forested Wetlands	Tier 1	1232_poor	Yes (including artificial)	3	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1232-Coastal freshwater swamp forest	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Coastal Swamp Forests This includes PCT's: 1232, 1723	Coastal Swamp Forests >=90%	1232_derived_exotic	Yes	0	Pittwater,Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Coastal Swamp Forests This includes PCT's: 1232, 1723	Coastal Swamp Forests >=90%	1232_pasture_weeds	No	0	Pittwater,Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Forested Wetlands	Tier 1	1232_derived_exotic	Yes (including artificial)	0	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Forested Wetlands	Tier 1	1232_pasture_weeds	No	0	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1793-Coastal Sand Bangalay Forest	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions This includes PCT's: 659, 1793, 1794	-	1793_poor	Yes	3	Pittwater,Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region

	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 3 or higher threat status	1793_poor	Yes (including artificial)	3	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Cercartetus nanus / Eastern Pygmy-possum	**1232_poor, 1793_poor**	0.4	6.00
Myotis macropus / Southern Myotis	**1232_poor, 1793_poor, 1232_derived_exotic, 1232_pasture_weeds**	1.2	8.00
Vespadelus troughtoni / Eastern Cave Bat	**1232_poor, 1793_poor, 1232_derived_exotic, 1232_pasture_weeds**	1.2	11.00

Credit Retirement Options

Like-for-like options

Cercartetus nanus/ Eastern Pygmy-possum

Spp	IBRA region
Cercartetus nanus/Eastern Pygmy-possum	Any in NSW

Variation options

Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region

	Fauna	Vulnerable	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Myotis macropus/ Southern Myotis	Spp	IBRA region	
	Myotis macropus/Southern Myotis	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Vespadelus troughtoni/ Eastern Cave Bat	Spp	IBRA region	
	Vespadelus troughtoni/Eastern Cave Bat	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region

	Fauna	Vulnerable	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.