

A photograph of a grey squirrel climbing a tree trunk. The squirrel is positioned vertically, facing upwards, with its front paws reaching up and its hind legs pushing off the bark. The tree bark is rough and textured. The background is a solid blue gradient.

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Biodiversity Certification Assessment Report

Lot 273 DP 755266
15 Mulloway Road
Chain Valley Bay

October 2021
(REF: 18OD02BCAR)



Biodiversity Certification Assessment Report

**Lot 273 DP 755266
15 Mulloway Road, Chain Valley Bay**

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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 are to be confirmed by a registered surveyor.

Executive Summary

Travers bushfire & ecology has been engaged to undertake a biodiversity certification assessment for a planning proposal within Lot 273 DP 755266 at 15 Mulloway Road, Chain Valley Bay. This lot will be hereafter referred to as the 'study area'.

Planning proposal

The planning proposal aims to retain and extend the southern E2 (Environmental Conservation) zone land and rezone the central and northern portions of the study area from E3 (Environmental Management) to part E2 (Environmental Conservation), part R2 (Low Density Residential) and part RE1 (Public Recreation). In addition, a smaller E3 (Environmental Management) parcel is proposed to be retained (see Figure 1.3). The R2 zoned portions are planned for development of 93 low density residential lots. The E3 parcel is approx. 3155 m² and forms a transition between the residential and conservation lands. An E2-zoned wildlife corridor (varying in width from 50–60 m) is proposed along the western and northern boundaries to link habitat to the south and north. The proposed RE1 zone is to accommodate a proposed 6 m-wide pedestrian/ cycleway / fire trail that will separate the corridor from the existing residential zoned lands of Chain valley Bay. The proposed zoning plan is shown in Figure 1.3. The proponent seeks biodiversity certification at the rezoning stage for certainty of development at the development application stage.

The 'subject site' will hereafter refer to the area of likely direct impacts by the proposal and development footprint associated with the rezoning incorporating roads, services, stormwater management, pedestrian /cycleway/ fire trails, Asset Protection Zones (APZs) and will include all areas outside the proposed wildlife corridor to the north of the proposed zoning boundary. The full study area is shown on Figure 2.

Recorded biodiversity

Ecological survey and assessment has been undertaken in accordance with 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)*. A full description is found within Section 2 of this report.

In respect of matters required to be considered under the *EP&A Act* and relating to the species / provisions of the *BC Act*, no threatened flora species were recorded on site, ten (10) threatened fauna species and one (1) TEC were recorded within the study area.

Fauna Species:

- Wallum Froglet (*Crinia tinnula*),
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*),
- Square-tailed Kite (*Lophoictinia isura*),
- Powerful Owl (*Ninox strenua*),
- Grey-headed Flying-fox (*Pteropus poliocephalus*),
- Southern Myotis (*Myotis macropus*),
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*),
- Greater Broad-nosed Bat (*Scoteanax rueppellii*),
- Little Bent-winged Bat (*Miniopterus australis*) and
- Large Bent-winged Bat (*Miniopterus orianae oceansis*)

Threatened Ecological Communities (TEC):

- *Swamp Sclerophyll Forest on Coastal Floodplains*

The Swift Parrot has been assumed present for calculating offsets as the site contains mapped important habitat areas, despite any surveys undertaken which have not recorded the species.

In respect of matters required to be considered under the *EPBC Act*, no threatened flora species, and no TECs were not recorded on site. One (1) threatened fauna species, two (2) protected migratory bird species and, listed under this Act were recorded within the study area.

Fauna Species:

- Grey-headed Flying-fox (*Pteropus poliocephalus*)

Migratory Species:

- White-bellied Sea Eagle (*Haliaeetus leucogaster*)
- White-throated Needletail (*Hirundapus caudacutus*)

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

Impact assessment

The potential impacts of the proposal have been considered in Section 5.2 of this report. Section 5.3 and 5.4 discuss avoidance and minimisation of impacts and appropriate mitigation measures for the identified potential ecological impacts of the proposal, to address threatening processes and to create a more positive ecological outcome for threatened species and their associated habitats.

The assessment of significance test is not required for Part 4 developments that enter into the Biodiversity Offset Scheme (BOS).

The principles for determining serious and irreversible impacts (SAILs) are set out under Section 6.7.2 of the *BC Regulation 2017*. Potential SAILs have been reviewed and impacts on recorded candidate SAIL species Little Bent-winged Bat and Large Bent-winged bat are assessed in detail in Appendix 2. Giant Dragonfly is also assessed as being with potential to occur as identified by the BAM-C. An assessment on Swift Parrot is also provided – this species has not been recorded present but the entire vegetation in the subject lot is mapped as important habitat for this species by DPIE (see Section 4.4.2). Almost the full extent of important winter flowering habitat for this species will be retained by the proposal, however further consideration to buffer protection and alternate foraging opportunity through the site has also been recognised. Thus the assessment has also brought to light and provided further mitigation measures on the potential indirect impacts on foraging habitat. It is considered that the proposal will not cause any SAILs on threatened biodiversity.

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

The proposed rezoning is not considered to have a significant impact on matters of national environmental significance. As such a referral to the Department of Environment and Energy should not be required.

Biodiversity Offsets Scheme (BOS) – Threshold assessment

The proposed development does exceed the nominated threshold triggers as outlined in Section 2. The study area is located on lands mapped as Biodiversity Values Land, and the proposal will also exceed the area clearing threshold of 1 ha. Therefore, biodiversity offsets are required under the Biodiversity Offsets Scheme (BOS).

The conservation area will be managed through a vegetation management plan (VMP) with the conservation protection mechanism to be resolved at a later. Whilst not included within the biodiversity certification application, the options for conservation include:

- A biodiversity stewardship agreement (if approved)
- A conservation agreement (if approved)
- A vegetation management plan and 88B instrument

All credit requirements for the impact of the biodiversity certification will be offset by purchasing credits on the open market, through the establishment of a biodiversity Stewardship agreement (BSA) or through payment into the Biodiversity Conservation Fund (BCF).

BAM Calculator results

The credit calculator results have been assessed by George Plunkett B. Sc. (Hons.), PhD – Botanist – Accredited Assessor no. BAAS19010.

The BAM Calculator provides a means of objectively determining the loss of biodiversity as a result of a proposed development. In this case residential development supported by the planning proposal. The 'credits' generated (Tables A & B) are the amount of credits required to be 'transferred' (purchased) to allow the proposed rezoning to proceed.

Table A – Requirement for ecosystem credits

Zone	Veg. zone name	Veg. integrity loss	Area (ha)	Sensitivity to potential gain	Biodiversity risk weighting	Potential SAI	Ecosystem credits
1	1619_moderate_good	62.3	7.6	High	1.50	no	177
2	1718_moderate_good	17.9	0.12	High	2	no	1
3`	1619_cleared	12.4	2.6	High	1.50	no	0
Total: 178							

Table B – Requirement for species credits

Veg. zone name	Veg. integrity loss	Area (ha)	Biodiversity risk weighting	Candidate SAI	Species credits
Wallum Froglet					
1619_cleared	12.4	2.6	1.5	False	12
1619_moderate_good	62.3	7.6	1.5	False	177
1718_moderate_good	17.9	0.12	1.5	False	1
Subtotal: 190					
Pale-headed Snake					
1619_moderate_good	62.3	7.6	2	False	236

1718_moderate_good	17.9	0.12	2	False	1
Subtotal: 237					
Swift Parrot					
619_cleared	12.4	0.99	3	True	9
1619_moderate_good	62.3	6.7	3	True	312
1718_moderate_good	17.9	0.04	3	True	1
Subtotal: 322					
Green and Golden Bell Frog					
1619_moderate_good	62.3	0.33	2	False	10
1718_moderate_good	17.9	0.12	2	False	1
Subtotal: 11					
Southern Myotis (Large-footed Myotis)					
1619_cleared	12.4	2.6	2	False	16
1619_moderate_good	62.3	7.6	2	False	236
1718_moderate_good	17.9	0.12	2	False	1
Subtotal: 253					
Giant Dragonfly					
1718_moderate_good	17.9	0.12	3	True	2
Subtotal: 2					
Squirrel Glider					
1619_moderate_good	62.3	7.6	2	False	236
1718_moderate_good	17.9	0.12	2	False	1
Subtotal: 237					

List of abbreviations

APZ	asset protection zone
BAM	Biodiversity Assessment Method (2017)
BAR	Biodiversity Assessment Report
<i>BC Act</i>	<i>Biodiversity Conservation Act (2016)</i>
<i>BC Reg</i>	<i>Biodiversity Conservation Regulation (2017)</i>
BCAR	Biodiversity Certification Assessment Report
BCT	Biodiversity Conservation Trust
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offset Scheme
BPA	bushfire protection assessment
BSA	Biodiversity Stewardship Agreement
BSSAR	Biodiversity Stewardship Site Assessment Report
CEEC	Critically endangered ecological community
<i>CM Act</i>	<i>Coastal Management Act 2016</i>
DCP	development control plan
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 OEHS from April 2011)
DEWHA	Commonwealth Department of Environment, Water, Heritage & the Arts (superseded by SEWPAC)
DOEE	Commonwealth Department of Environment & Energy
DPIE	Department of Planning Industry and Environment
EEC	endangered ecological community
EPA	Environment Protection Agency
<i>EP&A Act</i>	<i>Environmental Planning and Assessment Act (1979)</i>
<i>EPBC Act</i>	<i>Environment Protection and Biodiversity Conservation Act (1999)</i>
<i>FM Act</i>	<i>Fisheries Management Act</i>
IBRA	Interim Biogeographic Regionalisation for Australia
LEP	local environmental plan
LGA	local government area
<i>LLS Act</i>	<i>Local Land Services Act (2013)</i>
NES	national environmental significance
<i>NPW Act</i>	<i>National Parks and Wildlife Act (1974)</i>
NSW DPI	NSW Department of Industry and Investment
OEHS	Office of Environment and Heritage (replaced by DPIE)
PCT	plant community type
RFS	NSW Rural Fire Service
ROTAP	rare or threatened Australian plants
SAII	Serious And Irreversible Impacts
SEPP	State Environmental Planning Policy
SEWPAC	Commonwealth Dept. of Sustainability, Environment, Water, Population & Communities (superseded by DOEE)
SIS	species impact statement
TEC	threatened ecological community
<i>TSC Act</i>	<i>Threatened Species Conservation Act (1995) – Superseded by the Biodiversity Conservation Act (2016)</i>
VMP	vegetation management plan

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Introduction

1

Travers bushfire & ecology has been engaged to undertake a biodiversity certification assessment for a planning proposal within Lot 273 DP 755266 at 15 Mulloway Road, Chain Valley Bay within the local government area of the Central Coast. The site is located within the Sydney Basin Bioregion and the Wyong IBRA sub-region. The site is owned by a private land owner, who is seeking an amendment to the site's zoning and future subdivision. This lot will be hereafter referred to as the 'study area' (Figure 1.1).

Following review by the Biodiversity and Conservation Division (BCD), the proposal has been altered to allow greater buffer protection to important Swamp Sclerophyll Forest and Swift Parrot foraging resources in the south of the study area. The original zoning plan is shown on Figure 1.2, while the current plan is shown on Figure 1.3. The current planning proposal aims to rezone the central and northern portions of the study area from E3 (Environmental Management) to a combination of E2 (Environmental Conservation), E3 (Environmental Management), RE1 (Public Recreation) and R2 (Low Density Residential) (see Figure 1.3). The 'subject site' will hereafter refer to the area of likely direct impacts by the proposal and will include a development footprint associated with the proposed rezoning and subsequent subdivision incorporating roads, services, stormwater management and Asset Protection Zones (APZs). The study area and subject site are shown on Figure 1.1.

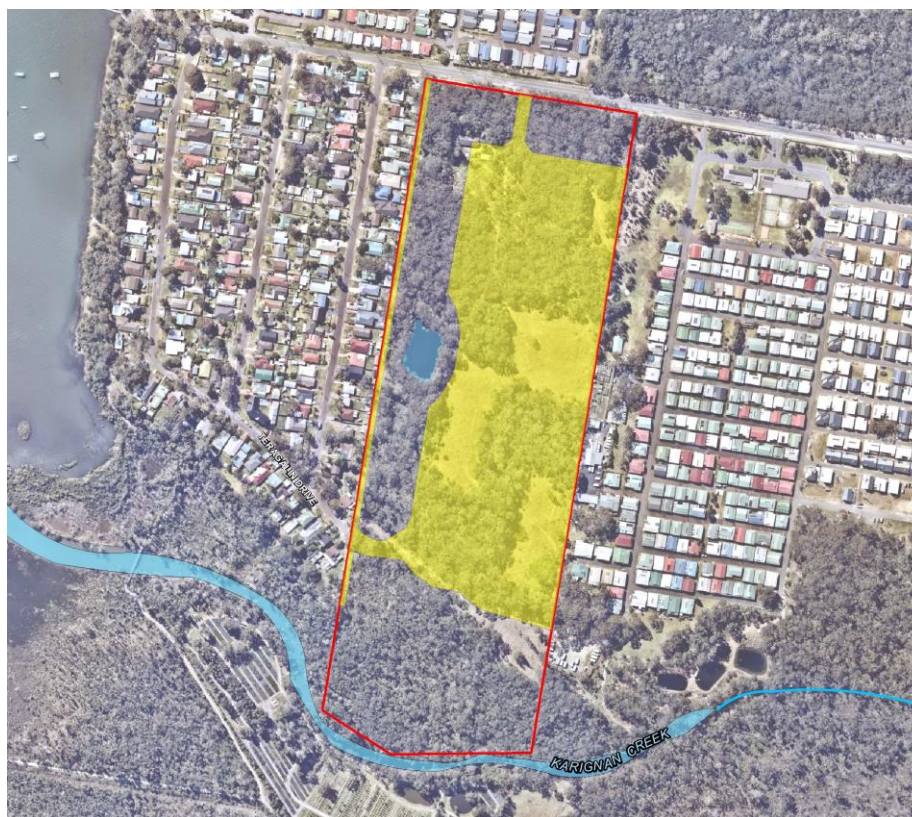


Figure 1.1 – Study area (red) and Biodiversity Certification area (subject site - yellow)

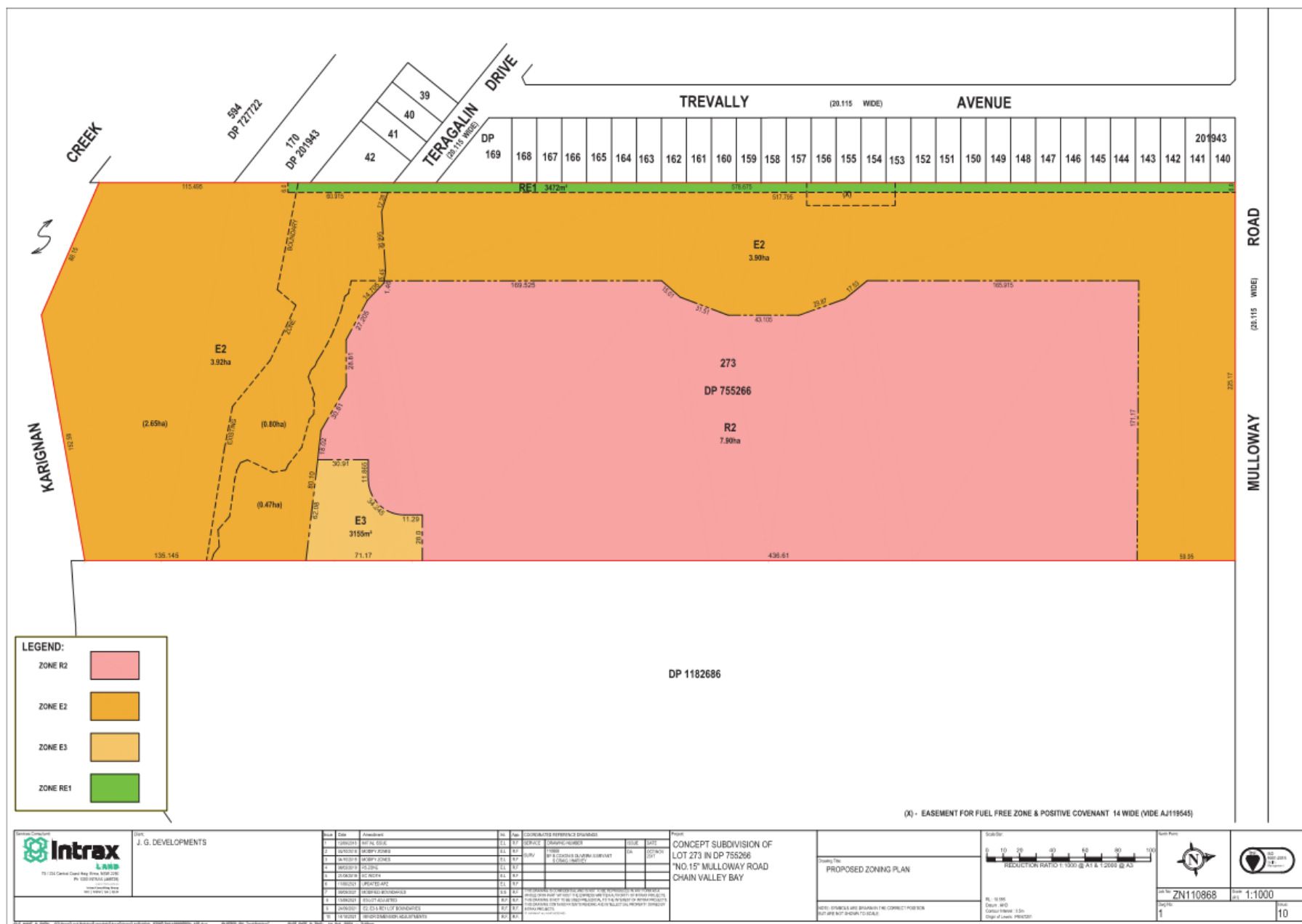


Figure 1.3 – Current proposed zoning plan

1.1 Purpose

The proponent seeks biodiversity certification at the rezoning stage for certainty of development at the development application stage.

The purpose of this Biodiversity Certification Assessment Report (BCAR) is to:

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

1.1.1 Certification of BAM compliance

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

- (1) *A biodiversity assessment report cannot be submitted in connection with a relevant application unless the accredited person certifies in the report that the report has been prepared on the basis of the requirements of (and information provided under) the biodiversity assessment method as at a specified date and that date is within 14 days of the date the report is so submitted.*
- (2) *A relevant application is an application for planning approval, for vegetation clearing approval, for biodiversity certification or in respect of a biodiversity stewardship agreement.*

George Plunkett (BAAS 19010) is an accredited person under the *BC Act*. I, George Plunkett certify here that the report has been prepared on the basis of the requirements of (and information provided under) the BAM (2017) as 13 October 2021, and that date is within 14 days of the date the report is so submitted.

1.1.2 Terminology

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

Subject site means the area directly affected by the proposal.

Study area has been refined to the site boundary. It will include all direct impacts and the majority of indirect impacts with the exception of connectivity and any minor or immeasurable impacts upon the hydrology of Karignan Creek or adjoining wetlands to the west.

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

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

1.2 Site description

1.2.1 Site overview

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

Table 1.1 – Site features

Location	Lot 273 DP 755266 at 15 Mulloway Road, Chain Valley Bay
Area	16.52 ha
Local government area	Central Coast
Current Zoning	E2 – Environmental Conservation; E3 – Environmental Management (see Figure 1.15)
Grid reference MGA-56	366900E 6328200N
Elevation	0–15 m AHD
Topography	Slopes are in the range of 0 to 5 degrees. The southern portion of the site has a southerly aspect towards the adjoining creek. The central part of the site slopes south-west and the northern portion is varied with a minor knoll approximately 100 m from the north-eastern boundary.
Catchment and drainage	Catchment - Lake Macquarie Karignan Creek occurs along the southern boundary of the site.
Existing land use	Residential (rural). Previously used for market gardening and livestock grazing - these long term existing land use rights remain in place

1.2.2 Landscape features

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

Table 1.2 – Landscape features

IBRA bioregions and subregions	Sydney Basin bioregion – Wyong subregion (Figure 1.7 and 1.8)
NSW landscape region and area (ha)	Gosford - Cooranbong Coastal Slopes
Patch size	1,381.11ha minimum. Size class >100 ha (Figure 1.9)
Native vegetation extent in the buffer area (1500 m)	614.03 ha approx. and 63.51%
Cleared areas	Just over 20% of the study area is currently cleared
Evidence to support differences between mapped vegetation extent and aerial imagery	Vegetation mapped closely matches the aerial imagery
Rivers and streams classified according to stream order	The location map (Figure 1.8) shows the study area with a third order stream, Karignan Creek, abutting the southern boundary
Wetlands within, adjacent to and downstream of the site	There is one dam close to the western boundary of the study area, shown on the site map (Figure 1.7)
Connectivity features	<p>The southern portion of the site provides connectivity from east to west along Karignan Creek. The remaining northern portions of the site provide a linkage between this riparian corridor and habitat extending north directly into Lake Munmorah State Conservation Area and up to the Gwandalan peninsula.</p> <p>The open forest vegetation within the study area provides natural habitat with connectivity to the north, south-west and south-east. The location map (Figure 1.8) shows an overview of the extent of native vegetation in the locality.</p>
Areas of geological significance and soil hazard features	<p>There are no areas of geological significance and soil hazard features within the site that will be impacted by the proposal.</p> <p>General descriptions of the geology and soils are provided below.</p> <p>Geology; Munmorah Conglomerate within the proposed R2 zone, and Quaternary geology in the E2 lands. Munmorah Conglomerate is comprised of conglomerate, pebbly sandstone, and grey to green shale. Quaternary is comprised of gravel and sand.</p> <p>Soils; Doyalson Soil Landscape covers most of the site except for the creek line. The creek line and extended riparian area contains the Wyong Soil Landscape. Usually alluvial soils.</p>
Identification of method applied (i.e. linear or site-based)	Site based assessment

1.3 Proposed rezoning

The current planning proposal aims to retain and extend the southern E2 (Environmental Conservation) zone land and rezone the central and northern portions of the study area from E3 (Environmental Management) to part E2 (Environmental Conservation), part R2 (Low Density Residential) and part RE1 (Public Recreation). In addition, a smaller E3 (Environmental Management) parcel is proposed to be retained (see Figure 1.3). The R2 zoned portions are planned for development of 93 low density residential lots. The E3 parcel is approx. 3155 m² and forms a transition between the residential and conservation lands. An E2-zoned wildlife corridor (varying in width from 50–60 m) is proposed along the western and northern boundaries to link habitat to the south and north. The proposed RE1 zone is to accommodate a proposed 6 m-wide pedestrian/ cycleway / fire trail that will separate the corridor from the existing residential zoned lands of Chain valley Bay. The proposed zoning plan is shown in Figure 1.3. The proponent seeks biodiversity certification at the rezoning stage for certainty of development at the development application stage.

1.3.1 Identification of development site footprint

The amount of native vegetation within the subject lot is estimated at 13.46 ha. Approximately 6.55 ha native vegetation, plus 2.5 ha of cleared vegetation, will be directly impacted through the construction of internal roads, buildings, APZs, stormwater basin and pedestrian /cycleway/ fire trails.

Figure 1.6 shows the concept layout.

1.3.2 Existing easement and Positive Covenant

An easement is located along the western boundary (not eastern) which was installed in 2014 as an Asset Protection Zone for the adjacent Lot 155 DP 755266 under Positive Covenant. Title documents are provided. This easement has been excluded from the Biodiversity Certification impact area and will not be included as part of any future conservation areas unless lifted. This easement is labelled with an “X” in Figure 1.6, and occupies an area of approx. 0.075 ha, of which 0.032 ha will contain part of the proposed bike path and fire trail.

1.4 Statutory assessment requirements

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

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

Local Planning Direction 2.1 under Section 9.1

For the purposes of Local Planning Direction 2.1, environmental protection zones apply to this site. Therefore, a planning authority must do the following:

- (4) *A planning proposal must include provisions that facilitate the protection and conservation of environmentally sensitive areas.*

(5) A planning proposal that applies to land within an environment protection zone or land otherwise identified for environment protection purposes in a LEP must not reduce the environmental protection standards that apply to the land (including by modifying development standards that apply to the land). This requirement does not apply to a change to a development standard for minimum lot size for a dwelling in accordance with clause (5) of Direction 1.5 “Rural Lands”.

The E2 conservation zone is proposed for the significant floodplain EEC vegetation communities within the site. Once a determination of the agreed corridor has been made an appropriate zone can be proposed for the habitat corridor.

The proposed zoning improves on the current environmental protection zones by increasing the area conserved under the proposed E2 zone and therefore is consistent with Planning Direction 2.1.

Table 1.3 – Proposed changes in zoning

Description of zone	Area
E2 zone protection under current LEP	2.65 ha
Proposed E2 zone protection (southern conservation area and habitat corridor)	7.71 ha
Net Change in E2 zone protection	+5.06 ha (gain)

The proposed environmental zones are not considered to be inconsistent with Planning Direction 2.1 and is justified by the proposed strategy. The reasons include:

- The proposed zoning considers the environmental constraints, effective function of this land to provide future habitat connectivity and increases the area of protection under zone E2 Environmental Conservation
- The Biodiversity Certification Assessment Report (BCAR) supports the current proposed zonings and has been designed to incorporate and absorb the connectivity concerns by Council and OEH / DPIE through extension of a corridor along the western and northern boundary, and rezoning such land as E2 for future protection and managed under a vegetation management plan (VMP).
- The Biodiversity Assessment does not identify any other significant ecological constraint other than the EEC vegetation that would constitute a significant inconsistency with Planning Direction 2.1.

A gateway determination for rezoning of the site was undertaken in 2017 and attached as Appendix 5. OEH / DPIE provided comments back to Council on flooding, biodiversity and Aboriginal cultural heritage. Response attached in Appendix 5 also.

1.4.2 Biodiversity Conservation Act 2016 (BC Act)

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

The *BC Act* and the *Biodiversity Conservation Regulation 2017* 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).

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 (SAIL) on biodiversity values. The determination of SAIL 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. Where a Part 4 development enters the BOS, a test of significance in accordance with s.7.3 of the *BC Act* is not required.

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

1.4.3 Fisheries Management Act 1994 (FM Act)

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

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

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

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

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

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, then the matter needs to be referred to the Commonwealth Department of Environment and Energy (DOEE) 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 apply to specific NES matters which may determine whether a referral is or is not required, such as for the *EPBC*-listed ecological communities Cumberland Plain Woodland and Shale-Gravel transition Forest. Consultation with DOEE may be required to determine whether a referral is or is not required. If there is any doubt as to the significance of impact or whether a referral is required, a referral is generally recommended to provide a definite decision under the *EPBC Act* thereby removing any further obligations in the case of 'not controlled' actions.

A significant impact is regarded as being:

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

Source: EPBC Policy Statement

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

1.4.5 Coastal Management Act 2016 (CM Act)

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

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

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

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

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

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

Karignan Creek enters Lake Macquarie which is defined as an estuary under the CM Act. The study area does not contain management areas 1 and 2, however areas 3 and 4 of the above apply.

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

State Environmental Planning Policy (Coastal Management) 2018

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

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

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

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

Wetlands on site or adjacent

The interactive mapping tool provides updated mapping of the former SEPP 14 wetlands. Former wetland no 890 occurs to the west of the study area along the mouth entry of Karignan Creek. The buffer applied to the wetland affects a small portion of the study area adjacent to Teraglin Drive. Figure 1.4 shows the location of the wetland and its buffer.

The proximity area of the wetland is protected by the proposed conservation areas or E2 zoned lands. However the access road to the south western corner is within the proximity area but matches the existing street alignment with the adjoining existing subdivision.

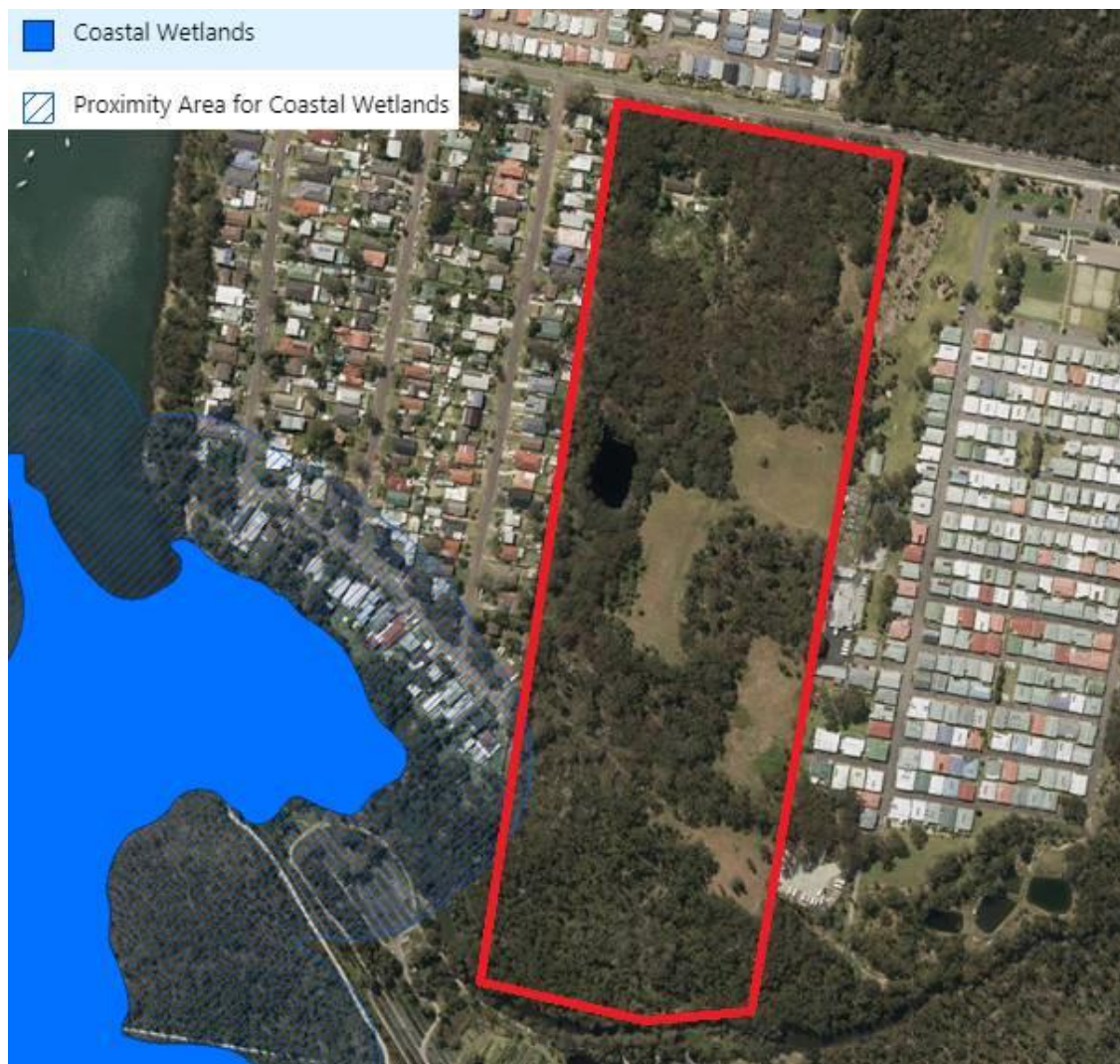


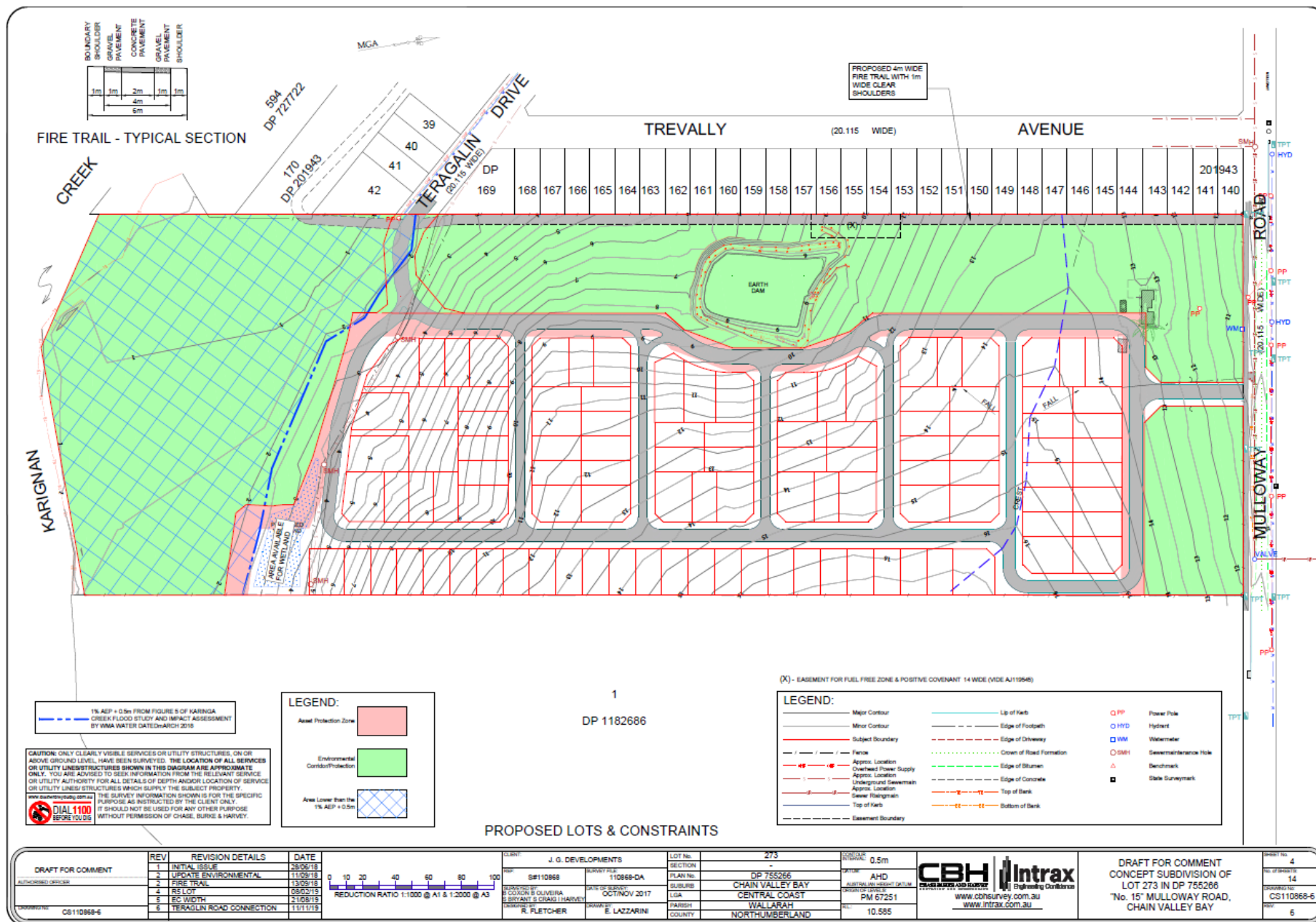
Figure 1.4 – Adjacent wetlands

(Source: Coastal Wetlands and Littoral Rainforest Area Map, NSW Department of Planning & Environment 2018)

1.4.6 Licences

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

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



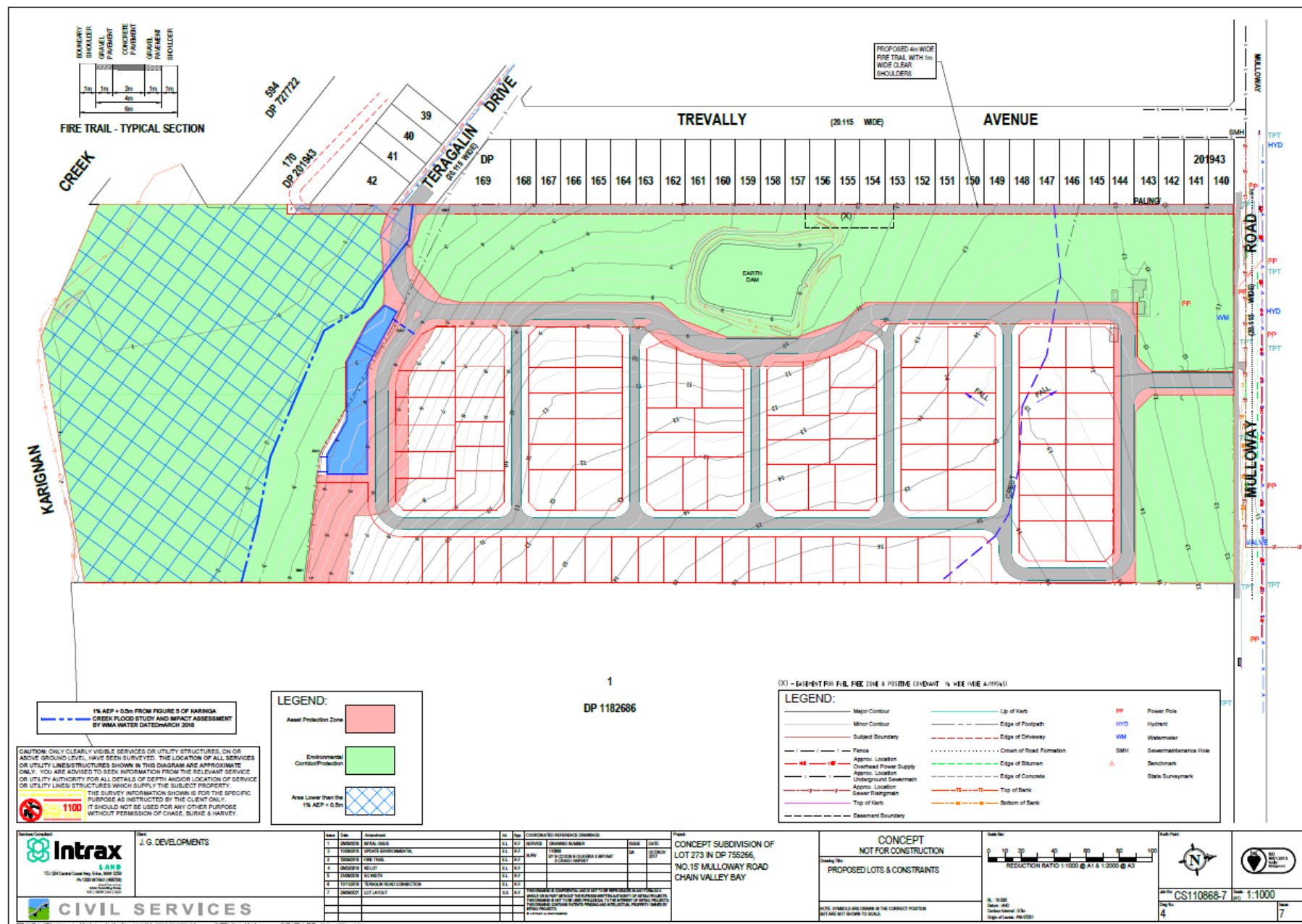


Figure 1.6 – Current proposed subdivision plan

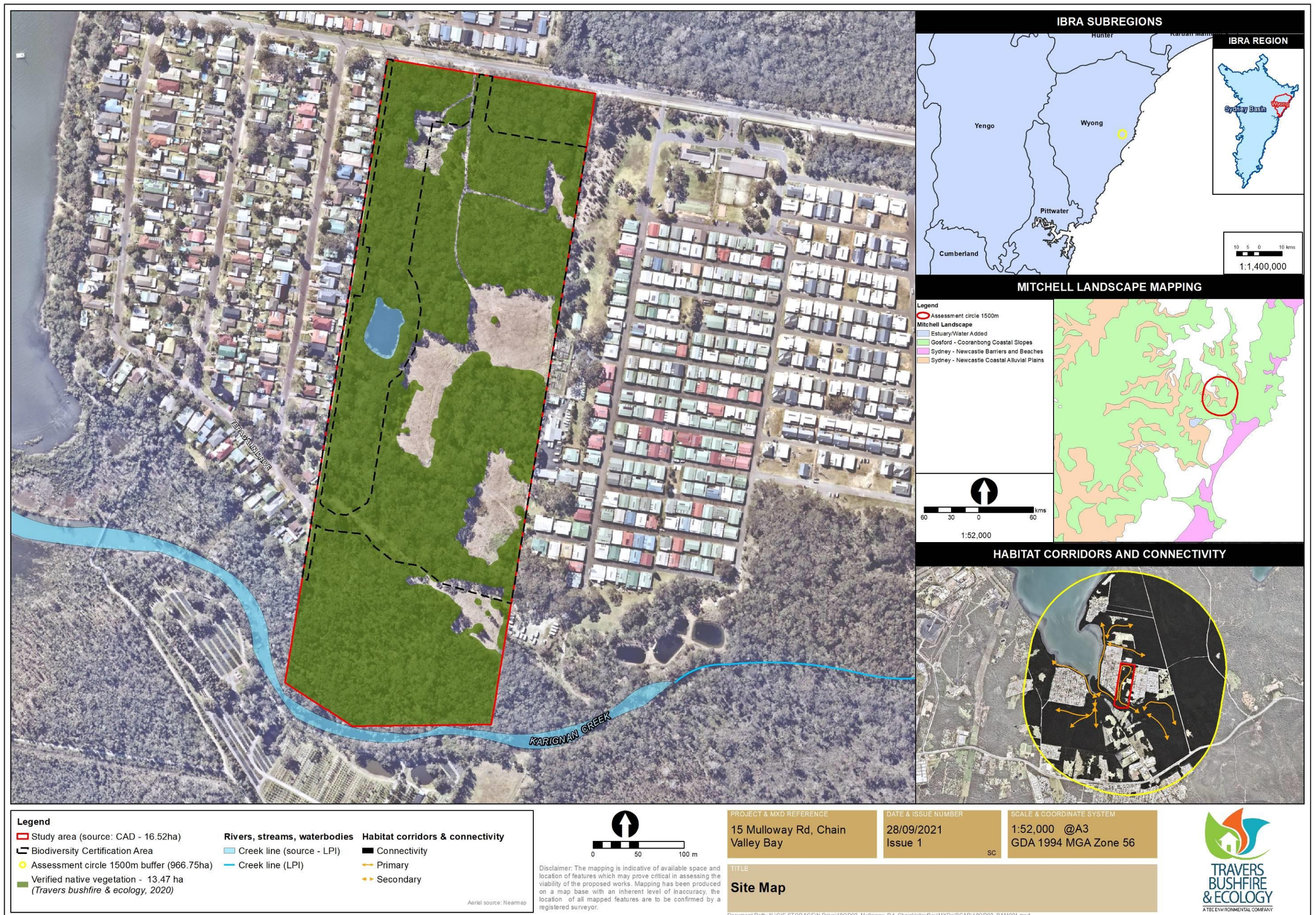


Figure 1.7 – Site map

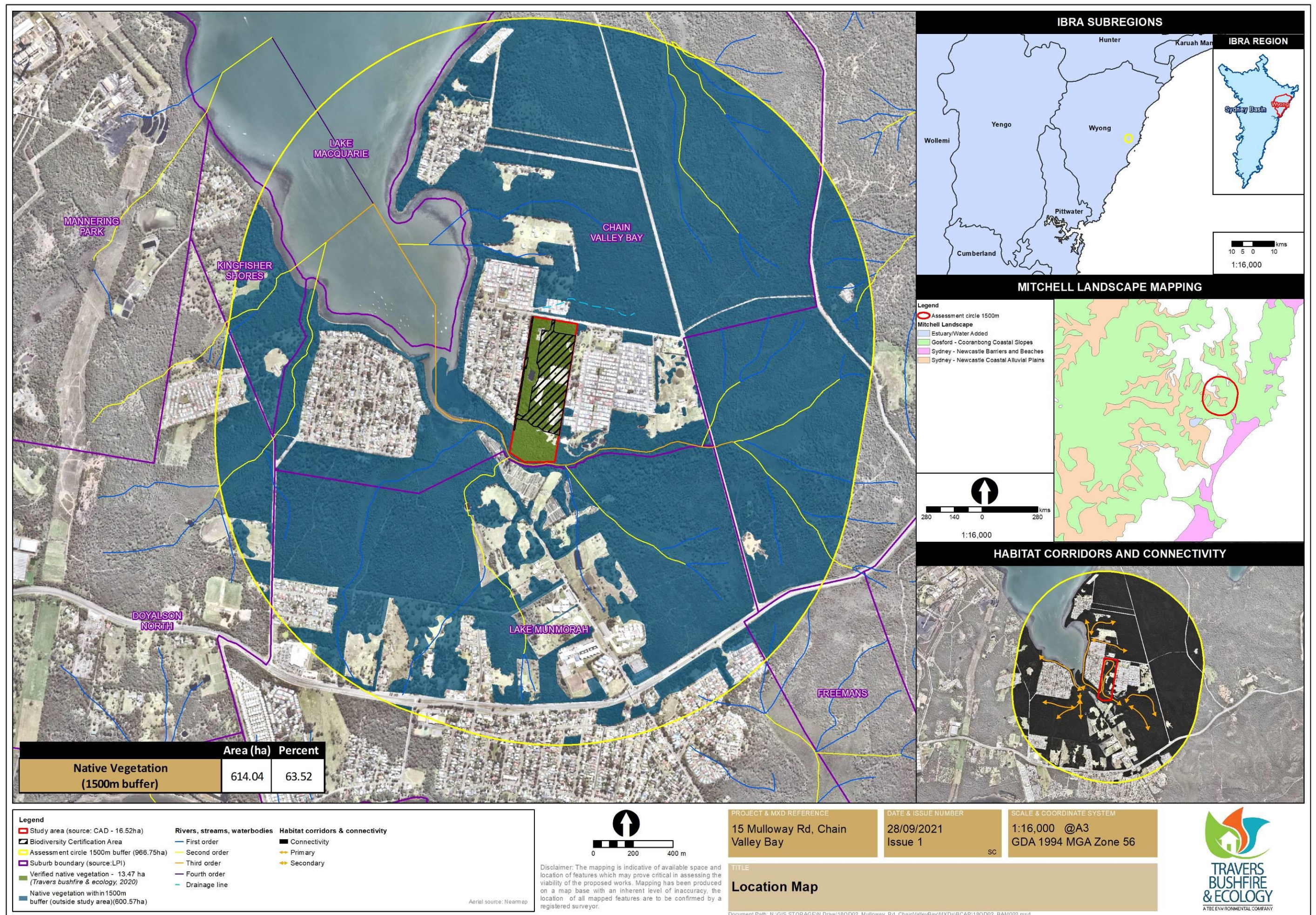


Figure 1.8 – Location map



Figure 1.9 – Patch size



Figure 1.10 – Mitchell Landscapes
 (Source: Google Earth – Mitchell Landscape Mapping)

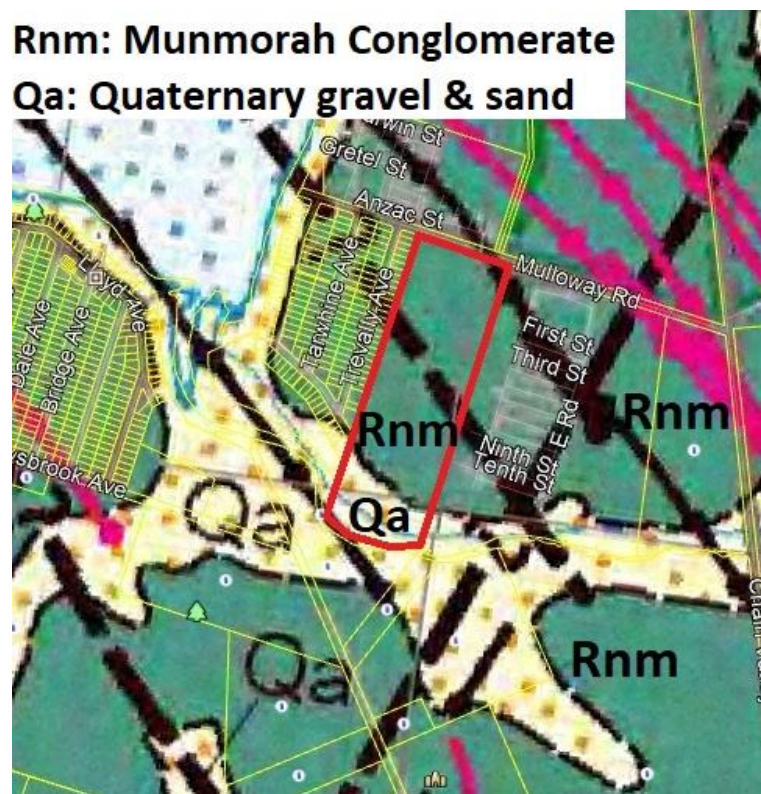


Figure 1.11 – Local geology
 (Source: Gosford-Lake Macquarie Special 1:100 000 Geological Sheet)



Figure 1.12 – Local soil landscapes
 (Source: Google Earth – Local soil landscape – Gosford/Lake Macquarie)

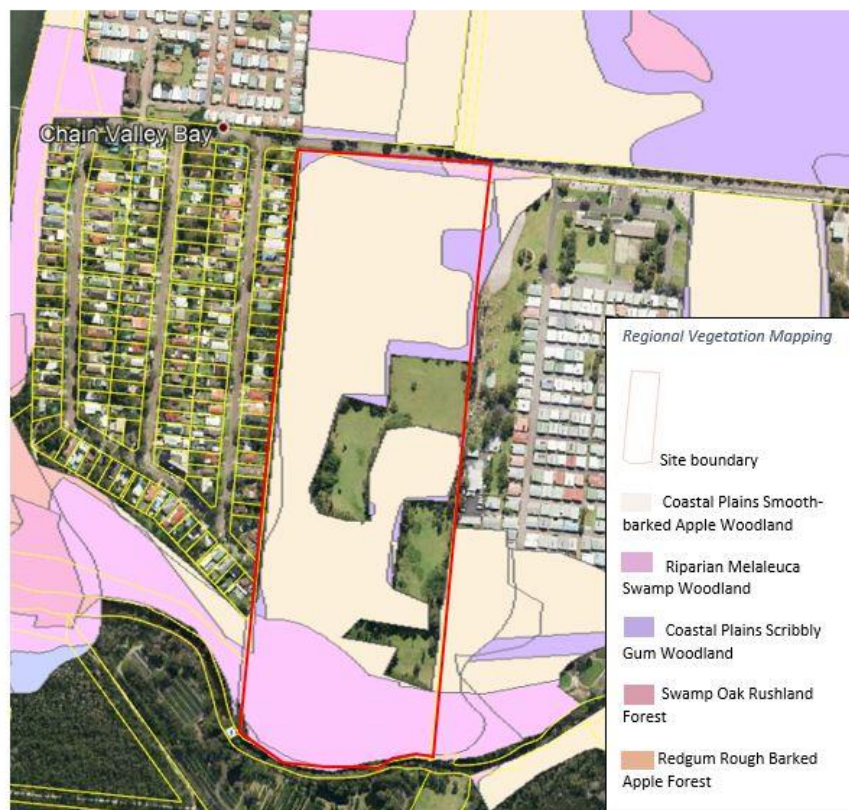


Figure 1.13 – Regional vegetation mapping (LHCCREMS 2003)
 (Source: Google Earth – LHCCREMS (2003) - Wyong LHCC extant May03)



Figure 1.14 – Wyong LGA vegetation mapping (2008)
(Source: Google Earth – Wyong Vegetation Mapping VISID 3807)



Figure 1.15 – Current zoning
(Source: Wyong Council LEP 2013, NSW planning portal)

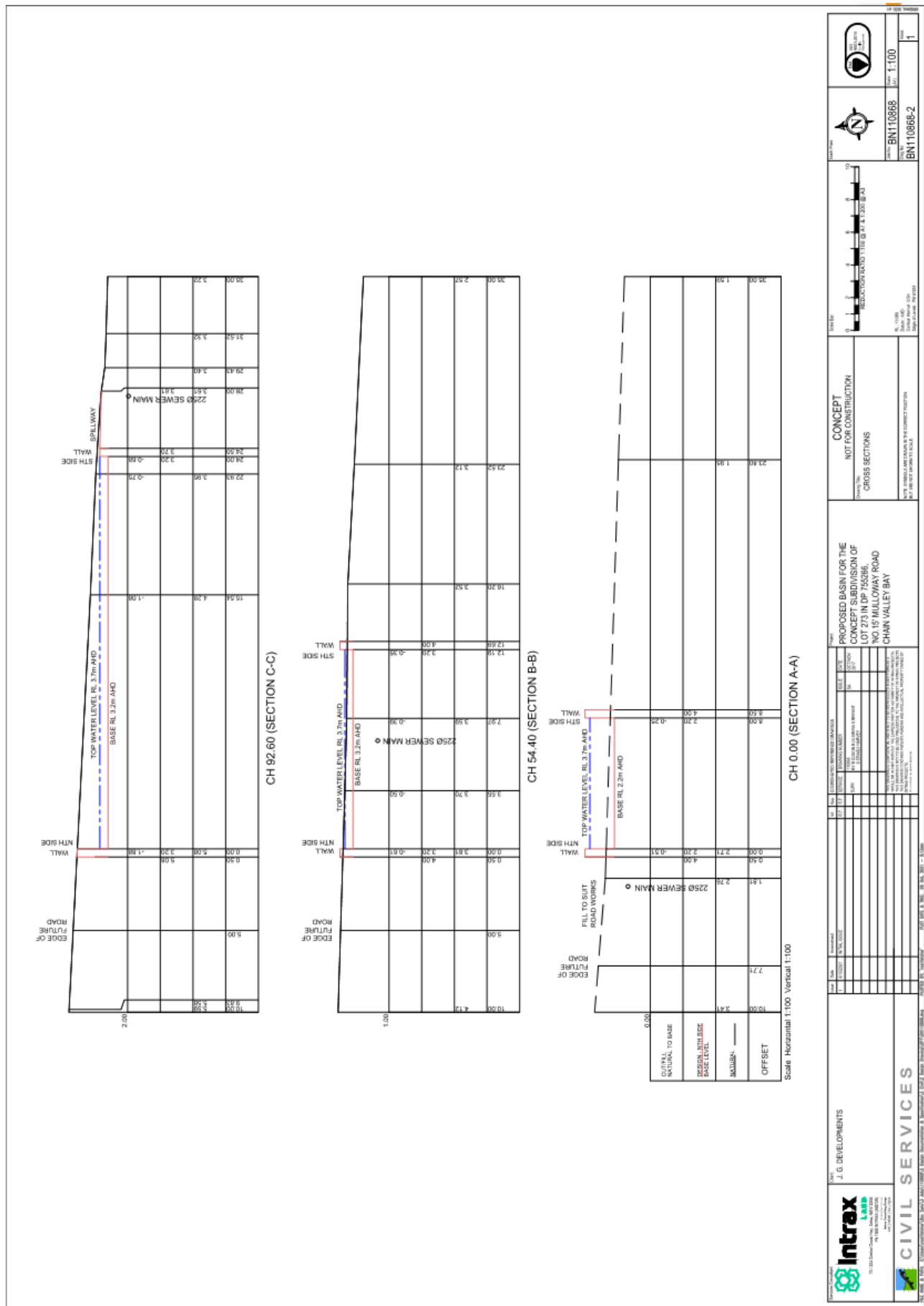


Figure 1.17 – Concept stormwater basin cross sections
 (Source: Intrax 6.10.2021)



Survey Methodology

2

2.1 Pre-survey information collation & resources

A review of the relevant information pertinent to the subject site was undertaken.

Standard technical resources utilised:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities 2004* (working draft), Department of Environment and Conservation (DEC)
- *Flora and Fauna Survey Guidelines* - Wyong Shire Council 2014
- Aerial photographs (*Google Earth Pro / Nearmap*)
- Topographical maps (scale 1:25,000)
- *Biodiversity Conservation Act 2016 (BC Act)*
- *Fisheries Management Act 1994 (FM Act)*
- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*
- Rare or Threatened Australian Plants (ROTAP)
- Wyong Shire Council vegetation mapping (2008)
- LiDAR data for contours (Land and Property Information, est. 2015 estimated)
- *Biodiversity Conservation Regulation 2017 (BCR)*
- *Fisheries Management Act 1994 (FM Act)*
- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*
- NSW Office of Environment and Heritage's BioNet - Atlas of NSW Wildlife, which holds data from a number of custodians. Data last obtained January 2018
- EPBC Protected Matters Search Tool - *DOEE* (January 2018)
- Lower Hunter Central Coast Regional Environmental Mapping System (LHCCREMS), 2003
- Previous reports and surveys within the site (refer to Section 4.2)

Desktop assessment:

To determine the likely and actual occurrence of flora species, fauna species and plant communities on the subject site, desktop assessments were undertaken including:

- **A literature review** – A review of readily available literature for the area was undertaken to obtain reference material and background information for this survey.
- **A data search** – A search of the *Atlas of NSW Wildlife* (OEH 2018) was undertaken to identify records of threatened flora and fauna species located within a 10 km radius of the site. Searches were also undertaken on the DOEE – 'protected matters search tool' website to generate a report that will help determine whether matters of NES or other matters protected by the *EPBC Act* are likely to occur in the area of interest. The search was broadened to a 10 km radius in accordance with the Atlas search of NSW. These two searches combined, enabled the preparation of a list of threatened flora and fauna species that could potentially occur within the habitats found on the site (Tables A2.1, A2.2 and A2.3).

Vegetation mapping:

LHCCREMS (2003) vegetation mapping (Figure 1.13) identifies the following communities within the study area:

- Coastal Plains Smooth-barked Apple Woodland
- Riparian Melaleuca Swamp Woodland
- Coastal Plains Scribbly Gum Woodland

Wyong LGA vegetation mapping (Figure 1.14) identifies the following communities within the study area:

- Narrabeen Doyalson Coastal Woodland
- Estuarine Swamp Oak Forest (equivalent to TEC Swamp Sclerophyll Forest)

Based on ground truthing and survey, we consider the Wyong LGA mapping to be the most accurate and it is generally consistent with our own vegetation mapping as shown in Figure 2.

2.2 Flora survey methodology

2.2.1 Methodology undertaken for the original gateway determination

A review of the Atlas of NSW Wildlife was undertaken in December 2015 prior to the commencement of field studies to advise the client of cryptic flora species which would require specific targeted survey during their known flowering periods.

The first survey included botanical survey for *Acacia bynoeana* and *Cryptostylis hunteriana* over a full day in February 2016 where it was deemed there would be suitable potential habitat. It should be noted there was a bushfire within the southern portion of the site in 2014 which may lessen the current potential for species to occur as well as there being floodplain vegetation which may or may not be appropriate for particular species.

On March 4 and 7, 2016, full botanical survey was undertaken across the entire site. The application of random meanders, biometric transect plots, and belt transects assisted in providing a species list, determining vegetation types and describing common species. Target threatened species searches were again undertaken but focused upon *Corunastylis* sp. Charmhaven.

Targeted threatened flora survey for species such as *Diuris praecox* were undertaken on 8 and 23 August 2016. No specimens of *Diuris praecox* were observed within the study area.

Targeted threatened flora survey for species such as *Tetratheca juncea*, *Caladenia porphyrea*, *Caladenia tessellata*, *Genoplesium insigne*, *Thelymitra* sp. *adorata* and *Rutidosia heterogama* were undertaken on 21 September 2016 (4 hours) and 17 October 2016 (4 hours).

Target searches involving belt transects 8–10 m apart have been conducted for all cryptic threatened species throughout the site, as shown in Figure 2.

2.2.2 Methodology undertaken for this rezoning proposal

Updated Bionet and EPBC searches were undertaken in January 2018. No new species require consideration or target threatened species surveys.

Target threatened species surveys were conducted for *Tetratheca juncea*, *Caladenia porphyrea*, *Caladenia tessellata*, *Genoplesium insigne*, *Thelymitra adorata* and *Rutidosia heterogama* on 26 September 2017. *Cryptostylis hunteriana* and *Acacia bynoeana* searches were undertaken on 11 and 18 December 2017. Target searches for *Corunastylis* sp. Charmhaven were conducted on the 17 March and 3 April 2018.

Determination of vegetation communities has been previously undertaken in 2016. For consistency with the BOS, a series of BAM plots were undertaken on 11, 12 and 18 December 2017, 8 April 2019, and 21 Oct 2020. Species observed within the plots that were not previously in the flora list were added.

The following information was collected at each of the 20 m x 20 m full floristic plots:

- Native overstorey, mid-storey and ground cover recorded for all observed species and an estimate of stems.
- Stratum (and layer): stratum and layer in which each species occurs
- Growth form: growth form for each recorded species
- Species name: scientific name and common name
- Percent projected foliage cover of the understorey strata and exotic vegetation

The following information was collected at each of the 20 m x 50 m transect plot sites:

- Number of trees with hollows visible from the ground within the 20 m x 50 m plot
- The total length of fallen logs >10 cm in diameter within the 20 m x 50 m plot
- The proportion of regenerating overstorey species within the vegetation zone
- Number of large trees
- Estimates of leaf litter cover, bare ground, cryptograms and rocks in 1 m x1 m subplots at five (5) locations along the 50 m central transect

The vegetation types observed in the study area were assigned to a plant community type (PCT). They were then stratified and plots located based on PCT and condition. Tables 1.1 and 1.2 indicates that the minimum number of plot and transect sites required has been sampled for this assessment.

Flora survey effort and results are shown on Figure 2.

All observed plant species are listed in Section 3.1.2.

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

2.3 Fauna survey methodology

Site survey effort accounting for techniques deployed, duration, and weather conditions are outlined in Table 3.1 and are depicted on Figure 3.

Current standard fauna survey techniques employed by *Travers bushfire & ecology* in line with relevant survey guidelines as well as current survey knowledge are provided in Appendix 1. Site specific fauna survey techniques that have been tailored to the study area are described below.

Diurnal birds

In early autumn 2016 ten (10) diurnal bird census points were undertaken within the study area. A minimum of 15 minutes of survey was undertaken at each census point in an area radiating out to between 30–50 m. Bird census points were selected to give an even spread and representation across the site and its communities (see Figure 3). 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.

In late 2017 (summer) diurnal bird survey was undertaken opportunistically whilst checking morning traps.

In early and mid-2018 (summer and winter) diurnal bird survey was undertaken opportunistically during the detailed habitat tree surveys throughout the habitat tree study area. Searches for hollows within this area also contributed to searches for presence of large raptor nests.

During surveys seeding *Allocasuarina* trees were opportunistically searched where encountered within the study area for chewed cones indicating foraging activity by Glossy Black-Cockatoo (*Calyptorhynchus lathamii*).

A song-meter was deployed for continuous recording over sixteen (16) days during November and December 2017. This was placed to the south of the dam and then moved to the north of the site. Calls were batched and analysed using *Kaleidoscope Pro* software.

Nocturnal birds

Given the suitability of habitat present Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Sooty Owl (*Tyto tenebricosa*) and Black Bittern (*Ixobrychus flavicollis*) were targeted by call-playback techniques during early 2015 & 2016 nocturnal surveys. Threatened owl call playback was undertaken centrally within the site and Black Bittern was targeted at two (2) locations along Karignan Creek.

Searches for significant habitat trees in 2016 included suitable hollows for owls. Where such hollows were located, searches were undertaken under nearby likely perches to detect current owl activity.

A song-meter was deployed for continuous recording over sixteen (16) days during November and December 2017. This was placed to the south of the dam (close to the large hollow in tree 2641) and then moved to the north of the site. Calls were batched and analysed using *Kaleidoscope Pro* software to search for owl calls.

A song-meter was again deployed to the south of the dam close to the large hollow in HT86 (tree 2641) for recording 4 hours after dusk and 3 hours before dawn over seventeen (17) days during July and August 2018. This large tree contained a hollow considered most suitable for large forest owls. This tree was later climbed and inspected by a tree climber on the 10 August 2018. The termite debris and mud at the base of the hollow was scraped with a net to search for any old pellet / prey bones / feather material. The rim and adjacent branches was searched for recent talon wear.

Stag-watching effort amounting to thirteen (13) early evening site visits in June, July and August 2018 also contributed to owl survey by listening for early evening owl calls at this time, which was during the Powerful Owl breeding season.

Following a request by the BCD (correspondence dated 14/4/21), further stag-watching effort was undertaken in 2021 to target any breeding presence of large forest owls. This included stag-watching of all hollows not previously stag-watched with an entry greater than 20 cm based on the Powerful Owl and Masked owl breeding habitat constraints descriptions in the TBDC. Hollow spouts less than 30 cm or hollows located close to the ground were excluded. This exclusion is not recognised by the TBDC but rather by the Recovery Plan for Large Forest Owls (DEC 2006). The recovery plan states that Powerful Owl are 60 cm long and nest in hollows great than 45 cm diameter and Masked Owl are 40-50 cm long and nest in hollows great than 40 cm diameter and both species select hollows greater than 100 cm deep. Therefore, whilst it is recognised that large forest owls may enter a hollow between 20-30 cm, this would be only in the situation where the hollow chamber widens beyond this entry, as neither species will likely nest in a hollow that remains less than 30 cm narrow throughout. The Recovery Plan also indicates that hollows used by Powerful Owl are at least 6 m above ground level in trees of at least 80 cm DBH.

Travers bushfire & ecology collects detailed hollow information for habitat trees. This includes not only size of entry hole but also hollow type. Hollow types including 'branch spouts' and 'broken trunks' are labelled where the hollow is located at the broken end of a branch or trunk and the hollow subsequently remains the same width or less than the entry and therefore has no larger internal chamber.

All hollow-bearing tree data for trees with hollows >20 cm has been collated and presented as a separate Table 3.10, and the exclusion of select trees for potential use by large forest owls has been outlined. As mentioned above, these are spouts less than 30 cm or hollows located only very low to the ground. Some hollows were also stag-watched during previous surveys in the appropriate month and this information has also been included. All trees identified with potential for use based on the refined criteria were stag-watched. This additional stag-watching survey amounted to seven (7) additional stag-watch nights in June 2021.

Arboreal and terrestrial mammals

Given the suitability of habitat present, Koala (*Phascolarctos cinereus*) and Squirrel Glider (*Petaurus norfolcensis*) were targeted in 2016 to 2018 by call-playback techniques during each nocturnal survey. Nocturnal call-playback locations for target species are shown on Figure 3. Call-playback is followed with detailed spotlighting throughout the study area on each nocturnal visit. Surveys typically incorporate opportunistic searches of secondary evidence of Koala habitation including characteristic scratches on smooth-barked trees and searches below trees for scats where scratches consistent with Koala is found. Large Swamp Mahogany trees were also opportunistically searched for presence of scats.

Koala was more comprehensively targeted in 2021 by applying three (3) SAT (Spot Assessment Technique) points as described by *Phillips & Callaghan* (2011) as a measure of

Koala 'activity'. SAT locations were selected based off a 250m grid overlay and aligned to represent at least one SAT in the southern Swamp Mahogany community; these locations and the grid are shown on Figure 3.

In late 2017 arboreal and terrestrial *Elliott* trapping was undertaken as well as terrestrial surveillance cameras.

Five (5) Elliott trap-lines were deployed each consisting of five trap stations. A terrestrial Elliott A trap and a terrestrial Elliott B trap were placed at every trap station separated by a minimum of 10 m. An arboreal Elliott B trap was also placed at two (2) trap stations along each trap-line. Traps were baited with the standard rolled oats, peanut butter and honey mix. These locations were selected to provide an even spread across the study area. Elliott traps were deployed for four (4) consecutive nights.

Elliott trapping in 2017 amounted to thirty-two (32) arboreal B trap nights, one hundred (100) terrestrial A trap nights and one hundred (100) terrestrial B trap nights. The location of the trap-lines is shown in Figure 3.

Elliott trapping was again undertaken along the same trap-lines in winter 2018 to target Squirrel Glider presence during the flowering of Swamp Mahogany. One additional line was also undertaken to the north of the dam. At this time five (5) arboreal Elliott B traps were placed along each line for four (4) nights amounting to one hundred and forty (140) arboreal B trap nights.

The song-meter effort during November and December 2017 and July – August 2018 also contributed to nocturnal mammal call survey.

Five (5) remote infra-red and motion sensing surveillance cameras were placed in random evenly spaced locations within the study area during late 2017 survey to evenly represent each vegetation community. Baited canisters were pegged to the ground in front of cameras containing the standard rolled oats, peanut butter and honey mix. White truffle oil was poured into the soil also to target Long-nosed Potoroo. Small chicken wings were placed also to target Spotted-tailed Quoll.

Cameras were placed out for six (6) weeks however only the first two (2) weeks are counted in the survey effort table given that the canister bait is usually depleted by ants after this. Therefore camera survey amounted to seventy (70) camera trap nights.

Extensive stag-watching effort was undertaken of selected hollow-bearing trees considered most suitable for Squirrel Glider (and others nearby) during winter 2018 surveys. This amounted to a total of ninety-two (92) hollow-bearing trees stag-watched.

Additional stag-watching surveys of hollows >20cm entry targeting breeding owl activity as described in the nocturnal bird section above, also contributed to arboreal mammal surveys.

Bats

Passive Anabat monitoring was undertaken during 2016 and 2017 nocturnal surveys targeting overnight concentrated bat activity at select locations through the study area. This included over the dam in the central portion of the study area, along Karignan Creek and along forest edges.

In late 2017 and following concentrated bat recordings over the dam, two (2) harp traps were deployed, one (1) on either side of the dam. These were deployed for four consecutive nights amounting to eight (8) harp trap nights.

Extensive stag-watching effort was undertaken of selected hollow-bearing trees with the most notable quality hollows during winter 2018 surveys. This amounted to a total of ninety-two (92) hollow-bearing trees stag-watched. An ultrasonic recorder was held to identify any emerging bats from these hollows at this time.

Amphibians

Wallum Froglet was heard calling during afternoon survey on 15 March, 2016. Nocturnal call-playback in the surrounds to this was then undertaken in March 2016 to stimulate calling activity and extent of breeding area during light rain after dark. Calls were played through a 15 watt Toa 'Faunatech' amplifier carried over the shoulder from a CD recording obtained from *Australian Frog Calls – Subtropical East (Nature Sound – David Stewart)*.

Green-thighed Frog and Mahony's Toadlet was surveyed for on the nights of the 27/10/20 and the 29/10/20 after considerable amounts of rain (62.8 mm on 26/10/20; 23.8 mm on 27/10/20). These ideal conditions are also considered appropriate for Green and Golden Bell Frog calling. A reference site at Norah Head was used for Mahony's toadlet with the species calling each night. A reference site at Davistown Wetlands was used for Green and Golden Bell Frog on the 29/10/21. Nocturnal call-playback for Green-thighed Frog and Mahony's Toadlet was undertaken across suitable habitat onsite on both nights to stimulate calling activity. Calls were played through a 15 watt Toa 'Faunatech' amplifier carried over the shoulder with recordings obtained off the *Australian Museum FrogID App*.

Habitat trees

Hollow-bearing trees were identified and recorded within the subject site on a *Trimble* handheld GPS unit during early 2018 surveys. This survey was updated and completed within the southern subject site area over winter 2018 surveys. All data such as hollow types, hollow size, tree species, diameter at breast height (DBH), canopy spread and overall height were collected. Some additional trees outside of the subject site within the riparian forest in the southern study area were also identified at this time.

A summary of hollow-bearing tree results is provided in Table 3.9 and locations are shown on Figure 4.

All trees within the subject site have been previously located by land surveyors. A metal tag with the corresponding tree reference number has been placed on the trunk by the surveyors for field relocation purposes. This reference number has been cited for habitat trees recorded during detailed hollow searches and is presented in column B of Table 3.9. In some instances, where the tree has not been located and the number off the tree plan was not confirmed (therefore not surveyed) a new tag was placed with the closest tree number followed by a "B". This was often the case for dead trees.

Other habitat trees were also recorded such as those containing nests (arboreal termite nest containing kingfisher holes) or notable presence of glider sap feeding incisions (on Red Bloodwood trees).

Significant habitat trees

Significant habitat trees are defined as trees containing large hollows suitable for use by owls or cockatoos and / or containing hollows considered potentially suitable for use by Squirrel Glider. These trees were first identified by GPS in 2016 to determine their layout across the potential development landscape.

More recent surveys in 2021 have made greater consideration to hollow sizes for owls in accordance with the TBDC. These are explained in the nocturnal bird section above.

Functional corridor analysis

On Tuesday 08/10/19 individual trees within range of the proposed roads and separation points on site at Chain Valley Bay, were assessed for suitability as gliding take-off and landing points. The assessment was constructed on the suitability for gliding distance and health of individual trees. Suitability based on the health of the tree was any tree with a health rating over 65% and ability to glide a certain distance. Distance was calculated from existing data for the Squirrel Glider glide angle of 28.5 degrees (Goldingay and Taylor 2009).

The gliding distance was measured based on landing trees and perch points, that being the furthest suitable branch from the tree facing towards the opposite side of the road. This was calculated using a clinometer and measuring tape, recording the distance of gliding angle from the height of the perch point to landing point (Assuming the landing point is 2 m above the ground). This was repeated throughout the site, and the most suitable trees were chosen to retain a gliding corridor. This process was repeated on the Wednesday the 9/10/19 in the southern part of the site. Trees surrounding the dam were also assessed for health and to ensure a corridor was already available as none of these trees were to be removed.

For mapping purposes, the coordinates of the tree trunk and perch point were recorded. This was displayed with a coloured dot for the tree trunk and a dotted line extending out to the location of the perch point. This was then displayed with a bolded line and arrow head to distinguish the direction and calculated distance of glide to the nearest landing tree. A semi-circle was then overlayed to demonstrate that any tree within this zone is a potential landing tree.

The results of the analysis were utilised to support a corridor along the northern and western boundary of 60 m width. This is an increase of 10 m wide from the former layout, and the road crossings were altered to assist in the retention of particular trees to allow for potential movement of the Squirrel Glider.

2.4 Field survey effort

Tables 2.1 and 2.2 below detail the flora and fauna survey effort undertaken for the subject site.

Table 2.1 – Fauna survey effort

Fauna group	Date	Weather conditions	Survey technique(s)	Survey effort / time (24hr)
Diurnal birds	15/3/16	8/8 cloud, no wind, prev rain, temp 24°C	Diurnal opportunistic & census points	6hrs 30min 1300 - 1930
	27/11 – 13/12/17	Various but mostly fine	Song-meter (recording full diurnal period)	16 days diurnal recording
	27/11/17	5/8 cloud, light NE wind, no rain, temp 23°C	Diurnal opportunistic	7hrs 55min 1000 - 1755
	28/11/17	4-8/8 cloud, no wind, no rain, temp 22-24°C	Diurnal opportunistic	2hrs 0900 - 1100
	29/11/17	7/8 cloud, no wind, no rain, temp 22-26°C	Diurnal opportunistic	3hrs 35min 0825 - 1200
	30/11/17	4/8 cloud, no wind, no rain, temp 20-25°C	Diurnal opportunistic	3hrs 50min 0810 - 1200
	1/12/17	0/8 cloud, no wind, no rain, temp 26°C	Diurnal opportunistic	3hrs 45min 0915 - 1300
	12/1/18	2/8 cloud, light NE wind, no rain, temp 26°C	Diurnal opportunistic	1hr 30min 1000 - 1130
	16/1/18	1-6/8 cloud, mod-gusty S wind, no rain, temp 22-19°C	Diurnal opportunistic	10hrs 1015 - 2015
	10/8/18	0/8 cloud, light W wind, no rain, temp 23°C	Diurnal opportunistic	5hrs 1000 - 1500
	1/6/21	3/8 cloud, 13 km/h N wind, no rain, temp 19 °C	Diurnal opportunistic	5hrs 1230 - 1730
Nocturnal birds	15/3/16	1/8 cloud, no wind, no rain, ½ moon, temp 24-21°C	Spotlighting Call playback (Section 3.5 species)	2hrs 30min 1930 - 2200 Commenced @ 2000
	27/11 – 13/12/17	Various but mostly fine	Song-meter (recording full nocturnal period)	16 days nocturnal recording
	16/1/18	2-0/8 cloud, mod S wind, no rain, temp 19°C	Spotlighting Call playback (Section 3.5 species)	1hrs 55min 2015 - 2210 Commenced @ 2100
	26/7-15/8/18	Various but mostly fine	Stag-watching x 2-3 person nights	37 stag-watch person nights
	24/7 – 10/8/18	Various but mostly fine	Song-meter (3hrs before dawn / 4hrs after dusk)	17 days (dusk>3.5hrs>dawn)
	1/6 – 4/6/21	Various but mostly fine	Stag-watching x 2-5 person nights	17 Stag-watch trees
	7/6 – 9/6/21	Various but mostly fine	Stag-watching x 2-4 person nights	9 Stag-watch trees

Fauna group	Date	Weather conditions	Survey technique(s)	Survey effort / time (24hr)
Arboreal mammals	15/3/16	1/8 cloud, no wind, no rain, ½ moon, temp 24-21°C	Spotlighting Call playback (Section 3.5 species)	2hrs 30min 1930 - 2200 Commenced @ 2015
	27/11/17	8/8 cloud, no wind, light rain, temp 18°C	Elliott trapping (8x B size)	8 trap nights
	28/11/17	8/8 cloud, no wind, possible light rain, temp 17°C	Elliott trapping (8x B size)	8 trap nights
	29/11/17	0/8 cloud, no wind, no rain, temp 19°C	Elliott trapping (8x B size)	8 trap nights
	30/11/17	0-8/8 cloud, no wind, no rain, temp 19°C	Elliott trapping (8x B size)	8 trap nights
	16/1/18	2-0/8 cloud, mod S wind, no rain, temp 19°C	Spotlighting Call playback (Section 3.5 species)	1hrs 55min 2015 - 2210 Commenced @ 2115
	2/7/18	0/8 Cloud, no wind, 12°C @ 8am	Elliott trapping (30x B size)	30 trap nights
	3/7/18	0/8 Cloud, no wind, 10°C @ 7:30am	Elliott trapping (30x B size)	30 trap nights
	4/7/18	0/8 Cloud, no wind, 10°C @ 7:30am	Elliott trapping (30x B size)	30 trap nights
	5/7/18	0/8 Cloud, no wind, 10°C @ 7:30am	Elliott trapping (30x B size)	30 trap nights
	26/6/18	0/8 cloud, no wind, full moon, temp 8°C	Stag-watching x3 person nights	8 Stag-watch trees
	3/7/18	0/8 cloud, no wind, ¾ moon, temp 15°C	Stag-watching x2 person nights	6 Stag-watch trees
	4/7/18	0/8 cloud, light wind, ¾ moon, temp 18°C	Stag-watching x3 person nights	10 Stag-watch trees
	6/7/18	5/8 cloud, windy, ½ moon, temp 15°C	Stag-watching x3 person nights	8 Stag-watch trees
	10/7/18	0/8 cloud, no wind, no moon, temp 10°C	Stag-watching x3 person nights	7 Stag-watch trees
	12/7/18	0/8 cloud, no wind, no moon, temp 10°C	Stag-watching x3 person nights	8 Stag-watch trees
	17/7/18	0/8 cloud, light S wind, ¼ moon, temp 16°C	Stag-watching x3 person nights	7 Stag-watch trees
	18/7/18	0/8 cloud, no wind, ¼ moon, temp 16-10°C	Stag-watching x2 person nights	6 Stag-watch trees
	24/7/18	0/8 cloud, no wind, ¾ moon, temp 16-12°C	Stag-watching x3 person nights	5 Stag-watch trees
	24/7 – 10/8/18	Various but mostly fine	Song-meter (3hrs before dawn / 4hrs after dusk)	17 days (dusk>3.5hrs>dawn)
	25/7/18	0/8 cloud, no wind, ¾ moon, temp 16-12°C	Stag-watching x3 person nights	6 Stag-watch trees
	26/7/18	1/8 cloud, no wind, full moon, temp 16-12°C	Stag-watching x3 person nights	7 Stag-watch trees
	14/8/18	0/8 cloud, light wind, ¼ moon, temp 18°C	Stag-watching x3 person nights	6 Stag-watch trees
	15/8/18	0/8 cloud, moderate wind, ¼ moon, temp 16°C	Stag-watching x3 person nights	6 Stag-watch trees
	8/10/19	not recorded	Squirrel Glider habitat corridor function analysis	2 people 1 day
	9/10/19	not recorded	Squirrel Glider habitat corridor function analysis	2 people 1 day
	8/6/21	7/8 cloud, 6 km/h N wind, no rain, temp 17°C	Koala Spot Assessment Technique (250m grid)	3 SAT points
	1/6 – 4/6/21	Various but mostly fine	Stag-watching x 2-5 person nights	17 Stag-watch trees
	7/6 – 9/6/21	Various but mostly fine	Stag-watching x 2-4 person nights	9 Stag-watch trees

Fauna group	Date	Weather conditions	Survey technique(s)	Survey effort / time (24hr)
Terrestrial mammals	15/3/16	1/8 cloud, no wind, no rain, ½ moon, temp 24-21°C	Spotlighting	2hrs 30min 1930 - 2200
	27/11/17	8/8 cloud, no wind, light rain, temp 18°C	Elliott trapping (25x A & 25x B size)	50 trap nights
	28/11/17	8/8 cloud, no wind, possible light rain, temp 17°C	Elliott trapping (25x A & 25x B size)	50 trap nights
	29/11/17	0/8 cloud, no wind, no rain, temp 19°C	Elliott trapping (25x A & 25x B size)	50 trap nights
	30/11/17	0-8/8 cloud, no wind, no rain, temp 19°C	Elliott trapping (25x A & 25x B size)	50 trap nights
	27/11-11/12/17	Various - mostly fine	Surveillance cameras x 5	70 camera nights
	16/1/18	2-0/8 cloud, mod S wind, no rain, temp 19°C	Spotlighting	1hrs 55min 2015 - 2210
Bats	15/3/16	1/8 cloud, no wind, no rain, ½ moon, temp 24-21°C	Spotlighting	2hrs 30min 1930 - 2200
			Anabat x1 (Passive monitoring)	Overnight from 19:30
	27/11-1/12/17	Various - mostly fine	SM4BAT x2 (Passive monitoring)	8 recorder nights
			Harp traps x2	8 harp trap nights
	16/1/18	2-0/8 cloud, mod S wind, no rain, temp 19°C	Spotlighting	1hrs 55min 2015 - 2210
	26/7-15/8/18	Various but mostly fine	Stag-watching x37 person nights	92 nights during/after dusk
	1/6 – 4/6/21	Various but mostly fine	Stag-watching x 2-5 person nights	17 Stag-watch trees
Reptiles	7/6 – 9/6/21	Various but mostly fine	Stag-watching x 2-4 person nights	9 Stag-watch trees
	15/3/16	8/8 cloud, no wind, prev rain, temp 24°C	Habitat search, opportunistic	6hrs 30min 1300 - 1930
	27/11/17	5/8 cloud, light NE wind, no rain, temp 23°C	Diurnal opportunistic	7hrs 55min 1000 - 1755
	28/11/17	4-8/8 cloud, no wind, no rain, temp 22-24°C	Diurnal opportunistic	2hrs 0900 - 1100
	29/11/17	7/8 cloud, no wind, no rain, temp 22-26°C	Diurnal opportunistic	3hrs 35min 0825 - 1200
	30/11/17	4/8 cloud, no wind, no rain, temp 20-25°C	Diurnal opportunistic	3hrs 50min 0810 - 1200
	1/12/17	0/8 cloud, no wind, no rain, temp 26°C	Diurnal opportunistic	3hrs 45min 0915 - 1300
	12/1/18	2/8 cloud, light NE wind, no rain, temp 26°C	Diurnal opportunistic	1hr 30min 1000 - 1130
Amphibians	16/1/18	1-6/8 cloud, mod-gusty S wind, no rain, temp 22-19°C	Diurnal opportunistic	10hrs 1015 - 2015
	15/3/16	1/8 cloud, no wind, prev rain, ½ moon, temp 24-21°C	Spotlighting & call identification	2hrs 30min 1930 - 2200
			Call-playback (Wallum Froglet)	Commenced @ ~2100
	16/1/18	2-0/8 cloud, mod S wind, no rain, temp 19°C	Spotlighting & call identification	1hrs 55min 2015 - 2210
	27/10/20	1/8 cloud, no wind, showers, 3/4 moon, temp 16-15°C	Spotlighting & call identification	4hrs 5mins 1915 - 2350
			Call-playback (Mahony's Toadlet & Green-thighed Frog) *	Commenced @ 1930
	29/10/20	0/8 cloud, no wind, previous storm, 3/4 moon, temp 15°C	Spotlighting & call identification	1hrs 55min 1650 - 2210
Amphibians			Call-playback (Mahony's Toadlet & Green-thighed Frog) *	Commenced @ 1930

Note: * Indicates Mahony's Toadlet reference site at Norah Head

Table 2.2 – Flora survey effort

Flora survey	Survey technique(s)	Dates
Vegetation communities	Survey of the boundaries of all communities – field verification and aerial photographic interpretation	4/3/16, 7/3/16
Stratified sampling	14x Biometric transect plots	4/3/16, 7/3/16
	2x linear transects	4/3/16, 7/3/16
	20 x BAM plots (not all used for calculations)	11/12/17, 12/12/17, 18/12/17, 21/10/20
Targeted searches (belt transects 8 – 10m apart)	<i>Cryptostylis hunteriana</i> and <i>Acacia bynoeana</i>	2/2/16, 11/12/17, 18/12/17
	<i>Corunastylis</i> sp. Charmhaven	4/3/16, 7/3/16
	<i>Diuris praecox</i>	8/8/16, 23/8/16
	<i>Genoplesium insignis</i> , <i>Caladenia porphyrea</i> , <i>Caladenia tessellata</i> , <i>Rutidosia heterogama</i> , <i>Tetratheca juncea</i> and <i>Thelymitra adorata</i>	21/9/16, 17/10/16, 26/9/17
Target searches - non-cryptic species (belt transects 8 – 10m apart)	<i>Angophora inopina</i> , <i>Callistemon linearifolius</i> , <i>Callistemon groveana</i> , <i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> , <i>Melaleuca biconvexa</i> , <i>Melaleuca groveana</i> , <i>Persicaria elatior</i> , <i>Prostanthera askania</i>	2/2/16, 4/3/16, 7/3/16, 8/8/16, 23/8/16, 21/9/16, 17/10/16, 26/9/17, 11/12/17, 18/12/17

Table 2.3 – Plot and transect survey effort – impact area

Veg zone no.	PCT	Condition	Area (ha)	Minimum plot transect sites required	Plot transect sites used
1	1619	Moderate_good	6.52	3	4
2	1718	Moderate_good	0.035	1	2
3	1619	Cleared	2.63	2	6

2.5 Survey limitations

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

Flora survey limitations

The species list does not include all household garden / landscaping species and those species which could not be identified at the time of the survey past genus level. Cryptic species not flowering at the time of the survey may not be observed during survey outside of peak flowering periods. Likewise, cryptic orchid species are generally only accurately identifiable when flowering.

Surveys have been undertaken on at least one (1) occasion during the flowering period for all threatened species with potential habitat. Where possible, surveys have been repeated during their flowering period to minimise limitations. It should be recognised that not all species or specimens will flower each year, thus there will always be that limitation on the survey effort.

Spring-flowering orchids and *Tetratheca juncea* were been surveyed in both 2016 and 2017, *Cryptostylis hunteriana* was surveyed late in the season in February 2016. It flowered early in the 2017-2018 season with records of flowering in mid-November. Survey for *C. hunteriana* was undertaken on 11 and 18 December 2017.

Fauna survey limitations

A threatened bat roost may be present in the hollows not stag-watched, yet a hollow observed may also be utilised as a roost on another occasion. The effort to date targeted the best trees and is considered sufficient and has guided the location of the proposed corridor. Any bat roost, or other resident fauna within hollows located within the development landscape will aim to be effectively recovered and relocated by a fauna ecologist supervising the habitat removal stages.

2.6 Accuracy of identification

Specimens of plants not readily discernible in the field were collected for identification. Structural descriptions of the vegetation were made according to Specht *et al* (1995).

PCT Impacts		
Vegetation Zone	Management Zone	Area (HA)
PCT 1619	PCT 1619 Direct	6.36
	PCT 1619 Indirect	1.21
PCT 1718	PCT 1718 Direct	0.02
	PCT 1718 Indirect	0.1
Cleared	Cleared Direct	2.38
	Cleared Indirect	0.18



Legend

- Study area (source: CAD) (16.52ha)
- Biodiversity Certification Area
- Creek line (source - LPI)
- Creek line (LPI)
- TEC Buffer
- Impacted Vegetation (10.25ha)
 - Partial impact (1.49ha)
 - Development impact (8.76ha)

Flora Survey Effort (2020)

- Flora quadrats (20x20m, 20x50m)

Flora Survey Effort (2019)

- Flora quadrats (20x20m, 20x50m)

Flora Survey Effort (2017)

- BCAR Flora quadrats (20x20m, 20x50m)
- BSAR Flora quadrats (20x20m, 20x50m)

Flora Survey Effort (2016-2017)

- Targeted belt transect

Flora Survey Effort (2016)

- Flora Quadrats (20x20m and 50x20m)
- Flora Transect

Vegetation Communities

- PCT 1619 - Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest - (9.98ha) (Impacted 7.57ha)
- PCT 1718 - Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast - (EEC - Swamp Sclerophyll Forest on Coastal Floodplains) (3.49ha) (Impacted 0.12ha)
- Cleared (2.86ha) (Impacted 2.56ha)
- Retain Dam (0.19ha)



PROJECT & MXD REFERENCE
15 Mulloy Road, Chain Valley Bay
180D02_FL001

DATE & ISSUE NUMBER
29/09/2021
Issue 1

SCALE & COORDINATE SYSTEM
1:2,500 @ A3
GDA 1994 MGA Zone 56

TITLE
Flora Survey Effort & Results

Document Path: N:\GIS STORAGE\N Drive\180D02_Mulloy_Rd_ChainValleyBay\MXD\BCAR\180D02_FL001.mxd

0 50 100 m

Disclaimer: 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 are to be confirmed by a registered surveyor.

Figure 2 – Flora survey effort and results



PROJECT & MXD REFERENCE
15 Mulloy Road, Chain Valley Bay
18OD02_FA001

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SCALE & COORDINATE SYSTEM
1:2,400 @ A3
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Fauna Survey Effort & Results

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Disclaimer: 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 are to be confirmed by a registered surveyor.

Figure 3 – Fauna survey effort and results



Survey Results

3

3.1 Flora results

3.1.1 Native vegetation extent

The native vegetation extent within the study area has been ground-truthed. The amount of native vegetation is 13.46 ha, plus 2.74 ha of cleared vegetation. The native vegetation to be impacted measures 6.55 ha, plus 2.5 ha of cleared vegetation. This is a combination of impacts from internal roads, building envelopes and APZs.

3.1.2 Flora species

The plants observed within the vegetation communities of the subject site are listed in the Table 3.1 below. Eleven (11) species were added to the list from the 2016 report. There is now a total of two hundred and thirty seven (237) species listed below. A number of landscaping species were observed around the existing residential dwelling in the northern portion of the study area but not necessarily added to the species list. The number of species indicate that the site contains a high diversity of species.

No threatened flora species have been detected during surveys undertaken in 2016, 2017 or 2018.

Table 3.1 – Flora observations for the subject site

Family	Scientific name	Common name
Trees		
Mimosaceae	<i>Acacia baileyana</i>	Cootamundra Wattle
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black She-oak
Myrtaceae	<i>Angophora costata</i>	Smooth-barked Apple
Araucariaceae	<i>Araucaria heterophylla</i> *	Norfolk Island Pine
Arecaceae	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak
Lauraceae	<i>Cinnamomum camphora</i> *	Camphor Laurel
Myrtaceae	<i>Corymbia gummifera</i>	Red Bloodwood
Eleocarpaceae	<i>Elaeocarpus reticulatus</i>	Blueberry Ash
Myrtaceae	<i>Eucalyptus capitellata</i>	Brown Stringybark
Myrtaceae	<i>Eucalyptus eugenioides</i>	Thin-leaved Stringybark
Myrtaceae	<i>Eucalyptus haemastoma</i>	Scribbly Gum
Myrtaceae	<i>Eucalyptus robusta</i>	Swamp Mahogany
Santalaceae	<i>Exocarpos cupressiformis</i>	Native Cherry
Oleaceae	<i>Fraxinus angustifolia</i> *	Claret Ash
Fabaceae	<i>Gleditsia triacanthos</i> *	Honey Locust

Family	Scientific name	Common name
Phyllanthaceae	<i>Glochidion ferdinandi</i>	Cheese Tree
Proteaceae	<i>Grevillea robusta</i>	Silky Oak
Lythraceae	<i>Lagerstroemia indica</i> *	Crepe Myrtle
Arecaceae	<i>Livistona australis</i>	Cabbage Tree Palm
Proteaceae	<i>Macadamia integrifolia</i>	Macadamia Nut
Myrtaceae	<i>Melaleuca decora</i>	-
Myrtaceae	<i>Melaleuca linariifolia</i>	Snow in Summer
Myrtaceae	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark
Meliaceae	<i>Melia azedarach</i> var. <i>australasica</i>	White Cedar
Myrsinaceae	<i>Myrsine variabilis</i>	Muttonwood
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum
Salicaceae	<i>Populus alba</i> *	White Poplar
Rosaceae	<i>Prunus</i> sp.*	Stone-fruit Tree
Shrubs		
Mimosaceae	<i>Acacia falcata</i>	Sickle Wattle
Mimosaceae	<i>Acacia implexa</i>	Hickory
Mimosaceae	<i>Acacia longifolia</i> var. <i>longifolia</i>	Sydney Golden Wattle
Mimosaceae	<i>Acacia myrtifolia</i>	Red Stem Wattle
Mimosaceae	<i>Acacia suaveolens</i>	Sweet Scented Wattle
Mimosaceae	<i>Acacia terminalis</i>	Sunshine Wattle
Proteaceae	<i>Banksia marginata</i>	Silver Banksia
Proteaceae	<i>Banksia oblongifolia</i>	-
Proteaceae	<i>Banksia spinulosa</i> var. <i>spinulosa</i>	Hairpin Banksia
Fabaceae	<i>Bossiaea heterophylla</i>	Variable Bossiaea
Fabaceae	<i>Bossiaea obcordata</i>	Spiny Bossiaea
Euphorbiaceae	<i>Breynia oblongifolia</i>	Coffee Bush
Caricaceae	<i>Carica papaya</i>	Papaya
Solanaceae	<i>Cestrum parqui</i> *	Chilean Cestrum
Asteraceae	<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> *	Bitou Bush
Lauraceae	<i>Cinnamomum camphora</i>	Camphor Laurel
Polygalaceae	<i>Comesperma ericinum</i>	Matchheads
Malaceae	<i>Cotoneaster glaucophyllus</i> *	Grey-leaved Cotoneaster
Sapindaceae	<i>Dodonaea triquetra</i>	Hop Bush
Epacridaceae	<i>Epacris pulchella</i>	NSW Coral Heath
Fabaceae	<i>Gompholobium latifolium</i>	Broad-leaf Wedge-pea
Proteaceae	<i>Grevillea sericea</i>	Pink Spider Flower
Proteaceae	<i>Hakea bakerana</i>	-
Proteaceae	<i>Hakea laevipes</i> subsp. <i>laevipes</i>	-
Proteaceae	<i>Hakea salicifolia</i>	Willow Hakea
Proteaceae	<i>Hakea sericea</i>	Needlebush
Malvaceae	<i>Hibiscus</i> sp. (cultivar)*	Hibiscus
Euphorbiaceae	<i>Homalanthus populifolius</i>	Bleeding Heart
Myrtaceae	<i>Kunzea ambigua</i>	Tick Bush
Proteaceae	<i>Lambertia formosa</i>	Mountain Devil

Family	Scientific name	Common name
Verbenaceae	<i>Lantana camara</i> *	Lantana
Myrtaceae	<i>Leptospermum juniperinum</i>	Prickly Tea-tree
Myrtaceae	<i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i>	Tantoon
Myrtaceae	<i>Leptospermum trinervium</i>	Flaky-barked Tea-tree
Proteaceae	<i>Lomatia silaifolia</i>	Crinkle Bush
Myrtaceae	<i>Melaleuca ericifolia</i>	Swamp Paperbark
Myrtaceae	<i>Melaleuca sieberi</i>	-
Myrtaceae	<i>Melaleuca thymifolia</i>	Thyme Honey Myrtle
Araceae	<i>Monstera deliciosa</i> *	Fruit-salad Plant
Berberidaceae	<i>Nandina domestica</i> *	Sacred Bamboo
Apocynaceae	<i>Nerium oleander</i> *	Oleander Bush
Oleaceae	<i>Notelaea longifolia</i>	Mock Olive
Ochnaceae	<i>Ochna serrulata</i> *	Mickey Mouse Plant
Rubiaceae	<i>Opercularia diphylla</i>	-
Proteaceae	<i>Persoonia lanceolata</i>	Lance-leaved Geebung
Proteaceae	<i>Persoonia levis</i>	Broad-leaved Geebung
Proteaceae	<i>Persoonia linearis</i>	Narrow-leaved Geebung
Euphorbiaceae	<i>Phyllanthus hirtellus</i>	Thyme Spurge
Phytolaccaceae	<i>Phytolacca octandra</i> *	Inkweed
Apiaceae	<i>Platysace linearifolia</i>	Narrow-leaved Platysace
Apocynaceae	<i>Plumeria obtusa</i> *	Frangipani
Fabaceae	<i>Podolobium ilicifolium</i>	Prickly Shaggy Pea
Araliaceae	<i>Polyscias sambucifolia</i>	Elderberry Panax
Rhamnaceae	<i>Pomaderris</i> sp.	-
Fabaceae	<i>Pultenaea daphnoides</i>	Large-leaf Bush Pea
Fabaceae	<i>Pultenaea retusa</i>	-
Fabaceae	<i>Pultenaea rosmarinifolia</i>	-
Fabaceae	<i>Pultenaea villosa</i>	-
Rosaceae	<i>Rhaphiolepis indica</i> *	Indian Hawthorn
Rosaceae	<i>Rubus anglocandicans</i> *	Blackberry
Fabaceae	<i>Senna pendula</i> var. <i>glabrata</i> *	-
Solanaceae	<i>Solanum mauritianum</i> *	Wild Tobacco
Bignoniaceae	<i>Tecoma capensis</i> *	Cape Honeysuckle
Groundcovers		
Asteraceae	<i>Actinotus minor</i>	Lesser Flannel Flower
Liliaceae	<i>Agapanthus praecox</i> *	Agapanthus
Asteraceae	<i>Ageratina adenophora</i> *	Crofton Weed
Asteraceae	<i>Ageratum houstonianum</i> *	Blue Billy Goat Weed
Poaceae	<i>Andropogon virginicus</i> *	Whisky Grass
Poaceae	<i>Anisopogon avenaceus</i>	Oat Speargrass
Poaceae	<i>Aristida vagans</i>	Three-awn Speargrass
Orchidaceae	<i>Arthrochilus prolixus</i>	Elbow Orchid
Asparagaceae	<i>Asparagus aethiopicus</i> *	Asparagus Fern
Poaceae	<i>Avena fatua</i> *	Wild Oats

Family	Scientific name	Common name
Poaceae	<i>Axonopus fissifolius</i> *	Narrow-leafed Carpet Grass
Restionaceae	<i>Baloskion gracile</i>	-
Cyperaceae	<i>Baumea juncea</i>	-
Asteraceae	<i>Bidens pilosa</i> *	Cobbler's Pegs
Blechnaceae	<i>Blechnum camfieldii</i>	-
Colchicaceae	<i>Burchardia umbellata</i>	Milkmaids
Cyperaceae	<i>Carex appressa</i>	Tall Sedge
Apocynaceae	<i>Catharanthus roseus</i>	Madagascar Periwinkle
Apiaceae	<i>Centella asiatica</i>	Indian Pennywort
Poaceae	<i>Chloris gayana</i> *	Rhodes Grass
Sinopteridaceae	<i>Cheilanthes sieberi</i>	Rock Fern
Asteraceae	<i>Cirsium vulgare</i> *	Spear Thistle
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew
Asteraceae	<i>Conyza bonariensis</i> *	Flaxleaf Fleabane
Asteraceae	<i>Conyza sumatrensis</i> *	Fleabane
Orchidaceae	<i>Cryptostylis erecta</i>	Bonnet Orchid
Orchidaceae	<i>Cryptostylis subulata</i>	Large Tongue Orchid
Cucurbitaceae	<i>Cucurbita maxima</i> *	Pumpkin
Cyperaceae	<i>Cyathochaeta diandra</i>	-
Poaceae	<i>Cynodon dactylon</i>	Common Couch
Cyperaceae	<i>Cyperus brevifolius</i> *	Mullumbimby Couch
Cyperaceae	<i>Cyperus eragrostis</i> *	Umbrella Sedge
Goodeniaceae	<i>Dampiera stricta</i>	Blue Dampiera
Phormiaceae	<i>Dianella caerulea</i> var. <i>caerulea</i>	Flax Lily
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed
Poaceae	<i>Dichelachne micrantha</i>	Short-hair Plume Grass
Poaceae	<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	Tufted Hedgehog Grass
Poaceae	<i>Echinopogon ovatus</i>	Forest Hedgehog Grass
Poaceae	<i>Ehrharta erecta</i> *	Panic Veldtgrass
Restionaceae	<i>Empodisma minus</i>	-
Poaceae	<i>Entolasia marginata</i>	Bordered Panic
Poaceae	<i>Entolasia stricta</i>	Wiry Panic
Asteraceae	<i>Epaltes australis</i>	-
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass
Asteraceae	<i>Erechtites valerianifolia</i> *	Brazilian Fireweed
Asteraceae	<i>Euchiton sphaericus</i>	-
Euphorbiaceae	<i>Euphorbia peplus</i> *	Spurge
Cyperaceae	<i>Ficinia nodosa</i>	-
Cyperaceae	<i>Fimbristylis dichotoma</i>	Common Fringe-rush
Cyperaceae	<i>Gahnia aspera</i>	Saw Sedge
Cyperaceae	<i>Gahnia clarkei</i>	Tall Saw-sedge
Cyperaceae	<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge
Asteraceae	<i>Gamochaeta spicata</i> *	Cudweed
Geraniaceae	<i>Geranium homeanum</i>	Northern Cranesbill
Haloragaceae	<i>Gonocarpus tetragynus</i>	Poverty Raspwort

Family	Scientific name	Common name
Haloragaceae	<i>Gonocarpus teuroides</i>	Raspwort
Goodeniaceae	<i>Goodenia hederacea</i> subsp. <i>hederacea</i>	Ivy-leaved Goodenia
Goodeniaceae	<i>Goodenia heterophylla</i> subsp. <i>heterophylla</i>	Variable Leaved Goodenia
Goodeniaceae	<i>Goodenia ovata</i>	-
Haemodoraceae	<i>Haemodorum planifolium</i>	Bloodroot
Zingiberaceae	<i>Hedychium gardnerianum</i> *	Ginger Lily
Dilleniaceae	<i>Hibbertia aspera</i>	Rough Guinea Flower
Dilleniaceae	<i>Hibbertia linearis</i>	-
Araliaceae	<i>Hydrocotyle bonariensis</i> *	Kurnell Curse / Pennywort
Araliaceae	<i>Hydrocotyle sibthorpioides</i>	Pennywort
Araliaceae	<i>Hydrocotyle tripartita</i>	Pennywort
Asteraceae	<i>Hypochaeris radicata</i> *	Flatweed
Dennstaedtiaceae	<i>Hypolepis muelleri</i>	Harsh Ground Fern
Poaceae	<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass
Juncaceae	<i>Juncus acutus</i> *	-
Juncaceae	<i>Juncus kraussii</i>	Sea Rush
Juncaceae	<i>Juncus planifolius</i>	Broad Rush
Juncaceae	<i>Juncus prismatocarpus</i>	Branching Rush
Juncaceae	<i>Juncus usitatus</i>	Common Rush
Asteraceae	<i>Lagenifera stipitata</i>	-
Cyperaceae	<i>Lepidosperma laterale</i>	Variable Sword-sedge
Restionaceae	<i>Leptocarpus tenax</i>	Slender Twine-rush
Lindsaeaceae	<i>Lindsaea linearis</i>	Screw Fern
Lobeliaceae	<i>Lobelia anceps</i>	-
Lomandraceae	<i>Lomandra cylindrica</i>	Needle Mat-rush
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Mat-rush
Lomandraceae	<i>Lomandra longifolia</i>	Spiky-headed Mat-rush
Lomandraceae	<i>Lomandra glauca</i>	-
Lomandraceae	<i>Lomandra obliqua</i>	Twisted Mat-rush
Myrsinaceae	<i>Lysimachia arvensis</i> *	Scarlet Pimpernel
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass
Malvaceae	<i>Modiola caroliniana</i> *	Red-flowered Mallow
Davalliaceae	<i>Nephrolepis cordifolia</i> *	Fish-bone Fern
Poaceae	<i>Oplismenus aemulus</i>	Basket Grass
Poaceae	<i>Oplismenus imbecillis</i>	-
Oxalidaceae	<i>Oxalis perennans</i>	-
Poaceae	<i>Panicum simile</i>	Two Colour Panic
Poaceae	<i>Paspalidium distans</i>	-
Poaceae	<i>Paspalum dilatatum</i> *	Paspalum
Poaceae	<i>Paspalum urvillei</i> *	Vasey Grass
Iridaceae	<i>Patersonia glabrata</i>	Leafy Purple-flag
Iridaceae	<i>Patersonia sericea</i>	Wild Iris
Sinopteridaceae	<i>Pellaea falcata</i>	Sickle Fern
Poaceae	<i>Pennisetum clandestinum</i> *	Kikuyu
Polygonaceae	<i>Persicaria strigosa</i>	-

Family	Scientific name	Common name
Poaceae	<i>Phalaris aquatica</i> *	Phalaris
Euphorbiaceae	<i>Phyllanthus tenellus</i> *	-
Thymelaeaceae	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	Slender Rice Flower
Plantaginaceae	<i>Plantago lanceolata</i> *	Ribwort
Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot
Acanthaceae	<i>Pseuderanthemum variabile</i>	Pastel Flower
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Bracken
Rubiaceae	<i>Richardia brasiliensis</i> *	Mexican Clover
Cyperaceae	<i>Schoenus brevifolius</i>	Bog-rush
Cyperaceae	<i>Schoenus melanostachys</i>	Black Bog Rush
Selaginallaceae	<i>Selaginella uliginosa</i>	Swamp Selaginella
Asteraceae	<i>Senecio madagascariensis</i> *	Fireweed
Poaceae	<i>Setaria parviflora</i> *	-
Malvaceae	<i>Sida rhombifolia</i> *	Paddy's Lucerne
Solanaceae	<i>Solanum nigrum</i> *	Black Nightshade
Poaceae	<i>Sporobolus africanus</i> *	Parramatta Grass
Asteraceae	<i>Taraxacum officinale</i> *	Dandelion
Orchidaceae	<i>Thelymitra ixioides</i> var. <i>ixioides</i>	Spotted Sun Orchid
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass
Anthericaceae	<i>Tricoryne elatior</i>	Yellow Autumn-lily
Fabaceae	<i>Trifolium repens</i> *	White Clover
Verbenaceae	<i>Verbena bonariensis</i> *	Purpletop
Verbenaceae	<i>Verbena litoralis</i> *	-
Asteraceae	<i>Vernonia cinerea</i> var. <i>cinerea</i>	-
Menyanthaceae	<i>Villarsia exaltata</i>	Yellow Marsh Flower
Apocynaceae	<i>Vinca major</i> *	Blue Periwinkle
Violaceae	<i>Viola hederacea</i>	Ivy-leaved Violet
Iridaceae	<i>Watsonia meriana</i> *	Wild Watsonia
Xanthorrhoeaceae	<i>Xanthorrhoea latifolia</i> subsp. <i>latifolia</i>	-
Apiaceae	<i>Xanthosia pilosa</i>	Woolly Xanthosia
Vines		
Pittosporaceae	<i>Billardiera scandens</i> var. <i>scandens</i>	Apple Dumplings
Lauraceae	<i>Cassytha glabella</i> forma <i>glabella</i>	Slender Devil's Twine
Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard
Fabaceae	<i>Desmodium rhytidophyllum</i>	-
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry
Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily
Fabaceae	<i>Glycine clandestina</i>	Twining Glycine
Fabaceae	<i>Hardenbergia violacea</i>	False Sarsparilla
Dilleniaceae	<i>Hibbertia scandens</i>	Climbing Guinea-flower
Oleaceae	<i>Jasminum polyanthum</i> *	Jasmine
Fabaceae	<i>Kennedia rubicunda</i>	Dusky Coral Pea
Caprifoliaceae	<i>Lonicera japonica</i> *	Japanese Honeysuckle
Bignoniaceae	<i>Macfadyena unguis-cati</i> *	Cat's Claw Creeper
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Vine

Family	Scientific name	Common name
Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod
Passifloraceae	<i>Passiflora edulis</i> *	Common Passionfruit
Smilacaceae	<i>Smilax glycyphylla</i>	Sarsaparilla
Menispermaceae	<i>Stephania japonica</i> var. <i>discolor</i>	Snake Vine
Fabaceae	<i>Wisteria sinensis</i> *	Wisteria
Epiphytes		
Orchidaceae	<i>Cymbidium suave</i>	Native Cymbidium
* denotes exotic species		

3.1.3 Plant community types (PCTs)

Evidence used to identify a PCT

Identification of the PCTs within the site was done using the online BioNet Vegetation Classification Tool (BVCT). Plot data was entered into the BVCT to produce a shortlist of potential PCTs. Interim Biogeographic Regionalisation for Australia (IBRA) sub-region (Wyong), and vegetation formation and class information were also utilised. The top five shortlisted PCTs for each plot are provided in Table 3.2, which includes the number of diagnostic species present for each shortlisted PCT in each plot. From the shortlist, final PCTs were then chosen based on diagnostic species presence and abundance, and similarity to descriptive attributes and distributional information provided in the BVCT. Justification for inclusion or exclusion of each shortlisted PCT is provided below and in Table 3.2.

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

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

Table 3.2 – PCT shortlist and justification

Zone	Shortlisted PCTs	PCT name	Number of diagnostic species matches (BVCT)							Match	Justification
			Q1	Q2	Q3	Q4	Q5	Q6	Mean		
1	1138	Scribbly Gum - Smooth-barked Apple - Red Bloodwood shrubby forest of the Lower Hunter, Sydney Basin Bioregion	-	-	9	13	17	11	12.5	x	Study area is outside of distribution, which is the Lower Hunter. <i>E. racemosa</i> is the diagnostic scribbly gum, rather than the <i>E. haemastoma</i> present on site.
	1776	Coastal enriched sandstone dry forest	-	-	9	11	14	10	11	x	Wrong location: upper slopes and dry gullies of Sydney urban areas. Site is not “enriched”, and soils are poor.
	1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	-	-	9	10	15	9	10.75	x	Study area is outside of distribution, which is the western portion of the Hornsby and Woronora plateaux and the lower Blue Mountains.
	1786	Sydney ironstone Bloodwood-Silvertop Ash forest	-	-	7	10	14	10	10.25	x	Wrong landscape position: occurs on the steep sandstone slopes that overlook the Hawkesbury River and its tributaries.
	1619	Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	-	-	9	10	14	8	10.25	✓	Correct landscape: Coastal lowlands and low ranges of the lower North Coast and Central Coast. High number of diagnostic species, including canopy dominants <i>A. costata</i>, <i>C. gummifera</i> & <i>E. capitellata</i>
	1636	Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast	-	-	3	6	7	4	5	✓	Correct landscape and location: coastal lowlands from northern Tuggerah Lake to the northern end of Lake Macquarie. Moderate number of diagnostic species; including canopy dominants <i>E. haemastoma</i> & <i>C. gummifera</i>.
2	1716	Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast	9	7	-	-	-	-	8	x	Canopy diagnostic <i>E. resinifera</i> absent from Zone. PCT vegetation description of “Tall Shrubland/Low Open Forest with emergent Eucalypts” does not match observed vegetation, which is tall forest with shrubs and graminoids.
	1718	Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	8	8	-	-	-	-	8	✓	High number of diagnostic species including canopy diagnostic <i>E. robusta</i>, midstorey diagnostics <i>Melaleuca linariifolia</i>, <i>Glochidion ferdinandi</i>, <i>Callistemon salignus</i> & <i>Acacia longifolia</i>. Correct landscape position: coastal lowlands.

Zone	Shortlisted PCTs	PCT name	Number of diagnostic species matches (BVCT)							Match	Justification
			Q1	Q2	Q3	Q4	Q5	Q6	Mean		
	1717	Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast	8	7	-	-	-	-	7.5	x	High number of diagnostic species including canopy diagnostic <i>Melaleuca quinquenervia</i> , <i>E. robusta</i> & <i>Livistona australis</i> , midstorey diagnostics <i>Melaleuca linariifolia</i> & <i>Glochidion ferdinandi</i> . Correct landscape position: coastal floodplains and poorly drained lowlands. Study site is outside of stated distribution.
	1795	Coastal flats Swamp Mahogany forest	8	7	-	-	-	-	7.5	x	Not listed as occurring within the Central Coast (Wyang) LGA.
	1721	Swamp Mahogany - Broad-leaved Paperbark - Saw Sedge - Yellow Marsh Flower swamp forest of coastal lowlands	4	9	-	-	-	-	6.5	x	This PCT is a close match floristically, with many diagnostic species present, but the vegetation description of "Myrtaceous Swamp Open Forests with areas of open water" does not apply - while there are small pools after heavy rain, it contains no open water.

Zone 1:

The identification of the most suitable PCT was based upon filtering for IBRA subregion (Wyang), vegetation class (Sydney Coastal Dry Sclerophyll Forests) and all native species within plots 3–6, using the BVCT. The top five filtered PCTs are provided in Table 3.2. Also added to the shortlist is PCT 1636, which is apparently equivalent to Narrabeen Doyalson Coastal Woodland mapped by the Wyong LGA mapping (Figure 1.14). PCT 1636 only ranked 23rd out of all filtered PCTs. PCTs 1138, 1776, 1181 and 1786 can be excluded due to lack of suitable landscape features, and/or the site being outside of the PCT distribution (reasoning is provided in Table 3.2). Both PCT 1619 and PCT 1636 are potential matches, but the species composition recoded within the BAM plots most closely matches PCT 1619 (Table 3.2). Diagnostic species present within the four Zone-1 plots averaged 10.25 matches for PCT 1619, but only 5 for PCT 1636. The provided landscape position for PCT 1619, coastal lowlands and low ranges, correctly describes the landscape of Zone 1. Whilst PCT 1636 is a potentially suitable match, PCT 1619 is a better match based on species composition.

Zone 2:

The identification of the most suitable PCT was based upon filtering for IBRA subregion (Wyang), vegetation class (Coastal Swamp Forests) and all native species within plots 1 and 2, using the BVCT. The top five filtered PCTs are provided in Table 3.2. All of the shortlisted PCTs are similar and potentially match the vegetation within Zone 2 in terms of floristic composition. PCT 1716 can be excluded as the single canopy diagnostic species, *E. resinifera*, is absent and the PCT vegetation description of “Tall Shrubland/Low Open Forest with emergent Eucalypts” does not match observed vegetation, which is tall forest with shrubs and graminoids. PCT 1785 is restricted to the Sydney Metropolitan Area and is not listed as occurring within the Central Coast LGA, and can therefore also be excluded. PCT 1721 is a close match floristically, with many diagnostic species present, but the vegetation description of “Myrtaceous Swamp Open Forests with areas of open water” does not apply - while there are small pools after heavy rain, it contains no open water. The remaining PCTs, 1717 and 1718, are very similar and either could be used to describe the vegetation within Zone 2. The distribution of PCT 1717 is provided as “the Broadwater to Failford”: the Broadwater being part of the Myall Lakes near Bulahdelah, and Failford being a small locality NW of Forster. As the study area is outside this distribution, PCT 1717 is a less likely candidate. Based on this, PCT 1718 is the best match for the vegetation within Zone 2.

Zone 3:

This Zone contains all cleared land within the development footprint. The most likely previous vegetation would have been commensurate with the same PCT as Zone 1, which is PCT 1619.

Table 3.3 – PCTs within the site

PCT code	PCT name	Species relied upon	Vegetation formation	Vegetation class	% Cleared	Area within development site (ha)	TEC status
1619	Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands.	<i>Angophora costata</i> , <i>Corymbia gummifera</i> , <i>Eucalyptus capitellata</i> , <i>Banksia spinulosa</i>	Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Coastal Dry Sclerophyll Forests	45	Moderate_good:9.98 on site, 6.5 to be directly impacted Cleared: 2.74 on site, 2.63 to be directly impacted	-
1718	Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	<i>Eucalyptus robusta</i> , <i>Melaleuca linariifolia</i> , <i>Acacia longifolia</i> , <i>Gahnia clarkei</i>	Forested Wetlands	Coastal Swamp Forests	74	3.49 on site, 0.04 to be directly impacted	Swamp Sclerophyll Forest on Coastal Floodplains

PCT descriptions

PCT 1619

IBRA Subregion: Occurs within the Wyong IBRA subregion

Vegetation formation/class: Dry Sclerophyll Forests (Shrubby sub-formation) / Sydney Coastal Dry Sclerophyll Forests.

Landscape position: Coastal lowlands and low ranges of the lower North Coast and Central Coast; mainly on sandy substrates.

PCT 1718

IBRA Subregion: Occurs within the Wyong IBRA subregion

Vegetation formation/class: Forested Wetlands / Coastal Swamp Forests.

Landscape position: It occurs typically on poorly drained unconsolidated sediments of the coastal lowlands | elevations are typically under 50m

The vegetation contained a high number of species that is listed in the final determinations for Swamp Sclerophyll Forest. PCT 1718 recognised as forming part of this TEC.

3.1.4 Vegetation descriptions of observed communities

The following vegetation communities were identified within the subject site through ground truthing. Threatened ecological communities are denoted with 'TEC'.

- Cleared Land - 2.74 ha
- PCT 1619 - Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands - 9.98 ha

- PCT 1718 - Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast 3.49 ha (TEC - Swamp Sclerophyll Forest on Coastal Floodplains)

Cleared Land

This describes all cleared land, managed land or landscaped land within the study area. There are five (5) main patches of cleared land. There is one (1) associated with the existing dwelling including the access off Mulloway Drive (Photo 1). The second patch comes off a track from the dwelling area and is sited along the eastern boundary approximately 50–100 m from the northern boundary. The third patch (Photo 3) occurs near the middle of the site to the east of the dam. The fourth patch occurs on the eastern boundary opposite the southern extent of residential dwellings on the mobile home allotment to the east, and the fifth patch occurs on the boundary between floodplain and non-floodplain vegetation.

This vegetation is dominated by exotic grass and groundcover species such as *Holcus lanatus*, *Andropogon virginicus*, *Stenotaphrum secundatum*, *Vulpia bromoides*, *Hypochaeris radicata*, *Plantago lanceolata*, *Trifolium repens*, *Briza* spp., *Cenchrus clandestinus*, *Paspalum dilatatum*, *Senecio madagascariensis*, *Bromus cartharticus*, *Stachys arvensis*, *Vicia sativa*, *Lolium perenne*, *Conyza sumatrensis*, *Modiola caroliniana* and *Eragrostis curvula*, which provide 12–100% PFC. Some exotic trees and shrubs are present, including *Morus alba*, *Cupressus* sp., *Lantana camara* and *Cestrum parqui*.

Native species are present generally in low abundance, but in some areas exceeding 80% PFC. Common species include *Cynodon dactylon*, *Hydrocotyle* spp., *Centella asiatica*, *Juncus usitatus*, *Lobelia purpurascens*, *Geranium homeanum*, *Oxalis perennans*, *Microlaena stipoides*, *Pteridium esculentum*, *Pellaea falcata*, *Commelina cyanea*. The cleared landscapes provide minimal value to fauna and flora, i.e., a lack of breeding or roosting value, but may have foraging value. Threatened species habitat in cleared areas is unlikely due to the degree of habitat modification, however targeted surveys have been undertaken as shown in Table 2.2 and Figure 2.

Plot data from the cleared areas was entered into the public BAM calculator to assess vegetation integrity (VI) scores for each plot, assuming PCT 1619 as the previous community before clearance (Table 3.4). The cleared areas were also treated as a separate zone in the full BAM calculator (Table 3.5). The VI scores are all below 17, which is the condition threshold for PCTs associated with threatened species habitat (Section 3.1.1.3 of the BAM). As these VI scores are below the threshold, the cleared areas do not require further assessment of vegetation beyond Section 5.4 of the BAM (generating a VI score), and assessment of threatened species habitat according to Section 6.2 and Paragraph 6.2.1.4 of the BAM (Assessment for ecosystem credits) is not required. This vegetation is still required to be assessed for species credit species through the BAM-C.

Table 3.4 – Current vegetation integrity score for individual plots within cleared areas

Cleared area plot	Composition condition score	Structure condition score	Function condition score	Current vegetation integrity score
Q1	19.9	2.9	11.3	8.6
Q2	12.8	23.3	4.3	10.8
Q3	6.5	24.6	6.6	10.1
Q4	1.7	22.7	6.1	6.2
Q5	11.7	3.3	8.4	6.8
Q6	26	5.1	27.8	15.5



Photo 1 – Cleared vegetation on the south side of the existing residence



Photo 2 – Example of the cleared and managed patches in the central eastern portion of the study area

PCT 1619 - Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands

This vegetation community describes all non-floodplain vegetation located within the study area, and occupies approximately 9.98 ha.

Canopy

Angophora costata, *Eucalyptus haemastoma*, *Corymbia gummifera* and *Eucalyptus capitellata* are the dominant species, 15–23 m tall with a PFC mostly between 25-40%.

Sub-canopy

Allocasuarina littoralis. Vegetation height to 14 m tall.

Mid-storey

Pittosporum undulatum, *Banksia spinulosa*, *Acacia terminalis*, *Acacia longifolia*, *Leptospermum trinervium*, *Lambertia formosa*, *Glochidion ferdinandi*, *Hakea laevipes*, *Hakea bakeriana*, *Persoonia levis*, *Banksia oblongifolia* and within moister areas, *Melaleuca sieberi*. Vegetation 1–18 m tall and PFC of 5-40%. Cover is variable due to the impacts of fire. The southern quadrats contain less diversity and lower coverage value in the mid-storey.

Ground layer

Pultenaea retusa, *Epacris pulchella*, *Gonocarpus teucroides*, *Pimelea linifolia*, *Lomatia silaifolia*, *Bossiaea obcordata*, *Platysace linearifolia*, *Mirbelia rubiifolia*, *Acacia myrtifolia*, *Billardiera scandens*, *Hardenbergia violacea*, *Xanthorrhoea latifolia*, *Patersonia sericea*, *Lomandra obliqua*, *Dianella caerulea*, *Pteridium esculentum*, *Lindsaea linearis*, *Actinotus minor*, *Cryptostylis subulata*, *Pteridium esculentum*, *Lepidosperma laterale* and *Pratia purpurascens*. Grasses include *Entolasia stricta*, *Eragrostis brownii*, *Themeda triandra*, *Panicum simile*, *Oplismenus aemulus*, *Imperata cylindrica* and *Anisopogon avenaceus*.



Photo 3 – Unburnt intact vegetation in the central northern portion of the study area



Photo 4 – Vegetation just east of the dam

PCT 1718 - Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast

This vegetation community describes the floodplain vegetation in the southern portion of the study area. The vegetation is upon hummocky grounds with small areas of soaks as well as mounds, thus there is a mixture of species that occur regularly in Swamp Sclerophyll vegetation as well as others that occur more regularly in drier locations but can handle the rare flood event.

Canopy

Eucalyptus robusta, *Angophora costata*, *Eucalyptus capitellata* and *Melaleuca quinquenervia* are the dominant species 12–23 m tall and with a PFC of 20–40%.

Mid-storey

Melaleuca sieberi, *Melaleuca linariifolia*, *Acacia longifolia*, *Pultenaea villosa*, *Glochidion ferdinandi* and *Dodonaea triquetra*. Vegetation 1–12 m tall and average PFC of 15–40%.

Ground layer

Gahnia spp., *Pteridium esculentum*, *Centella asiatica*, *Goodenia heterophylla*, *Goodenia ovata*, *Villarsia exaltata*, *Pimelea linifolia*, *Gonocarpus teucroides*, *Pultenaea retusa*. Grasses include *Entolasia stricta*, *Panicum simile* and *Imperata cylindrica*.



Photo 5 – Swamp Sclerophyll vegetation near Quadrat 2 (of 2016)



Photo 6 – Burnt vegetation on the northern tip of the Swamp Sclerophyll forest

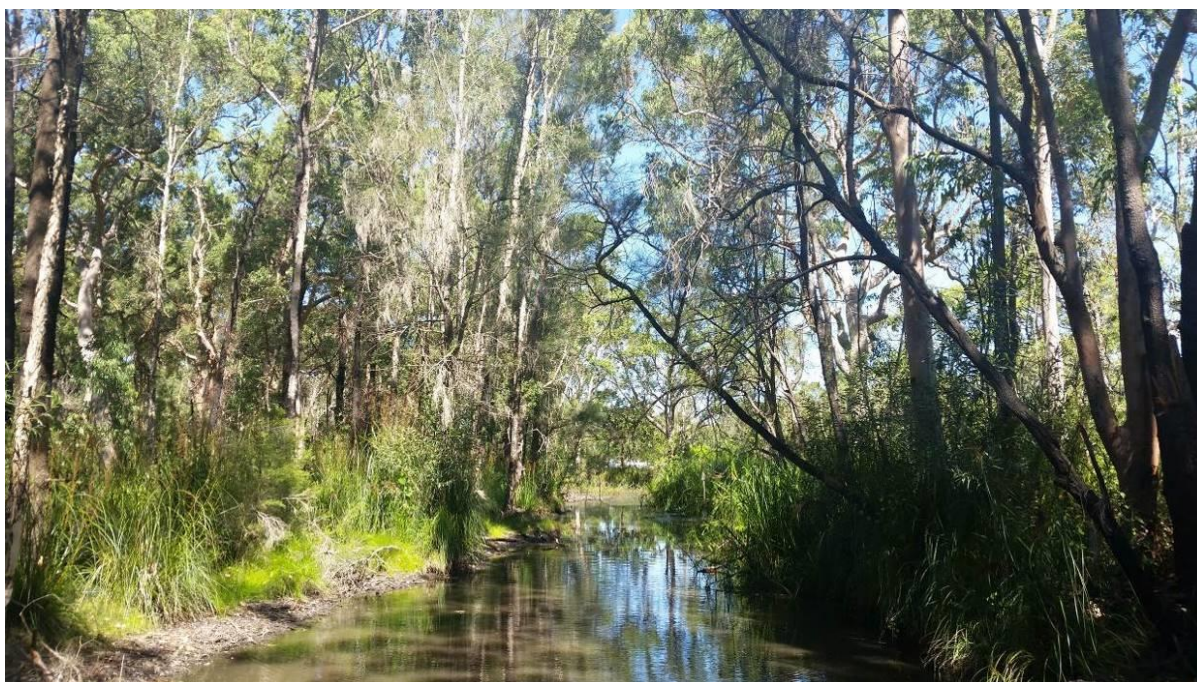


Photo 7 – Vegetation along the southern boundary which is Karignan Creek

3.1.5 Vegetation integrity assessment

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

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

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

The location of plots and PCTs (in this case PCTs and zones are equivalent) is shown on Figure 2. Impacted areas (the subject site) are shown hatched.

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.

Both vegetation zones are in moderate to good condition with few high threat exotics. Table 3.5 shows the current vegetation integrity score.

Table 3.5 – Current vegetation integrity score

Vegetation zone name	Area (ha)	Composition condition score	Structure condition score	Function condition score	Current vegetation integrity score
1619_moderate_good	7.57	80.1	47.8	93.4	71
1718_moderate_good	0.12	87.6	94.7	71.5	84
1619_cleared	2.56	11.6	22.9	8.5	13.1

Direct impact areas:

It is assumed there will be no vegetation retained in the direct impact areas, thus the vegetation integrity score for all zones will be 0 as indicated in Table 3.6.

Indirect impact areas:

The proposed avoidance, minimisation and mitigation measures (Sections 5.4 & 5.3) are likely to reduce indirect impacts due to edge effects but not eliminate them entirely. In accordance with Section 2.4.1 of the *BAM Operational Manual Stage 2* (DPIE 2019), an estimate of the likely reduction in VI scores from edge effects is provided. This has then been integrated into the BAM-C to calculate additional credits to offset these indirect impacts. For the purposes of this assessment, we have placed a 10 m buffer from the edge of the development footprint to account for edge effects. Where this buffer overlaps mapped vegetation, it is treated as part of a separate management zone in the BAM-C, and credits are calculated for partial loss of VI.

To estimate the partial loss in VI, we assume the following changes to the vegetation may occur following indirect impacts caused by increased nutrient, weed propagules, lighting and disturbance:

- Trees: richness and cover will not change
- Shrubs: richness and cover decrease by 1/4
- Grasses: richness and cover decrease by 1/4
- Forbs: richness and cover decrease by 1/4
- Ferns: richness and cover decrease by 1/4
- Other: richness and cover decrease by 1/4
- Large trees: no change
- Litter cover: no change
- Coarse woody debris: no change
- Hollows: no change
- Tree stem classes: no change
- High threat weed cover: no change*

*Ideally and increase in high threat weed cover would be accounted for in these assumption, but the BAM-C does not allow this value to be greater than the current recorded value. As the main impact of increased weed abundance is competition with, and a reduction in, native species richness and abundance, the predictions made above are considered more than sufficient to account for the impact of weeds on the future VI score.

Table 3.6 – Future vegetation integrity score

Vegetation zone name	Management Zone	Area (ha)	Composition condition score	Structure condition score	Function condition score	Future vegetation integrity score	Change in VI score	Total VI loss
1619_moderate_good	Direct	6.5	0	0	0	0	-71	-63
	Indirect	1.12	51.6	33	95.8	54.6	-16.4	
1718_moderate_good	Direct	0.04	0	0	0	0	-84	-17.9
	Indirect	0.25	76.6	83.6	78	79.3	-4.7	
1619_cleared	Direct	2.63	0	0	0	0	-13.1	-12.5
	Indirect	0.15	6.6	19.1	8.5	10.2	-2.9	

3.2 Fauna results

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

Table 3.7 – Fauna observations for the study area

Common name	Scientific name	Method observed			
Birds		March 2016	Nov 2017- Jan 2018	June – Aug 2018	Sept 2020
Australian Magpie	<i>Cracticus tibicen</i>	O W	O W		
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>	W	W		
Australian Raven	<i>Corvus coronoides</i>	W	O W	O W	
Australian Wood Duck	<i>Chenonetta jubata</i>	O W	O W	W	
Azure Kingfisher	<i>Alcedo azurea</i>		W		
Bar-shouldered Dove	<i>Geopelia humeralis</i>		O W Q	W	
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>		O W		
Brown Thornbill	<i>Acanthiza pusilla</i>	O W	W	W	
Brush Cuckoo	<i>Cacomantis variolosus</i>		W		
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>		O W		
Chestnut Teal	<i>Anas castanea</i>		O		
Cicadabird	<i>Coracina tenuirostris</i>		W		
Common Koel	<i>Eudynamis scolopacea</i>		W		
Common Myna *	<i>Acridotheres tristis</i>	O W	O W Q		
Crested Pigeon	<i>Ocyphaps lophotes</i>	O			
Dollarbird	<i>Eurystomus orientalis</i>		O W		
Eastern Rosella	<i>Platycercus eximius</i>	O W	O W	O W	
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	O W	O W	W	
Eastern Yellow Robin	<i>Eopsaltria australis</i>	O W	O W	W	
Eurasian Coot	<i>Fulica atra</i>	O W			
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>		W	W	
Galah	<i>Cacatua roseicapilla</i>	O W	O W	O W	
Golden Whistler	<i>Pachycephala pectoralis</i>	O		W	
Goose (domestic) *	<i>Anser</i> sp.		O W		
Grey Butcherbird	<i>Cracticus torquatus</i>	O W	O W	O W	
Grey Fantail	<i>Rhipidura albiscapa</i>	O	O W	O W	
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	O W	O W Q	O W	
Leaden Flycatcher	<i>Myiagra rubecula</i>		W ^{PR}		
Lewin's Honeyeater	<i>Meliphaga lewinii</i>	O	W	W	
Little Corella	<i>Cacatua sanguinea</i>	OW	W	OW	
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>	O			
Little Wattlebird	<i>Anthochaera chrysoptera</i>		OW		
Magpie-lark	<i>Grallina cyanoleuca</i>	OW	OW	W	
Masked Lapwing	<i>Vanellus miles</i>	W	W		
Musk Lorikeet	<i>Glossopsitta concinna</i>		W	W	
Noisy Friarbird	<i>Philemon corniculatus</i>		W		
Noisy Miner	<i>Manorina melanocephala</i>	OW	OW	OW	
Olive-backed Oriole	<i>Oriolus sagittatus</i>		W		
Pacific Black Duck	<i>Anas superciliosa</i>	O W	O		
Pheasant Coucal	<i>Centropus phasianinus</i>		W ^{PR}	OW	

Common name	Scientific name	Method observed			
Pied Currawong	<i>Strepera graculina</i>	W	OW	OW	
Powerful Owl ^{TS}	<i>Ninox strenua</i>			W	
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	OW	OW	OW	
Rufous Whistler	<i>Pachycephala rufiventris</i>		W		
Sacred Kingfisher	<i>Todiramphus sanctus</i>		OW		
Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>	OW	OW	W	
Scaly-breasted Lorikeet	<i>Trichoglossus chlorolepidotus</i>	OW	OW		
Scarlet Honeyeater	<i>Myzomela sanguinolenta</i>		W		
Southern Boobook	<i>Ninox novaeseelandiae</i>		H ^{PR}	O	
Spotted Turtle-Dove *	<i>Streptopelia chinensis</i>	OW	OW		
Square-tailed Kite ^{TS}	<i>Lophoictinia isura</i>			O	
Striated Heron	<i>Butorides striatus</i>	O			
Striated Pardalote	<i>Pardalotus striatus</i>		W		
Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	OW	OW	OW	
Superb Fairy-wren	<i>Malurus cyaneus</i>		OW		
Variegated Fairy-wren	<i>Malurus lamberti</i>	OW			
Welcome Swallow	<i>Hirundo neoxena</i>	O	O		
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	W			
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>	O ^{PO}			
White-browed Scrubwren	<i>Sericornis frontalis</i>	OW	OW	W	
White-throated Needletail	<i>Hirundapus caudacutus</i>		O		
White-throated Treecreeper	<i>Cormobates leucophaea</i>		W	W	
White-winged Chough	<i>Corcorax melanorhamphos</i>	O			
Willie Wagtail	<i>Rhipidura leucophrys</i>	OW	OW		
Yellow-faced Honeyeater	<i>Caligavis chrysops</i>	W	W	W	
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	W	W	W	
Mammals					
Black Rat *	<i>Rattus rattus</i>		ETQ		O
Brown Antechinus	<i>Antechinus stuartii</i>		T		
Bush Rat	<i>Rattus fuscipes</i>			T	
Cat *	<i>Felis catus</i>	O	O		
Chocolate Wattled Bat	<i>Chalinolobus morio</i>		U ^{PO}		
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	O	OTQ		
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	OE	OTQ		
Domesticated Dog *	<i>Canis lupus familiaris</i>	W	OW		
Eastern Coastal Free-tailed Bat ^{TS}	<i>Micronomus norfolkensis</i>	U	U		
Large Bent-winged Bat ^{TS}	<i>Miniopterus orianae oceanensis</i>	U			
Eastern Broad-nosed Bat	<i>Scotorepens orion</i>		U ^{PR}		
Eastern Forest Bat	<i>Vespadelus pumilus</i>		T		
Eastern Freetail-bat	<i>Mormopterus ridei</i>		U		
European Red Fox *	<i>Vulpes vulpes</i>		PQ		
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	U	U		
Greater Broad-nosed Bat ^{TS}	<i>Scoteanax rueppellii</i>		U ^{PR}		
Grey-headed Flying-fox ^{TS}	<i>Pteropus poliocephalus</i>		O		
Southern Myotis ^{TS}	<i>Myotis macropus</i>	OU	U		
Little Bent-winged Bat ^{TS}	<i>Miniopterus australis</i>	U	U		
Little Forest Bat	<i>Vespadelus vulturnus</i>	U ^{PO}	U		
Northern Brown Bandicoot	<i>Isodon macrourus</i>		Q		

Common name	Scientific name	Method observed			
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>		Q		
Southern Forest Bat	<i>Vespadelus regulus</i>		TU		
Squirrel Glider ^{TS}	<i>Petaurus norfolcensis</i>	W ^{PO}			
Sugar Glider	<i>Petaurus breviceps</i>	F ^{PR}		T	OW
Swamp Rat	<i>Rattus lutreolus</i>		T		
Swamp Wallaby	<i>Wallabia bicolor</i>	P	OPQ		
Reptiles					
Delicate Skink	<i>Lampropholis delicata</i>	O	O		
Lace Monitor	<i>Varanus varius</i>		P		
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>		O		
Amphibians					
Broad-palmed Frog	<i>Litoria latopalmata</i>		W		
Brown Brood Frog	<i>Pseudophryne bibronii</i>	W ^{PO}			
Common Eastern Froglet	<i>Crinia signifera</i>	W	W	W	OW
Dusky Toadlet	<i>Uperoleia fusca</i>	W			
Dwarf Tree Frog	<i>Litoria fallax</i>		W		
Eastern Banjo Frog	<i>Limnodynastes dumerilii</i>				W
Peron's Tree Frog	<i>Litoria peronii</i>		W		W
Striped Marsh Frog	<i>Limnodynastes peronii</i>	W	W		OW
Wallum Froglet ^{TS}	<i>Crinia tinnula</i>	W			OW
<p>Note: * indicates introduced species ^{TS} indicates threatened species</p> <p>All species listed are identified to a high level of certainty unless otherwise noted as:</p> <p>^{PR} indicates species identified to a 'probable' level of certainty – more likely than not ^{PO} indicates species identified to a 'possible' level of certainty – recorded to a moderate to high level of uncertainty usually applied to a threatened species of note.</p>					
E - Nest/roost	H - Hair/feathers/skin	P - Scat	W - Heard call		
F - Tracks/scratchings	K - Dead	Q - Camera	X - In scat		
FB - Burrow	O - Observed	T - Trapped/netted	Y - Bone/teeth/shell		
G - Crushed cones	OW - Obs & heard call	U - Anabat/ultrasound	Z - In raptor/owl pellet		

3.3 Habitat results

3.3.1 Fauna habitat observations

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

Table 3.8 – Observed fauna habitat

Topography																									
Flat		✓	Gentle		✓	Moderate		x	Steep		x	Drop-offs		x											
Vegetation structure																									
Closed Forest		x	Open Forest		✓	Woodland		✓	Heath		x	Grassland		✓											
Disturbance history																									
Fire			✓		Under-scrubbing				✓		Cut and fill works				✓										
Tree clearing			✓		Grazing				?																
Soil landscape																									
DEPTH:		Deep		✓		Moderate		✓		Shallow		✓		Skeletal		x									
TYPE:		Clay		✓		Loam		✓		Sand		x		Organic		✓									
VALUE:		Surface foraging				✓				Sub-surface foraging				✓				Denning/burrowing		✓					
WATER RETENTION:		Well Drained		✓		Damp / Moist		✓		Water logged		✓		Swamp / Soak		✓									
Rock habitat																									
CAVES:		Large		x		Small		x		Deep		x		Shallow		x									
CREVICES:		Large		x		Small		x		Deep		x		Shallow		x									
ESCARPMENTS:		Winter / late sunny aspects						x		Shaded winter / late aspects						x									
OUTCROPS:		High Surface Area Hides				x				Med. Surface Area Hides				x				Low Surface Area Hides				x			
SCATTERED/ISOLATED:		High Surface Area Hides				x				Med. Surface Area Hides				x				Low Surface Area Hides				x			
Feed resources																									
FLOWERING TREES:		Eucalypts				✓				Corymbias				✓				Melaleucas				✓			
		Banksias				✓				Acacias				✓				Angophoras				✓			
SEEDING TREES:		Allocasuarinas				✓				Conifers				x											
WINTER FLOWERING EUCALYPTS:		C. maculata				✓				E. crebra		x		E. globoidea		x		E. sideroxylon				x			
		E. squamosa								E. grandis		x		E. multicaulis		x		E. scias				x			
		E. robusta				✓				E. tereticornis		✓		E. agglomerata		x		E. siderophloia				x			
FLOWERING PERIODS:		Autumn				✓				Winter		✓		Spring		✓		Summer				✓			
OTHER:		Mistletoe				✓				Figs / Fruit		✓		Sap / Manna		✓		Termites				✓			
Foliage protection																									
UPPER STRATA:		Dense				x				Moderate				✓				Sparse				✓			
MID STRATA:		Dense				x				Moderate				✓				Sparse				✓			
PLANT / SHRUB LAYER:		Dense				x				Moderate				✓				Sparse				✓			
GROUNDCOVERS:		Dense				✓				Moderate				✓				Sparse				✓			
Hollows / logs																									
TREE HOLLOW:		Large				✓				Medium				✓				Small				✓			
TREE HOLLOW TYPES		Spouts / branch				✓				Trunk		✓		Broken Trunk		✓		Basal Cavities		✓		Stags		✓	
GROUND HOLLOW:		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 x	
CONSISTENCY:	Permanent ✓		Perennial x		Ephemeral x	
RUNOFF SOURCE:	Urban / Industrial x		Parkland ✓		Grazing x	Natural ✓
RIPARIAN HABITAT:	High quality ✓		Moderate quality ✓		Low quality x	Poor quality
Artificial habitat						
STRUCTURES:	Sheds ✓		Infrastructure x		Equipment ✓	
SUB-SURFACE	Pipe / culvert(s) x		Tunnel(s) x		Shaft(s) x	
FOREIGN MATERIALS:	Sheet ✓		Pile / refuse ✓			

3.3.2 Habitat tree data

Hollow-bearing trees were identified and recorded within the subject site during 2018 surveys. These are shown on Figure 4 and listed in Table 3.9. Previous surveys of significant habitat trees in 2016 have been included on this figure for the entire study area. Significant habitat trees are defined as trees containing large hollows suitable for use by owls or cockatoos and / or containing hollows considered potentially suitable for use by Squirrel Glider. It is considered that 164 recorded hollow-bearing trees containing 375 hollows will be removed as a result of the proposal, including 49 significant habitat trees.

Following recent survey only one (1) large hollow (in tree 2641) is considered suitable for threatened large forest owls. This large cavity was inspected by tree climber on the 10 August 2018. This was particularly important given that Powerful Owl was heard to the north of the study area during recent stag-watching surveys on the 4 August 2018. The base of the hollow was found covered with fresh leaf material indicating recent Common Brushtail Possum use. The termite mud in the base was scraped with a net to sample the upper profile for any recent owl use. No feathers, pellets or bone material from prey species were recorded indicating that the study area has not been used for breeding by Powerful Owl or for roosting by Masked Owl over recent years. Given the Powerful Owl call heard to the north it is expected that a nearby nest in the locality to the north does exist.

Since the completion on onsite surveys *Travers bushfire & ecology* has recorded a Masked Owl nesting tree and male roosting trees approximately 500 m to the east of the site. This knowledge reduces the chance of the large hollow mentioned being of importance to Masked Owl during the breeding period. It may instead be utilised as a roost by this local pair infrequently outside of breeding.

No whitewash indicating roosting or perching by large forest owls has been recorded within the study area however a Common Ringtail Possum was found in the northern extent at the time the call was heard suggesting Powerful Owl does forage at times within the study area during the breeding period.

The large hollow within survey tree 2641 previously had a high entry in the trunk and a second entry through a branch both meeting further down the trunk. Given the size of both entries and being sheltered from weather this hollow is expected to have been important for owls previously. More recently the top of the trunk has largely split away and the crown of the tree has fallen. As a result the base cavity is more exposed and not now of its former quality. This tree will be retained within the corridor as part of the proposal and there is scope to improve its use by sealing around the split. It is recommended that remedial works are undertaken on this large tree such that the hollow is improved for use by owls in the locality.

Other significant habitat trees suitable for Squirrel Glider were identified in order to target these trees during 2018 stag-watching effort. The Squirrel Glider was recorded in 2016 only from a call to the south to a 'possible' level of certainty. No Squirrel Gliders were however recorded following two (2) seasons of target trapping effort and therefore the study area is not suspected of conservation significance for this species.

One (1) glider den tree was recorded during survey indicated by landing scratches on the base and an ideal trunk hollow. This is considered to belong to the non-threatened Sugar Glider which was captured during trapping effort. The proposed corridor has been established to ensure ongoing connectivity for any dispersing gliders that still occur in the locality. Any hollows found to be used by Sugar Gliders within the development landscape are recommended for relocation and attachment to remaining trees within the retained habitat and corridor.

Hollow-bearing trees are otherwise present within the study area in notable high density and quality of various size classes, including some other high quality large hollows. A summary of hollow-bearing tree results is provided in Table 3.9. All hollow-bearing trees have been numbered also according to the land survey tree number with corresponding numbered tree tags, therefore this number is cited in the tree data.

Hollow-dependent threatened fauna species recorded during previous or recent surveys include the Powerful Owl, Eastern Coastal Free-tailed Bat, Southern Myotis and Greater Broad-nosed Bat. As mentioned above, Powerful Owl has not been found to utilise the only suitable hollow. The hollows within the subject site may however support roosting/breeding habitat for threatened microbat species. Extensive stag-watching effort through the study area was undertaken during 2018 winter survey. Hollows selected were prioritised based on size and quality (mostly suitable for gliders and others nearby) but not all hollows were observed. Therefore future habitat removal should include supervision by a fauna ecologist to recover and effectively relocate any microbat roosts found at this time.

Table 3.9 – Habitat tree data

Tree no.	Surv. tree no.	Scientific name	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & other habitat features recorded	Retain or remove
HT1	13	<i>E. haemastoma</i>	Scribbly Gum	40	18	18	65	3x 0-5cm spout, 2x 0-5cm trunk split	Retain
HT2	69	<i>E. haemastoma</i>	Scribbly Gum	25	10	15	70	1x 5-10cm trunk low	Retain
HT3	84	<i>E. haemastoma</i>	Scribbly Gum	22	2	6	50	1x 0-5cm trunk	Remove
HT4	93	<i>E. capitellata</i>	Brown Stringybark	35	7	10	0	2x 0-5cm spout, 1x 5-10cm trunk	Retain
HT5	112	<i>E. capitellata</i>	Brown Stringybark	70	20	20	70	1x 5-10cm spout	Retain
HT6	128	<i>E. haemastoma</i>	Scribbly Gum	80	18	20	65	2x 10-15cm trunk 1x 20-30cm trunk Notably suitable for Large Forest Owl	Retain
HT7	138	<i>E. haemastoma</i>	Scribbly Gum	25	5	10	65	2x 0-5cm trunk	Retain
HT8	156	<i>E. capitellata</i>	Brown Stringybark	30	10	14	70	2x 0-5cm trunk	Retain
HT9	191	<i>A. costata</i>	Smooth-barked Apple	90	18	20	70	1x 5-10cm trunk 3x 10-15cm trunk 1x 20-30cm trunk 1x 30-40cm trunk Suitable for gliders Large Forest Owl but no talon marks	Retain
HT10	225	<i>E. capitellata</i>	Brown Stringybark	50	10	15	45	2x 0-5cm spout 1x 0-5cm trunk 2x 5-10cm trunk 1x 5-10cm spout Suitable for gliders	Remove

Tree no.	Surv. tree no.	Scientific name	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & other habitat features recorded	Retain or remove
HT11	260	A. costata	Smooth-barked Apple	80	20	22	80	1x 5-10cm spout 1x 5-10 branch Suitable for gliders	Retain
HT12	261	E. haemastoma	Scribbly Gum	70	18	19	70	1x 0-5cm trunk 1x 0-5cm spout 3x 5-10cm spout	Retain
HT13	284	C. gummifera	Red Bloodwood	60	20	24	65	1x 0-5cm spout 1x 5-10cm spout 1x 5-10cm trunk	Retain
HT14	303	E. haemastoma	Scribbly Gum	60	12	24	80	1x 5-10cm branch spout	Retain
HT15	306	E. haemastoma	Scribbly Gum	40	12	15	70	1x 10-15cm spout 1x 10-15cm trunk Suitable for gliders	Retain
HT16	307	E. capitellata	Brown Stringybark	42	15	20	60	1x 5-10cm spout 1x 5-10cm trunk Suitable for gliders	Retain
HT17	323	E. capitellata	Brown Stringybark	30	11	19	70	1x 5-10cm trunk spout	Remove
HT18	340	E. capitellata	Brown Stringybark	19	4	16	30	1x 10-15cm low trunk Suitable for gliders	Retain
HT19	342	E. haemastoma	Scribbly Gum	57	12	19	80	1x 20-30cm low trunk Suitable for gliders & Small Forest Owl	Retain
HT20	345	E. haemastoma	Scribbly Gum	30	8	16	80	1x 5-10cm branch spout	Retain
HT21	355	E. haemastoma	Scribbly Gum	30	7	15	60	1x 15-20cm trunk Suitable for gliders possum scratches at entry	Retain
HT22	358	Stag	Stag	30	4	10	0	1x 5-10cm trunk 1x 5-10cm broken trunk Suitable for gliders	Retain
HT23	397	E. capitellata	Brown Stringybark	45	15	17	75	2x 5-10cm trunk Suitable for gliders	Remove
HT24	399	E. capitellata	Brown Stringybark	45	14	20	60	1x 15-20cm branch 1x 30-40cm trunk	Remove
HT25	415	C. gummifera	Red Bloodwood	37	9	12	20	1x 5-10cm branch spout	Retain
HT26	416	A. costata	Smooth-barked Apple	32	8	16	65	1x 5-10cm trunk	Retain
HT27	424	C. gummifera	Red Bloodwood	60	10	17	60	1x 0-5cm branch spout 1x 5-10cm branch spout	Retain
HT28	430	E. capitellata	Brown Stringybark	40	13	16	70	1x 5-10 trunk split 1x 15-20 trunk split	Remove
HT29	455	C. gummifera	Red Bloodwood	60	17	22	80	2x 0-5cm branch spout	Retain
HT30	467	A. costata	Smooth-barked Apple	40	10	17	70	1x 5-10cm branch	Retain
HT31	479	E. haemastoma	Scribbly Gum	55	11	21	65	1x 5-10cm branch spout	Retain
HT32	500	E. haemastoma	Scribbly Gum	48	13	20	80	1x 10-15cm branch spout	Retain
HT33	502	C. gummifera	Red Bloodwood	65	12	17	65	2x 5-10cm spout 3x 10-15cm trunk Suitable for gliders	Retain
HT34	539	E. haemastoma	Scribbly Gum	21	4	15	60	1x 0-5cm trunk (good)	Remove
HT35	547	A. costata	Smooth-barked Apple	60	12	19	90	1x 5-10cm low trunk Suitable for gliders possum scratches	Remove
HT36	554	E. haemastoma	Scribbly Gum	60	12	16	70	1x 0-5cm branch spout	Remove
HT37	555	E. haemastoma	Scribbly Gum	35	11	14	55	1x 0-5cm branch spout	Remove
HT38	564	E. haemastoma	Scribbly Gum	36	11	16	85	1x 10-15cm trunk Suitable for gliders	Remove
HT39	614	C. gummifera	Red Bloodwood	35	25	5	40	1x 10-15cm branch spout	Remove
HT40	618	A. costata	Smooth-barked Apple	40	12	17	75	1x 10-15cm trunk Suitable for gliders	Remove
HT41	630	C. gummifera	Red Bloodwood	60	15	16	70	1x 0-5cm trunk 1x 0-5cm spout	Remove
HT42	632	C. gummifera	Red Bloodwood	45	25	20	50	1x 15-20cm split	Remove
HT43	636	E. haemastoma	Smooth-barked Apple	40	30	25	50	1x 5-10cm branch spout 1x 15-20cm trunk	Remove

Tree no.	Surv. tree no.	Scientific name	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & other habitat features recorded	Retain or remove
HT44	641	E. haemastoma	Scribbly Gum	40	8	15	65	1x 5-10cm trunk Suitable for gliders	Remove
HT45	671	C. gummifera	Red Bloodwood	60	10	19	75	1x 20-30cm trunk split	Remove
HT46	788	E. capitellata	Brown Stringybark	25	12	5	50	1x 5-10cm trunk	Retain
HT47	789	C. gummifera	Red Bloodwood	40	6	12	65	3x 5-10cm trunk Suitable for gliders	Remove
HT48	811	E. haemastoma	Scribbly Gum	55	10	15	65	2x 0-5cm branch	Remove
HT49	812	A. costata	Smooth-barked Apple	55	17	18	75	2x 0-5cm spout 1x 5-10cm spout	Remove
HT50	818	E. haemastoma	Smooth-barked Apple	30	20	15	40	1x 5-10cm trunk	Remove
HT51	823	E. capitellata	Brown Stringybark	50	15	18	70	1x 15-20cm spout	Remove
HT52	824	E. capitellata	Brown Stringybark	45	15	17	75	1x 20-30cm spout	Remove
HT53	826	E. haemastoma	Scribbly Gum	26	5	8	70	1x 5-10cm spout	Remove
HT54	848	E. capitellata	Brown Stringybark	50	15	17	70	1x 5-10cm trunk	Remove
HT55	870	C. gummifera	Red Bloodwood	30	7	15	70	2x 5-10cm spout	Remove
HT56	894	E. capitellata	Brown Stringybark	25	6	8	65	1x 5-10cm trunk	Remove
HT57	906	E. capitellata	Brown Stringybark	25	8	12	65	2x 0-5cm branch	Remove
HT58	916	E. capitellata	Brown Stringybark	30	8	12	60	1x 5-10cm trunk	Remove
HT59	939	A. costata	Smooth-barked Apple	65	16	21	65	1x 0-5cm branch spout 2x 5-10cm branch spout	Remove
HT60	953	E. haemastoma	Scribbly Gum	58	7	15	35	2x 0-5cm branch spout	Remove
HT61	959	E. haemastoma	Scribbly Gum	16	7	12	40	1x 0-5cm low trunk	Remove
HT62	965	E. capitellata	Brown Stringybark	45	5	12	50	1x 5-10cm trunk	Remove
HT63	966	E. capitellata	Brown Stringybark	75	18	10	50	1x 0-5cm branch 1x 10-15cm branch spout 1x 10-15cm hollow in termite nest 1x 20-30cm trunk	Remove
HT64	990	E. capitellata	Brown Stringybark	45	12	10	70	1x 10-15cm hollow in termite nest	Remove
HT65	991	C. gummifera	Red Bloodwood	60	15	6	40	2x 20-30cm trunk	Remove
HT66	992	C. gummifera	Red Bloodwood	60	21	8	30	1x 15-20cm branch spout	Remove
HT67	1004	C. gummifera	Red Bloodwood	45	10	17	70	1x 10-15cm branch spout	Remove
HT68	1022	E. haemastoma	Scribbly Gum	39	7	14	75	1x 0-5cm branch 1x 0-5cm branch spout 1x 5-10cm trunk glider den tree	Remove
HT69	1051	E. haemastoma	Scribbly Gum	15	10	12	40	1x 5-10cm trunk	Remove
HT70	1055	E. haemastoma	Scribbly Gum	43	9	16	65	1x 5-10cm branch spout	Remove
HT71	1079	A. costata	Smooth-barked Apple	31	9	16	80	1x 5-10 trunk Suitable for gliders wear around hollow	Remove
HT72	1080	E. capitellata	Brown Stringybark	65	25	14	80	1x10-15cm trunk 1x 20-30cm trunk	Remove
HT73	1085	E. haemastoma	Scribbly Gum	30	6	14	65	1x 20-30 low trunk	Remove
HT74	1103	C. gummifera	Red Bloodwood	45	8	12	65	1x 0-5cm trunk 1x 5-10cm trunk 1x 10-15cm trunk Suitable for gliders	Remove
HT75	1119	E. haemastoma	Scribbly Gum	35	7	12	60	2x 0-5cm trunk 1x 5-10cm spout	Remove
HT76	1146	E. haemastoma	Scribbly Gum	50	7	15	55	1x 15-20cm broken trunk	Remove
HT77	1224	A. costata	Smooth-barked Apple	40	14	20	80	1x 20-30cm low trunk	Remove
HT78	1267	E. haemastoma	Scribbly Gum	38	9	20	70	1x 0-5cm low trunk	Remove
HT79	1315	A. costata	Scribbly Gum	45	3	8	60	1x 0-5cm branch	Retain
HT80	1317	A. costata	Smooth-barked Apple	70	20	23	75	2x 0-5cm spout Suitable for gliders	Retain
HT81	1318	E. haemastoma	Scribbly Gum	40	10	14	60	1x 5-10cm trunk Suitable for gliders	Retain

Tree no.	Surv. tree no.	Scientific name	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & other habitat features recorded	Retain or remove
								3x 0-5cm spout 1x 5-10cm trunk 1x 5-10cm branch 2x 10-15cm branch 1x 15-20cm trunk 1x 20-30cm spout Suitable for gliders	
HT82	1320	A. costata	Smooth-barked Apple	60	20	22	80		Retain
HT83	1337	E. haemastoma	Scribbly Gum	29	12	26	60	2x 0-5cm branch	Retain
HT84	1374	A. costata	Smooth-barked Apple	60	19	25	25	1x 0-5cm branch	Remove
HT85	1386	C. gummifera	Red Bloodwood	47	11	20	70	1x 5-10cm broken trunk	Remove
HT86	1387	A. costata	Smooth-barked Apple	60	12	20	75	1x 5-10cm branch spout 1x 10-15cm branch spout	Remove
HT87	1423	E. haemastoma	Scribbly Gum	50	8	19	35	1x 5-10cm low trunk	Retain
								3x 5-10cm trunk 1x 5-10cm branch 1x 10-15cm trunk Suitable for gliders	
HT88	1433	E. haemastoma	Scribbly Gum	85	20	22	60		Remove
HT89	1435	E. haemastoma	Scribbly Gum	55	6	15	40	1x 10-20cm low trunk	Retain
HT90	1443	A. costata	Smooth-barked Apple	43	15	19	30	1x 40-50cm low broken trunk	Retain
								1x 0-5cm branch spout 1x 5-10cm branch spout 1x 15-20cm low trunk	
HT091	1452	A. costata	Smooth-barked Apple	100	25	28	85		Retain
HT092	1459	E. haemastoma	Scribbly Gum	44	9	21	60	2x 5-10cm branch spout	Retain
HT093	1497	E. haemastoma	Scribbly Gum	30	7	18	55	1x 0-5cm branch	Remove
HT094	1508	C. gummifera	Red Bloodwood	31	7	15	60	1x 5-10cm trunk Suitable for gliders	Remove
HT095	1509	C. gummifera	Red Bloodwood	44	11	18	65	1x 5-10cm branch spout	Remove
HT096	1510	E. haemastoma	Scribbly Gum	36	9	16	65	1x 5-10cm trunk Suitable for gliders	Remove
								1x 5-10cm branch 1x 5-10cm trunk Suitable for gliders	
HT097	1528	C. gummifera	Red Bloodwood	50	11	21	70		Remove
HT098	1536	E. capitellata	Brown Stringybark	0	15	16	60	1x 10-15cm trunk	Retain
HT099	1553	E. haemastoma	Scribbly Gum	45	10	19	90	1x 10-15cm trunk Suitable for gliders	Retain
HT100	1561	E. haemastoma	Scribbly Gum	60	10	15	60	1x 5-10cm branch spout	Retain
HT101	1621	E. haemastoma	Scribbly Gum	28	4	13	55	1x 5-10cm trunk	Retain
HT102	1646	A. costata	Smooth-barked Apple	72	19	20	80	1x 5-10cm branch	Retain
HT103	1667	E. haemastoma	Scribbly Gum	58	10	20	65	5-10cm branch spout	Retain
HT104	1692	C. gummifera	Red Bloodwood	47	11	18	60	2x 0-5cm branch spout 2x 5-10cm branch spout	Remove
								1x 5-10cm trunk 1x 5-10cm branch 1x 10-15cm spout	
HT105	1718	C. gummifera	Red Bloodwood	40	6	12	60		Remove
								2x 0-5cm spout 2x 5-10cm spout 1x 10-15cm trunk Notably suitable for Small Forest Owl	
HT106	1725	E. haemastoma	Scribbly Gum	50	5	10	55		Remove
HT107	1748	E. haemastoma	Scribbly Gum	0	18	18	40	1x 5-10cm split 1x 10-15cm trunk	Remove
								1x 0-5cm branch spout 2x 10-15cm branch spout 1x 10-15cm trunk	
HT108	1749	E. capitellata	Brown Stringybark	50	19	12	70		Remove
HT109	1783	E. capitellata	Brown Stringybark	33	5	14	65	1x 0-5cm trunk 1x 5-10cm trunk wear	Retain
								1x 5-10cm trunk 1x 10-15cm trunk Suitable for gliders	
HT110	1787	E. haemastoma	Scribbly Gum	42	8	15	70		Retain
HT111	1799	E. haemastoma	Scribbly Gum	38	4	13	85	1x 10-15cm trunk Suitable for gliders	Retain
HT112	1813	E. haemastoma	Scribbly Gum	14	5	6	65	1x 0-5cm low trunk	Remove

Tree no.	Surv. tree no.	Scientific name	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & other habitat features recorded	Retain or remove
HT113	1857	E. haemastoma	Scribbly Gum	45	20	17	55	1x 5-10cm spout	Remove
HT114	1860	C. gummifera	Red Bloodwood	55	15	18	75	1x 5-10cm trunk 1x 10-15cm trunk Suitable for gliders	Remove
HT115	1874	A. costata	Smooth-barked Apple	65	12	18	75	1x 15-20cm trunk Notably suitable for Small Forest Owl	Remove
HT116	1875	E. haemastoma	Scribbly Gum	55	16	18	50	2x 0-5cm spout 4x 5-10cm trunk	Remove
HT117	1886	E. haemastoma	Scribbly Gum	25	4	8	60	1x 5-10cm trunk	Remove
HT118	1896	E. haemastoma	Scribbly Gum	27	2	7	30	1x 0-5cm trunk 1x 5-10cm spout	Remove
HT119	1910	C. gummifera	Red Bloodwood	27	8	15	60	1x 5-10cm spout	Remove
HT120	1950	E. haemastoma	Scribbly Gum	60	15	20	70	2x 20-30cm trunk	Retain
HT121	1997	E. capitellata	Brown Stringybark	75	10	15	55	2x 0-5cm spout 1x 5-10cm spout 1x 5-10cm trunk 1x 15-20cm trunk Suitable for gliders	Retain
HT122	2004	E. capitellata	Brown Stringybark	32	5	16	45	1x 5-10cm trunk Suitable for gliders	Retain
HT123	2010	E. haemastoma	Scribbly Gum	65	4	12	25	1x 5-10cm trunk	Remove
HT124	2032	E. capitellata	Brown Stringybark	19	6	12	55	1x 5-10cm low trunk Suitable for gliders	Retain
HT125	2050	A. costata	Smooth-barked Apple	110	18	20	75	4x 0-5cm spout 2x 5-10cm spout 3x 20-30cm branch Notably suitable for Large Forest Owl	Retain
HT126	2056	E. haemastoma	Scribbly Gum	90	16	18	60	1x 0-5cm spout 1x 20-30cm spout 1x 20-30cm trunk Notably suitable for Large Forest Owl	Retain
HT127	2077	A. costata	Smooth-barked Apple	120	20	26	80	2x 5-10cm branch spout 1x 10-15cm branch spout 2x 10-15cm trunk	Retain
HT128	2083	A. costata	Smooth-barked Apple	80	16	18	65	1x 15-20cm branch 1x 30-40cm Large Forest Owl	Remove
HT129	2090	E. haemastoma	Scribbly Gum	140	28	20	80	2x 30-40cm trunk	Retain
HT130	2098	E. haemastoma	Scribbly Gum	90	18	23	65	3x 5-10cm spout 1x 5-10cm trunk 2x 10-15cm spout 1x 15-20cm spout Suitable for gliders	Retain
HT131	2125	E. capitellata	Brown Stringybark	80	14	20	50	1x 5-10cm branch spout 1x 5-10cm trunk 2x 10-15cm branch spout	Retain
HT132	2137	E. haemastoma	Scribbly Gum	90	18	20	75	2x 10-15cm trunk	Remove
HT133	2138	Stag	Stag	60	1	9	0	1x 30-40cm broken trunk	Remove
HT134	2147	E. haemastoma	Scribbly Gum	80	12	17	70	1x 0-5cm spout 1x 5-10cm spout Suitable for gliders	Remove
HT135	2278	A. costata	Smooth-barked Apple	110	18	20	75	1x 10-15cm spout 1x 10-15cm branch Suitable for gliders	Remove
HT136	2440	E. haemastoma	Scribbly Gum	90	11	15	15	1x 10-15cm branch spout 1x 30-40cm low broken trunk	Retain
HT137	2510	E. haemastoma	Scribbly Gum	60	10	16	65	1x 5-10cm trunk 1x 10-15cm branch spout	Retain
HT138	2563	E. haemastoma	Scribbly Gum	100	18	24	70	1x 0-5cm trunk 2x 5-10cm branch spout	Retain
HT139	2623	A. costata	Smooth-barked Apple	90	12	19	30	1x 15-20cm trunk split 1x 20-30cm branch spout	Retain

Tree no.	Surv. tree no.	Scientific name	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & other habitat features recorded	Retain or remove
HT140	2641	E. haemastoma	Scribbly Gum	110	19	35	65	1x 10-15cm low trunk 1x 15-20cm branch spout 1x 40-50cm trunk 1x >50cm broken trunk, Notably suitable for Large Forest Owls	Retain
HT141	2680	C. gummifera	Red Bloodwood	105	18	14	65	3x 5-10cm branch spout 1x 10-15cm trunk Suitable for gliders 1x 15-20cm branch spout	Retain
HT142	2734	A. costata	Smooth-barked Apple	140	17	16	70	1x 5-10cm branch spout 1x 10-15cm branch spout Suitable for gliders	Retain
HT143	2736	A. costata	Smooth-barked Apple	90	17	15	75	2x 5-10cm branch spout	Retain
HT144	2750	E. haemastoma	Scribbly Gum	30	25	15	50	1x 10-15cm branch spout	Retain
HT145	2751	E. haemastoma	Scribbly Gum	25	25	15	50	1x 5-10cm branch spout	Retain
HT146	2759	A. costata	Smooth-barked Apple	60	30	20	45	1x 15-20cm trunk 2x 20-30cm broken trunk	Remove
HT147	2774	E. haemastoma	Scribbly Gum	100	17	15	65	4x 5-10cm branch spout	Remove
HT148	2777	A. costata	Smooth-barked Apple	93	17	15	75	1x 5-10cm branch spout	Remove
HT149	2783	A. costata	Smooth-barked Apple	60	30	15	60	1x 10-15cm trunk 5x 15-20cm branch spout	Remove
HT150	2788	E. haemastoma	Scribbly Gum	40	20	20	40	3x 10-15cm branch spout	Remove
HT151	2791	E. haemastoma	Scribbly Gum	60	30	20	60	3x 5-10cm branch spout	Remove
HT152	2799	A. costata	Smooth-barked Apple	119	18	16	65	2x 0-5cm branch spout 1x 10-15cm branch spout Suitable for gliders 1x 15-20cm trunk 1x 20-30cm trunk	Remove
HT153	2800	E. haemastoma	Scribbly Gum	105	15	13	65	2x 10-15cm trunk Suitable for gliders 1x 15-20cm branch spout	Remove
HT154	2813	A. costata	Smooth-barked Apple	100	18	16	80	2x 5-10cm branch spout 2x 5-10cm trunk Suitable for gliders 1x 15-20cm branch spout	Retain
HT155	2817	E. haemastoma	Scribbly Gum	60	30	20	60	4x 10-15cm branch spout	Retain
HT156	2822	A. costata	Smooth-barked Apple	35	25	20	50	2x 5-10cm branch spout	Retain
HT157	2826	Stag	Stag	100	30	10	0	sig large hollows >40cm	Retain
HT158	2836	E. haemastoma	Scribbly Gum	110	17	16	60	5x 0-5cm branch spout 2x 5-10cm branch spout 2x 15-20cm trunk Suitable for gliders	Retain
HT159	2875	C. gummifera	Red Bloodwood	40	25	15	50	3x 10-15cm branch spout 1x 15-20cm trunk	Retain
HT160	2892	A. costata	Smooth-barked Apple	110	15	27	40	2x 5-10cm branch spout 3x 10-15cm branch spout 1x 15-20cm branch spout	Remove
HT161	2952	A. costata	Smooth-barked Apple	45	30	20	40	1x 15-20cm trunk Bee hive	Remove
HT162	2958	A. costata	Smooth-barked Apple	60	30	25	50	1x 5-10cm branch spout	Remove
HT163	2969	E. haemastoma	Scribbly Gum	50	25	15	50	2x 15-20cm branch spout	Remove
HT164	2972	E. haemastoma	Scribbly Gum	100	20	25	30	2x 20-30cm branch spout 1x 30-40cm trunk base hollow	Remove
HT165	2978	E. haemastoma	Scribbly Gum	86	17	14	70	1x 5-10cm trunk Suitable for gliders	Remove
HT166	2981	A. costata	Smooth-barked Apple	55	15	27	60	1x 0-5cm trunk 1x 5-10cm trunk 2x 10-15cm branch spout	Remove
HT167	2985	E. haemastoma	Scribbly Gum	150	20	25	50	1x 30-40cm broken trunk 2x 40-50cm trunk 1x 50+cm trunk base	Remove

Tree no.	Surv. tree no.	Scientific name	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & other habitat features recorded	Retain or remove
HT168	3000	E. haemastoma	Scribbly Gum	100	14	25	40	1x 5-10cm branch spout 2x 10-15cm branch spout 1x 15-20cm branch spout 1x 15-20cm trunk	Remove
HT169	3014	A. costata	Smooth-barked Apple	45	30	20	50	1x 5-10cm branch spout	Remove
HT170	3028	A. costata	Smooth-barked Apple	80	30	30	60	3x 5-10cm branch	Remove
HT171	3053	E. haemastoma	Scribbly Gum	70	30	15	50	1x 10-15cm branch spout 1x 20-30cm broken trunk 1x 20-30cm trunk base hollow	Remove
HT172	3054	E. haemastoma	Scribbly Gum	90	35	25	50	2x 15-20cm branch spout 2x 20-30cm trunk	Remove
HT173	3057	E. haemastoma	Scribbly Gum	70	30	25	50	3x 10-15cm branch spout	Remove
HT174	3074	A. costata	Smooth-barked Apple	60	30	25	50	3x 5-10cm branch spout	Remove
HT175	3079	A. costata	Smooth-barked Apple	30	30	20	40	1x 5-10cm branch spout	Remove
HT176	3085	A. costata	Smooth-barked Apple	40	25	20	50	1x 10-15cm branch spout 1x 15-20cm branch spout	Remove
HT177	3094	A. costata	Smooth-barked Apple	20	30	8	25	1x 5-10cm branch spout 1x 10-15cm trunk	Retain
HT178	3096	E. haemastoma	Scribbly Gum	20	15	8	30	1x 5-10cm branch spout 1x 15-20cm broken trunk	Retain
HT179	3100	A. costata	Smooth-barked Apple	35	30	15	50	1x 5-10cm trunk	Retain
HT180	3101	E. haemastoma	Scribbly Gum	55	30	15	50	3x 5-10cm branch spout	Retain
HT181	3103	E. haemastoma	Scribbly Gum	20	20	10	40	2x 5-10cm branch spout	Retain
HT182	3112	E. haemastoma	Scribbly Gum	50	30	25	0	1x 5-10cm branch spout 2x 10-15cm branch spout	Retain
HT183	3113	E. haemastoma	Scribbly Gum	45	30	20	30	3x 5-10cm branch spout	Retain
HT184	3122	E. haemastoma	Scribbly Gum	45	30	20	60	3x 5-10cm branch spout	Retain
HT185	3123	E. haemastoma	Scribbly Gum	45	30	20	60	2x 5-10cm branch spout	Retain
HT186	3124	Stag	Stag	30	10	5	0	1x 5-10cm branch spout 1x 20-30cm trunk	Retain
HT187	3140	E. robusta	Swamp Mahogany	90	30	25	50	2x 5-10cm branch	Remove
HT188	3149	E. haemastoma	Scribbly Gum	70	35	10	40	2x 10-15cm branch spout 1x 15-20cm trunk 1x 20-30cm trunk	Remove
HT189	3151	A. costata	Smooth-barked Apple	40	30	20	50	1x 5-10cm branch spout	Remove
HT190	3283	E. capitellata	Brown Stringybark	83	17	15	60	1x 5-10cm branch spout 1x 10-15cm trunk 1x 10-15cm branch spout Suitable for gliders	Retain
HT191	3298	Stag	Stag	130	18	16	0	2x 5-10cm branch 2x 5-10cm branch spout 1x 10-15cm branch spout 3x 15-20cm branch spout, Suitable for gliders	Remove
HT192	3316	E. haemastoma	Scribbly Gum	130	15	12	70	1x 0-5cm branch 1x 5-10cm branch 2x 5-10cm branch spout 1x 30-40cm trunk Suitable for gliders and Large Forest Owl	Remove
HT193	3320	E. haemastoma	Scribbly Gum	130	17	15	60	5x 0-5cm branch spout 2x 5-10cm branch spout 1x 10-15cm trunk 1x 10-15cm branch spout 1x 20-30cm trunk 1x 30-40cm trunk Suitable for gliders	Remove
HT194	3346	C. gummifera	Red Bloodwood	73	16	15	60	1x 20-30cm branch spout	Remove
HT195	3418	E. capitellata	Brown Stringybark	45	7	3	50	1x 15-20cm trunk spout 2x 20-30cm broken trunk	Remove

Tree no.	Surv. tree no.	Scientific name	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & other habitat features recorded	Retain or remove
HT196	3425	A. costata	Smooth-barked Apple	110	12	15	75	1x 5-10cm branch 1x 10-15cm trunk 1x 20-30cm trunk Suitable for gliders	Remove
HT197	3434	E. haemastoma	Scribbly Gum	100	14	12	45	1x 20-30cm trunk spout	Remove
HT198	3452	E. capitellata	Brown Stringybark	64	17	15	70	1x 5-10cm branch 1x 5-10cm branch spout Suitable for gliders	Remove
HT199	3504	E. haemastoma	Scribbly Gum	30	25	15	50	1x 5-10cm branch spout 1x 15-20cm branch spout	Remove
HT200	3508	E. haemastoma	Scribbly Gum	60	30	20	50	3x 10-15cm branch spout 5x 15-20cm branch spout	Retain
HT201	3509	E. haemastoma	Scribbly Gum	50	25	15	50	1x 10-15cm branch spout 1x 15-20cm trunk 2x 15-20cm branch spout	Retain
HT202	3510	E. haemastoma	Scribbly Gum	70	30	30	70	3x 5-10cm branch spout 2x 20-30cm branch spout	Retain
HT203	3511	A. costata	Smooth-barked Apple	60	35	25	60	4x 5-10cm branch spout 2x 20-30cm branch spout	Remove
HT204	165	Stag	Stag	65	12	20	0	2x 10-15cm branch spout 2x 20-30cm broken trunk	Retain
HT205	166	E. haemastoma	Scribbly Gum	80	15	24	2	2x 5-10cm branch spout 2x 20-30cm branch spout	Retain
HT206	104b	Stag	Stag	80	1	4	0	4x 0-5cm trunk 1x 40-50cm broken trunk	Retain
HT207	1050b	Stag	Stag	33	1	5	0	1x 20-30 broken trunk	Remove
HT208	1274b	Stag	Stag	40	1	6	0	1x 20-30cm low trunk	Retain
HT209	1351b	Stag	Stag	50	10	16	0	1x 0-5cm branch spout 1x 10-15cm branch	Retain
HT210	1374b	Stag	Stag	41	17	21	0	1x 0-5cm branch 1x 10-15cm low branch spout 1x 15-20cm branch spout	Remove
HT211	1376b	Stag	Stag	55	16	20	0	1x 0-5cm branch (good) 1x 5-10cm branch spout	Remove
HT212	1508b	Stag	Stag	30	1	8	0	1x 0-5cm branch spout 1x 20-30cm low trunk	Remove
HT213	1516b	Stag	Stag	32	5	14	0	1x 5-10cm trunk	Remove
HT214	1524b	Stag	Stag	46	1	9	0	1x 40-50cm low broken trunk	Remove
HT215	1526b	Stag	Stag	31	1	10	0	1x 5-10cm branch spout 1x 10-15cm trunk	Remove
HT216	1585b	Stag	Stag	58	1	7	0	1x 30-40cm broken trunk 1x 30-40cm low trunk	Remove
HT217	1599b	Stag	Stag	40	6	14	0	2x 5-10cm branch spout 1x 10-15cm branch spout	Retain
HT218	1659b	Stag	Stag	43	11	18	0	1x 5-10cm trunk	Remove
HT219	1923b	E haemastoma	Scribbly Gum	30	5	10	50	1x 10-15cm trunk	Remove
HT220	1932b	E haemastoma	Scribbly Gum	90	3	7	10	1x 20-30cm trunk Notably suitable for Small Forest Owl	Retain
HT221	2061b	Stag	Stag	30	1	3	0	1x 0-5cm spout 1x 10-15cm spout	Retain
HT222	2066b	Stag	Stag	48	4	14	0	2x 0-5cm branch 1x 5-10cm branch spout 1x 15-20cm spout	Retain
HT223	2122b	Stag	Stag	80	4	8	0	1x 0-5cm spout 1x 0-5cm trunk 2x 5-10cm trunk Suitable for gliders honey bees present	Retain
HT224	2507b	Stag	Stag	100	4	14	0	2x 10-15cm branch spout, 1x 30-40cm low broken trunk	Retain
HT225	252b	C gumifera	Red Bloodwood	0	20	12	50	6x 0-5cm branch spout, 5x 5-10cm branch spout, 1x 15-20cm branch spout Suitable for gliders	Retain
HT226	2605b	Stag	Stag	46	4	13	0	1x 20-30cm low trunk	Retain

Tree no.	Surv. tree no.	Scientific name	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & other habitat features recorded	Retain or remove
HT227	327b	E. haemastoma	Scribbly Gum	10	1	8	70	1x 5-10cm glider scratches	Retain
HT228	3427b	Stag	Stag	36	8	2	0	1x 5-10cm trunk	Remove
								4x 0-5cm trunk splits 1x 5-10cm branch spout 1x 10-15cm branch spout 1x 10-15cm trunk split 1x 20-30cm trunk	
HT229	3439b	Stag	Stag	60	7	1	0		Remove
HT230	3439c	Stag	Stag	17	3	1	0	1x 5-10cm trunk	Remove
HT231	3451b	Stag	Stag	103	12	8	0	1x 15-20cm branch spout 1x 20-30cm branch spout	Remove
HT232	3452b	Stag	Stag	17	3	3	0	1x 0-5cm trunk	Remove
HT233	3455b	Stag	Stag	74	7	1	0	1x 30-40cm broken trunk	Remove
HT234	3460b	Stag	Stag	52	9	7	0	2x 0-5cm branch spout 1x 5-10cm branch spout	Remove
HT235	3460c	Stag	Stag	58	9	5	0	3x 0-5cm branch spout 1x 5-10cm trunk split	Remove
HT236	355b	Stag	Stag	30	4	15	0	1x 5-10cm branch spout 1x 10-15cm trunk	Retain
HT237	358b	A. costata	Smooth-barked Apple	9	1	4	10	1x 5-10cm broken trunk	Retain
HT238	376b	Stag	Stag	55	3	11	0	1x 15-20cm branch spout 1x 20-30cm broken trunk	Remove
HT239	380b	Stag	Stag	32	1	6	0	1x 20-30cm broken trunk	Remove
HT240	388b	E. haemastoma	Scribbly Gum	22	2	5	15	1x 0-5cm branch	Remove
								3x 0-5cm spout 1x 5-10cm trunk 1x 15-20cm trunk	
HT241	43b	Stag	Stag	60	5	10	0		Retain
HT242	474b	Stag	Stag	30	1	9	0	1x 10-15cm trunk/spout	Retain
								1x 5-10cm trunk 1x 15-20cm trunk spout	
HT243	479b	E. haemastoma	Scribbly Gum	42	8	19	75	Suitable for gliders	Retain
HT244	636b	Stag	Stag	40	4	15	0	2x 5-10cm branch spout 1x 10-15cm branch spout	Retain
HT245	881b	Stag	Stag	28	1	10	0	1x 5-10cm branch spout	Remove
HT246	888b	Stag	Stag	44	1	7	0	1x 40-50 low broken trunk	Remove
								1x 0-5cm branch spout 1x 5-10cm branch spout 1x 10-15 cm trunk	
HT247	923b	Stag	Stag	40	3	10	0		Remove
HT248	HT001G	E. haemastoma	Scribbly Gum	70	25	20	40	2x 5-10cm branch spout 3x 15-20cm branch spout	Retain
HT249	HT002G	E. haemastoma	Scribbly Gum	45	25	8	20	3x 15-20cm branch spout	Retain
HT250	HT003G	M. quinquenervia	Broad-leaved Paperbark	40	20	7	10	1x 20-30cm trunk	Retain
HT251	HT004G	Stag	Stag	45	25	10	0	3x 20-30cm branch spout	Retain
HT252	HT005G	A. costata	Smooth-barked Apple	40	25	25	50	2x 15-20cm branch spout 1x 20-30cm branch spout	Retain
HT253	HT006G	Stag	Stag	100	35	20	0	2x 20-30cm branch spout 1x 40-50cm trunk	Retain
HT254	HT007G	A. costata	Smooth-barked Apple	60	30	20	50	3x 5-10cm branch spout 1x 10-15cm branch spout	Retain
								2x 5-10cm branch spout 1x 15-20cm branch spout 1x 20-30cm trunk	
HT255	HT008G	E. haemastoma	Scribbly Gum	60	30	20	50		Retain
HT256	HT009G	M. quinquenervia	Broad-leaved Paperbark	60	25	10	40	1x 20-30cm trunk	Retain
HT257	HT010G	HT281	Smooth-barked Apple	70	30	25	50	2x 5-10cm branch spout 3x 20-30cm branch spout	Retain
HT258	HT011G	Stag	Stag	40	30	7	0	2x 10-15cm branch spout 1x 15-20cm branch spout	Retain
HT259	HT012G	A. costata	Smooth-barked Apple	45	30	20	50	1x 10-15cm trunk 1x 15-20cm trunk	Retain
HT260	HT013G	Stag	Stag	70	30	10	0	2x 5-10cm branch spout	Retain
HT261	HT014G	Stag	Stag	60	25	5	0	3x 10-15cm branch	Retain
HT262	HT015G	A. costata	Smooth-barked Apple	40	20	15	60	2x 5-10cm branch spout	Retain

Tree no.	Surv. tree no.	Scientific name	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & other habitat features recorded	Retain or remove
HT263	HT016G	E. haemastoma	Scribbly Gum	25	15	8	10	1x 5-10cm branch spout	Remove
HT264	HT017G	M. quinquenervia	Broad-leaved Paperbark	60	30	20	75	1x 15-20cm trunk Sugar glider den	Retain
HT265	HT018G	M. quinquenervia	Broad-leaved Paperbark	80	30	10	50	1x 30-40cm broken trunk	Retain
HT266	HT019G	M. quinquenervia	Broad-leaved Paperbark	80	30	10	50	1x 20-30cm trunk 1x 20-30cm branch	Retain
HT267	HT020G	A. costata	Smooth-barked Apple	45	25	15	30	1x 20-30cm trunk	Retain
HT268	HT021G	A. costata	Smooth-barked Apple	60	25	25	60	2x 15-20cm branch spout 1x 20-30cm trunk	Retain
HT269	HT022G	M. quinquenervia	Broad-leaved Paperbark	80	30	25	50	2x 20-30cm trunk	Retain
HT270	HT023G	Stag	Stag	50	25	5	0	1x 5-10cm branch spout 1x 5-10cm trunk 1x 20-30cm branch spout	Retain
HT271	HT024G	A. costata	Smooth-barked Apple	45	30	20	50	1x 5-10cm branch spout 1x 20-30cm branch spout 1x 20-30cm trunk	Retain
HT272	HT025G	A. costata	Smooth-barked Apple	40	25	20	60	3x 10-15cm branch spout	Retain
HT273	HT027G	Stag	Stag	120	6	3	0	2x 20-30cm broken trunk	Retain
HT274	HT028G	E. capitellata	Brown Stringybark	30	5	4	10	1x 5-10cm branch spout 1x 40-50cm split	Remove
HT275	HT029G	Stag	Stag	30	3	3	0	2x 15-20cm trunk spout	Remove
HT276	HT030	E. capitellata	Brown Stringybark	40	20	5	20	1x 20-30cm broken trunk	Remove
HT277	HT0399	E. capitellata	Brown Stringybark	45	20	14	60	1x 15-20cm branch spout 1x 30-40cm trunk	Remove
HT278	HT788	E. haemastoma	Scribbly Gum	0	12	5	0	1x 0-5cm trunk 1x 5-10cm branch spout	Remove
HT279	Stag	Stag	Stag	60	20	15	0	3x 10-15cm branch spout 2x 20-30cm branch spout	Retain
HT286	not surveyed	Stag	Stag	65	20	12	0	2x 10-15cm branch spout 2x 20-30cm broken trunk	Retain
HT287	not surveyed	E. haemastoma	Scribbly Gum	80	24	15	2	2x 5-10cm branch spout 2x 23-30cm branch spout	Retain

Other habitat trees were also recorded such as those containing nests (arboreal termite nest containing kingfisher holes) or notable presence of glider sap feeding incisions (on Red Bloodwood trees). These additional habitat trees as well as all recorded hollow-bearing trees are depicted on Figure 4.

Following a review and subsequent request by DPIE, more detailed information on hollows specifically in consideration to potential for use by large forest owls has been undertaken in Table 3.10. This table is a summary of information for all trees containing hollows with an entry hole larger than 20cm.

It is recognized (and as stated in the TBDC) that Powerful Owl and Masked Owl may utilize hollows with an entry of 20cm and above, however this is only in the situation where there is a larger chamber beyond the narrow entry for the female to effectively nest within, particularly if the entry hole is in the 20-30cm size range. As outlined by the Recovery Plan for Large Forest Owls (DEC 2006), Powerful Owl are 60cm long and nest in hollows great than 45cm diameter and Masked Owl are 40-50cm long and nest in hollows great than 40cm diameter and both species select hollows greater than 100cm deep. Therefore neither species will nest (or roost) in a hollow that remains less than 30cm narrow throughout. The Recovery Plan also indicates that hollows used by Powerful Owl are at least 6m above ground level in trees of at least 80cm DBH.

The following table outlines why the hollow is unsuitable or otherwise where the hollow was stag-watched over winter for use. Hollows considered unsuitable are those located very low in the tree (generally below 6m from ground level) or any ‘branch spouts’ or ‘broken trunks’ that are less than 30cm narrow throughout (no larger internal chamber as explained above).


All trees identified with potential for use based on the refined criteria were stag-watched this winter 2021. No nesting or roosting activity use of hollows was recorded.

Table 3.10 – Summary of large hollows >20cm entry

Tree no.	Surv. tree no.	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & other habitat features recorded	Retain or remove	Stag-watched / climbed 2018	Reason for excluded consideration for use	Further survey 2021
HT6	128	Scribbly Gum	80	18	20	65	1x 20-30cm trunk	Retain	✓	Tree was Stag-watched in July 2018.	✓
HT9	191	Smooth-barked Apple	90	18	20	70	1x 20-30cm trunk, 1x 30-40cm trunk	Retain	✓	Tree was Stag-watched in July 2018. No talon wear was observed below hollow rim.	✓
HT19	342	Scribbly Gum	57	12	19	80	1x 20-30cm low trunk	Retain	✓	Hollow is only low in the trunk. Tree has also been Stag-watched in July 2018. Hollow has been broken off in a storm.	
HT24	399	Brown Stringybark	45	14	20	60	1x 30-40cm trunk	Remove	✓	Tree was Stag-watched in July 2018.	✓
HT45	671	Red Bloodwood	60	10	19	75	1x 20-30cm trunk split	Remove		Hollow is an unsuitable split	
HT52	824	Brown Stringybark	45	15	17	75	1x 20-30cm spout	Remove		Hollow is at the end of a narrow spout	
HT63	966	Brown Stringybark	75	18	10	50	1x 20-30cm trunk	Remove		Hollow shape is too narrow for owl use, 5cm wide but 30cm long	
HT65	991	Red Bloodwood	60	15	6	40	2x 20-30cm trunk	Remove		Tree is only 6m high, hollow is too low in the trunk	
HT72	1080	Brown Stringybark	65	25	14	80	1x 20-30cm trunk	Remove	✓	Tree was Stag-watched in July 2018.	✓
HT73	1085	Scribbly Gum	30	6	14	65	1x 20-30 low trunk	Remove	✓	Hollow is only low in the trunk. Tree has also been Stag-watched in July 2018.	
HT77	1224	Smooth-barked Apple	40	14	20	80	1x 20-30cm low trunk	Remove		Hollow is too low	
HT82	1320	Smooth-barked Apple	60	20	22	80	1x 20-30cm spout	Retain	✓	Hollow is at the end of a narrow spout	
HT90	1443	Smooth-barked Apple	43	15	19	30	1x 40-50cm low broken trunk	Retain		Hollow is only low in the trunk	
HT120	1950	Scribbly Gum	60	15	20	70	2x 20-30cm trunk	Retain	✓	Tree was Stag-watched in July 2018.	✓
HT125	2050	Smooth-barked Apple	110	18	20	75	3x 20-30cm branch	Retain			✓ x2
HT126	2056	Scribbly Gum	90	16	18	60	1x 20-30cm trunk	Retain	✓	Tree was Stag-watched in July 2018.	✓
HT128	2083	Smooth-barked Apple	80	16	18	65	1x 30-40cm suit Large Forest Owl	Remove			✓ x2
HT129	2090	Scribbly Gum	140	28	20	80	2x 30-40cm trunk	Retain	✓	Tree was Stag-watched in July 2018.	✓
HT133	2138	Stag	60	1	9	0	1x 30-40cm broken trunk	Remove		Tree is only just over 6m high (9m) but hollow is too low in the trunk and tree is dead.	
HT136	2440	Scribbly Gum	90	11	15	15	1x 30-40cm low broken trunk	Retain		Hollow destroyed in storm	
HT139	2623	Smooth-barked Apple	90	12	19	30	1x 20-30cm branch spout	Retain		Hollow is at the end of a narrow branch spout	
HT140	2641	Scribbly Gum	110	19	35	65	1x 40-50cm trunk, 1x >50cm broken trunk	Retain	climbed	Tree was climbed and inspected for owl use on 10/8/18	✓
HT146	2759	Smooth-barked Apple	60	30	20	45	2x 20-30cm broken trunk	Remove		Hollow is at the end of a narrow trunk spout	
HT157	2826	Stag	100	30	10	0	sig. large hollows >40cm	Retain			✓ x2
HT164	2972	Scribbly Gum	100	20	25	30	2x 20-30cm branch spout	Remove		Hollow is at the end of a narrow branch spout	
HT167	2985	Scribbly Gum	150	20	25	50	1x 30-40cm broken trunk, 2x 40-50cm trunk	Remove			✓ x2
HT171	3053	Scribbly Gum	70	30	15	50	1x 20-30cm broken trunk	Remove		Hollow is at the end of a narrow trunk spout	
HT172	3054	Scribbly Gum	90	35	25	50	2x 20-30cm trunk	Remove		Hollows destroyed in storm	
HT186	3124	Stag	30	10	5	0	1x 20-30cm trunk	Retain		Tree is only 5m high and dead	
HT188	3149	Scribbly Gum	70	35	10	40	1x 20-30cm trunk	Remove		Hollow has been filled by ant nest	
HT192	3316	Scribbly Gum	130	15	12	70	1x 30-40cm trunk Suitable for gliders and Large Forest Owl	Remove	✓	Tree was Stag-watched in July 2018.	✓
HT193	3320	Scribbly Gum	130	17	15	60	1x 20-30cm trunk, 1x 30-40cm trunk	Remove	✓	Tree was Stag-watched in July 2018.	✓
HT194	3346	Red Bloodwood	73	16	15	60	1x 20-30cm branch spout	Remove	✓	Hollow is at the end of a narrow branch spout. Tree was Stag-watched in July 2018.	

Tree no.	Surv. tree no.	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & other habitat features recorded	Retain or remove	Stag-watched / climbed 2018	Reason for excluded consideration for use	Further survey 2021
HT195	3418	Brown Stringybark	45	7	3	50	2x 20-30cm broken trunk	Remove		Tree is only 3m high	
HT196	3425	Smooth-barked Apple	110	12	15	75	1x 20-30cm trunk	Remove		Hollow destroyed by storm	
HT197	3434	Scribbly Gum	100	14	12	45	1x 20-30cm trunk spout	Remove		Hollow is at the end of a narrow trunk spout	
HT202	3510	Scribbly Gum	70	30	30	70	2x 20-30cm branch spout	Retain		Hollow is at the end of a narrow branch spout	
HT203	3511	Smooth-barked Apple	60	35	25	60	2x 20-30cm branch spout	Remove		Hollow is at the end of a narrow branch spout	
HT204	-	Stag	65	12	20	0	2x 20-30cm broken trunk	Retain		Tree is dead and hollow is at the end of a narrow trunk spout	
HT205	-	Scribbly Gum	80	15	24	2	2x 20-30cm branch spout	Retain		Tree is in poor health and hollow is at the end of a narrow branch spout	
HT206	104b	Stag	80	1	4	0	1x 40-50cm broken trunk	Retain	✓	Tree is only 4m high, dead with no spread. Tree was Stag-watched in July 2018.	
HT207	1050b	Stag	33	1	5	0	1x 20-30 broken trunk	Remove		Tree is only 5m high, dead with no spread and hollow is at the end of a narrow trunk spout	
HT208	1274b	Stag	40	1	6	0	1x 20-30cm low trunk	Retain		Tree is only 6m high and hollow is low	
HT212	1508b	Stag	30	1	8	0	1x 20-30cm low trunk	Remove		Tree is only just over 6m high but hollow is low and tree is dead.	
HT214	1524b	Stag	46	1	9	0	1x 40-50cm low broken trunk	Remove		Tree is only just over 6m high but hollow is low and tree is dead.	
HT216	1585b	Stag	58	1	7	0	1x 30-40cm low trunk	Remove		Tree is only just over 6m high but hollow is low and tree is dead.	
HT220	1932b	Scribbly Gum	90	3	7	10	1x 20-30cm trunk, suit Small Forest Owl	Retain	✓	Tree is only 7m high, dying and considered suitable only for Small Forest Owl. Tree was Stag-watched in July 2018.	✓
HT224	2507b	Stag	100	4	14	0	1x 30-40cm low broken trunk	Retain	✓	Tree is dead. Hollow is only low in the trunk. Tree has also been Stag-watched in July 2018. Hollow was destroyed in a storm.	
HT226	2605b	Stag	46	4	13	0	1x 20-30cm low trunk	Retain		Hollow is too low in the trunk.	
HT229	3439b	Stag	60	7	1	0	1x 20-30cm trunk	Remove		Tree is only 1m high and dead	
HT231	3451b	Stag	103	12	8	0	1x 20-30cm branch spout	Remove		Hollow is at the end of a narrow branch spout	
HT233	3455b	Stag	74	7	1	0	1x 30-40cm broken trunk	Remove	✓	Tree is only 1mm high and dead, Tree was Stag-watched in July 2018.	
HT238	376b	Stag	55	3	11	0	1x 20-30cm broken trunk	Remove		Hollow is at the end of a narrow trunk spout	
HT239	380b	Stag	32	1	6	0	1x 20-30cm broken trunk	Remove		Tree is only 6m high and hollow is at the end of a narrow trunk spout	
HT246	888b	Stag	44	1	7	0	1x 40-50 low broken trunk	Remove		Tree is only just over 6m but hollow is low and tree is dead.	
HT250	HT003G	Broad-leaved Paperbark	40	20	7	10	1x 20-30cm trunk	Retain		Hollow destroyed by storm	
HT251	HT004G	Stag	45	25	10	0	3x 20-30cm branch spout	Retain		Hollow is at the end of a narrow branch spout	
HT252	HT005G	Smooth-barked Apple	40	25	25	50	1x 20-30cm branch spout	Retain		Hollow is at the end of a narrow branch spout	
HT253	HT006G	Stag	100	35	20	0	2x 20-30cm branch spout, 1x 40-50cm trunk	Retain			✓ x2
HT255	HT008G	Scribbly Gum	60	30	20	50	1x 20-30cm trunk	Retain		Hollow destroyed by storm	
HT256	HT009G	Broad-leaved Paperbark	60	25	10	40	1x 20-30cm trunk	Retain		Hollow too low	
HT257	HT010G	Smooth-barked Apple	70	30	25	50	3x 20-30cm branch spout	Retain		Hollow is at the end of a narrow branch spout	
HT265	HT018G	Broad-leaved Paperbark	80	30	10	50	1x 30-40cm broken trunk	Retain		Hollow destroyed by storm	
HT266	HT019G	Broad-leaved Paperbark	80	30	10	50	1x 20-30cm trunk, 1x 20-30cm branch	Retain		Trunk hollow too small, branch hollow destroyed by storm	
HT267	HT020G	Smooth-barked Apple	45	25	15	30	1x 20-30cm trunk	Retain			✓ x2
HT268	HT021G	Smooth-barked Apple	60	25	25	60	1x 20-30cm trunk	Retain		Hollow is smaller than originally recorded, too small for owl use (15-20cm)	
HT269	HT022G	Broad-leaved Paperbark	80	30	25	50	2x 20-30cm trunk	Retain			✓ x2
HT270	HT023G	Stag	50	25	5	0	1x 20-30cm branch spout	Retain		Tree is only 5m high, hollow is at the end of a narrow branch spout	
HT271	HT024G	Smooth-barked Apple	45	30	20	50	1x 20-30cm branch spout, 1x 20-30cm trunk	Retain			✓ x2
HT273	HT027G	Stag	120	6	3	0	2x 20-30cm broken trunk	Retain	✓	Tree is only 3m high, hollow is at the end of a narrow trunk spout. Tree was Stag-watched in July 2018.	
HT274	HT028G	Brown Stringybark	30	5	4	10	1x 40-50cm split	Remove		Tree is only 4m high, hollow is at the end of a narrow branch spout	
HT276	HT030	Brown Stringybark	40	20	5	20	1x 20-30cm broken trunk	Remove		Tree is only 5m high, hollow is at the end of a narrow trunk spout, Tree was Stag-watched in July 2018.	
HT279	Stag	Stag	60	20	15	0	2x 20-30cm branch spout	Retain		Hollow is at the end of a narrow branch spout	
HT286	Not surveyed	Stag	65	20	12	0	2x 20-30cm broken trunk	Retain		Hollow is at the end of a narrow trunk spout	
HT287	Not surveyed	Scribbly Gum	80	24	15	2	2x 20-30cm branch spout	Retain		Hollow is at the end of a narrow branch spout	





PROJECT & MXD REFERENCE
15 Mullaway Road, Chain Valley Bay
180D02_FA002

DATE & ISSUE NUMBER
30/09/2021
Issue 1

SCALE & COORDINATE SYSTEM
1:2,500 @ A3
GDA 1994 MGA Zone 56

TITLE
Habitat Trees

Document Path: N:\GIS STORAGE\N Drive\180D02_Mullaway Rd_ChainValleyBay\MXDs\BCAR\180D02_FA002.mxd

Disclaimer: 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 are to be confirmed by a registered surveyor.

Figure 4 – Habitat trees



Biodiversity Assessment

4

4.1 BOS thresholds

The BOS includes two (2) elements to the threshold test – an area trigger and a Biodiversity Values Land Map trigger. If clearing exceeds either trigger, the Biodiversity Offset Scheme applies to the proposed clearing.

4.1.1 Biodiversity Values Land

The study area is located on lands mapped as Biodiversity Values Land, therefore offsetting is required as part of any further development of the site (refer to Figure 5).



Figure 5 – Biodiversity Land Map (purple) – study area shown in yellow
(source: <https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BosetMap>)

4.1.2 Area clearing threshold

The area threshold varies depending on the minimum lot size (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).

The area threshold applies to all proposed native vegetation clearing associated with a development proposal – for example in the case of a subdivision; all future clearing across the lots subject to the subdivision, must be considered. Thresholds outlined under the BOS are outlined in the table below.

Council's minimum lot size shows the site as having a minimum lot size of 40 ha which means the area clearing threshold is 1 ha. This is contrary to the OEH mapping which states the clearing threshold as being 0.5 ha based off the actual lot size. The LEP maps are what needs to be adhered to for determining the minimum lot size after discussion with ecologists at Central Coast Council.

The development proposal will exceed the nominated clearing thresholds therefore offsetting is required as an outcome of both tests.

4.1.3 Serious and Irreversible Impacts

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* (OEH 2017). The principles for determining serious and irreversible impacts are set out under Section 6.7.2 of the *Biodiversity Conservation Regulation 2017*.

Survey has not recorded any listed candidate threatened flora species or threatened ecological communities. Candidate species recorded or with potential to occur within the study area include:

Table 4.1 – Candidate SAIL species

Scientific name	Common name	Threshold criteria	Considered potential to occur
<i>Miniopterus schreibersii oceanensis</i>	Large Bent-winged Bat	breeding habitat	species recorded
<i>Miniopterus australis</i>	Little Bent-winged Bat	breeding habitat	species recorded
<i>Lathamus discolor</i>	Swift parrot	Habitat mapping	mapped on site
<i>Anthochaera phrygia</i>	Regent honeyeater	Habitat mapping	absent
<i>Petalura gigantea</i>	Giant Dragonfly	Disturbance to swamp hydrology	unlikely

The additional impact assessment provisions for threatened species are outlined under Section 10.2.3 of the BAM (2017) and have been applied to the recorded Large Bent-winged Bat and Little Bent-winged Bat within Appendix 2. An assessment has also been undertaken for Swift Parrot given Important Habitat Mapping (refer to this mapping in Appendix 2 - *DPIE* 2020) and therefore assumed presence for BAM assessment. An additional assessment has also been undertaken for Giant Dragonfly as requested by the BCD, as it is assumed present. The study area is not part of any Regent Honeyeater Important Habitat Mapping, therefore the species breeding habitat is not assumed present and no SAIL assessment has been undertaken for this species.

As a result of the SAI assessment and mitigation measures to address indirect impacts on Swift Parrot foraging habitat, it is considered that the proposal will not likely cause a serious or irreversible impact on the four candidate SAI fauna species considered.

4.2 Previous surveys reviewed

For assistance determining the vegetation types on site, the following information was reviewed:

- *Lower Hunter and Central Coast Regional Environment Management Strategy Vegetation Survey, Classification and Mapping; Lower Hunter and Central Coast Region (LHCCREMS)* (NPWS 2003)
- *Wyong LGA Vegetation Map, 2008. VIS_ID 3807*
- Documentation by Stephen Bell (Eastcoast Flora Surveys) in March 2016 which converts Lake Macquarie vegetation mapping to corresponding PCTs.

The following Council derived information was also reviewed as part of this work:

- Flora and Fauna Survey Guidelines
- Squirrel Glider Conservation Management Plan
- Interim Survey Guidelines for Ground Orchids in Wyong Shire
- Wyong Shire Council Development Control Plan 2013
- PVP for Valhalla MHE.

4.3 Flora

No threatened flora species were observed.

All observed species are listed in Table 3.1.

4.3.1 Local / Regional flora matters

A number of specimens of *Eucalyptus robusta*, which is classed as a regionally significant species by the former Wyong Council (now part of the amalgamated Central Coast Council), were observed during the survey. These occur only within the Swamp Mahogany - Flaxleaved Paperbark swamp forest community and will almost fully conserved. The proposed E2 boundary has been shifted to the north from its current position to protect the EEC.

The ROTAP species *Arthrochilus proxilus* was observed on the western boundary of the site, on the grassy track just south of Teragalin Dr by Ms Evelyn Craigie of the Central Coast Council northern office. This area may be subject to impacts from a proposed road, APZ or sediment and stormwater basins (or equivalent). Two (2) other specimens have been observed approximately 15 m north of the large dam within an area proposed for retention as part of a corridor during December 2017 surveys. Whilst not within Q5 (BSAR plot, 2017), it was noted approximately 5 m to the south. The specimens were in flower but were not located by GPS.

The following species, listed as Keystone Species in the Development Control Plan (DCP) 14 Tree Management, were observed within the study area:

Botanical name	Common name	Potential Schedule 1 or 2 fauna
<i>Acacia irrorata</i> and other 'gum' producing <i>Acacia</i> species	Wattle	Squirrel Glider
<i>Allocasuarina torulosa</i>	Forest Oak	Glossy Black-Cockatoo
<i>Eucalyptus robusta</i>	Swamp Mahogany	Yellow-bellied Glider / Squirrel Glider / Koala / Regent Honeyeater
<i>Melaleuca biconvexa</i> and other local <i>Melaleuca</i> species		Ringtail Possum

4.3.2 State legislative flora matters

(a) Threatened flora species (NSW)

The BAM calculator identifies potential threatened flora species based on the PCT surrogate. The following species in Table 4.2 are the predicted threatened flora species that require survey.

Table 4.2 – State listed threatened flora species from the BAM calculator

Scientific name	BC Act	Potential to occur
<i>Acacia bynoeana</i>	E1	✓
<i>Angophora inopina</i>	V	✓
<i>Astrotricha crassifolia</i>	V	x
<i>Callistemon linearifolius</i>	V	✓
<i>Corunastylis</i> sp. Charmhaven	E4A	low
<i>Cryptostylis hunteriana</i>	V	✓
<i>Diuris praecox</i>	V	✓
<i>Eucalyptus oblonga</i> (endangered population)	E2	x
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	V	low
<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> (endangered population)	E2	low
<i>Genoplesium insigne</i> (<i>Corunastylis insignis</i>)	E1	✓
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	V	x
<i>Maundia triglochinosoides</i>	V	x
<i>Melaleuca biconvexa</i>	V	low
<i>Melaleuca groveana</i>	V	unlikely
<i>Persicaria elatior</i>	V	low
<i>Prostanthera askania</i>	E1	unlikely
<i>Rutidosia heterogama</i>	V	✓
<i>Tetratheca glandulosa</i>	V	x
<i>Tetratheca juncea</i>	V	✓

No state listed threatened flora species were observed during survey(s) undertaken.

(b) Endangered flora populations (NSW)

Eucalyptus parramattensis subsp. *parramattensis* population, Wyong and Lake Macquarie LGAs.

The population of *Eucalyptus parramattensis* subsp. *parramattensis* in Wyong and Lake Macquarie LGAs is at the north-eastern limit of the range of the species and is disjunct from other known populations of the subspecies.

The majority of the population occurs within Wyong in the Porter's Creek and the Wallarah Creek catchments.

This species is associated with low moist areas alongside drainage lines and adjacent to wetlands. It is often found in woodland on sandy soils. The endangered population occurs on sandy alluvium within a floodplain community which also supports *Eucalyptus robusta* (Swamp mahogany), *E. tereticornis* (Forest Red Gum), *C. gummifera* (Sydney Bloodwood) as well as *Melaleuca* (Paperbark) species.

The interface between PCT 1718 and PCT 1619 could form potential habitat for the endangered population to occur, i.e. the southern portion of the study area.

There is one part of the population located approximately 4 km away, however the rest of the known population is largely centred closer to Warnervale almost 10 km away.

Surveys conducted on site have not located any specimens of *E. parramattensis* subsp. *parramattensis* within the study area. As such, endangered populations form no constraint to future development of the site.

(c) Threatened ecological communities (NSW)

One (1) threatened ecological community (TEC) – Swamp Sclerophyll Forest on Coastal Floodplains – was observed within the subject site.

The extent of this EEC varies from approximately 85 m to 200 m in width and over an area of 3.49 ha north from Karignan Creek which forms the southern boundary of the study area. The EEC continues east and west along Karignan Creek but grades to another EEC, Swamp Oak Floodplain Forest towards the foreshore of Lake Macquarie.

The Swamp Sclerophyll Forest on Coastal Floodplains currently goes beyond (upslope) of the E2 boundary. As a response to protecting the ecological community, the proposal seeks to move the E2 boundary upslope to protect the EEC insitu.

Impacts upon Swamp Sclerophyll Forest are not listed as a potential SAI (*Reference - Guidance to assist a decision-maker to determine a serious and irreversible impact Office of Environment & Heritage 2017*).

(d) Ecosystem credit species

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

(e) Species credit species

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

Table 4.3 – Species credit species (flora)

Scientific name	BC Act	Associated PCTs	Potential to occur (presence status)	Confirmed candidate species	Survey adequacy			Presence		Confirmed Candidate Species
					Preferred survey period (OEH)	Actual survey period	Survey sufficient to rule out presence (Yes/No)	Assumed	Expert report	
<i>Acacia bynoeana</i>	E1	1619	✓	✓	Sept–March	Feb, Dec	Yes			x
<i>Angophora inopina</i>	V	1619	✓	✓	All months	Feb, Mar, Aug, Oct, Dec	Yes			x
<i>Astrotricha crassifolia</i>	V	1619 1718	unlikely	✓	July–Dec	Aug, Oct, Dec	Yes			x
<i>Callistemon linearifolius</i>	V	1619	✓	✓	Sept–March	Feb, March, Sept, Oct, Dec	Yes			x
<i>Corunastylis</i> sp. Charmhaven	CE	1619	low	✓	Nov–April	March	Yes			x
<i>Cryptostylis hunteriana</i>	V	1619 1718	✓	✓	Nov–Jan	Feb, Dec	Yes			x
<i>Diuris praecox</i>	V	1619	✓	✓	July–Sept	Aug	Yes			x
<i>Eucalyptus oblonga</i> - endangered population	E2	-	x	x	-	-	Yes			x
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	V	1619	low	✓	All months	Feb, Mar, Aug, Sept, Oct, Dec	Yes			x
<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> - endangered population	E2	1619	low	✓	All months	Feb, Mar, Aug, Sept, Oct, Dec	Yes			x
<i>Genoplesium insigne</i>	E1	1619	✓	✓	Sept–Nov	Sept, Oct	Yes			x
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	V	1619 1718	unlikely	✓	Aug–Nov	Aug, Sept, Oct	Yes			x
<i>Maundia triglochoides</i>	V	1619 1718	unlikely	✓	Nov–March	Feb, March, Dec	Yes			x
<i>Melaleuca biconvexa</i>	V	1718	unlikely	✓	All months	Feb, Mar, Aug, Sept, Oct, Dec	Yes			x
<i>Melaleuca groveana</i>	V	1619	not likely	✓	All months	Feb, Mar, Aug, Sept, Oct	Yes			x
<i>Persicaria elatior</i>	V	1718	not likely	✓	Dec–May	Feb, Mar	Yes			x
<i>Prostanthera askania</i>	E	1619	not likely	✓	Sept–Dec	Sept, Oct, Dec	Yes			x
<i>Rutidosis heterogama</i>	V	1619	unlikely	✓	All months	Feb, March, Aug, Sept, Oct, Dec	Yes			x
<i>Tetradlea glandulosa</i>	V	1619 1718	unlikely	✓	Aug–Nov	Aug, Sept, Oct	Yes			x
<i>Tetradlea juncea</i>	V	1619	✓	✓	July–Dec	Sept, Oct	Yes			x

Exclusions based on habitat features / survey

Habitat assessments for all species recorded within 10 km of the study area are provided in detail and based on local records within Appendix 1. Some additional species for consideration have been generated by the BAM calculator and their potential to occur is considered here only. Species recorded present or considered with any potential to occur are then assessed for habitat presence. If these species have not been recorded some may be ruled out based on adequacy of survey (survey techniques and methodology have been described in section 3).

General exclusions from assessment have been based on a number of features. Although the BAM calculator may suggest particular species have potential habitat based upon the vegetation type, they may be excluded due to geographic distribution, last known local record being decades old, lack of suitable geological features, isolation of particular habitats or degradation of habitats. These factors were considered in detail to advise which candidate species could potentially be impacted.

Excluded species are mentioned below:

Eucalyptus oblonga - endangered population

This disjunct outlier population is restricted to Bateau Bay, Forresters Beach and Tumbi Umbi, and does not extend to Chain Valley Bay.

Prostanthera askania

Within the Wyong IBRA subregion, this species restricted to south of the Wyong River, according to the threatened species data profile. As the subject land is well north of the Wyong River, this species can be excluded.

(f) Local data

Local data has not been used in this case.

(g) Expert reports

Expert reports have not been utilised for flora on this project.

(h) Endangered wetland communities

A number of wetland communities have been listed as TECs under the NSW *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 Sclerophyll Forest on Coastal Floodplains is present within the southern portion of the study area, which is an EEC as listed within the *BC Act*, but not within the *EPBC Act*.

- *Impact on the extent of wetland vegetation*

The proposal will directly impact 0.05 ha, and indirectly impact 0.25 ha, of vegetation pertaining to this endangered wetland community. It is expected that impacts will be both direct and indirect from works adjoining its edge such as stormwater detention basins and road works. Protection of the EEC and the installation of sediment and erosion control measures will however mitigate these impacts. The placement and discharge of the proposed wetland basin is to consider the potential to cause erosion and to facilitate the spread of weed species. The design and future management of the discharge areas is to include target weed control and revegetation works to enrich the bushland interface adjoining the proposed wetland basin.

- *Impact on acid sulphate soils*

The proposal protects lands classed as 1 and 2 acid sulphate soils. However, any works in this areas e.g. for stormwater purposes will need to be accompanied by an acid sulphate soil management plan.

- *Indirect impacts of wetlands*

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

To limit and minimise indirect impacts on endangered wetland vegetation, the non-developed portion will be need to have a conservation management plan prepared to avoid degradation of all conserved bushland areas.

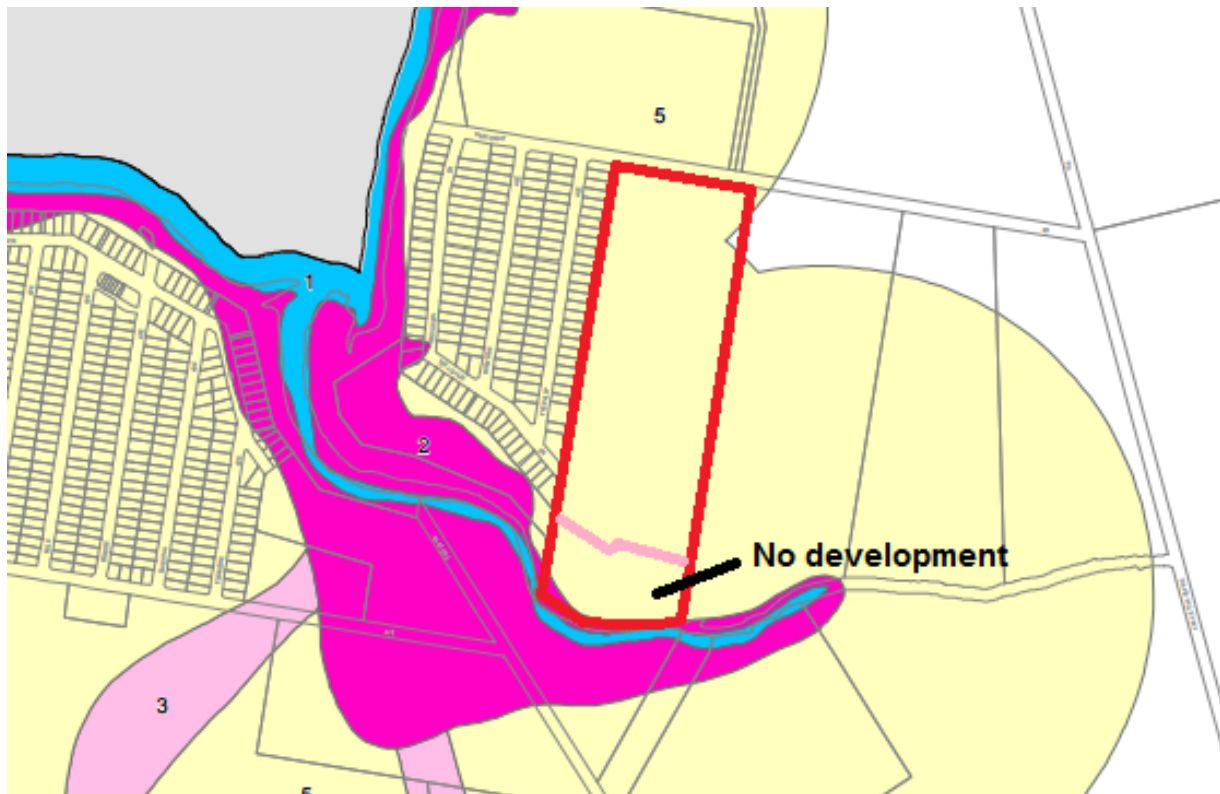


Figure 6 – Location of acid sulphate soils

- *Impacts due to storm water quality or quantity*

This will be controlled through a proposed wetland that will filter the impacts prior to discharge into surrounding vegetation.

- *Impacts on groundwater*

The proposal is not expected to impact on groundwater resources or groundwater dependent ecosystems

- *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.

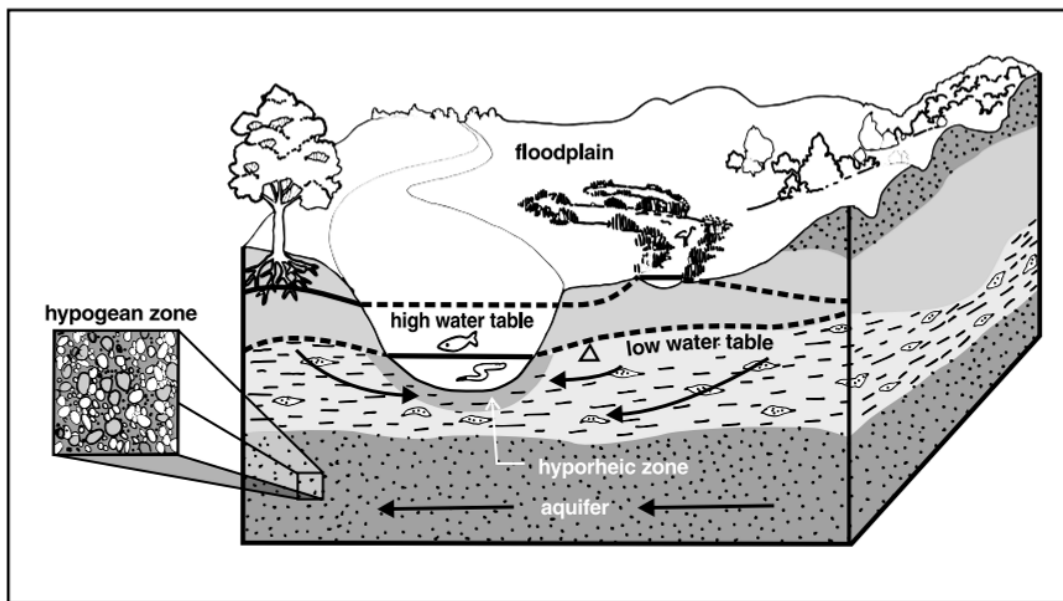
- *Watercourses and waterfront lands*

There are no riparian streams or zones throughout the site with the exception of the Karignan Creek corridor which abuts the southern boundary. The area of EEC – Swamp Sclerophyll Forest is classed as an endangered protected wetland and is a 'lake' as defined under the *WM Act* therefore it is deemed as 'waterfront land'.

(i) Groundwater dependent ecosystems

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.



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 Sclerophyll Forest on Coastal Floodplains is considered to be a wetland community and, in the context of the landscape is likely to be a GDE. To assist in protecting this in the future, it is proposed that retained vegetation relating to GDE will be rezoned to E2 and managed under a VMP.

4.3.3 Matters of national environmental significance - flora

(a) Threatened flora species (national)

A review of the schedules of the *EPBC Act* indicated the potential for a list of threatened flora species to occur within a 10 km radius of the site. These species have been considered for habitat presence and potential to occur within Appendix 1.1.

Based on the habitat assessment within Appendix 1.1, it is considered that the subject site provides varying levels of potential habitat for the following nationally listed threatened flora species:

Table 4.4 – Nationally listed threatened flora species with suitable habitat present

Common name	EPBC Act	Potential to occur
<i>Acacia bynoeana</i>	V	✓
<i>Angophora inopina</i>	V	✓
<i>Cryptostylis hunteriana</i>	V	✓
<i>Diuris praecox</i>	V	✓
<i>Genoplesium insigne</i> (<i>Corunastylis insignis</i>)	CE	✓
<i>Tetradlea juncea</i>	V	✓
<i>Caladenia tessellata</i>	V	low
<i>Corunastylis</i> sp. Charmhaven	CE	low
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	V	low

No nationally-listed threatened flora species were observed within the study area.

(b) Threatened ecological communities (national)

No nationally-listed TECs occur within the study area.

4.4 Fauna

All fauna species recorded during survey(s), key fauna habitat observations and habitat tree data are provided in Section 3.

4.4.1 Local fauna matters

4.4.1.1 Regionally significant fauna

Fauna species recorded present during survey and listed as a regionally significant species under Section 8.4.3 of the Wyong Shire Council Flora and Fauna Survey Guidelines are listed in Table 4.5. Each of these species and their potential impacts by the proposal are discussed further below.

Table 4.5 – Recorded regionally significant fauna

Common name	Scientific name
Birds	
Green Catbird	<i>Ailuroedus crassirostris</i>
White-bellied Sea Eagle	<i>Haliastur leucogaster</i>
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>
Mammals	
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>
Sugar Glider	<i>Petaurus breviceps</i>
Southern Forest Bat	<i>Vespadelus regulus</i>
Eastern Forest Bat	<i>Vespadelus pumilus</i>
Amphibians	
Bibron's Toadlet	<i>Pseudophryne bibroni</i>
Tinkling Toadlet	<i>Crinia tinnula</i>

The study area provides suitable breeding habitat for all of the abovementioned species. Based on survey observations nesting habitat values are not present within the study area for White-bellied Sea Eagle. Such nesting habitat may be present along Karignan Creek to the west, based on calls from this location in 2016. The planning proposal will not provide any notable impacts on this species.

Breeding habitat for the Bibron's Toadlet and Tinkling Toadlet will be retained by protection of Swamp Mahogany - Flaxleaved Paperbark swamp forest / Swamp Sclerophyll TEC as proposed. Indirect impacts on breeding habitat and direct impacts on shelter, foraging and dispersal habitat may however result from the proposal. Subsequent measures to adequately retain buffers to recorded breeding areas and ensure adequate stormwater management to prevent altered hydrology (quantity and quality) supply to the Swamp Mahogany - Flaxleaved Paperbark swamp forest areas are of primary concern.

Sugar Glider has been confirmed present from recent trapping survey. Denning and breeding potential is present throughout the study area and as such dens are expected to exist within the development landscape. Important winter flowering resources as well as connectivity through the site will be maintained however potential for core habitat area to continue within the study area will be reduced. This further highlights the importance of relocating quality hollows into the conserved areas as well as maintaining the corridor free from edge effects. Habitat is otherwise well represented in the locality and nearby records are also known to the north. Refer to Section 4.4.1.2 Squirrel Glider habitat assessment.

Suitable breeding (nesting) hollows are present for Yellow-tailed Black-Cockatoo. Recent 2017-18 survey was undertaken during the nesting period. The species was recorded at this time, however nesting is not expected based on observations.

Short-beaked Echidna was recorded on two surveillance cameras during recent surveys located in the southern half of the study area. Habitat will be removed for this species and potential for core habitat area to continue within the study area will be reduced. It is considered that sufficient recorded habitat will be retained within the study area and locality.

Recent 2017-18 survey was undertaken during the Green Catbird breeding period. The recorded location of this species within the central areas suggests that breeding habitat for a local pair will be removed by the proposal. Suitable habitat for this species is otherwise well represented in the locality.

The study area contains numerous hollows and provides potential roosting and breeding habitat for the Southern Forest Bat and Eastern Forest Bat. It is difficult to determine the presence of such important habitat without undertaking exhaustive surveys. Extensive stag-watching to date has not recorded a microbat roost within the proposed development landscape. If present, such habitat is considered to be otherwise well represented in the locality.

4.4.1.2 Squirrel Glider habitat assessment

Squirrel Glider habitat in the study area has been assessed below according to Wyong Shire Council's *Interim Ecological Assessment Information Required to Assess Clearing Impacts within Squirrel Glider Habitat in Wyong Shire* (SGHWS - Wyong Shire Council, August 2000). A standardised field proforma providing consideration to this document is completed during field surveys undertaken within the Central Coast LGA.

The assessment of Squirrel Glider habitat considers the following:

- (a) habitat quality (vegetation type);

- (b) remnant patch size;
- (c) density of habitat trees;
- (d) abundance of food plants;
- (e) habitat vulnerability;
- (f) disturbance factors.

The available habitat for Squirrel Gliders occupies approximately 81% of the study area. All other areas are cleared and/or highly disturbed.

(a) Habitat quality

The 9.98 ha of PCT 1619 making up 58% of the central and northern portions of the study area is consistent with the Sydney Red Gum / Scribbly Gum with Banksia understorey. Small patches of Melaleuca and Allocasuarina understorey are also present.

The remaining 3.49 ha of PCT 1718 containing Melaleuca and Swamp Mahogany also provides 20% of high quality habitat within the study area. This community is not cited by the SGHWS but is well known to *Travers bushfire & ecology* as supporting high quality and particularly winter flowering habitat.

Prominent trees occurring within these communities include *Eucalyptus robusta* (Swamp Mahogany), *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Angophora costata* (Smooth-barked Apple), *Eucalyptus haemastoma* (Scribbly Gum), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus capitellata* (Brown Stringybark), *Eucalyptus eugenioides* (Thin-leaved Stringybark) and *Glochidion ferdinandi* (Cheese tree). Squirrel Gliders have been recorded foraging on the many of these species, particularly those with higher occurrence. Prominent native shrubs are *Acacia longifolia*, *Pittosporum undulatum*, *Leptospermum trinervium*, *Banksia spinulosa*, *Lambertia formosa*, *Hakea laevipes*, *Acacia terminalis*, *Banksia oblongifolia* and *Melaleuca sieberi*.

Some fringing areas of open forest have been impacted by invasive weeds, however the majority (approximately >80%) is considered of good condition.

The available habitat within the study area and adjacent connective open forest is therefore suitable for Squirrel Glider. This habitat provides year-round foraging resources (particularly winter flowering Swamp Mahogany), presence of a high density of medium hollows and the forest structure being suitable for gliding.

(b) Remnant patch size

The remnant patch size of usable habitat for the Squirrel Glider within the study area is approximately 13 ha incorporating the mapped open forest communities. Connectivity exists to the north, south-west and south-east.

(c) Density habitat trees

The density of habitat trees within the Open Forest remnant is very high and categorised at greater than 1 per hectare. Trees identified to date as containing hollows that appear most suitable or may be suitable for denning are depicted on Figure 3. In respect to the availability of suitable hollows and the density of these hollows, the habitat present is therefore of good quality for Squirrel Gliders.

(d) Abundance of food plants of Squirrel Glider

The abundance of Squirrel Glider food resources within the study area are summarised in Table 4.6 for the recorded vegetation communities.

Table 4.6 – Squirrel Glider food resource abundance

Food plants	Food item	Estimated average No. of plants / hectare in	
		PCT 1618 - 9.98 ha	PCT 1718 - 3.49 ha
<i>Angophora costata</i>	Sap, nectar & pollen	80	80
<i>Eucalyptus haemastoma</i>	Sap, nectar & pollen	150	40
<i>Eucalyptus robusta</i>	Sap, nectar & pollen	-	100
<i>Corymbia gummiifera</i>	Sap, nectar & pollen	150	5
<i>Melaleuca linariifolia</i>	Nectar & insects	-	150
<i>Melaleuca quinquenervia</i>	Nectar & insects	-	75
<i>Melaleuca sieberi</i>	Nectar & insects	1	500
<i>Acacia</i> spp.	Seeds & gum	250	250
<i>Banksia spinulosa</i>	Nectar & pollen	100	50
<i>Banksia oblongifolia</i>	Nectar & pollen	25	100
<i>Xanthorrhoea</i> spp.	Nectar & gum	100	20

(e) Edge to width ratio

The patch shape is irregular and linear between connective options to the north and south. This is given the cleared patches within the outer edges of the rectangle study area. The result is a moderate edge: width ratio. Due to the patches of clearing around remaining forest there have been greater edge effects around the perimeter of the site. Therefore restoration of any disturbed areas and dense planting of shrubs on the bushland interface is recommended.

(f) Habitat disturbance

Some portions of the open forest and woodland communities present are disturbed, particularly along the western boundary, surrounding the house and the dam and in edge affected areas. The southern portions have been impacted by fire. As noted above edge effects such as weeds and altered native vegetation composition occurs along the cleared edges. Otherwise the core habitat is in good quality with little disturbance.

(g) Proximity to existing or future residential development

The study area is bounded to the east and north-west by private recreation (RE2) and to the west by low density residential (R2) containing cleared lands development. Remaining lands to the north-east (E1 - National Parks & Reserves) and south (E2 - Environmental Conservation) contain native remnant vegetation.

Conclusion of Squirrel Glider assessment

Survey to date has recorded Squirrel Glider to a 'possible' level of certainty from a call to the south outside of the study area in 2016. Target trapping effort over two (2) separate seasons has not captured Squirrel Glider within the study area but has captured the non-threatened Sugar Glider. A previous survey on adjacent lands to the east by *Conacher Travers* (2005)

also recorded Sugar Glider by observation and trapping but did not record Squirrel Glider. Glider chew markings on Red Bloodwood trees are thus likely from Sugar Glider.

There are one hundred and seventy-one (171) records of Squirrel Glider within 10 km of the study area, with previous records surrounding Chain Valley Bay with the closest records 1–1.4 km from the study area to the north, north-east, south, west and south-west. The most recent of these nearby records is from 2002. However, other recent records in the locality and retention of extensive suitable habitat areas suggest that nearby populations persist.

The study area is considered as suitable habitat for the Squirrel Glider based on the above examined habitat attributes, specifically seasonal foraging attributes, density of hollows, connectivity, quality of vegetation and patch size.

There is potential for Squirrel Gliders to be seasonally utilising the habitats present as part of extended home ranges, or in future population movements. However, based on the absence of Squirrel Gliders during targeted trapping efforts, the study area is not expected to form core or central to home range habitat values. The proposed corridor running north-south allows for future movement for this species.

The proposal will retire credits for Squirrel Glider.

4.4.2 State legislative fauna matters

(a) Threatened fauna species (NSW)

Ten (10) state listed threatened fauna species including Wallum Froglet (*Crinia tinnula*), White-bellied Sea-Eagle (*Haliaeetus leucogaster*), Square-tailed Kite (*Lophoictinia isura*), Powerful Owl (*Ninox strenua*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Southern Myotis (*Myotis macropus*), Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), Little Bent-winged Bat (*Miniopterus australis*) and Large Bent-winged Bat (*Miniopterus orianae oceansis*) were recorded during surveys. The Greater Broad-nosed Bat was recorded to a 'probable' level of certainty. The Squirrel Glider (*Petaurus norfolkensis*) was also 'possibly' recorded by call outside the study area to the south-west during 2016 survey.

The proposal has potential to directly impact on breeding habitat for threatened microbats and indirectly impact on breeding habitat for the Wallum Froglet. Mitigation measures and hollow inspections are recommended to mitigate impacts on locally resident species.

FM Act – No threatened or protected species records relative to the *FM Act* on the DPI records viewer are known to the Central Coast or Lake Macquarie LGAs. Therefore, no suitable habitat for threatened aquatic species was observed within the study area and no matters require further consideration under this Act.

(b) Endangered fauna populations (NSW)

There are no endangered fauna populations within the Central Coast LGA.

(c) State Environmental Planning Policy (Koala Habitat Protection) 2021

SEPP (Koala Habitat Protection) 2019 was implemented in March 2020 and later revised in October 2020. The NSW Government then announced the implementation of SEPP (Koala Habitat Protection) 2020 in November 2020. This was fundamentally a reinstatement of the old SEPP 44 - Koala Habitat protection (SEPP 44), which was in force from 1995 through to

2019. SEPP (Koala Habitat Protection) 2021 then came into effect in March 2021 reinstating the policy framework of the 2019 Koala SEPP only for non-rural zones in the interest of farmers, with the exception of some LGAs.

The new 2021 legislation states under Part 4 Savings and transitional provisions that “a development application made in relation to land, but not finally determined before this policy applied to the land, must be determined as if this Policy had not commenced in its application to the land”. The site will therefore continue to be assessed under Koala SEPP 2020 as follows.

State Environmental Planning Policy (Koala Habitat Protection) 2020 (Koala SEPP 2020) applies to land within LGAs listed under Schedule 1 of the Policy. In addition, Part 2 of the Policy outlines a three (3) step process to assess the likelihood of the land in question being potential or core koala habitat. Part 2 applies to land which has an area of greater than 1 hectare or has, together with any adjoining land in the same ownership, an area of more than 1 hectare.

The study area is required to be considered under the Koala SEPP 2020 as it falls within the Central Coast LGA, which is listed on Schedule 1 of this Policy. In addition, the total area of the study area is greater than 1 ha, hence Part 2, Development Control of Koala Habitats, of the Policy applies.

Potential Koala Habitat (PKH) is defined as land where at least 15% of the total number of trees in the upper or lower strata constitutes any of the tree species listed in Schedule 2 of the policy.

Core Koala Habitat (CKH) is defined as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (i.e. females with young) and recent sightings of and historical records of a population.

A Koala Plan of Management is required to be prepared where Council is satisfied that the land is CKH.

Step 1 – Is the land PKH?

Two (2) Koala food tree species – Swamp Mahogany (*Eucalyptus robusta*) and Scribbly Gum (*Eucalyptus haemastoma*), as listed on Schedule 2 of KOALA SEPP 2020 were found within the study area. Scribbly Gum occurred at approximately 30% within PCT 1619, and Swamp Mahogany (with a few Scribbly Gum) occurred at likely above 15% within PCT 1718. All this habitat is connected and available to Koala. Therefore, all forested portions of the study area are classified under Koala SEPP 2020 as PKH.

Step 2 – Is the land CKH?

No Koalas have been observed during combined fauna surveys to date, which has included diurnal searches of all trees during hollow searches, as well as nocturnal call-playback and spotlighting. More recent surveys have also included undertaking three Spot Assessment Points (SATs) within the study area within a 250m grid (refer to Figure 3). Two SATs are represented within PCT 1619 and the last is located centrally within PCT 1718. No evidence of Koala from scat searches was found.

In addition, there has been no secondary evidence of Koala habitation in the area during remaining survey time, including characteristic scratches on smooth-barked trees and scats beneath other trees. Scratches observed were considered consistent with the recorded Common Brushtail Possum.

A search of the Atlas of NSW Wildlife (OEH 2021) found nineteen (19) records of Koala habitation within a 10 km search from the study area. The closest four (4) records are located just beyond 2 km to the east all in 2003. It is possible that a local Koala population does persist in this area. Three (3) of these records which are separated by 200–300 m were recorded on the same day. The fourth record was from two (2) months later suggesting also the records may be of the same individual relocated or in transient dispersal.

Given that Koala has not been recorded and no records exist in the immediate local surrounding the study area, it is not expected that the site comprises CKH under the definitions of Koala SEPP 2020. A Koala Plan of Management is therefore not considered to be required.

(d) Ecosystem credit species

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

Table 4.8 – Ecosystem credit species (fauna)

Common name	BC Act	Potential to occur	Foraging habitat absent	Excluded (justified below)	Confirmed predicted species	Associated PCT
Eastern Coastal Free-tailed Bat	V	Yes (recorded)	n/a		✓	1619, 1718
Greater Broad-nosed Bat	V	Yes (recorded)	n/a		✓	1619, 1718
Grey-headed Flying-fox (foraging)	V	Yes (recorded)	x		✓	1619, 1718
Large Bent-winged Bat (foraging)	V	Yes (recorded)	x		✓	1619, 1718
Little Bent-winged Bat (foraging)	V	Yes (recorded)	x		✓	1619, 1718
Powerful Owl (foraging)	V	Yes (recorded)	x		✓	1619
Square-tailed Kite (foraging)	V	Yes (recorded)	x		✓	1619
White-bellied Sea Eagle (foraging)	V	Yes (recorded)	x		✓	1619, 1718
Eastern False Pipistrelle	V	Yes	n/a		✓	1619, 1718
Glossy Black-Cockatoo (foraging)	V	Yes	x		✓	1619, 1718
Little Lorikeet	V	Yes	n/a		✓	1619, 1718
Masked Owl (foraging)	V	Yes	x		✓	1619
Swift Parrot (foraging)	E	Yes	x (& mapped DPIE)		✓	1619, 1718
Varied Sittella	V	Yes	n/a		✓	1619, 1718
Barking Owl (foraging)	V	Yes (low)	x		✓	1619, 1718
Black Bittern	V	Yes (low)	n/a		✓	1718
Eastern Osprey (foraging)	V	Yes (low)	x		✓	1619, 1718
Little Eagle (foraging)	V	Yes (low)	x		✓	1619, 1718
Regent Honeyeater (foraging)	E4A	Yes (low)	x		✓	1718
Yellow-bellied Sheath-tail-bat	V	Yes (low)	n/a		✓	1619, 1718
Koala (foraging)	V	Yes (unlikely)	x		✓	1619, 1718
Long-nosed Potoroo	V	Yes (unlikely)	n/a		✓	1718
Scarlet Robin	V	Yes (unlikely)	n/a		✓	1619
Spotted-tailed Quoll	V	Yes (unlikely)	n/a		✓	1619, 1718
Black-chinned Honeyeater	V	Yes (not likely)			✓	1619
Black-necked Stork	E	Yes (not likely)			✓	1718
Brown Treecreeper	V	Yes (not likely)			✓	1619
Eastern Chestnut Mouse	V	Yes (not likely)			✓	1619, 1718
Gang-gang Cockatoo (foraging)	V	Yes (not likely)			✓	1619, 1718

Common name	BC Act	Potential to occur	Foraging habitat absent	Excluded (justified below)	Confirmed predicted species	Associated PCT
Golden-tipped Bat	V	Yes (not likely)			✓	1619, 1718
Grey-crowned Babbler	V	Yes (not likely)			✓	1619
Painted Honeyeater	V	No (not likely)		✓	x	
Speckled Warbler	V	Yes (not likely)			✓	1619
Turquoise Parrot	V	Yes (not likely)			✓	1619
Yellow-bellied Glider	V	Yes (not likely)			✓	1619, 1718

The Painted Honeyeater may be excluded as the species is vagrant in the IBRA subregion and the density of mistletoes is also too low.

(e) Species credit species

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

Table 4.9 – Species credit species (fauna)

Common name	BC Act	Potential of species to occur (presence status) / Habitat	Breeding habitat absent	Survey adequacy			Presence		Confirmed Candidate Species	Associated PCTs
				referred Survey period (TBDC)	Actual Survey period	Survey sufficient to rule out presence	Assumed	Expert report		
Grey-headed Flying-fox (breeding)	V	Yes (recorded)		Oct–Dec	Nov, Dec	✓				
Large Bent-winged Bat (breeding)	V	Yes (recorded)	✓							
Little Bent-winged Bat (breeding)	V	Yes (recorded)	✓							
Powerful Owl (breeding)	V	Yes (recorded)	x	May–Aug	May, Jun, Jul, Aug	✓				
Southern Myotis	V	Yes (recorded)	n/a	Oct–Mar	Jan, Mar, Nov, Dec	x			✓	1619m-g, 1619cl, 1718m-g
Square-tailed Kite (breeding)	V	Yes (recorded)	x	Sept–Jan	Nov Dec	✓				
Squirrel Glider	V	Yes	n/a	All months	Jan Mar Jun Jul Aug Nov	✓	✓		✓	1619m-g, 1718m-g
Wallum Froglet	V	Yes (recorded)	n/a	All months	Jan, Mar, Apr	x			✓	1619m-g, 1619cl, 1718m-g
White-bellied Sea Eagle (breeding)	V	Yes (recorded)	x	July–Dec	Aug, Nov, Dec	✓				
Glossy Black-Cockatoo (breeding)	V	Yes	x	Apr–Aug	March, Aug	✓				
Masked Owl (breeding)	V	Yes	x	May–Aug	May, Jun, Jul, Aug	✓				
Swift Parrot (breeding)	E	Yes	✓ (but mapped by DPIE)	May–Aug	Aug	x	✓		✓	1619m-g, 1619cl, 1718m-g
Barking Owl (breeding)	V	Yes (low)	x	May–Dec	Jul, Aug, Nov, Dec	✓				
Little Eagle (breeding)	V	Yes (low)	x	Aug–Oct	Aug	✓				
Osprey (breeding)	V	Yes (low)	✓							
Regent Honeyeater (breeding)	E4A	Yes (low)	✓							
Eastern Pygmy Possum	V	Yes (unlikely)	n/a	Oct–Mar	Jan, March, Nov	✓				
Green-thighed Frog	V	Yes (unlikely)	n/a	Oct–Mar	Oct	✓				
Koala (breeding)	V	Yes (unlikely)	n/a	All months	Jan Mar Jun Jul Aug Nov	✓				
Long-nosed Potoroo	V	Yes (unlikely)	n/a	All months	Mar, Nov, Dec, Jan	✓				
Mahony's Toadlet	E	Yes (unlikely)	n/a	Oct–Mar	Oct	✓				
Pale-headed Snake	V	Yes (unlikely)	n/a	Nov–Mar	x	x	✓		✓	1619m-g, 1718m-g
Green and Golden Bell Frog	E	Yes (unlikely)	n/a	Nov–Mar	Very late Oct	✓ on site breeding	✓ off site breeding		✓	1619m-g, 1718m-g
Giant Dragonfly	E	Yes (unlikely)	n/a	Dec–Jan	x	x	✓		✓	1718m-g
Brush-tailed Phascogale	V	No (not likely)	n/a	All months	Jan Mar Jun Jul Aug Nov	✓				
Bush Stone-curlew	E	No (not likely)	n/a	All months	Jan Mar Jun Jul Aug Nov	✓				
Common Planigale	V	No (not likely)	n/a	All months	Jan Mar Jun Jul Aug Nov	✓				
Gang-gang Cockatoo (breeding)	V	No (not likely)	x	Oct–Jan	Jan, Oct, Dec	✓				
Large-eared Pied Bat	V	No (not likely)	n/a	Nov–Jan	Jan, Mar, Nov, Dec	✓				
Greater Glider	n/a	No (not likely)	n/a	All months	Mar, Nov, Dec, Jan	✓				
Brush-tailed Rock Wallaby	E	No	n/a							

Candidate species credits are often additional measures of offsetting where threatened fauna could be impacted beyond those predicted by the associated ecosystem. This may include specific additional values of breeding habitat presence (where noted).

Exclusions based on habitat features / survey

General exclusions from assessment have been based on a number of features. Although the BAM calculator may suggest particular species have potential habitat based upon the vegetation type, they may be excluded due to geographic distribution, last known local record being decades old, lack of suitable geological features, isolation of particular habitats or degradation of habitats. These factors were considered in detail to advise which candidate species could potentially be impacted.

Excluded species based on absence of breeding or foraging habitat are mentioned below:

Brush-tailed Rock Wallaby - There are no rocky habitats including escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliff lines within 1 km of the study area.

Excluded species based on absence of breeding habitat only are mentioned below:

Large Bent-winged Bat and Little Bent-winged Bat - Whilst recorded, the study area does not contain any habitat constraint for breeding. There are no caves, tunnels, mine shafts, culverts or other structure known or suspected to be used for breeding. There are no species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500.

Osprey - There are no outlook nesting opportunities overlooking extensive open water foraging habitat within the development footprint. The TBDC identifies the habitat constraint for breeding as *Presence of stick-nests in living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting*. This habitat is not present and this has also been confirmed by surveys during the appropriate seasons.

Regent Honeyeater - This species is not known to breed in the local region and the site has not been mapped as Important Habitat by DPIE.

Species ruled out by suitability of survey (see Table 2.1 and Figure 3 for survey effort).

Green and Golden Bell Frog (GGBF) – Survey for GGBF was carried out during ideal weather conditions on the 27th and 29th October 2020. These surveys were undertaken not specifically targeting GGBF but rather Mahony's Toadlet in the southern study area as a result of initial comments received by the Biodiversity and Conservation Division dated 14 July 2020. This correspondence stated that it was based on "a preliminary review of the application to ensure the form is complete and all relevant information has been provided".

More recent correspondence dated on the 14th April 2021 (following the completion of the GGBF breeding period) then required further justification why GGBF was excluded from the list of candidate species credit species. Had the initial correspondence also prompted the need for this survey it could have also been undertaken three days after the Mahony's Toadlet survey within the species recognised period in the TBDC. Nonetheless the survey was undertaken 5 and 3 days prior to this in ideal conditions when GGBF was also known to be calling at a separate reference site at Davistown (a known local population on the Central Coast).

Furthermore, the following local, state and national guidelines also recognise the species to call in October:

- 1) The Recovery Plan for GGBF (DEC 2005) state that breeding events have been recorded from late winter to early autumn but generally between September and February (four sources cited).
- 2) Threatened Species Survey and Assessment Guidelines – Amphibians (DECC 2009)
- 3) Survey Guidelines for Australia's Threatened Frogs (DEWHA 2010)
- 4) Flora and Fauna Survey Guidelines V2.4 (Wyong Shire Council 2014)

Aside from survey, *Travers bushfire & ecology* also considers that the habitat within the study area itself is poor quality for GGBF breeding. The habitat constraint identified within the TBDC is very broadly described as being “within 1 kilometre of wet areas / swamp / waterbody”. This would be applied to almost any area along the NSW coast within the species range. The TBDC then gives prompting to refer to the 'NSW Survey Guide for Threatened Frogs' (2020), for specific survey requirements.

These guidelines define the following:

Potential habitat: *Suitable breeding and non-breeding shelter habitat consists of any waterbody with emergent aquatic vegetation and without the plague minnow (Gambusia holbrooki), although the GGBF will still occasionally breed in sites with this introduced pest fish. Foraging habitat and migratory habitat are areas of native and non-native vegetation.*

Species polygon: *The species polygon boundary should align with aquatic habitats linked directly to the record and a buffer, incorporating the PCTs with which the species is associated, of 200 metres radius from the top of bank. The polygon should include minimum 50 metre wide corridors of native and non-native vegetated areas linking the available waterbodies, where relevant.*

Again, the above criteria is too broad for a frog species that can utilise disturbed landscapes but will not breed in poor quality or saline waters, both of which can contain emergent aquatic vegetation as described above.

The dam present on site is too deep and steep sided with no emergent vegetation providing in-water shelter opportunity. The swamp habitat in the lower southern depressions of the site does not sustain large open water breeding opportunity that will prolong for long enough after summer rains to support the tadpole development period and these potholes are well shaded by the surrounding dense Gahnia vegetation. Nonetheless GGBF was not recorded within these areas during call surveys, spotlighting, diurnal habitat searches and tadpole observations.

The survey did not however extend beyond the study area boundary for consideration to a buffer from other nearby potential breeding habitats. Therefore a recent habitat assessment outside of the breeding season was undertaken in these adjacent areas. Karignan Creek along the southern boundary, links directly with Lake Macquarie. There is also no likely breeding potential within 200m to the east of the development footprint. The stormwater detention basins on the neighbouring property to the south-east, as seen on aerial photography, are all deep, have concrete edges and no emergent vegetation.

Much of the local floodplain wetland on the other side to the south-west and lining the entry to Karignan Creek are tidal and unsuitable due to salinity. The habitat assessment in this area was undertaken on the 22/6/21 after 37mm of rain over the preceding 3 days. Although many temporary shallow potholes were inundated at this time these were temporary and similar to the study area itself. Some larger and prolonged freshwater pools were observed.

These areas are considered most suitable for breeding potential based on their longevity, open basking habitat, surrounding and emergent *Baumea* sedges for shelter, and quite possibly some degree of brackish influence that may alleviate the chytrid fungus, as in other coastal populations.

The species polygon for GGBF is to be drawn to align with aquatic habitats “linked directly to the record” and with a 200m buffer. Whilst we don’t have a record, a species polygon has been drawn from the most suitable breeding location as described above.

Grey-headed Flying Fox - Breeding habitat is the same as roosting habitat typically located in dense shelter foliage close to water in lower depressions. Such habitat is not present within the development footprint. In either case the habitat constraint for breeding is the presence of breeding camps. The southern study area is the only portion of the site to support any similarity with suitable roosting habitat. Survey in November and December has sufficiently ruled out roosting presence within the southern study area.

Eastern Pygmy Possum, Squirrel Glider, Brush-tailed Phascogale & Common Planigale - These species have been targeted during two sessions of separate seasonal trapping surveys and have not been recorded present.

Powerful Owl, Masked Owl, Barking Owl, Glossy Black-Cockatoo & Gang-gang Cockatoo - Large hollows suitable for nesting by these species have been targeted during stag-watching during the appropriate breeding period and/or tree climbing inspections.

Little Eagle & White-bellied Sea Eagle - No large raptor nests were recorded present within the stud area during combined surveys and extensive tree inspections.

Square-tailed Kite – The Square-tailed Kite was observed on a single occasion in flight gliding at twice canopy height heading north of the study area over Mulloway Drive during 2018 winter surveys (refer to Figure 3 for location and flight direction). The sex of the individual was not determined and there was no nesting material being carried. This species has not been recorded perched or otherwise directly utilising the habitat within the study area during combined surveys to date. The study area has been extensively surveyed in the appropriate season (September to January) and at no time has both a male and female been observed together, or a female observed with nesting material, or an individual on a large stick nest in the top half of the tree canopy (as identified by the TBDC).

Koala - Target surveys including extensive diurnal tree inspections, nocturnal target surveys and scat searches below large suitable feeds trees have not recorded any presence of this species.

Greater Glider – Considerable spotlighting and stag-watching effort has been undertaken throughout the study area to effectively rule out presence of this species.

Large-eared Pied Bat - This species has not been recorded during sufficient nocturnal ultrasonic recording efforts.

Large-eared Pied Bat - Whilst not considered likely to occur this species has not been recorded during sufficient nocturnal surveys incorporating spotlighting, call-playback and call identifications.

Inclusions based on inadequacy of survey

Whilst considered with unlikely potential to occur the *Pale-headed Snake* and *Giant Dragonfly* have both been included because there has been no sufficient survey effort during the appropriate season to effectively rule out presence.

Inclusions based on request by DPIE

Squirrel Glider - was located to a “possible” level of certainty outside of the development footprint during spotlighting survey on the 15/3/2016. This call was heard at approximately 40–50 m beyond the site boundary to the south-west. Based on the orientation and distance, this location was predicted to be most likely on the other side of Karignan Creek.

Subsequent to this and as required to effectively rule out species credits, target trapping surveys were undertaken amounting to 32 trap nights in November 2017 and then 120 trap nights in July 2018. The November effort coincided with flowering by Red Bloodwood and the July effort was additionally undertaken with the intent to target the species during flowering of Swamp Mahogany, located closer to the creek.

Both of the arboreal trapping efforts undertaken in separate seasons satisfy arboreal trapping effort recommended by both the DEC (2004) and Wyong Shire Council (2014) Survey Guidelines. Further to this, extensive habitat tree surveys and stag-watching of all hollows considered suitable for *Squirrel Glider* was undertaken between June and August 2018.

This effort amounted to thirty-seven (37) person nights over a total of thirteen (13) separate nights and stag-watching a total of ninety (90) trees containing hollows. This effort is also in addition to two nights of other previous spotlighting survey undertaken in January 2017.

Squirrel Glider was therefore not previously included as a species credit, however based on a request by DPIE in correspondence dated 14 April 2021, the species has now been added given the suitability of habitat and the initial potential recording.

Present based on important mapped area

The Swift Parrot has been assumed present based on the Important Area mapping (see Figure 7). The important habitat areas mapped covers most vegetation within the development footprint, not just the southern portion containing the winter flowering resources. Further discussion and SAI assessment for Swift Parrot is also provided in Appendix 2.

Species polygons are provided on Figures 12.1 & 12.2.

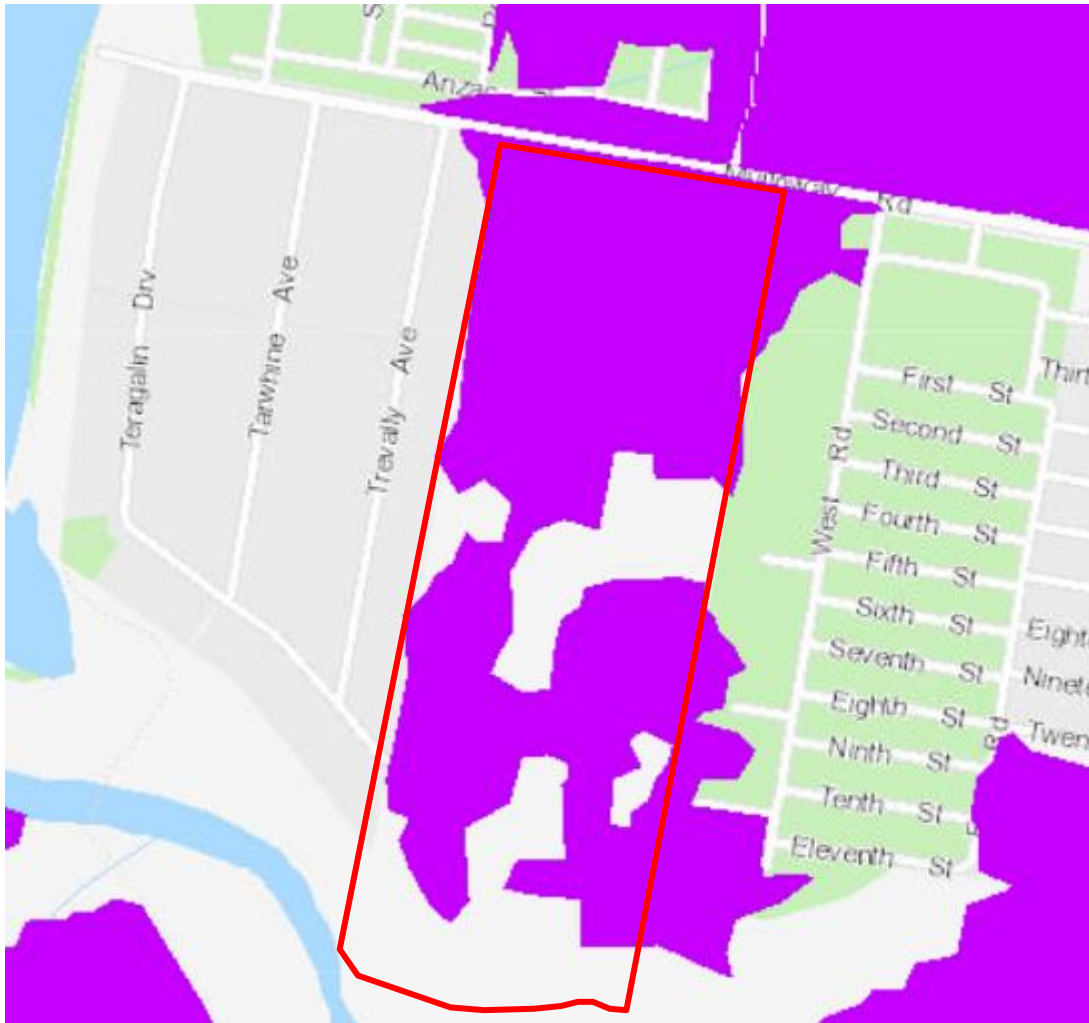


Figure 7– Swift Parrot important areas mapping
 (Source: Important Areas Map, DPIE, accessed through BAAS portal)

(f) Local data

Local data has not been used in this case.

(g) Expert reports

Expert reports have not been utilised for fauna on this project.

4.4.3 Matters of national environmental significance - fauna

(a) Threatened fauna species (National)

EPBC Act – A review of the schedules of the *EPBC Act* identified a list of threatened fauna species or species habitat likely to occur within a 10 km radius of the subject site. These species have been listed in Table A1.2 (Appendix 1).

Based on the habitat assessment within Appendix 1, it is considered that the subject site provides varying levels of potential habitat for the following nationally listed threatened fauna species:

Table 4.10 – Nationally listed threatened fauna species with suitable habitat present

Common name	EPBC Act	Potential to occur
Grey-headed Flying-fox	V	recorded
Swift Parrot	E	✓
Regent Honeyeater	CE	low
Green and Golden Bell Frog	V	unlikely
Spotted-tailed Quoll	E	unlikely
Koala	V	unlikely
Long-nosed Potoroo	V	unlikely
New Holland Mouse	V	unlikely

One (1) nationally listed threatened fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*), was recorded during surveys.

Grey-headed Flying-fox

A single individual Grey-headed Flying-fox was recorded in flight over the subject site during early 2018 survey. There was no record of this species foraging within the site, although this is expected on a seasonal basis. There is no likelihood of this species utilising the site for roosting and subsequent breeding habitat.

The significant impact criteria for a vulnerable species listed under the *EPBC Act* (Appendix 4) was reviewed to assess the impacts on this species as a result of the planning proposal within the subject site. As the subject site does not contain any likely roosting or subsequent breeding habitat and foraging habitat will remain well represented in the locality, it is concluded that there will not be any significant impact on this species.

Swift Parrot

The Swift Parrot also has potential to seasonally forage within the study area. More than 97% of winter flowering habitat in the southern portions will be retained by the planning proposal. Edge effects, particularly the impacts of Noisy Miners along the cleared edges has been considered for this area which may reduce potential for Swift Parrot occurrence to the inner areas where Miners are less likely to persist. Whilst this is outlined by *Roderick & Ingwersen* (2014), it is not a notable factor within the nearby Joshua Porter Reserve where the species has been regularly recorded in recent years.

While it is impossible to accurately account for the indirect impacts from aggressive bird competition through credit offsets, we have assumed a 10 m indirect impact buffer from the development footprint that is treated as a separate management zone in the BAM-C. The change in VI score calculated within this buffer (see Section 5.5.2 a.) is assumed to be sufficient to account for these indirect impacts.

It is concluded that there will not be any significant impact on the above considered species or any other nationally listed threatened fauna species with potential to occur, as a result of the rezoning or likely future subdivision of the lands.

(b) Protected migratory species (National)

The EPBC Act Protected Matters Report provides additionally listed terrestrial, wetland and marine migratory species of national significance likely to occur, or with habitat for these

species likely to occur, within a 10 km radius of the subject site. The habitat potential of migratory species is considered in Table A1.3 (Appendix 1). The habitat potential of threatened migratory species is considered in Table A1.3 Table A1.2 (Appendix 2).

Two (2) protected migratory bird species White-bellied Sea Eagle (*Haliaeetus leucogaster*) and White-throated Needletail (*Hirundapus caudacutus*) were recorded during surveys. Nesting habitat for White-bellied Sea Eagle may be present along Karignan Creek to the west based on calls from this location in 2016. No nests are however present within the study area or likely to be indirectly impacted nearby to the planning proposal.

The planning proposal will not provide any notable impacts on any habitat of importance to the White-throated Needletail.

The impact assessment for these species and other nationally protected migratory species with potential to occur, based on the significant impact criteria in Appendix 4, has therefore concluded a not significant impact.

4.5 Vegetation connectivity and habitat corridors

The Wildlife Corridors Strategy – Field Evaluation of Linkage (Payne 2002) identified regional and subregional corridors of significance within the former Wyong Shire. Section 7 of the draft Wyong Conservation Strategy (2003) indicates that Wyong Shire Council has conducted mapping and analysis based on the work by Payne and others depicting future wildlife corridors. This is provided in the North Wyong Shire Structure Plan (NWSSP 2012). It should be noted that whilst draft Wyong Conservation Strategy is widely used, it was never formally adopted by Council. These structure plans are also based primarily on desktop assessments with an overlay of broad-scale layers that often do not have a high degree of accuracy. *Travers bushfire & ecology* have undertaken a significant level of survey to assist the determining authority that the placement and width of the provided corridor is sufficient and the most effective.

The southern portion of the site currently zoned as E2 provides connectivity from east to west along Karignan Creek. This is mapped as a green corridor and habitat networks within the NWSSP. The remaining northern portions of the site provide a linkage between this riparian corridor and habitat extending north directly into Lake Munmorah State Conservation Area and up to the Gwandalan peninsula. The northern portion of the study area is mapped in the NWSSP as 'Development Precincts'.

The open forest vegetation within the study area provides natural habitat with connectivity to the north, south-west and south-east. This connectivity is depicted in Figure 8 which shows that the site has connective values for wildlife between these aspects.

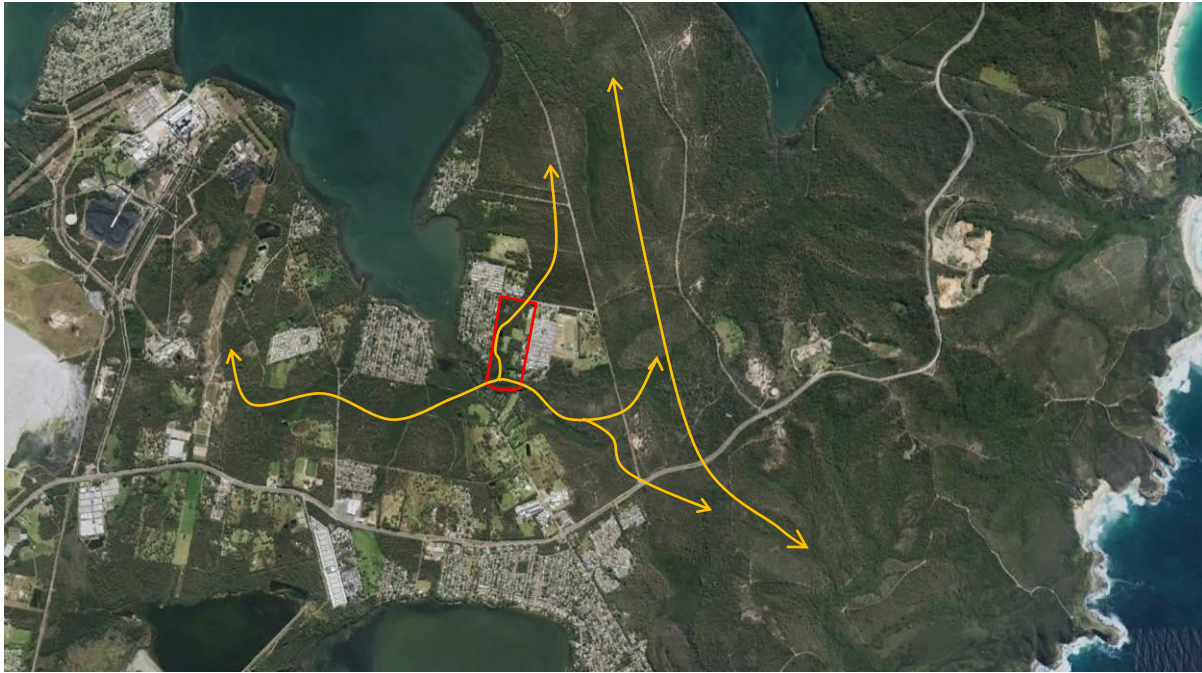


Figure 8 – Broad landscape connectivity

The rezoning for development will not significantly effect this connectivity given that the east-west connectivity through the southern E2 portions will be retained and this ultimately also connects to the north. The east-west corridor provides more direct connectivity at widths between 60–160 m wide.

As stated by Ambrose (2007) it is essential for a corridor to have the following characteristics in order to be effective:

- Vegetated corridors that comprise a mosaic of different habitats are considered more likely to contain the necessary food, shelter and nesting resources for fauna. Therefore, corridors that link patches over the entire ecological gradient from ridge to gully would conserve more species, especially those that have large home ranges and changing seasonal requirements (Lindenmayer *et al.* 1994).
- The quality of the habitat within the corridor is important. Some fauna would reluctantly utilise corridors of low quality, such as areas invaded by weeds or subject to frequent fires, or due to a reduction in the availability of essential resources (such as feeding, shelter, roosting and breeding sites).
- The size of the corridor is also important. For example, corridors with mature trees, but with little or no understorey may afford good habitat for birds, bats and some arboreal fauna, but not for ground-dwelling fauna.

The meandering of Karignan Creek along the southern boundary of the study area provides a variable barrier for terrestrial fauna passage. Fauna passage along the east-west transition of this corridor will likely encounter a creek barrier at two (2) locations however only one crossing of this creek would be required for the more direct north-south line of passage through the study area. Local roads also potentially limit connectivity throughout the landscape but not of sufficient width to limit movement of mammals and other wildlife throughout the adjoining lands. See Figure 9 for a closer review of the current connectivity and creek barriers through the study area.

Following discussions with Council and based on the current extent of habitat and connectivity values mentioned above, a 60 m wide corridor through the study area has been incorporated into the planning proposal (originally 50 m but extended further again). This corridor will fundamentally aim to link the flood prone Swamp Sclerophyll Forest along Karignan Creek (in the south), to the extensive retained vegetation patch to the north of Mulloway Road that forms part of the Lake Macquarie State Conservation Area (LMSCA).

The placement of the corridor has considered the location and presence of suitable habitat which provides a variety of habitat structure and foraging species. The corridor has been proposed along the western and northern boundaries as this will ensure the inclusion of the following habitat features:

- the largest hollow-bearing tree containing a large hollow suitable for owls,
- larger mature trees in the north-western corner,
- retention of the large dam of recorded threatened microbat activity, and
- representative Red Bloodwood trees with glider sap feeding incisions.
- representation of each of the mature canopy tree species that occurs in the central and northern parts of the study area.
- a potential bat roost located in the north-western corner of the site.

The corridor will be protected with fencing and a dense planting of native shrubs. Interface planting will be used to reduce light penetration to the understorey in order to retain the natural assemblage of understorey vegetation and other edge effects.

The corridor will be bisected by both site entry roads. Canopy connectivity is to be maintained within the road corridor with trees to be retained with no greater than a 15 m separation between trunks on either side to ensure glider passage. Tree investigation zones have been nominated at all critical road crossings to determine the best placement of the road, retention of existing trees and planting of supplementary large canopy trees. As a supplementary measure, gliding poles will be utilised as an additional measure for the corridor restoration, along with the restoration of shrubs and small trees to provide a positive outcome. Figure 12 - Vegetation Management Works - shows the chosen location of the glider poles.

A VMP has been prepared for the proposed E2 lands containing the proposed habitat corridor that specifies the restoration requirements (see Figure 12).

The connectivity across Mulloway Road is tenuous and marginal. To ensure that this connectivity maintains and retains the functionality it would be necessary to ensure that trees are present in either side of the pavement of Mulloway Road that allow gliders to climb to a suitable height and glide across the road corridor. Consequently, glider poles are recommended to be installed and planting of additional rapid growing tall trees on either side of Mulloway Road with the permission of the adjoining landholders which is believed to be National Parks and Wildlife Services. These measures will allow the effective width of the corridor connection across Mulloway Road to increase from 20 to 40 m.

The second point of glider connectivity analysis is the main entrance into the proposed residential subdivision. The glider connectivity analysis shows once the trees impacted as a result of the proposed future entry road, are considered, connectivity is disrupted from east to west. An option to shift the road corridor slightly to the west was considered, to conserve selected trees then connectivity is maintained in both directions without the need for Glider poles. However, we have confirmed that this slight shift is not supportable to meet current road design requirements. Consequently, we advise that the road entrance either remains with additional pole installation or the road entrance is moved to the west or east to identify another location that results in better arboreal/glider connectivity.

The remaining aspect of the functional connectivity analysis is at the southern end of the proposed corridor in the vicinity of Teragalin Drive. The analysis shows that the glider connectivity to the south of the corridor is tenuous, because the existing water main and access roadworks have already cleared significant trees from this locality which would otherwise be present under natural circumstances. There are two or three pre-existing trees present in the proposed road that crosses the corridor to access the development that provide potential glider connectivity. As the proposed road will remove these trees and the road connection in this location is essential, measures to maintain a functional corridor will need to include modification of the road alignment and pavement position, the planting of additional tall growing trees and installation of glider poles.

The final point is concerning terrestrial or on ground connectivity. The installation of roads will present a threat to wildlife movement due to the potential for road kills. Whilst residents would be asked to drive slowly through these corridors and appropriate signage could reinforce this point, a preferred mitigation measure is to install a sub pavement culvert to enable wildlife to move under the roads. This element can also be addressed at the engineering design and DA stage of the subdivision.

Consequently, as recommended in the Biodiversity Certification Assessment (2019) *Travers bushfire & ecology* recommend that culverts are placed under these roads to allow ground dwelling animals to traverse through the road corridor without risk of being run over by cars accessing the future lots. Therefore, mitigation measures are required to ensure a functional corridor include a road culvert as well as arboreal planting measures.

The full corridor functional analysis can be viewed as Appendix 6.

Consultation between Central Coast Council and DPIE was undertaken in the preparation of the updated planning proposal and concept layout. DPIE advised Council that the proposed 60 m wide corridor along the western and northern boundary was considered to be a suitable functional width for this site. The concept mapping provided to Council identified the inclusion of the fire trail within the western boundary of the corridor. The current concept is consistent with this advice.

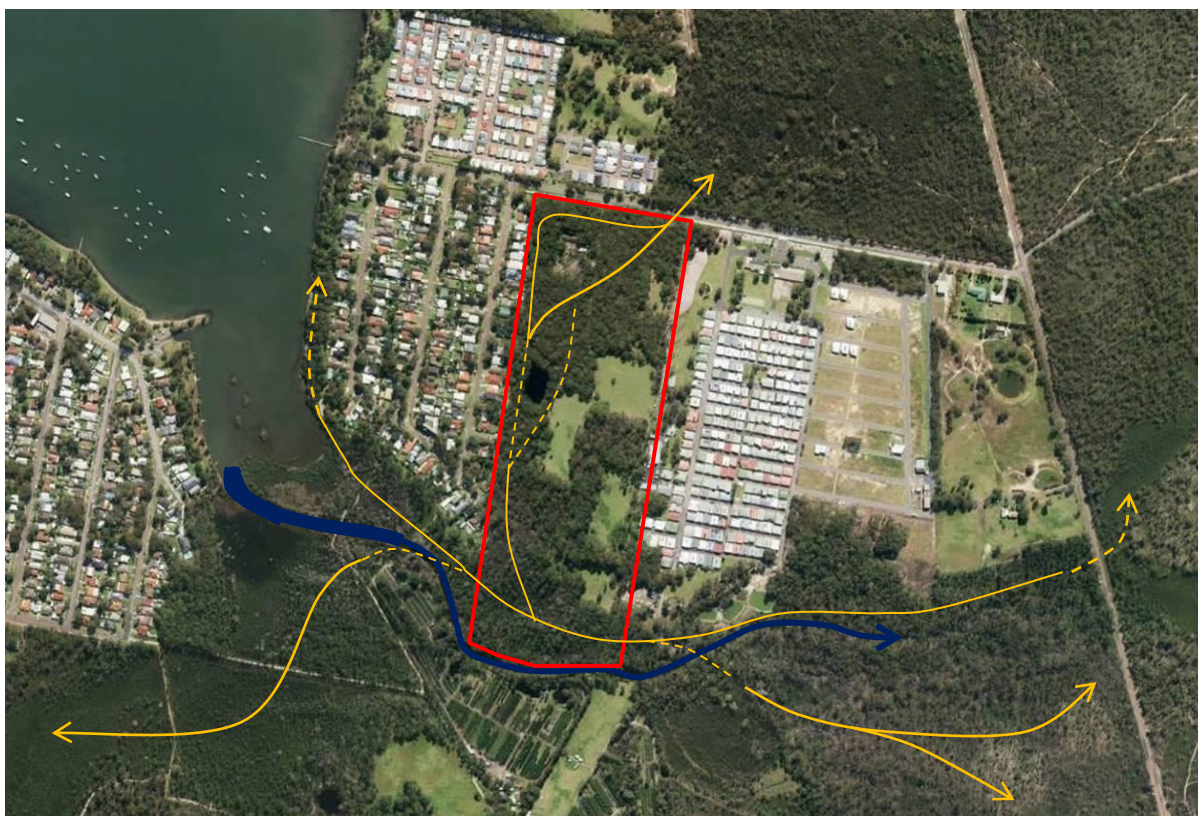


Figure 9 – Study area connectivity

4.5.1 PVP implications for the site

The adjacent *Valhalla Village* to the east has a Property Vegetation Plan (PVP) imposed (shown on Figure 10). It indicates that vegetation abutting approximately two-thirds of the eastern site boundary is either protected, or is required to be restored to native vegetation communities.

The restoration of these areas along the boundary may have future implications for the site, such as bushfire threats.

The corridor along the boundary is narrow and it will take more than several decades establish semi-mature vegetation within those cleared areas. The usefulness of this as a corridor function will not occur for a long time. The addition of lands on site to that in the *Valhalla Village* lands may be a positive outcome, but the value of it won't be seen until the vegetation on the *Valhalla Village* lands has been restored. The addition of a corridor on this eastern boundary makes it less viable, and our preference is to retain it along the western and northern boundaries where existing important vegetation and hollows are present.

The bushfire assessment needs to consider future threats that arise from offsets in the *Valhalla Village*. In terms of ecological issues, the assessment considers the connectivity that the *Valhalla Village* lands and the study area provides. *Travers bushfire & ecology* considers that any future revegetation lands are not reliable outcomes subject to any future development applications that may apply to the *Valhalla Village* lands. Therefore, the proposed habitat corridor within the study area is independent of any works that may be undertaken within the *Valhalla Village*, however they would complement these works by ensuring that habitat connectivity is maintained along Mulloway Road.

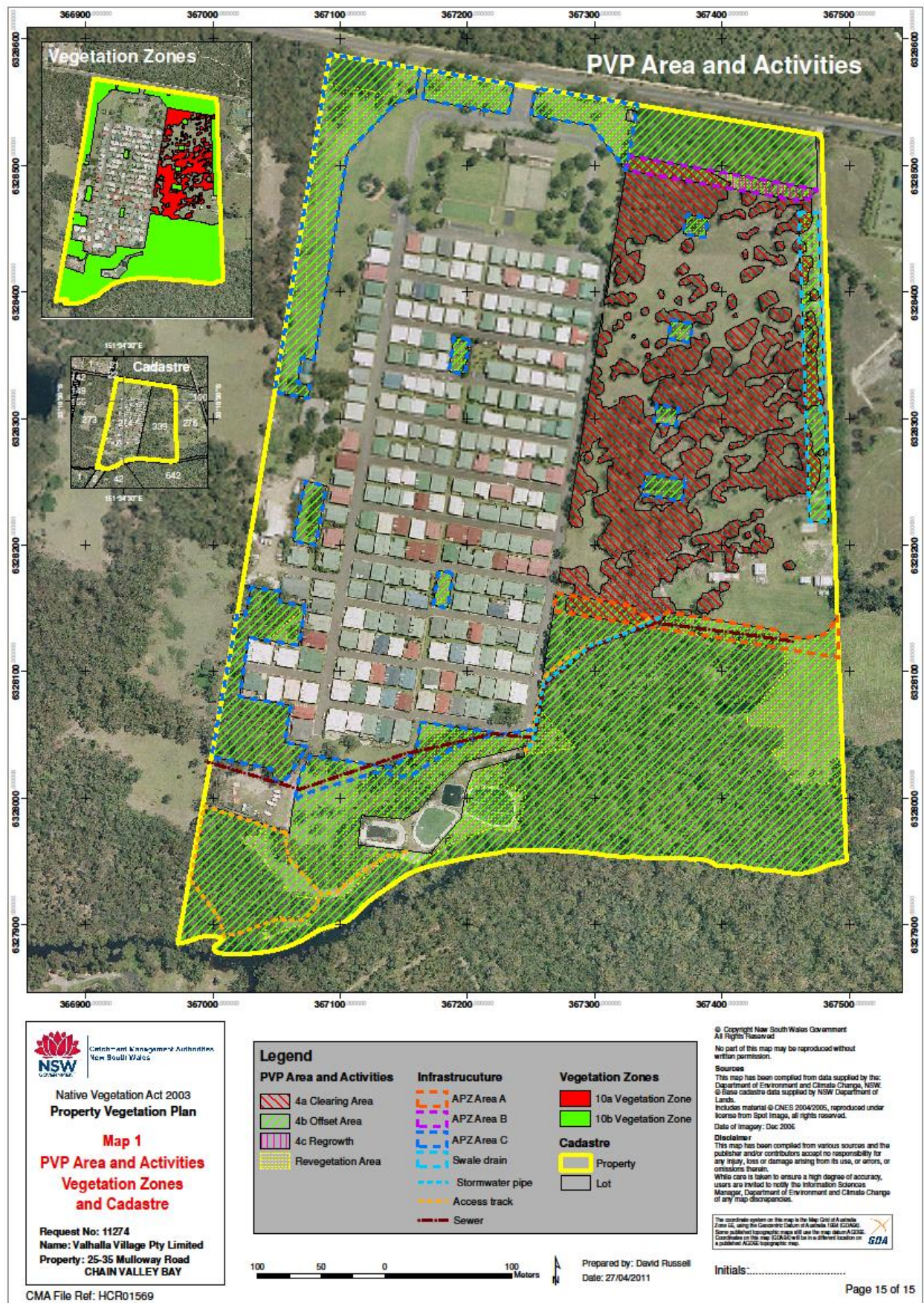


Figure 10 – PVP mapping of adjacent Valhalla Village lands



Impact Assessment

5

Travers bushfire & ecology has been engaged to undertake a biodiversity assessment for a planning proposal within Lot 273 DP 755266 at 15 Mulloway Road, Chain Valley Bay. See Figure 1.6 for current concept subdivision layout.

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

5.1 Legislative compliance

In respect of matters required to be considered under the *EP&A Act* and relating to the species / provisions of the *BC Act*, ten (10) threatened fauna species Wallum Froglet (*Crinia tinnula*), White-bellied Sea-Eagle (*Haliaeetus leucogaster*), Square-tailed Kite (*Lophoictinia isura*), Powerful Owl (*Ninox strenua*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Southern Myotis (*Myotis macropus*), Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), Little Bent-winged Bat (*Miniopterus australis*) and Large Bent-winged Bat (*Miniopterus orianae oceansis*), no threatened flora species, and one (1) TEC, Swamp Sclerophyll Forest on Coastal Floodplains, were recorded within the study area.

The state assessment of significance is not required for part 4 development proposals that enter the BOS.

The additional impact assessment provisions for threatened species to determine a Serious and Irreversible Impact (SII) are outlined under Section 10.2.3 of the BAM (2017) and have been applied to the recorded Large Bent-winged Bat and Little Bent-winged Bat in Appendix 2. This criteria has also been applied to the Swift Parrot, which has not been recorded present during surveys but is assumed to occur based on the Important Mapped Areas (DPIE) covering the site. It is concluded that the proposal will not cause any serious and irreversible impacts on threatened biodiversity.

In respect of matters required to be considered under the *EPBC Act*, one (1) threatened fauna species Grey-headed Flying-fox (*Pteropus poliocephalus*), two (2) protected migratory bird species White-bellied Sea Eagle (*Haliaeetus leucogaster*) and White-throated Needletail (*Hirundapus caudacutus*), no threatened flora species, and no TECs listed under this Act were recorded within the study area.

The planning proposal is not considered to have a significant impact on matters of national environmental significance. As such a referral to Department of Environment and Energy should not be required.

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

In respect to considerations and the threshold tests for entry into the BOS, the residual impact of the proposed development is required to be offset. A biodiversity credit offset assessment has been undertaken and the credit requirements are provided in Section 5.5.

5.2 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:

The direct impacts of the proposal within the subject site are considered as:

- Removal of 6.36 ha (63.73%) of good-quality non-TEC vegetation (PCT 1619 - Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest).
- Removal of 0.02 ha (0.57%) of good-quality TEC vegetation (PCT 1718 - Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast).
- Loss of good-quality native vegetation providing potential and known habitat for threatened species.
- Removal of high-quality hollows suitable for threatened species.
- Removal of one hundred and sixty-four (164) hollow-bearing trees containing 375 hollows.
- Loss of 2.5 ha of previously cleared vegetation

The potential indirect impacts of the proposal are considered as:

- Minor reduction of arboreal connectivity for arboreal mammals, but implementation of the western corridor retains connectivity across the site.
- Reduced cross-site movements by small bird species such as passerines.
- Increased presence of visiting dogs and cats, and resultant impacts on native wildlife.
- Edge effects such as weed incursions caused from soil disturbance, repeated clearing and naturalised landscaping species in the surrounding retained vegetation.
- Edge effects from inappropriate use of remaining native vegetation areas such as additional clearing, dumping of materials, dumping of faecal, food or general waste and building refuse.
- Increased spill-over from noise, activity, scent and lighting into the adjacent quality natural habitat areas.
- Increased soil nutrients from changes to runoff that may provide further opportunities for weed plumes.
- Concentrated stormwater runoff from solid surfaces and subsequent increased flows.

The potential cumulative impacts (combined results of past, current and future activities) of the proposal are considered as:

- Increased risk of weed invasion and fungal mobilisation or infections.
- Cumulative loss of PCT 1619 - Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest within the locality.
- Minor cumulative loss of Swamp Sclerophyll Forest TEC within the locality.

- Increased varied human presence and activity within the remaining natural habitat areas of the adjacent bushland remnant.

Potential uncertain impacts of the proposal are considered as:

- Increased injury and mortality of native fauna from vehicle strikes.

5.3 Avoid and minimise impacts

The following actions and designing of works have been undertaken to either avoid or minimise impacts on biodiversity values:

1. *Utilisation of cleared areas and areas subject to edge effects.*

20% of the site is already cleared. Future development will utilise the cleared areas for residential development and APZs. The southern portion of PCT 1619 being impacted has more edge effects than the northern portion. The *Swamp Sclerophyll TEC* on site has been given increased protection by extension of E2 zoning north to cover the entire TEC area.

2. *Identification and avoidance of habitat resources and important hollow-bearing trees as a result of the habitat corridor*

An analysis of the site's fauna habitat features including detailed review of hollow-bearing tree data was undertaken to guide the most appropriate location and size of the habitat corridor. These also included identifying hollows potentially suitable for owls and gliders, locations of seeding *Allocasuarina* trees, glider sap feeding incisions on Red Bloodwood trees, terrestrial habitat logs and shelter as well as floristic diversity for nectar foraging. A detailed comparative functional corridor analysis of corridor options was undertaken which determined that the proposed corridor equally represented these features and protected more mature stands of foraging canopy. It also recognised that some of these features such as terrestrial logs and good quality tree hollows may also be relocated into the corridor to further enhance this habitat. A full tree hollow relocation protocol is recommended as a mitigation measure, whereby all hollows with residing fauna or otherwise of good quality will be prepared and placed into recipient trees in the corridor.

3. *Placement of roads entering the site to reduce tree impacts*

An analysis of tree heights and Squirrel Glider gliding angles around the two proposed entry roads into the site was undertaken to guide the best location for these roads to minimise connectivity impacts on gliders. Detailed mapping showing the glider perch points and potential gliding distances from all trees in good health advised the trees most suitable for retention at these locations.

More recent observations of regrowth of Swamp Mahogany trees along the Teragalin Drive entry road has also prompted a need for future realignment of this road to make best avoidance of these small trees. This will be undertaken in conjunction with consideration to glider tree retention on both sides of the road where possible.

4. *Avoidance of Wallum Froglet habitat and Swift Parrot foraging habitat in the Swamp Sclerophyll TEC vegetation in the southern portion of the site.*

Wallum Froglet has been recorded within PCT 1718 in the southern portions of the study area. It is recognised also that this portion of the site containing Swamp Sclerophyll Forest vegetation does also have potential to support seasonal (winter) foraging habitat for the endangered Swift Parrot; as the species is typically known in the locality to inhabit areas where winter flowering resources, usually Swamp Mahogany and similar species, are available.

The proposal was initially placed abutting the 1 in 100 year flood line. This line has been previously used to define the land zoning between E2 and R2. The proposal initially sought to move the E2 zone boundary further north to avoid impacts on Swamp Sclerophyll TEC vegetation. Following more recent discussion with the BCD, this line has been further extended up to 49 m in the east (refer to Figure 11).

Detailed mapping of Swamp Mahogany locations has been undertaken to effectively determine best measures to retain individual trees, particularly outliers. Seven outliers (>10 cm DBH) were identified, four of which will be retained where possible within lots (including an expanded E3 lot to accommodate a cluster of 3) subject to a health and safety assessment. Regardless of this outcome, all of these outliers will be replaced with the planting of Swamp Mahogany trees within the area surrounding the proposed stormwater detention pond.

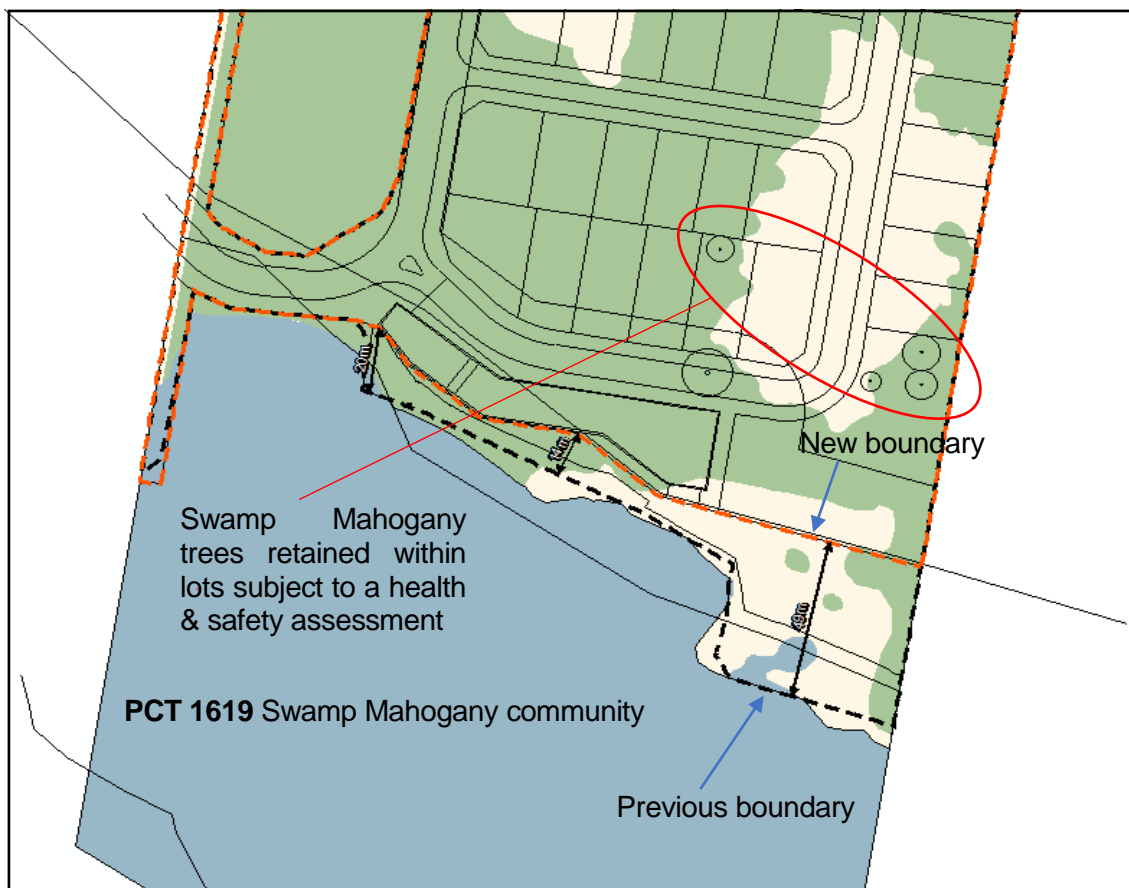


Figure 11 – Locations of new setback and Swamp Mahogany outlier trees

A cluster of regrowth Swamp Mahogany were also identified along the western boundary at the location of the proposed fire trail, just south of the Taragalin Drive site entry (refer to Figure 20 in Appendix 2). A field analysis at this location has found that a current 4m wide managed vehicle passageway exists between the boundary

fence and the swamp mahogany trees, such that passage for the proposed fire trail may run on this same alignment to permit retention of these trees.

Approximately 97% of Swamp Mahogany will therefore be retained by the planning proposal as they occur almost exclusively within PCT 1718. Edge effects, particularly the impacts of Noisy Miners on the cleared edges has also been considered for this area which may reduce potential for Swift Parrot occurrence to the inner areas where Miners are less likely to persist. Hence the more recent extension described above. The protection fencing will also be extended out to the edge of the proposed road in the southern portions of the site to minimise edge effects and subsequent potential competition.

5. *Proposed rehabilitated corridor as part of a habitat corridor and TEC conservation area to retain important north–south connectivity values*

The corridor is maintaining current connectivity value across pinch points and has avoided loss of arboreal connectivity. Further mitigation with additional glider poles and canopy planting works is proposed.

6. *Preparation of a VMP*

Management actions are specifically written in these documents to avoid and mitigate indirect impacts on the urban interface. The VMP specifies actions that avoid further impacts that minimise environmental risks such as dumping and trampling due to pedestrian access. It contributes to the avoidance of indirect impacts and therefore is an avoidance action in itself.

7. *Fencing to exclude general access to the habitat corridor and TEC conservation area*

Fencing contributes to the avoidance of indirect impacts by removing the damaging effects of pest species as well as protecting from other edge effects. The fencing will also alternatively direct wildlife within the corridor away from proposed adjacent roads.

Given the road design adjacent to winter flowering Swamp Mahogany habitat, the erection of a fence at least 3 m high, covered with shade cloth, netting, mesh or other visual noise, should be placed on the southern side of the most southern road (closest to the potential foraging trees). This would encourage Swift Parrots to approach the food source at a higher altitude, thereby reducing the potential for vehicle collisions.

8. *Undertake feral pest management including control of foxes, cats, avian pests and any other miscellaneous species as required.*

Feral pest management contributes to the avoidance of indirect impacts by removing the damaging effects of weed invasion.

9. *Integrated weed management and control of high threat exotics.*

Weed management contributes to the avoidance of indirect impacts by removing the damaging effects of weed invasion both now and into the future. Edge effects will likely occur around the perimeter of the development area, and garden waste dumping may cause future weed outbreaks that cannot be predicted.

10. Avoiding removal of the large dam

This dam was found to support microbat foraging activity during surveys including the threatened Southern Myotis, Greater Broad-nosed Bat, Little Bent-winged Bat, Large Bent-winged Bat and Eastern Coastal Free-tailed Bat. The retention of the dam has avoided the impacts by retaining it within the corridor.

5.4 Mitigation of impacts

The following mitigation measures are to be undertaken to mitigate and manage impacts on biodiversity values:

- a) Restore the conservation area to fully-structured native vegetation native vegetation equivalent to PCT 1619 - Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest and PCT 1718 - Swamp Mahogany - Broad-leaved Paperbark - Saw Sedge - Yellow Marsh Flower swamp forest.
- b) Maintenance of Swift Parrot foraging habitat in the long-term, involves management of natural ground litter that is to be detailed in the VMP, via means such that the floristic diversity and structure will not be compromised by environmental burns.

Detailed mapping of Swamp Mahogany locations has identified seven outliers (>10cm DBH) beyond the boundary of PCT 1718. More recent design changes have provided for the retention of four of these trees within lots where health permits. Three of these will now be contained within a single large E3 zoned lot. These trees will align closer to boundaries as opposed to likely building footprints; however, field inspections have identified two of them containing arboreal termite nests and in poor health. Therefore, a more thorough investigation of these trees by an AQ5 qualified arborist is required to determine what provisions can be made, to prioritise their retention and safety. The other three Swamp Mahogany trees will be required for removal for the placement of the southern road, which has also been moved north to provide greater setback distance from the Swamp Mahogany community further south. Any Swamp Mahogany trees requiring removal will be replaced with plantings of Swamp Mahogany trees within the area surrounding the proposed stormwater detention pond.

- c) The boundaries of the corridor interface shall be clearly marked and fenced to ensure protection of its habitat prior to the commencement of any construction works. All areas of retained natural vegetation shall be protected by permanent fencing, prior to and post construction, to ensure that these areas are not damaged during the construction phase and are protected from trampling and general pedestrian access long-term.
- d) Based on the potential also for vehicle collisions, measures to avoid frog and other terrestrial wildlife access to the proposed internal residential road network is necessary. Particularly to protect the threatened Wallum Froglet during wet weather dispersal conditions. This should be in the form of a solid weatherproof permanent barrier fencing at 500mm in minimum height and 200mm depth below ground, running along the proposed fencing of the conservation area and corridor. This will instead direct any dispersing frogs along the corridor.
- e) The Habitat Corridor Functional Analysis prepared by *Travers bushfire & ecology* in 2019 (refer to Appendix 6) also highlighted the potential for the two proposed roads that will bisect the corridor to impact on terrestrial fauna trying to make passage. Therefore, the installation of under road culverts were recommended below both the

Teraglin Drive access road and the site entry road off Mulloway Drive (both of which bisect the proposed corridor) to facilitate the movement of wildlife.

This will need to be designed so that the under-road passage surface is naturally vegetated as much as possible up to the culverts with other available shelter opportunities where the vegetation doesn't grow inside. The under surface should not be solid concrete construction or rubble but rather soil surface. The culverts should each have a minimum combined total width of 4m below each road. These measures will also minimise the potential for culverts to act as a predation point.

The frog proof fencing is to be designed to direct frogs, and other small terrestrial fauna, through the culverts without any gaps towards the roads at these junctions.

- f) Construction activities will be directed on-site and monitored by a project ecologist to ensure that the recommendations of this report are implemented and no inadvertent damage or clearing occurs. All staff involved with the development shall undergo an induction and training program to reinforce the ecological and environmental objectives of the development.
- g) Target weed control is to be undertaken within the corridor and remaining conservation area to control the invasion or spread of weed species.
- h) *Phytophthora cinnamomi* protocol applies to the cleaning of all plant, equipment, hand tools and work boots when working within the corridor and conservation areas to ensure that there is no loose soil or vegetation material caught under or on the equipment and within the tread of vehicle tyres.
- i) Erosion control measures are to be in place to reduce temporary erosion and sedimentation risks to adjacent TEC vegetation and any nearby drainage channel.
- j) TEC - *Swamp Sclerophyll Forest on Coastal Floodplains*, should be restored or regenerated in accordance with the VMP.
- k) The bushland / urban interface is to be densely planted in the outer 10–15 m to provide a visual and light barrier into the corridor to promote ongoing fauna use. Plant trees along the northern edge of the PCT 1718 area to act as a vegetated buffer for Noisy Miner and other aggressive bird edge impacts into this community. Planting of additional winter flowering street trees as well as other Myrtaceous species to reduce indirect impacts on Swift Parrot foraging habitat.
- l) Monitoring for evidence of disease such as *Phytophthora cinnamomi* or Myrtle Rust and management implemented as appropriate.
- m) To minimise the impacts of collisions most notably with window strikes that cause mortality to Swift Parrots, buildings to be located directly adjacent to all proposed retained vegetation which offers potential swift parrot habitat and flyways will have extra construction design standards imposed. These are to include minimising large expanses of glazing as well as glass reflectivity and transparency. For example, reduced- or low-reflectivity glass (0–10% reflectivity) should be used and be integrated into the overall building design. Windows directly adjacent to habitat are to be installed at an angle (i.e. angled in at their base) such that the glass pane reflects the ground instead of the surrounding habitat and sky in the birds' direct line of sight. Angles become effective at a minimum of 20 degrees from vertical, although 40-degree angles are known to be more effective.

- n) Impacts of displaced aggressive birds such as Noisy Miner, Noisy Friarbirds, Common Myna and Little Wattlebird on Swift Parrot are to be minimised by appropriate fencing of the E2 areas and street planting of Myrtaceous trees particularly winter flowering species including Swamp Mahogany. Wire mesh fencing should be avoided or covered with shade cloth or planted and trained vines. Clear glass fencing, panelling or balustrading is to be avoided.
- o) Implement a yearly survey program to check for swift parrot in the southern conservation area and provide a community awareness program including educational signage outlining how to also assist.
- p) Ten (10) nest boxes of different types and hinged lids are to be installed in the corridor prior to the removal of hollow-bearing trees as a relocation point for recovered hollow-dependent fauna.
- q) Hollow-bearing trees are to be clearly marked prior to clearing. The felling of hollow-bearing trees is to be conducted under the supervision of a fauna ecologist to ensure appropriate animal welfare procedures are undertaken, particularly for threatened species. The number of hollows counted during surveys are always an overestimate, as many hollows are found to be shallow or otherwise unsuitable for use by fauna once they are inspected more closely on the ground.

The proposal has identified the removal of 164 counted hollow-bearing trees containing 375 hollows. This is an extremely large number of hollows from a high-density site to be relocated all into the corridor which already contains hollows. Hence not all of these hollows will be worth relocating. Hollows of high quality or with fauna recorded residing within should be sectionally dismantled for relocation and all hollows should be inspected for occupation, signs of previous activity and potential for reuse.

- r) Any hollows required to be removed that have retention value, are to be relocated into the corridor. Where possible these are to be securely placed into a recipient tree in a manner that will not affect the recipient tree and will permit ongoing growth without the hollow being pushed off. The end capping is to be high grade marine ply glued and screwed onto the end of the hollow and coated with two coats of external acrylic paint. The fastening technique is to use external grade hardware and any securing through the cambium is to use stainless steel to prevent reaction from the tree.

All hollows are different shapes and weights, and some may not be practical to be placed within any available recipient tree. If these are therefore instead 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 at a ratio of 1:1. Boxes should be constructed of weatherproof timber (marine ply), fasteners and external paint and also appropriately affixed to a recipient tree in the manner described above under the guidance of a fauna ecologist.

- s) If a threatened species is found to be occupying the hollow, then the hollow section is to be reattached to a recipient tree within the nearby corridor as a priority 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.
- t) If any fauna species, nest or roost is located during development works, then works should cease until safe relocation can be advised by a contact fauna ecologist.

- u) Installation of fauna underpasses under the two (2) internal roads that break up the corridor, plus one (1) additional underpass under Malloway road to link with habitat to the north-east.
- v) Adaptive management is to be undertaken for uncertain impact such as vehicle strikes.

In accordance with the BAM, Table 5.1 details proposed mitigation measures including the proposed techniques, responsibility, timing and risk of failure consequences.

Table 5.1 – Table of mitigation measures

Impacts / Mitigation measures	Technique	Timing / frequency	Responsibility	Risk of failure / Consequence
Direct				
<p>Clearing of vegetation:</p> <ul style="list-style-type: none"> Establish conservation area site to partially protect retained vegetation Restore clear areas within E2 parts of the site to fully-structured native vegetation Conservation site boundary marked and fenced Retirement of biodiversity credits to offset remaining loss Supervision and monitoring of construction activities to ensure no inadvertent damage 	<p>Establish a VMP for the habitat corridor and conservation area. A Vegetation Management Plan (VMP) is to specify restoration requirements in accordance with Section 13.2 of the BAM.</p> <p>Install chain-link or ringlock wire (50x100 mm mesh) fence surrounding conservation site (minimum height of 1.5 m).</p>	<p>Prior to issuance of subdivision certificate.</p> <p>Fencing installed prior to issuance of construction certificate.</p>	<p>The land owner (Proponent)</p>	<p>low-med</p> <p>Consequence: loss of habitat caused by vegetation clearing</p>

Impacts / Mitigation measures	Technique	Timing / frequency	Responsibility	Risk of failure / Consequence
<p>Removal of hollow-bearing trees</p> <ul style="list-style-type: none"> Supervision by fauna ecologist during removal High-quality hollows to be relocated into trees within the corridor or replaced with nest boxes at 1:1 ratio If a threatened species is found in the hollow then the hollow section is to be reattached to a recipient tree within the corridor as priority. If fauna species, a nest or roost is located, works to cease until safe relocation advised by fauna ecologist 	<p>Hollows of high quality or with fauna recorded residing within should be sectionally dismantled for relocation and all hollows should be inspected for occupation, signs of previous activity and potential for reuse.</p> <p>Any hollows required to be removed, and that have retention value, are to be relocated to the corridor and where possible affixed to a recipient tree. If due to practical reasons (size/shape/weight) these cannot be placed into a recipient tree then they are to be placed as on ground habitat and replaced in a recipient tree with appropriately sized nest boxes at a ratio of 1:1. Installed hollows/nest boxes are to be monitored every 12 months and repaired / replaced if necessary, under guidance of the fauna ecologist.</p> <p>Boxes and hollow end caps should be constructed of weatherproof timber (marine ply), fasteners and external paint and appropriately affixed to a recipient tree under the guidance of a fauna ecologist.</p>	<p>Hollow bearing trees to be removed progressively prior to the start of vegetation removal, allowing a minimum of 48hrs for fauna to relocate at their discretion. Removal of hollow-bearing trees to avoid breeding and nursing periods.</p> <p>Ten (10) nest boxes are to be installed prior to the removal of hollow-bearing trees as a relocation point for recovered hollow-dependent fauna.</p>	<p>Civil contractors under direction of the fauna ecologist</p>	<p>med-high</p> <p>Consequence: predation on arboreal gliders and other hollow-dependent fauna</p>
Indirect				
<p>Minor reduction in arboreal connectivity</p> <ul style="list-style-type: none"> Implementation of conservation corridor to retain primary connectivity 	<p>Regeneration works to enhance corridor connectivity.</p> <p>Install chain-link or ringlock wire (50x100 mm mesh) fence surrounding conservation site (minimum height of 1.5 m) to create a functional and protected corridor.</p>	<p>Revegetation completed during the construction phase.</p> <p>Fencing installed prior to commencement of construction works.</p>	<p>The land owner (Proponent)</p>	<p>low-med</p> <p>Consequence: reduction connectivity</p>

Impacts / Mitigation measures	Technique	Timing / frequency	Responsibility	Risk of failure / Consequence
<p>Reduced cross-site bird movement</p> <ul style="list-style-type: none"> - Landscaping to provide habitat and encourage bird dispersal 	<p>Landscaping within future subdivision is to utilise locally-occurring native species, with particular emphasis on flowering shrubs, to provide bird habitat and encourage cross-site bird movement. Plantings are to be at a density that allows small birds to disperse easily.</p>	<p>Post construction.</p>	<p>The land owner (Proponent)</p>	<p>high</p> <p>Consequence: restriction of cross-site bird dispersal</p>
<p>Impacts on native wildlife from feral species and domestic cat & dog presence</p> <ul style="list-style-type: none"> - Pest management 	<p>Regeneration to encourage native fauna in shelter habitat which will provide improved protection from predators.</p> <p>Undertake feral pest management within the conserved fenced areas including:</p> <ul style="list-style-type: none"> - Control of foxes and rabbits using baiting program if deemed appropriate. Care needed to avoid non-target kill; - Install chain-link or ringlock wire (50x100 mm mesh) fence surrounding conservation site (minimum height of 1.5 m) to exclude dogs and discourage cats. Placement of educational signage along the fence indicating a 'no go' area and information of impacts from domestic cats and dogs. This signage will note that the conservation area will also be subject to a baiting program; - Provide a linear hedging of native plants along the fence line to reduce the edge to width impact from Noisy Miners and other dominant edge birds. 	<p>Regeneration, fencing, signage and initial baiting to be completed prior to issuance of occupational certificate.</p> <p>Regen every six months and baiting followed up in 5 years as to be specified in VMP</p>	<p>The landowner (Proponent)</p>	<p>med</p> <p>Consequence: Increased predation on, and deterrence of, fauna</p>
<p>Edge effects</p> <ul style="list-style-type: none"> - Dense revegetation plantings - Fencing of conservation site - Targeted weed control 	<p>Denser plantings to within 15 m of the conservation area to reduce noise and light pollution, and Noisy Miner impacts.</p> <p>Install chain-link or ringlock wire (50x100 mm mesh) fence surrounding conservation site (minimum height of 1.5 m).</p> <p>Target weed control is to be undertaken within the conservation site to control the invasion or spread of weed species. VMP is to specify weed control procedures and frequency.</p>	<p>Fence completed prior to issuance of subdivision certificate</p>	<p>Civil contractors under direction of the project ecologist</p>	<p>low</p> <p>Consequence: Increased weed presence within conservation site</p>

Impacts / Mitigation measures	Technique	Timing / frequency	Responsibility	Risk of failure / Consequence
Spill-over from noise, activity, scent & lighting <ul style="list-style-type: none"> - Dense revegetation plantings - Fencing of conservation site 	Denser plantings to within 15 m of the conservation area to reduce noise and light pollution, and Noisy Miner impacts. Install chain-link or ringlock wire (50x100 mm mesh) fence surrounding conservation site (minimum height of 1.5 m) at the bushland / urban interface.	Prior to issuance of construction certificate	Civil contractors under direction of the project ecologist	low Consequence: disturbance and discouragement of resident fauna
Increased sediment and nutrient runoff <ul style="list-style-type: none"> • Water monitoring • Sediment control 	Implementation of Water Sensitive Urban Design will reduce impacts on hydrology (see Table 5.2). Stormwater detention basin (plans shown in Figures 1.16 & 1.17) will temporarily detain stormwater and slowly trickly through level spreader via outlets stabilised with rock armouring. Bioretention system will help reduce sediment and nutrient loads. Standard water monitoring procedures downstream of site. Sediment control as per <i>Managing Urban Stormwater Soils and Construction</i> (Landcom, 2004).	Monitoring directly prior to construction, then every 6 months for duration of construction period.	The land owner (Proponent)	low Consequence: increased sediment and nutrient input to conservation site and downstream watercourses
Concentrated & increased stormwater runoff <ul style="list-style-type: none"> • Appropriate storm water infrastructure and erosion control measures • Water monitoring 	Implementation of Water Sensitive Urban Design will reduce impacts on hydrology (see Table 5.2). Stormwater detention basin (plans shown in Figures 1.16 & 1.17) will temporarily detain stormwater and slowly trickly through level spreader via outlets stabilised with rock armouring. Standard water monitoring procedures downstream of site.	Stormwater management plan finalised as part of DA approval. Monitoring directly prior to construction, then every 6 months for duration of construction period.	The land owner (Proponent) / Civil engineer	low Consequence: soil erosion and concentrated stormwater water runoff
Cumulative				

Impacts / Mitigation measures	Technique	Timing / frequency	Responsibility	Risk of failure / Consequence
<p>Increased weed invasion & fungal mobilisation / infection</p> <ul style="list-style-type: none"> Standard hygiene protocol Monitoring for evidence of disease (<i>Phytophthora cinnamomi</i> and Myrtle Rust) 	<p>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 fungicide.</p> <p>Monitor plants for signs of disease.</p> <p>Quarantine any affected areas.</p>	<p>Hygiene: During site preparation & construction / at every entry of machinery and personnel onto site.</p> <p>Monitoring for disease every six months during construction period.</p>	<p>Civil contractors under direction of project ecologist</p>	<p>med</p> <p>Consequence: spread of disease leading to plant deaths and subsequent loss of fauna habitat</p>
<p>Cumulative loss of native vegetation</p> <ul style="list-style-type: none"> Restore clear areas of conservation site to fully-structured native vegetation 	<p>VMP is to specify restoration requirements.</p>	<p>Prior to issuance of construction certificate.</p>	<p>The land owner (Proponent)</p>	<p>low</p> <p>Consequence: loss of habitat caused by vegetation clearing</p>
<p>Increased human presence</p> <ul style="list-style-type: none"> Conservation site boundary fenced to exclude pedestrian access 	<p>Install chain-link or ringlock wire (50x100 mm mesh) fence surrounding conservation site (minimum height of 1.5 m).</p>	<p>Prior to issuance of construction certificate</p>	<p>Civil contractors under direction of project ecologist</p>	<p>low</p> <p>Consequence: trampling of vegetation and disturbance of resident fauna</p>
<i>Uncertain impacts</i>				

Impacts / Mitigation measures	Technique	Timing / frequency	Responsibility	Risk of failure / Consequence
<p>Increased fauna mortality from vehicle strikes</p> <ul style="list-style-type: none"> Adaptive management 	<p>Fencing to divert fauna crossing to preferred locations.</p> <p>Installation of fauna underpasses under the two (2) internal roads that break up the corridor, plus one (1) additional underpass under Malloway road to link with habitat to the north-east.</p> <p>Slow traffic at crossings to 40 km/h.</p> <p>Use traffic slowing devices and signage.</p> <p>Monitoring of roadkill and reported vehicle strikes within subdivision internal roads. Reduction in speed limit and placement of speed humps if there is increase in vehicle strikes.</p>	<p>Monitoring following internal road construction / every 12 months</p>	<p>The land owner (Proponent)</p>	<p>med / low</p>

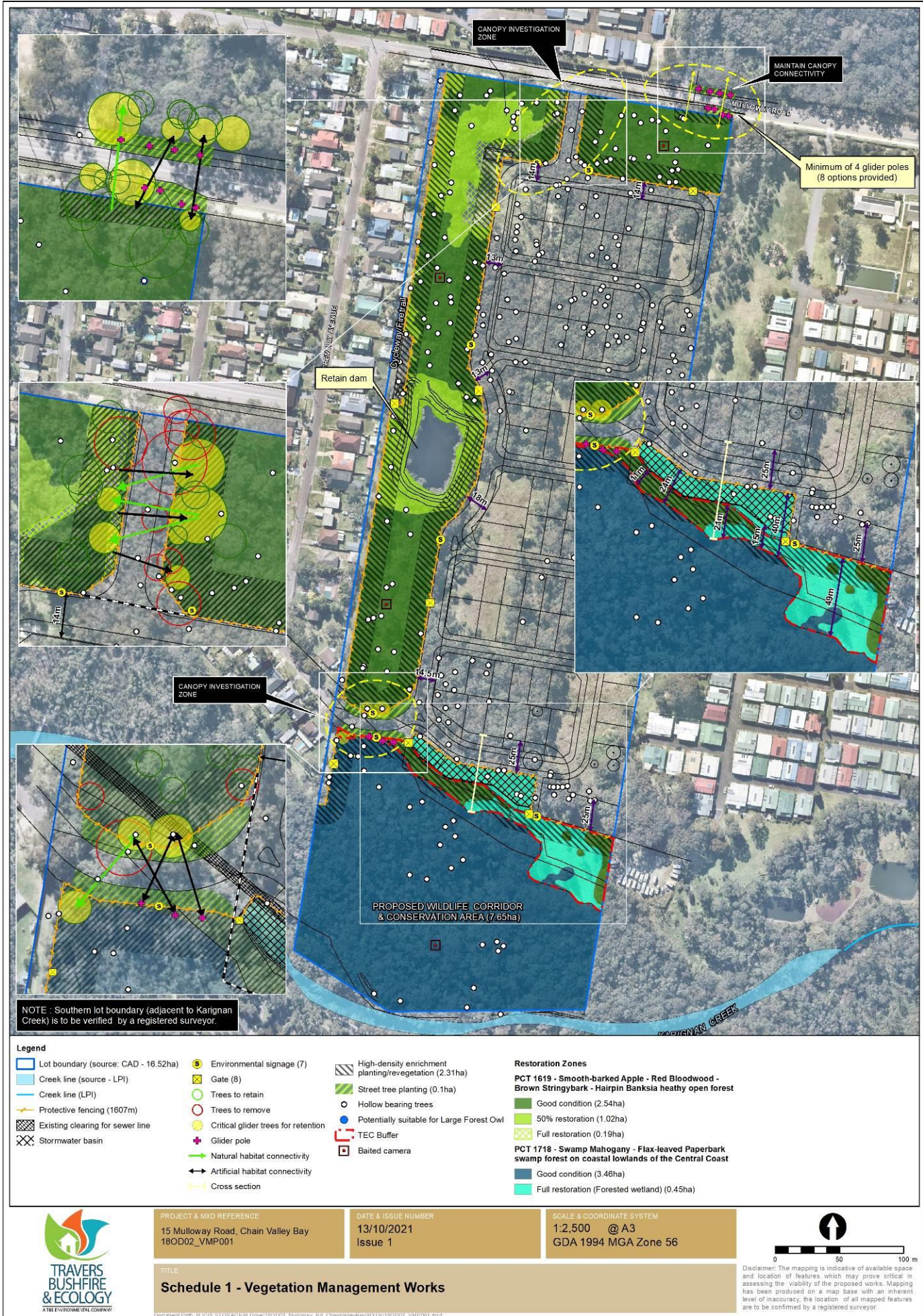


Figure 12– Vegetation Management Works

5.5 Biodiversity credit requirements

5.5.1 Prescribed impacts (BC Reg)

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

- *Human made structures*

There is an abandoned dwelling on site as well as an outbuilding (shed) which have both been checked for potential microbat roosts. None have been observed during those surveys. As a condition of consent, it is recommended that these structures on site be checked for use by microbats approximately 1-2 weeks before their demolition or removal.

- *Non-native vegetation*

Non-native vegetation exists in large patches within the site which include improved pasture. There is no regeneration of native bushland within these open spaces which have been mapped as cleared and would not likely provide any sufficient resources for fauna species as they are regularly mown.

The vegetation along the western boundary of approximately 2 m width is generally devoid of native vegetation but contains weed plumes or garden escapes from adjoining properties. These areas provide such minimal resources for fauna species and being in close proximity to the human interface including predators such as domestic animals, would be rarely used by threatened species.

- *Connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range*

This has been assessed in detail according to the criteria outlined in Section 9.2.1.5 of the BAM and with consideration to avoidance and minimising impacts as outlined in Section 8.2:

(a) Current and proposed connectivity is described in detail Section 4.5. Broad scale local area connectivity is depicted on Figure 8 (and also on site and location Figures 1.5 & 1.6) and connectivity across the study area and immediate surrounds is depicted on Figure 9.

(b) Terrestrially dependent threatened species recorded and potentially benefitting from the current connectivity through the study area (between habitats to the north and south) includes Squirrel Glider and Wallum Froglet. Squirrel Glider was not captured during combined trapping surveys but was heard to a 'possible' level of certainty and is known historically in the locality (see Figure 13). Wallum Froglet was recorded in the southern portions of the site which become temporary inundated after heavy rains within PCT 1718. Wallum Froglet may disperse through the locality during ideal weather events. As seen on Figure 13, the species is established in more suitable breeding habitat to both the north and south. The other threatened fauna recorded are highly mobile flying species. There are no other terrestrially dependent threatened fauna considered with a high potential to occur based on Table 4.9.

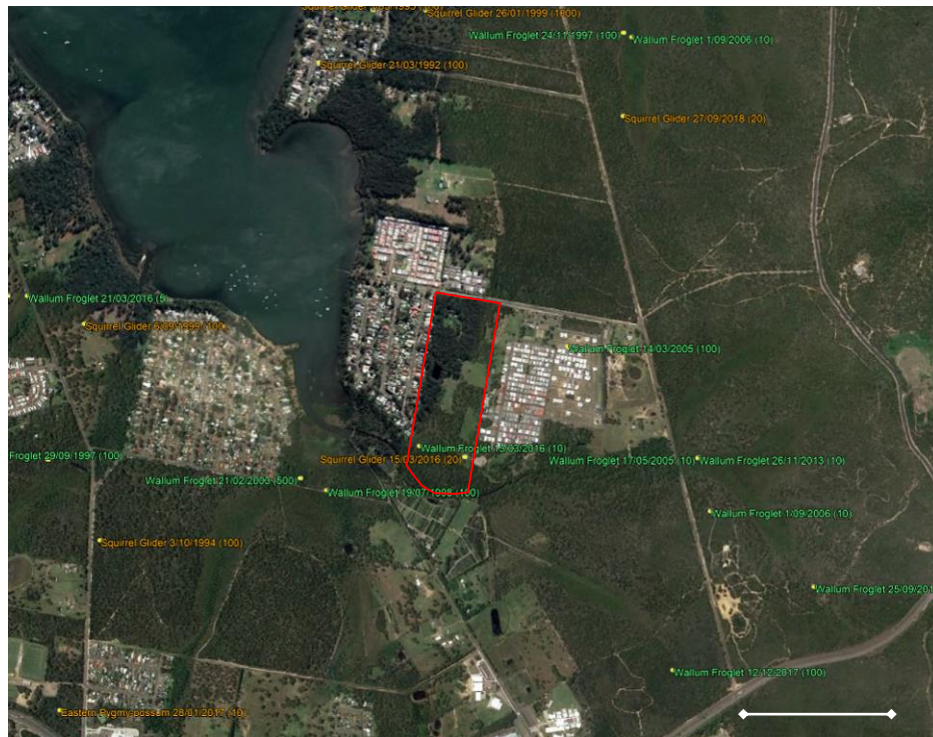


Figure 13 – Local records of Wallum Froglet and Squirrel Glider

- (c) For Squirrel Glider, potential movements through the study area are considered to be seasonal as foraging resources permit and become available. This more so than as core denning and breeding habitat given that the species was not recorded during trapping efforts. This may also change in time.

For Wallum Froglet, the current connectivity may provide some shelter and foraging potential away from moist core habitat areas however is likely more valued as dispersal habitat to other breeding sites and subsequent value to local gene flow. Such dispersal would be expected to occur on rare occasions during more prolonged rain events. This species has been observed dispersing in notable numbers by *Travers bushfire & ecology* staff during such an event at Forster.

- (d) Section 4.5 cites relevant local council resources identifying the history of important regional and local connectivity. The North Wyong Shire Structure Plan (2012) identifies the southern portion of the study area (currently zoned as E2) as a 'green corridor and habitat network' east to west along Karignan Creek. This connectivity will remain unchanged by the proposal. The remaining northern portions of the study area providing connectivity north into Lake Macquarie State Conservation Area and up to the Gwandalan peninsula is mapped in the NWSSP as 'Development Precincts'. The connectivity portions that will be narrowed by the proposal is therefore not identified as important within any local literature sourced.
- (e) Connectivity to the north will not be eliminated by the proposal but rather narrowed to 60 m, also with two road bisections causing added fragmentation. The road bisections will not cause any barrier effect on fauna that aren't already impacted by Mulletway Road. The consequences of these prescribed impacts are considered to be minor with consideration to potentially affected fauna. Squirrel Glider has been considered as part of the Habitat Corridor Functional Analysis prepared by *Travers bushfire & ecology* in 2019 (refer to Appendix 6) and

appropriate measures of providing poles on either side of the roads will be implemented. These measures to minimise connectivity impacts outlined by the Habitat Corridor Functional Analysis are in addition to those otherwise specified in Section 5.3.

The proposed corridor was located following the preparation of the Habitat Corridor Functional Analysis and liaisons with council, and the reasons of avoiding and minimising subsequent impacts are outlined in the connectivity discussions in Section 4.5.

- *Water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining or other development),*

This has been assessed in detail according to the criteria outlined in Section 9.2.1.7 of the BAM and with consideration to avoidance and minimising impacts as outlined in Section 8.2:

- (a) The existing dam will be retained within the corridor, and Karignan Creek to the south is well outside the development footprint.

Potential hydrological and water quality of overland flow south to Swamp Sclerophyll Forest vegetation may be impacted by the proposal.

- (b) The key threatened entity likely to utilise or depend on the current overland flow hydrology is Swamp Sclerophyll Forest. Wallum Froglet has also been recorded within this vegetation community which supports suitable breeding habitat and shelter opportunity. Wallum Froglet is not likely to utilise the dam for breeding, nor are any other threatened frog species.
- (c) Swamp Sclerophyll 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. Given the largely flat nature of the site and restriction of the majority of the EEC to below the 1 in 100 year flood level, it is reasonable to infer that the extent of the flood plain and the flooding regime is of most importance for the persistence of the EEC vegetation within the site. However, the flooding regime will not be impacted by the proposal as no drainage or major elevation changes are proposed. Overland flow from rain runoff, even though of less importance to the EEC than flooding regime, is the key hydrological process of interest here as it may be impacted by the proposal through increased volume and velocity of runoff, and higher sediment and nutrient loads. MUSIC modelling provided by Dr Peter Bacon of Woodlots and Wetlands Pty Ltd is summarised below in Table 5.2. Using Water Sensitive Urban Design (WSUD), the proposal is likely to increase stormwater flow by 47 ML/yr, suspended solids by 355 kg/yr, phosphorus by 8.2 kg/yr and nitrogen by 53.7 kg/yr, but will decrease gross pollutants by 202 kg/yr.

The proposed detention basin will only temporarily hold drainage water which will be dissipated through a level spreader at the south-eastern end of the basin (see Figures 1.16 and 1.17). The discharge waters are delivered to the existing non-EEC cleared areas that will be stabilised and revegetated under the VMP. The discharge area will be restored to Swamp Sclerophyll Forest on Coastal Floodplains (PCT 1718) in recognition of the adjoining vegetation with the intention of delivering treated stormwater to a vegetation community that can receive the water. As a result, there will be negligible risk of sediment discharge

or erosion within the EEC. There will be no significant change in surface runoff patterns from the site because of the proposed basin.

The VMP also incorporates a maintenance and target weed control program to minimise the risk of weed invasion whilst the basin is being established and revegetated.

Hydrological processes provide breeding opportunity for Wallum Froglet as the species breeds in swamps with permanent water as well as shallow ephemeral pools. Shelter sites are also wet or very damp and often located near the water's edge. The site-relevant threats on Wallum Froglet outlined under the species OEH profile are all related to hydrological processes, and include:

- Destruction and degradation of coastal wetlands as a result of roadworks, coastal developments and sandmining.
- Reduction of water quality and modification to acidity in coastal wetlands.
- Nutrient enrichment and chemical run off from urban and agricultural areas and as a result of mosquito control.

- (d) The Final Determination for Swamp Sclerophyll Forest (NSW Scientific Committee 2011) states that the composition of the EEC "is primarily determined by the frequency and duration of waterlogging and the texture, salinity nutrient and moisture content of the soil, and latitude". Changes to hydrological regime is listed as a key threatening process for this EEC in BioNet, and can alter the composition and structure of the understorey of this EEC. Changes to hydrological regimes include increased and decreased periods of inundation and changes to salinity. As stated under point c) above, overland flow is likely to be of less importance than flood regime for the EEC within the study area. Changes in overland flow hydrology such as increased volume and velocity of runoff, and higher sediment and nutrient loads are likely to have importance in relation to understorey composition and prevalence of weed species. The proposed measures, including WSUD and the vegetated sedimentation basin, will reduce changes to hydrology and surface runoff patterns from the site.

Whilst Wallum Froglet has been recorded in a range of habitats, they are usually associated with acidic swamps on coastal sand plains, typically occurring in sedgeland and wet heath, but as the species profile outlines, they are occasionally found in Swamp Sclerophyll Forests. Figure 13 above shows local records of Wallum Froglet occurring nearby in all directions. Wet heath (for which they are more typically associated) can be seen on this aerial photo as the more uniform and lighter coloured areas. This Figure shows that there are large areas of more typical habitat in the nearby surrounding locality where the species is known to occur. Therefore, the importance of the water bodies for Wallum Froglet within the study area is not of unique importance in the bioregion.

- (e) 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 including WSUD (Table 5.2) and diversion of stormwater into the proposed sedimentation basin (Figures 1.16 and 1.17), such that hydrological process in the Swamp Sclerophyll Community may persist under natural scenarios.

- (f) 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. Stormwater management including WSUD and the proposed sedimentation basin (Figures 1.16 and 1.17) will further reduce sediment and nutrient loads entering the EEC (Table 5.2). Implementation of the VMP in the conservation areas will allow the control of weed species.
- (g) The bioregional persistence of Swamp Sclerophyll Forest is not likely to be substantially altered as a consequence of the proposal, provided the above-mentioned measures are taken to avoid and mitigate impacts.
- (h) With the provision of stormwater management to control the indirect impacts of water quantity and quality into the Swamp Sclerophyll Forest and the management of edge effects, the remaining impacts on Wallum Froglet core habitat for critical life-cycle stages is expected to be minimal. This for both the short and long-term. This is through ensuring the control measures typical for development as well as those proposed specific to this site, are implemented and adequately reported.
- (i) BioNet list several threats to Swamp Sclerophyll Forest, of which the following are relevant to the potential hydrological changes:
 - Changes to hydrological regimes. (e.g. increased and decreased periods of inundation and changes to salinity). These include draining associated with ditching, levees and dykes; infill, altered inundation conditions.
 - Changes in species diversity, soil chemistry, fire frequency, vegetation structure and loss of ecological function caused by weeds. This includes woody weeds (e.g. groundsel bush, lantana, camphor laurel and bitou bush), Exotic vines & scramblers, Invasive grasses & other weeds (including aquatics).
 - Pollution (including herbicide, pesticides, fertilisers) & sedimentation from runoff.
- (j) There are no existing mining operations mining underneath the same water dependent plant communities on site.
- (k) The Upland Swamp Policy does not apply to Swamp Sclerophyll Forest on Coastal Floodplains.
- (l) Impacts on hydrological processes influencing the extent and composition of Swamp Sclerophyll Forest are able to be avoided or mitigated by appropriate stormwater management, and erosion and sediment control measures. This includes the WSUD and detention basin noted above. In addition, the VMP will detail management actions to mitigate any residual indirect impacts including weed establishment.

Table 5.2 – Pre- and post-development stormwater attributes

Stormwater attributes	Pre-development	Development without WSUD components as modelled	Development with WSUD components as modelled	Percent reduction due to WSUD components	WSC WSUD performance criteria	Compliance
Flow (ML/yr)	33.0	87	80	8	Not given	n/a
Total Suspended Solids (kg/yr)	705	18600	1060	94	80%	Yes
Total Phosphorus (kg/yr)	1.8	31	10	67	45%	Yes
Total Nitrogen (kg/yr)	20.3	193	74	61	45%	Yes
Gross Pollutants (kg/yr)	202	2160	0	100	90%	Yes

- *Vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community*

This has been assessed in detail according to the criteria outlined in Section 9.2.1.9 of the BAM and with consideration to avoidance and minimising impacts as outlined in Section 8.2:

- (a) Figure 1.6 shows the proposed subdivision layout associated with the rezoning. Proposed perimeter roads run along the edges of the conservation area as well as across the proposed corridor at two locations.

The Wallum Froglet is the only threatened fauna species recorded and potentially impacted as a result of vehicle collision. All other threatened fauna with considered potential to occur (as listed in Tables 4.8 & 4.9) are species capable of flight and not considered to be at risk from the slower internal street traffic. The SAIL assessment on Swift Parrot has considered vehicle collisions but more likely window and fence collisions and subsequent design measures have been outlined in Section 5.3 minimisation of impacts.

- (b) Taking into consideration mobility, abundance and range, the likelihood of Wallum Froglet vehicle strike is considered to be generally very low, with increased potential during wet weather periods of dispersal from the southern study area.
- (c) Vehicle strike rates on Wallum Froglet together with another threatened frog species (Wallum Sedge Frog) was studied by *Goldingay & Taylor (2006)* along two 100 m sections of a road that traverses known frog habitat near Lennox Head, in north-eastern New South Wales. This documented numerous (over 1000 counted over 13 mornings) frog deaths from vehicle collision during suitable conditions for movement. Whilst the population dynamics, habitat quality, distance from road and vehicle activity on roads varies between all sites, the study does demonstrate the species (and other frogs) susceptibility to impact from roads.
- (d) The habitat supporting Wallum Froglet breeding within the southern portions of the study area is not considered as ideal or as extensive as other Wallum froglet breeding habitat in the local surrounds. This is demonstrated also from call surveys. Figure 13 shows Wallum Froglet records in the locality and also the corresponding extent of wet heath (wallum type) habitat where the vegetation is

most uniform colour on the aerial photograph. Whilst the development has potential for vehicle strike impacts this would not be considered of any likely greater impact than the main roads of Chain Valley Bay Road or Mulloway Road, or of the existing development to the immediate east and west.

Based on the potential for vehicle collisions, measures to avoid frog access to the proposed internal residential road network is necessary. This should be in the form of a solid weatherproof permanent barrier fencing at 500 mm in minimum height running along the proposed fencing of the conservation area and corridor. This will instead direct any dispersing frogs along the corridor.

The Habitat Corridor Functional Analysis prepared by *Travers bushfire & ecology* in 2019 (refer to Appendix 6) also highlighted the potential for the two proposed roads that will bisect the corridor to impact on terrestrial fauna trying to make passage. Therefore, the installation of under road culverts were recommended below both the Teraglin Drive access road and the site entry road off Mulloway Drive (both of which bisect the proposed corridor) to facilitate the movement of wildlife.

This will need to be designed so that the under-road passage surface is naturally vegetated as much as possible up to the culverts with other available shelter opportunities where the vegetation doesn't grow inside. The under surface should not be solid concrete construction or rubble but rather soil surface. The culverts should each have a minimum combined total width of 4m below each road. These measures will also minimise the potential for culverts to act as a predation point.

The frog proof fencing is to be designed to direct frogs, and other small terrestrial fauna, through the culverts without any gaps towards the roads at these junctions.

Note: Karst, caves, crevices, cliffs, rock outcrops are absent from the site. No wind turbines are proposed.

5.5.2 Impacts requiring offset

The following impacts will require offsetting:

- 6.36 ha loss of good-quality PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands;
- 0.02 ha loss of good-quality 1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast equivalent to TEC Swamp Sclerophyll Forest;
- 2.5 ha loss of cleared grassland
- Indirect impacts causing loss of vegetation integrity outside of direct impact zones (see below)
- Subsequent impacts on Wallum Froglet, Pale-headed Snake, Giant Dragonfly, Green and Golden Bell Frog, Swift Parrot, Squirrel Glider and Southern Myotis species habitat;

(a) Offsetting of indirect impacts

Residual indirect impacts from edge effects are proposed to be offset through the BOS. Section 3.1.5 of this BCAR details the assumptions made in calculating the change in VI score within additional management zones up to 10 m from the direct impact area.

5.5.3 Impacts not requiring offset

All areas of native vegetation impact will require offsetting and have been accounted for in the BAM calculator. Pasture improved areas, existing pathways without vegetation, and the weedy cleared area along parts of the western boundary do not contain native vegetation and will not require an offset.

The Pale-headed Snake species polygon has not included the cleared vegetation zones of the development footprint. The TBDC habitat and ecology tab for the species provides 6 points of descriptive habitat for the species. Five of these relate to the dependence on tree habitats such as hollows, woodland, forest or prey species being predominantly tree frogs. The last relates to occurrences favouring areas close to riparian habitat in drier environments. There is no descriptive text relating to the species use of open cleared areas. Given also the species high dependence on hollows and its tree climbing habits described.

5.6 Biodiversity offset strategy

The key elements of the biodiversity offset strategy include:

- Purchase credits from the biodiversity credit market
- Payment into the Biodiversity Conservation Fund (BCF)

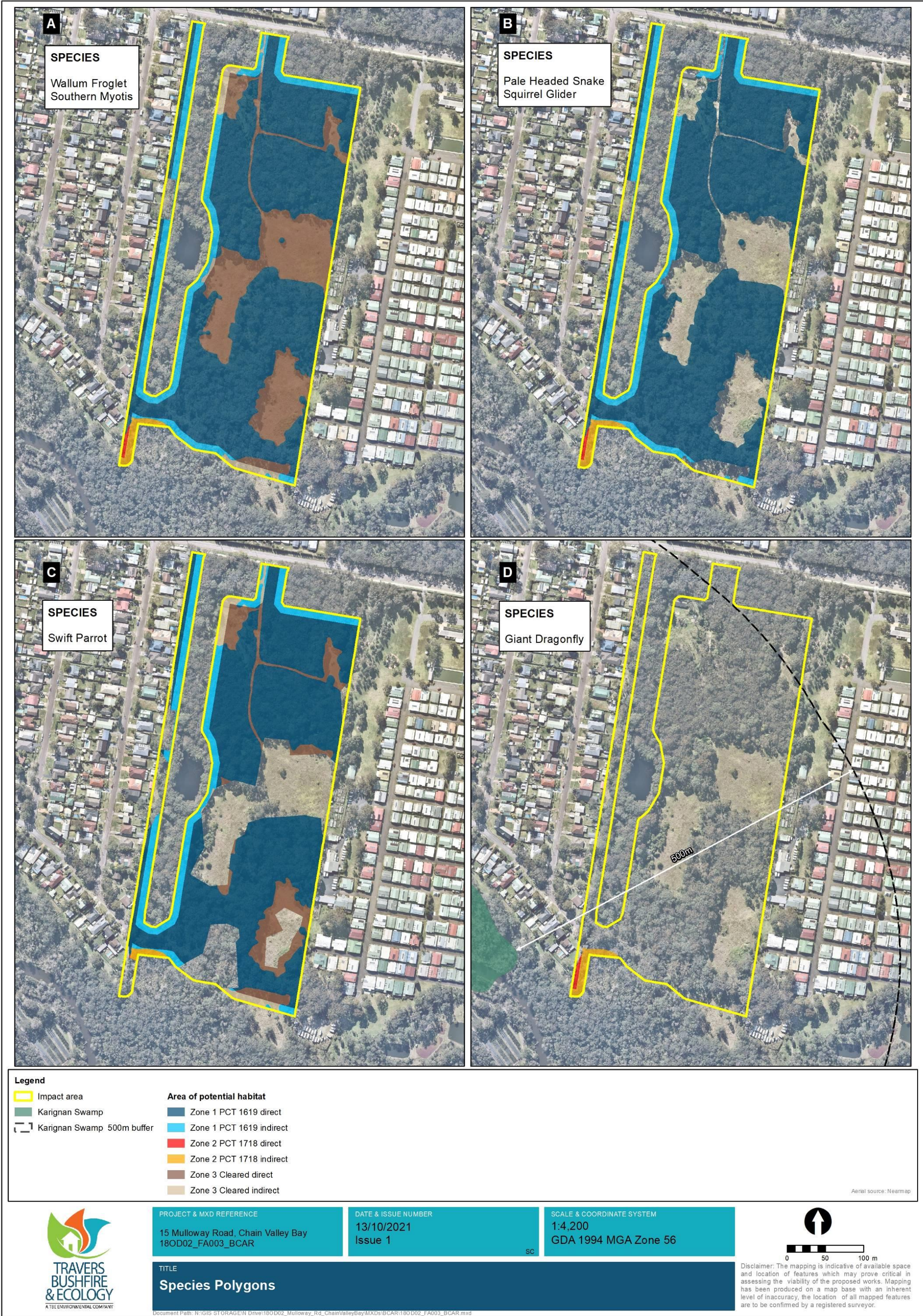


Figure 14.1 – Species habitat polygons (WF, SM, PHS, SG, SP & GD)



Legend

Impact area

Green & Golden Bell Frog potential breeding habitat 200m buffer

Area of potential habitat

- Zone 1 PCT 1619 direct
- Zone 1 PCT 1619 indirect
- Zone 2 PCT 1718 direct
- Zone 2 PCT 1718 indirect
- Zone 3 Cleared direct
- Zone 3 Cleared indirect

Aerial source: Nearmap

TRAVERS BUSHFIRE & ECOLOGY
A TBE ENVIRONMENTAL COMPANY

PROJECT & MXD REFERENCE

15 Mulloway Road, Chain Valley Bay
18OD02_FA006_BCAR

DATE & ISSUE NUMBER

13/10/2021
Issue 1

SCALE & COORDINATE SYSTEM

1:2,200
GDA 1994 MGA Zone 56

TITLE

Species Polygons

Document Path: N:\GIS STORAGE\N Drive\18OD02_Mulloway Rd_ChainValleyBay\MXD\BCAR\18OD02_FA006_BCAR.mxd

0 50 100 m

Disclaimer: 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 are to be confirmed by a registered surveyor.

Figure 14.2 – Species habitat polygons (GGBF)



BAM Credit Results

6

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 within the impact area, and a future vegetation integrity score of 0.

Habitat suitability for threatened species has been considered in Section 4. Some species are considered for species credits, particularly if potential breeding habitat is compromised or impacted. Presence of threatened species has been assumed where survey is insufficient to rule out presence, such as for Pale-headed Snake.

Ecosystem credits for plant community types (PCTs), ecological communities and threatened species habitat is shown below in Table 6.1. Species credits for threatened species are shown in Table 6.2.

Table 6.1 – Requirement for ecosystem credits

Zone	Veg. zone name	Veg. integrity loss	Area (ha)	Sensitivity to potential gain	Biodiversity risk weighting	Potential SAI	Ecosystem credits
1	1619_moderate_good	62.3	7.6	High	1.50	no	177
2	1718_moderate_good	17.9	0.12	High	2	no	1
3	1619_cleared	12.4	2.6	High	1.50	no	0
Total:							178

Table 6.2 – Requirement for species credits

Veg. zone name	Veg. integrity loss	Area (ha)	Biodiversity risk weighting	Candidate SAI	Species credits
Wallum Froglet					
1619_cleared	12.4	2.6	1.5	False	12
1619_moderate_good	62.3	7.6	1.5	False	177
1718_moderate_good	17.9	0.12	1.5	False	1
Subtotal:					190
Pale-headed Snake					
1619_moderate_good	62.3	7.6	2	False	236
1718_moderate_good	17.9	0.12	2	False	1
Subtotal:					237
Swift Parrot					
1619_cleared	12.4	0.99	3	True	9
1619_moderate_good	62.3	6.7	3	True	312

1718_moderate_good	17.9	0.04	3	True	1
Subtotal: 322					
Green and Golden Bell Frog					
1619_moderate_good	62.3	0.33	2	False	10
1718_moderate_good	17.9	0.12	2	False	1
Subtotal: 11					
Southern Myotis (Large-footed Myotis)					
1619_cleared	12.4	2.6	2	False	16
1619_moderate_good	62.3	7.6	2	False	236
1718_moderate_good	17.9	0.12	2	False	1
Subtotal: 253					
Giant Dragonfly					
1718_moderate_good	17.9	0.12	3	True	2
Subtotal: 2					
Squirrel Glider					
1619_moderate_good	62.3	7.6	2	False	236
1718_moderate_good	17.9	0.12	2	False	1
Subtotal: 237					

6.2 Ecosystem credit classes

Table 6.3 – Ecosystem credit summary

PCT	TEC	Area (ha)	Credits
1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	Not a TEC	10.1	177
1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.12	1

Table 6.4 – Credit classes for PCT 1619 and 1718 - Like for like options

PCT	Vegetation Class	Trading group	TEC	Containing hollow-bearing trees?	Credits
1619	Sydney Coastal Dry Sclerophyll Forests	Sydney Coastal Dry Sclerophyll Forests - < 50% cleared group (including Tier 4 or higher). This includes PCTs: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776,	-	Yes	Wyong, Hunter, Pittwater and Yengo <u>OR</u> any IBRA subregion that is within 100 km of the outer edge of the impacted site

		1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787			
1718	-	-	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. This includes PCTs 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	Yes	Wyong, Hunter, Pittwater and Yengo OR any IBRA subregion that is within 100 km 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
<i>Crinia tinnula</i> / Wallum Froglet	1619_moderate_good, 1619_cleared, 1718_moderate_good	10.3	190
<i>Hoplocephalus bitorquatus</i> / Pale-headed Snake	1619_moderate_good, 1718_moderate_good	7.7	237
<i>Lathamus discolor</i> / Swift Parrot	1619_moderate_good, 1619_cleared, 1718_moderate_good	7.7	322
<i>Litoria aurea</i> / Green and Golden Bell Frog	1619_moderate_good, 1718_moderate_good	0.45	11
<i>Myotis macropus</i> / Southern Myotis	1619_moderate_good, 1619_cleared, 1718_moderate_good	10.3	253
<i>Petalura gigantea</i> / Giant Dragonfly	1718_moderate_good	0.12	2
<i>Petaurus norfolcensis</i> / Squirrel Glider	1619_moderate_good, 1718_moderate_good	7.7	237

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

6.4 Ecosystem and species credit costs

The costing of credits regularly changes and in recent editions of the calculator, prices have risen quite substantially for many of both the ecosystem and credit species. Appendix 7 provides a current appraisal of the credits at the time when this report was written.

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Threatened & Migratory Species Habitat Assessment

A1

Table A1.1 provides an assessment of potential habitat within the subject site for nationally listed threatened flora species indicated to have potential habitat present within 10 km on the *EPBC Act* Protected Matters Tool.

Table A1.1 – National threatened flora habitat assessment

Scientific name <small>DATABASE SOURCE</small>	BC Act	EPBC Act	Growth form and habitat requirements	Recorded on site (✓)	If not recorded on site			
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) <small>Notes 1,2 & 3</small>	Record(s) from recent years (✓) <small>Notes 1,2 & 3</small>	Potential to occur (✓)
<i>Acacia bynoeana</i>	E1	V	Erect or spreading shrub to 0.3 m high growing in heath and dry sclerophyll Open Forest on sandy soils. Often associated with disturbed areas such as roadsides. Distribution limits N-Newcastle S-Berrima.	x	✓	✓	✓	✓
<i>Astrotricha crassifolia</i> <small>BAMC</small>	V	V	Shrub to 2.4 m high. Grows in dry sclerophyll woodland on sandstone. Distribution limits N-Patonga S-Royal NP.	x	✓	-	-	x
<i>Angophora inopina</i>	V	V	Small tree in open sclerophyll forest growing on deep sandy soils with associated lateritic outcrops. Distribution limits N-Wyee S-Gorokan with a disjunct population near Karuah.	x	✓	✓	✓	✓

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements	Recorded on site (✓)	If not recorded on site			
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur (✓)
<i>Caladenia tessellata</i>	E1	V	Terrestrial orchid. Clay-loam or sandy soils. LHCCREMS guidelines suggest the species grows in Map Unit 34 – Coastal Sand Wallum Woodland - Heath. Flowers in September – November. Distribution limits N-Swansea S-south of Eden.	x	marginal	4 km is nearest	x	low
<i>Corunastylis</i> sp. Charmhaven	E4A	CE	Terrestrial orchid currently only known from the Wyong Shire of NSW in the Gorokan/Charmhaven area. It occurs within low woodland to heathland with a shrubby understorey and ground layer. Dominants include <i>Allocasuarina littoralis</i> , <i>Leptospermum juniperinum</i> , <i>Melaleuca nodosa</i> , <i>Callistemon linearis</i> and <i>Schoenus brevifolius</i> . Flowers likely in Feb-Mar.	x	✓	10 km away	✓	low likelihood
<i>Cryptostylis hunteriana</i>	V	V	Saprophytic orchid. Grows in swamp heath on sandy soils. Distribution limits N-Gibraltar Range S-south of Eden.	x	✓	✓	✓	✓
<i>Cynanchum elegans</i>	E1	E	Climber or twiner to 1 m. Grows in rainforest gullies, scrub & scree slopes. <i>Distribution limits N-Gloucester S-Wollongong.</i>	x	x	-	-	x
<i>Diuris praecox</i>	V	V	Terrestrial orchid. Grows in sclerophyll forest near the coast. Distribution limits N-Nelson Bay S-Ourimbah.	x	✓	✓	✓	✓
<i>Eucalyptus camfieldii</i>	V	V	Stringybark to 10 m high. Grows on coastal shrub heath and woodlands on sandy soils derived from alluviums and Hawkesbury sandstone. Distribution limits N-Norah Head S-Royal NP.	x	x	-	-	x
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	V	V	Red gum to 15 m high. Grows in dry open forest on sandy to clay soils often in lowly elevated moist sites. Distribution limits N-Port Macquarie S-Central Coast.	x	✓	Very few records, nearest is 4 km away	x	low likelihood

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements	Recorded on site (✓)	If not recorded on site			
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur (✓)
<i>Genoplesium insigne</i> (<i>Corunastylis insignis</i>)	E1	CE	Terrestrial orchid. Found in <i>Themeda</i> patches among shrubs and sedges in heathland and forest. Known from 3 localities in Wyong-Charmhaven area. Occurs in vegetation dominated by Scribbly Gum, Red Bloodwood, Smooth-barked Apple and Black She-oak at Charmhaven. Flowers Sept-Oct.	x	✓	✓	✓	✓
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	V	V	Open to erect shrub to 1 m. Grows in woodland on light clayey soils Distribution limits N-Cessnock S-Appin.	x	x	-	-	x
<i>Melaleuca biconvexa</i>	V	V	Tall shrub. Grows in wetlands adjoining perennial streams and on the banks of those streams, generally within the geological series known as the Terrigal Formation. Distribution limits N-Port Macquarie S-Jervis Bay.	x	✓	Nearest is 9 km away	✓	unlikely
<i>Persoonia hirsuta</i>	E1	E	Erect to decumbent shrub. Grows in dry sclerophyll forest and woodland on Hawkesbury sandstone with infrequent fire histories. Distribution limits N-Glen Davis S-Hill Top.	x	marginal	x	x	x
<i>Pterostylis gibbosa</i>	E1	E	Terrestrial orchid which occurs near Wollongong and in Hunter Valley in sclerophyll forest, sometimes with paperbarks.	x	x	-	-	x
<i>Rutidosia heterogama</i>	V	V	Erect herb to 30 cm. Grows mostly in heath, often along roadsides. Distribution limits N-Maclean S-Hunter Valley.	x	unlikely	nearest record is 4 km away	✓	unlikely
<i>Syzygium paniculatum</i>	V	V	Small tree. Subtropical and littoral rainforest on sandy soil. Distribution limits N-Forster S-Jervis Bay.	x	x	-	-	x
<i>Tetratheca juncea</i>	V	V	Prostrate shrub to 1 m high. Dry sclerophyll forest and heath. Distribution limits N-Bulahdelah S-Port Jackson.	x	✓	✓	✓	✓

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements	Recorded on site (✓)	If not recorded on site			
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) <i>Notes 1, 2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1, 2 & 3</i>	Potential to occur (✓)
<i>Thelymitra adorata</i>	E4A	CE	A ground orchid up to 60 cm tall with a single leaf. Occurs from 10-40 m a.s.l. in grassy woodland or occasionally derived grassland in well-drained clay loam or shale derived soils. The vegetation type in which the majority of populations occur (including the largest colony) is a Spotted Gum - Ironbark Forest with a diverse grassy understorey and occasional scattered shrubs	x	x	-	-	x
<i>Thesium australe</i>	V	V	Erect herb to 0.4 m high. Root parasite. Themeda grassland or woodland often damp. Distribution limits N-Tweed Heads S-south of Eden.	x	x	-	-	x
BAMC	- Denotes species produced by the BAM calculator as having potential habitat (nationally listed)							
V	- Denotes vulnerable listed species under the relevant Act							
E or E1	- Denotes endangered listed species under the relevant Act							
E2	- Denotes endangered population							
E4a or CE	- Denotes critically endangered listed species under the relevant Act							
NOTE:	1. This field is not considered if no suitable habitat is present within the study area 2. 'records' refer to those provided by the <i>Atlas of NSW Wildlife</i> 3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle							

Table A1.2 provides an assessment of potential habitat within the subject site for nationally listed threatened fauna species recorded within 10 km on *Bionet* (DPIE) or indicated to have potential habitat present within 10 km on the *EPBC Act* Protected Matters Tool.

Table A1.2 – Nationally threatened fauna habitat assessment

Common name Scientific name DATABASE SOURCE	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site			
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur (✓)
Giant Burrowing Frog <i>Heleioporus australiacus</i> EPBC	V	V	Inhabits open forests and riparian forests along non-perennial streams, digging burrows into sandy creek banks. <i>Distribution Limit: N-Near Singleton S-South of Eden.</i>	x	x	-	-	x
Green and Golden Bell Frog <i>Litoria aurea</i> OEH EPBC	E	V	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. <i>Distribution Limit: N-Byron Bay S-South of Eden.</i>	x	marginal	✓	x	unlikely
Littlejohn's Tree Frog <i>Litoria littlejohni</i> EPBC	V	V	Found in wet and dry sclerophyll forest associated with sandstone outcrops at altitudes 280–1,000 m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. <i>Distribution Limit: N-Hunter River S-Eden.</i>	x	x	-	-	x

Common name Scientific name DATABASE SOURCE	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site			
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur (✓)
Australasian Bittern <i>Botaurus poiciloptilus</i> EPBC	E	E	Found in or over water of shallow freshwater or brackish wetlands with tall reedbeds, sedges, rushes, cumbungi, lignum and also in ricefields, drains in tussocky paddocks, occasionally saltmarsh, brackish wetlands. <i>Distribution Limit: N-North of Lismore. S- Eden.</i>	x	x	-	-	x
Eastern Curlew <i>Numenius madagascariensis</i> TBE	-	CE	Primarily coastal especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. Often recorded among saltmarsh and on mudflats fringed by mangroves and also in coastal saltworks and sewage farms. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	Sub-optimal	x	x	Not likely
Swift Parrot <i>Lathamus discolor</i> OEH EPBC	E	E	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. <i>Distribution Limit: N-Border Ranges National Park. S-South of Eden.</i>	x	✓	✓	✓	✓
Eastern Bristlebird <i>Dasyornis brachypterus</i> EPBC	E	E	Coastal woodlands, dense scrubs and heathlands, especially where low heathland borders taller woodland or dense tall tea-tree. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	x	-	-	x
Regent Honeyeater <i>Xanthomyza Phrygia</i> OEH EPBC	E4A	CE	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. <i>Distribution Limit: N-Urbanville. S-Eden.</i>	x	✓	x	x	low

Common name Scientific name DATABASE SOURCE	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site			
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur (✓)
Painted Honeyeater <i>Grantiella picta</i> EPBC	V	V	A nomadic bird occurring in low densities within open forest, woodland and scrubland feeding on mistletoe fruits. Inhabits primarily Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. <i>Distribution Limit: N-Boggabilla. S-Albury with greatest occurrences on the inland slopes of the Great Dividing Range.</i>	x	Sub-optimal	x	x	Not likely
Spotted-tailed Quoll <i>Dasyurus maculatus</i> OEH EPBC	V	E	Dry and moist open forests containing rock caves, hollow logs or trees. <i>Distribution Limit: N-Mt Warning National Park. S-South of Eden.</i>	x	✓	x	✓	unlikely
Koala <i>Phascolarctos cinereus</i> OEH EPBC	V	V	Inhabits both wet and dry eucalypt forest on high nutrient soils containing preferred feed trees. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	✓	x	unlikely
Greater Glider <i>Petauroides volans</i> EPBC	-	V	Favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. Population density is optimal at elevation levels at 845 m above sea level. Prefer overstorey basal areas in old-growth tree stands. Highest abundance typically in taller, montane, moist eucalypt forests, with relatively old trees and abundant hollows <i>Distribution Limit: N-Border Ranges National Park. S- South of Eden.</i>	x	x	-	-	x

Common name Scientific name DATABASE SOURCE	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site			
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur (✓)
Long-nosed Potoroo <i>Potorous tridactylus</i> EPBC	V	V	Coastal heath and dry and wet sclerophyll forests with a dense understorey. <i>Distribution Limit: N-Mt Warning National Park. S-South of Eden.</i>	x	✓	x	x	unlikely
Brush-tailed Rock-wallaby <i>Petrogale penicillata</i> EPBC	E	V	Found in rocky gorges with a vegetation of rainforest or open forests to isolated rocky outcrops in semi-arid woodland country. <i>Distribution Limit: N-North of Tenterfield. S-Bombala.</i>	x	x	-	-	x
Grey-headed Flying-fox <i>Pteropus poliocephalus</i> OEH EPBC	V	V	Found in a variety of habitats including rainforest, mangroves, paperbark swamp, wet and dry open forest and cultivated areas. Forms camps commonly found in gullies and in vegetation with a dense canopy. <i>Distribution Limit: N-Tweed Heads. S-Eden.</i>	✓	-	-	-	-
Large-eared Pied Bat <i>Chalinolobus dwyeri</i> EPBC	V	V	Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. <i>Distribution Limit: N-Border Ranges National Park. S-Wollongong.</i>	x	Sub-optimal	x	x	Not likely

Common name Scientific name DATABASE SOURCE	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site			
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur (✓)
New Holland Mouse <i>Pseudomys novaehollandiae</i> EPBC	-	V	Occurs in heathlands, woodlands, open forest and paperbark swamps and on sandy, loamy or rocky soils. Coastal populations have a marked preference for sandy substrates, a heathy understorey of leguminous shrubs less than 1 m high and sparse ground litter. Recolonise of regenerating burnt areas. <i>Distribution Limit: N-Border Ranges National Park. S-South of Eden.</i>	x	Sub-optimal	x	x	unlikely
Australian Greyling <i>Prototroctes maraena</i> EPBC	Part 2, Section 19 – Protected Fish (FM Act 1994)	V	Clear, moderate to fast flowing water in the upper reaches of rivers (sometimes to altitudes above 1,000 m). Typically found in gravel bottom pools. Often forming aggregations below barriers to upstream movement (e.g. weirs, waterfalls).	x	marginal	x	x	Not likely
OEH	- Denotes species listed within 10 km of the subject site on the <i>Atlas of NSW Wildlife</i>							
EPBC	- Denotes species listed within 10 km of the subject site in the <i>EPBC Act</i> habitat search							
V	- Denotes vulnerable listed species under the relevant Act							
E	- Denotes endangered listed species under the relevant Act							
E4a or CE	- Denotes critically endangered listed species under the relevant Act							
NOTE:	1. This field is not considered if no suitable habitat is present within the subject site 2. 'records' refer to those provided by the <i>Atlas of NSW Wildlife</i> 3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle							

Table A1.3 provides an assessment of potential habitat within the subject site for nationally *protected* migratory fauna species recorded within 10 km on the *EPBC Act* Protected Matters Tool. Nationally *threatened* migratory species are considered in Table A1.2.

Table A1.3 – Migratory fauna habitat assessment

Common name Scientific name	Preferred habitat Migratory breeding	Suitable habitat present (✓)	Recorded on site (✓)	Comments
Oriental Cuckoo (<i>Cuculus optatus</i>)	It mainly inhabits forests, occurring in coniferous, deciduous and mixed forest. It feeds mainly on insects and their larvae, foraging for them in trees and bushes as well as on the ground.	✓	×	
White-throated Needletail (<i>Hirundapus caudacutus</i>)	Airspace over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies forage often along favoured hilltops and timbered ranges. <i>Breeds Siberia, Himalayas, and east to Japan. Summer migrant to eastern Australia.</i>	✓	✓	See Section 4.5.5 for assessment.
Fork-tailed Swift (<i>Apus pacificus</i>)	Aerial: over open country, from semi-arid deserts to coasts, islands; sometimes over forests, cities. Breeds Siberia, Himalayas, and east to Japan south east Asia. Summer migrant to east Australia. Mass movements associated with late summer low pressure systems into east Australia. Otherwise uncommon.	✓	×	-
Black-faced Monarch (<i>Monarcha melanopsis</i>)	Rainforests, eucalypt woodlands; coastal scrubs; damp gullies in rainforest, eucalypt forest; more open woodland when migrating. <i>Summer breeding migrant to coastal south east Australia, otherwise uncommon.</i>	✓	×	-
Spectacled Monarch (<i>Monarcha trivirgatus</i>)	Understorey of mountain / lowland rainforest, thickly wooded gullies, waterside vegetation, mostly well below canopy. <i>Summer breeding migrant to south-east Qld and north-east NSW down to Port Stephens from Sept/Oct to May. Uncommon in southern part of range.</i>	migratory	×	-
Satin Flycatcher (<i>Myiagra cyanoleuca</i>)	Heavily vegetated gullies in forests, taller woodlands, usually above shrub-layer; during migration, coastal forests, woodlands, mangroves, trees in open country, gardens. <i>Breeds mostly south east Australia and Tasmania over warmer months, winters in north east Qld.</i>	migratory	×	-
Rufous Fantail (<i>Rhipidura rufifrons</i>)	Undergrowth of rainforests / wetter eucalypt forests / gullies; monsoon forests, paperbarks, sub-inland and coastal scrubs; mangroves, watercourses; parks, gardens. On migration, farms, streets buildings. <i>Breeding migrant to south east Australia over warmer months. Altitudinal migrant in north east NSW in mountain forests during warmer months.</i>	✓	×	-

Common name Scientific name	Preferred habitat Migratory breeding	Suitable habitat present (✓)	Recorded on site (✓)	Comments
Little Tern (<i>Sternula albifrons</i>)	In Australia, Little Terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbors and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches. Little Terns nest on sand-spits, banks, ridges or islets and also on wide and flat or gently sloping sandy ocean beaches, and occasionally in sand-dunes. Forage in shallow waters of estuaries, coastal lagoons and lakes, frequently over channels next to spits and banks or entrances, and often close to breeding colonies. They also forage along open coasts, especially around bars off the entrances to rivers and lagoons, less often at sea, and usually within 50 m of shore.	x	-	-
Yellow Wagtail (<i>Motacilla flava</i>)	The yellow wagtail typically forages in damp grassland and on relatively bare open ground at edges of rivers, lakes and wetlands, but also feeds in dry grassland and in fields of cereal crops.	x	-	-
Swinhoe's Snipe (<i>Gallinago megala</i>)	During the non-breeding season Swinhoe's Snipe occurs at the edges of wetlands, eg. wet paddy fields, swamps and freshwater streams. Also known in grasslands, drier cultivated areas and market gardens. Habitat specific to Australia includes the dense clumps of grass and rushes around the edges of fresh and brackish wetlands. This includes swamps, billabongs, river pools, small streams and sewage ponds. Also found in drying claypans and inundated plains pitted with crab holes. <i>Breeds in central Siberia and Mongolia and moving south for the boreal winter.</i>	x	-	-
Pin-tailed Snipe (<i>Gallinago stenura</i>)	During non-breeding period the Pin-tailed Snipe occurs most often in or at the edges of shallow freshwater swamps, ponds and lakes with emergent, sparse to dense cover of grass/sedge or other vegetation. The species is also found in drier, more open wetlands such as claypans in more arid parts of species' range. It is also commonly seen at sewage ponds; not normally in saline or inter-tidal wetlands. <i>Breeds in Russia. Australian distribution is not well understood. There are confirmed records from NSW, with a single banded bird reported near West Wyalong.</i>	x	-	-
Latham's Snipe (<i>Gallinago hardwickii</i>)	Soft wet ground or shallow water with tussocks and other green or dead growth; wet parts of paddocks; seepage below dams; irrigated areas; scrub or open woodland from sea-level to alpine bogs over 2,000 m; samphire on saltmarshes; mangrove fringes. <i>Breeds Japan. Regular summer migrant to Australia. Some overwinter.</i>	x	-	-
Bar-tailed Godwit (<i>Limosa lapponica</i>)	The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh.	x	-	-

Common name Scientific name	Preferred habitat Migratory breeding	Suitable habitat present (✓)	Recorded on site (✓)	Comments
Black-tailed Godwit (<i>Limosa limosa</i>)	Primarily coastal habitat environment. The species is commonly found in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats, or spits and banks of mud, sand or shell-grit; occasionally recorded on rocky coasts or coral islets. The use of habitat often depends on the stage of the tide. It is also found in shallow and sparsely vegetated, near-coastal, wetlands; such as saltmarsh, saltflats, river pools, swamps, lagoons and floodplains. There are a few inland records, around shallow, freshwater and saline lakes, swamps, dams and bore-overflows. They also use lagoons in sewage farms and saltworks	x	-	-
Red Knot (<i>Calidris canutus</i>)	Intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps.	x	-	-
Great Knot (<i>Calidris tenuirostris</i>)	Prefers sheltered coastal habitats, with large intertidal mudflats or sandflats. This includes inlets, bays, harbours, estuaries and lagoons. They are occasionally found on exposed reefs or rock platforms, shorelines with mangrove vegetation, ponds in saltworks, at swamps near the coast, saltlakes and non-tidal lagoons. The Great Knot rarely occurs on inland lakes and swamps.	x	-	-
Common Greenshank (<i>Tringa nebularia</i>)	Found in a wide variety of inland wetlands and sheltered coastal habitats (with large mudflats and saltmarsh, mangroves or seagrass) of varying salinity. Habitats include embayments, harbors, river estuaries, deltas and lagoons. It uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. Also artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. In NSW the Hunter River estuary has been identified as a site of international importance. <i>Breeds in Eurasia, the northern British Isles, Scandinavia, east Estonia and north-east Belarus, through Russia and east.</i>	x	-	-

Common name Scientific name	Preferred habitat Migratory breeding	Suitable habitat present (✓)	Recorded on site (✓)	Comments
Sanderling (<i>Calidris alba</i>)	Almost always found on the coast, mostly on open sandy beaches exposed to open sea-swell, and also on exposed sandbars and spits, and shingle banks, where they forage in the wave-wash zone and amongst rotting seaweed. Sanderlings also occur on beaches that may contain wave-washed rocky outcrops. Less often the species occurs on more sheltered sandy shorelines of estuaries, inlets and harbours. Rarely, they are recorded in near-coastal wetlands, such as lagoons, hypersaline lakes, saltponds and samphire flats. There are rare inland records from sandy shores of ephemeral brackish lakes and brackish river-pools	x	-	-
Marsh Sandpiper (<i>Tringa stagnatalis</i>)	Lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltponds, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks. Less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. Three of the five sites with highest recorded numbers are saltwater habitats (Hunter Estuary, NSW; Port Hedland Saltworks, Western Australia; Tullakool Evaporation Ponds, NSW). Elsewhere they said to avoid, or rarely occur in, tidal habitats, and rarely occur on beaches.	x	-	-
Curlew Sandpiper (<i>Calidris ferruginea</i>)	Mainly coastal, but many inland feeding along tidal mudflats, salt marsh, salt fields, fresh, brackish or saline wetlands and sewerage ponds. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	-	-
Common Sandpiper (<i>Actitis hypoleucos</i>)	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags.	x	-	-
Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltponds and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves.	x	-	-

Common name Scientific name	Preferred habitat Migratory breeding	Suitable habitat present (✓)	Recorded on site (✓)	Comments
Pectoral Sandpiper (<i>Calidris acuminata</i>)	Prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. The species is usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands	x	-	-
Terek Sandpiper (<i>Calidris acuminata</i>)	Mostly forages in the open, on soft wet intertidal mudflats or in sheltered estuaries, embayments, harbours or lagoons. The species has also been recorded on islets, mudbanks, sandbanks and spits, and near mangroves and occasionally in samphire (<i>Halosarcia</i> spp.). Birds are seldom near the edge of water, however, birds may wade into the water. Occasionally, on sandy beaches, among seaweed and other debris and in rocky areas, Will use the supralittoral or upper littoral zone, where a film of water covers the sand. However, on exposed rock platforms, the species forages in the lower littoral zone and not the supralittoral or upper littoral zones. Less often seen on sandy or shingle beaches, or on rock or coral reefs or platforms, Terek Sandpipers are occasionally sighted around drying sewage ponds and salt pans if surrounded by mudflats. The species is also found around brackish coastal swamps, lagoons and dune-lakes; and also on gravel or rocky edges of estuarine pools and freshwater river-pools. Very occasionally, birds use swampy, grassy or cultivated paddocks near the coast	x	-	-
Red-necked Stint (<i>Calidris ruficollis</i>)	Mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally they have been recorded on exposed or ocean beaches, and sometimes on stony or rocky shores, reefs or shoals. They also occur in saltworks and sewage farms; saltmarsh; ephemeral or permanent shallow wetlands near the coast or inland, including lagoons, lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in saltflats. They sometimes use flooded paddocks or damp grasslands. They have occasionally been recorded on dry gibber plains, with little or no perennial vegetation	x	-	-
Ruddy Turnstone (<i>Arenaria interpres</i>)	Found on coastal regions with exposed rock coast lines or coral reefs. It also lives near platforms and shelves, often with shallow tidal pools and rocky, shingle or gravel beaches. It can, however, be found on sand, coral or shell beaches, shoals, cays and dry ridges of sand or coral. It has occasionally been sighted in estuaries, harbours, bays and coastal lagoons, among low saltmarsh or on exposed beds of seagrass, around sewage ponds and on mudflats.	x	-	-

Common name Scientific name	Preferred habitat Migratory breeding	Suitable habitat present (✓)	Recorded on site (✓)	Comments
Double-banded Plover (<i>Charadrius bicinctus</i>)	Found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. It occurs on muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers. Sometimes associated with coastal lagoons, inland saltlakes and saltworks. Also found on seagrass beds. Found on open grassy areas including short pasture, ploughed or newly cropped paddocks, swards, airstrips, and sports grounds such as golf courses or race-tracks near the coast and further inland. The species is sometimes found on exposed reefs and rock platforms with shallow rock pools and also on coastal sand dunes.	x	-	-
Lesser Sand Plover (<i>Charadrius mongolus</i>)	Occurs in coastal littoral and estuarine environments. It inhabits large intertidal sandflats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops. It also sometime occurs in short saltmarsh or among mangroves. Also inhabits saltworks and near-coastal salt pans, brackish swamps and sandy or silt islands in river beds. Seldom recorded away from the coast, at margins of lakes, soaks and swamps associated with artesian bores.	x	-	-
Pacific Golden Plover (<i>Pluvialis fulva</i>)	Usually inhabits coastal habitats, though it occasionally occurs around inland wetlands. Pacific Golden Plovers usually occur on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as <i>Sarcocornia</i> , or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks. The species is also sometimes recorded on islands, sand and coral cays and exposed reefs and rocks. They are less often recorded in terrestrial habitats, usually wetlands such as fresh, brackish or saline lakes, billabongs, pools, swamps and wet claypans, especially those with muddy margins and often with submerged vegetation or short emergent grass. Other terrestrial habitats inhabited include short (or, occasionally, long) grass in paddocks, crops or airstrips, or ploughed or recently burnt areas, and they are very occasionally recorded well away from water. On its breeding grounds it occurs in tundra.	x	-	-
Grey Plover (<i>Pluvialis squatarola</i>)	Occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons. Also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes. Very occasionally recorded further inland, where they occur around wetlands or salt-lakes. On their breeding grounds they inhabit tundra.	x	-	-

Common name Scientific name	Preferred habitat Migratory breeding	Suitable habitat present (✓)	Recorded on site (✓)	Comments
Grey-tailed Tattler (<i>Tringa brevipes</i>)	Often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. It can also be found at intertidal rocky, coral or stony reefs as well as platforms and islets that are exposed at low tide. It has been found around shores of rock, shingle, gravel or shells and also on intertidal mudflats in embayments, estuaries and coastal lagoons, especially fringed with mangroves. It is less often on open flat sandy beaches or sandbanks, especially around accumulated seaweed or isolated clumps of dead coral. It is occasionally found around near-coastal wetlands, such as lagoons and lakes and ponds in sewage farms and saltworks. Inland records for the species are rare with sightings on river banks and the edges of rock pools	x	-	-
Little Curlew (<i>Numenius minutus</i>)	Feeds in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated. Open woodlands with a grassy or burnt understorey, dry saltmarshes, coastal swamps, mudflats or sandflats of estuaries or beaches on sheltered coasts, mown lawns, gardens, recreational areas, ovals, racecourses and verges of roads and airstrips are also used. When resting, congregates around pools, river beds and water-filled tidal channels, and shallow water at edges of billabongs. Prefers pools with bare dry mud and they do not use pools if they are totally dry, flooded or heavily vegetated. <i>Breeds in Russia.</i>	x	-	-
Eastern Curlew (<i>Numenius madagascariensis</i>)	Primarily coastal especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. Often recorded among saltmarsh and on mudflats fringed by mangroves and also in coastal saltworks and sewage farms. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	-	-
Whimbrel (<i>Numenius phaeopus</i>)	Found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms. Infrequently recorded using saline or brackish lakes near coastal areas. It also used saltflats with saltmarsh, or saline grasslands with standing water left after high spring-tides, and in similar habitats in sewage farms and saltfields. There are a small number of inland records from saline lakes and canegrass swamps. It has also been recorded in coastal dunes and on a football field.	x	-	-



SAIL Impact Assessment Species

A2

The additional impact assessment provisions for threatened species to determine a Serious and Irreversible Impact (SAIL) are outlined under Section 10.2.3 of the BAM (2017) and have been applied to the recorded Large Bent-winged Bat and Little Bent-winged Bat as follows. This criteria has also been applied to the Swift Parrot, which has not been recorded present during surveys but is assumed to occur based on the Important Area Maps (DPIE) covering the site. An assessor is required to address the following provisions where a species is at potential risk of a SAIL, and the proposed development is within an important mapped area.

Measures taken to avoid the direct and indirect impact on species at risk of SAIL are outlined in Section 5.3. 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)	TDBC
Little Bent-winged Bat				✓	The species is dependent on non-responding attribute (breeding habitat only)	TDBC
Swift Parrot	✓	✓			Data from listing determination	Final Determination
Giant Dragonfly				✓	The species is dependent on non-responding attribute (upland swamp habitat)	TDBC

Little Bent-winged Bat & Large Bent-winged Bat (*Miniopterus australis* and *Miniopterus schreibersii*)

These two (2) species are considered here together and in the detailed assessment below because of their similar roosting/breeding habitat requirements, credit class, profiles and subsequent assessment outcome.

The Little Bent-winged Bat forages below the canopy within open forests and woodlands, feeding on small insects (Dwyer 1995b). This species roosts in caves, tunnels, tree hollows and occasionally old buildings (Dwyer 1995b). Caves are an important resource for this species, particularly for breeding where maternity caves must have suitable temperature, humidity and physical dimensions to permit breeding (Dwyer 1995b). One record exists of this species utilising a tree hollow however hollows are not currently considered as preferred habitat for this species (pers. com. Brad Law).

The Large Bent-winged Bat forages above and below the canopy within open forests and woodlands, feeding on small flying insects, predominantly moths (Dwyer 1995). The Large Bent-winged Bat is known to roost in a range of habitats including stormwater channels, under bridges, occasionally in buildings, old mines and, in particular, caves (Dwyer 1995). Caves are an important resource for this species, particularly for breeding where maternity

caves must have suitable temperature, humidity and physical dimensions to permit breeding (Dwyer 1995). Roost sites in tree hollows have not been reported within the literature reviewed. This species has not been identified as utilising culverts for maternity roosts. Maternity roosts rather are occupied by up to 100, 000 females with only twelve (12) maternity roosts known throughout the complete range (Hoy & Hall 2008).

Both species are allocated to species credit class for breeding habitat only. For both also, species sensitivity to loss is indicated by the TDBC as 'moderate', species sensitivity to potential gain for breeding is 'very high' and species sensitivity to potential gain for foraging is 'high'. '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".

It is considered that the subject site provides suitable foraging only habitat for the Little Bent-winged Bat and Large Bent-winged Bat. It is expected that anywhere between 1 - 10 individual bats of each species would routinely utilise the study area for foraging. The Little Bent-winged Bat would forage more predominantly below the canopy where an open structure below the shrub layer permits. The Large Bent-winged Bat would forage more predominantly above the canopy and down in more open areas. Concentrated activity is likely in some locations such as along the creek, forest fringes and trails, particularly for the Large Bent-winged Bat.

Giant Dragonfly (*Petalura gigantea*)

Petalura gigantea are known from isolated swamps and streamlines or seepages in more-or-less natural condition in the eastern part of the state, with short or moderate vegetation on a deep soil base (Watson 1991). Adults are rather poor flyers and hopelessly bad at dispersing (Trueman 1997), being incapable of finding ideal habitat within 10km of known locations. Emergence takes place in late October and the flight season runs until January, but adults are never found far from their emergence site.

The important habitat is the larval habitat, which unlike other dragonfly larvae that live in the water column, make a permanent burrow in suitably soft ground / swamp / bog / mud, catching animals as they pass the entrance (Watson 1991). Some are known from around the edges of sphagnum bogs, from tea tree swamp growing on "foul black ooze" and seepages or springlines along creeks. The larvae stage is known to last at least 6 years.

It is the combination of poor dispersal ability, long larval life and absolute need for permanent swamp with a stable water table which makes *P. gigantea* so susceptible to human interference.

This species is allocated to species credit class. Sensitivity to loss is indicated by the TDBC as 'high', species sensitivity to potential gain is 'very high'.

Whilst the southernmost portions of the study area have undulating topography that gets periodically inundated after heavy rains, this area does dry out and is not considered suitable for development of larval stages. It is considered that the study area does not provide suitable habitat for the larval stage. Field observations of adjacent lands has found that habitat to the south-east and on the same side of Karignan Creek provides potentially suitable habitat within the Karignan Swamp.

Whilst also the species is poor at dispersing from swamp habitat, this adjacent area is only approximately 75m away from the site boundary. Surveys within the study area during the appropriate survey period of December-January have not recorded the species present. These surveys however did not include searches of the adjacent lands at that time. Therefore, the Giant Dragonfly has been assumed present and species polygons have been

provided extending into the study area 500m from the potential habitat area and including relevant PCTs.

Swift Parrot (*Lathamus discolor*)

Important Area Maps

The study area falls within the DPIE Important Area Map for Swift Parrot as can be seen in the insert below.



Figure 15 – Swift Parrot – Important Area Mapping

As indicated by DPIE, mapped important areas identify land that is considered important to a few dual credit species that are highly mobile and difficult to reliably detect by survey, and for which DPIE holds extensive, long-term data sets that indicate the importance of areas in the landscape.

No further survey is required if the subject land is in a mapped important area for a species unless the species profile in the TBDC states otherwise. In mapped areas the species is considered present and the part of the subject land that is within the mapped location forms the species polygon used to generate species credits

To establish the localised Important Map Area, a dataset of swift parrot sighting records from 1990-2018 was extracted by DPIE from *BioNet* and *Birdlife Australia*. These are checked, cleaned and then a 2 km radial buffer is applied. This is qualified by sightings of five or more birds recorded over any two or more years, or single sightings of 40 or more birds.

The NSW State Vegetation Type Map (including draft East Coast classification) was used to select Plant Community Types associated with the Swift Parrot within the buffers. Any areas less than one hectare were excluded.

Species Background

The Swift Parrot is a migratory species that breeds in Tasmania and its offshore islands in summer, where it feeds mainly on nectar and lerp from eucalypt flowers, particularly Tasmanian Blue Gum (*Eucalyptus globulus*) (NSW OEH 2021) and Swamp Gum (*Eucalyptus ovata*) (DEWHA 2010). The proposal will therefore have no impact on breeding habitat for the species.

In late March almost the entire population migrates to mainland Australia spreading from Victoria through to central and coastal NSW and south east Queensland (Schodde and Tiedemann, 1986). Movements on the mainland are nomadic and eruptive, moving in response to food supply, especially areas of heavily flowering eucalypts (Higgins 1999).

On the mainland, the Swift Parrot congregates where winter flowering species occur such as Red Ironbark (*Eucalyptus sideroxylon*), White Box (*Eucalyptus albens*) and Yellow Gum (*Eucalyptus leucoxylon*) (Brown, 1989). This species also occurs within Swamp Mahogany (*Eucalyptus robusta*) or Spotted Gum (*Corymbia maculata*) dominated communities along the coast. The TBDC (NSW OEH 2021) also indicates that Red Bloodwood (*C. gummifera*) and Forest Red Gum (*E. tereticornis*) may also be utilised. They also feed on lerps in *Eucalyptus* spp. In NSW, they forage in forests and woodlands throughout the coastal and western slopes region each year. Coastal regions tend to support larger numbers of birds when inland habitats are subjected to drought.

Swift Parrot is allocated to species credit class for breeding habitat which is based on mapped important areas for the species. The species sensitivity to loss is indicated by the TBDC as 'very high', species sensitivity to potential gain for breeding is 'moderate' and species sensitivity to potential gain for foraging is 'moderate'. The species is recognised as a candidate SAI entity due to Principle 1 in which there is evidence of rapid decline. The species has been subject to annual volunteer-based survey programs both in Tasmania and the mainland since 1995. For the purposes of this assessment and as required by the BAM the species is also considered with respect to Principle 2, based on recent evidence of a potential small population size. Olah et al. (2020) report that recent genetic data from DNA sampling indicates that there may be a few as 300 Swift Parrots remaining.

Although the species is not allocated to a suitable survey period within the TBDC (as presence is rather determined by the important mapped areas), surveys have nonetheless been undertaken on site. These targeted presence in August 2018 and recently in May and June 2021. Surveys targeted the areas containing the winter flowering resources at these times, primarily Swamp Mahogany and *Melaleuca quinquenervia* associated with the Swamp Sclerophyll Forest and around the dam.

The recent late May/June 2021 site surveys also focused on recording locations of all individual Swamp Mahogany and Red Bloodwood within the study area. The locations of these trees are shown on Figure 20. Additionally, the extensive stag-watching surveys over the late afternoon period on 10 separate days in July 2018, was also undertaken by reputable bird observer Paul Shelley. No Swift Parrots have been recorded present during the combined survey effort within the study area.

SAI ASSESSMENT

(a) The action and measures taken to avoid the direct and indirect impact on the potential entity for an SAI

Little Bent-winged Bat & Large Bent-winged Bat - No specific measures are considered necessary to apply to Little Bent-winged Bat and Large Bent-winged Bat given that no important habitat will be likely directly or indirectly impacted.

Giant Dragonfly – This species is associated only with PCT 1718 within the study area. More than 96% of this community will be retained by the proposal adjacent to the potential habitat on the neighbouring lands to the south-west. No other specific measures are considered necessary to apply to Giant Dragonfly, particularly given that no likely important habitat for will be likely directly or indirectly impacted.

Swift Parrot - With respect to the Swift Parrot the planning proposal aims to retain almost the entirety of PCT 1718 containing existing and important winter flowering Swamp Mahogany trees. This area is to be rezoned from E3 (Environmental Management) to E2 (Environmental Conservation) (refer to the insert below).

Seven, outlier Swamp Mahogany trees are located within the development footprint. More recent design changes have provided for the retention of four of these trees within lots where health permits. Three of these will now be contained within a single large E3 zoned lot. These trees will align closer to boundaries as opposed to likely building footprints; however, field inspections have identified two of them containing arboreal termite nests and in poor health. Therefore, a more thorough investigation of these trees by an AQ5 qualified arborist is required to determine what provisions can be made, to prioritise their retention and safety.

Furthermore, to permit connectivity for wildlife to continue to the north a 60 m wide E2-zoned wildlife corridor is provided along the western and northern boundaries.

The proposal was also initially going further south to the 1 in 100-year flood line. This arbitrary line has been previously used to define the land zoning between E2 and R2. The proposal has sought to move the arbitrary line further north to avoid impacts on Swamp Sclerophyll TEC vegetation. There is approximately 0.02 ha of direct impact on this vegetation.

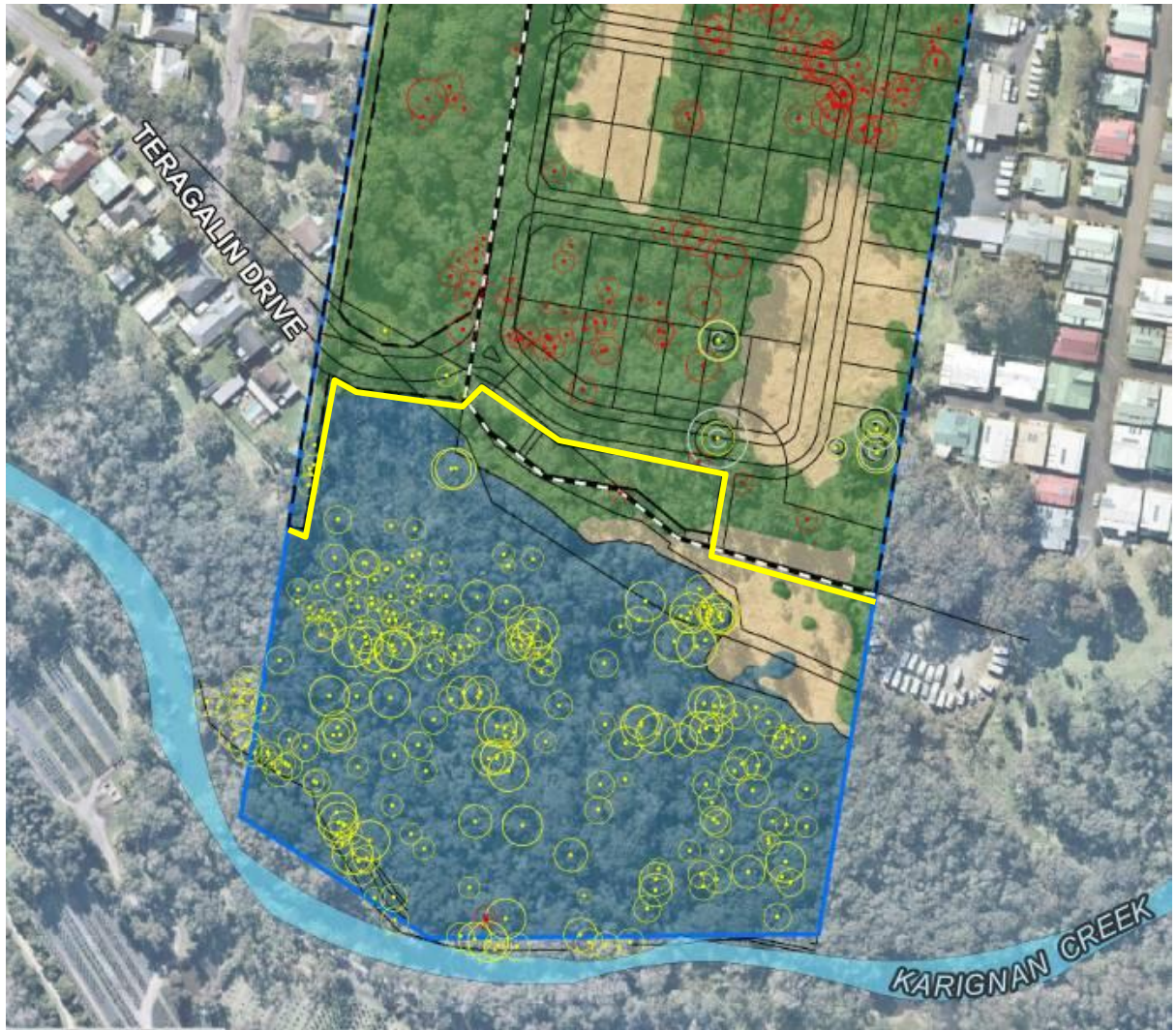


Figure 16 – Proposed rezoning boundary and retention of PCT 1718
(Yellow line indicating location of protection fencing providing a buffer to PCT 1718)

The retained Swamp Mahogany habitat area and the corridor will be established as a conservation corridor with a VMP to assist in the enhancement of the retained vegetation and habitat to reduce indirect impacts of edge effects.

The indirect impacts of collisions with cars and windows as well as competition with aggressive birds are minimised through building designs, fencing requirements and street planting as outlined in Section 5.4.

(b) The size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification

Little Bent-winged Bat & Large Bent-winged Bat - Due to the migratory nature of these two species to breeding caves within inland regions of the state, the local populations are difficult to predict at any time. These species are expected to be well represented in the locality with regular recordings.

Giant Dragonfly – This species has never been recorded within the nearby locality. The closest record is located at approximately 9.5 km to the south at Toukley in 2006. There are no other records within 10km. The species is assumed present based on a lack of

survey in the neighbouring lands during the appropriate survey season. So if a population is present it would be expected to be centred on the lower reaches of the Karignan Creek in adjacent swamp habitats.

Swift Parrot - The Swift Parrot breeds in Tasmania in summer and the entire population of migrates north to the mainland Australia for the winter where it disperses widely, but mainly in Victoria and New South Wales where it forages on flowers and lerps in *Eucalyptus* spp. In NSW, they forage in forests and woodlands throughout the coastal and western slopes region each year. Coastal regions tend to support larger numbers of birds when inland habitats are subjected to drought. Therefore, the number likely to utilise the winter flowering resources for foraging in the immediate locality will vary from year to year and are not likely to visit most years.

Swift parrots show site fidelity to certain areas or even specific stands of trees on the mainland; however, they do not necessarily return to these every consecutive year (Pfennigwerth 2008). Mainland distribution depends largely on food availability. While swift parrots have been shown to return to the same flowering street trees on the central coast of NSW, large numbers of the species would not travel that far if the box-ironbark woodlands of central Victoria had sufficient food (Pfennigwerth 2008). Therefore, the number likely to utilise the winter flowering resources for foraging in the immediate locality will vary from year to year and are not likely to visit most years.

In a summary of recorded parrots in the Lake Macquarie LGA to the north between 1995-2014 (Roderick & Ingwersen 2014) only in two years were up to (and maybe over) 100 birds were recorded visiting. No birds were recorded visiting in 8 these 20 years and only five locations in the LGA recorded visits on more than 1 occasion.

We note that there have been very close sightings of the species in recent years and would expect that given there are quite reasonable resources available (nectar) during winter, that it is possible that in any given year they could occur within the study area. The *eBird Australia* online portal has two nearby identified 'Birding Hotspots' being at Joshua Porter Reserve and Karignan Creek Reserve. These reserve locations are within 400 m and 250 m to the west of the study area respectively, as shown on the insert map below (source: *eBird Australia* 11/5/21).

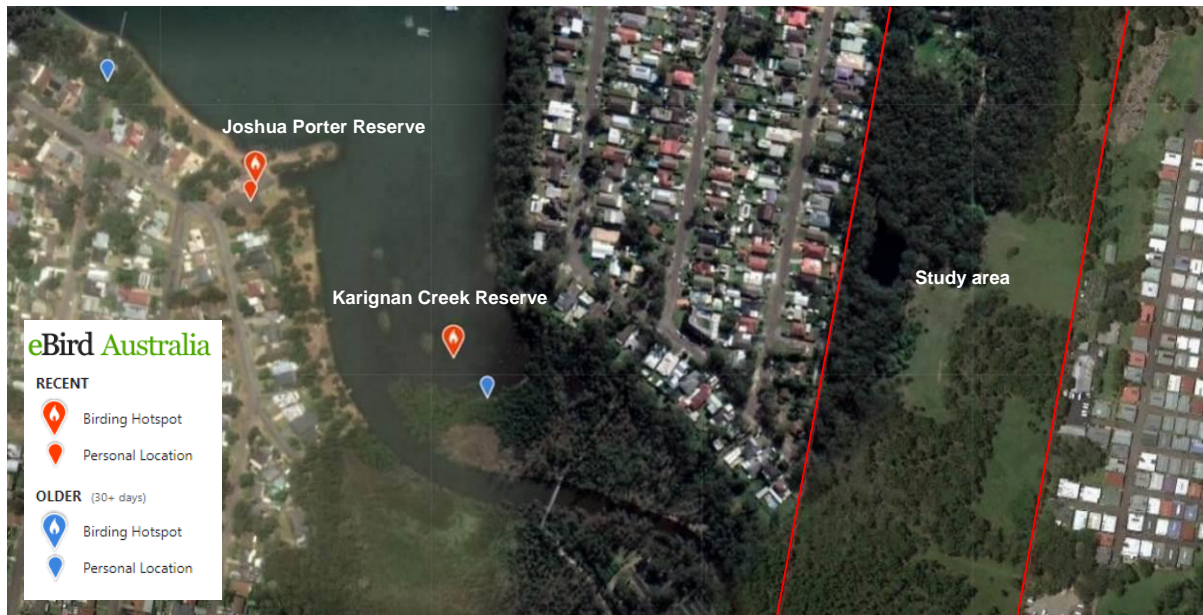


Figure 17 – Site Proximity to Joshua Porter Reserve and Karignan Creek Reserve

The records from both birding hotspots are summarised in the following tables showing that records of Swift Parrot have been observed within both locations in the last 4 weeks, at the time of writing. Records of the species presence goes back to 2011, with other personal recorded locations present nearby also. Hence, a 2 km buffer area has been applied to the species centred on these reserves for the DPIE Important Area Map for Swift Parrot, which also incorporates the whole of the study area.

Karignan Creek Reserve, Chain Valley Bay

Wyong, AU-NSW

DATE	#	OBSERVER
2021-05-09	1	Archie Brennan
2011-09-04	6	Jon Spicer-Bell
2011-07-15	30	Birdline Australia
2011-07-10	30	Peter Waanders
2011-06-04	X	Joshua Bergmark
2011-06-04	X	Max Breckenridge

Joshua Porter Reserve, Chain Valley Bay

Wyong, AU-NSW

DATE	#	OBSERVER	DATE	#	OBSERVER	DATE	#	OBSERVER
2021-04-20	2	Daniel Allen	2019-05-24	100	Rebecca Citroni	2019-05-14	100	Nick Carson
2021-04-19	1	Chad Beranek	2019-05-20	100	Rebecca Citroni	2019-05-13	100	Rebecca Citroni
2021-04-19	6	Rebecca Citroni	2019-05-19	60	Tim Henderson	2011-08-27	30	Birdline Australia
2019-06-15	2	Tom Wilson	2019-05-19	80	Liam Murphy	2011-08-21	6	Greg McLachlan
2019-06-08	X	Cameron D	2019-05-19	100	Jenny Stiles	2011-08-14	X	Jenny Stiles
2019-06-08	X	John W G Doubikin	2019-05-19	150	Archie Brennan	2011-08-11	10	Marc Anderson
2019-06-06	70	Rebecca Citroni	2019-05-18	120	Tim Henderson	2011-08-06	6	Birdline Australia
2019-06-01	100	Clint Hook	2019-05-18	100	Jodi Webber	2011-07-06	10	Birdline Australia
2019-05-31	50	Ákos Lumnitzer	2019-05-18	100	Richard Webber	2011-07-03	10	Birdline Australia
2019-05-31	100	David Irving	2019-05-18	30	Greg and Georgie Shaw	2011-06-18	2	Birdline Australia
2019-05-31	100	Rebecca Citroni	2019-05-18	110	David Ongley	2011-06-09	20	Birdline Australia
2019-05-30	X	Martin Allen	2019-05-18	137	Chris Rehberg Sydney Birdi	2011-06-07	X	Narelle Power
2019-05-29	30	Clint Hook	2019-05-17	20	Jennifer Smith	2011-06-03	7	Peter Hosking
2019-05-27	100	Rebecca Citroni	2019-05-16	60	Rod Lennon	2011-05-11	18	Birdline Australia
2019-05-25	15	Jennifer Smith	2019-05-15	X	Ashley Mullahey	2011-04-28	7	Deryk Engel
2019-05-24	25	Jennifer Smith	2019-05-14	100	Rod Lennon	2011-04-28	X	Birdline Australia
2019-05-24	15	Grant Brosie	2019-05-14	100	Deb Lennon			
			2019-05-14	100	Rebecca Citroni			

Based on these observations and other knowledge of localised habitat use by Swift Parrot, it is possible that anywhere between 1 and over 100 birds may utilise the foraging potential within the study area on any given winter. Given this high variation, unknown actual use, if any, and that such use could even be represented by a large proportion of the population, the actual indirect impact on the species from the proposal is very difficult to quantify. It may have no impact, it may have some impact on any alternate year, but it is not expected to have any serious or irreversible impact to warrant refusal.

(c) *The extent to which the impact exceeds any threshold for the potential entity*

Little Bent-winged Bat & Large Bent-winged Bat - both species are *dependent on non-responding attribute (breeding habitat only)*. No breeding habitat will be impacted for these species and no such habitat is present within the remaining study area.

Giant Dragonfly – The threshold for the species is identified in the TBDC as *only proposals that will result in disturbances to swamp hydrology*. The proposed development may alter runoff and groundwater hydrology to the lower areas of the study area but is not expected to cause any changes to the hydrology of the areas identified on neighbouring lands as potential habitat.

Swift Parrot – The TBDC identifies the threshold as mapped important areas for the species. From this the extent of habitat impacted is 7.92 ha.

(d) *The likely impact (including direct and indirect impacts) that the development, clearing or biodiversity certification will have on the habitat of the local population, including but not limited to:*

(i) *An estimate of the change in habitat available to the local population as a result of the proposed development*

Little Bent-winged Bat & Large Bent-winged Bat - The local natural foraging habitat extent for these two species will be reduced by 9.05 ha (including cleared areas) however both are known to forage around streetlights and within developed landscapes, so the site will still maintain some foraging habitat post-development.

Giant Dragonfly – This species is associated only with PCT 1718 within the study area. The proposal will result in direct impacts on 0.02 ha and indirect impact on 0.1 ha of this PCT. This total is approximately 3.5% of the total 3.49 ha of this habitat within the study area. The remaining portion of the community will be retained and enhanced through a VMP.

Swift Parrot – The development will directly impact on up to seven (7) Swamp Mahogany trees providing potential winter foraging habitat for Swift Parrot. This is supported by the listed key tree species within the National Recovery Plan (*Birds Australia* 2011).

This foraging habitat represented by Swamp Mahogany within the retained portions of PCT 1718 may also be indirectly impacted by edge effects along the remaining northern edge to this community.

The cleared edge and the presence of a nearby road provides potential for urban associated impacts such as collisions with vehicles and windows but more so from competition with dominant birds species, such as Noisy Miner, that are likely to occupy the remaining vegetated edges.

There is some lower potential for removal of roosting or even pre-winter foraging habitat within the development area, and lessening chance of the remaining corridor to provide this also. Red Bloodwood, whilst not recognised as an important local tree for Swift Parrot foraging (refer to (d)(ii) below) has been listed as a food tree within the species profile.

(ii) *The proposed loss, modification, destruction or isolation of the available habitat used by the local population, and*

The proposal will remove 6.55 ha and indirectly impact on 1.47 ha of vegetated habitat plus encroach on 2.5 ha and indirectly impact on 0.15 ha of cleared land.

Little Bent-winged Bat & Large Bent-winged Bat - For the Bent-winged Bats this would support prey species lifecycle habitat and subsequent foraging. This is not a total loss given that foraging by both species is sometimes concentrated below street lights in urban areas on the fringes of vegetated habitats.

Giant Dragonfly – This species is associated only with PCT 1718 within the study area. The proposal will result in direct impacts on 0.02 ha and indirect impact on 0.1 ha of this PCT. This total is approximately 3.5% of the total 3.49 ha of this habitat within the study area. The remaining portion of the community will be retained and enhanced through a VMP.

Swift Parrot – With respect to the Swift Parrot, loss of habitat is considered for foraging potential during mainland migration. The OEH online species profile indicates six (6) favoured winter flowering feed trees for foraging. The list

includes the Swamp Mahogany (*Eucalyptus robusta*) which is of well-known importance to Swift Parrot in the region, but also includes another tree species recorded within the study area, Red Bloodwood (*Corymbia gummifera*).

A recent and detailed site investigation has identified the number of individual trees of >10 cm DBH of both the June to November (and predominantly winter) flowering Swamp Mahogany as well as the January to May flowering Red Bloodwood. A map of these results is provided on Figure 20 below showing the separate species locations and their relative size based on DBH measurements. It is noted that smaller trees (<10 cm) were not recorded, although there are present in the southern portions of the site, particularly adjacent to Teragalin Drive.

From this analysis we find that the proposed vegetated areas of forest habitat removed contains 7 Swamp Mahogany trees >10 cm DBH, located as scattered individuals along the fringes of the PCT 1718. This amounts to less than 3% of the total number of Swamp Mahogany recorded within the study area.

The proposal will remove 427 Red Bloodwood trees within PCT 1619 amounting to 65% of the total number present within the study area. This impact raises questions on the true value of this tree species not generally acknowledged in the Central Coast to Lake Macquarie LGAs for Swift Parrot importance, particularly by comparison to Swamp Mahogany and other more strictly winter flowering trees like Spotted Gum (*Corymbia maculata*) and Forest Red Gum (*Eucalyptus tereticornis*).

Red Bloodwood occurs in coastal areas from eastern Victoria to south-eastern Queensland. The flowering period for Red Bloodwood varies between sources with the peak coinciding with when Swift Parrots first arrive on the mainland in March. Some sources recognise the flowering period to extends between Summer and late Autumn, with a few others recognising that it may also flower into June.

Aside from the OEH species profile, a few other sources such as the Tasmanian Swift Parrot Recovery Plan (DPIWE 2001), Australian *Threatened Species Network* (2007), *Birdlife Australia* Swift Parrot Search guide (2021), Victorian *Beauty of Birds* webpage <https://www.beautyofbirds.com/swiftparrot.html> and *Saunders & Heinsohn* (2008) also report Red Bloodwood as a recognised feed tree on the mainland. These sources are not however locally specific but rather provide a summary of foraging over the total area of occupation.

There are two alternate migration routes undertaken by Swift Parrot on entry into NSW from Victoria, one is west of the ranges and the other is along the south coast, which also aligns with the southern Red Bloodwood distribution. These two routes can be observed in the *BioNet* insert of southern NSW records below (DPIE 2021)

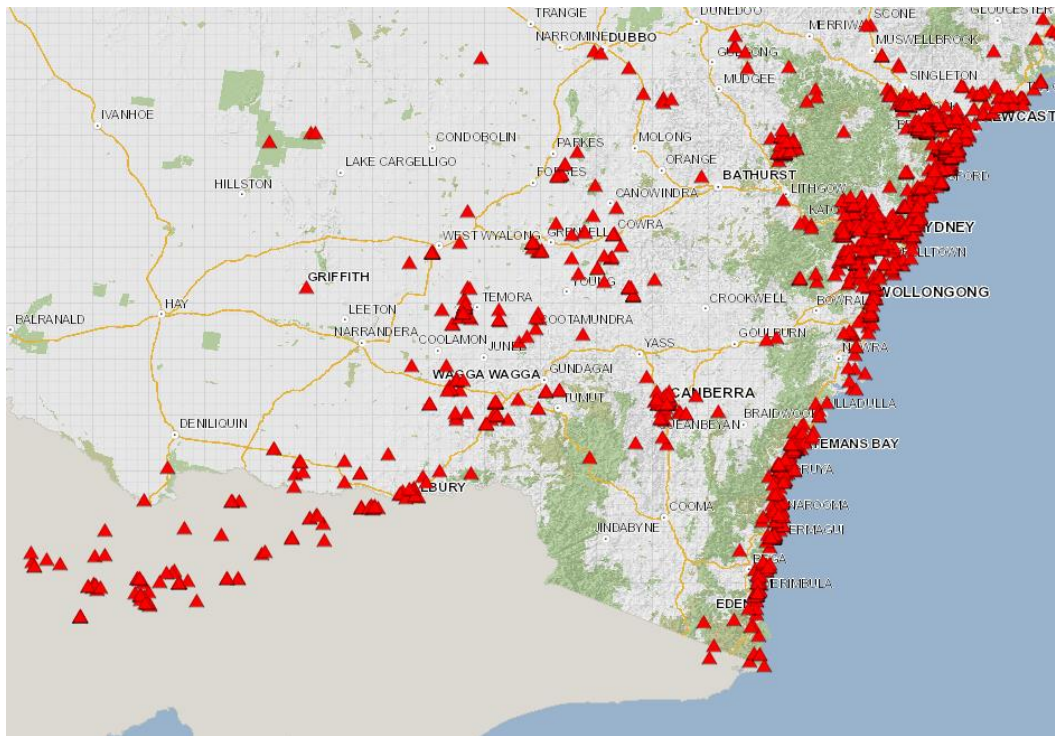


Figure 18 – Southern NSW records of Swift Parrot (DPIE Bionet 2021)

Red Bloodwood is well documented to be of importance to Swift Parrot in the NSW south coast areas. As noted above, these areas are still in the peak of bloodwood flowering when Swift Parrots first enter NSW. The Far South Coast Conservation Management Network newsletter (Cooke 2007) states that the birds rely on winter flowering eucalypts (Spotted Gum and Red Bloodwood in the south-east) and also feed on lerp. No other tree species are mentioned. News articles by the Narooma News (Gorton, 2016) and ABC South East NSW (Campbell 2015) also recognise these same two tree species (as well as Swamp Mahogany and Ironbark) of importance for residents to check in the region during the coastal migration.

The National Recovery Plan for the Swift Parrot (Saunders & Tzaros 2011) does however not recognise Red Bloodwood as a key foraging tree species. OEH (2016) in their document *Planting to Conserve Threatened Nomadic Pollinators in NSW* also does not mention Red Bloodwood as part of the winter flowering diet for the Swift Parrot.

But more specific to the local area, Roderick & Ingwersen (2014, on behalf of Birds Australia) produced a report for Lake Macquarie City Council titled *Swift Parrots and Regent Honeyeaters in the Lake Macquarie City Council area of New South Wales: an assessment of status, identification of high priority habitats and recommendations for conservation*. The study area, whilst located in the far northern extent of the Central Coast LGA, is located along the southern shores of Lake Macquarie where this document identifies important stands of Swamp Mahogany for both Swift Parrot and Regent Honeyeater (refer to the insert map below).

The document details records of both species in the region from 1995 to 2014. Red Bloodwood is not mentioned from any recordings or significance to Swift Parrot. The report does however mention that whilst Regent Honeyeater is

primarily located on sites with Swamp Mahogany there are occasional records in Red Bloodwood generally only of a few days' duration. The report states:

*Of interest, an observation from Coal Point in April 2002 (of up to 10 birds) was made of birds feeding on the blossom of Red Bloodwood *Corymbia gummifera*, a species that is not widely used by Regent Honeyeaters for foraging. However, this record was the very first for 2002, which was the most significant year for Regent Honeyeaters in the Lake Macquarie area in recent years, with birds found feeding in Swamp mahogany blossom only 3 weeks after the Coal Point sighting (where they persisted for at least a month). This was followed by the reports of high numbers around Morisset in June/July (peaking at a count of 100 birds in mid-July). The use of Red Bloodwood is considered likely to have been for birds in transit to the more productive Swamp Mahogany forests.*

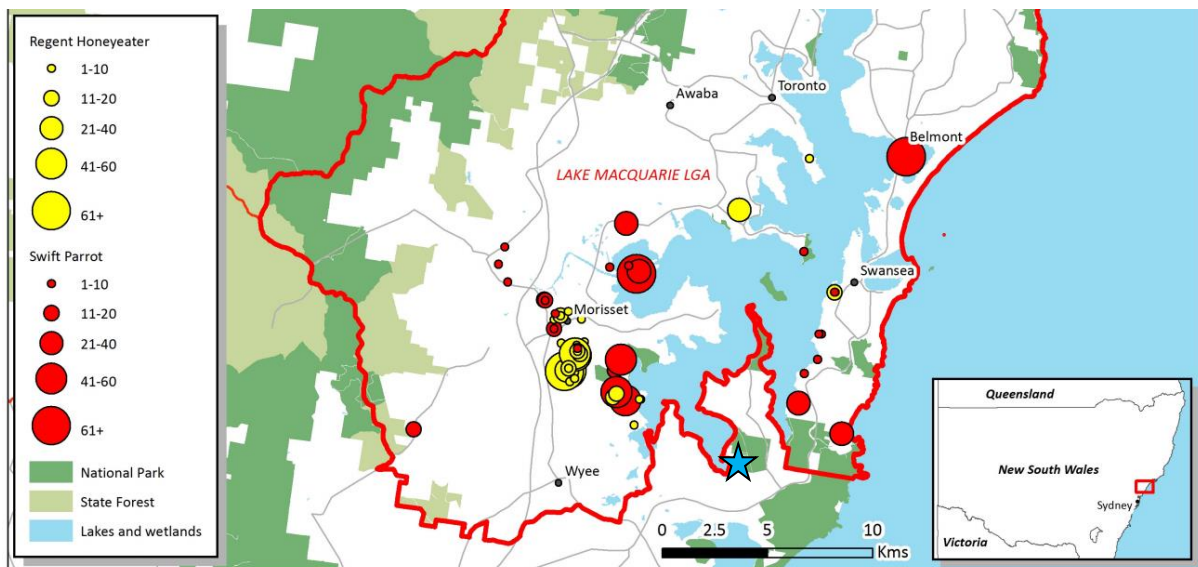
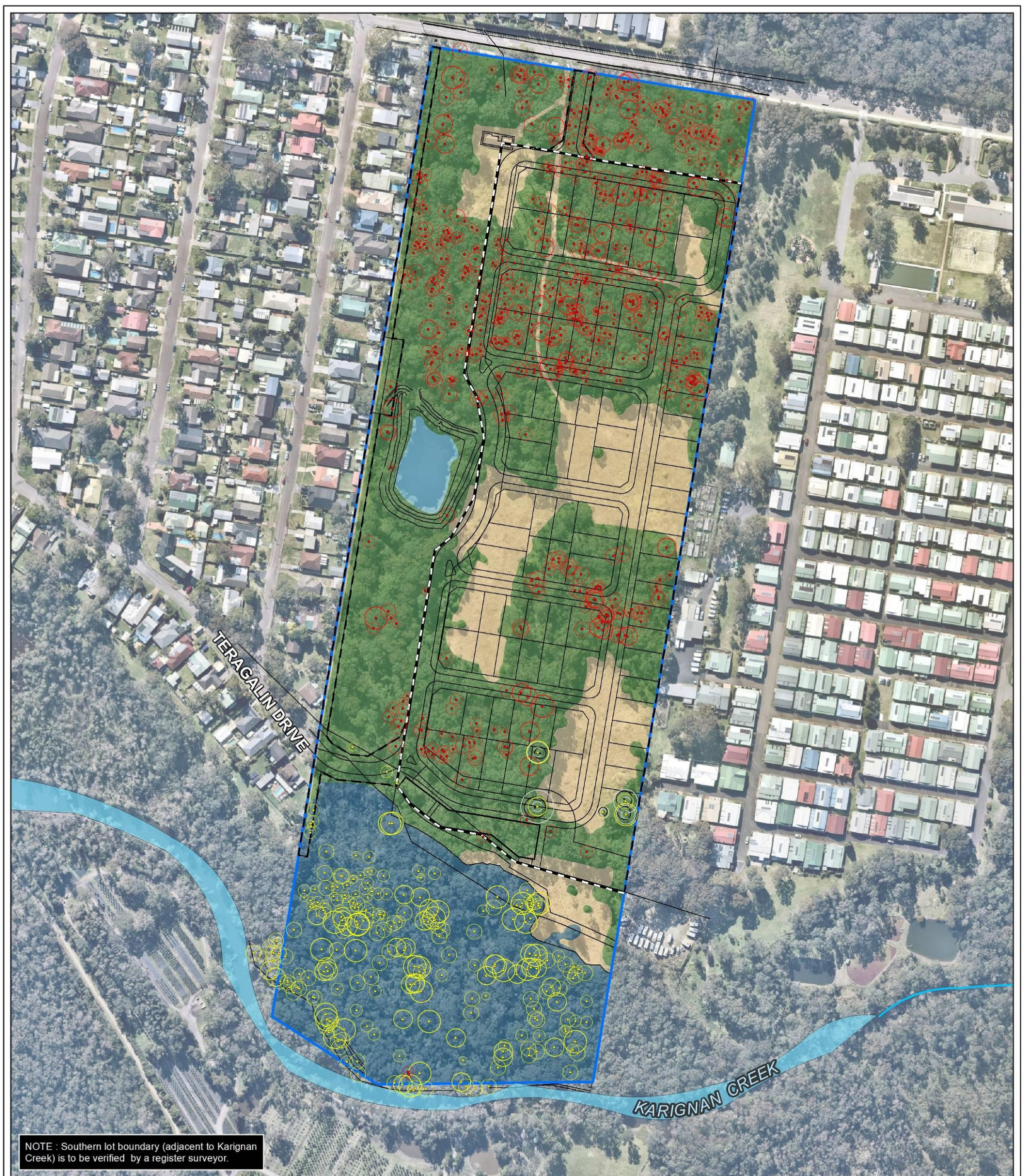


Figure 19 – Proposed Swift Parrot records (red) in the southern Lake Macquarie LGA. (Roderick & Ingwersen 2014). Study area location shown as a blue star.

Further to this, *Saunders & Heinsohn (2008)* in their paper Winter Habitat Use by the Endangered, Migratory Swift Parrot (*Lathamus discolor*) in New South Wales summarise state-wide tree species and recorded lerp and nectar feeding observations. These are separated into Coastal and Western Slopes regions. Red Bloodwood, whilst not mentioned for the Central Coast region was recorded with one-hundred and thirty (130) lerp feeding records and no (0) nectar feeding records in the north coast region. Swamp Mahogany by comparison was recorded with one-thousand four-hundred and forty-one (1441) lerp feeding records and seven-hundred and thirty-eight (738) nectar feeding records in the central and north coast regions combined.

A *BioNet* search of all Swift Parrot records and associated information within 10 km of the study area totalled one-hundred and sixty-five (165) records ranging in observations between one and several hundred birds. Only one record from Wyongah in 2002 mentions use of trees surrounding Swamp Mahogany, including Red Bloodwood, Woollybutt and Forest Red Gum. Swamp Mahogany is mentioned twenty-eight (28) times and Forest Red Gum is mentioned fifty (50) times as observed feed trees in these records. Only about half of the records have foraging notes provided by the observer(s).

It therefore appears from current literature that Red Bloodwood has been of higher potential use for nectar foraging for Swift Parrot in its more southern distribution and lerp feeding in its more northern distribution. This tree species is therefore receiving greater attention for conservation, yet its use is clearly varied across its range. We do not discount that Red Bloodwood within the study area and elsewhere on the Central Coast may provide seasonal foraging potential, perhaps by nectar or lerp. It is however clear from more local analysis of historical foraging evidence that Red Bloodwood is by no means close to the importance of Swamp Mahogany in the Chain Valley Bay locality and the surrounding region.



Legend

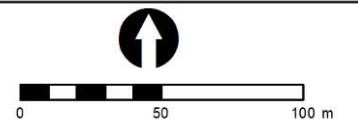
Lot boundary (source: CAD - 16.52ha)	Swamp Mahogany (DBH)	Red Bloodwood (DBH)	Biodiversity Certification Area
Creek line (source - LPI)	<21	<21	Vegetation Communities
Creek line (LPI)	21-30	21-30	PCT 1619 - Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest - (9.98ha) (Impacted 7.57ha)
Proposed zoning boundary	31-50	31-50	PCT 1718 - Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast - (EEC - Swamp Sclerophyll Forest on Coastal Floodplains) (3.49ha) (Impacted 0.12ha)
Swamp Mahogany	51-70	51-70	Cleared (2.86ha) (Impacted 2.56ha)
Red Bloodwood	>70	>70	Retain Dam (0.19ha)
Tree protection zone (TPZ)			
Structural root zone (SRZ)			



PROJECT & MXD REFERENCE
15 Mulloway Road, Chain Valley Bay
18OD02_FA004

DATE & ISSUE NUMBER
30/09/2021
Issue 1

SCALE & COORDINATE SYSTEM
1:2,500 @ A3
GDA 1994 MGA Zone 56



TITLE
Swamp Mahogany & Red Bloodwood Locations

Document Path: N:\GIS STORAGE\N Drive\18OD02_Mulloway_Rd_ChainValleyBay\MXD\BICAR\18OD02_FA004.mxd

Disclaimer: 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 are to be confirmed by a registered surveyor.

Figure 20 – Swamp Mahogany and Red Bloodwood Locations in the Study area

(iii) Modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development. BioNet Atlas records or other documented, quantifiable means must be used by the assessor to estimate what percentage of the species' population and habitat is likely to be lost in the long term within the IBRA subregion due to the direct and indirect impacts of the development

Little Bent-winged Bat & Large Bent-winged Bat - Whilst foraging by both species may be more concentrated in some habitats (most based on structure and insect activity) no specific valued habitat features within the study area are identified. No important roosting or breeding habitat is likely present within the study area. Therefore no habitat important to the life-cycle of these two species will be impacted. Roosting locations are expected to occur throughout the locality and many of these are likely within man-made structures.

Giant Dragonfly – It is not anticipated that there will be any indirect modifications to the habitat identified nearby as potential habitat for the species and important for life-cycle stages. No such important habitat likely exists within the study area itself.

Swift Parrot – Habitat is for foraging only, or adjacent to foraging. No breeding habit will be impacted. Foraging habitat and resultant impacts is discussed elsewhere in this assessment.

(e) The likely impact on the ecology of the local population. At a minimum, address the following:

(i) for Fauna:

- **Breeding** – No breeding habitat will be impacted
- **Foraging** – Negligible foraging habitat will be impacted for the Bent-winged Bats and the Giant Dragonfly.

High potential foraging habitat for Swift Parrot represented by Swamp Mahogany will be impacted by <3% (7 Individuals). Red Bloodwood will also be directly impacted by 65% (approx. 427 Individuals), however this tree species has not been demonstrated of importance in the locality.

Given the extent of important as well as potential foraging habitat retained the proposal will permit ongoing use of the study area for foraging, if such areas are utilised.

- **Roosting, and** – No likely roosting will be impacted for the Bent-winged Bats or the Giant Dragonfly. Potential roosting habitat considered for Swift Parrot is equivalent to the considered impacts of foraging above.
- **Dispersal or movement pathways** – The Giant Dragonfly is not likely to successfully disperse through the proposed development landscape area to suitable habitat elsewhere. The potentially successful dispersal pathway for this species to other potential important habitat areas is more likely along the lower floodplain closest to Karignan Creek supporting the suitable PCT 1718 which will be retained by the proposal.

The bats and the parrot are highly mobile over urban landscapes. The proposal will not inhibit or reduce the local movement pathways. The proposal will retain a 60 m wide corridor for wildlife movement and dispersal along the western and northern extent of the existing lot. This

corridor will retain a representative portion of connectivity for fauna however would not be expected to benefit the Swift Parrot to any notable capacity given its highly mobile and migratory nature. The corridor will contain Red Bloodwood trees which can flower up to mid-May and has been identified by the TBDC as providing potential foraging habitat.

(ii) for Flora, address how the proposal is likely to affect the ecology and biology of any residual plant population that will remain post development including where information is available:

- ***Pollination cycle*** – N/A
- ***Seedbanks*** – N/A
- ***Recruitment, and*** – N/A
- ***Interactions with other species*** – N/A
(e.g. pollinators, host species, mycorrhizal associations)

(f) A description of the extent to which the local population will become fragmented or isolated as a result of the proposed development

If the Giant Dragonfly was present within nearby identified habitats to the south-west, the proposal will act as a potential further barrier between this habitat and other potential habitats further north along the Gwandalan peninsula. Other swamp areas that have not also recorded the species do exist just over 1km to the north from the nearby potential habitat to the south-west. At present there is a pinch point of habitat heading north along Malloway Road. The proposed habitat corridor will maintain the existing connectivity north yet this will be slightly narrowed. The closest other swamp areas offering potential habitat (via the study area) are located at 1km away on the other side of Chain Valley Bay Rd. The proposal will not cause fragmentation towards this area. Closer habitat exists in the other direction on the other side of Karignan Creek.

In conclusion, whilst the proposal will not cause isolation from other habitat to the north, some additional fragmentation will occur in this direction. It is more likely that successful dispersal is more likely to happen towards the east before heading north, simply due to the closer proximity of habitat. The available habitats described are shown on Figure 21.

Due to their highly mobile nature, and ability to pass over and forage on the fringes of urban landscapes, the proposal will not likely cause any fragmentation or isolation of habitat for the local populations of the bat and parrot species considered.



Figure 21 – Nearby swamp habitats – potential for Giant Dragonfly

(g) The relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range

Little Bent-winged Bat & Large Bent-winged Bat - All individuals in the locality, region and extending out to this part of the state are part of the same populations for both species.

Giant Dragonfly – This species has never been recorded within the nearby locality. The closest record is located at approximately 9.5 km to the south at Toukley in 2006. There are no other records within 10km. The species is assumed present based on a lack of survey in the neighbouring lands during the appropriate survey season. So if a nearby population is present it would be expected to be centred on the lower reaches of the Karignan Creak in adjacent swamp habitats. The locality has a number of wet heath / swamp type habitats that may support the same or sub-populations, if present. The relationship between these areas is described above and shown on Figure 21.

Swift Parrot – Genetic studies of birds that breed on outlier islands of Tasmania are found to be all part of the same population, that all together make their annual migration north for winter. The winter migrations can extend to Queensland and west of the ranges therefore the study area is also not located at the limit of the species migratory range.

(h) The extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population

Little Bent-winged Bat & Large Bent-winged Bat - No such threats are likely to arise from the development.

Giant Dragonfly – The proposal is not considered likely to lead to an increase in any notable threats for this species.

Swift Parrot – The National Recovery Plan (Saunders & Tzaros 2011) for the species indicates that the major threats to the survival of the Swift Parrot are the ongoing loss of breeding and foraging habitat in Tasmania through forestry operations and land clearing, and predation by Sugar Gliders of nestlings and sitting females. Managing these threats is the primary focus of this Recovery Plan. Other identified threats include competition for foraging and nesting resources, mortality from collisions with human-made objects and impacts from climate change.

The following threats mentioned by the recovery plan are considered relevant to the proposal:

Fire – Where increases in fire frequency occur flowering events and maturation of nectar-rich plant species may be reduced, resulting in a reduction of foraging resources for Swift Parrot. The Recovery Plan notes that this is of particular concern in coastal NSW and in central Victoria where there is increasing residential and industrial development in close proximity to Swift Parrot habitat. Such developments are required to comply with new fire safety regulations involving clearing trees within fire protection zones and undertaking hazard reduction burns. With an increase in the human population residing adjacent to Swift Parrot habitat and increased accessibility to bushland areas, an increase in the incidence of accidental and deliberate fire may also be an issue. The extent of this potential is difficult to predict and a non-burn imposed on the proposed E2 areas despite suitable asset protection may be difficult to enforce.

Residential development – The proposed urban expansion will directly impact on less than 3% of the sites potentially important Swamp Mahogany foraging habitat but may indirectly impact by bushland degradation and modification of foraging habitat by edge effects and increased human presence. Collisions with wire netting, mesh fences, cars and most notably with window strikes cause mortality to Swift Parrots in urban areas throughout the species' range. Up to 2% of the entire swift parrot breeding population is killed every year as a result of collisions (Pfennigwerth 2008). These impacts may be reduced by appropriate fencing of the E2 areas and the incorporation of building design considerations as outlined by Pfennigwerth (2008). The speed of cars within the proposed development footprint is not expected to be a real concern.

Competition – Swift parrots can experience increased competition for resources from large, aggressive honeyeaters within altered habitats. Within the study area this includes the recorded Common Myna, Little Wattlebird, Noisy Friarbird and Noisy Miner. "Decline in woodland and forest birds due to aggressive exclusion by abundant Noisy Miners" is a Key Threatening Process (KTP) identified by the NSW Scientific Committee. Even if these species do not currently occupy the proposed E2 areas, they will be displaced by habitat clearing and may therefore concentrate their dominance in remaining areas. This is difficult to predict however Noisy Miner management to reduce this impact should be investigated.

While it is impossible to accurately account for the indirect impacts from aggressive bird competition through credit offsets, we have assumed a 10 m indirect impact buffer from the development footprint that is treated as a separate management zone in the BAM-C. The change in VI score calculated within this buffer (see Sections 3.1.5 and 5.5.2 a.) is assumed to be sufficient to account for these indirect impacts.

Climate Change – Whilst almost negligible in the scale of overall vegetation clearance, the proposal will contribute to the cumulative effect of this process.

Cumulative impacts – The Recovery Plan states that *each of the identified threats to the Swift Parrot has the potential to compromise the long-term survival of the species, and where more than one threat is present the cumulative effect is likely to be substantially greater than the sum of the individual threats. When assessing threats to the Swift Parrot, combinations of threats need to be considered to provide a realistic assessment of impacts on the species.*

Of the site species potential threats mentioned above, the potential for competition from other birds is considered the most notable in the remaining habitat parcels. This impact will receive specific management by planting of street trees, fencing of the E2 fringe to reduce edge impacts and habitat restoration of E2 lands. More recently this has also included further extension of setbacks to the Swamp Mahogany community.

(i) An estimate of the area, or number of populations and size of populations that is in the reserve system in NSW, the IBRA region and the IBRA subregion

Little Bent-winged Bat & Large Bent-winged Bat - This is not possible to predict for these two species however both disperse from breeding locations within the eastern extent of NSW to the coast and into the ranges (more so for the Large Bent-winged Bat). Foraging extent is expected to be relatively evenly represented in the reserves in this part of the state, as well as the associated IBRA regions and subregions.

Giant Dragonfly – This is not possible to predict for this species. The nearby swamps explained above to the east, north and further south-west are all located within the Lake Macquarie State Recreation Area, Joshua Porter Reserve and McCulloch Reserve.

Swift Parrot – As mentioned earlier above the Swift Parrot is considered a single migratory population in Australia.

The species has been known to forage within Yengo, Wollemi, Blue Mountains, Kuring-gai Chase and Goulburn Rivers National Parks. More locally, many of the sightings are within Council foreshore reserves and parks, as well as Koompahtoo (aboriginal owned land between Wyee Point and Morisset).

Species sightings are well distributed across the Sydney IBRA region, with the majority of recordings in lower lying areas; hence recordings are very limited over sandstone plateau areas. Within the Wyong IBRA subregion, the pattern is similar with most records close to the foreshore of Lake Macquarie and a large congregation on the low flats around Bateau Bay and some to the west of Tuggerah Lake on the lower flats. These areas in the locality are fundamentally floodplain habitats supporting Swamp Mahogany and Forest Red Gum forests. Therefore in the immediate locality Swift Parrot habitat is equally if not more represented within the council reserves. Given the high profile of the species and known local importance of

Swamp Mahogany, large tracts of this habitat on private lands will remain protected from development as in the case of the subject lot.

This is particularly guided as a priority action in (Roderick & Ingwersen 2014) report for Lake Macquarie City Council on behalf of Birds Australia.

(j) The measure/s proposed to contribute to the recovery of the species in the IBRA subregion.

Little Bent-winged Bat & Large Bent-winged Bat - Relevant management actions outlined by the TBDC include:

- *Reduce use of pesticides within breeding and foraging habitat.*
- *Ensure adequate foraging habitat is retained when undertaking hazard reduction activities, particularly during the breeding/reproduction season.*

All other measures outlined are related to management around roosting and important breeding habitat which is not present in the study area.

Giant Dragonfly - Relevant management actions outlined by the TBDC include:

- *Retain or reintroduce natural water flows to swamp habitats.*
- *Protect swamps from pollution.*
- *Minimise the use of pesticides in and adjacent to swamps.*
- *Reduce urban runoff, sewerage overflows, illegal stormwater connections and groundwater extraction.*
- *Prevent access to swamp habitats by off-road vehicles, bushwalkers or other trampling agents through signage, fencing or re-routing of tracks.*
- *Undertake weed control as required using bush regeneration techniques that will not damage the sensitive swamp habitat.*
- *Exclude pigs and cattle from swamp habitat.*
- *Manage fire trails and unsealed roads to reduce sedimentation impacts.*

Swift Parrot - Relevant management actions outlined by the TBDC include:

- *Reduce collisions in areas where Swift Parrots are foraging by closing window blinds or letting windows get dirty. Alternatively hang wind chimes, mobiles etc in front of windows. Hang strips of fabric across wire mesh fences.*
- *Retain stands of winter-flowering feed-trees, particularly large mature individuals.*
- *Revegetate with winter-flowering tree species where appropriate.*
- *Participate in biannual surveys to locate the winter foraging areas for this species.*

These actions are addressed in the mitigation measures outlined in Section 5.4.1 including:

- Maintain winter foraging trees in the E2 zone, and planting of additional specimens as street trees.
- Plant trees along the northern edge of the PCT 1718 area to act as a vegetated buffer for Noisy Miner edge impacts into this community.
- Incorporate a yearly survey program to check for species in the southern conservation area.
- Use of non-collision fencing of conservation areas to minimise the number of domestic animals in the E2 zone where possible. Wire mesh fencing should be

avoided or covered with shade cloth or planted and trained vines. Given the road design adjacent to Swamp Mahogany habitat, the erection of a fence at least 3 m high, covered with shade cloth, hedging, netting, mesh or other visual noise, should be placed on the southern side of the most southern road (closest to the potential foraging trees). This would encourage the birds to approach the food source at a higher altitude, thereby reducing the potential for vehicle collisions.

- Buildings to be located in or adjacent to potential swift parrot habitat and flyways (all proposed retained vegetation) should seek to minimise large expanses of glazing as well as glass reflectivity and transparency. For example, reduced- or low-reflectivity glass (0–10% reflectivity) should be used wherever possible and be integrated into the overall building design. Furthermore, install windows adjacent to habitat at an angle (i.e. angled in at their base) such that the glass pane reflects the ground instead of the surrounding habitat and sky in the birds' direct line of sight. Angles become effective at a minimum of 20 degrees from vertical, although 40-degree angles are known to be more effective. Visual noise or muting window reflection may also be used to prevent the appearance of windows as providing flying space beyond. Clear glass fencing, panelling or balustrading is to be avoided.
- Provide a community awareness program including educational signage.
- Undertake appropriate on-site stormwater management to prevent altered water quality on neighbouring areas.
- Manage and improve the retained bushland within PCT 1718 under a VMP.



Plot Datasheets

A3

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline. Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

Counts must apply to each size class when the **number of living tree stems** within the size class is ≤ 10 . Estimates can be used when the number of living tree stems within a class is > 10 . Estimates should draw from the number series: 10, 20, 30..., 100, 200, 300

For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. For **hollows** count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

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

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

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

400m ² plot: Sheet of	Survey Name	Plot Identifier	Recorders
Date 11/12/17	A17182 Chain Valley Bay	BCAR Q1	LH

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	voucher
T	Angophora costata	N	10	10	Can	
T	Eucalyptus rubusta	N	12	12	Can	
T	Melaleuca quinquenervia	N	10	16	Can	
S	Acacia longifolia / longifolia	N	18	400	Mid	
T	Gleichenia fernandii	N	3	18	Mid	
L	Stephania japonica	N	0.5	20	Mid	
F	Centella asiatica	N	0.5	250	GC	
	Andropogon virginicus	HTE	0.3	80	GC	
	Cinnamomum camphora	HTE	0.3	4	Mid	
D	Opismenus imbecilis	N	1	200	GC	
S	Melaleuca sieberi	N	6	55	Mid	
F	Geranium humanum	N	0.1	3	GC	
L	Hibbertia scandens	N	0.2	8	GC	
L	Glycine clandestina	N	0.1	15	GC	
G	Microlaena stipoides	N	10	2500	GC	
F	Hydrocotyle pendulata ^{pilotharpoides}	N	0.1	30	GC	
F	Dichandra repens	N	0.2	70	GC	
L	Cayratia climacidea	N	0.1	2	Mid	
S	Melaleuca linariifolia	N	1	8	Mid	
G	Entolasia stricta	N	8	1500	GC	
R	Juncus acutatus	N	2.5	250	GC	
	Rubus fruticosus sp. agg.	HTE	0.1	3	GC	
V	Gahnia sieberiana aspera	N	8	200	GC	
S	Pittosporum undulatum (all juveniles)	N	0.2	12	GC	
	Verbena bonariensis	E	0.1	2	GC	
	Sida rhombifolia	E	0.1	3	GC	
E	Adiantum aethiopicum	N	0.1	10	GC	
G	Echinopogon caespitosus	N	3	500	GC	
E	Pteridium esculentum	N	0.2	17	GC	
F	Dignella caerulea	N	0.2	26	GC	
F	Epilobium australe	N	0.1	3	GC	
T	Alluvium littoralis (juvenile in tall)	N	0.1	1	Mid	
V	Fimbristylis dichotoma	N	0.1	20	GC	
G	Imperata cylindrica var. major	N	0.2	60	GC	
T	Eucalyptus haemastoma	N	8	5	Can	
L	Hardenbergia violacea	N	0.1	1	GC	
R	Lomandra longifolia	N	0.1	2	GC	
L	Cassipoupa pubescens	N	0.1	1	Mid	
V	Lepidosperma laterale	N	0.1	4	GC	
P	Livistona australis (juvenile, 60cm tall)	N	0.1	1	GC	

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 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.

F	Rhynchospora Desmodium chytidophyllum	N	0.2	40	GC
T	Melia azedarach var. australasica	N	0.1	1	Mid
L	Callistemon scandens	N	0.1	1	GC

Site Sheet no: 1 of

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline. Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10 . Estimates can be used when the number of living tree stems within a class is > 10 . Estimates should draw from the number series: 10, 20, 30..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Morphological Type		Landform Element		Landform Pattern		Microrelief	hummock
Lithology		Soil Surface Texture	clay-loam	Soil Colour	Pale brown	Soil Depth	deep
Slope	1°	Aspect	South	Site Drainage	Poor	Distance to nearest water and type	Karimong Crk 125m

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

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

BAM Site – Field Survey Form

Site Sheet no: 1 of 1

Survey Name		Plot Identifier		Recorders	
Date	12/12/17	A17182 Chain Valley Bay	BCAR Q3	LH	
Zone	56	IBRA region	Photo #	✓	Zone ID
Easting	Northing	Dimensions		Orientation of midline from the 0 m point.	
Vegetation Class					Confidence: H M L
Plant Community Type					EEC: <input checked="" type="checkbox"/> (H) M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.

Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m ² plot)	Sum values
Trees	6
Shrubs	9
Grasses etc.	6
Forbs	3
Ferns	2
Other	7
Count of Native Richness	
Trees	30.5
Shrubs	8.9
Grasses etc.	18.9
Forbs	1.7
Ferns	12.1
Other	6
Sum of Cover of native vascular plants by growth form group	
High Threat Weed cover	

BAM Attribute (20 x 50 m plot)		# Tree Stems Count		Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately
dbh	Euc*	Non Euc	Hollows†	
large trees for Euc* & Non Euc	80+ cm	111	④	
	50 – 79 cm	11	②	
	30 – 49 cm	111	⑤	
	20 – 29 cm	111	⑦	③
	10 – 19 cm	111 111	⑫	⑦
	5 – 9 cm	1	①	n/a
	< 5 cm			n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	111 111 111 111 111 111			total 32

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30, ..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	60	30	75	50	60	5	5	5	5	15	2	2	2	2	2	0	0	0	0	0
Average of the 5 subplots	55					7					2					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

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

Morphological Type		Landform Element		Landform Pattern		Microrelief	flat, uniform
Lithology		Soil Surface Texture	loam	Soil Colour	med brown	Soil Depth	moderate-deep
Slope	30°	Aspect	South	Site Drainage	good	Distance to nearest water and type	Karrington creek 200m

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)

[illegible]

33

BAM Site – Field Survey Form

Site Sheet no: 1 of 1

Survey Name		Plot Identifier		Recorders	
Date	12/12/17	A1782 Chain Valley Bay	BCAR Q4	LH	
Zone	Datum	IBRA region	Photo #	Zone ID	
86					
Easting	Northing	Dimensions	in	Orientation of midline from the 0 m point	Magnetic
Vegetation Class					Confidence: H M L
Plant Community Type					EEC: x Confidence: (H) M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.

Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m ² plot)		Sum values	BAM Attribute (20 x 50 m plot)				# Tree Stems Count		Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately
			dbh	Euc*	Non Euc	Hollows†			
Count of Native Richness	Trees	6	large trees for Euc* & Non Euc	80 + cm	1	Non Euc	Hollows		
	Shrubs	16		50 – 79 cm	1				
	Grasses etc.	7		30 – 49 cm	1				
	Forbs	5		20 – 29 cm	10				
	Ferns	3		10 – 19 cm	15				
	Other	5		5 – 9 cm	6				
Sum of Cover of native vascular plants by growth form group	Trees	21.7		< 5 cm	1				
	Shrubs	15		Length of logs (m) (≥10 cm diameter, >50 cm in length)	1				
	Grasses etc.	22.3							
	Forbs	0.7							
	Ferns	0.3							
	Other	10.7							
High Threat Weed cover		4.5							

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	25 25 50 15 20	15 5 10 10 10	2 2 2 2 2	0 0 0 0 0
Average of the 5 subplots	27	10	2	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

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)	0		
Cultivation (inc. pasture)	0		
Soil erosion	0		
Firewood / CWD removal	0		
Grazing (identify native/stock)	0		
Fire damage	1	NR	Burnt trunks
Storm damage	1	R	Large limbs lost
Weediness	1	R	Edge effects
Other			

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

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

400m ² plot: Sheet 1 of 2	Survey Name	Plot Identifier	Recorders
Date 12/12/17	A17182 Chain Valley Bay	BCAR 04	LH

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	voucher
T	<i>Eucalyptus haemastera</i>	N	7	2	Can	
T	<i>Angophora costata</i>	N	2	2	Can	
T	<i>Corymbia gummiifera</i>	N	5	9	Can	
S	<i>Acacia longifolia</i> / <i>longifolia</i>	N	3	16	Mid	
S	<i>Braeyna oblongifolia</i>	N	4	60	Mid	
T	<i>Eucalyptus capitellata</i>	N	6	3	Can	
X	<i>Xanthorrhoea latifolia</i> subsp. <i>latifolia</i>	N	10	250	GC	
K	<i>Glyceria clandestina</i>	N	0.1	15	GC	
	<i>Lantana camara</i>	HTE	0.2	8	Mid	
	<i>Andropogon virginicus</i>	HTE	0.2	100	GC	
G	<i>Microlaena stipoides</i> var. <i>stipoides</i>	N	4	1000	GC	
T	<i>Glechidion ferdinandi</i>	N	1.5	150	Mid	
S	<i>Pultenaea retusa</i>	N	3.55	150	GC	
S	<i>Dodonaea triquetra</i>	N	1.5	800	Mid	
S	<i>Banksia spinulosa</i> var. <i>spinulosa</i>	N	2	10	Mid	
S	<i>Acacia suaveolens</i>	N	0.3	20	Mid	
G	<i>Imperata cylindrica</i> var. <i>major</i>	N	2	150	GC	
G	<i>Pennisetum simile</i>	N	3	300	GC	
	Steno <i>Axonopus fissifolius</i>	HTE	2	200	GC	
G	<i>Entolasia stricta</i>	N	2	250	GC	
	<i>Sida rhombifolia</i>	E	0.1	12	GC	
	<i>Richardia setacea</i> brasilensis	E	0.1	1	GC	
F	<i>Proelia purpurascens</i>	N	0.1	5	GC	
S	<i>Acacia myrtifolia</i>	N	0.2	30	GC	
S	<i>Lambertia formosa</i>	N	0.2	4	Mid	
	<i>Cyperus brevifolius</i>	E	0.1	1	GC	
Z	<i>Epacris pulchella</i>	N	0.1	3	GC	
F	<i>Centella asiatica</i>	N	0.2	75	GC	
T	<i>Albocarynia litoralis</i> (brasilensis)	N	0.2	25	Mid	
S	<i>Pomadouris</i> sp. (leaf 125x30mm)	N	0.1	1	Mid	
	<i>Rubus fruticosus</i> ssp. agg.	HTE	0.1	1	GC	
L	<i>Kennedia rubicunda</i>	N	0.2	1	GC	
G	<i>Entolasia marginata</i>	N	10	2500	GC	
	<i>Campylopusium</i>	E	0.1	2	GC	
	<i>Pennisetum clandestinum</i>	E	0.1	1	GC	
G	<i>Dichelachne micrantha</i>	N	1	100	GC	
E	<i>Calchlena dubia</i>	N	0.1	2	GC	
S	<i>Banksia oblongifolia</i>	N	0.1	1	Mid	
F	<i>Dampiera stricta</i>	N	0.1	1	GC	
F	<i>Dichondra repens</i>	N	0.2	75	GC	

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 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

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

BAM Site – Field Survey Form

Site Sheet no: 1 of 1

Survey Name		Plot Identifier		Recorders	
Date	18/12/17	A17182 chain Valley Bay	BCAR 05	LH	
Zone	Datum	IBRA region	Photo #	Zone ID	
56			✓		
Easting	Northing	Dimensions	Orientation of midline from the 0 m point.		Magnetic
Vegetation Class					Confidence: H M L
Plant Community Type					EEC: X Confidence: (H) M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m ² plot)		Sum values	BAM Attribute (20 x 50 m plot)				# Tree Stems Count				Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately
			dbh	Euc*	Non Euc	Hollows†					
Count of Native Richness	Trees	7	large trees for Euc* & Non Euc	80 + cm	11	Euc*	Non Euc	Hollows			* includes all species of Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia † Record total number of stems by size class with hollows (including dead stems/trees)
	Shrubs	20	50 – 79 cm	11	2						
	Grasses etc.	9	30 – 49 cm	11	4						
	Forbs	6	20 – 29 cm	11	23	11	11	11	11		
	Ferns	2	10 – 19 cm	11	11	23	5	11	3		
	Other	6	5 – 9 cm	11	5	11	2	n/a			
Sum of Cover of native vascular plants by growth form group	Trees	42.3	< 5 cm	1	1	2	n/a				
	Shrubs	18.5	Length of logs (m) (≥10 cm diameter, >50 cm in length)	11	Tally space						
	Grasses etc.	18.3									
	Forbs	1.2									
	Ferns	0.5									
	Other	18.5									
High Threat Weed cover	0.4									total	27

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30, ..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	40	45	65	30	50	10	5	5	5	5	2	2	2	2	2	0	0	0	0	0
Average of the 5 subplots	50					6					2					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

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

Morphological Type	Landform Element	Landform Pattern	Microrelief	criform
Lithology	Soil Surface Texture	Soil Colour	Soil Depth	mod-deep
Slope	Aspect	Site Drainage	Distance to nearest water and type	250m down
1-2°	north	good		

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)	0		
Cultivation (inc. pasture)	0		
Soil erosion	0		
Firewood / CWD removal	0		
Grazing (identify native/stock)	0		
Fire damage	0		
Storm damage	0		
Weediness	1	R	<5% cover of exotics
Other			

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

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

400m ² plot: Sheet 1 of 2	Survey Name	Plot Identifier	Recorders
Date 18/12/17	ART 182 Chain Valley Bay	BCAE QS	WH

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	voucher
T	<i>Corymbia guumifera</i>	N	15	21	Can	
T	<i>Eucalyptus haemastoma</i>	N	7	5	Can	
T	<i>Eucalyptus capitellata</i>	N	12	8	Can	
T	<i>Angophora costata</i>	N	2.5	1	Can	
T	<i>Glochidion ferdinandi</i>	N	3	16	Mid	
S	<i>Lambertia formosa</i>	N	4	18	Mid	
S	<i>Pittosporum undulatum</i>	N	4	15	Mid	
S	<i>Leptospermum polygalifolium</i>	N	2	9	Mid	
T	<i>Allocastraria littoralis</i>	N	5	4	Mid	
L	<i>Glycine clandestina</i>	N	0.1	6	GC	
Z	<i>Epacris pulchella</i>	N	0.1	6	GC	
F	<i>Cryptostylis subulata</i>	N	0.2	80	GC	
X	<i>Xanthorrhoea latifolia</i>	N	18	500	GC	
F	<i>Centella asiatica</i>	N	0.2	200	GC	
G	<i>Entolasia stricta</i>	N	3	750	GC	
S	<i>Acacia terminalis</i>	N	0.2	10	GC	
	<i>Anthopogon virginicus</i>	HTE	0.2	12	GC	
S	<i>Breynia oblongifolia</i>	N	0.5	25	Mid	
S	<i>Banksia oblongifolia</i>	N	0.8	13	Mid	
S	<i>Persoonia linearis</i>	N	0.1	1	Mid	
	<i>Taraxacum officinale</i>	E	0.1	1	GC	
L	<i>Hardenbergia violacea</i>	N	0.1	1	GC	
G	<i>Pultenaea retusa</i>	N	0.1	3	GC	
S	<i>Acacia longifolia/longifolia</i>	N	0.3	3	Mid	
F	<i>Hovea linearis</i>	N	0.1	1	GC	
F	<i>Dinnella caerulea</i>	N	0.2	30	GC	
S	<i>Lamaria cilicifolia</i>	N	0.1	2	GC	
	<i>Passiflora edulis</i>	E	0.2	3	Mid	
S	<i>Persoonia levis</i>	N	0.4	3	Mid	
S	<i>Hakea bakeriana</i>	N	1.5	8	Mid	
F	<i>Protea purpurascens</i>	N	0.3	40	GC	
S	<i>Pinetum limicola</i>	N	0.1	8	GC	
G	<i>Entolasia marginata</i>	N	12	3000	GC	
E	<i>Pteridium esculentum</i>	N	0.2	13	GC	
G	<i>Imperata cylindrica</i>	N	2	400	GC	
S	<i>Banksia spinulosa var. spinulosa</i>	N	0.5	6	Mid	
S	<i>Acacia myrtifolia</i>	N	0.1	1	GC	
	<i>Paspalum dilatatum</i>	E	0.1	3	GC	
T	<i>Melia azedarach</i>	N	0.8	17	Mid	
L	<i>Billardiera scandens</i>	N	0.1	2	GC	

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 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 1

Date		Survey Name		Plot Identifier		Recorders	
18/12/17		A17182 Chain Valley Bay		BCAR Q6		LU	
Zone	Datum	IBRA region	Photo #		Zone ID		
5b							
Easting	Northing	Dimensions		Orientation of midline from the 0 m point.		Magnetic	
Vegetation Class							Confidence: H M L
Plant Community Type		EEC: X					Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
 Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m ² plot)	Sum values
Count of Native Richness	
Trees	6
Shrubs	10
Grasses etc.	50
Forbs	5
Ferns	2
Other	70
Sum of Cover of native vascular plants by growth form group	
Trees	39
Shrubs	22.4
Grasses etc.	13.5
Forbs	0.6
Ferns	2.1
Other	5.1
High Threat Weed cover	10.5

BAM Attribute (20 x 50 m plot)		# Tree Stems Count		Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately
dbh	Euc*	Non Euc	Hollows†	
large trees for Euc* & Non Euc	80+ cm	11	2	
	50 – 79 cm	14	6	
	30 – 49 cm	11		
	20 – 29 cm	11	2	
	10 – 19 cm	11	13	3
	5 – 9 cm	1	9	n/a
	< 5 cm	1	1	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)		11	11	56

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30, ..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	100	80	80	40	80	0	2	2	10	0	2	2	2	2	2	0	0	0	0	0
Average of the 5 subplots	76					4.8					2					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

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

Morphological Type		Landform Element		Landform Pattern		Microrelief	uniform
Lithology		Soil Surface Texture	sandy-barn	Soil Colour	light grey	Soil Depth	med-deep
Slope	1°	Aspect	north	Site Drainage	good	Distance to nearest water and type	350m dam

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)	1	0	Reduced shrub layer
Cultivation (inc. pasture)	0		
Soil erosion	0		
Firewood / CWD removal	0		
Grazing (identify native/stock)	0		
Fire damage	0		
Storm damage	1	2	2 trees fallen
Weediness	1	2	Edge effects
Other			

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

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

400m ² plot: Sheet of	Survey Name	Plot Identifier	Recorders
Date 18/12/17	A17.82 Chain Valley Bay	BCAR Q6	LH

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	voucher
T	<i>Eucalyptus haemastoma</i>	N	12	7	Can	
T	<i>Eucalyptus capillata</i>	N	3	2	Can	
T	<i>Corymbia gummifera</i>	N	8	5	Can	
T	<i>Angophora costata</i>	N	5	4	Can	
T	<i>Allocasuarina littoralis</i>	N	8	8	Mid	
S	<i>Ptilospermum undulatum</i>	N	10	16	Mid	
E	<i>Pteridium esculentum</i>	N	2	45	Gr	
T	<i>Glacidium ferdinandi</i>	N	3	13	Mid	
S	<i>Dodonaea triquetra</i>	N	8	150	Mid	
	<i>Asparagus acutispinus</i>	HTE	0.4	15	Gr	
S	<i>Acacia longifolia / longifolia</i>	N	0.5	7	Mid	
G	<i>Entolasia marginata</i>	N	8	1000	Gr	
X	<i>Xanthorrhoea latifolia</i>	N	3	70	Gr	
S	<i>Lomatia silaifolia</i>	N	0.2	8	Gr	
S	<i>Breynia oblongifolia</i>	N	1.5	22	Mid	
	<i>Wisteria sinensis</i>	E	0.2	2	Gr	
F	<i>Dionella caerulea</i>	N	0.2	40	Gr	
F	<i>Vernonia cinerea var. cinerea</i>	N	0.1	1	Gr	
G	<i>Imperata cylindrica var. major</i>	N	1	50	Gr	
V	<i>Lepidosperma laterale</i>	N	2	150	Gr	
L	<i>Parsonsia straminea</i>	N	0.5	3	Mid	
D	<i>Opismenus imberilis</i>	N	0.5	100	Gr	
G	<i>Entolasia stricta</i>	N	2	150	Gr	
	<i>Ocoba serrulata</i>	HTE	2.5	28	Mid	
	<i>Cinnamomum camphora</i>	HTE	1.5	1	Mid	
S	<i>Pinetia linifolia</i>	N	0.2	18	Gr	
L	<i>Hardenbergia violacea</i>	N	0.3	8	Gr	
F	<i>Pratia purpurascens</i>	N	0.1	10	Gr	
	<i>Chrysanthemoides monilifera subsp rotundata</i> (B. ton)	HTE	1	3	Mid	
S	<i>Acacia suaveolens</i>	N	0.1	3	Gr	
	<i>Monstera deliciosa</i>	E	0.1	1	Gr	
	<i>Senna pendula var. glabrata</i>	HTE	1.5	22	Mid	
S	<i>Acacia myrtifolia</i>	N	0.2	11	Gr	
L	<i>Hibbertia scandens</i>	N	0.3	16	Gr	
F	<i>Cryptanthus umbellata</i>	N	0.1	3	Gr	
S	<i>Banksia spinulosa var. spinulosa</i>	N	0.2	3	Mid	
P	<i>Livistona australis (juvenile)</i>	N	0.1	3	Gr	
L	<i>Glycine clandestina</i>	N	0.1	1	Gr	
	<i>Axonopus fissifolius</i>	HTE	0.1	3	Gr	
	<i>Sida rhombifolia</i>	E	0.5	37	Gr	

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 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.

24

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 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 1

Date		Survey Name		Zone ID		Recorders	
20/10/2018		180502 TSS				AP	
Zone	Datum	Plot ID		Plot dimensions	Photo #		
		AL1		20 x 50			
Easting	Northing	IBRA region		Midline bearing from 0 m	Magnetic °		
Vegetation Class							Confidence:
Plant Community Type							H M L
					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 m ² 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 m ² 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
0		

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)		25 30 60 60 30					a b c d e					a b c d e					a b c d e				
Average of the 5 subplots																					

er 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 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

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

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

Date	Survey Name	Plot Identifier	Recorders
20/10/20	140302TSS	ALI	GP

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	voucher
1	Yorkshire fog: <i>Trifolium latifolium</i>	E	20	2000		
2	Whiskey grass <i>Andropogon virginicus</i>	HTE	15	1000		
3	Cenchrus clandestinus Buffalo grass	HTE	25	2000		
4	<i>Hydrocotyle tripartita</i>	N	20	50		
5	<i>Senecio madagascariensis</i>	HTE	2	50		
6	<i>Centella asiatica</i>	N	0.5	20		
7	<i>Trifolium repens</i>	E	5	100		
8	<i>Medicago</i> sp.	E	0.2	10		
9	<i>Verbena bonariensis</i>	E	0.1	10		
10	<i>Juncus rotundifolius</i>	N	0.2	20		
11	<i>Hypochaeris radicata</i>	E	0.1	10		
12	<i>Hydrocotyle bonariensis</i>	E	0.1	5		
13	<i>Amagathis arvensis</i>	E	0.1	5		
14	<i>Briza minor</i>	E	2	50		
15	<i>Pratia purpurascens</i>	N	0.1	10		
16	<i>Sida rhombifolia</i>	E	0.1	10		
17	Buffalo grass	HTE				
18	<i>Vicia sativa</i>	E	0.1	5		
19	<i>Cynodon dactylon</i>	N	4	1000		
20	<i>Plantago lanceolata</i>	E	0.1	20		
21	<i>Lotus</i> sp.	E	0.1	5		
22	<i>Sesuvia sesuvia</i>	E	0.1	10		
23	<i>Hydrocotyle sibirica-pioides</i>	N	0.1	3		
24	<i>Richardia scabra</i>	E	0.2	20		
25	<i>Gnaphalium</i> sp.	E	0.1	5		
26	<i>Cyperus gracilis</i>	N	0.1	3		
27	<i>Senecio jacobaeus</i>	E	0.1	3		
28	<i>Geranium hibernicum</i>	N	0.1	3		ph
29	<i>Briza major</i> (B)	E	0.1	10		
30	<i>Cirsium vulgare</i>	E	0.1	1		
31	grass 1 = <i>Dichelachne micrantha</i>	N	0.1	3		✓
32	grass 2 = <i>Vulpia bromoides</i>	E	0.5	20		✓
33	<i>Oxalis</i> sp. <i>perennans</i>	N	0.1	3		
34	<i>Bidens pilosa</i>	HTE	0.1	3		
35	<i>Conyza bonariensis</i>	E	0.1	3		
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 1

Date	Survey Name	Zone ID	Recorders			
Zone	Datum	Plot ID	Plot dimensions	Photo #		
Easting	Northing	IBRA region	In m	Midline bearing from 0 m	Magnetic °	
Vegetation Class			Confidence:			
Plant Community Type			H M L			
Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.			EEC:			
			Confidence:			
			H M L			

BAM Attribute (400 m ² 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 m ² 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)	20 30 15 15 25	a b c d e	a b c d e	a b c d e
Average of the 5 subplots				

er 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 er 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

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

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

Date

20/10/20

180202BS

C12

CP

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	Voucher
1	Cynodon dactylon	N	20	1000		
2	grass 2 = Vulpia bromoides	E	15	50		
3	Oxalis pesonana	N	0.1	10		
4	Sanichus oleaceus	E	1	40		
5	Juncus urtatis	N	12.5	50		
6	Yorkshire Fog = Holcus lanatus	E	5	100		
7	Whitty grass = Andropogon virginicus	NTE	15	200		
8	Hypochaeris radicata	E	2	50		
9	Plantago lanceolata	E	2	50		
10	Microklena stipoides	N	5	50		
11	Trifolium repens	E	0.1	3		
12	Medicago sp	E	0.1	3		
13	Anagallis arvensis	E	2	20		
14	Lolium perenne	E	5	40		
15	Verbena bonariensis	E	0.1	10		
16	Sida rhomboides	E	0.1	10		
17	Briza minor	E	0.5	20		
18	Pellaea falcata	N	0.1	5		
19	Pteridium esculentum	N	2	10		
20	Geum humifusum	N	0.1	5		
21	Modiola caroliniana	E	0.2	10		
22	Vicia sativa	E	5	20		
23	Conyza sumatrensis	E	0.1	10		
24	Lamiaceae: Stachys arvensis	E	0.1	3		ph
25	Cenchrus clandestinus	NTE	4	20		
26	Stellaria Richardia stelleris	E	0.1	10		
27	Juncus prismatocarpus s.l.	N	0.1	1		ph
28	Solidago senilis	E	0.1	20		
29	Cirsium vulgare	E	0.1	3		
30	Lotus sp.	E	0.2	10		
31	Paspalum dilatatum	NTE	2	10		
32	Senecio madagascariensis	NTE	0.5	10		
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 1

Date	20/10/20	Survey Name	180002 TSS	Zone ID	Recorders		
Zone	Datum	Plot ID	CL3	Plot dimensions	20x50	Photo #	✓
Easting	Northing	IBRA region	In m	Midline bearing from 0 m	Magnetic °		
Vegetation Class		Confidence:					
Plant Community Type		H M L					
Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.					EEC:		Confidence:
					H M L		

BAM Attribute (400 m ² 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	

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)	30 30 25 25 20	a b c d e	a b c d e	a b c d e
Average of the 5 subplots				

er 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 er 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

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

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

Date

20/10/20

KODORISS

GL3

GP

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	Voucher
1	<i>Cynodon dactylon</i>	N	80	500		
2	<i>Oxalis pes-caprae</i>	N	2	50		
3	<i>Juncus nodatus</i>	N	4	20		
4	<i>Hypochaeris radicata</i>	E	0.2	20		
5	<i>Setaria merid</i>	HTE	0.5	10		
6	<i>Sida rhombifolia</i>	E	0.1	5		
7	pale underleaf - <i>Lepidoptera</i> ? <i>Facilis</i> <i>retunda</i>	E	0.1	3		✓
8	<i>Briza minor</i>	E	1	20		
9	<i>Richardia stellaris</i>	E	0.2	20		
10	<i>Amorpha arvensis</i>	E	0.1	10		
11	<i>Conyza sumatrensis</i>	E	0.1	10		
12	<i>Lolium perenne</i>	E	1	20		
13	grass 2 = <i>Vulpia bromoides</i>	E	0.5	10		
14	<i>Cenchrus clandestinus</i>	HTE	4	50		
15	Yorkshire Fog = <i>Holcus lanatus</i>	E	2	50		
16	<i>Sida rhombifolia</i>	E	0.1	10		
17	<i>Bromus catharticus</i>	E	1	20		
18	<i>Briza subaristata</i>	HTE	0.1	3		ph
19	Lamiaceae = <i>Stachys arvensis</i>	E	0.1	5		
20	<i>Vicia sativa</i>	E	0.1	10		
21	<i>Commelina cyanea</i>	N	0.5	10		
22	<i>Paspalum dilatatum</i>	HTE	0.2	3		
23	<i>Daucus carota</i>	E	0.1	3		
24	<i>Cyperus aggregatus</i>	E	0.2	20		
25	<i>Platia purpurascens</i>	N	0.1	3		
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 1

Date	20/10/20	Survey Name	180002LTS5	Zone ID	CLP	Recorders		
Zone	Datum	Plot ID	CL4	Plot dimensions	20x50	Photo #	✓	
Easting	Northing	IBRA region	In m	Midline bearing from 0 m		Magnetic °		
Vegetation Class						Confidence: H M L		
Plant Community Type						Confidence: H M L		
Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.						EEC:		Confidence: H M L

BAM Attribute (400 m ² plot)	Sum values
Trees	
Shrubs	
Grasses etc.	
Forbs	
Ferns	
Other	
Count of Native Richness	
Sum of Cover of native vascular plants by growth form group	
Trees	
Shrubs	
Grasses etc.	
Forbs	
Ferns	
Other	
High Threat Weed cover	

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 (%)
Subplot score (% in each)	20 25 20 20 30	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 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

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

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

Date

20/10/20

180102 T88

16L4

AP

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	voucher
1	<i>Cynodon dactylon</i>	N	40	1000		
2	<i>Abrus longifolius</i>	N	2	1		
3	grass 2 = <i>Vulpia bromoides</i>	E	50	3000		
4	<i>Briza minor</i>	E	3	100		
5	<i>Briza sp. subaristata</i>	HTE	0.1	3		
6	<i>Pennisetum purpureum</i>	E	2	20		
7	<i>Hypochaeris radicata</i>	E	1	20		
8	<i>Anagallis arvensis</i>	E	0.2	10		
9	<i>Richardia scabra</i>	E	2	20		
10	<i>Juncus urbinianus</i>	N	0.2	20		
11	<i>Lolium perenne</i>	E	2	20		
12	<i>Lotus sp.</i>	E	1	10		
13	<i>Senecio madagascariensis</i>	HTE	2	30		
14	<i>Conyza sumatrensis</i>	E	0.1	3		
15	<i>Stenotaphrum secundatum</i>	HTE	0.1	3		
16	<i>Sporobolus africanus</i>	E	0.2	10		
17	pink umbellifer - <i>Utricularia</i> <i>pauciflora</i>	E	0.1	10		
18	Whisky grass - <i>Andropogon virginicus</i>	HTE	0.2	5		
19	<i>Paspalum dilatatum</i>	HTE	0.5	10		
20	pink apple <i>Monarda</i> = <i>Sisyrinchium</i>	E	0.1	30		ph.
21	<i>Commersonia</i> sp. <i>microanthum</i>	E	0.1	3		
22	<i>Briza</i> - big - <i>maxima</i>	E	0.1	3		
23	Lamiaceae - <i>Stachys arvensis</i>	E	0.1	3		
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 1

Date	20/10/20	Survey Name	180002-TSS	Zone ID	Recorders		
Zone	Datum	Plot ID	GL5	Plot dimensions	20x50	Photo #	✓
Easting	Northing	IBRA region	In m	Midline bearing from 0 m	Magnetic °		
Vegetation Class						Confidence: H M L	
Plant Community Type						Confidence: H M L	
Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.						EEC:	H M L

BAM Attribute (400 m ² plot)	Sum values
Trees	
Shrubs	
Grasses etc.	
Forbs	
Ferns	
Other	
Count of Native Richness	
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 m ² 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)	a b c d e	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 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

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

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

400 m ² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 20/10/20	180007-TSS	GLS	GP

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	voucher
1	<i>Bromus catherartus</i>	E	15	500		
2	<i>Cenchrus clandestinus</i>	HTE	30	2000		
3	<i>Hieracium alba</i>	E	5	1		
4	<i>Cyperus</i> sp.	E	3	1		
5	<i>Bidens pilosa</i>	HTE	10	200		
6	<i>Modiola caroliniana</i>	E	1	10		
7	<i>Sida rhomboides</i>	E	2	50		
8	<i>Calysia lanceolata sumatrensis</i>	E	3	60		
9	<i>Verbena bonariensis</i>	E	1	10		
10	<i>Sonchus oleraceus</i>	E	1	20		
11	<i>Trifolium repens</i>	E	2	40		
12	<i>Eragrostis curvula</i>	HTE	1	10		
13	<i>Gambusia sp.</i>	E	0.2	20		
14	<i>Paspalum dilatatum</i>	HTE	2	10		
15	<i>Cynodon dactylon</i>	N	8	200		
16	<i>Hypochaeris radicata</i>	E	0.1	10		
17	<i>Salix usitata</i>	N	0.1	3		
18	<i>Phytolacca octandra</i>	E	1	4		
19	<i>Cestrum parqui</i>	HTE	4	3		
20	<i>Rumex acetosella</i>	E	0.1	3		
21	<i>Hydrocotyle sp. laxiflora?</i>	N	0.1	3		✓
22	<i>Colium perene</i>	E	8	200		
23	<i>Daucus carota</i>	E	0.1	3		
24	<i>Solanum americanum</i>	N	0.2	3		
25	<i>Annagalis arvensis</i>	E	0.2	20		
26	<i>Rumex</i> sp.	E	3	1		
27	<i>Medicago</i> sp.	E	0.1	3		
28	<i>Ceranium koreanum</i>	N	0.1	3		
29	pale purple - <i>Sisyrinchium micranthum</i>	E	0.1	20		
30	<i>Hypolepis mureletii</i>	N	1	5		
31	<i>Commelina cyanea</i>	N	0.1	5		
32	Exotic tree = <i>Lagerstroemia indica</i>	E	4	1		phi
33	<i>Physalis peruviana</i>	E	1	5		
34	<i>Vicia Vicia sativa</i>	E	0.1	3		
35	Yorkshire Fog = <i>Holcus lanatus</i>	E	6	200		
36	<i>Lambium camera</i>	HTE	4	5		
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 1

Date	20/10/20	Survey Name	180002 TSS	Zone ID	Recorders		
Zone	Datum	Plot ID	AL6	Plot dimensions	20x80m	Photo #	/
Easting	Northing	IBRA region	In m	Midline bearing from 0 m	Magnetic °		
Vegetation Class		Confidence:					
Plant Community Type		H M L					
Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.					EEC:	Confidence:	
						H M L	

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

DBH	# Tree Stems Count	# Stems with Hollows
80 + cm		
50 – 79 cm	1	
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)	4	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)	15 60 50 55 30	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			
Browsing (identify native/stock)			
Fire damage			
Storm damage			
Feediness			
Other			

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

Date

20/10/20

180002TS5

GL6

GP

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	voucher
1	Cynodon dactylon	N	5	200		
2	Grass 2 = Vulpia bromoides	E	50	2000		
3	Certhella asiatica	N	0.1	3		
4	Acacia longifolia	N	3	2		
5	yellow fl. Hypericum gramineum	N	0.1	10		
6	Briza minor	E	1	10		
7	Gammochaeta sp.	E	0.1	10		
8	Lotus sp.	E	0.2	20		
9	Juncus unitatus	N	0.1	5		
10	Oxalis perennans	N	0.1	3		
11	Hypochaeris radicata	E	0.5	20		
12	Elialyptis sp. (seedling)	N	0.1	1		
13	Eragrostis brownii	N	5	100		
14	Andropogon virginicus	HTE	3	20		
15	Stenotaphrum secundatum	HTE	30	200		
16	Portia purpurascens	N	0.1	8		
17	Richardia stelaris	E	0.2	20		
18	Orchid = Microtis parviflora	N	0.1	2		ph
19	Juncus sp. - clumped - prismatocarpus	N	0.1	5		✓
20	Dichelachne micrantha = grass	N	0.5	10		
21	Briza sp. subaristata	HTE	0.1	5		
22	Allocastrum sp. (seedling)	N	0.1	1		
23	Yorkshire fog = Lolium lanatum	E	0.1	3		
24	Annisopogon avaricus	N	0.1	3		
25	Senecio madagascariensis	HTE	0.2	3		
26	Vicia Vicia sativa	E	0.2	10		
27	Sida rhombifolia	E	0.1	10		
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, ...



National - Significant Impact Criteria

A4

Under the *EPBC Act* an action will require approval from the Australian Government Environment Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. The following significant impact criteria were sourced from the EPBC Act Policy Statement 1.1 (May 2006):

CRITICALLY ENDANGERED AND ENDANGERED SPECIES

Significant impact criteria

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- Lead to a long-term decrease in the size of a population;
- Reduce the area of occupancy of the species;
- Fragment an existing population into two or more populations;
- Adversely affect habitat critical to the survival of a species;
- Disrupt the breeding cycle of a population;
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
- Introduce disease that may cause the species to decline; or
- Interfere with the recovery of the species.

>> What is a population of a species?

A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- a geographically distinct regional population, or collection of local populations; or
- a population, or collection of local populations, that occurs within a particular bioregion.

>> What is habitat critical to the survival of a species or ecological community?

'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal;
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- To maintain genetic diversity and long term evolutionary development; or
- For the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

VULNERABLE SPECIES

Significant impact criteria

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species;
- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
- introduce disease that may cause the species to decline; or
- interfere substantially with the recovery of the species.

>> What is an important population of a species?

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal;
- Populations that are necessary for maintaining genetic diversity; and/or
- Populations that are near the limit of the species range.

CRITICALLY ENDANGERED AND ENDANGERED ECOLOGICAL COMMUNITIES

Significant impact criteria

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- Reduce the extent of an ecological community;
- Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;
- Adversely affect habitat critical to the survival of an ecological community;
- Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;
- Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;
- Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
 - assisting invasive species, that are harmful to the listed ecological community, to become established; or
 - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or
- Interfere with the recovery of an ecological community.

MIGRATORY SPECIES

Significant impact criteria

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

>> What is important habitat for a migratory species?

An area of 'important habitat' for a migratory species is:

- a) Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
- b) Habitat that is of critical importance to the species at particular life-cycle stages; and/or
- c) Habitat utilised by a migratory species which is at the limit of the species range; and/or
- d) Habitat within an area where the species is declining.

>> What is an ecologically significant proportion?

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

>> What is the population of a migratory species?

'Population', in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.



Gateway Determination and OEH Response

A5



Planning &
Environment

Mr Rob Noble
Chief Executive Officer
Central Coast Council
PO Box 21
GOSFORD NSW 2250

Our ref: PP_2017_CCOAS_003_00 (17/06492)
Your ref: RZ/1/2017

Dear Mr Noble

Planning Proposal to amend Wyong Local Environmental Plan 2013

I am writing in response to your Council's letter dated 4 May 2017 requesting a Gateway determination under section 56 of the *Environmental Planning and Assessment Act 1979* (the Act) in respect of the Planning Proposal to rezone land at 15 Mulloway Road, Chain Valley Bay for residential and environmental protection purposes and apply development standards to the site to allow residential development.

As delegate of the Minister for Planning, I have now determined the Planning Proposal should proceed subject to the conditions in the attached Gateway determination.

Council may still need to obtain the agreement of the Department's Secretary to comply with the requirements of relevant section 117 Directions. Council should ensure this occurs prior to the plan being made.

Plan making powers were delegated to councils by the Minister in October 2012. It is noted that Council has requested to be issued with delegation for this Planning Proposal. I have considered the nature of Council's Planning Proposal and have decided not to issue an authorisation for Council to exercise delegation to make this plan given the requirement for the proposal to be updated to address a number of unresolved section 117 Directions.

The amending Local Environmental Plan (LEP) is to be finalised within 12 months of the week following the date of the Gateway determination. Council should aim to commence the exhibition of the Planning Proposal as soon as possible. Council's request for the Department of Planning and Environment to draft and finalise the LEP should be made 6 weeks prior to the projected publication date.

The State Government is committed to reducing the time taken to complete LEPs by tailoring the steps in the process to the complexity of the proposal, and by providing clear and publicly available justification for each plan at an early stage. In order to meet these commitments, the Minister may take action under section 54(2)(d) of the Act if the time frames outlined in this determination are not met.

Should you have any queries regarding this matter, I have arranged for Ms Corrine Manyweathers of the Department's regional office to assist you. Ms Manyweathers can be contacted on (02) 4345 4404.

Yours sincerely

 16 June 2017
Stephen Murray
Executive Director, Regions
Planning Services

Encl: Gateway determination

Gateway Determination

Planning Proposal (Department Ref: PP_2017_CCOAS_003_00): to rezone land at 15 Mulloway Road, Chain Valley Bay for residential and environmental protection purposes and apply development standards to the site to allow residential development.

I, the Executive Director, Regions, at the Department of Planning and Environment as delegate of the Minister for Planning, have determined under section 56(2) of the *Environmental Planning and Assessment Act 1979* (the Act) that an amendment to the Wyong Local Environmental Plan (LEP) 2013 to rezone land at 15 Mulloway Road, Chain Valley Bay for residential and environmental protection purposes and apply development standards to the site to allow residential development should proceed subject to the following conditions:

1. Council is to update the Planning Proposal prior to community consultation to:
 - include discussion on the relationship of this site to the rezoning of the rest of North Wyong Shire Structure Plan Precinct 19;
 - investigate and include discussion on the proposed biodiversity corridor in this location;
 - review transport and traffic information to reflect the current proposal;
 - ensure that the Planning Proposal satisfies the requirements of State Environmental Planning Policy (SEPP) 55 – Remediation of Land. If required, Council is to prepare an initial site contamination investigation report to demonstrate that the site is suitable for rezoning to the proposed zone; and
 - include mapping that demonstrates the existing and proposed land use zones and development standards for the site.
2. Council is to update the Planning Proposal to demonstrate consistency with the following section 117 Directions and the State Environmental Planning Policy (SEPP) after supporting information has been obtained and/or following agency consultation:
 - 1.3 Mining, Petroleum Production and Extractive Industries;
 - 2.1 Environmental Protection Zones;
 - 2.2 Coastal Protection;
 - 2.3 Heritage Conservation;
 - 4.1 Acid Sulphate Soils;
 - 4.2 Mine Subsidence and Unstable Land;
 - 4.3 Flood Prone Land;
 - 4.4 Planning for Bushfire Protection;
 - 5.10 Implementation of Regional Plans;
 - 6.2 Reserving Land for Public Purposes;
 - SEPP 44 – Koala Habitat; and
 - SEPP 71 – Coastal Protection

3. Community consultation is required under sections 56(2)(c) and 57 of the Act as follows:
 - (a) the Planning Proposal must be made publicly available for a minimum of **28 days**; and
 - (b) the relevant planning authority must comply with the notice requirements for public exhibition of Planning Proposals and the specifications for material that must be made publicly available along with Planning Proposals as identified in section 5.5.2 of *A guide to preparing local environmental plans* (Department of Planning and Environment 2016).
4. Consultation is required with the following public authorities under section 56(2)(d) of the Act and/or to comply with the requirements of relevant section 117 Directions:
 - NSW Office of Environment and Heritage;
 - Subsidence Advisory NSW;
 - Transport for NSW;
 - Transport for NSW – Road and Maritime Services;
 - NSW Rural Fire Service;
 - Darkinjung Local Aboriginal Land Council; and
 - Guringai Tribal Link.

Each public authority is to be provided with a copy of the Planning Proposal and any relevant supporting material, and given at least 21 days to comment on the proposal.

5. A public hearing is not required to be held into the matter by any person or body under section 56(2)(e) of the Act. This does not discharge Council from any obligation it may otherwise have to conduct a public hearing (for example, in response to a submission or if reclassifying land).
6. The timeframe for completing the LEP is to be **12 months** from the week following the date of the Gateway determination.

Dated 16th day of June 2017

Stephen Murray
Executive Director, Regions
Planning Services
Department of Planning and Environment
Delegate of the Minister for Planning

Central Coast Council PP_2017_CCOAS_003_00 (17/07508)



Office of
Environment
& Heritage

DOC17/373458-10

Ms Jenny Mewing
Strategic Planner Rezoning, Strategic Planning
Central Coast Council
jenny.mewing@centralcoast.nsw.gov.au

Dear Ms Mewing

Planning Proposal – OEH advice on rezoning of land at Lot 273 DP 755266, 15 Mulloway Road, Chain Valley Bay (PP_2017_CCOAS_003_00).

I refer to your email dated 14 July 2017 in which you request consideration and comment under Section 56 (2)(d) of the Environmental Planning and Assessment (EP&A Act 1979), regarding a proposal to rezone land at Chain Valley Bay from E3 to R2 and E2. The Office of Environment and Heritage (OEH) has been asked to comment on the planning proposal's consistency or otherwise with Ministerial Directions 2.1, 2.3 and 4.3 of Section 117 of the EP&A Act 1979, Section 34A as well as specifying any requirements for future investigative studies. The Gateway determination was issued on the 16 June 2017. This review is based on reports provided by Central Coast Council.

OEH recommends that Council seeks additional information from the proponent to allow Council to determine the most appropriate areas of the rezoning application for development and conservation. The additional information should include:

- Flood modelling that includes the impact of floods from all sources
- Appropriately timed seasonal surveys for threatened orchid species
- Further surveys for the squirrel glider to inform the location of the green corridor
- Identification of the areas (in hectares) to be removed for development and preserved for conservation
- Details and results of the biometric assessment undertaken
- The quantum of offsets likely to be required, the location of potential offsets and the conservation mechanism to secure offsets
- An Aboriginal cultural heritage assessment of the site
- Maps of the location of all asset protection zones showing that none occur in National Parks estate.

Background

The planning proposal rezones land from an environmental management zone (E3) to low density residential (R2) and Environmental protection (E2). It is acknowledged that this site forms part of the Precinct 19 of the North Wyong Shire Structure Plan (2012) and is thus consistent with the intent of the plan, although the plan stipulates that this precinct was intended for development in the long-term (land

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that will not be zoned before 15 years, not the 5 years it has been since the start of the plan). A total of 102 lots are planned to be created across an area of 16.59 hectares.

The impact of flooding from all sources has not been included

Page 16 and 17 of the planning proposal includes discussion of the flood impacts on the site. Figure 11 indicates the approximate 1% Annual Exceedance Probability (AEP) and the Probable Maximum Flood (PMF) flood extents from Lake Macquarie. As stated on Page 16, the impacts of flooding from Karignan Creek have not been identified.

The planning proposal does not include a map that indicates the proposed zoning for the lot. A zoning map for the planning proposal would enable assessment of the proposal against the constraints of the land. A zoning plan would indicate if constraints such as flooding and water management have been taken into account. It is recognised that the finer details may change and zone boundaries may vary slightly from the initial proposal to the final design, however without a proposed zoning map overlaid with the constraints mapping, there is no evidence to suggest the proponent has taken constraints into consideration in their planning proposal. Without such evidence of these constraint considerations, OEH cannot endorse a planning proposal that includes flood and water management constraints.

The impacts of flooding from all sources have not been included in this planning proposal, and as a result OEH is unable to assess the potential full flooding impacts of the proposed rezoning.

The planning proposal needs to clearly indicate flood impacts from all sources, including, but not limited to Lake Macquarie, Karignan Creek and any overland sources as well as flooding impacts on the access roads to and from the site. As this planning proposal includes alteration of a zone provision that affects floodprone land, then Local Planning Direction 4.3 Floodprone Land issues under Section 117 (2) of the EP&A Act (1979) applies. In its current form and with the lack of flooding information available, this planning proposal is considered inconsistent with this Direction.

Rezoning of floodprone land to a more intense land use is generally not supported, as per Local Planning Direction 4.3 Flood Prone Land issued under Section 117(2) of the EP&A Act 1979. The PMF is considered as an appropriate mechanism for consideration for this application as both rezoning and subdivision are considered significant developments as per Council's DCP. It is OEH's position that these discrepancies should be managed at this rezoning stage, rather than the individual development application stage further down the track where there is an expectation for development approval.

Council should seek additional information on the biodiversity values of the rezoning area

This planning proposal reduces the environmental protection of the site and is therefore inconsistent with S117 Direction 2.1 and should be justified. It is evident from the Ecological Constraints Assessment report (Travers Nov. 2016) that the vegetation on the site is of a high quality and predominantly in a natural condition and contains high environmental values, including:

- an Endangered Ecological Community (Swamp Sclerophyll Forest on Coastal Floodplains),
- koala habitat, with at least 15% koala feed trees (i.e. *Eucalyptus robusta* and *Eucalyptus haemastoma*) and therefore triggers consideration under SEPP 44, with koalas recorded in the near vicinity,
- records for threatened species such as squirrel gliders, wallum froglet, several micro-bats,
- potential habitat for threatened species on site including spotted-tailed quoll, large forest owls, glossy black-cockatoo, and
- potential winter flowering resources for threatened species such as regent honeyeaters.

Other environmental considerations which should be taken into account by Council are:

- that part of the site has been included in the North Wyong Shire Structure Plan Green Corridor and habitat networks, and is indicated in the Central Coast Regional Plan,
- the vegetation communities are also likely to support additional threatened flora species such as orchids and *Tetratheca juncea*. Surveys were not carried out in the most suitable times of the year according to the Ecological Constraints Assessment report and some species may occur but not have been detected,

- the site includes waterfront land and works may require 40 m buffers from development under the *Water Management Act 2000*,
- the riparian zone associated with Karignan Creek in the south which forms a wildlife link to the Lake Macquarie State Conservation Area should be retained.

The Ecological Constraints Assessment states that surveys have been brief and not necessarily at the time of year required to have confidence in the presence/absence of some species (in particular orchids). It also recommends further surveys for squirrel gliders, so that the wildlife corridors which are to be provided on the site are in a suitable position. Central Coast Council recommends in its report for its Ordinary Council Meeting that the environmental zone is extended to the north of its present position to incorporate all of the endangered ecological community vegetation.

It is not clear, how much vegetation will be removed or retained as part of the proposed rezoning and subsequent development as no area calculations have been supplied. Additionally, while it is stated that a biometric assessment has been carried out, no information has been provided on the type of biometric assessment undertaken or the results of the biometric assessment. The quantum of offsets required for the impacts on biodiversity has not been identified, nor has it been stated whether offsets would be provided on site or offsite. Further, the proponent has not identified a conservation mechanism to secure offsets for the project. OEH recommends that Council requires offsets for the rezoning to be secured via a Biodiversity Stewardship Agreement.

The proponent proposes to retain a green corridor through the site but does not identify the location of the corridor. OEH recommends that the location of the green corridor is finalised during the assessment of the rezoning application.

The proponent has not mapped the distribution of trees across the site that contain small tree hollows and has rather, focused on medium to large hollows as indicators of potential habitat for owls and the squirrel glider. As the proponent has not identified the size class of 'small' hollows, Council should consider that 'small' hollows may be suitable for the squirrel glider. Additionally, 'small' hollows provide potential habitat for a number of hollow roosting threatened and non-threatened bat species. Council should consider all trees with hollows potential habitat for threatened species across the rezoning area.

OEH recommends Council seeks the above information from the proponent to assist Council to assess the most appropriate areas of the rezoning for development and conservation.

Aboriginal Cultural Heritage

In accordance with the Department of Planning and Environment (DPE) Gateway Determination (DPE Ref: PP_2017_CCOAS_003_00), the Office of Environment and Heritage (OEH) provides the following Aboriginal cultural heritage management advice for the Planning Proposal to rezone land at 15 Mullet Road, Chain Valley Bay NSW. The Aboriginal cultural heritage advice detailed in **Attachment A** has been developed to inform Council on how best to demonstrate consistency with Section 117 (Direction 2.3- Heritage Conservation) of the Environmental Planning and Assessment Act 1979 (EP&A Act).

Areas of development must not impact on National Parks estate

The required Asset Protection Zone must be fully contained on private property and must not be identified or constructed on national park estate under any circumstance. Any existing cleared area that may be situated on national park estate must not be considered to be or incorporated into an Asset Protection Zone as part of this development application, any amendments or future development applications. Please find the guidelines for development adjacent to National Parks at the following link.

<http://www.environment.nsw.gov.au/resources/protectedareas/development-land-adjointing-130122.pdf>

If you require any further information regarding this matter please contact Karen Thumm, Conservation Planning Officer, on 4927 3153 or karen.thumm@environment.nsw.gov.au.

Yours sincerely



STEVEN COX
Senior Team Leader Planning,
Hunter Central Coast Branch
Regional Operations Division

31 August 2017

Attachment A – Aboriginal cultural heritage assessment advice

ATTACHMENT A: ASSESSING ABORIGINAL CULTURAL HERITAGE IN PLANNING PROPOSALS

To adequately capture the Aboriginal cultural heritage significance of lands subject to a planning proposal, OEH recommends that planning authorities clearly identify all potential Aboriginal cultural heritage values that may potentially constrain future land-use planning.

We note that Section 117 Direction 2.3(4)(b) of the EP&A Act refers specifically to the conservation and protection of Aboriginal objects and declared Aboriginal Places in accordance with the provisions of the *National Parks and Wildlife Act 1974*. Section 117 Direction 2.3(4)(c) of the EP&A Act conversely requires the investigation of Indigenous heritage significance, which in-turn requires a broader focus that must incorporate an assessment of social value. OEH therefore advises that undertaking due diligence in accordance with the requirements of the DECCW 2010 *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* will not necessarily demonstrate consistency with the requirements of Section 117 (Direction 2.3 - Heritage Conservation) of the EP&A Act. OEH recommends that the following two types of Aboriginal cultural heritage assessments be undertaken to adequately capture the information required to support a planning proposal:

1. A cultural heritage assessment – involving consultation with Aboriginal people (groups and individuals) and can include historical and oral history assessment and broader values assessment (e.g. landscape and spiritual values); and
2. An archaeological assessment – involving the identification and assessment of Aboriginal objects (often referred to as 'sites') and their management based on archaeological criteria.

Identifying Aboriginal cultural heritage values and consultation with Aboriginal people should be guided by the following OEH documents.

- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (DECCW, 2011) available at www.environment.nsw.gov.au/licences/investassessreport.htm
- *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW, 2010) available at www.environment.nsw.gov.au/licences/consultation.htm
- *Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales* (OEH, 2010) www.environment.nsw.gov.au/licences/archinvestigations.htm.

OEH notes that the conservation of significant Aboriginal cultural heritage values is consistent with the requirements of Section 117 (Direction 2.3 - Heritage Conservation) of the EP&A Act. OEH would consider the application of appropriate land-use zoning (such as E2 conservation) as a suitable mechanism to promote the conservation of significant Aboriginal cultural heritage values.



Functional Corridor Analysis

A6

Our Ref: 18OD02FUNC-L

4 November 2019

Optima Developments
PO Box 3136
UNIMA BEACH NSW 2250



Attention: Mr C Oliver

Dear Chris

**Re: Habitat Corridor Functional Analysis at
15 Mulloway Road, Chain Valley Bay**

Travers bushfire and ecology has been requested to prepare a functional corridor analysis of the proposed wildlife corridor, traversing the western and the northern boundaries of the as part of a Planning Proposal seeking rezoning from E3 Environmental Management to part E2 Environmental Conservation and R2 Low Density Residential. The corridor is proposed to be included in the proposed E2 zone.

Background

The corridor is intended as a wildlife corridor to provide connectivity from the southern EEC conservation area to national parks land to the north east. By virtue of the sites proximity this land is a partial connection from the north to south.

It is noted that whilst this corridor has been designed with Squirrel Gliders as the target species, they have not been observed or recorded in recent times within this site. They may be present to the north and to the south of the site within the main regional corridor. Consequently, this functional corridor analysis has assessed the ability of Squirrel Gliders to physically cross the landscape.

It is also noted that OEH, in consultation with Central Coast Council have confirmed that the proposed 60 m width corridor is a functional corridor width for this location. Previous correspondence on the habitat comparison between the two corridor options demonstrated that the proposed corridor is the most diverse with structurally mature vegetation to support foraging, with large mature trees in addition to also containing similar species diversity and habitat structure.

The habitat comparison also supports the enrichment of foraging habitat through revegetation works and protection measures to ensure that the corridor remains mostly free of human interference. The primary function of the corridor is wildlife movement between two larger parcels of significant vegetation extent and consequently with exception to a cycleway/fire trail along the western boundary the corridor is to exclude recreational activity.

Purpose of the functional corridor analysis

The purpose of the functional corridor analysis is to undertake an assessment of arboreal connectivity for Squirrel Gliders and to identify any features or lack of important elements necessary to maintaining the function of the corridor.

Of key importance to this functional corridor analysis is the following tasks.

- An analysis of the ability of gliders to traverse across the existing and proposed road linkages.
- To examine which trees will be retained and removed as a result of these proposed future subdivision works.
- To provide recommendations as to what mitigation might be needed to improve or maintain connectivity for a functional corridor.

Assessment of glide capability across the main existing roads and proposed road linkages

For the purposes of this assessment, it has been assumed that there is no limitation to the movement of Squirrel Gliders through vegetated portions of the corridor. An investigation of the existing dam was undertaken to prove that enough trees were present to the east of its main body and the adjoining proposed road. A GPS survey of the trees in this location established that a decent row of trees were present and hence movement is possible around the dam on its eastern and western sides.

Fauna ecologist Mr Corey Mead has undertaken an assessment of the glide distances and angles from existing launch points, on trees immediately adjoining and within 15 to 20 metres of Mulloway Road, the proposed entrance to the site and to the proposed extension to Teragalin Drive on the southern end of the site. The results of this glider connectivity is shown on the attached figure (figure 1).

In addition, an Arboriculture assessment of the trees was conducted by Mr Robert Sansom and Mr Nathan Stewart to provide an indication of trees to be impacted by the proposed works to either side of the road corridors. Only trees of good condition were assessed based on a basic SULE assessment.

Mulloway Road is the existing main road providing access to the main urban zoned area of Chain Valley Bay at the northern boundary of the site and the analysis has identified that the glider connectivity across Mulloway Road whilst currently physically possible, is somewhat tenuous in mostly a northern direction. The connectivity at this location relies on the presence of four *Melaleuca* trees that have been retained along the pathway within the road reserve. Without these four *Melaleuca* trees arboreal connection across Mulloway Road will effectively be severed.

This is demonstrated by the green arcs and green dashed arcs (Figure 1). The green dashed arcs indicates where gliders can effectively reach based on the physical gliding capability known for squirrel gliders. I note that only trees of good condition have been considered and the assessment has excluded poor condition trees that may be removed or fall. The green and red arcs indicate to which side of the road corridor that gliding is currently feasible. The red arcs demonstrate the impact on glide distance as a result of the proposed roads based on the trees to be removed effectively resulting in the loss of gliding capability.

This clearly indicates ~~is~~ that the connectivity across Mulloway Road is tenuous and marginal. To ensure that this connectivity maintains and retains the functionality it would be necessary to ensure that trees are present in either side of the pavement of Mulloway Road that allow gliders to climb to a suitable height and glide across the road corridor. Consequently, glider poles are recommended to be installed and planting of additional rapid growing tall trees on either side of Mulloway Road with the permission of the adjoining landholders which is believed to be National Parks and Wildlife Services.

These measures will allow the effective width of the corridor connection across Mulloway Road to increase from 20 to 40 m.

The second point of glider connectivity analysis is the main entrance into the proposed residential subdivision. The glider connectivity analysis shows once the trees impacted as a result of the proposed future entry road, are considered, connectivity is disrupted from east to west. However, once the road corridor is shifted slightly to the west, to conserve selected trees then connectivity is maintained in both direction without the need for Glider poles. The engineering aspect of the re-positioning of the road will need to be confirmed at the DA stage.

The remaining aspect of the functional connectivity analysis is at the southern end of the proposed corridor in the vicinity of Teragalin Drive. The analysis shows that the glider connectivity to the south of the corridor is tenuous, because the existing water main and access roadworks have already cleared significant trees from this locality which would otherwise be present under natural circumstances. There are two or three pre-existing trees present in the proposed road that crosses the corridor to access the development that provide potential glider connectivity. As the proposed road will remove these trees and the road connection in this location is essential, measures to maintain a functional corridor will need to include modification of the road alignment and pavement position, the planting of additional tall growing trees and installation of telephone poles.

The final point is concerning terrestrial or on ground connectivity. The installation of roads will present a threat to wildlife movement due to the potential for road kills. Whilst residents would be asked to drive slowly through these corridors and appropriate signage could reinforce this point, a preferred mitigation measure is to install a sub pavement culvert to enable wildlife to move under the roads. This element can also be addressed at the engineering design and DA stage of the subdivision.

Consequently, as recommended in the Biodiversity Certification Assessment (2019) *Travers bushfire & ecology* recommend that culverts are placed under these roads to allow ground dwelling animals to traverse through the road corridor without risk of being run over by cars accessing the future lots. Therefore, mitigation measures are required to ensure a functional corridor include a road culvert as well as arboreal planting measures.

Impact of tree retention and removal

In the glider connectivity analysis, trees to be retained and removed are critical to ensuring that these corridors remain functional, so consequently the current layout will need to be modified at the DA stage, to enhance arboreal connectivity. Additionally, the southern end is already unavoidably impacted by existing infrastructure and the future need to connect the proposed development to Teragalin Drive will necessitate the removal of some further trees from that corridor. Consequently, recommendations are proposed for all three road crossings to ameliorate impacts caused by tree loss on the functionality of the proposed corridor.

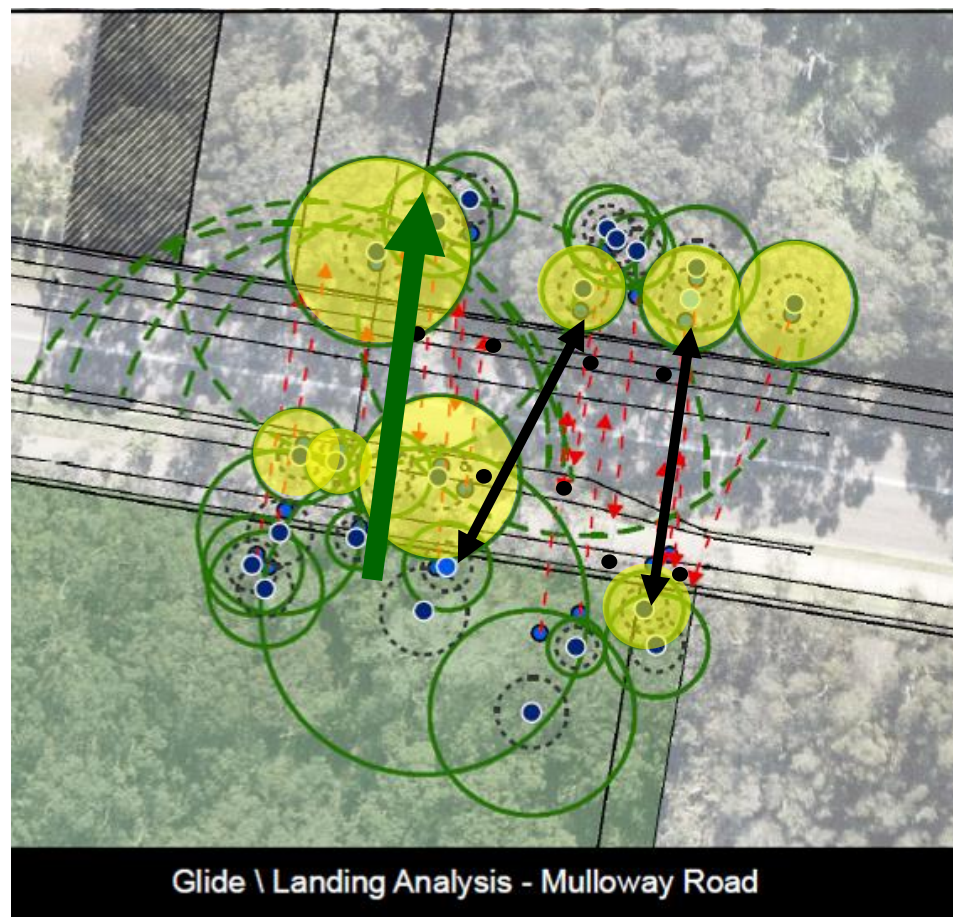
Conclusion and recommendations

The functional corridor analysis concludes that the existing connectivity across Mulloway Road is tenuous but able to be improved with additional street planting and installation of glider poles. The corridor connectivity across the main road entrance is partly disrupted by the road design and can be enhanced by relocating the road marginally to the west.

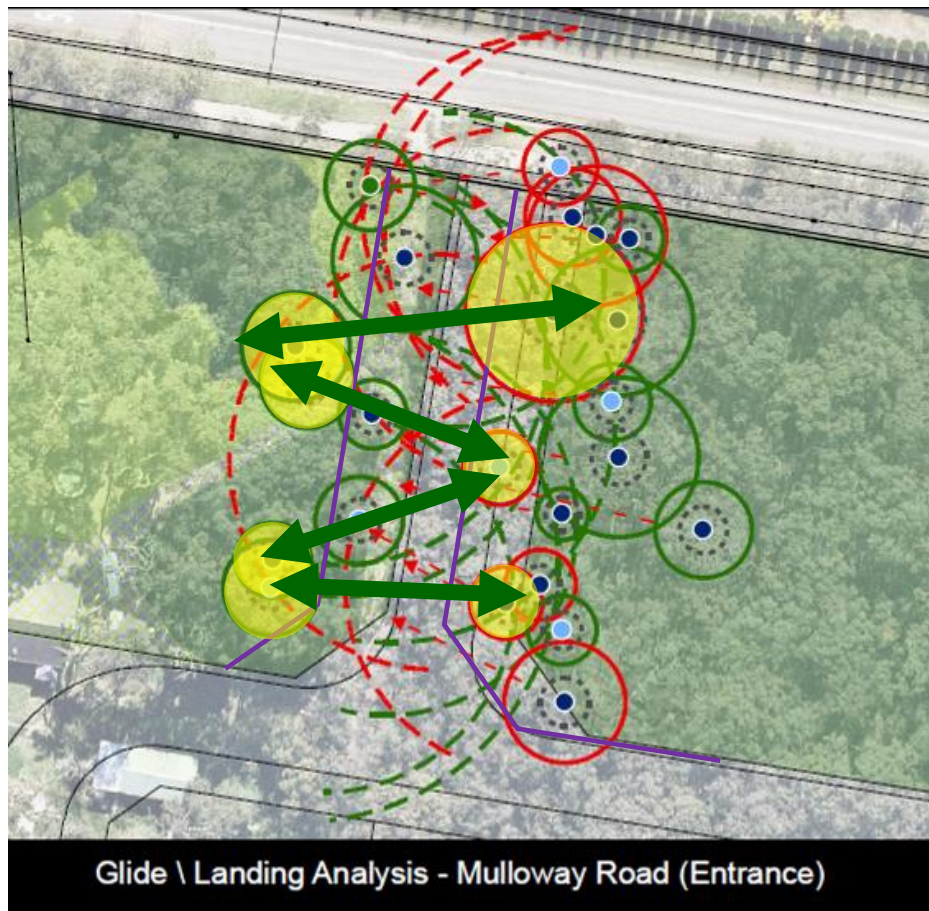
The southern corridor crossing is also disrupted and can be improved with a realignment of the road corridor.

The following mitigation measures are recommended to result in an improved outcome for the future corridor functionality:

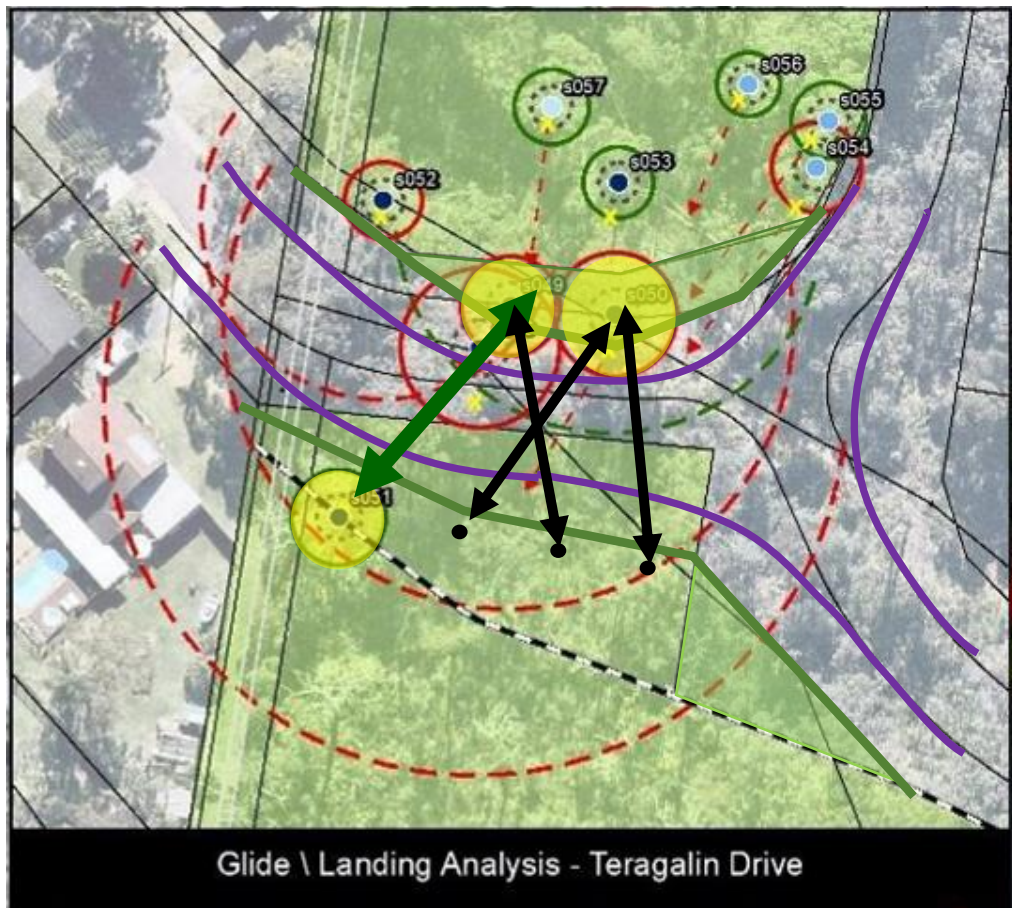
- In the Malloway Road reserve *Travers bushfire & ecology* recommend:
 - a) The planting of tall fast-growing foraging tree species that would grow tall in the next 10-20 years.
 - b) In the short term a minimum of four glider poles (eight options provided), two on the southern side of Malloway Road and two on the northern side of Malloway Road be installed preferably to the east of the existing melaleuca trees.
 - c) That both sides of the road reserve are planted with Melaleucas such as the existing shrubbery for protection to potential gliders moving through the site.



- In regards, to the entrance to the site off Malloway Road, *Travers bushfire & ecology* recommends terrestrial culverts be included beneath the road as part of the subdivision design works and the road corridor, services and pathway is shifted to the west as marked to enhance tree retention.



- For the Teraglin Drive access road *Travers bushfire & ecology* recommend the installation of a minimum of 2 glider poles to the south of the pavement, together with the installation of culverts under the road to facilitate the movement of wildlife to the north and south without crossing the pavement. Additionally, enhancement of the corridor in this location by planting of fast-growing tall tree species and the road alignment adjusted to retain the identified trees.



- All Glider poles are to have signage attached to identify them as glider poles and not to be removed. The glider poles will need to be maintained until the planted tree canopy is fully established.

Travers bushfire & ecology concludes that with the above mitigation measures the corridor should retain its functionality and in fact improve existing connectivity for arboreal gliders to the north and to the south.

Should you have any questions regarding his functional corridor analysis do not hesitate to contact the undersigned on (02) 4340 5331 or at info@traverseecology.com.au.

Yours faithfully

Michael Sheather-Reid – Managing Director
Travers bushfire & ecology

Attachment 1 – Functional Corridor Analysis



Attachment 1 – Functional Corridor Analysis



BAM Calculator Outputs

A7

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00015232/BAAS19010/19/00015233	18OD02BCAR 15 Mulloway Road Chain Valley bay	10/06/2021
Assessor Name	Report Created	BAM Data version *
Corey Mead	13/10/2021	45
Assessor Number	BAM Case Status	Date Finalised
BAAS19050	Finalised	13/10/2021
Assessment Revision	Assessment Type	
5	Biocertification	

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

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

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAI	Ecosystem credits
Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands											
1	1619_mod erate_good	Not a TEC	71	62.3	7.6			High Sensitivity to Potential Gain	1.50		177
3	1619_clear ed	Not a TEC	13.1	12.4	2.6			High Sensitivity to Potential Gain	1.50		0
										Subtotal	177

Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast										
2	1718_moderate_good	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	84	17.9	0.12	Endangered Ecological Community	Not Listed	High Sensitivity to Potential Gain	2.00	1
									Subtotal	1
									Total	178

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAIL	Species credits
Crinia tinnula / Wallum Froglet (Fauna)								
1619_moderate_good	62.3	62.3	7.6	Vulnerable	Not Listed	1.5	False	177
1619_cleared	12.4	12.4	2.6	Vulnerable	Not Listed	1.5	False	12
1718_moderate_good	17.9	17.9	0.12	Vulnerable	Not Listed	1.5	False	1
							Subtotal	190
Hoplocephalus bitorquatus / Pale-headed Snake (Fauna)								
1619_moderate_good	62.3	62.3	7.6	Vulnerable	Not Listed	2	False	236

BAM Credit Summary Report

1718_moderate_god	17.9	17.9	0.12	Vulnerable	Not Listed	2	False	1
							Subtotal	237
<i>Lathamus discolor / Swift Parrot (Fauna)</i>								
1619_moderate_god	62.3	62.3	6.7	Endangered	Critically Endangered	3	True	312
1619_cleared	12.4	12.4	0.99	Endangered	Critically Endangered	3	True	9
1718_moderate_god	17.9	17.9	0.04	Endangered	Critically Endangered	3	True	1
							Subtotal	322
<i>Litoria aurea / Green and Golden Bell Frog (Fauna)</i>								
1619_moderate_god	62.3	62.3	0.33	Endangered	Vulnerable	2	False	10
1718_moderate_god	17.9	17.9	0.12	Endangered	Vulnerable	2	False	1
							Subtotal	11
<i>Myotis macropus / Southern Myotis (Fauna)</i>								
1619_moderate_god	62.3	62.3	7.6	Vulnerable	Not Listed	2	False	236
1619_cleared	12.4	12.4	2.6	Vulnerable	Not Listed	2	False	16
1718_moderate_god	17.9	17.9	0.12	Vulnerable	Not Listed	2	False	1
							Subtotal	253

BAM Credit Summary Report

<i>Petalura gigantea / Giant Dragonfly (Fauna)</i>								
1718_moderate_goo	17.9	17.9	0.12	Endangered	Not Listed	3	True	2
							Subtotal	2
<i>Petaurus norfolcensis / Squirrel Glider (Fauna)</i>								
1619_moderate_goo	62.3	62.3	7.6	Vulnerable	Not Listed	2	False	236
1718_moderate_goo	17.9	17.9	0.12	Vulnerable	Not Listed	2	False	1
							Subtotal	237

BAM Vegetation Zones Report

Proposal Details

Assessment Id	Assessment name	BAM data last updated *
00015232/BAAS19010/19/00015233	18OD02BCAR 15 Mulloway Road Chain Valley bay	10/06/2021
Assessor Name	Report Created	BAM Data version *
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Assessor Number	Assessment Type	BAM Case Status
BAAS19050	Biocertification	Finalised
Assessment Revision	Date Finalised	
5	13/10/2021	

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Vegetation Zones

#	Name	PCT	Condition	Area	Minimum number of plots	Management zones
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BAM Vegetation Zones Report

1	1619_moderate_good	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	moderate_good	7.57	3	Direct (6.36 ha) Indirect (1.21 ha)
2	1718_moderate_good	1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	moderate_good	0.12	1	Direct (0.02 ha) Indirect (0.1 ha)
3	1619_cleared	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	cleared	2.56	2	Direct (2.38 ha) Indirect (0.18 ha)

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00015232/BAAS19010/19/00015233	18OD02BCAR 15 Mulloway Road Chain Valley bay	10/06/2021
Assessor Name	Report Created	BAM Data version *
Corey Mead	13/10/2021	45
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BAAS19050	Biocertification	Finalised
Assessment Revision		Date Finalised
5		13/10/2021

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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)
Barking Owl	Ninox connivens	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands 1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Black Bittern	Ixobrychus flavicollis	1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
Eastern Chestnut Mouse	Pseudomys gracilicaudatus	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands 1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands

BAM Predicted Species Report

Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Eastern False Pipistrelle	Falsistrellus tasmaniensis	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
		1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Eastern Osprey	Pandion cristatus	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
		1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Gang-gang Cockatoo	Callocephalon fimbriatum	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
Glossy Black-Cockatoo	Calyptorhynchus lathami	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
Golden-tipped Bat	Phoniscus papuensis	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
		1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Greater Broad-nosed Bat	Scoteanax rueppellii	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
		1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Grey-crowned Babbler (eastern subspecies)	Pomatostomus temporalis	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
Grey-headed Flying-fox	Pteropus poliocephalus	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
		1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Koala	Phascolarctos cinereus	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
		1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast

BAM Predicted Species Report

Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
		1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Little Bent-winged Bat	<i>Miniopterus australis</i>	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
		1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Little Eagle	<i>Hieraaetus morphnoides</i>	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
		1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Little Lorikeet	<i>Glossopsitta pusilla</i>	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
		1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Masked Owl	<i>Tyto novaehollandiae</i>	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
Powerful Owl	<i>Ninox strenua</i>	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
Regent Honeyeater	<i>Anthochaera phrygia</i>	1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Scarlet Robin	<i>Petroica boodang</i>	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
Speckled Warbler	<i>Chthonicola sagittata</i>	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
		1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast

BAM Predicted Species Report

Square-tailed Kite	Lophoictinia isura	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
Swift Parrot	Lathamus discolor	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands 1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Turquoise Parrot	Neophema pulchella	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
Varied Sittella	Daphoenositta chrysoptera	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands 1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
White-bellied Sea-Eagle	Haliaeetus leucogaster	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands 1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
White-throated Needletail	Hirundapus caudacutus	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands 1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
Yellow-bellied Glider	Petaurus australis	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
Yellow-bellied Sheath-tail-bat	Saccolaimus flaviventris	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands 1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast

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

Common Name	Scientific Name	Plant Community Type(s)
Painted Honeyeater	Grantiella picta	1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands

BAM Predicted Species Report

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
Painted Honeyeater	Grantiella picta	Species is vagrant

BAM Candidate Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00015232/BAAS19010/19/00015233	18OD02BCAR 15 Mulloway Road Chain Valley bay	10/06/2021
Assessor Name	Report Created	BAM Data version *
Corey Mead	13/10/2021	45
Assessor Number	Assessment Type	BAM Case Status
BAAS19050	Biocertification	Finalised
Assessment Revision	Date Finalised	
5	13/10/2021	

* 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
<i>Acacia bynoeana</i> Bynoe's Wattle	No (surveyed)	<div> <input type="checkbox"/> Jan <input checked="" type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug </div> <div> <input checked="" type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Angophora inopina</i> Charmhaven Apple	No (surveyed)	<div> <input type="checkbox"/> Jan <input checked="" type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug </div> <div> <input checked="" type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Astrotricha crassifolia</i> Thick-leaf Star-hair	No (surveyed)	<div> <input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug </div> <div> <input type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>

BAM Candidate Species Report

<i>Burhinus grallarius</i> Bush Stone-curlew	No (surveyed)	<input checked="" type="checkbox"/> Jan <input type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input checked="" type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Callistemon linearifolius</i> Netted Bottle Brush	No (surveyed)	<input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug <input type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Callocephalon fimbriatum</i> Gang-gang Cockatoo	No (surveyed)	<input checked="" type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug <input type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Calyptorhynchus lathami</i> Glossy Black-Cockatoo	No (surveyed)	<input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Cercartetus nanus</i> Eastern Pygmy-possum	No (surveyed)	<input checked="" type="checkbox"/> Jan <input type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input checked="" type="checkbox"/> Nov <input type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	No (surveyed)	<input checked="" type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input checked="" type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?

BAM Candidate Species Report

<i>Corunastylis sp. Charmhaven</i> (NSW896673) Corunastylis sp. Charmhaven (NSW896673)	No (surveyed)	<div> <input type="checkbox"/> Jan <input type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input checked="" type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug </div> <div> <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input checked="" type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Crinia tinnula</i> Wallum Froglet	Yes (surveyed)	<div> <input checked="" type="checkbox"/> Jan <input type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug </div> <div> <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Cryptostylis hunteriana</i> Leafless Tongue Orchid	No (surveyed)	<div> <input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug </div> <div> <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input checked="" type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Diuris praecox</i> Rough Doubletail	No (surveyed)	<div> <input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug </div> <div> <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Eucalyptus parramattensis subsp. decadens</i> Eucalyptus parramattensis subsp. decadens	No (surveyed)	<div> <input type="checkbox"/> Jan <input checked="" type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug </div> <div> <input checked="" type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Eucalyptus parramattensis subsp. parramattensis - endangered population</i> Eucalyptus parramattensis C. Hall. subsp. parramattensis in Wyong and Lake Macquarie local government areas	No (surveyed)	<div> <input type="checkbox"/> Jan <input checked="" type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug </div> <div> <input checked="" type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>

BAM Candidate Species Report

<i>Genoplesium insigne</i> Variable Midge Orchid	No (surveyed)	<div> <input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug </div> <div> <input checked="" type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Grevillea parviflora subsp. parviflora</i> Small-flower Grevillea	No (surveyed)	<div> <input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug </div> <div> <input checked="" type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle	No (surveyed)	<div> <input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug </div> <div> <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input checked="" type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Hieraaetus morphnoides</i> Little Eagle	No (surveyed)	<div> <input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug </div> <div> <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Hoplocephalus bitorquatus</i> Pale-headed Snake	Yes (assumed present)	<div> <input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug </div> <div> <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Lathamus discolor</i> Swift Parrot	Yes (assumed present)	<div> <input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug </div> <div> <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>

BAM Candidate Species Report

<i>Litoria aurea</i> Green and Golden Bell Frog	Yes (assumed present)	<div> <input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug </div> <div> <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Litoria brevipalmata</i> Green-thighed Frog	No (surveyed)	<div> <input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug </div> <div> <input type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Lophoictinia isura</i> Square-tailed Kite	No (surveyed)	<div> <input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug </div> <div> <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input checked="" type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Maundia triglochinoides</i> Maundia triglochinoides	No (surveyed)	<div> <input type="checkbox"/> Jan <input checked="" type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug </div> <div> <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Melaleuca biconvexa</i> Biconvex Paperbark	No (surveyed)	<div> <input type="checkbox"/> Jan <input checked="" type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug </div> <div> <input checked="" type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>
<i>Melaleuca groveana</i> Grove's Paperbark	No (surveyed)	<div> <input type="checkbox"/> Jan <input checked="" type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr </div> <div> <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug </div> <div> <input checked="" type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec </div> <div> <input type="checkbox"/> Survey month outside the specified months? </div>

BAM Candidate Species Report

<i>Myotis macropus</i> Southern Myotis	Yes (surveyed)	<input checked="" type="checkbox"/> Jan <input type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input checked="" type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Ninox connivens</i> Barking Owl	No (surveyed)	<input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input checked="" type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input checked="" type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Ninox strenua</i> Powerful Owl	No (surveyed)	<input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr <input checked="" type="checkbox"/> May <input checked="" type="checkbox"/> Jun <input checked="" type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Persicaria elatior</i> Tall Knotweed	No (surveyed)	<input type="checkbox"/> Jan <input checked="" type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Petalura gigantea</i> Giant Dragonfly	Yes (assumed present)	<input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Petauroides volans</i> Greater Glider	No (surveyed)	<input checked="" type="checkbox"/> Jan <input type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input checked="" type="checkbox"/> Jun <input checked="" type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?

BAM Candidate Species Report

<i>Petaurus norfolcensis</i> Squirrel Glider	Yes (assumed present)	<input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Phascogale tapoatafa</i> Brush-tailed Phascogale	No (surveyed)	<input checked="" type="checkbox"/> Jan <input type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input checked="" type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Phascolarctos cinereus</i> Koala	No (surveyed)	<input checked="" type="checkbox"/> Jan <input type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input checked="" type="checkbox"/> Jun <input checked="" type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input checked="" type="checkbox"/> Nov <input type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Planigale maculata</i> Common Planigale	No (surveyed)	<input checked="" type="checkbox"/> Jan <input type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input checked="" type="checkbox"/> Jun <input checked="" type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input checked="" type="checkbox"/> Nov <input type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Potorous tridactylus</i> Long-nosed Potoroo	No (surveyed)	<input checked="" type="checkbox"/> Jan <input type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input checked="" type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	No (surveyed)	<input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input checked="" type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?

BAM Candidate Species Report

<i>Rutidosia heterogama</i> Heath Wrinklewort	No (surveyed)	<input type="checkbox"/> Jan <input checked="" type="checkbox"/> Feb <input checked="" type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug <input checked="" type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input checked="" type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Tetratheca glandulosa</i> Tetratheca glandulosa	No (surveyed)	<input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug <input checked="" type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Tetratheca juncea</i> Black-eyed Susan	No (surveyed)	<input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug <input checked="" type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Tyto novaehollandiae</i> Masked Owl	No (surveyed)	<input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr <input checked="" type="checkbox"/> May <input checked="" type="checkbox"/> Jun <input checked="" type="checkbox"/> Jul <input checked="" type="checkbox"/> Aug <input type="checkbox"/> Sep <input type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?
<i>Uperoleia mahonyi</i> Mahony's Toadlet	No (surveyed)	<input type="checkbox"/> Jan <input type="checkbox"/> Feb <input type="checkbox"/> Mar <input type="checkbox"/> Apr <input type="checkbox"/> May <input type="checkbox"/> Jun <input type="checkbox"/> Jul <input type="checkbox"/> Aug <input type="checkbox"/> Sep <input checked="" type="checkbox"/> Oct <input type="checkbox"/> Nov <input type="checkbox"/> Dec <input type="checkbox"/> Survey month outside the specified months?

Threatened species assessed as not on site

Refer to BAR for detailed justification

Common name	Scientific name	Justification in the BAM-C
Brush-tailed Rock-wallaby	Petrogale penicillata	Refer to BAR
Eastern Osprey	Pandion cristatus	Refer to BAR

BAM Candidate Species Report

Eucalyptus oblonga population at Bateau Bay, Forrester's Beach and Tumby Umbi in the Wyong local government area	Eucalyptus oblonga - endangered population	Refer to BAR
Large Bent-winged Bat	Miniopterus orianae oceanensis	Refer to BAR
Little Bent-winged Bat	Miniopterus australis	Refer to BAR
Regent Honeyeater	Anthochaera phrygia	Refer to BAR
Tranquillity Mintbush	Prostanthera askania	Refer to BAR



BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00015232/BAAS19010/19/00015233	18OD02BCAR 15 Mulloway Road Chain Valley bay	10/06/2021
Assessor Name	Assessor Number	BAM Data version *
Corey Mead	BAAS19050	45
Proponent Names	Report Created	BAM Case Status
Dominic Ursino	13/10/2021	Finalised
Assessment Revision	Assessment Type	Date Finalised
5	Biocertification	13/10/2021

* 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		
Lathamus discolor / Swift Parrot		
Petalura gigantea / Giant Dragonfly		

Additional Information for Approval

Assessment Id	Proposal Name
00015232/BAAS19010/19/00015233	18OD02BCAR 15 Mulloway Road Chain Valley bay

BAM Biodiversity Credit Report (Like for like)

PCTs With Customized Benchmarks

PCT

No Changes

Predicted Threatened Species Not On Site

Name

Grantiella picta / Painted Honeyeater

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
1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	Not a TEC	10.1	177	0	177
1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.1	1	0	1

1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
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BAM Biodiversity Credit Report (Like for like)

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1619_moderate_good	Yes	177	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1619_cleared	No	0	Wyong, Hunter, Pittwater 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)

1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	Like-for-like credit retirement options					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1718_moderate_good	Yes	1	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

BAM Biodiversity Credit Report (Like for like)

Species	Vegetation Zone/s	Area / Count	Credits
Crinia tinnula / Wallum Froglet	1619_moderate_good, 1619_cleared, 1718_moderate_good	10.3	190.00
Hoplocephalus bitorquatus / Pale-headed Snake	1619_moderate_good, 1718_moderate_good	7.7	237.00
Lathamus discolor / Swift Parrot	1619_moderate_good, 1619_cleared, 1718_moderate_good	7.7	322.00
Litoria aurea / Green and Golden Bell Frog	1619_moderate_good, 1718_moderate_good	0.5	11.00
Myotis macropus / Southern Myotis	1619_moderate_good, 1619_cleared, 1718_moderate_good	10.3	253.00
Petalura gigantea / Giant Dragonfly	1718_moderate_good	0.1	2.00
Petaurus norfolcensis / Squirrel Glider	1619_moderate_good, 1718_moderate_good	7.7	237.00

Credit Retirement Options

Like-for-like credit retirement options

Crinia tinnula / Wallum Froglet	Spp	IBRA subregion
	Crinia tinnula / Wallum Froglet	Any in NSW

BAM Biodiversity Credit Report (Like for like)

Hoplocephalus bitorquatus / Pale-headed Snake	Spp	IBRA subregion
	Hoplocephalus bitorquatus / Pale-headed Snake	Any in NSW
Lathamus discolor / Swift Parrot	Spp	IBRA subregion
	Lathamus discolor / Swift Parrot	Any in NSW
Litoria aurea / Green and Golden Bell Frog	Spp	IBRA subregion
	Litoria aurea / Green and Golden Bell Frog	Any in NSW
Myotis macropus / Southern Myotis	Spp	IBRA subregion
	Myotis macropus / Southern Myotis	Any in NSW
Petalura gigantea / Giant Dragonfly	Spp	IBRA subregion
	Petalura gigantea / Giant Dragonfly	Any in NSW
Petaurus norfolcensis / Squirrel Glider	Spp	IBRA subregion
	Petaurus norfolcensis / Squirrel Glider	Any in NSW

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00015232/BAAS19010/19/00015233	18OD02BCAR 15 Mulloway Road Chain Valley bay	10/06/2021
Assessor Name	Assessor Number	BAM Data version *
Corey Mead	BAAS19050	45
Proponent Name(s)	Report Created	BAM Case Status
Dominic Ursino	13/10/2021	Finalised
Assessment Revision	Assessment Type	Date Finalised
5	Biocertification	13/10/2021

* 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		
Lathamus discolor / Swift Parrot		
Petalura gigantea / Giant Dragonfly		

Additional Information for Approval

PCTs With Customized Benchmarks

PCT
No Changes

BAM Biodiversity Credit Report (Variations)

Predicted Threatened Species Not On Site

Name

Grantiella picta / Painted Honeyeater

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
1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	Not a TEC	10.1	177	0	177.00
1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.1	1	0	1.00

1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1619_moderate_good	Yes	177	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1619_cleared	No	0	Wyong, Hunter, Pittwater 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 4 or higher threat status	1619_moderate_good	Yes (including artificial)	177	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1718-Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1619_cleared	No	0	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Like-for-like credit retirement options					
	Class	Trading group	Zone	HBT	Credits	IBRA region

BAM Biodiversity Credit Report (Variations)

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1718_moderate_good	Yes	1	Wyong, Hunter, Pittwater 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	1718_moderate_good	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
Crinia tinnula / Wallum Froglet	1619_moderate_good, 1619_cleared, 1718_moderate_good	10.3	190.00
Hoplocephalus bitorquatus / Pale-headed Snake	1619_moderate_good, 1718_moderate_good	7.7	237.00

BAM Biodiversity Credit Report (Variations)

Lathamus discolor / Swift Parrot	1619_moderate_good, 1619_cleared, 1718_moderate_good	7.7	322.00
Litoria aurea / Green and Golden Bell Frog	1619_moderate_good, 1718_moderate_good	0.5	11.00
Myotis macropus / Southern Myotis	1619_moderate_good, 1619_cleared, 1718_moderate_good	10.3	253.00
Petalura gigantea / Giant Dragonfly	1718_moderate_good	0.1	2.00
Petaurus norfolcensis / Squirrel Glider	1619_moderate_good, 1718_moderate_good	7.7	237.00

Credit Retirement Options Like-for-like options

Crinia tinnula / Wallum Froglet	Spp		IBRA region
	Crinia tinnula /Wallum Froglet		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	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

Hoplocephalus bitorquatus/ Pale-headed Snake	Spp		IBRA region
	Hoplocephalus bitorquatus /Pale-headed Snake		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
Lathamus discolor/ Swift Parrot	Fauna	Vulnerable	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Spp		IBRA region
	Lathamus discolor /Swift Parrot		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	Endangered	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

Litoria aurea / Green and Golden Bell Frog	Spp		IBRA region
	Litoria aurea /Green and Golden Bell Frog		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
Myotis macropus / Southern Myotis	Fauna	Endangered	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	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	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

Petalura gigantea/ Giant Dragonfly	Spp		IBRA region
	Petalura gigantea /Giant Dragonfly		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
Petaurus norfolcensis/ Squirrel Glider	Fauna	Endangered	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Spp		IBRA region
	Petaurus norfolcensis /Squirrel Glider		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	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.



Staff qualifications and experience

A8

Table A 8.1 – Staff qualifications and experience

Team member (role)	Accreditations and qualifications	Experience	Employment history	Skills and expertise
George Plunkett (Botanist)	<ul style="list-style-type: none"> Biodiversity Assessment Method (BAM) Assessor (Accredited Assessor no. BAAS19010) PhD – Plant systematics, ecology and evolution Bachelor of Science (Honours) – Ecology / Botany, University of New England (UNE), NSW Four-wheel drive vehicle operation Senior First Aid Certificate 	George has 12 years of experience as a plant taxonomist, flora ecologist and botanist, including a PhD in plant systematics, ecology and evolution, and has a very well-developed understanding of the Australian flora.	<ul style="list-style-type: none"> 2017-Current: Botanist, Travers bushfire & ecology 2016-2017: Research Botanist, UNE 2010-2011: Research Botanist, UNE 2008-2009: Plant Ecologist, Ecotone Flora Fauna Consultants 	<ul style="list-style-type: none"> High-quality report writing Application of the BAM and BOS Highly experienced in botanical survey and ecological analysis Plant identification and taxonomy Flora and fauna assessment Threatened species, ecological communities and endangered population surveys and analysis Habitat tree analysis and assessment Noxious weed identification Tree assessment
Lindsay Holmes (Manager of Ecology)	<ul style="list-style-type: none"> Bachelor of Science – Biology, James Cook University, Qld Bush Regeneration II Certificate, Ourimbah TAFE NSW WorkCover OHS Construction Induction Senior First Aid Certificate BioBanking Assessor (No. 199) Biodiversity Assessment Method (BAM) Assessor (BAAS17032) 	Lindsay has 21 years of experience as a flora ecologist and bushland regeneration supervisor and has expertise in botanical survey, ecological analysis, maintain and improve analysis, biometric analysis and geo-plotting of ecological data.	<ul style="list-style-type: none"> 2007-Current: Senior Botanist, Travers bushfire & ecology 2006-2007: Ecologist, Conacher Travers Pty Ltd 1999-2006: Field Operations Manager, Microclimate 	<ul style="list-style-type: none"> Highly experienced in botanical survey and ecological analysis Vegetation management planning Flora and fauna assessment Species impact statement Threatened species, ecological communities and endangered population surveys and analysis Preparation of BioBanking and Biodiversity Development Assessment Reports Riparian, bushland and wetland restoration Habitat tree analysis and assessment Noxious weed identification and control SULE assessment

Team member (role)	Accreditations and qualifications	Experience	Employment history	Skills and expertise
Corey Mead (Contract fauna ecologist)	<ul style="list-style-type: none"> Southern Cross University – B. App. Sc. BAM Accredited Assessor (BAAS.19050) Accredited BioBanking Assessor (No.231) Scientific License (SI102477) Animal Ethics Permit (TRIM V20/32969) Bionet Sensitive Species Data License (No. 1589) Licence to Harm Protected Animals (MWL000103525) Possum Catch & Release Licence (MWL000103525) Reptile Catch & Release Licence (MWL000103525) Tre climbing techniques (AHCARB312) Chainsaw operation NSW NPWS – Intro to ArcView GIS First Aid Certificate (HLTAID003) Class C vehicle, Boat & Divers Licences OHS General Induction (CGI00761144SEQ1) Risk Assessment Training (Taronga Zoo) NSW RFS – Firefighters Certificate Report Writing – Pollack Learning Alliance Frog, Reptile & Bat Survey, ID & Mgt Training – NSW Forestry Anabat Techniques Training – Titley Scientific – Smiths Lake Cert III – Building & Carpentry (assist in construction of nest boxes) 	<p>Corey has developed extensive specialist knowledge over 20 years in fauna survey techniques, threatened species target surveys, data analysis and visual and call identification of vertebrate fauna within coastal habitats of NSW.</p> <p>Corey has also worked alongside a number of industry recognised specialists including Prof Michael Mahony (Giant Burrowing Frog), John Young (owls), Dr Brad Law (microbats), Dr Ross Goldingay (Yellow-bellied Glider and Eastern Pygmy Possum), Gerry Swan (Rosenberg's Goanna), Ross Wellington (Giant Barred Frog & Stuttering Frog) and Frank Lemckert (frogs).</p>	<ul style="list-style-type: none"> Nov 20 – Present – Contract Fauna Ecologist (<i>TreeHouse Ecology</i>) Oct 07 – Nov 20 – Senior Fauna Ecologist (<i>Travers Bushfire & Ecology</i>) Jan 06 – Oct 07 – Field Tech / Fauna Ecologist (<i>Conacher Travers Environmental Consultants</i>) Feb 03 – Jan 06 – Head Reptile Keeper (<i>Australian Reptile Park</i>) Jan 03 – Sept 05 – Visitor Services Officer (<i>National Parks & Wildlife Service</i>) Dec 02 – Jan 03 – Marine Turtle Project Officer (<i>National Park & Wildlife Service</i>) Aug 00 – Feb 03 – Venom Room Attendant (<i>Australian Reptile Park</i>) Nov 99 – Feb 00 – Waste Minimisation Education Officer (<i>Manly Council</i>) Apr 97 – Sept 00 – Environmental Education Officer (<i>Australian Reptile Park</i>) 	<ul style="list-style-type: none"> BAM-C fauna data and credit assessment Remote and independent terrestrial vertebrate surveys Threatened fauna target surveys & assessment Large hollow relocation methods Microbat Call Identification & active monitoring AnalogW, Anapocket, Insight & CFC Read bat analysis software Kaleidoscope Pro song-meter clustering & classifier analysis Advanced song classifiers for threatened owls, frogs & gliders Owl breeding ecology Squirrel Glider radio-tracking surveys Project Ecologist during habitat clearance Habitat tree assessment / audits Advanced reptile captive management Fire trail audits & bushfire risk analysis Advanced venomous snake handling & training Education/training program development GPS data transfer and management

Team member (role)	Accreditations and qualifications	Experience	Employment history	Skills and expertise
Michael Sheather-Reid (Managing Director)	<ul style="list-style-type: none"> Bachelor of Natural Resources (Hons), University of New England BioBanking Assessor Engineering Assistant – CAD Drafting MUSIC Modelling – Stormwater quality and quantity modelling (RMIT) Bush Regeneration II Certificate, Ryde TAFE NSW WorkCover OHS Construction Induction Chemical Handling Certificate, Ryde TAFE 	Michael has a wealth of experience in environmental consulting and on ground management of bushland, wetland and riparian habitats having undertaken environmental assessment, ecological consultancy and restoration in both the private and public sectors for over 22 years.	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Ecological assessment Rezoning studies Biodiversity offset planning Restoration management and coordination Biotic and soil translocation Watercourse assessment Project ecologist services EPBC Act referrals Controlled Activity Approvals Vegetation management plans
Sandy Cardow (GIS officer)	<ul style="list-style-type: none"> 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).	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Geographic Information Systems Data management and analysis Spatial databases and database administration GPS Cartography Natural resource management Client liaison

Team member (role)	Accreditations and qualifications	Experience	Employment history	Skills and expertise
Nathan Stewart (Fauna Ecologist)	<ul style="list-style-type: none"> Bachelor of Environmental Science and Management (University of Newcastle) (2016-2019) 	Nathan has experience in fauna survey techniques and visual and call identification of vertebrate fauna within coastal habitats of NSW.	<ul style="list-style-type: none"> 2019 – Current: Fauna Ecologist, Travers bushfire and ecology. 2019: Volunteer at Australian Museum in the herpetological department. 	<ul style="list-style-type: none"> Report Writing Fauna Field Assessments Project Ecologist during habitat clearance and installation of nest boxes Habitat tree analysis and assessment
Geoff Coates (Fauna ecologist)	<ul style="list-style-type: none"> Bachelor of Zoology (Animal Ecology) (University of New England) (2011-2013) Bachelor of Science (Honours) (University of New England) (2014) Venomous Snake Catch and Release Certification Chemical Certification 	Geoff has experience in vertebrate fauna identification and survey techniques, report writing, aquatic sampling, weed control and laboratory work. For his honours project, he utilised engineering software to determine the structural integrity of mammalian carnivore skulls.	<ul style="list-style-type: none"> 2020 – Current: Fauna Ecologist, Travers Bushfire and Ecology 2018 – 2020: Research Support Officer/Research Agronomist, Kalyx Australia 2017: Green Army Team Leader, ET Australia 2015 – 2016: Project Officer/Casual Academic, University of Newcastle 	<ul style="list-style-type: none"> Fauna identification and surveying Project management Report writing Data collation and analysis Liaising with clients, landowners, universities, government agencies and field staff Weed management in both conservation and agriculture Collecting environmental samples including soil, water, plant tissue and invertebrates for stable isotope analysis Supervising and instructing undergraduate environmental science students in practicals and university field trips

Team member (role)	Accreditations and qualifications	Experience	Employment history	Skills and expertise
Lachlan McRae (Fauna ecologist)	<ul style="list-style-type: none"> Bachelor of Environmental Science and Management (University of Newcastle) (2016 -2020) Currently studying - Bachelor of Environmental Science and Management HONOURS (University of Newcastle) (2020-present) 	Lachlan has several years' experience in fauna survey techniques and specializes in morphological, behavioural and call identification of vertebra fauna within coastal habitats of NSW. He has experience in leading research projects and is confident in experimental design, data collection, data analysis and report writing.	<ul style="list-style-type: none"> 2019 – Current: Fauna Ecologist, Travers bushfire and ecology. 2019 – Botanical intern, CSIRO Canberra 2018-2019 – Amphibian Research Assistant, UoN Callaghan 2019 – Research Leader, NSW NPWS/UoN 2019 – Reptile Zookeeper Assistant, Canberra Reptile Zoo 	<ul style="list-style-type: none"> Survey techniques for all major vertebrate fauna groups (including threatened species target searches) Coastal fauna identification via call, morphology and behaviour Ecological sound analysis with SoundID Habitat tree assessment / audits Experimental design and statistical analysis Scientific report writing Nest Box monitoring