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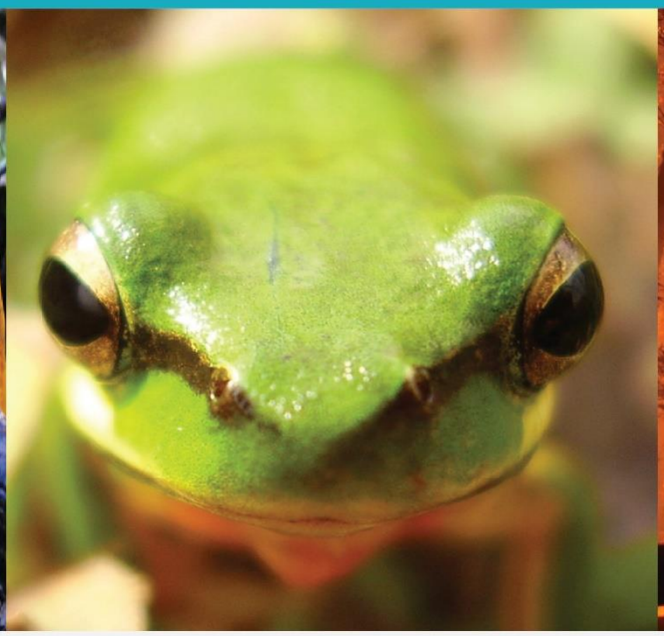


BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT

Streamlined assessment – Small Area Module

Proposed Development

Lots 3 and 4 DP26902

10 and 12 Boondah Road

Warriewood

1 July 2024

(REF: HEN09ECO)

BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT

Proposed Commercial Development

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

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Date:	01/07/24
File:	HEN09ECO

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Disclaimer:

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The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features is to be confirmed by a registered surveyor.

EXECUTIVE SUMMARY

Travers bushfire & ecology has been engaged to prepare a biodiversity development assessment report (BDAR) for the proposed plant nursery at 10 and 12 Boondah Road, Warriewood. The entire two (2) lots have 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 proposed development will incorporate a plant nursery containing a garden centre, toilet facilities, plant room, storage, loading dock, internal road network, pathways, rear fire trail, a children's playground, a garden, relax area, car and bike parking, propagation area, and multiple areas for the plant storage.

The site is bushfire prone and will require management around the inhabited garden centre for compliance.

The site is zoned RU2 currently, which allows for a plant nursery to be permitted with consent.

Travers bushfire & ecology have a long history with this site, having undertaken various ecological surveys since 2013. For compliance with the Biodiversity Assessment Methodology (BAM 2020), only surveys that are <5 years are can be used for compliance, ie, 2019 onwards.

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*).

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 5.1. The resultant direct, indirect and cumulative ecological impacts of the proposal have been carefully considered in Section 5.3. 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 5.2.

The Development Proposal will see the impact of 0.83 ha of all vegetation types, which includes impacts to five different vegetation units including the following (PCT below refers to Plant Community Type):

- Zone1: PCT 4028 - Estuarine Swamp Oak Twig-rush Forest (TEC) – 0.06 ha impacted
- Zone 2: PCT 3638 - Coastal Sand Bangalay Forest (TEC) – 0.11 ha impacted
- Planted and derived exotic vegetation – 0.18 ha impacted
- Pasture and weeds – 0.40 ha impacted
- Planted native vegetation – 0.06 ha impacted

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

The assessment of serious and irreversible impacts are set out under Section 6.7.2 of the *BC Reg 2017* to guide the determining authority on this decision. These principles have been reviewed and assessed in Section 5.3.4 and Appendix 1 and 2.

Biodiversity Offsets Scheme (BOS) – Threshold assessment

The proposed development exceeds the nominated threshold triggers of 1) impacting Biodiversity Values Land and 2) the Area clearing Threshold as assessed in Section 1.4. Therefore, biodiversity offsets are required under the Biodiversity Offsets Scheme (BOS).

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.

Table A – Requirement for ecosystem credits

PCT	TEC	Area (ha)	Credits
4028 - Estuarine Swamp Oak Twig-rush Forest	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.06	1
3638 - South Coast Sands Bangalay Forest	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions	0.11	2

Table B – Requirement for species credits

Species	Area (ha)	Credits
Eastern Cave Bat	0.17	5

Species	Area (ha)	Credits
Southern Myotis	0.17	3

As of October 2022, accredited assessors cannot access the BOP-C payment calculator to provide an estimation of costs for credits. For estimates on credit values, the proponent may engage with the Biodiversity Conservation Trust (BCT) who now provide a credit costing service through the Conservation Fund Charge System (see https://www.bct.nsw.gov.au/cards/pay-fund-offset-development).

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	Commonwealth Department of Agriculture, Water and the Environment (superseded by DCCEEW)
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
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 Dec 2022)
EEC	Endangered Ecological Community
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
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
TEC	Threatened Ecological Community
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 development 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 this entire lot is shown in Figure 1-1 below. This lot is subject to a proposed development 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 'development footprint' (refer to Figure 1-2).

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

Figure 1-1 – Study area (red) and development footprint (yellow)

1.1 Purpose

The purpose of this Biodiversity Development Assessment Report (BDAR) 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 BDAR 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 BDAR 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 BDAR 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.

Lindsay Holmes (BAAS 17032) is an accredited person under the *BC Act.* I  certify here that the report has been prepared on the basis of the requirements of (and information provided under) the BAM and I declare that I have no conflict of interest with this proposal. The data finalised in the BAM-C is 01 July 2024. The BDAR is to be lodged within 14 days of this date for compliance.

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 footprint 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 and landscape features

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

Table 1-1 – Site and landscape features

Location	Lots 3 and 4 DP26902 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 2.04 ha
Local government area	Northern Beaches (formerly Pittwater)
Zoning	RU2 – Rural Landscape
Minimum lot size	10,000 m^2 (1 ha)
Grid reference MGA-56	342213E 6270482S
Elevation	Approximately 3-6m 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.

Is a watercourse or waterfront land impacting the site?	Yes. Warriewood Wetlands
Are GDEs present onsite?	Yes
Is site mapped as a Coastal Wetland or proximity area to a Coastal Wetland?	Yes
Patch size	>100 ha
IBRA bioregions and subregions	Sydney Basin bioregion / Pittwater subregion
NSW landscape region and area (ha)	Sydney - Newcastle Barriers and Beaches
Native vegetation extent in the buffer area (1,500 m)	181 ha approx. and 23% Cover class: 10–30%
Cleared areas	Approximately 0.4 / 2.04 ha of native vegetation remains, thus 80% has been 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.
SEPP (Biodiversity and Conservation) 2021 – Koala Habitat Protection	Schedule 2 LGA: Yes Core Koala Habitat: No Koala SEPP applies?: Yes
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 creek line 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

1.3 Proposed development and BOS entry pathway

1.3.1 Proposal description

The proposed development will incorporate a plant nursery containing a garden centre, toilet facilities, plant room, storage, loading dock, internal road network, pathways, rear fire trail, a children’s playground, a garden, relax area, car and bike parking, propagation area, and multiple areas for the plant storage.

The site is bushfire prone and will require minimum setbacks around the garden centre. The perimeter of the site was previously utilised as an APZ, however this is now a wetland buffer where APZ management will now not be undertaken.

The site is zoned RU2 currently, which allows for a plant nursery to be permitted with consent.

There is a setback along the western boundary to the wetland that avoids the bulk of Swamp Oak Floodplain Forest (threatened ecological community) within the site boundary, allowing for a buffer to the adjoining wetland area.

Part of the northern portion of the site has been redesigned to protect additional trees of Bangalay Sand Forest (threatened ecological community) origin also.

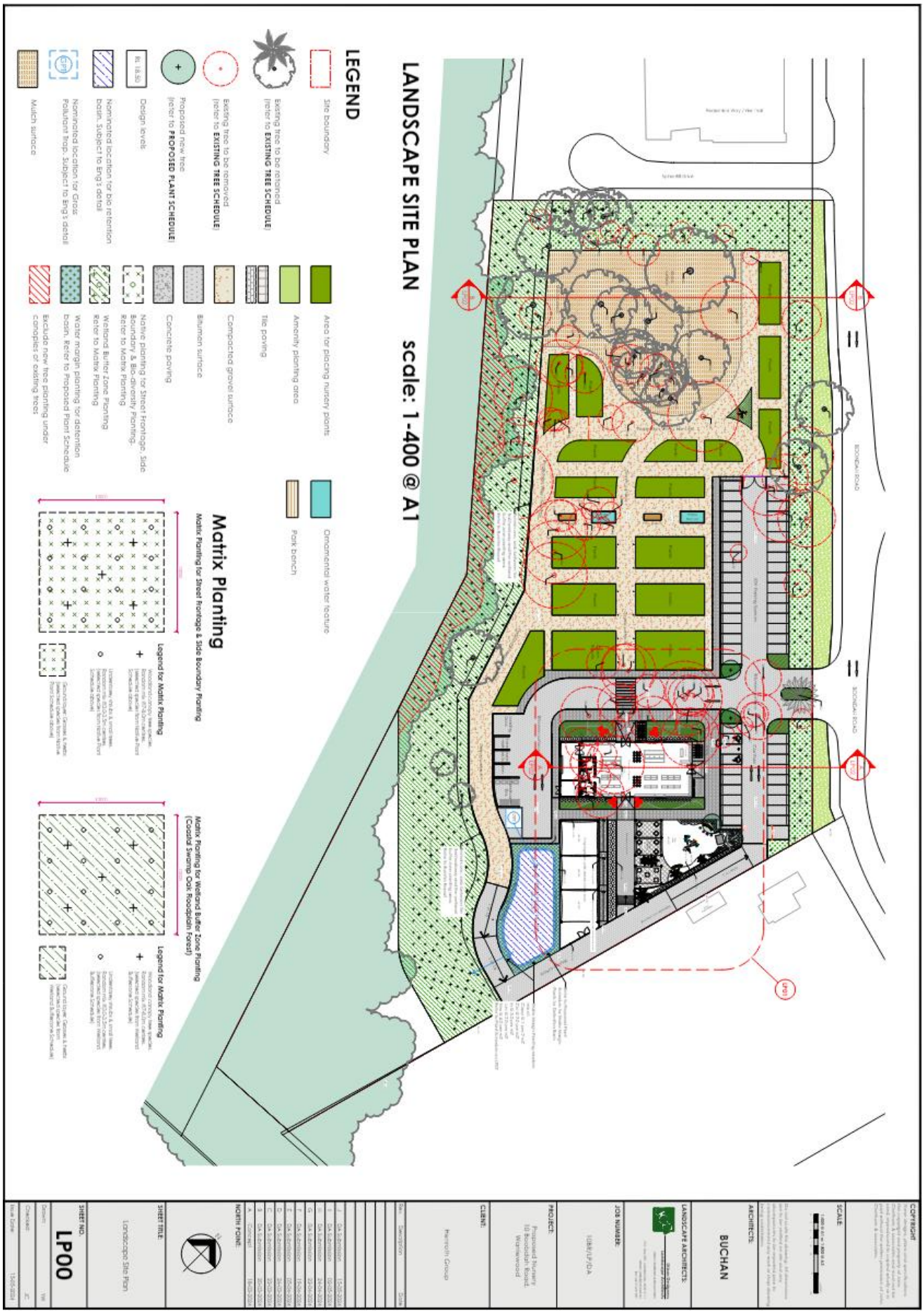


Figure 1-2 - Current proposed development layout

1.3.2 BOS entry pathway

Entry into the Biodiversity Offset Scheme (BOS) can occur through multiple mechanisms. The BOS applies to:

- local development (assessed under Part 4 of the *Environmental Planning and Assessment Act 1979*) that is likely to significantly affect threatened species. Local development is likely to significantly affect threatened species and require a biodiversity development assessment report (section 7.7 of the *Biodiversity Conservation Act 2016*) if impacts either:
    - exceed the Biodiversity Offsets Scheme threshold (*BC Act*, section 7.4); the threshold includes clearing on land within the Biodiversity Values Map or clearing of an area that exceeds the threshold
    - are carried out on an Area of Outstanding Biodiversity Value (AOBV)
    - are likely to significantly affect threatened species, ecological communities and their habitats according to the test in section 7.3 of the *BC Act*
- state significant development and state significant infrastructure projects, unless the Secretary of the Department of Climate Change, Energy, the Environment and Water 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 the Biodiversity Offsets Scheme threshold and does not require development consent
- clearing of native vegetation that requires approval by the Native Vegetation Panel under the *LLS Act, 2013.*

Application under the *EP&A Act*

This is a Part 4 development.

State Significant Project

This project is not a State Significant Project. The BOS is not triggered by this action.

Area clearing trigger

BAM 2020 lists the minimum lot size and clearing threshold as per the screen shot below.

Minimum lot size associated with the property	Threshold for clearing, above which the Biodiversity Assessment Method (BAM) and offsets scheme apply
Less than 1 ha	0.25 ha or more
1 ha to less than 40 ha	0.5 ha or more
40 ha to less than 1000 ha	1 ha or more
1,000 ha or more	2 ha or more

The minimum lot size associated with the development footprint is <1ha. The proposal will impacts below 0.25 ha therefore does not trigger the BOS under this criterion.

Mapped biodiversity values trigger

Any impacts on biodiversity values will trigger the BOS. The mapped biodiversity values is just clear of the outer fire trail, but if we were to apply a tiny buffer (yellow) line to account for

potential construction footprint impacts to allow for any minor filling for the fire trail base, trimming of vegetation, access to build the trail etc, then there would be a minute impact on biodiversity value lands as shown in Figure 1-3.

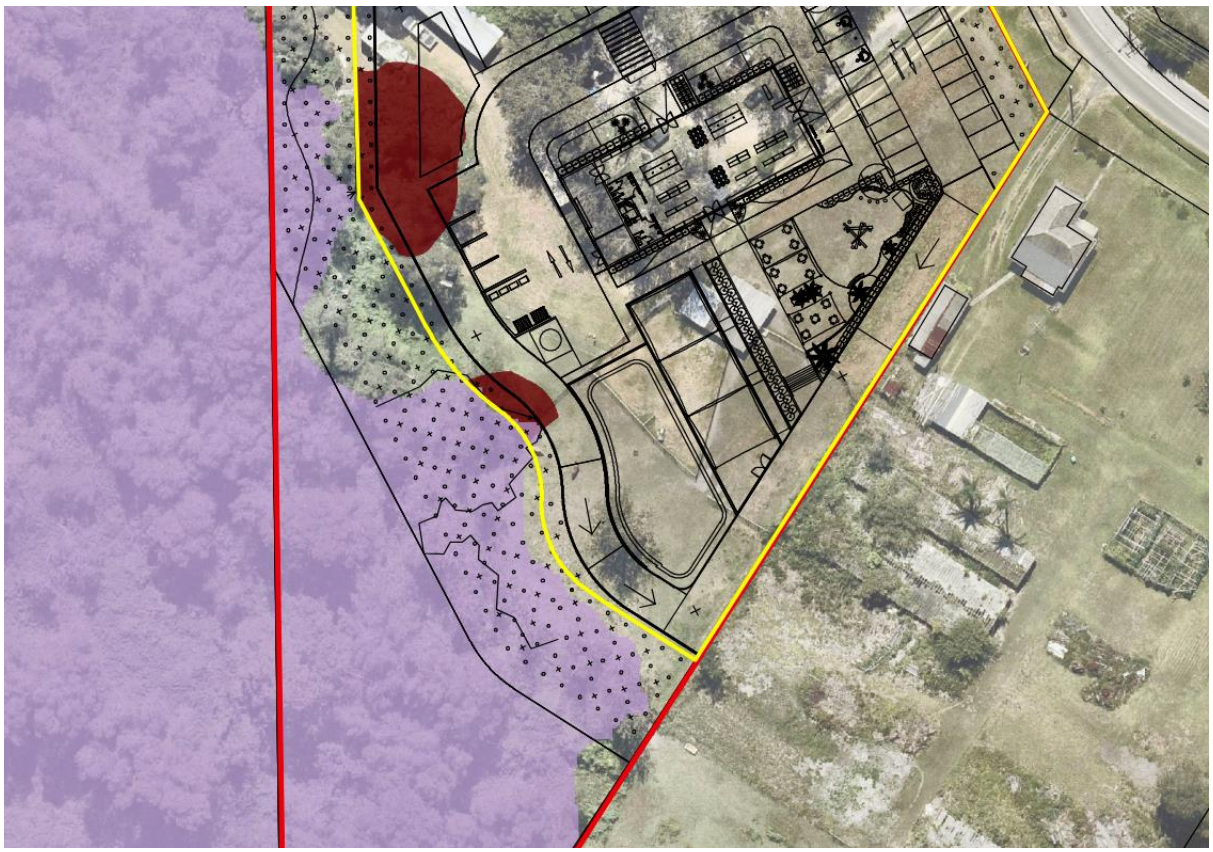


Figure 1-3 - Mapped biodiversity values impacted along the south-east edge of the development footprint

Test of significance trigger

The BOS can be triggered where a test of significance advises a significant impact upon a threatened entity, be it a species, population or community. Whilst this test of significance has not been undertaken, it is possible that a significant impact may have occurred on Bangalay Sand Forest (TEC) given its fragmented nature and isolation in the locality. There are only very small remnants left in the general location, and they predominantly occur as isolated individual trees or very small remnants of less than 0.5 ha. These are generally subject to extreme edge effects where they will unlikely re-establish due to depleted seed banks.

Even if the proposal avoided all biodiversity values land, the potential for a significant impact on Bangalay Sand Forest was a possibility and would have triggered a BDAR. As such, we have applied the precautionary principle to assess the proposal under a BDAR.

1.3.3 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 BDAR. 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 BDAR.

Table 1-2 – 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
	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	If biodiversity values mapped for core koala habitat, then small area streamlined assessment cannot be used Is the area of native vegetation clearing less than or equal to the thresholds as shown in Table 1-3 (BAM Table 12)? This depends on minimum or actual lot size:	**Yes, for Lot sizes <1ha the clearing threshold of 0.25 ha applies. As the clearing is less than 1 ha, a small area module can be used.**	**Yes**

Streamlined assessment module	Criteria for application	Does the impacted vegetation meet this criterion?	Can this module be applied?
	• **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		
Planted native vegetation	**Is any planted native vegetation impacted?**	Yes	No

Table 1-3 – 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	

1.3.4 Streamlined assessment - small area module

Table 1-2 identifies that the small area streamlined assessment module can be used when preparing a BDAR for any future impacts on native vegetation within the site. This will still require offsetting through the BOS, but candidate species credit species that are not at risk of an SAII and are not incidentally recorded on the subject land do not require further assessment or offsets.

1.3.5 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 tea tree 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.

1.3.6 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*.

1.3.7 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 the *EP&A Act*

1.3.8 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.

1.3.9 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 Climate Change, Energy, the Environment and Water (DCCEEW) 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 DCCEEW 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.

1.3.10 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.

1.3.11 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.

1.3.12 State Environmental Planning Policy (Biodiversity and Conservation) 2021

The State Environmental Planning Policy (Biodiversity and Conservation) 2021 (BC SEPP) consolidates, transfers and repeals provisions of the following 11 SEPPs (or deemed SEPPs):

1. SEPP (Vegetation in Non-Rural Areas) 2017 (Vegetation SEPP)
2. SEPP (Koala Habitat Protection) 2020 (Koala SEPP 2020)

3. SEPP (Koala Habitat Protection) 2021 (Koala SEPP 2021)
4. Murray Regional Environmental Plan No 2—Riverine Land (Murray REP)
5. SEPP No 19—Bushland in Urban Areas (SEPP 19)
6. SEPP No 50—Canal Estate Development (SEPP 50)
7. SEPP (Sydney Drinking Water Catchment) 2011 (Sydney Drinking Water SEPP)
8. Sydney Regional Environmental Plan No 20 – Hawkesbury – Nepean River (No 2 – 1997) (Hawkesbury–Nepean River SREP)
9. Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 (Sydney Harbour Catchment SREP)
10. Greater Metropolitan Regional Environmental Plan No 2 – Georges River Catchment (Georges River REP)
11. Willandra Lakes Regional Environmental Plan No 1 – World Heritage Property (Willandra Lakes REP).

No policy changes have been made. The SEPP consolidation does not change the legal effect of the existing SEPPs, with section 30A of the Interpretation Act 1987 applying to the transferred provisions. The SEPP consolidation is administrative. It has been undertaken in accordance with section 3.22 of the Environmental Planning and Assessment Act 1979.

The Biodiversity and Conservation SEPP:

- transfers most existing provisions from the 11 SEPPs being consolidated into chapters 2 to 12. Chapter 1 contains preliminary information and commencement details
- repeals the 11 SEPPs being consolidated.

Koala habitat

The Biodiversity and Conservation SEPP (BC SEPP) repeals the former Koala SEPPs (2020, 2021). 'Chapter 3 – Koala habitat protection 2020' contains provisions from the Koala SEPP 2020 and, as an interim measure, applies in the NSW core rural zones of RU1, RU2 and RU3, except within the Greater Sydney and Central Coast areas. 'Chapter 4 – Koala habitat protection 2021' contains the land-use planning and assessment framework from the Koala SEPP 2021 for koala habitat within Metropolitan Sydney and the Central Coast and applies to all zones except RU1, RU2 and RU3 in the short term – it will apply to all zones once the Koala SEPP 2020 is repealed.

The BC SEPP 2021 commenced on 1st March 2022. Of primary importance for this report, this SEPP now includes the former *State Environmental Planning Policy (Koala Habitat Protection) 2021* which was made and commenced on 17 March 2021. Chapter 4 of the SEPP (Biodiversity and Conservation) 2021, now covers *Koala Habitat Protection (2021)* which incorporates the *State Environmental Planning Policy (Koala Habitat Protection) 2021.*

The Koala SEPP 2021 reinstates the policy framework of SEPP Koala Habitat Protection 2019 to 83 Local Government Areas (LGA) in NSW. At this stage:

- In nine of these LGAs – Metropolitan Sydney (Blue Mountains, Campbelltown, Hawkesbury, Ku-Ring-Gai, Liverpool, Northern Beaches, Hornsby, and Wollondilly) and the Central Coast LGA – Koala SEPP 2021 applies to all zones.
- In all other identified LGAs, Koala SEPP 2021 does not apply to land zoned RU1 Primary Production, RU2 Rural Landscape or RU3 Forestry. For these land types, *State Environmental Planning Policy (Koala Habitat Protection*) 2020 applies.

For all RU1, RU2 and RU3 zoned land outside of the Sydney Metropolitan Area and the Central Coast, Koala SEPP 2020 continues to apply. This is an interim measure while new

land management and private native forestry codes are developed in line with the NSW Government's announcement on 8 March 2021.

The principles of the Koala SEPP 2021 are to:

- Help reverse the decline of koala populations by ensuring koala habitat is properly considered during the development assessment process.

- Provide a process for councils to strategically manage koala habitat through the development of koala plans of management.

Figure 1-4 - Site map

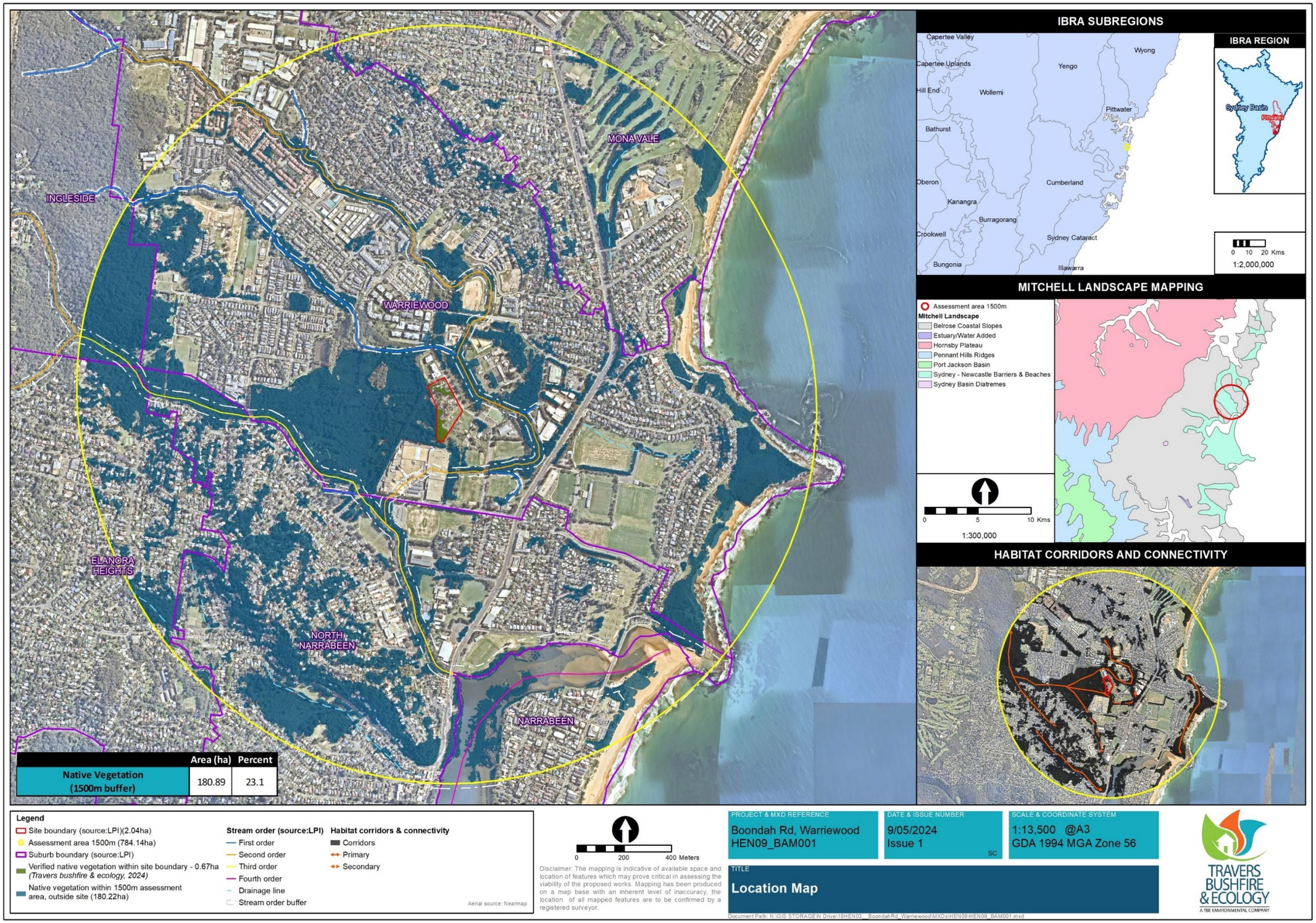


Figure 1-5 - Location map

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:

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

- Correspondence from Henroth outlining the proposal
- Landscape masterplan (Buchan Landscape Architects – 15 May 2024)
- Bushfire Protection Assessment by *Travers bushfire and ecology* (2024)
- 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)
- Biodiversity Certification Assessment Report by *Travers bushfire & ecology* (2022)

Technical resources utilised:

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)
- 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 (2024 to 10 km)

- Atlas of Living Australia (NCRIS/GBIF 2017)
- Birdata (Birdlife Australia 2017)
- NSW Bird Atlas (NSWBA 2017)
- OZCAM (Online Zoological Collection of Australian Museums 2017)
- EPBC Protected Matters Search Tool - DAWE (2024 to 10 km)

Vegetation mapping/resources:

- BioNet Vegetation Classification System
- State Vegetation Type Map (Eastern NSW) (DPE 2022)
- Native Vegetation of the Sydney Metropolitan Area (OEH 2016)

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

Two (2) state listed threatened fauna species including Large Bent-winged 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 BDAR, the threatened fauna recorded as part of this assessment are displayed on Figure 3-1.

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, and
- 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 Bent-winged Bat, Large Bent-winged Bat and Southern Myotis. The Sothern Myotis was recorded roosting in the culvert under the nearby neighbouring shopping complex outside of the subject land.

Biodiversity Certification Assessment Report prepared by Travers bushfire & ecology (2022)

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 and derived exotic vegetation
- Pasture and weeds
- Planted native vegetation

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.

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*) were observed within the study site during 2021/2022 survey.

As the 2019 survey was conducted within 5 years of the 2022 proposal, it was utilised for the purposes of threatened species credit assessment in the BDAR in accordance with the BAM.

Threatened fauna recorded as part of the 2022 BCAR assessment are displayed on Figure 3-1.

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 in 1 m x 1 m subplots at five (5) locations along the central transect (20 m x 50 m)

2024

Additional flora survey was undertaken 26th March 2024.

Stratified survey using the BAM was undertaken. The following information was collected at each of four (2) 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 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 4, this includes the 2 plots undertaken in the 2021/2022 survey in remnant vegetation, and the 2 plots undertaken in 2024 in similar locations.

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 2-1.

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 2-1). 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 2-1 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. 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. 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 2-1.

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 3-6 – Habitat tree data.

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

Several surveys have been undertaken. Table 2-1 and Table 2-2 details the survey effort undertaken in the study area. Table 2-3 lists out the flora plot details used in the BAM-C.

Table 2-1 – Fauna survey effort

Fauna group	Date	Weather conditions	Survey technique(s)	Time effort (24hr)
	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
	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
			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

Fauna group	Date	Weather conditions	Survey technique(s)	Time effort (24hr)
	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
	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

Fauna group	Date	Weather conditions	Survey technique(s)	Time effort (24hr)
	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
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
	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

Fauna group	Date	Weather conditions	Survey technique(s)	Time effort (24hr)
		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, 26 March 2024
Stratified sampling	Four (4) 20 m x 20 m flora quadrats Four (4) 20 m x 50 m BAM plots within the subject land Two (2) 20 m x 50 m BAM plots within the subject land	19 June, 8 Aug 2019 13 Dec 2021 26 March 2024
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	Plots sampled	Plot identifier	Plot size	Centroid easting	Centroid northing	Bearing
1	3638	Poor	0.11	1	2	Q1 (2021) Q1 (2024)	20 m x 20 m	342180 342176	6270599 6270602	99 284
2	4028	Poor	0.06	1	2	Q2 (2021) Q2 (2024)	20 m x 20 m	342180 342176	6270452 6270471	165 330

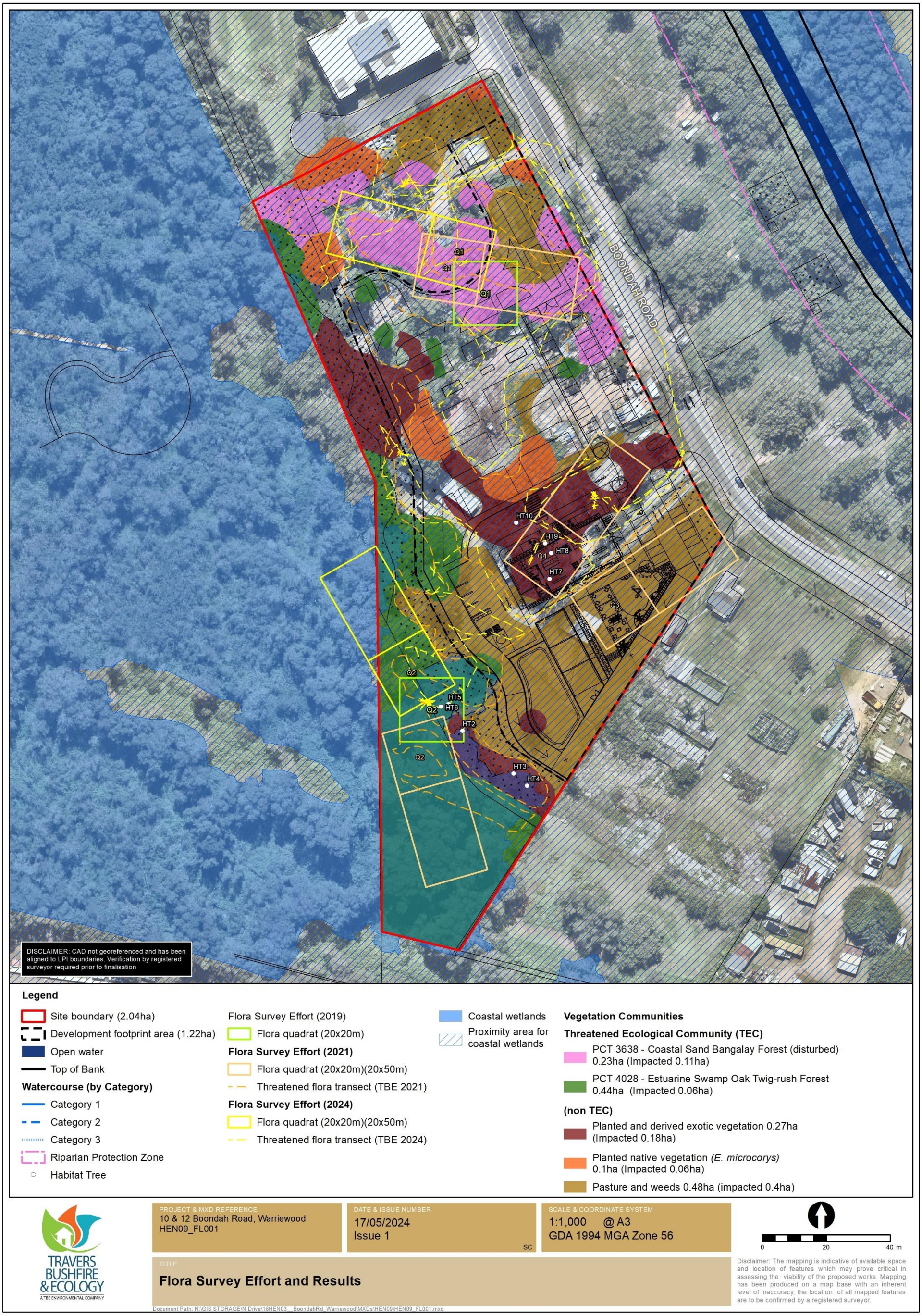


Figure 2-1 - Flora survey effort and results

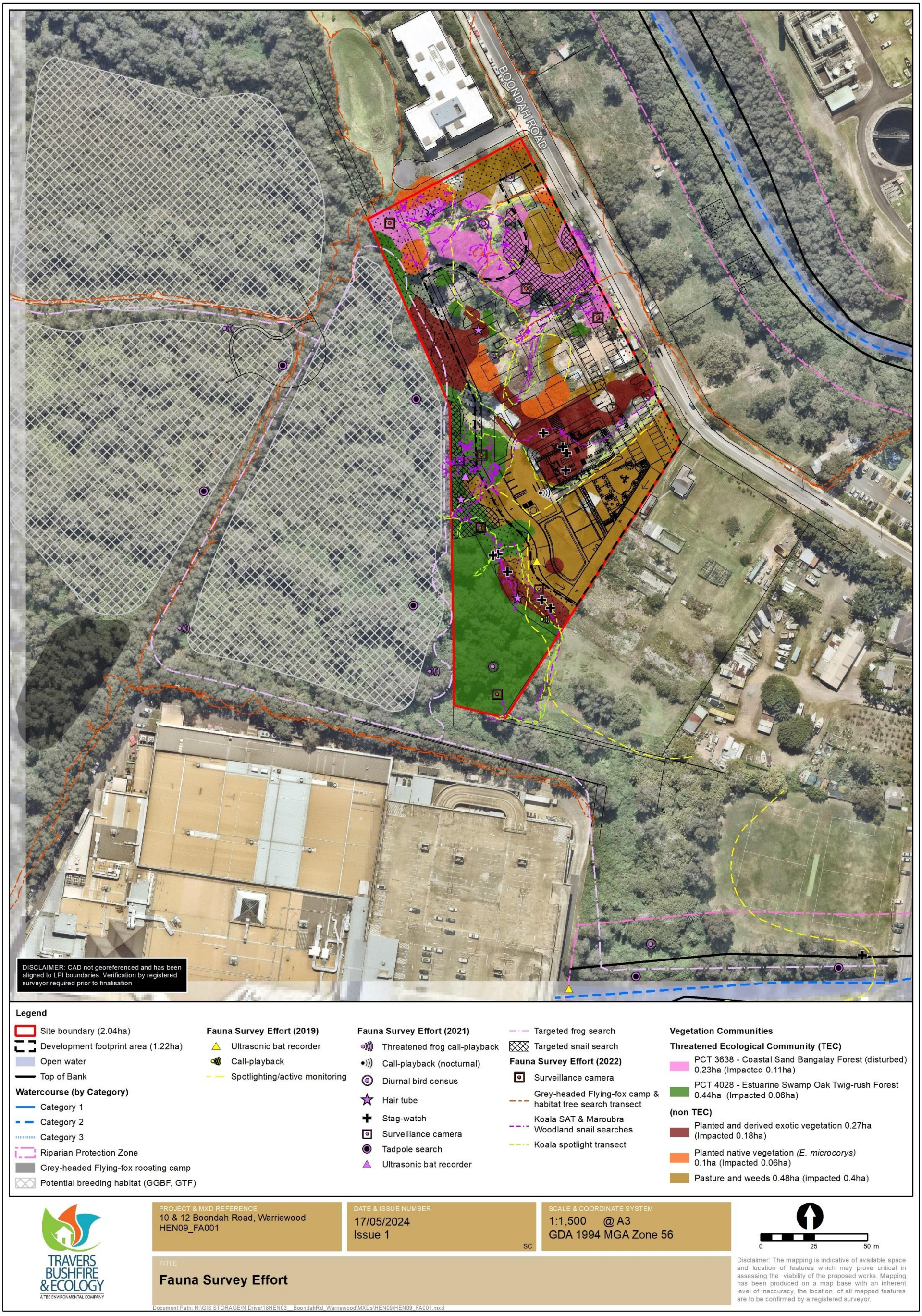


Figure 2-2 - Fauna survey effort

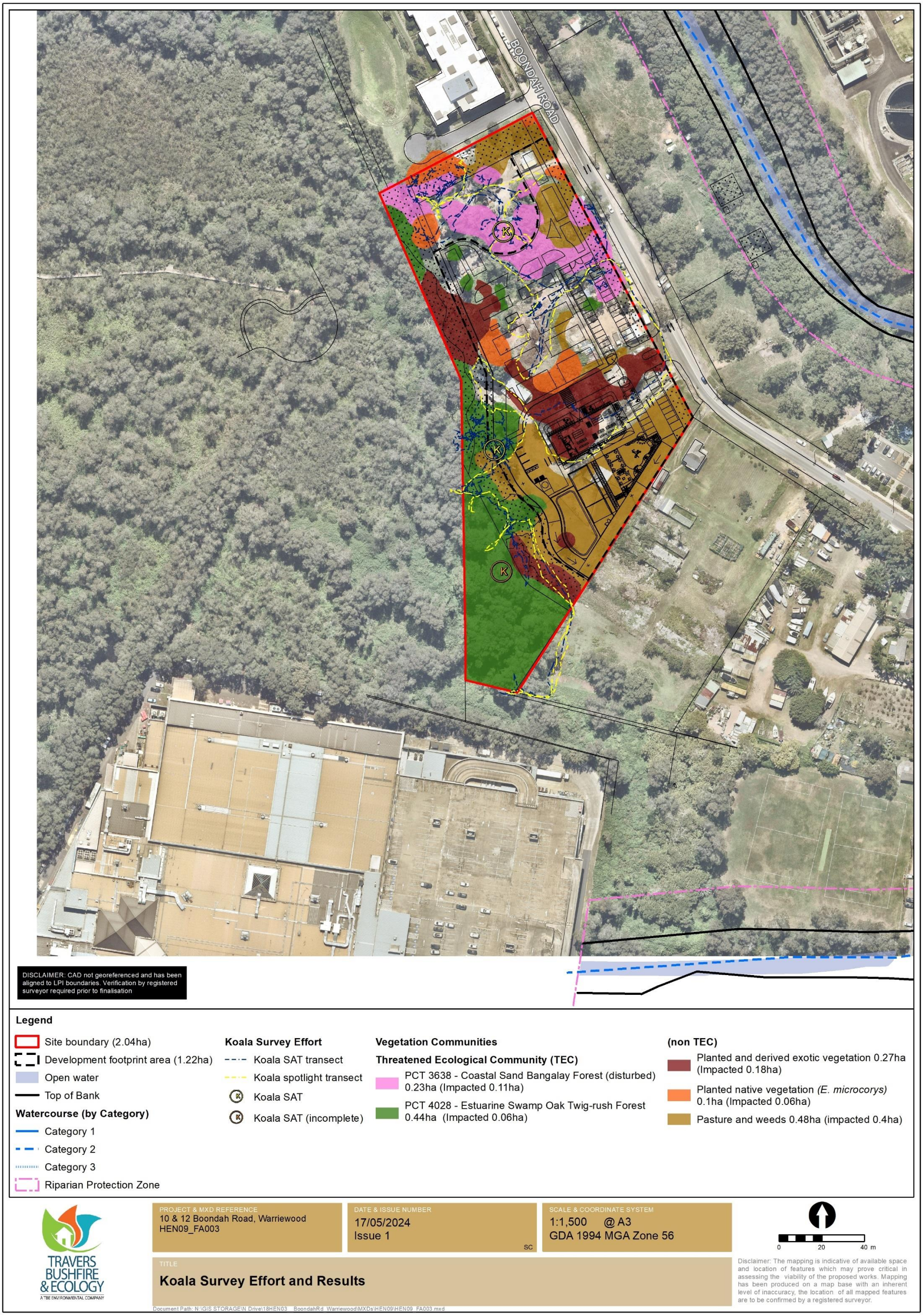


Figure 2-3 - Koala survey effort and results

3. SURVEY RESULTS

3.1 Flora results

3.1.1 Vegetation communities observed

The following vegetation communities were recorded within the study area:

- Zone 1: PCT 4028 - Estuarine Swamp Oak Twig-rush Forest
- Zone 2: PCT 3638 - South Coast Sands Bangalay Forest
- Planted and derived exotic vegetation
- Pasture and weeds
- Planted native vegetation

Zone 1 short list and justification

Table 3-1 - Zone 1 PCT short list

PCT ID	Formation	Class	Vegetation type	No of matches	Suitable?
3234	Wet Sclerophyll Forests (Grassy sub-formation)	Northern Hinterland Wet Sclerophyll Forests	Hunter Coast Lowland Spotted Gum Moist Forest	13	Wrong formation
3242	Wet Sclerophyll Forests (Grassy sub-formation)	Northern Hinterland Wet Sclerophyll Forests	Lower North Ranges Turpentine Moist Forest	13	Wrong formation
3262	Wet Sclerophyll Forests (Grassy sub-formation)	Northern Hinterland Wet Sclerophyll Forests	Sydney Turpentine Ironbark Forest	13	Wrong formation
3546	Dry Sclerophyll Forests (Shrubby sub-formation)	Coastal Dune Dry Sclerophyll Forests	Coastal Sands Littoral Scrub-Forest	13	Wrong class
3133	Rainforests	Littoral Rainforests	Sydney Coast Tuckeroo Littoral Rainforest	12	Wrong formation
3592	Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Coastal Dry Sclerophyll Forests	Sydney Coastal Enriched Sandstone Forest	12	Possible
3039	Rainforests	Northern Warm Temperate Rainforests	Sydney Coastal Lilly Pilly-Palm Gallery Rainforest	11	Wrong formation
3040	Rainforests	Northern Warm Temperate Rainforests	Sydney Coastal Foreshores Gully Rainforest	11	Wrong formation
3594	Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Coastal Dry Sclerophyll Forests	Sydney Coastal Sandstone Foreshores Forest	11	Possible
3638	Dry Sclerophyll Forests (Shrubby sub-formation)	South Coast Sands Dry Sclerophyll Forests	South Coast Sands Bangalay Forest	11	Possible
3237	Wet Sclerophyll Forests (Grassy sub-formation)	Northern Hinterland Wet Sclerophyll Forests	Hunter Range Blue Gum Gully Forest	11	Wrong formation
4006	Forested Wetlands	Coastal Swamp Forests	Northern Paperbark-Swamp Mahogany Saw-sedge Forest	11	Wrong formation
4036	Forested Wetlands	Coastal Floodplain Wetlands	Hunter Coast Lake Flats Apple Forest	11	Wrong formation

Based off the native species list from Quadrat 1 (2024), the short list of potential PCTs has been reduced to PCT 3592, PCT 3594 and PCT 3638 based on the observed vegetation formation and class.

PCT 3592 – Sydney Coastal Enriched Sandstone Forest

The study area is located upon quaternary geology, not sandstone geology.

PCT 3594 – Sydney Coastal Sandstone Foreshores Forest

The study area is located upon quaternary geology, not sandstone geology.

PCT 3638 – South Coast Sands Bangalay Forest

Bangalay is a dominant tree with Smooth-barked Apple on site, both of which are common to the community. The shrub layer has been removed due to the long history of land use, and the ground layer is heavily modified, with only species that are found in all types of communities, that are not very specific to a particular type of vegetation formation or class. Of the ground layer, species observed that are common to PCT 3638 include *Oplismenus imbecillis, Dianella caerulea* and *Commelina cyanea.* Within the plot though, these three (3) species made up less than 5% cover because the exotic species dominated.

Out of the short list of PCTs for consideration, PCT 3638 was the best fit.

Zone 1 short list and justification

PCT ID	Formation	Class	Vegetation type	No of matches	Suitable?
4006	Forested Wetlands	Coastal Swamp Forests	Northern Paperbark-Swamp Mahogany Saw-sedge Forest	11	Possible
4044	Forested Wetlands	Coastal Floodplain Wetlands	Northern Creekflat Eucalypt-Paperbark Mesic Swamp Forest	11	Possible
4028	Forested Wetlands	Coastal Floodplain Wetlands	Estuarine Swamp Oak Twig-rush Forest	11	Possible
3039	Rainforests	Northern Warm Temperate Rainforests	Sydney Coastal Lilly Pilly-Palm Gallery Rainforest	10	Wrong formation
4019	Forested Wetlands	Coastal Floodplain Wetlands	Coastal Alluvial Bangalay Forest	10	Possible
4057	Forested Wetlands	Coastal Floodplain Wetlands	Sydney Creekflat Swamp Mahogany-Paperbark Forest	10	Possible
3986	Forested Wetlands	Coastal Swamp Forests	Coastal Sands Swamp Mahogany Rush Forest	9	Possible
4009	Forested Wetlands	Coastal Swamp Forests	Shoalhaven Lowland Flats Wet Swamp Forest	9	Geographically no

PCT 4006 – Northern Paperbark-Swamp Mahogany Saw-sedge Forest

Swamp Mahogany is absent, however it does occur extensively across Warriewood Wetlands, outside of the study area.

PCT 4044 - Northern Creekflat Eucalypt-Paperbark Mesic Swamp Forest

Eucalyptus species are absent.

PCT 4028 – Estuarine Swamp Oak Twig-rush Forest

Swamp Oak dominates the canopy. Twig-rush is absent from the study area but noted just off site. Melaleucas are often present, but not dominant which is as expected.

PCT 4019 – Coastal Alluvial Bangalay Forest

Bangalay is absent.

PCT 4057 – Sydney Creekflat Swamp Mahogany-Paperbark Forest

Swamp Mahogany is absent from the study area but occurs close. None of the ten (10) most dominant canopy species are present, and *Casuarina glauca* only occurs at 12% of site but is the dominant canopy species in the study area.

PCT 3986 – Coastal Sands Swamp Mahogany Rush Forest

Swamp Mahogany is absent from the study area but occurs close. None of the ten (10) most dominant canopy species are present, and *Casuarina glauca* only occurs at 12% of site but is the dominant canopy species in the study area.

Out of the short list of PCTs for consideration, PCT 4028 was the best fit.

3.1.2 Plant community types (PCTs)

All plot sheets utilised for the BAM calculator are in Appendix 3.

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.

Table 3-2 – PCTs

PCT code	PCT name	Species relied upon	Vegetation formation	Vegetation class	% Cleared	Area within development site (ha)	TEC status
4028	Estuarine Swamp Oak Twig-rush Forest	*Casuarina glauca*	Forested Wetlands	Coastal Swamp Forests	63	0.44 on site, 0.06 to be impacted	Swamp Oak Floodplain Forest
3638	South Coast Sands Bangalay Forest	*E. botryoides A. costata Glochidion ferdinandi*	Dry Sclerophyll Forests (Shrubby sub-formation);	South Coast Sands Dry Sclerophyll Forests;	45	0.23 ha on site, 0.11 ha to be impacted	Bangalay Sand Forest

3.1.3 Vegetation descriptions of observed communities

Zone 1: PCT 4028-Estuarine Swamp Oak Twig-rush 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*.

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 (Casuarina glauca) Forest of New South Wales and South East Queensland* which is listed under the *EPBC Act* as an EEC.

Photo 3.1 – PCT 4028-Estuarine Swamp Oak Twig-rush Forest in the southern portion of the subject land

Photo 3.2 – PCT 4028 – Swamp Oak floodplain swamp forest within Plot 2

Zone 2: 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 3.3 – Disturbed PCT 3638-South Coast Sands Bangalay in the northern portion of the subject land

Photo 3.4 – Disturbed PCT 3638-South Coast Sands Bangalay Forest in the northern portion of the subject land

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.

Zone 4 - 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. 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.

3.1.4 Threatened ecological communities

PCT 4028 - Estuarine Swamp Oak Twig-rush Forest

- *BC Act* – Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions, endangered ecological community
- *EPBC Act* – Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales, endangered ecological community

BC Act – The vegetation within the development footprint comprising this TEC is poor quality. The composition and structure condition scores were below 25, and the overall VI score was below 30.

EPBC Act – All PCT 4028 vegetation forms part of the *EPBC*-listed community. The extent of the TEC goes south, as far as Bermagui.

The proposal will impact an estimated 0.06 ha of TEC vegetation.

PCT 3638 – Smooth-barked Apple - Bangalay / Tuckeroo - Cheese Tree open forest

- *BC Act* – Bangalay Sand Forest, Sydney Basin and South East Corner Bioregions, endangered ecological community.
- *EPBC Act* – No equivalent TEC.

The proposal will impact an estimated 0.11 ha of TEC vegetation.

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.

Figure 2-1 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 3-3 – 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	3638_poor	0.11	29.9	22.7	61.9	34.7
2	4028_poor	0.06	24.9	35.2	77.1	40.7

The future vegetation integrity score is measured assuming there will be no vegetation retained within, and to 2 m from, the building footprint and driveway. These areas will have a future vegetation integrity score of zero.

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 3-4.

Table 3-4 – 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	3638_poor	0.11	0	0	0	0
2	4028_poor	0.06	0	0	0	0

3.2 Fauna results

3.2.1 Fauna habitat observations

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

Table-3-5 – 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:	No caves, crevices, escarpments or outcrops recorded within the subject site			
CREVICES:				
ESCARPMENTS:				
OUTCROPS:				
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 ✓	
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 ✓

Topography				
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 ✓		

3.2.2 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 3-6. 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 3-6 – 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

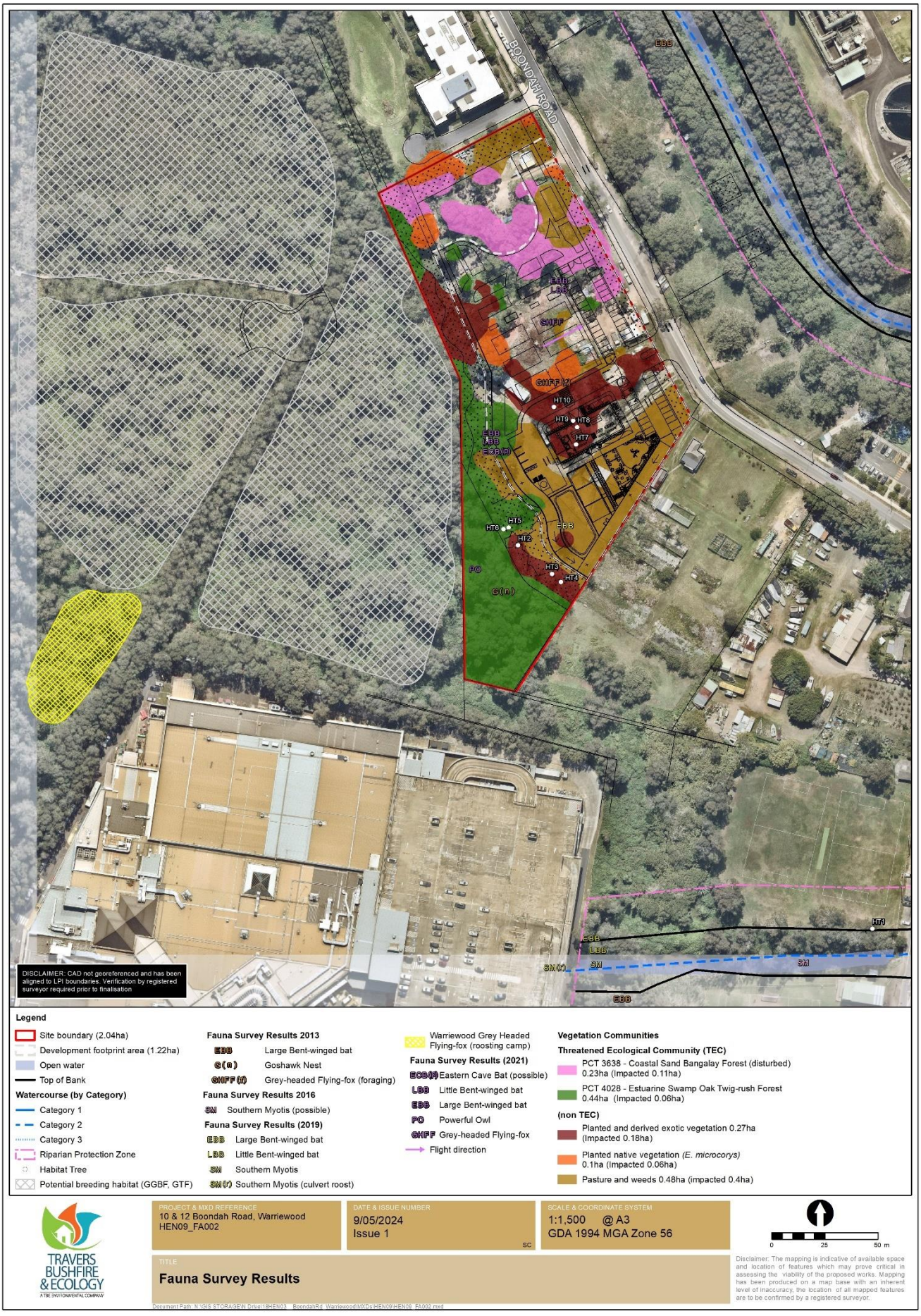


Figure 3-1 - Fauna survey results

3.3 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 3-2 in red (approximate location), 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. Solid lines show high quality links and dashed lines show low-moderate links that are more utilised by highly mobile species.

Figure 3-2 – Local connectivity

4. BIODIVERSITY ASSESSMENT

4.1 Flora 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 4028 - Estuarine Swamp Oak Twig-rush 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 3638 - South Coast Sands Bangalay 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)	
Caladenia tessellata	E	4028, 3638	Yes	Yes	Sep-Oct	Oct	Yes	Absent (survey)
Deyeuxia appressa	E	4028, 3638	Yes	Yes	Dec	Dec	Yes	Absent (survey)
Galium australe	E	4028, 3638	Yes	Yes	Oct-Feb	Oct & Dec	Yes	Absent (survey)
Rhizanthella slateri	V	4028, 3638	No	No (habitat too degraded)	n/a	n/a	n/a	Absent (habitat degraded)

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 Bionet threatened species profiles 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:

Eastern Australian Underground Orchid (*Rhizanthella slateri*)

This species is extremely difficult to detect and often only located once the soil has been disturbed. The species grows in eucalypt forest but no informative assessment of the likely preferred habitat for the species is available.

There are only a few known locations where the species has been observed in NSW including near Bulahdelah (Alum Mountain), Watagan Mountains near Freemans Waterhole, Wisemans Ferry, Agnes Banks, Woollamia – Vincentia area just south of Nowra and two (2) locations in northern Sydney, one (1) of which was discovered in the Ku-ring-gai local government area (Lane Cove catchment) by a conservation detection dog in 2020. One recent finding in 2024 was in Appin, but this data is not published, nor is there a description of the vegetation or edaphic features.

The orchids are usually buried in leaf litter and hence why they are rarely seen.

The habitat within the site is very poor in the ground layer. Only parts of the site contain lawn (southern portion) whilst other areas are covered in wood / woodchip, are mounded, were previously used for horses or are used as driveways. There is a distinct lack of natural leaf littler, with the a very high presence of exotic species. The entire site has been extensively trampled and heavily utilised for several decades.

Given the historical use of the site, lack of leaf litter, very poor disturbed ground layer, and very few records in the Sydney Basin bioregion, it was considered that the site was unlikely to support a population of the orchid species and it will not require target surveys during its spring flowering period.

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 3-6. 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 3-6 provides hollow-bearing tree data and other habitat features recorded. Figure 3-1 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 (9) hollow-bearing trees will be removed by the proposal. A strict removal of hollows process is recommended in Section 5.2 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 Northern Beaches LGA, which is listed under Schedule 2, it is considered that the Koala SEPP 2021 does 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 location 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) lists 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 Northern Beaches 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	Associated PCT	Habitat constraint (Bionet - April 2024)	Habitat constraint presence	Confirmed predicted species
Australasian Bittern	4028	"Brackish or freshwater wetlands"	Absent	No

Common name	Associated PCT	Habitat constraint (Bionet - April 2024)	Habitat constraint presence	Confirmed predicted species
Australian Painted Snipe	4028	No habitat constraints	N/A	No. Excluded due to geographic limitation. Subject site not within 5 km of Homebush Bay
Bar-tailed Godwit	4028	No habitat constraints	N/A	Yes
Black Bittern	3638	"Land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation"	Present	Yes
Brown Treecreeper	4028, 3638	"Only if within 100 m of moderate to good condition vegetation of suitable type"	Present	Yes
Curlew Sandpiper (foraging)	4028	No habitat constraints	N/A	Yes
Dusky Woodswallow	4028, 3638	No habitat constraints	N/A	Yes
Eastern Coastal Free-tailed Bat	4028, 3638	No habitat constraints	N/A	Yes
Eastern Curlew	4028	No habitat constraints	N/A	Yes
Eastern Grass Owl	4028	No habitat constraints	N/A	Yes
Eastern Osprey (foraging)	4028, 3638	"Dead or living trees in cleared and riparian areas"	Present	Yes
Flame Robin	3638	No habitat constraints	N/A	Yes
Gang-gang Cockatoo (foraging)	4028, 3638	No habitat constraints	N/A	Yes
Great Knot (foragining)	4028	No habitat constraints	N/A	Yes
Greater Sand-plover (foraging)	4028	No habitat constraints	N/A	Yes
Grey-headed Flying-fox (foraging)	4028, 3638	No habitat constraints	N/A	Yes
Large Bent-winged Bat (foraging)	4028, 3638	No habitat constraints	N/A	Yes
Lesser Sand-plover (Foraging)	4028	No habitat constraints	N/A	Yes
Little Bent-winged Bat (foraging)	4028	No habitat constraints	N/A	Yes
Little Eagle (foraging)	4028, 3638	No habitat constraints	N/A	Yes
Little Lorikeet	4028, 3638	No habitat constraints	N/A	Yes
Little Tern	4028	No habitat constraints	N/A	Yes
Red Knot	4028	No habitat constraints	N/A	Yes

Common name	Associated PCT	Habitat constraint (Bionet - April 2024)	Habitat constraint presence	Confirmed predicted species
Rosenberg's Goanna	4028, 3638	No habitat constraints	N/A	Yes
South-eastern Glossy Black-Cockatoo (Foraging)	4028, 3638	Presence of Allocasuarina and Casuarina species	Present (4028 only)	Yes
Spotted Harrier	4028, 3638	No habitat constraints	N/A	Yes
Spotted-tailed Quoll	4028, 3638	No habitat constraints	N/A	Yes
Square-tailed Kite (foraging)	4028, 3638	No habitat constraints	N/A	Yes
Swift Parrot (foraging)	4028, 3638	No habitat constraints	N/A	Yes
Turquoise Parrot	4028, 3638	No habitat constraints	N/A	Yes
Varied Sittella	4028, 3638	No habitat constraints	N/A	Yes
White-bellied Sea-Eagle (foraging)	4028, 3638	"Within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines"	Present	Yes
White-throated needletail	4028, 3638	No habitat constraints	N/A	Yes
Yellow-bellied Sheathtail-bat	4028, 3638	No habitat constraints	N/A	Yes

The following species have been excluded from ecosystem credit obligations:

Australasian Bittern – The development footprint does not contain any waterbodies or brackish or freshwater wetlands therefore, this species can be excluded as a predicted species based the lack of habitat constraints.

Australian Painted Snipe - The subject site is not within 5 km of Homebush Bay therefore this species can be excluded as a predicted species based on geographic limitations.

(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	Associated PCTs	Habitat constraint	Confirmed candidate species	Survey adequacy			Presence
				Defined survey months (TBDC)	Actual survey period	Survey compliant (yes / no)	
Curlew Sandpiper (Breeding)	4028	☐ as per mapped areas ☐ Other	no	-	-	-	absent (no mapped important areas)
Great Knot (Breeding)	4028	☐ as per mapped areas ☐ Other	no	-	-	-	absent (no mapped important areas)
Eastern Curlew (Breeding)	4028	☐ as per mapped areas ☐ Other	no	-	-	-	absent (no mapped important areas)
Large Bent-winged Bat (breeding)	4028, 3638	☐ 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	no	Nov-Jan	Nov-Dec	yes	absent (no breeding habitat)
Large-eared Pied Bat	3638	☑ Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, ☐ or within two kilometres of old mines or tunnels	yes	Nov-Jan	Nov-Dec	yes	absent (survey)
Southern Myotis	Not associated	☑ Hollow bearing trees within 200 m of riparian zone ☑ Bridges, caves or artificial structures within 200 m of riparian zone ☐ Waterbodies	yes – recorded	n/a	n/a	n/a	present (recorded)
Little Bent-winged Bat (Breeding)	4028	☐ 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	no	Nov-Jan	Nov-Dec	yes	absent (no breeding habitat)
Swift Parrot (Breeding)	4028, 3638	☐ as per mapped areas ☐ Other	no	n/a	n/a	n/a	absent (no mapped important areas)

Common name	Associated PCTs	Habitat constraint	Confirmed candidate species	Survey adequacy			Presence
				Defined survey months (TBDC)	Actual survey period	Survey compliant (yes / no)	
Eastern Cave Bat	Not associated	☑ Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds."	yes – recorded	Nov-Jan	Nov-Dec	yes	present (recorded)

Excluded species based on the absence of breeding habitat:

- *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.

Excluded species based on the absence of important mapped habitat:

- *Curlew Sandpiper*

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

- *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 (DPE) mapping.

Inclusions due to recorded presence

- *Eastern Cave Bat & Southern Myotis*

  Although not listed as a potential candidate species associated with PCTs 4028 and 3638 these species were 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.

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. 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 2 km of identified potential roost habitat features (TBDC). This equates to all vegetation zones within the subject land (Figure 5-2).

- 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 5-2), which includes the whole extent of all vegetation zones within the subject land.

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 0.06 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 dumping of rubbish and garden waste from the nursery.

  As part of the proposal, a Vegetation Management Plan (VMP) is to be prepared to protect, and mitigate impacts on, the SOFF in the southern portion of the site (*Travers bushfire & ecology,* 2024). The VMP will extend along the outer boundary and will also consolidate and restore adjoining Bangalay Sand Forest (BSF) as well.

All green waste on site is to be disposed of in skip bins or similar, or taken to a nearby waste facility that accepts green waste.

- *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.

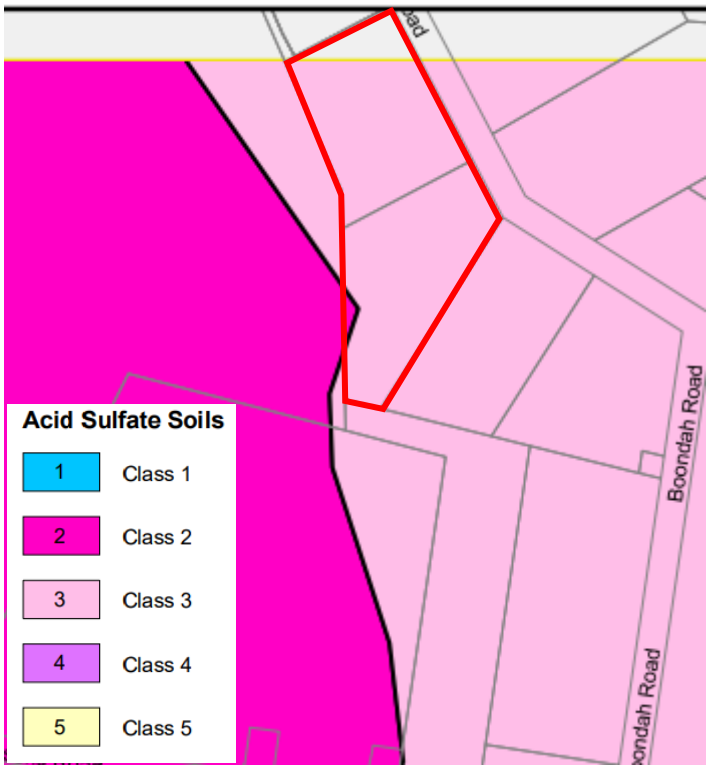


Figure 4-1 – Acid sulfate soils

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.

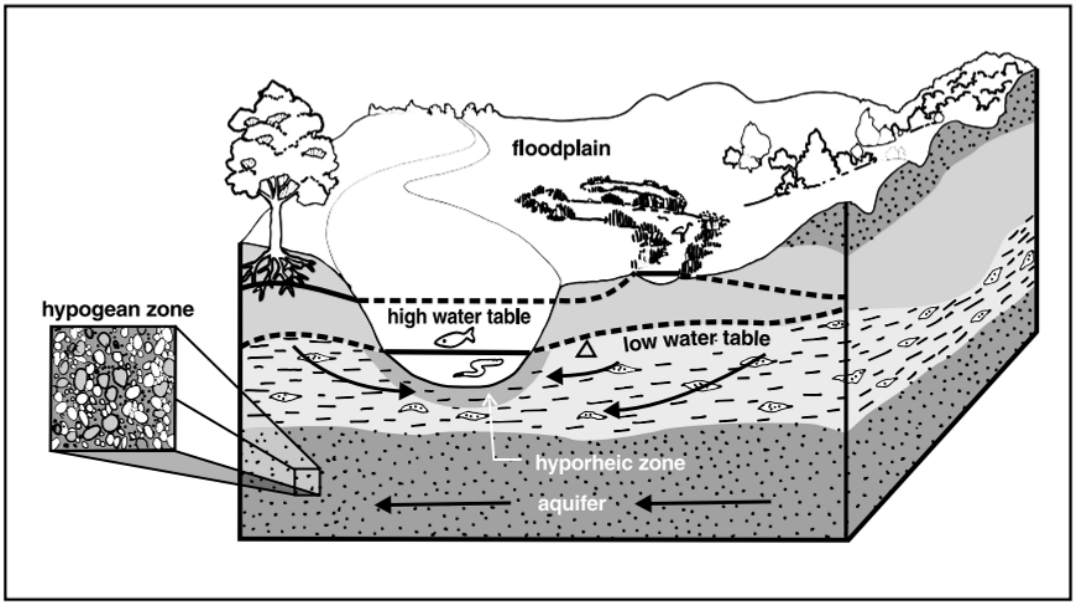


Figure 4-2 – Alluvial groundwater system discharging into a river

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 4-3). 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 (4) 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(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.

There has been significant development in the Warriewood valley area of the last 10-20 years, with low density through to high density developments, all of which have a cumulative impact on the adjacent wetland to the site. The addition of hard surfaces means added runoff and if Warriewood Wetlands are the primary location for storage of this additional runoff from altered hydrology regimes, this puts the site potentially at an increased risk of future flooding at higher levels, long times or high frequency.

To minimise the impacts of the proposal on the adjoining wetland;

- Within APZs the ground layer is maintained, ie. no bare surfaces, to allow infiltration.
- Weed management should be carried out to encourage regeneration of native species that can tolerate acid sulfate soils that regularly occur where SOFF grows.
- Limit or remove access from the nursery to the wetland to reduce or deter trampling and compaction of the soils, potential rubbish dumping or exotic garden wastage.
- Implement the VMP to manage and monitor remnant vegetation and restore existing cleared areas to near natural state of SOFF and BSF.
- Monitor the water levels and nutrients on the adjacent wetland regularly.
- Provide habitat augmentation within the area managed by the VMP to counter some habitat resources which are lost by the development, eg. nest boxes and on-ground logs.

On May 15, 2024, the fire trail on the outer western edge of the site was modified to avoid a direct impact on Coastal Wetland mapped lands (Figure 4-5). A 2m (average) buffer has been applied to the fire trail to account for accidental spill over or indirect impacts, although essentially, the proponent has sought to minimise impacts by adjusting the fire trail design to avoid the mapped wetland.

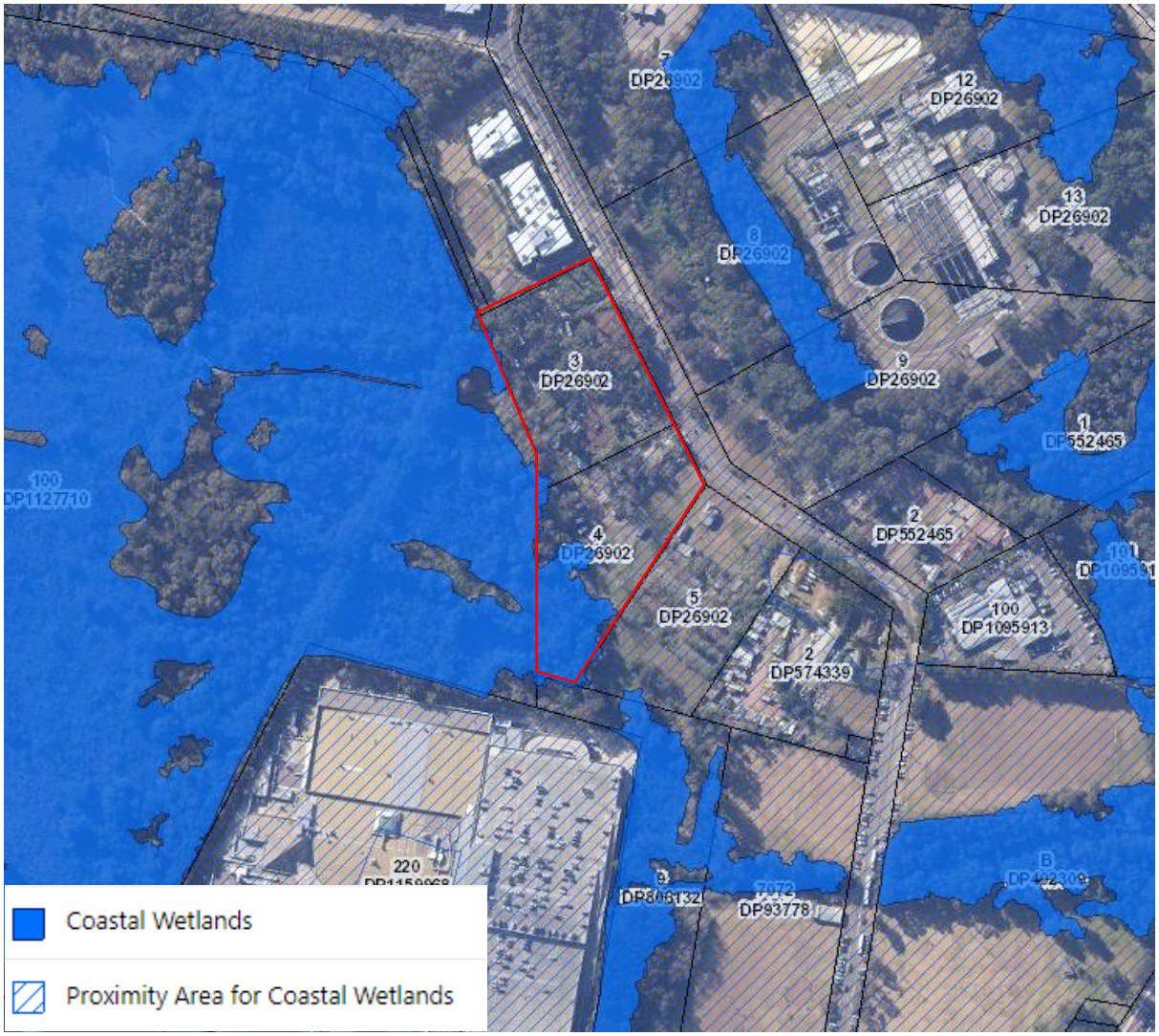


Figure 4-4 – Coastal wetlands areas

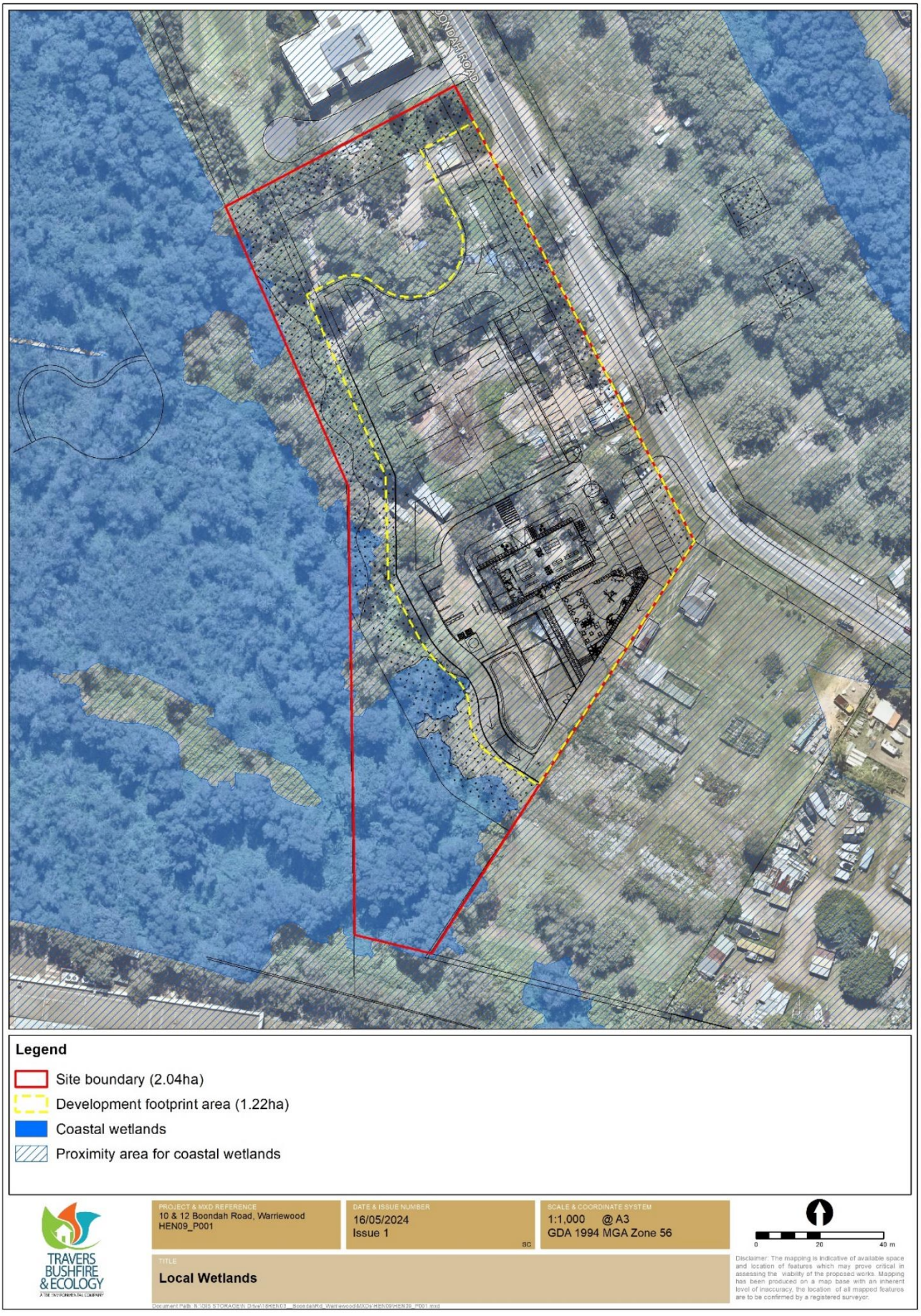


Figure 4-5 - Proposed development in the context of local wetlands

5. IMPACT ASSESSMENT

5.1 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 TEC vegetation. The initial layout is displayed on Figure 5-1 which shows impacts over remnant trees in the northern part of the site. The updated layout as provided in Figure 1-2 seeks the retention of addition trees primarily associated with Bangalay Sand Forest TEC and will provide an opportunity for improvements to be made to the ground layer.
- Avoidance of direct impacts on the majority of SOFF, leaving more intact areas and straightening up the edge of the remnant bushland. The south-western portion will be protected, managed and enhanced via the mechanism of a VMP.
- Subsequent avoidance of foraging habitat for recorded Southern Myotis, Little Bent-winged Bat, Large Bent-winged Bat, Eastern Cave Bat and Powerful Owl.
- Implementation of a stormwater management plan, that will avoid impacts caused by changes in hydrology or increases in pollution, nutrient or sediment inputs into the SOFF and BSF.
- 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.
- Provision of a buffer to the wetland with no APZ management. This addresses one of the key reasons for previous DA refusal. The provided buffer reduces impacts to native vegetation by nearly 50% also.
- Avoidance of the majority of mapped Coastal Wetland within the subject lots.
- The perimeter APZ extending to the boundary of the site has been removed and confined to the central portion of the site, allocating a wetland buffer in its (former) place for added avoidance measures to coastal wetlands.
- Preparation and implementation of a VMP to assist with rehabilitation, ecological restoration and ongoing maintenance of retained SOFF and BSF vegetation and threatened species habitat.
- The proposal has been updated on May 15 2024 to avoid coastal wetland mapped areas through a change to the fire trail design along the western boundary of the development area.
- A proposed pathway through the BSF protected area has been taken out of the design to ensure better connection of conserved ecological resources.

The initial concept design (Figure 5-1) showed a protected buffer to the majority of mapped coastal wetlands and protection of SOFF on the western boundary, however it showed almost no protection to the remnant trees of BSF origin. The updated landscape plan (Figure 1-2) has a modified western fire trail to avoid the mapped coastal wetland, and the northern portion of the property is now largely avoided to provide protection to BSF remnant trees.

The VMP has two distinct restoration / revegetation areas for each TEC to undertaken bushland regeneration and improve the ecological values of the retained and restored vegetation.

Restoration of SOFF occupies an area of 1.02 ha, and restoration of BSF occupies 0.38 ha, which is an improvement in occupied area from what is currently on site which is 0.44 ha and 0.23 ha respectively.

Figure 5-1 – Initial concept plan

5.2 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 5-1 – Measures to mitigate & manage impacts

Action / Technique	Outcome	Timing / Frequency	Responsibility	Risk of failure	Impacts likely to remain after action and consequence
Prepare a **Vegetation Management Plan (VMP)** to identify mitigation actions and establish a bushland protection zone within the site:					
(a) Protection and conservation of SOFF and BSF to the north, west and south west of the development footprint. • Limit access to the proposed bushland protection zone 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 bushland protection 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 in the protected bushland habitat in the southern portion of the site adjacent to the wetland Enhancement of poor-quality vegetation on the site's perimeter to lessen the edge effects on the adjoining wetland Improve ecological values to local TECs Consolidate areas containing remnant native trees to protect them for future generations 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 VMP	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 bushland protection zone 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 bushland protection area habitat adjoining the wetland Fencing to reduce chance of vehicle strike to fauna	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 BDAR 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
(e) 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. (f) 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
(g) 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
(h) 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: • 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
(i) 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
• 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

Action / Technique	Outcome	Timing / Frequency	Responsibility	Risk of failure	Impacts likely to remain after action and consequence
• 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
• 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

Action / Technique	Outcome	Timing / Frequency	Responsibility	Risk of failure	Impacts likely to remain after action and consequence
(j) 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
(k) 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
(l) Stormwater management devices and techniques as per Water Management Report by Calibre 2022 or subsequent updates	Minimise hydrological changes to the adjacent wetland	During and post construction	Project Engineer / contractors	Low-moderate	Impacts likely to be felt more often after large rainfall events
Additional mitigation measures					
(m) 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
(n) Lighting baffles on lights used during construction and road lights to direct light down and away	Reduce lighting spill-over into protected and managed bushland, and adjacent wetland vegetation	Construction and ongoing	Proponent / contractors	Low–moderate	Slight increase in disturbance of local fauna

5.3 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:

5.3.1 Prescribed impacts

In accordance with Section 6 of the BAM, Table 5-2 identifies potential 'prescribed' impacts on biodiversity.

Table 5-2 – 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 BDAR 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 Bent-winged Bat, & Little Bent-winged Bat	5.3.1
Non-native vegetation	yes	planted and naturalised exotic vegetation providing foraging habitat and hollow-bearing trees	removal of vegetation	no threatened species recorded using habitat, but may be used sporadically by, Eastern Coastal Free-tailed Bat, Southern Myotis, Eastern Falsistrelle, Green and Golden Bell Frog. Grey-headed Flying-fox may forage on fruiting trees	5.3.1
Habitat connectivity	yes	minor local connectivity	very slight reduction in cross-site connectivity	none	4.2

Feature	Present (yes / no)	Description of feature characteristics and location	Potential impact	Threatened species or community using or dependent on feature	Section of the BDAR where prescribed impact is addressed
Waterbodies, water quality and hydrological processes	yes	hydrological processes: wetland vegetation	indirect impacts	Swamp Oak Forest	4.3 / 5.3.1
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	5.3.1

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 (DPE) 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* (Coral 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.

- *Stormwater, proximity to sensitive 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) for the previous proposal 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 that summarises 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.

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*

shows the current proposed concept masterplan layout associated with 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.

5.3.2 Direct impacts

Table 5-3 – Direct impact assessment

Direct impact	*BC Act* status	SAII entity	Project phase/timing of impact	Extent (ha, number of individuals)
Removal of PCT 4028_poor (Estuarine Swamp Oak Twig-rush Forest)	EEC	No	Demolition / clearing	0.06 ha
Removal of PCT 3638_poor (Coastal Sand Bangalay Forest)	EEC	No	Demolition / clearing	0.11 ha
Removal of planted *Eucalyptus microcorys*	No	No	Demolition / clearing	0.06 ha
Removal of derived exotic-dominated vegetation, pasture and weeds (including garden beds)	No	No	Demolition / clearing	0.58 ha
Removal of nine hollow bearing trees, some containing hollows suitable for threatened species including the recorded Southern Myotis	Various	No	Demolition / clearing	4/9 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 (Little and Large Bent-winged Bats, and Eastern Cave Bat) – but no breeding habitat	Demolition / clearing	0.6 ha (all vegetation excluding pasture and weeds)
Direct impact on habitat for species credit species Southern Myotis and Eastern Cave Bat	V	Yes (ECB) – but no breeding habitat	Demolition / clearing	0.17 ha
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,	Various	No	Demolition / clearing	0.17 ha (natural vegetation)

Direct impact	*BC Act* status	SAII entity	Project phase/timing of impact	Extent (ha, number of individuals)
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				

5.3.3 Indirect impacts

Table 5-4 – 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)
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)

5.3.4 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 5-5 – 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.

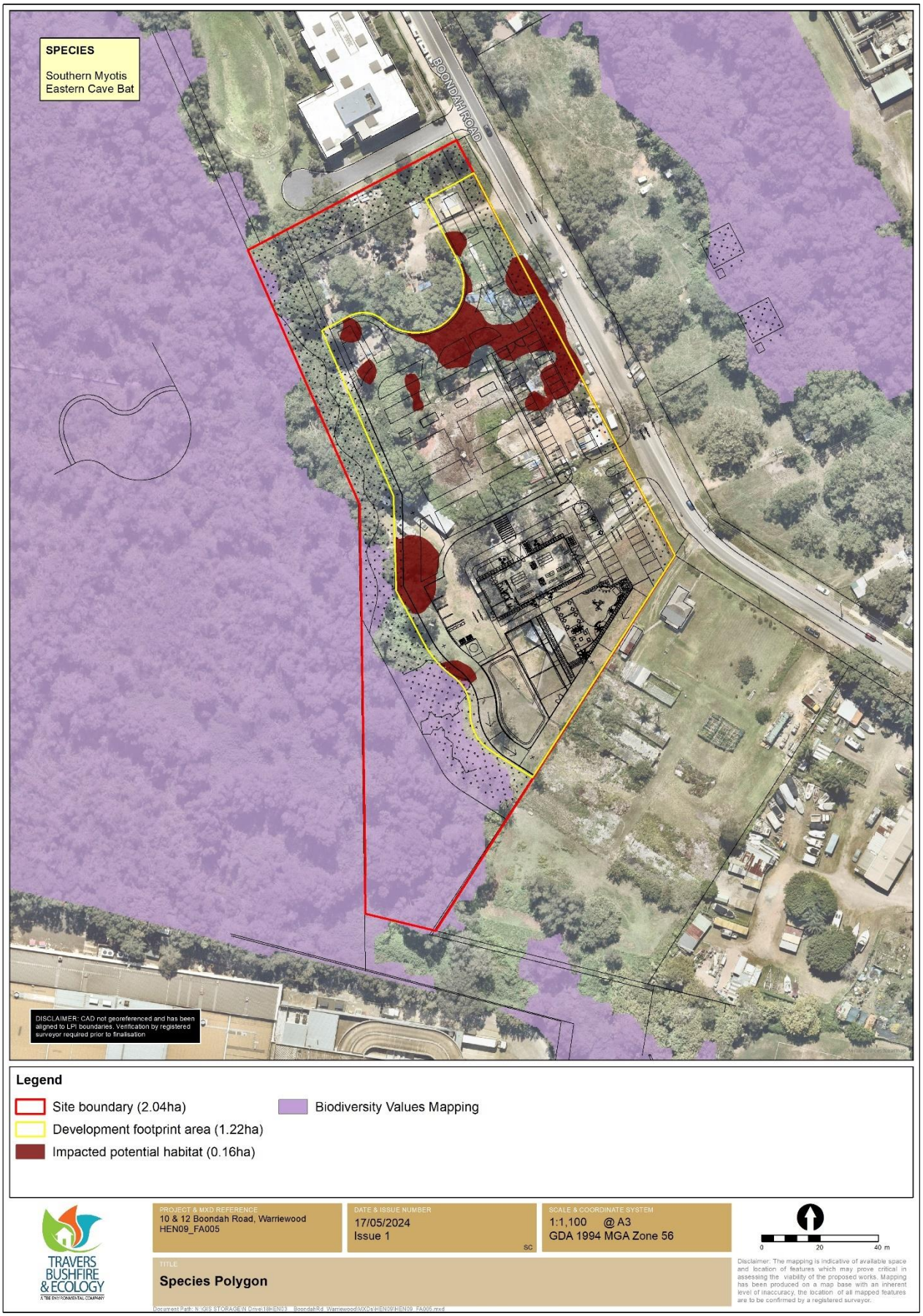


Figure 5-2 - Species credit species polygons

6. BAM CREDIT RESULTS

6.1 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 for roads, removal of trees and shrubs for fence lines with retention of some ground layer species and thinning of vegetation in APZs reducing both cover and abundance. The result of this means that all impacted areas will still have some future biodiversity value, and as such, the future vegetation integrity score will be above 0. There will be a significant drop in the scores, but as they still retain some value, the number of credits required is less. Future vegetation integrity score for each vegetation zone at the development site is shown in Section 0.

Credit species assessment has been undertaken in Section 4. Some species are considered for species credits, particularly if potential breeding habitat is compromised or impacted.

Ecosystem credits for plant community types (PCTs), ecological communities and threatened species habitat is shown in Table 6-1 Species credits for threatened species are shown in Table 6-2.

Table 6-1 – Requirement for ecosystem credits

Zone	Vegetation zone name	Vegetation integrity loss	Area	Sensitivity to loss	Sensitivity to loss(Justification)	Sensitivity to gain class	Biodiversity risk weighting	Potential SAII	Ecosystem credits
South Coast Sands Bangalay Forest									
1	3638_poor	32.8	0.11 hectares	High Sensitivity to Loss	Biodiversity Conservation Act listing status	High Sensitivity to Gain	2		2
									Subtotal: 2
Estuarine Swamp Oak Twig-rush Forest									
2	4028_poor	28.4	0.06 hectares	High Sensitivity to Loss	Biodiversity Conservation Act listing status	High Sensitivity to Gain	2		1
									Subtotal: 1
									Total: 3

Table 6-2 – Requirement for species credits

Vegetation zone name	Habitat condition (vegetation integrity) loss	Area / Count	Sensitivity to loss	Sensitivity to loss (Justification)	Sensitivity to gain	Sensitivity to gain (Justification)	Biodiversity risk weighting	Potential SAII	Species credits
***Myotis macropus* / Southern Myotis (Fauna)**									
3638_poor	32.8	0.11 hectares	Moderate Sensitivity to Loss	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Species dependent on habitat attributes	2	False	2
4028_poor	28.4	0.06 hectares	Moderate Sensitivity to Loss	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Species dependent on habitat attributes	2	False	1
									Subtotal: 3
***Cercartetus nanus* / Eastern Pygmy-possum (Fauna)**									
3638_poor	32.8	0.11 hectares	Moderate Sensitivity to Loss	Biodiversity Conservation Act listing status	Very High Sensitivity to Gain	Species dependent on habitat attributes	3	True	3
4028_poor	28.4	0.06 hectares	Moderate Sensitivity to Loss	Biodiversity Conservation Act listing status	Very High Sensitivity to Gain	Species dependent on habitat attributes	3	True	2
									Subtotal: 4

6.2 Ecosystem credit classes

Table 6-3 – Ecosystem credit summary

PCT	TEC	Area (ha)	Credits
4028 - Estuarine Swamp Oak Twig-rush Forest	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.06	1
3638-South Coast Sands Bangalay Forest	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions	0.11	2

Table 6-4 – Credit classes for PCT 4028 and 3638- Like for like options

PCT	Vegetation Class	Trading group	TEC	Containing hollow-bearing trees?	Credits
4028	Coastal Floodplain Wetlands	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 1731, 3962, 3963, 3985, 3987, 3993, 4016, 4023, 4026, 4027, 4028, 4030, 4035, 4038, 4040, 4048, 4049, 4050, 4056	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Yes	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometres of the outer edge of the impacted site
3638	South Coast Sands Dry Sclerophyll Forests	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions This includes PCT's: 3546, 3638, 3639, 3640	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions	Yes	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometres of the outer edge of the impacted site

6.3 Species credit classes

Table 6-5 – Species credit summary

Species	Vegetation zones	Area (ha)	Credits
Myotis macropus / Southern Myotis (Fauna)	4028_poor & 3638_poor	0.17	3
Vespadelus troughtoni / Eastern Cave Bat (Fauna)	4028_poor & 3638_poor	0.17	5

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

6.4 Credit pricing

As of October 2022, accredited assessors cannot access the BOP-C payment calculator to provide an estimation of costs for credits. For estimates on credit values, the proponent may engage with the Biodiversity Conservation Trust (BCT) who now provide a credit costing service through the Conservation Fund Charge System (see https://www.bct.nsw.gov.au/cards/pay-fund-offset-development).

7. CONCLUSIONS

This BDAR has been produced to accompany the proposed development at Lots 3 and 4 DP26902 , DP26902, 10 and 12 Boondah Road, Warriewood.

7.1 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*).

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.

7.2 Impact summary

Avoidance actions are outlined in Section 5.1. The resultant direct, indirect and cumulative ecological impacts of the proposal have been carefully considered in Section 5.3. 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 5.2.

The Development Proposal will see the impact of 0.17 ha of remnant native vegetation, which includes impacts to different vegetation units including the following (PCT below refers to Plant Community Type):

- Zone1: PCT 4028 - Estuarine Swamp Oak Twig-rush Forest (TEC) – 0.06 ha impacted
- Zone 2: PCT 3638 - Coastal Sand Bangalay Forest (TEC) – 0.11 ha impacted

There is also impact to non-remnant vegetation including:

- Zone 3: Planted and derived exotic vegetation – 0.18 ha impacted
- Zone 4: Pasture and weeds – 0.40 ha impacted
- Planted native vegetation – 0.06 ha impacted

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

The assessment of serious and irreversible impacts are set out under Section 6.7.2 of the *BC Reg 2017* to guide the determining authority on this decision. These principles have been reviewed and assessed in Section 5.3.4 and Appendix 1.

7.3 Biodiversity Offsets Scheme (BOS) – Threshold Assessment

As the proposal triggers the area clearing threshold and impacts on Biodiversity Values land, entry into the Biodiversity Offsets Scheme (BOS) is required under Section 7.14 of the *BC Act***.**

Based on the assessment in this BDAR, offset credits are required for:

- PCT 4028 - Estuarine Swamp Oak Twig-rush Forest (TEC) – 0.06 ha impacted
- PCT 3638 - Coastal Sand Bangalay Forest (TEC) – 0.11 ha impacted
- Species credits for Eastern Cave Bat and Southern Myotis

Planted native vegetation has been assessed using Appendix D of the BAM in Section 1.3.5 of this BDAR. No offset credits are required for planted native vegetation.

8. BIBLIOGRAPHY

Bain, D., Kavanagh, R., Hardy, K. and Parsons, H. (2014). The Powerful Owl Project: Conserving owls in Sydney's urban landscape. BirdLife Australia, Melbourne.

Barker, J., Grigg, G. C. & Tyler, M. J. (1995) *A Field Guide to Australian Frogs.* Surrey Beatty & Sons.

Bennett, A. F. (1990a) *Habitat Corridors: Their Role in Wildlife Management and Conservation*. Department of Conservation and Environment, Victoria).

Bennett, A. F. (1990b) Habitat corridors and the conservation of small mammals in a fragmented forest environment. *Landscape Ecology.* 4: 109-122.

Churchill, S. (2008) *Australian Bats*, 2nd Ed., Jacana Books, Crows Nest, Sydney.

Cogger, H. G. (1996) *Reptiles and Amphibians of Australia*. Reed Books, Australia.

Cropper, S. (1993) *Management of endangered plants.* CSIRO Publications, Melbourne.

DAWE (2022) Environmental Protection and Biodiversity Conservation Act 1999 - Protected Matters Search Tool - http://www.environment.gov.au/webgis-framework/apps/pmst/pmst-coordinate.jsf

DEC (2004) Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft), New South Wales Department of Environment and Conservation, Hurstville, NSW.

DECC (2008) *Hygiene protocol for the control of disease in frogs*. Information Circular Number 6. DECC (NSW), Sydney South.

DECC (2008) Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Authority Area Department of Environment and Climate Change, Hurstville.

DECCW & Water NSW (2010) *NSW Wetlands Policy* – NSW Department of Environment, Climate Change.

DEWHA (2010) *Survey guidelines for Australia's threatened bats*. Department of Environment Water Heritage and Arts.

DPIE (2019) *Biodiversity Assessment Method Operational Manual: Stage 2.* State of NSW and Department of Planning, Industry and Environment.

DPIE (2020) *Biodiversity Assessment Method Operational Manual: Stage 1.* State of NSW and Department of Planning, Industry and Environment.

DPIE (2020) *Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Method.* State of NSW and Department of Planning, Industry and Environment.

DPIE (2013/2016/2019/2021/2022/2024) *Atlas of NSW Wildlife* (BioNet).

DPIE (2020) *Biodiversity Assessment Method.* State of NSW and Department of Planning, Industry and Environment.

Ehmann, H. (1997) Threatened Frogs of New South Wales. FATS Group.

EPBC Listing Advice (2009) Advice to the Minister for the Environment, Heritage and the Arts from the Threatened Species Scientific Committee on an amendment to the List of Threatened Ecological Communities and the EPBC Act 1999 – Cumberland Plain Woodlands and Shale-Gravel Transition Forest.

Harden, G. (1993) *Flora of New South Wales.* University NSW Press.

Hoser, R. (1989) *Australian Reptiles and Frogs.* Pierson & Co.

Klaphake, V. (2002) *Key to the grasses of Sydney.* Van Klaphake, Byabarra.

Klaphake, V. (2010) *Eucalypts of the Sydney Region. 2nd Ed.* Van Klaphake, Byabarra.

Law, B. Chidel, M. and Mong, A. (2005) Life under a sandstone overhang: the ecology of the eastern cave bat *Vespadelus troughtoni* in northern New South Wales. Australian Mammalogy.

Lamp, C. & Collett, F. (1996) *A Field Guide to Weeds in Australia.* Inkata Press.

Lunney, D., Urquhart, C. A. & Reed, P. (1988) *Koala Summit,* NPWS.

Marchant, S., & P. J. Higgins (Eds) (1990) *Handbook of Australian, New Zealand and Antarctic Birds.* Volumes 1-7 Oxford University Press, Melbourne.

Morrison, R. G. B. (1981) A Field Guide to the Tracks & Traces of Australian Animals. Rigby.

Murphy, C. L. & Tille, P. J. (1993) *Soil Landscapes of the Sydney 1:100,000 Sheet.* Department of Conservation & Land Management.

NSW National Parks and Wildlife Service (1997) *Urban Bushland Biodiversity Survey* NSW NPWS, Hurstville.

NSW National Parks and Wildlife Service (1997) *Urban Bushland Biodiversity Survey* NSW NPWS, Hurstville.

OEH (2016) The Native Vegetation of the Sydney Metropolitan Area. Version 3.0. NSW Office of Environment and Heritage, Sydney.

OEH (2017) *Biodiversity Assessment Method.* Office of Environment and Heritage for the NSW Government.

OEH (2018a) 'Species credit' threatened bats and their habitats, NSW survey guide for the Biodiversity Assessment Method

OEH (2018a) Biodiversity Assessment Method Operational Manual – Stage 1.

Parnaby, H. (1992) An interim guide to identification of insectivorous bats of south-eastern Australia. The Australian Museum, Sydney, Technical Report, No. 8.

Pennay, M., Law, B., Reinhold, L. (2004). Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats. NSW Department of Environment and Conservation, Hurstville.

Phillips, S. & Callaghan, J. (2008) The *Spot Assessment Technique*: a tool for determining levels of localised habitat use by Koalas *Phascolarctos cinereus*. Aust. Koala Foundation. Manuscript submitted to: Ecological management and Restoration

Phillott, A. D, Skerratt, L. F., McDonald, K. R., Speare, R., Hines, H. B., Meyer, E., Cashins, S. D, Mendez, D. & Berger, L. (2010) Minimising exposure of amphibians to pathogens during field studies. Inter-research. Diseases of Aquatic Organisms, *Contribution to DAO Special 4: 'Chytridiomycosis: an emerging disease'*

Pizzey, G. & Knight, F. (1997) *A Field Guide to the Birds of Australia.* Angus & Robertson.

Reader's Digest (1976) Complete Book of Australian Birds.

Richardson, F. J., Richardson, R. G. & Shepherd, R. C. H (2011) *Weeds of the South-East: an Identification Guide for Australia.* Everbest Printing Co. Pty. Ltd. China.

Robinson, L. (2003) Field Guide to the Native Plants of Sydney. 3rd ed. Simon & Shuster.

Robinson, M. (1996) A Field Guide to Frogs of Australia. Reed.

Roads and Traffic Authority (2011) RTA Biodiversity Guidelines Guide 1: Pre-Clearing Process

Schodde, R. and Tidemann, S. (Eds) (1986) *Readers Digest complete book of Australian Birds.* Second Edition. Reader's Digest Services Pty Ltd, Sydney.

Simpson & Day (1996) Field Guide to the Birds of Australia. Viking.

Specht, R. L., Specht, A., Whelan, M. B. & Hegarty, E. E. (1995) *Conservation Atlas of Plant Communities in Australia.* Southern Cross University Press, Lismore.

State Forests of NSW (1995) *Morisset Forestry District EIS. Vol C - Fauna Impact Statements.* State Forests of NSW, Pennant Hills.

Strahan, R. (Ed.) (1995) *The Mammals of Australia.* Reed Books, Chatswood.

Triggs, B. (1996) Tracks, Scats & Other Traces: A Field Guide to Australian Mammals. Oxford University Press, Melbourne.

Trounson, Donald & Molly (1998) *Australian Birds Simply Classified*. Murray David Publishing Pty Ltd, NSW.

Van der Ree, Gulle, Holland, Van der Grift, Mata, Suarez (2007) *Overcoming the Barrier Effect of Roads-How Effective are Mitigation Strategies?* – An international review of the use and effectiveness of underpasses and overpasses designed to increase the permeability of roads for wildlife.

Van Dyke, S. and Strahan, R. (Eds) (2008) *The Mammals of Australia* (3rd Edn). Reed New Holland. Sydney.

Williams, J. B., Harden, G. J. & McDonald W. J. F. (1984) *Trees & shrubs in rainforests of New South Wales & southern Queensland.* Botany Department, University of New England, Armidale.

Wilson, K. W. and Knowles, D. G. (1988) Australia's Reptiles - A Photographic Reference to the Terrestrial Reptiles of Australia. Cornstalk Publishing.

Appendix 1. SAII impact assessment species

The additional impact assessment provisions for threatened species to determine a Serious and Irreversible Impact (SAII) are outlined under Section 9.2 of the BAM (2020) and have been applied to the recorded Eastern Cave Bat, Large Bent-winged Bat and Little Bent-winged Bat as follows below.

Measures taken to avoid the direct and indirect impact on species at risk of SAII are outlined in Section 5.1. We have consulted the Threatened Biodiversity Data Collection (TBDC) and other sources to enable the application of the four principles set out in clause 6.7 of the *BC Reg*. For the species considered this is summarized as follows:

Common Name	Principle				Justification	Reference
	1	2	3	4		
Large Bent-winged Bat				✓	The species is dependent on non-responding attribute (breeding habitat only)	TBDC
Little Bent-winged Bat				✓	The species is dependent on non-responding attribute (breeding habitat only)	TBDC
Little Bent-winged Bat				✓	The species is dependent on non-responding attribute (breeding habitat only)	TDBC

The criteria as specified in Section 9.1.2.4 of the BAM required to be considered for candidate SAII species nominated is with respect to Principles 1–3 only. As these do not apply to the recorded microbat species a summary is provided below:

Large Bent-winged Bat & **Little Bent-winged Bat** – These species are allocated to species credit class for breeding habitat only. Species sensitivity to loss is indicated by the TBDC as 'moderate'. Species sensitivity to potential gain for breeding is 'very high'. Species sensitivity to potential gain for foraging is 'high'.

The Large Bent-winged Bat and Little Bent-winged Bat were recorded foraging on passive ultrasonic recording devices within the study area during 2021 survey. The recorded locations are shown on Figure 2-2 - Fauna survey effort.

'Potential breeding habitat' as defined by *The BAM Bat Guide* for these species includes "caves, tunnels, mines or other structures known or suspected to be used". No such habitat exists within the study area or nearby, therefore there will be no likely SAII on Large Bent-winged Bat or Little Bent-winged Bat.

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.

Large-eared Pied Bat - Insufficient information is available on the species' distribution and ecology to guide effective management (DPIE – Saving Our Species Strategies). This is a species credit species. Species sensitivity to loss is indicated by the TDBC as 'moderate'. Species sensitivity to potential gain is 'very high'.

The Large-eared Pied Bat has been recorded foraging on passive ultrasonic recording devices within the study area during 2021 survey. The recorded locations are shown on Figure 2-1

The *'Species credit' threatened bats and their habitats – NSW survey guide for the Biodiversity Assessment Method (The BAM Bat Guide)* outline how to define presence of important 'breeding habitat'. Species polygons for offsetting calculations have also been generated in accordance with Table 1 of this guide.

Potential breeding habitat for this species is defined by *The BAM Bat Guide* as "The PCTs associated with the species (as per the TBDC) within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings."

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.

Appendix 2. SAII impact assessment - communities

The additional impact assessment provisions for threatened ecological communities (TECs) to determine a Serious and Irreversible Impact (SAII) are outlined under Section 9.1.1 of the BAM (2020). No SAII listed TEC's were observed within the study site.

Appendix 3. MICROBAT CALL ANALYSIS

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.

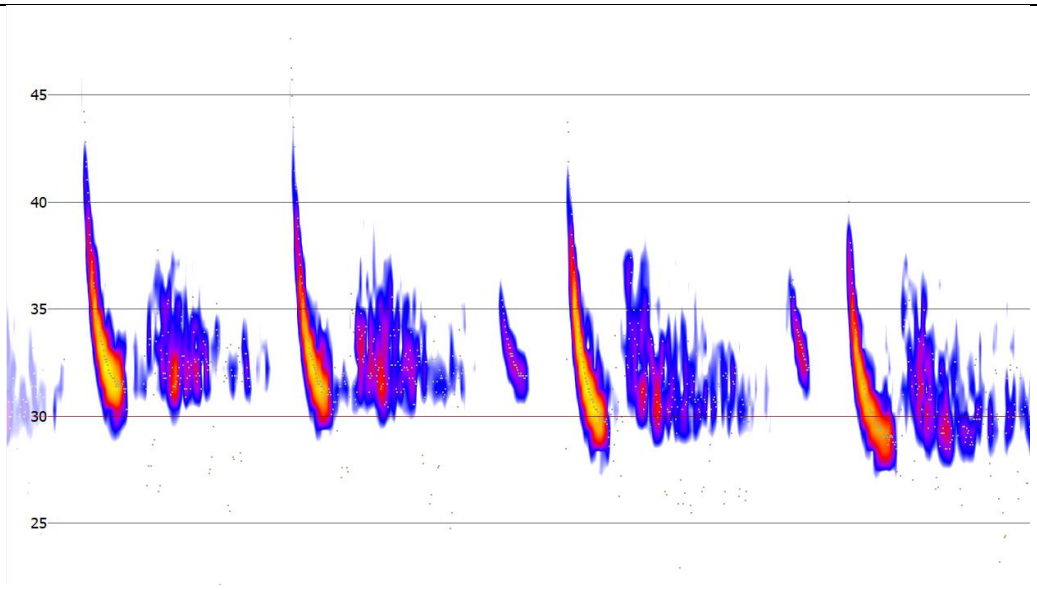
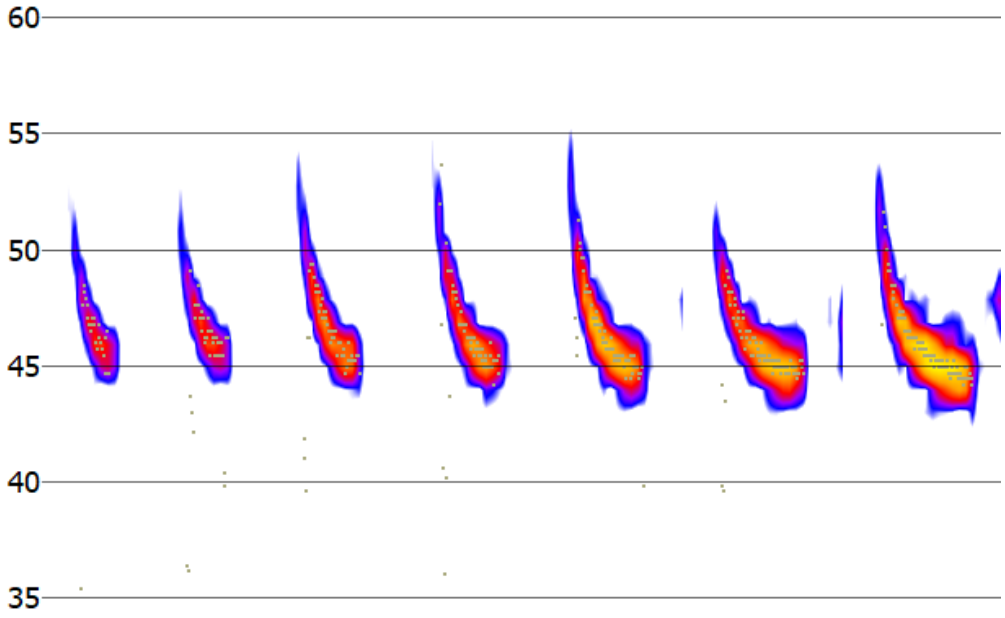
Figure 1: Gould's Wattle Bat (*Chalinolobus gouldii*) in uncompressed mode. This sequence was identified as *C. gouldii* call due to the alternating characteristic frequency, long frequency sweep and down-sweeping tail.	
Figure 2: Large bent-winged Bat (*Miniopterus orianae oceansis*) in uncompressed 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.	

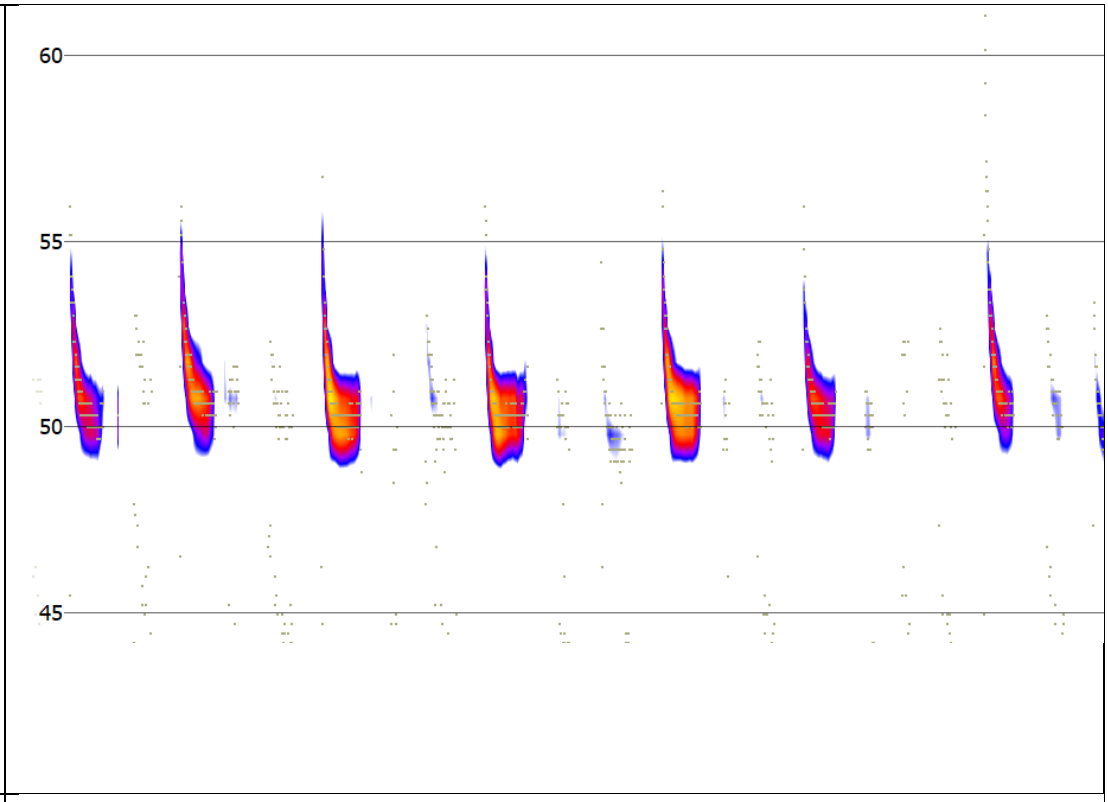
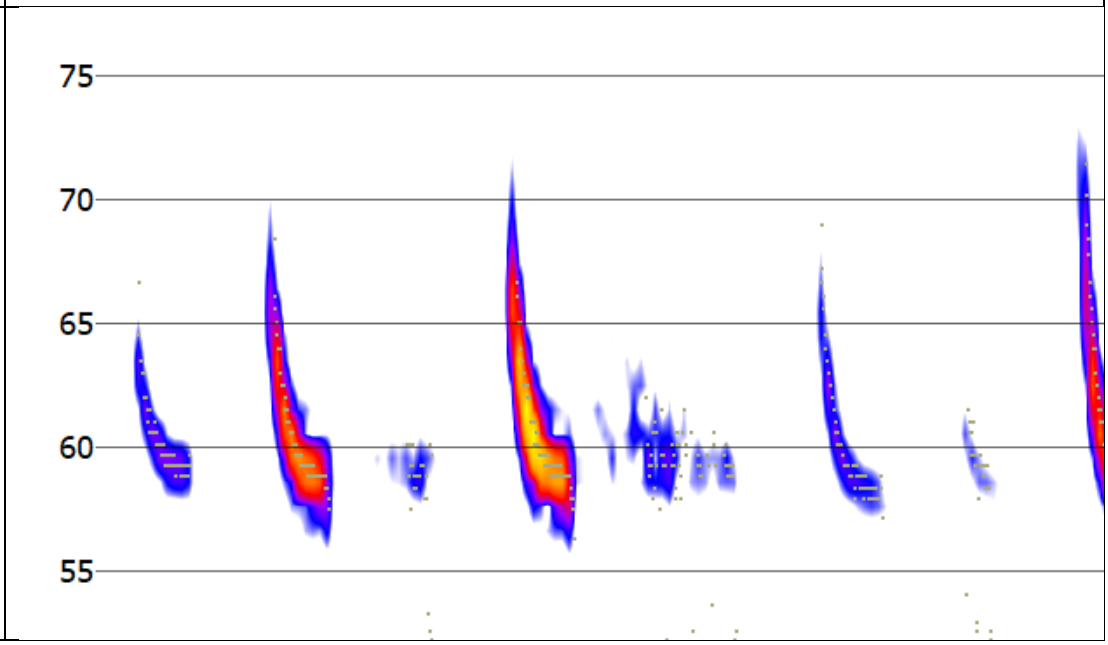
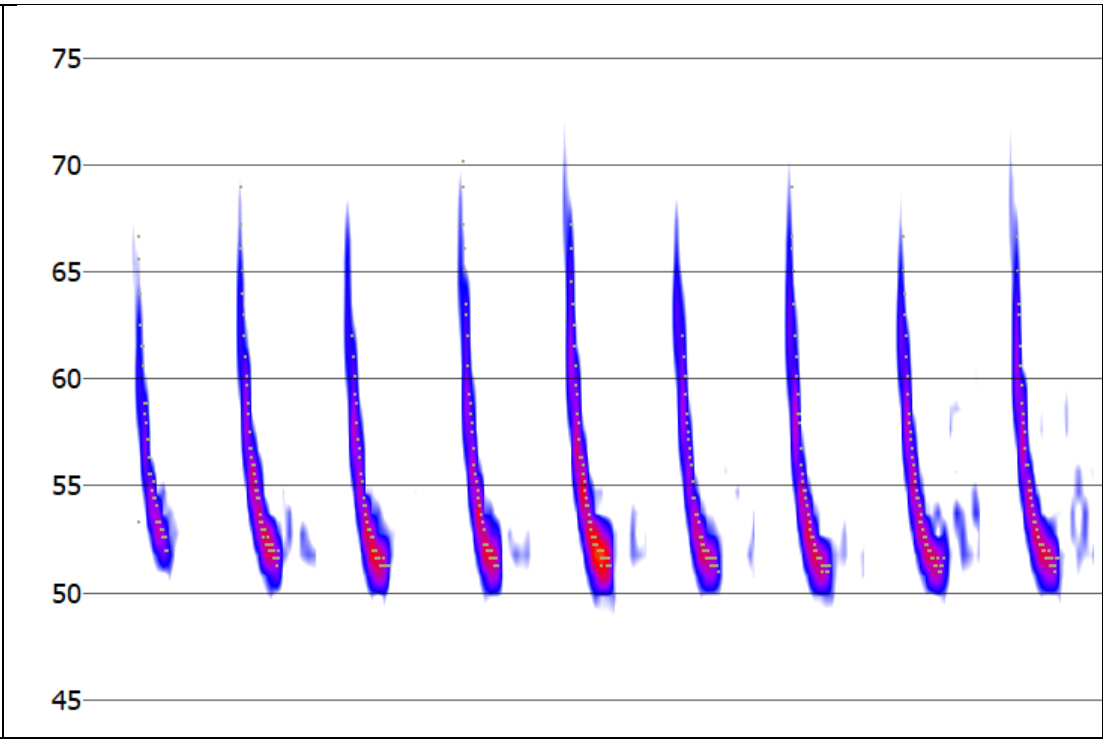
Figure 3: *Vespadelus* sp. in compressed mode. This sequence was identified as a *Vespadelus* call due to the characteristic frequency and majority of pulses having an up-sweeping tail. The call could not be identified to species due to the end frequency of 50.1kHz.	
Figure 4: Little Bent-winged Bat (*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 4. Plot datasheets

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BAM Site – Field Survey Form

Site Sheet no: 1 of

		Survey Name	Zone ID	Recorders		
Date: 26/03/24		HEN09ECO Harrewood		LH / CE		
Zone	Datum	Plot ID: 1		Plot dimensions: 20×20 50×20m	Photo #:	
Easting	Northing	IBRA region: In m		Midline bearing from 0 m:	Magnetic °	
Vegetation Class						Confidence: H M L
Plant Community Type				EEC: n/a		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	6
	Shrubs	0
	Grasses etc.	3
	Forbs	2
	Ferns	1
	Other	1
Sum of Cover of native vascular plants by growth form group	Trees	57.2
	Shrubs	0
	Grasses etc.	6
	Forbs	0.4
	Ferns	0.2
	Other	0.7
High Threat Weed cover		50.8

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	III	
50 – 79 cm	I	
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)	0	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)	85	75	20	0	40															
Average of the 5 subplots	44																			

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)

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 26/03/24	HENSMERE Warrewood	1	LH / CE

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund.	stratum n*ht's	voucher
T	1. Eucalyptus botryoides		25	5		
T	2 Angophora costata		20	4		
	3 Ipomoea indica	HTE	15	200		
	4 Lantana camara	HTE	15	200		
	5 Cestrum parqui	HTE	3	60		
	6 Conyza sumatrensis	E	1	100		
	7 Erechites valerianifolia	E	1	70		
	8 Cirsium vulgare	E	0.3	30		
	9 Paspalum urvillei	E	1	100		
	10 Cyperus eragrostis	HTE	0.3	30		
	11 Ehrharta erecta	HTE	2	500		
	12 Acetosa sagittata	HTE	0.3	20		
	13 Digitaria parviflora	E	0.1	5		
	14 Senna pendula var. glabrata	HTE	1	3		
	15 Ageratina adenophora	HTE	0.5	30		
T	16 Brachychiton populneus		4	1		
	17 Cenchrus clandestinus	HTE	5	1000		
	18 Stenotaphrum secundatum	HTE	1	150		
Fe	19 Calochlaena dubia		0.2	7		
G	20 Cynodon dactylon		1	200		
G	21 Oplismenus imbecillis		3	700		
	22 Phytolacca octandra	E	0.1	2		
	23 Paspalum dilatatum	HTE	0.3	25		
	24 Setaria parviflora	E	0.2	25		
F	25 Dianella caerulea		0.1	1		
	26 Cyclosperma leptophyllum	E	0.1	5		
F	27 Commelina cyanea		0.3	30		
G	28 Oplismenus aemulus		2	500		
T	29 Ficus sp. (juvenile 0.6m tall)		0.1	1		
	30 Oxalis corniculata	E	0.1	10		
	31 Ligustrum sinense	HTE	02	2		
	32 Conyza bonariensis	E	0.3	30		
	33 Lilium formosum	E	0.1	2		
T	34 Cupaniopsis anacardioides (juv)		0.1	1		
	35 Axonopus fissifolius	HTE	0.2	20		
O	36 Stephania japonica		0.7	5		
	37 Cinnamomum camphora	HTE	1	2		
	38 Lysimachia arvensis	E	0.1	2		
T	39 Glochidion ferdinandi		8	1		
	40 Euphorbia peplus	E	0.1	2		

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF = circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

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BAM Site – Field Survey Form

Site Sheet no: 1 of

		Survey Name	Zone ID	Recorders		
Date	26/03/24	HENSPECO Warriewood		LH / CE		
Zone	Datum	Plot ID	2	Plot dimensions	20x20 50x20m	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	1
	Shrubs	1
	Grasses etc.	3
	Forbs	3
	Ferns	1
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	25
	Shrubs	4
	Grasses etc.	0.9
	Forbs	0.5
	Ferns	20
	Other	2
High Threat Weed cover		99.8

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)	0 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)	60	30	60	75	50															
Average of the 5 subplots	55																			

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)

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 26/03/24	HEN09ECO Harriswood	2	LA / CE

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund.	stratum no.	voucher
T	1. Casuarina glauca		25	13		
S	2 Melaleuca linariifolia		4	2		
Fe	3 Hypolepis muelleri		20	2000		
	4 Senna pendula var. glabrata	HTE	12	200		
	5 Lantana camara	HTE	10	200		
	6 Ipomoea indica	HTE	70	5000		
	7 Lonicera japonica	HTE	7	500		
	8 Zantedeschia aethiopica	E	2	80		
G	9 Carex appressa		0.2	10		
	10 Ehrharta erecta	HTE	0.5	100		
	11 Populus nigra	HTE	8	2		
	12 Xanthium occidentale	HTE	0.2	10		
F	13 Persicaria decipiens		0.2	20		
	14 Erechites valerianifolia	E	0.1	10		
Q	15 Parsonsia straminea		2	10		
E	16 Viola hederacea		0.1	2		
F	17 Alternanthera denticulata		0.2	30		
	18 Hydrocotyle bonariensis	HTE	0.2	30		
	19 Solanum mauritianum	E	0.5	2		
	20 Ligustrum sinense	HTE	0.1	1		
G	21 Gahnia sieberiana		0.2	2		
G	22 Oplismenus imbecillis		0.5	75		
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m .*

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			
Date	13/12/24	18HEN03.2 Warrieweal		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	Plot Identifier	Recorders
Date 13/12/21	HEN03 Worrielwood	P1	GP

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		✓		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	Setaria sphacelata		✓		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	Cliochidion ferdinandi	✓			5	1	
	28							
	29							
	30							
	31							
	32							
	33							
	34							
	35							
	36							
	37							
	38							
	39							
	40							
	41							
	42							
	43							
	44							
	45							
	46							
	47							

N: native, E: exotic, HTE: high threat exotic GF – circle code of 'top 3'

GF Code: see growth form definitions in Appendix 1 **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

Date	13/12/21	Survey Name	HEN09.2 Warrigwood	Zone ID		Recorders	GP		
Zone	Datum	Plot ID	P2			Plot dimensions	20x50m	Photo #	✓
Easting	Northing	IBRA region				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 (%)				
Subplot score (% in each)	50	60	75	95	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: HEN09 Woodland | Plot Identifier: P2 | Recorders: CR | 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 Casuarina glauca	✓			10	6	
	2 Hypolepis muelleri	✓			15	100	
	3 Lantana camara			✓	80	200	
	4 Ipomoea indica			✓	10	50	
	5 Lonicera japonica			✓	5	20	
	6 Senna pendula			✓	1	10	
	7 Poplar		✓	✓	5	3	
	8 Cyathea cooperi	✓		✓	2	10	
	9 Liquidambar styraciflua			✓	2	10	
	10 Adiantum aethiopicum	✓			1	5	
	11 Spirodela punctata	✓			5	thousands	
	12 Cyathea australis	✓			1	10	
	13 Pyrrosia rupestris	✓			0.1	10	
	14 Carex appressa	✓			0.5	10	
	15 Eucalyptus botryoides	✓			5	2	
	16 Cyperus [illegible] Hyparrhenia rufa	✓			0.5	1	
	17 Paspalum dilatatum	✓			2	100	
	18 Hydrocotyle bonariensis		✓		1	20	
	19 Persicaria hydropiper	✓			0.1	10	
	20 Solanum pseudocapsicum		✓		0.1	3	
	21 Arum lily		✓		2	10	
	22 Commelina cyanea	✓			1	20	
	23 Centella asiatica	✓			1	50	
	24 Tradescantia fluminensis			✓	1	80	
	25 Ranunculus plebeius	✓			0.1	3	
	26 Cerastium glomeratum			✓	0.1	3	
	27 Oxalis corniculata			✓	0.1	3	
	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...

Appendix 5. Staff qualifications and experience

Team member (role)	Accreditations and qualifications	Experience	Employment history	Skills and expertise
Michael Sheather-Reid (Managing Director) Project management and review	• 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 25 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
Lindsay Holmes (Principal Ecologist) BDAR author, BAM-C owner and flora survey	• Biodiversity Assessment Method (BAM) Assessor (BAAS17032) • 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)	Lindsay has 25 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

Team member (role)	Accreditations and qualifications	Experience	Employment history	Skills and expertise
				• SULE assessment.
Sandy Cardow (GIS officer) Figure production (GIS)	• 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
Wayne Davis (GIS officer) Figure production (GIS)	• Bachelor of Science (Marine Science) (University of Newcastle) • Master of Spatial Science Technology (Geographic Information Systems) (University of Southern Queensland) • FWPCOT2237 Maintain Chainsaws • FWPCOT2239 Trim and Cut Felled Trees • AHCPMG301A: Control Weeds • CPCCOHS1001A Work safely in the construction industry • Open Water Diver • AQF3 Chemical Accreditation: AHCCHM307 - Prepare and apply chemicals to control pest, weeds and diseases, AHCCHM304 - Transport and store chemicals • HLTAID009 Provide cardiopulmonary resuscitation, HLTAID010 Provide basic emergency life support, HLTAID011 Provide first aid. • Microsoft Certified Azure Fundamentals	Wayne has over eighteen years of experience in IT which included roles as a senior systems designer with the CBA and data scientist with Catholic Schools NSW. Mapping projects for ecology, bushfire planning, student enrolments and demographics reporting. He has completed a Bachelor of Science (marine science), Master of Spatial Science Technology (GIS) and is a member of the Geospatial Council of Australia. Wayne also has 2 years bush regeneration supervisory experience. His Master's thesis involved using a machine learning approach to develop habitat suitability models for Piping Plovers.	• 2022 – Current: GIS Officer, Travers bushfire & ecology • 2022 – 2022: Spatial Data Analyst, Lotsearch • 2021 – 2022: Data Analyst - Strategic Data Analysis Unit, ACCC • 2018 – 2020: Data Scientist, Catholic Schools NSW • 2016 – 2018: Green Army Conservation Project Supervisor Central Coast Council, Ku-ring-gai Council, NPWS. • 2014 – 2014: Website Administrator, The Telecom Shop • 1997 – 2004 Senior Information Specialist, EDS • 1996 – 1997 Senior Systems Designer, CBA • 1989 – 1996 Analyst Programmer, CBA	• Geographic Information Systems • Spatial Data Science • Habitat Suitability Modelling • Predictive Analytics • Machine Learning • ArcGIS • Alteryx • Python

Team member (role)	Accreditations and qualifications	Experience	Employment history	Skills and expertise
Lachlan McRae (Fauna ecologist) Fauna surveys	• 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
Corrine Edwards (Fauna Ecologist) BDAR author (fauna)	• 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 • 2020 – Recipient of the Marilyn Fox Environmental Science Prize • 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, morphology, and behaviour • Fauna field assessment • Microhabitat identification • Project ecology • Experimental design and statistical analysis • Scientific report writing

Appendix 6. BAM-C outputs

BAM Vegetation Zones Report

Proposal Details

Assessment Id	Assessment name	BAM data last updated *
00048760/BAAS17032/24/00048761	Nursery Streamlined BDAR	14/03/2024
Assessor Name	**Report Created**	**BAM Data version ***
Lindsay Holmes	12/06/2024	67
Assessor Number	**Assessment Type**	**BAM Case Status**
BAAS17032	Part 4 Developments (Small Area)	Finalised
Assessment Revision	**Date Finalised**	**BOS entry trigger**
0	12/06/2024	BOS Threshold: Biodiversity Values Map

* 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	4028_poor	4028-Estuarine Swamp Oak Twig-rush Forest	poor	0.06	1	

2	3638_poor	3638-South Coast Sands Bangalay Forest	poor	0.11	1	

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00048760/BAAS17032/24/00048761	Nursery Streamlined BDAR	14/03/2024
Assessor Name	Report Created	BAM Data version *
Lindsay Holmes	12/06/2024	67
Assessor Number	Assessment Type	BAM Case Status
BAAS17032	Part 4 Developments (Small Area)	Finalised
Assessment Revision	BOS entry trigger	Date Finalised
0	BOS Threshold: Biodiversity Values Map	12/06/2024

* 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)
Bar-tailed Godwit (baueri)	Limosa lapponica baueri	4028-Estuarine Swamp Oak Twig-rush Forest
Black Bittern	Ixobrychus flavicollis	3638-South Coast Sands Bangalay Forest
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Curlew Sandpiper	Calidris ferruginea	4028-Estuarine Swamp Oak Twig-rush Forest
Dusky Woodswallow	Artamus cyanopterus cyanopterus	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Eastern Curlew	Numenius madagascariensis	4028-Estuarine Swamp Oak Twig-rush Forest
Eastern Grass Owl	Tyto longimembris	4028-Estuarine Swamp Oak Twig-rush Forest
Eastern Osprey	Pandion cristatus	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Flame Robin	Petroica phoenicea	3638-South Coast Sands Bangalay Forest
Gang-gang Cockatoo	Callocephalon fimbriatum	4028-Estuarine Swamp Oak Twig-rush Forest

Gang-gang Cockatoo	Callocephalon fimbriatum	3638-South Coast Sands Bangalay Forest
Great Knot	Calidris tenuirostris	4028-Estuarine Swamp Oak Twig-rush Forest
Greater Sand-plover	Charadrius leschenaultii	4028-Estuarine Swamp Oak Twig-rush Forest
Grey-headed Flying-fox	Pteropus poliocephalus	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Large Bent-winged Bat	Miniopterus orianae oceanensis	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Lesser Sand-plover	Charadrius mongolus	4028-Estuarine Swamp Oak Twig-rush Forest
Little Bent-winged Bat	Miniopterus australis	4028-Estuarine Swamp Oak Twig-rush Forest
Little Eagle	Hieraaetus morphnoides	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Little Lorikeet	Glossopsitta pusilla	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Little Tern	Sternula albifrons	4028-Estuarine Swamp Oak Twig-rush Forest
Red Knot	Calidris canutus	4028-Estuarine Swamp Oak Twig-rush Forest
Rosenberg's Goanna	Varanus rosenbergi	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Sanderling	Calidris alba	4028-Estuarine Swamp Oak Twig-rush Forest
South-eastern Glossy Black-Cockatoo	Calyptorhynchus lathami lathami	4028-Estuarine Swamp Oak Twig-rush Forest
Spotted Harrier	Circus assimilis	4028-Estuarine Swamp Oak Twig-rush Forest
Spotted-tailed Quoll	Dasyurus maculatus	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Square-tailed Kite	Lophoictinia isura	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Swift Parrot	Lathamus discolor	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Terek Sandpiper	Xenus cinereus	4028-Estuarine Swamp Oak Twig-rush Forest
Turquoise Parrot	Neophema pulchella	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Varied Sittella	Daphoenositta chrysoptera	4028-Estuarine Swamp Oak Twig-rush Forest

Varied Sittella	Daphoenositta chrysoptera	3638-South Coast Sands Bangalay Forest
White-bellied Sea-Eagle	Haliaeetus leucogaster	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
White-throated Needletail	Hirundapus caudacutus	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	4028-Estuarine Swamp Oak Twig-rush Forest
		3638-South Coast Sands Bangalay Forest

Threatened species Manually Added

None added

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

Common Name	Scientific Name	Plant Community Type(s)
Australasian Bittern	Botaurus poiciloptilus	4028-Estuarine Swamp Oak Twig-rush Forest
Australian Painted Snipe	Rostratula australis	4028-Estuarine Swamp Oak Twig-rush Forest
South-eastern Glossy Black-Cockatoo	Calyptorhynchus lathami lathami	3638-South Coast Sands Bangalay Forest

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

Refer to BAR for detailed justification

Common Name	Scientific Name	Justification in the BAM-C
Australasian Bittern	Botaurus poiciloptilus	Habitat constraints
Australian Painted Snipe	Rostratula australis	Refer to BAR

BAM Candidate Species Report

Proposal Details

Assessment Id 00048760/BAAS17032/24/00048761	Proposal Name Nursery Streamlined BDAR	BAM data last updated * 14/03/2024
Assessor Name Lindsay Holmes	Report Created 12/06/2024	BAM Data version * 67
Assessor Number BAAS17032	Assessment Type Part 4 Developments (Small Area)	BAM Case Status Finalised
Assessment Revision 0	Date Finalised 12/06/2024	BOS entry trigger BOS Threshold: Biodiversity Values Map

* 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
Caladenia tessellata Thick Lip Spider Orchid	No (surveyed)	☐ 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?
Deyeuxia appressa Deyeuxia appressa	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?

Galium australe Tangled Bedstraw	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?
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
Southern Myotis	Myotis macropus
Eastern Cave Bat	Vespadelus troughtoni

Threatened species assessed as not on site

Refer to BAR for detailed justification

Common name	Scientific name	Justification in the BAM-C
Curlew Sandpiper	Calidris ferruginea	Habitat constraints
Eastern Australian Underground Orchid	Rhizanthella slateri	Habitat degraded
Eastern Curlew	Numenius madagascariensis	Habitat constraints
Great Knot	Calidris tenuirostris	Habitat constraints
Large Bent-winged Bat	Miniopterus orianae oceanensis	Habitat constraints
Little Bent-winged Bat	Miniopterus australis	Habitat constraints
Swift Parrot	Lathamus discolor	Habitat constraints

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00048760/BAAS17032/24/00048761	Nursery Streamlined BDAR	14/03/2024
Assessor Name	Report Created	BAM Data version *
Lindsay Holmes	12/06/2024	67
Assessor Number	BAM Case Status	Date Finalised
BAAS17032	Finalised	12/06/2024
Assessment Revision	Assessment Type	BOS entry trigger
0	Part 4 Developments (Small Area)	BOS Threshold: Biodiversity Values Map

* 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

Estuarine Swamp Oak Twig-rush Forest											
1	4028_poor	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	34.7	34.7	0.06	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	1
										Subtotal	**1**
South Coast Sands Bangalay Forest											
2	3638_poor	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions	40.7	40.7	0.11	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	2
										Subtotal	**2**
										Total	**3**

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

Myotis macropus / Southern Myotis (Fauna)									
4028_poor	34.7	34.7	0.06	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	1
3638_poor	40.7	40.7	0.11	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	2
								Subtotal	**3**
Vespadelus troughtoni / Eastern Cave Bat (Fauna)									
4028_poor	34.7	34.7	0.06	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	True	2
3638_poor	40.7	40.7	0.11	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	True	3
								Subtotal	**5**

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00048760/BAAS17032/24/00048761

Proposal Name
Nursery Streamlined BDAR

BAM data last updated *
14/03/2024

Assessor Name
Lindsay Holmes

Assessor Number
BAAS17032

BAM Data version *
67

Proponent Names

Report Created
12/06/2024

BAM Case Status
Finalised

Assessment Revision
0

Assessment Type
Part 4 Developments (Small Area)

Date Finalised
12/06/2024

BOS entry trigger
BOS Threshold: Biodiversity Values Map

* 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

BAM Biodiversity Credit Report (Like for like)

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
Botaurus poiciloptilus / Australasian Bittern
Rostratula australis / Australian Painted Snipe

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
4028-Estuarine Swamp Oak Twig-rush Forest	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.1	1	0	1
3638-South Coast Sands Bangalay Forest	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions	0.1	2	0	2

3638-South Coast Sands Bangalay Forest	**Like-for-like credit retirement options**					
	Name of offset trading	Trading group	Zone	HBT	Credits	IBRA region

	group					
	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions This includes PCT's: 3546, 3638, 3639, 3640	-	3638_poor	Yes	2	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
4028-Estuarine Swamp Oak Twig-rush 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: 1731, 3962, 3963, 3985, 3987, 3993, 4016, 4023, 4026, 4027, 4028, 4030, 4035, 4038, 4040, 4048, 4049, 4050, 4056	-	4028_poor	Yes	1	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

4028-Estuarine Swamp Oak Twig-rush Forest

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Myotis macropus / Southern Myotis	**4028_poor, 3638_poor**	0.2	3.00
Vespadelus troughtoni / Eastern Cave Bat	**4028_poor, 3638_poor**	0.2	5.00

Credit Retirement Options

Like-for-like credit retirement options

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
00048760/BAAS17032/24/00048761

Proposal Name
Nursery Streamlined BDAR

BAM data last updated *
14/03/2024

Assessor Name
Lindsay Holmes

Assessor Number
BAAS17032

BAM Data version *
67

Proponent Name(s)

Report Created
12/06/2024

BAM Case Status
Finalised

Assessment Revision
0

Assessment Type
Part 4 Developments (Small Area)

Date Finalised
12/06/2024

BOS entry trigger
BOS Threshold: Biodiversity Values Map

* 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

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
Botaurus poiciloptilus / Australasian Bittern
Rostratula australis / Australian Painted Snipe

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
4028-Estuarine Swamp Oak Twig-rush Forest	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.1	1	0	1.00
3638-South Coast Sands Bangalay Forest	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions	0.1	2	0	2.00

3638-South Coast Sands 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: 3546, 3638, 3639, 3640	-	3638_poor	Yes	2	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	3638_poor	Yes (including artificial)	2	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
4028-Estuarine Swamp Oak Twig-rush 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: 1731, 3962, 3963, 3985, 3987, 3993, 4016, 4023, 4026, 4027, 4028, 4030, 4035, 4038, 4040, 4048, 4049, 4050, 4056	-	4028_poor	Yes	1	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 3 or higher threat status	4028_poor	Yes (including artificial)	1	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
Myotis macropus / Southern Myotis	**4028_poor, 3638_poor**	0.2	3.00

Vespadelus troughtoni / Eastern Cave Bat	**4028_poor, 3638_poor**	0.2	5.00

Credit Retirement Options

Like-for-like options

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.