ecoplanning
ecology | planning | offsets

Matters of National Environmental Significance Assessment

Lot 172 // DP 755923 & Lot 823 DP // 247285, Manyana, NSW

Residential Subdivision

Prepared for: Ozy Homes Pty Ltd

23 June 2020 Version: 1.2 – Final

PROJECT NUMBER	2019-237		
PROJECT NAME	Matters of National Environmental Significance Assessment		
PROJECT ADDRESS	Lot 172 // DP 755923 & Lot 823 DP // 247285, Manyana, NSW		
PREPARED FOR	Ozy Homes Pty Ltd		
AUTHOR/S	BS		
REVIEW	**Technical / QA**	**Version**	**Date to client**
	LJM	1.0 – Final	11 June 2020
	BS	1.1 – Final	18 June 2020 EPBC referral submission
	BS	1.2 – Final	23 June 2020 EPBC referral re-submission
LICENCES	**Scientific Licence**	SL101557	
	Bionet Sensitive Species Data Licence	1115	
	Animal Research Authority Ethics Licence	Fauna Surveys and Monitoring (16/346)	
	Scientific Collection - Aquatic	P19/0009-1.0 & OUT19/2602	

This report should be cited as: 'Ecoplanning (2020). Matters of National Environmental Significance Assessment– Lot 172 // DP 755923 & Lot 823 DP // 247285, Manyana, NSW.'

ECOPLANNING PTY LTD | PO BOX 919 THIRROUL NSW 2515 | P: (02) 4244 2736

Contents

Appendices

Figures

Tables

Glossary and abbreviations

Acronym	Description
ANU	Australian National University
APZ	Asset Protection Zone
BBAM	BioBanking Assessment Method
BC Act	*NSW Biodiversity Conservation Act 2016*
BES	Bushfire Environmental Services
BOM	Bureau or Meteorology
Commonwealth	Australian Government Department of Agriculture Water and the Environment (or preceding department)
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DEC	Department of Environment and Climate Change
DoEE	(former) Commonwealth Department of Environment and Energy (now DAWE)
DPIE	NSW Department of Planning, Industry and Environment
EEC	Endangered Ecological Community
EPBC Act	*Commonwealth Environment Protection and Biodiversity Conservation Act 1999*
FFMP	Flora and Fauna Management Plan
GEEBAM	Google Earth Engine Burnt Area Map
ha	Hectares
HBT	Hollow-bearing tree or habitat tree
IBOC	Illawarra Bird Observers Club
KBA	Key Biodiversity Area
LGA	Local Government Area

Acronym	Description
locality	5 km radius from the site
MNES	Matter of National Environmental Significance
NPWS	New South Wales National Parks and Wildlife Service
SE	South-East
TSC Act	*NSW Threatened Species Conservation Act 1995*
WBFB	Birdlife Australia Woodland Birds for Biodiversity

Executive Summary

Ecoplanning Pty Ltd has been retained by Colin Biggers & Paisley on behalf of Ozy Homes Pty Ltd to prepare an assessment of Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) potentially impacted by vegetation clearing and residential subdivision development works (the action) at Lot 172 // DP 755923 & Lot 823 DP // 247285 Berringer Road, Cunjurong Point Road and Sunset Strip, Manyana, NSW.

This assessment has been provided to contemporise the results of prior assessments (Ecoplanning 2018a and 2018b) in light of a recent bushfire event in the summer of 2019-20. Species were selected for this assessment based on Ecoplanning (2018a) assessment of species with potential to occur on site coupled with species listed in DAWE (2020) *Provisional list of animals requiring urgent management intervention* and additional species considered potentially affected by bushfire. The species assessed were:

- *Petauroides volans* (Greater Glider) – vulnerable
- *Pteropus poliocephalus* (Grey-headed Flying-fox) – vulnerable
- *Dasyurus maculatus maculatus* (South-east mainland population) (Spotted-tailed Quoll) – endangered
- *Isoodon obesulus obesulus* (Southern Brown Bandicoot (eastern)) – endangered
- *Lathamus discolor* (Swift Parrot) – critically endangered
- *Monarcha melanopsis* (Black-faced Monarch) – migratory

This assessment is informed by literature and database review coupled with the following targeted survey:

- Remote cameras deployed in two separate events
  - 9 cameras over 18 days in 2018
  - 10 cameras over 14 days in 2020
- Spotlighting over three separate survey periods
  - 14 person-hours over 5 nights
  - 85 person hours over 3 nights using systematic transects
  - 15 person-hours over 2 nights
- Bird census 15 hours 20 minutes over 7 days
- Opportunistic bird survey over 16 days
- Nest box inspections
- Habitat assessment
- Vegetation validation of Google Earth Engine Burnt Area Mapping in locality

Of the target fauna species, only Grey-headed Flying-fox were detected. Species recorded include ten mammals, 53 birds, three frogs, and one reptile. Vegetation validation provided an estimate of at least 812 ha of suitable intact habitat (unburnt or canopy/understorey intact) for the target fauna species within the locality (5 km radius of site).

Matters of National Environmental Significance Significant Impact Guidelines 1.1 (DoE 2013) were applied considering the impact of recent bushfires as well as the outcome of targeted surveys. The assessment considered whether the entire proposed development, including approximately 17 ha of vegetation clearing, is likely to have a significant impact on any MNES under the EPBC Act in the context of recent bushfires and in consideration of the current state

of vegetation in the locality. The assessment found that the action is not likely to have a significant impact on a MNES protected under the EPBC Act, with the following conclusions:

- Survey was sufficient to confirm the absence of the following species:
  - Greater Glider
  - Southern Brown Bandicoot
  - Spotted-tailed Quoll
- Swift Parrots were not detected despite sufficient survey. The site lacks habitat characteristics known to be important for foraging. The site and surrounding locality, including habitats similar to those on site, do not support significant movements of Swift Parrots with site fidelity and site persistence.
- Grey-headed Flying-fox were recorded on site. Based on the mobility of the species, importance of the local population in the context of the broad range of the species, availability of foraging habitat in the locality, and intermittent use of foraging resources on site, the proposed action is not likely to significantly impact this species.
- Black-faced Monarchs are assumed to be using the site for breeding due to previous records. The site does not support an ecologically significant proportion of the population or a significant area of important habitat for this species.
- Regarding the impact of the action in the context of recent bushfires, the habitat found on site is not critical to the survival of any of the species assessed, or to the survival of a local population of these species. Moreover, the site is to be cleared in stages, with Stage 1 and associated APZs being cleared in 2020 (7.41 ha), Stage 2 in late 2021/early 2022, and the remainder over 7-10 years. DPIE (2020) guidelines for assessment of burnt sites list habitat attributes that are missing from severely burnt sites, the vast majority of which will have returned to the areas of Very High and High Burnt Area Class after 2 years. On this basis, the majority of the site will not be cleared until after the surrounding bushland has recovered. Notwithstanding, the overall impact of the action is not significant to any MNES in the context of recent bushfires.

A referral for formal assessment and approval under the EPBC Act is not required, however, a determination from the Commonwealth cannot be assured without referral.

1 Introduction

Ecoplanning Pty Ltd has been retained by Colin Biggers & Paisley on behalf of Ozy Homes Pty Ltd to prepare an assessment of Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) potentially impacted by vegetation clearing and residential subdivision development works (the action) at Lot 172 // DP 755923 & Lot 823 DP // 247285 Berringer Road, Cunjurong Point Road and Sunset Strip, Manyana, NSW, 2539. Hereafter referred to as the 'site' (refer to **Figure 1.1** and **Figure 1.2**).

1.1 Background

Ozy Homes, the developer carrying out the action on site, has requested this assessment of MNES in order to exercise due care and diligence as prescribed under Section 18 of the EPBC Act. Previous MNES assessments have been undertaken by Ecoplanning and presented in a letter dated 17 April 2018 (**Attachment 1**). A response to a request from the Department of Environment and Energy (DoEE) for further information was also provided by Ecoplanning in a letter dated 27 July 2018 (**Attachment 2**). The current assessment has been provided to contemporise the results of prior assessments in light of a recent bushfire event, known as the Currowan fire, which occurred in the Shoalhaven Local Government Area (LGA) in the summer of 2019-20.

1.2 Scope

This assessment aims to contemporise previous MNES assessments for certain bushfire-affected species identified as potentially occurring on site by Ecoplanning (refer **Attachment 1**) and listed in the '*Provisional list of animals requiring urgent management intervention*' released on 20 March 2020 by the Commonwealth Department of Agriculture, Water and Environment (DAWE 2020). The key species assessed herein are:

- *Dasyurus maculatus maculatus* (South-east mainland population) (Spotted-tailed Quoll) – endangered
- *Monarcha melanopsis* (Black-faced Monarch) – migratory
- *Petauroides volans* (Greater Glider) – vulnerable
- *Pteropus poliocephalus* (Grey-headed Flying-fox) – vulnerable

The list of key species was based on species listed under the EPBC Act as either critically endangered, endangered, vulnerable or migratory, with a likelihood of occurrence ranked as either, 'recent record', 'high' or 'moderate' (refer **Attachment 1**). Each species assessed is also found on the DAWE (2020) provisional list.

To produce a comprehensive contemporary assessment, additional species which meet the above criteria in Appendix B of **Attachment 1**, but are not listed by DAWE (2020) were selected for assessment due to concerns raised in correspondence received from Birdlife Shoalhaven on 7 May 2020 and a report prepared by OMVI Ecological dated 13 May 2020. The additional species assessed are:

- *Isoodon obesulus obesulus* (Southern Brown Bandicoot (eastern)) – endangered
- *Lathamus discolor* (Swift Parrot) – critically endangered

Figure 1.1: Site CC Plans Stage 1

Figure 1.2: Site staging and habitat features

2 Methods

2.1 Literature review and database analysis

This assessment was informed by a review of previous assessments, management plans, and reports produced for the site, including:

- Flora and Fauna Assessment (BES 2006)
- Response to letter from Department of the Environment and Energy, regarding 182 lot sub-division, Berringer and Cunjurong Roads, Manyana (Ecoplanning 2018a) (**Attachment 1**)
- Response to the Department of the Environment and Energy requesting additional information regarding EPBC Act application to the 182 lot residential subdivision at Berringer and Cunjurong Point Roads, Manyana (Ecoplanning 2018b) (**Attachment 2**)
- Environmental Management Plan (Ecoplanning 2019a)
- Flora and Fauna Management Plan (Ecoplanning 2019b)

Commonwealth reports relating to the impact of the 2019-20 summer bushfires were also used to inform this assessment, including:

- *Preliminary Draft Design considerations for post natural disaster (fire) on-ground assessment of status of species, ecological communities, habitats and threats* (Southwell 2020)
- *Provisional list of animals requiring urgent management intervention* (DAWE 2020a)
- *Rapid analysis of impacts of the 2019-20 fires on animal species, and prioritisation of species for management response* and supporting information, accessed from https://www.environment.gov.au/biodiversity/bushfire-recovery/priority-animals on 26 May 2020 (DAWE 2020b)

Desktop analysis included review of mapping, databases, and published reports from regional sources listed in **Table 2.1**. Additionally, peer-reviewed literature describing the ecology of the species assessed was used to inform assessment of habitat requirements and response of the species to bushfire.

Table 2.1: Database analysis

Data source	URL	Notes
Atlas of Living Australia	https://www.ala.org.au/	Spotted-tailed Quoll, Greater Glider, Southern Brown Bandicoot, Grey-headed Flying-fox, Swift Parrot, and Black-faced Monarch records searched (all years)
Birdlife Australia Woodland Birds for Biodiversity (WBFB) *Swift Parrot and Regent Honeyeater survey update*	http://birdlife.org.au/projects/woodland-birds-for-biodiversity/latest-news-wl	Years reviewed 2009 – 2019
Birdlife Australia *Birdata*	https://birdata.birdlife.org.au/	Swift Parrot records searched (all years)
Commonwealth Department of the Environment (DoE). National Flying-fox monitoring viewer	http://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf	Grey-headed Flying-fox roost camp records searched
Cornell Lab of Ornithology *eBird*	https://ebird.org/home	Swift Parrot sightings searched (all years)
Department of Planning, Industry and Environment (DPIE) Google Earth Engine Burnt Area Map (GEEBAM)	https://datasets.seed.nsw.gov.au/dataset/google-earth-engine-burnt-area-map-geebam	Mapping showing Burnt Area Classes: • No Data • Low (burnt understory, unburnt canopy) • Medium (understorey may be burnt, canopy partially burnt) • High (canopy and understorey likely completely burnt) • Very High (canopy or highest stratum completely consumed) • Not Native Vegetation Mapping used to guide vegetation validation ground-truthing surveys
Illawarra Bird Observers Club (IBOC) *Members' Monthly Sightings*	https://www.iboc.com.au/sightings.html	Years reviewed 2007 – 2019 Swift Parrot sightings searched
Nearmap High Resolution Aerial Imagery	https://www.nearmap.com/au/en	Image date 31 January 2020 Mapping overlaid with GEEBAM and used to guide vegetation validation ground-truthing surveys

Data source	URL	Notes
NSW Office of Environment and Heritage Atlas of NSW Wildlife (BioNet)	http://www.bionet.nsw.gov.au/	Spotted-tailed Quoll, Greater Glider, Southern Brown Bandicoot, Grey-headed Flying-fox, Swift Parrot, and Black-faced Monarch records searched (all years)

2.2 Field survey

Surveys of the site were conducted by Ecoplanning between 11 – 29 March 2018 and 6 May 2020 – 18 June 2020. Surveys targeted the key species assessed in this report. Survey methods employed include:

- Remote camera surveys
- Spotlighting
- Bird census
- Opportunistic diurnal records of birds and mammals
- Nest box inspection
- Diurnal searches for habitat features and secondary evidence of fauna activity

2.2.1 Remote cameras

Nine remote cameras (Reconyx HC 500) were installed over 18 days from 11-29 March 2018. Ten remote cameras (Reconyx HC 500) were installed over 14 days from 14-27 May 2020. The cameras were placed in low shrubby areas and facing universal bait lures (made using oats, peanut butter and truffle oil or mushrooms) (refer to **Figure 2.1**). The lure was contained within 100 mm long tube that was inaccessible to vertebrate fauna and secured to an object such as logs and branches. All remote camera images of bandicoots from 2018 surveys were collated, and identification confirmed with Threatened Species Officers of the NSW Office of Environment and Heritage (OEH; now a part of the NSW Department of Planning, Industry and Environment [DPIE]) and experienced fauna ecologists at Ecoplanning. All remote camera images of Bandicoots from 2020 surveys were collated and identification confirmed by experienced fauna ecologists at Ecoplanning.

Remote cameras targeted Southern Brown Bandicoot and Spotted-tailed Quoll.

Figure 2.1: Remote camera locations

2.2.2 Spotlighting and call playback

Ecoplanning surveys

Surveys were conducted by senior staff of Ecoplanning with experience undertaking fauna survey. Curriculum vitae of survey staff is provided at **Appendix A**.

Spotlighting surveys were undertaken over five nights (14 and 18-21 May 2020) by senior Ecoplanning staff. Spotlighting was conducted in teams of two using high powered handheld and headtorches (>1,000 lm) positioned close to the line of site of the viewer. Observers used torches to illuminate foliage, branches, trunks of trees and shrubs in a 'sweeping' motion. Species were detected by eye shine or otherwise observed. Observers carried binoculars and cameras with high optical zoom to gain a better view of fauna detected and confirm identification.

Spotlighting transects undertaken covered the entire site (refer to **Figure 2.2**). Spotlighting was also undertaken in surrounding forested lands, including Crown Land directly adjacent to the site and parts of Conjola National Park north west of Bendalong (refer to **Figure 2.3**).

Spotlighting was conducted by two Ecoplanning staff members each night, targeting Greater Gliders, a duration totalling approximately 21.5 person-hours (14 hours onsite, 7.5 hours offsite) over the five nights (14 and 18-21 May 2020), between the hours of 17:30 and 21:45. Stagwatch of trees containing large hollows was undertaken on two nights preceding spotlighting survey. Survey effort targeted areas with Greater Glider food trees such as *Eucalyptus botryoides* (Lindenmayer 2020) and areas with greater numbers of hollow bearing trees in the immediate vicinity. In conjunction with spotlighting and stagwatching, and call playback surveys were undertaken for Squirrel Glider (*Petaurus norfolkensis*), Yellow-bellied Glider (*P. australis*), Masked Owl (*Tyto novaehollandiae*), Barking Owl (*Ninox connivens*) and Powerful Owl (*N. strenua*).

Spotlighting targeted the Greater Glider.

Australian National University (ANU) – Supplementary surveys

Surveys were conducted between 31 May and 2 June 2020 (three nights) led by researchers from Australian National University (ANU) Fenner School of Environment & Society together with Rewilding Australia Incorporated and Ecoplanning staff. Supplementary surveys targeted the Greater Glider and ANU determined the survey method and effort. Surveys were conducted across 6 × 300 m north-south transects, spread equidistant across the site at approximately 100 m intervals. In addition, the perimeter of the site was surveyed with all observed and heard fauna recorded. Call playback was undertaken on at least two occasions on the second and third night of survey from different locations across the site, for Powerful Owl and Yellow-bellied Glider.

Surveys were conducted by four ecologists in pairs on the first and second night. Surveys on night three were conducted by six ecologists in pairs.

Surveys were undertaken between the hours of 17:30 and 01:00 over three nights totalling approximately 85 person-hours of supplementary survey.

Gaia Research Environmental Consultants – Supplementary surveys

Surveys were conducted on 17 and 18 June 2020 (two nights) by Gaia Research and Ecoplanning staff. Surveys targeted the Greater Glider and followed the transects previously established by ANU.

Three ecologists walked all transects and the south and east perimeter of the site together in a group. Surveys were undertaken between the hours of 18:00 and 21:00 over two nights totalling approximately 15 person-hours of supplementary survey.

NPWS – Conjola National Park surveys

NSW National Parks and Wildlife Service has engaged local fauna consultants to survey for arboreal mammals and large forest owls on the south coast of NSW following the 2019-20 bushfires (NPWS pers. comm., 18 June 2020). Over 70 transects have been surveyed to date in several national parks in the Shoalhaven LGA. These were transects established previous to the fire. Thirteen transects have been surveyed in Conjola National Park to date. Only two Greater Gliders have been detected in Conjola NP on Mondayong Road in the north of the park (NPWS pers. comm.).

Spotlighting survey effort

Total spotlighting survey effort is summarised in **Table 2.2** below.

Table 2.2: Spotlighting survey effort

Date	Survey onsite (person-hours)	Survey offsite (person-hours)
14/5/2020	5	-
18/5/2020	3.5	1.5
19/5/2020	2.5	2
20/5/2020	2	4
21/5/2020	1	-
Subtotal – Ecoplanning survey	**14**	**7.5**
31/5/2020	22	-
1/6/2020	24	-
2/6/2020	39	-
17/6/2020	7.5	-
18/6/2020	7.5	-
Subtotal – supplementary survey	**100**	**-**
Total	**114**	**7.5**

Figure 2.2: Survey effort on site (note not all survey tracks are provided due to a device failure)

Figure 2.3: Survey effort on and off site

2.2.3 Bird survey

Ecoplanning survey – bird census (2 ha, 20 minute)

Opportunistic bird surveys were conducted on site over sixteen days, 6, 14, 15, 18-22, 25-30 May 2020, 1 and 3 June 2020. Systematic bird census surveys were undertaken over seven days from 18-22, 30 May and 1 June 2020. Systematic bird census surveys utilised a 2ha, 20 minute search method undertaken at dawn (07:00 – 10:30) and dusk (15:00 – 17:15). A total of 920 minutes of bird census were undertaken onsite and in surrounding habitats targeting the Swift Parrot.

Ecoplanning survey – Opportunistic/incidental records

A list of opportunistic species was recorded throughout all survey work on site, including mammals, frogs, reptiles and additional bird species not recorded during census. Opportunistic survey during May and June totalled at least 16 days, with intermittent site visits not tallied, however any species not detected during bird census were recorded.

Bird surveys targeted the Swift Parrot.

Supplementary survey (ANU)

Supplementary diurnal bird census was undertaken by ANU during daylight hours, between 09:00 and 16:00, Saturday 30 May and Monday 1 June 2020. The bird census was undertaken for a period of 5 mins, at two points at least 50 m from the site boundary along the six spotlighting transects, and all observed and heard birds were noted.

2.2.4 Nest box inspection

Nest box monitoring inspections were undertaken on 14-15 May 2020. A total of 107 Cyplass and plywood nest boxes of various dimensions had been installed between 9 December 2019 and 30 January 2020 across retained vegetation on site and in Crown Lands adjacent to the site.

Nest box inspections aimed to detect utilisation of boxes by fauna, in particular by Greater Gliders.

2.2.5 Diurnal habitat searches

Ecoplanning – on site habitat assessment

Searches for habitat features considered significant to this MNES assessment were conducted between 6/5/2020 and 22/5/2020. These habitat features are listed in **Table 2.3**. Habitat searches included verification of previous hollow bearing tree records (Ecoplanning 2019b), recording flowering eucalypt species, recording secondary evidence of target fauna species such as diggings, and recording habitat attributes required for foraging or denning by the target fauna species.

Table 2.3: Significant habitat features

Significant habitat features	Species
Hollow bearing trees	Greater Glider, Spotted-tailed Quoll
Winter flowering eucalypt species/ Eucalypts in flower	Swift Parrot, Grey-headed Flying-fox
Ground logs	Spotted-tailed Quoll
Dense understorey vegetation	Southern Brown Bandicoot
Sandy soils	Southern Brown Bandicoot
Dense mesic mid-storey and understorey vegetation	Black-faced Monarch
Tree species in fruit	Grey-headed Flying-fox

Ecoplanning – off site habitat assessment (GEEBAM validation)

Ground-truthing of burnt areas was undertaken in lands surrounding the site. Ground-truthing aimed to verify the accuracy of GEEBAM mapping in the locality and its usefulness as a proxy for determining the extent of habitat attributes considered significant to the target fauna species. Habitat attributes considered significant to the target species are listed in **Table 2.3** above, and the off site habitat assessment aimed to detect condition of these attributes (i.e. present, intact, not showing significant signs of fire damage) – canopy not consumed and without epicormic growth, understorey mature and not consumed by fire, logs present and not consumed by fire For example, unburnt canopy may provide cover and forage for Greater Gliders and may produce flower for Swift Parrots. Undamaged tree hollows in areas of lower apparent fire intensity may provide den sites for Greater Gliders.

ANU – Supplementary habitat assessment

Supplementary habitat surveys were undertaken by ANU at five locations along the six spotlighting transects. These surveys quantified the number of large trees (30-50 cm and >50 cm) in a 20x20 m (0.04 ha) quadrat. Data from this habitat assessment has not been requested nor provided to Ecoplanning, but it is assumed to be used to determine the age class and habitat suitability for targeted fauna, in particular the Greater Glider.

2.2.6 Survey effort

Survey adequacy with regard to guidelines published by the Commonwealth is presented in **Table 2.3**.

Total field survey effort is summarised together with notes on observations and survey timing in **Table 2.4**.

Table 2.4: Survey adequacy summary

Species	Commonwealth survey recommendation	Survey on site (Ecoplanning)
Greater Glider	5 nights spotlighting (Southwell 2020)	10 nights spotlighting
Grey-headed Flying-fox	Ground counts of roosting sites (Southwell 2020)	Entire site traversed on foot, no roosting sites found
Spotted-tailed Quoll	3 weeks 1-4 cameras per km²; or 12.6 camera-nights 5 cameras (Southwell 2020)	4.5 weeks 44 cameras per km² 300 camera-nights 9-10 cameras
Southern Brown Bandicoot	Daytime habitat search Daytime search for signs Collection of predator scats Soil plot survey Spotlight survey Hair sampling survey Camera trapping in Autumn after rainfall 14 days x 2 separate events Community liaison (DSEWPaC 2011)	Daytime habitat search Daytime search for signs Spotlight survey (10 nights) Camera trapping in Autumn after rainfall 2 separate events 18 days (2018) and 14 days (2020) Community liaison
Swift Parrot	20 hours 8 days (DEWHA 2010)	15.3 hours diurnal census 7 days 16 days on site opportunistic bird survey
Black-faced Monarch	Habitat assessment Timed survey during Spring – Autumn (Southwell 2020)	Habitat assessment No survey during appropriate season

Table 2.5: Survey effort

Date	Technique and effort	Notes
11/3/2018 – 29/3/2018	9 remote cameras with lure	Baited with oats, peanut butter, and truffle oil. Notable – Long-nosed Bandicoot, European Red Fox
6/5/2020	Incidental bird/fauna survey during BBAM vegetation plots	Notable – Two pairs of Gang-gang Cockatoos foraging in *Eucalyptus pilularis* in Stage 1 area
14/5/2020 – 15/5/2020	Nest box inspection	107 boxes. Two brushtail possums found – 1 box in retained area on site and 1 box in burnt area off site.
14/5/2020	Spotlighting in Stage 1 Area	Traversed entire area between 17.45 and 20.15. No fauna were detected, although one bird was startled, flew off and was not seen. Suspected owl as its flight was silent.
14/5/2020	Mobile Echometer in Stage 1 Area	Traversed entire area between 17.45 and 20.15. Recordings are still to be analysed.
14/5/2020 – 28/5/2020	10 remote cameras with lure	Baited with oats, peanut butter and mushrooms. Placed in same locations as previous survey. Notable – Long-nosed Bandicoot, European Red Fox
14/5/2020 – 15/5/2020	Incidental bird/fauna survey during nest box inspections	Some birds not recorded as calls were unknown. Two kangaroos sighted – one in burnt area, one in development area. One dead grey-headed flying fox found on the development site. Notable – Two pairs of Gang-gang Cockatoos in the development area. Also heard in surrounding burnt areas.
18/5/2020	Bird census on site	5 x 20 minute bird census surveys conducted on site between 16:00 and 17:00 Notable – Two pairs of Gang-gang cockatoos on site and flying over site

Date	Technique and effort	Notes
18/5/2020	Spotlighting on site	Traversed site on foot between 17:15 and 19:00 Grey-headed Flying-fox (heard) *Litoria verreauxii, Limnodynastes peronii, Pseudophryne bibronii* (heard) Ringtail possum – 1 individual in EEC area of site Brushtail Possum – 2 in Stage 6 area
18/5/2020	Spotlighting off site	2 people spotlighting from car between 19:00 and 19:45 Brushtail Possum – 2 in crown land west of site
19/5/2020	Bird census on site	10 x 20 minute surveys between 07:30 and 10:00 3 x 20 minute surveys between 16:10 and 17:10 Notable – Gang-gang cockatoos (heard)
19/5/2020	Vegetation validation	Local reconnaissance of vegetation mapping targeting Coastal Sand Forest for winter flowering Eucalypt spp. (specifically *E. botryoides*) and fire damage, between 08:00 and 11:00. Notable – many mapped areas of Northern Coastal Sands Shrub/Fern Forest had intact canopy and *E. botryoides* present, had not burnt or were only partially burnt (understorey, not canopy), likely in back burning operations.
19/5/2020	Bird census off site	2 x 20 minute surveys between 15:00 and 15:40 Crown land south of The Bounty Road Notable – Two pairs of Gang-gang cockatoos flying over Manyana
19/5/2020	Call playback	Squirrel Glider, Yellow-bellied Glider, Masked Owl, Barking Owl, Powerful Owl calls played between 17:30 and 18:00 No response to calls

Date	Technique and effort	Notes
19/5/2020	Spotlighting on site	Traversed site on foot between 17:20 and 17:30; 18:00 and 19:00 Eastern Grey Kangaroo Sugar Glider (heard, possibly to the north off site) Brushtail Possum – 2 in Stage 6 area *Litoria tyleri* (heard) Bandicoot diggings observed throughout the site
19/5/2020	Spotlighting off site	Traversed crown land to the west and south of site on foot between 19:00 and 20:00 Brushtail Possum – at least 9 individuals Long-nosed Bandicoot Eastern Grey Kangaroo Swamp Wallaby Tawny Frogmouth
20/5/2020	Bird census on site	8 x 20 minute surveys between 07:10 and 10:10 Notable – Varied Sittella, one seen foraging in clearing in north Stage 5 area Gang-gang Cockatoo (heard)
20/5/2020	Vegetation validation	Local reconnaissance of vegetation mapping targeting Coastal Sand Forest for flowering Eucalypt spp. and fire damage, between 10:30 and 13:00. Notable – many mapped areas of Northern Coastal Sands Shrub/Fern Forest had intact canopy and were only partially burnt (groundcover layer and/or understorey, not canopy) indicating lower intensity fire
20/5/2020	Incidental bird/fauna survey during BBAM vegetation plot off site	Incidental observations between 15:15 and 17:15 on crown lands south of site

Date	Technique and effort	Notes
20/5/2020	Spotlighting off site	2 people spotlighting from car to the north and west of Bendalong between 17:50 and 19:45 Tawny Frogmouth *Crinia signifera, Litoria peronii, Paracrinia haswelli, Pseudophryne bibronii* (heard) *Limnodynastes peronii*
20/5/2020	Call Playback	Squirrel Glider, Yellow-bellied Glider, Masked Owl, Barking Owl, Powerful Owl calls played between 19:50 and 20:20 No response to calls
20/5/2020	Spotlighting on site	Traversed site on foot between 19:50 and 20:50 Southern Boobook (heard) Brushtail Possum
21/5/2020	Bird census on site	8 x 20 minute surveys between 07:15 and 10:00 2 x 20 minute surveys between 16:30 and 17:10 Notable – Bandicoot flushed from dense *Gahnia* in Stage 3 area Swamp Wallaby
21/5/2020	Bird census off site	1 x 20 minute surveys between 16:10 and 16:30 in burnt area of crown land west of site
21/5/2020	Spotlighting on site	2 people spotlighting from car along north and west of site between 21:00 and 21:30
22/5/2020	Bird census off site	3 x 20 minute surveys between 07:30 and 08:50 in burnt area of crown land south west of site and near flowering eucalypts at east end of Sunset Strip
22/5/2020	Bird census on site	2 x 20 minute surveys between 09:10 and 09:50 Notable – Crested Shrike-tit
30/5/2020	Bird census on site	Bird census during systematic spotlight transect setup

Date	Technique and effort	Notes
31/5/2020 – 3/6/2020	Spotlighting on site	Supplementary systematic transect spotlighting surveys over three nights between 17:30 and 00:30, totaling approximately 84 person-hours of targeted surveys for the Greater Glider Notable – Feathertail Glider & Barn Owl recorded during supplementary spotlighting surveys are only additional species found on site and not previously recorded by Ecoplanning
17/6/2020 – 18/6/2020	Spotlighting on site	Supplementary spotlighting surveys over two nights between 18:00 and 21:00, totaling approximately 15 person-hours of targeted surveys for the Greater Glider Notable – Brushtail Possums, Common Ringtail Possum, and Sugar Glider recorded

3 Results

3.1 Literature and database review

3.1.1 Previous reports

Previous site documents were reviewed in relation to threatened species records and habitat. Results relevant to the current assessment are provided below.

Greater Glider

Greater Glider was recorded on site by BES (2006), which described the species as '*relatively abundant in suitable habitats elsewhere in the locality*'.

Suitable denning habitat in the form of tree hollows was systematically surveyed by Ecoplanning (2019b). A total of 51 hollow-bearing trees, containing up to 56 tree hollows were recorded on site. Fifteen of these trees retained hollows large enough (>15 cm diameter; 15 hollows) to accommodate Greater Glider.

Grey-headed Flying-fox

BES (2006) notes the presence of suitable foraging habitat, but no individuals recorded during survey.

Spotted-tailed Quoll

This species was not recorded on site during previous surveys. Ecoplanning (2018a) notes the presence of suitable habitat.

Southern Brown Bandicoot (eastern)

This species was not recorded on site during previous surveys. Ecoplanning (2018a) reports on targeted remote camera surveys for this species. This survey effort has been combined with the current survey when discussing the overall contemporary survey effort targeting this species.

Swift Parrot

Swift Parrot has not recorded on site during previous surveys. No significant habitat features for these species, such as winter flowering *Eucalyptus robusta*, were noted during BES (2006) surveys. Ecoplanning (2019b) records *E. robusta* occurring in the sub-canopy of the Bangalay Paperbark Woodland EEC, which will be retained on site. Habitat surveys conducted for the current assessment were unable to locate *E. robusta* on site.

Black-faced Monarch

Black-faced Monarch was recorded on site by BES (2006), which also recorded evidence of breeding in the Bangalay Moist Woodland Open Forest in the north east of the site.

3.1.2 Database records

The BioNet Atlas database was accessed and background data in relation to dataset, sighting notes, and description was interrogated in relation to recent records and any other records considered significant to this assessment. All BioNet records within 5 km of the site, Shoalhaven LGA (excluding Grey-headed Flying-fox due to the large number of records), and for the wider region (60 km – Swift Parrot only due to wide-ranging foraging behaviour) are displayed in **Figure 3.1** to **Figure 3.4** below. These records are not time limited, and many date back >20 years.

In addition, Atlas of Living Australia, Birdata, Birdlife WBFB, eBird, and Illawarra Bird Observers Club (IBOC) records were searched in relation to the subject species of this assessment in order to develop a comprehensive regional assessment of the species' occurrence and to ensure assessment of records that may not have been uploaded to the BioNet Atlas. No additional relevant records were found in these datasets.

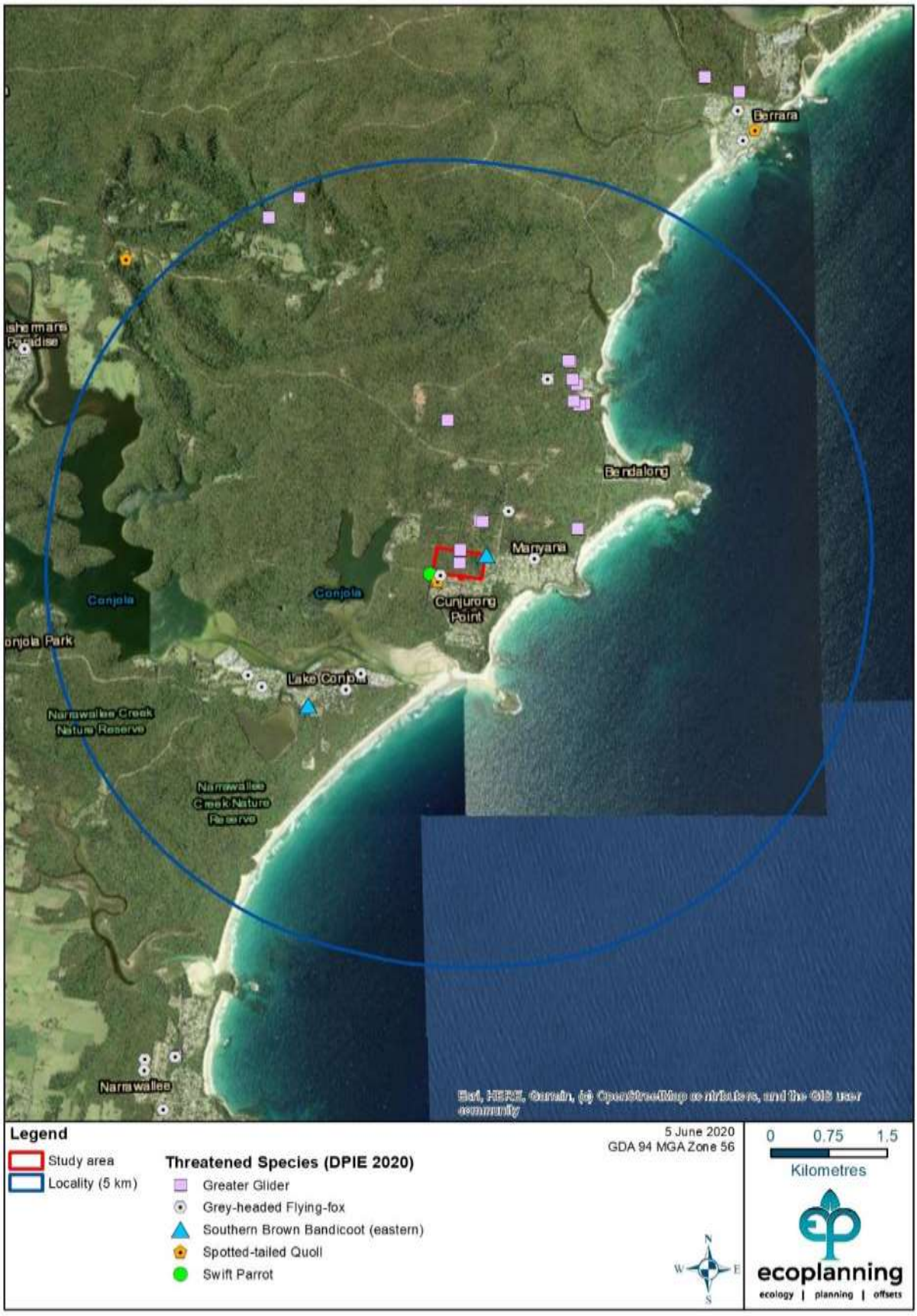

Figure 3.1: BioNet records – Locality (5km)

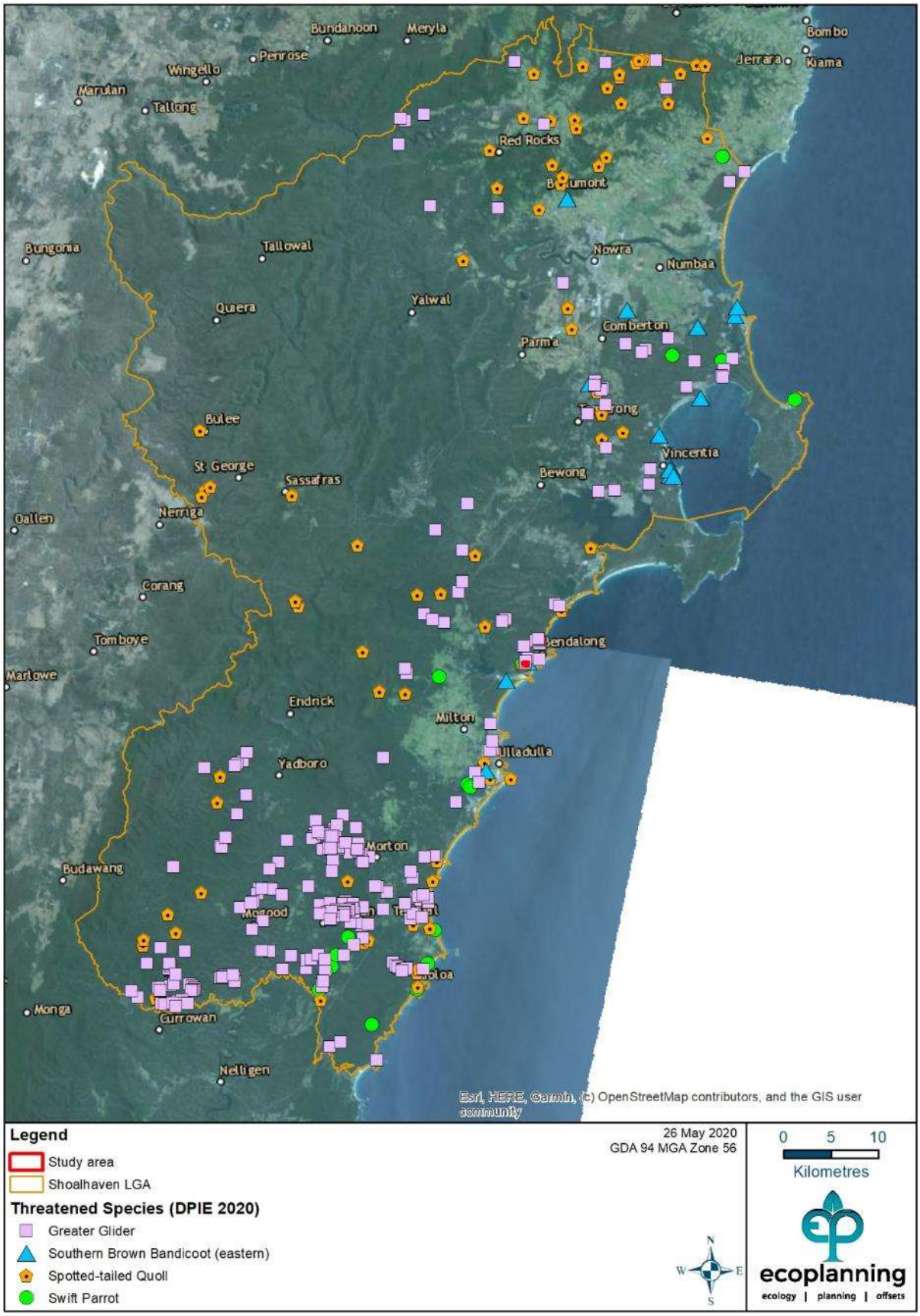

Figure 3.2: BioNet records – Shoalhaven LGA

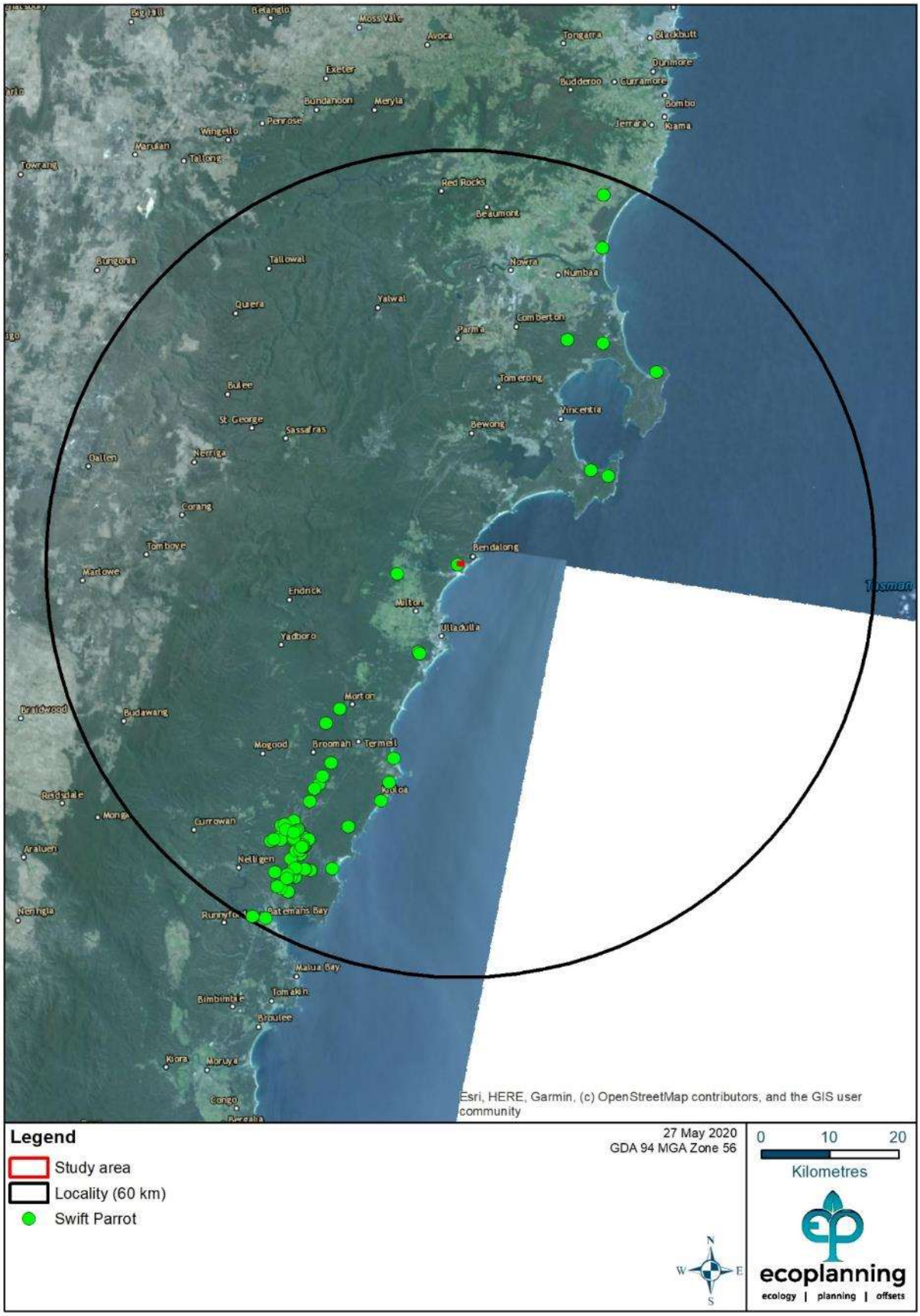

Figure 3.3: BioNet records – All records (60 km)

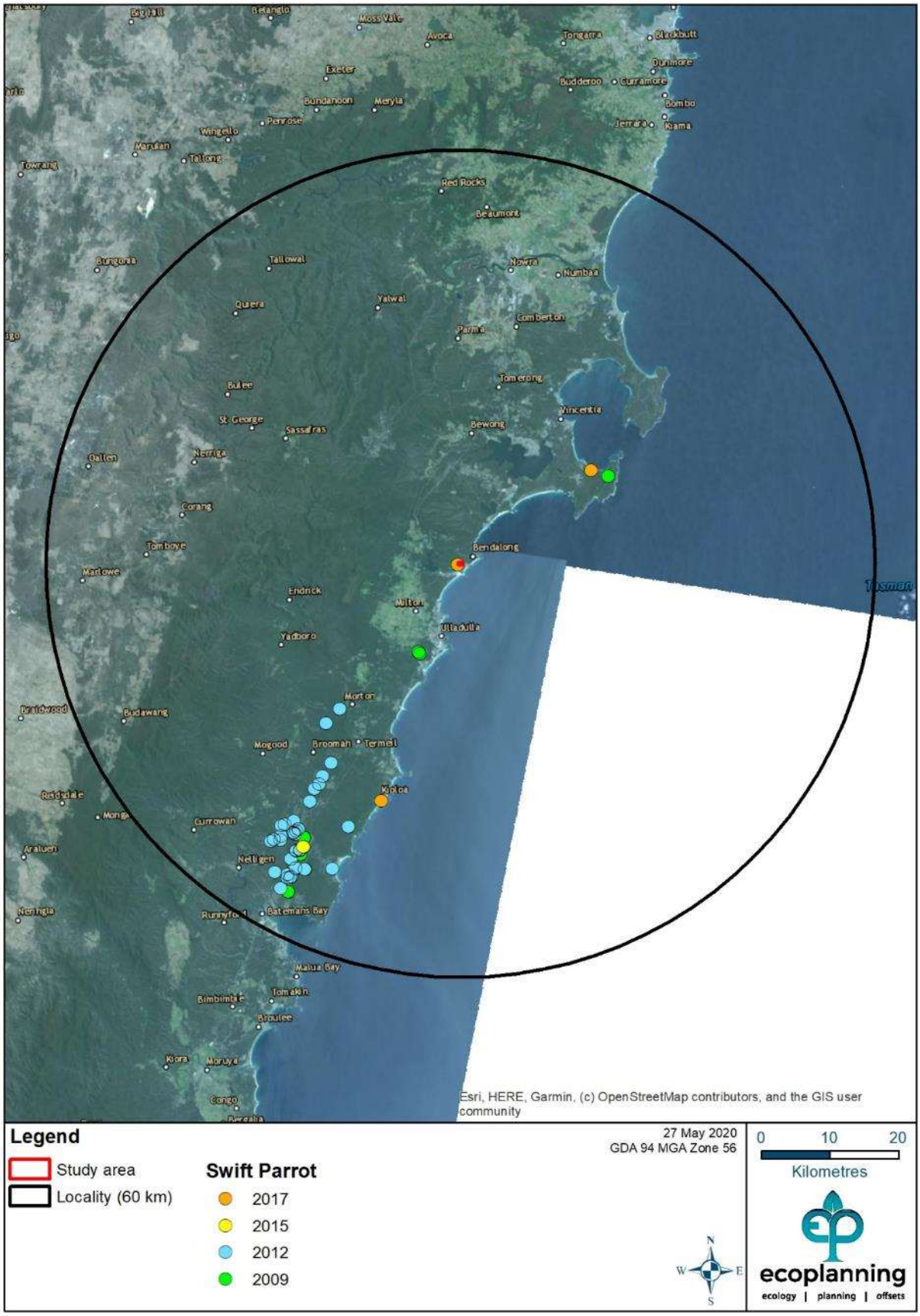

Figure 3.4: BioNet records – 2009, 2012, 2015, 2017 (60 km)

3.1.3 Habitat assessment

The site is surrounded by Crown Land and National Parks Estate, much of which has been affected to some extent by the Currowan fire. Prior to the Currowan fire, 4,049 ha of intact bushland was mapped in the locality, 3,022 ha (74.6 %) of which is in either Crown Land or National Parks Estate.

3.1.4 GEEBAM

Analysis of the GEEBAM found that within 5 km of the site (the 'locality') out of a total of 4,049 ha, 3,064 ha of vegetation has been burnt in either 'Very High' or 'High' Burnt Area Class (75.7 %). Burnt Area Classes 'Medium' and 'Low' total approximately 593 ha (14.6 %) in the locality, much of which is found in Conjola National Park. There are also large areas of unburnt vegetation in the locality, totalling approximately 219 ha (5.4 %).

The GEEBAM was also compared against recent Nearmap imagery (31 January 2020) to identify areas of intact canopy for ground-truthing surveys. From the desktop, canopy condition on the NearMap imagery could be correlated well with the GEEBAM, particularly the difference between 'Very High/High' and 'Medium/Low' Burnt Area Classes.

3.2 Habitat cleared/ retained in locality

The results of GEEBAM analysis were compared against the anticipated staging of the development to estimate the area of habitat impacted by the development compared to the area of habitat remaining in the locality after bushfires. The analysis considered DPIE (2020) *Guideline for applying the Biodiversity Assessment Method at severely burnt sites* to estimate the period over which habitat will recover after bushfire. The attributes listed in Table 1 of DPIE (2020) are expected to recover over a time period of approximately 2 years, after which the vegetation would no longer be classed as 'severely burnt' for the purposes of habitat assessment. Results of this analysis are presented in **Table 3.1** below.

Table 3.1: Habitat cleared/ retained in locality (ha)

Date	Native vegetation in locality	Native vegetation in reserves	Habitat severely affected (high/ very high)	Habitat intact (med/ low/ unburnt)	Habitat cleared on site	% cleared of intact habitat	Notes
2018	4049.0	3022.0	0.0	4049.0	0.0	0.0	No clearing
2020 prior to clearing	4049.0		3064.0	812.0	0.0	0.0	After bushfires, prior to clearing Stage 1
2020 after clearing	4041.9		3064.0	804.9	7.1	0.8	After bushfires, after clearing Stage 1
2022	4039.2		3064.0	802.2	9.8	1.2	After clearing Stage 2
2023 - 2030	4029.4		0.0	4041.9	16.7	0.4	Post-bushfire habitat recovery (DPIE 2020), after clearing Stages 3-6

3.3 Survey results

A total of ten species of mammal, 53 birds, three frogs and one reptile were recorded on site. Rodents and Dasyurids were also recorded on remote cameras, but were not identified to species. Of the target fauna species, only Grey-headed Flying-fox were recorded.

An inventory of fauna species recorded is provided in **Appendix B**.

3.3.1 Remote cameras

No Spotted-tailed Quolls or Southern Brown Bandicoots were detected on remote camera traps over 23 nights in two separate survey events, 2018 (before the Curowan fire), nor 2020 (post the Currowan fire). Notably, Long-nosed Bandicoots (*Parameles nasuta*) were frequently recorded and a noticeable decrease in recordings of European Red Fox (*Vulpes vulpes*).

3.3.2 Spotlighting and call playback

No Greater Gliders or other threatened species were detected in approximately 114 person-hours onsite over 10 nights of survey. Common Brushtail Possums (*Trichosurus vulpecula*) were the most frequent record during spotlighting surveys. Two definite records of Grey-headed Flying Fox (*Pteropus poliocephalus*) calls were made during spotlight surveys.

3.3.3 Bird census

No Swift Parrots, or flocks of typically associated honeyeaters or lorikeets (e.g. Fuscous Honeyeaters, White-naped Honeyeaters, Scarlet Honeyeaters, Little Lorikeets, Musk Lorikeets) were detected.

3.3.4 Nest box inspections

Nest box inspection resulted in the detection of two Common Brushtail Possums, one onsite (BOX 24), and one offsite on the adjacent Crown Land to the west (BOX 75). One incidental records of a deceased Grey-headed Flying Fox was recorded onsite during nest box inspections.

3.3.5 Diurnal habitat searches

Ecoplanning – onsite habitat assessment

Extensive habitat survey including mapping of hollow bearing trees (HBTs) and stags was undertaken as part of the Ecoplanning (2019a) and were not repeated. These surveys determined the habitat to be representative of a relatively mature forest with 51 x HBTs/stags present and a mixed age class of trees present. Within these HBTs, 56 hollows where recorded (2.8 / ha), with only 15 suitable for large arboreal animals (~0.75 / ha). With the exception of a cleared area associated with a former dwelling (demolished in the past 10 years), the vegetation onsite is relatively intact, with all structural layers present.

Ecoplanning – offsite habitat assessment

The GEEBAM was ground-truthed to determine the vegetation condition in the Manyana-Bendalong area including Conjola National Park, following the Currowan fire. Ground-truthing found that Burnt Area Classes 'Low' and 'Medium' still contained habitat for the threatened species assessed, including unburnt and intact canopy and mid-storey, unburnt or regenerating groundcover, and hollow-bearing trees without significant fire damage or evidence of high-intensity fire (e.g. blackened trunks and/or epicormic growth) .

Surveys of the vegetation surrounding the site were undertaken to validate the accuracy of GEEBAM, following the Currowan fire. Surveys aimed to record vegetation condition particularly with respect to habitat attributes considered important to the fauna species assessed herein. The results of vegetation validation surveys are provided in **Figure 3.5** to and **Figure 3.7** and **Appendix C**. Vegetation validation surveys detected significant areas of unburnt canopy and understorey in the area surrounding the site including Conjola National Park (812 ha total estimated remnant habitat). Generally, vegetation validation was able to confirm that Burnt Area Classes 'Low' and 'Medium' still contain significant habitat features for the fauna species assessed, including intact canopy, midstorey and understorey, with evidence of lower intensity fire, which has not affected hollow bearing trees.

ANU – Supplementary habitat assessment

This data has not been requested or provided by ANU.

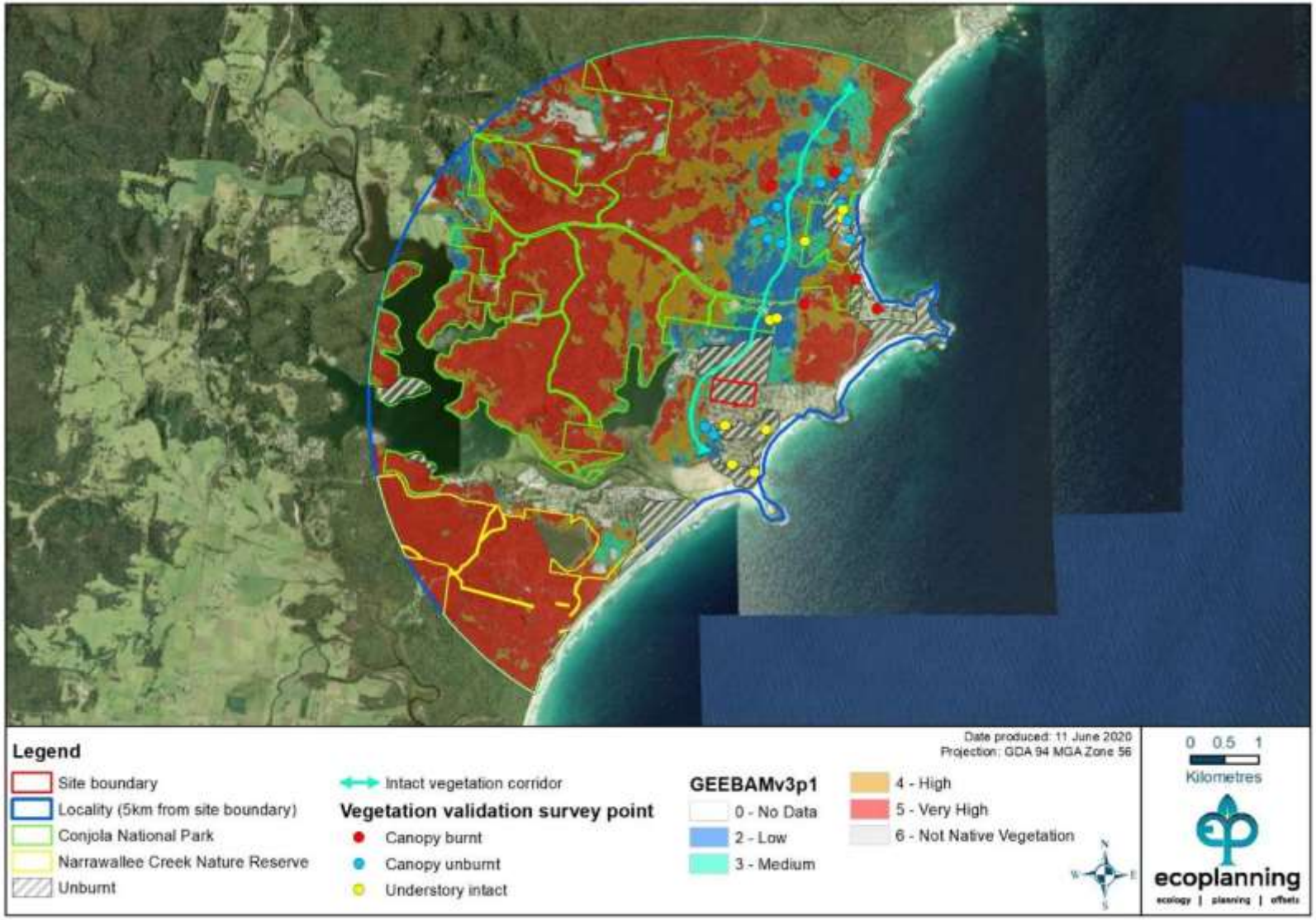

Figure 3.5: GEEBAM (locality), vegetation validation points and intact connectivity corridor of intact bushland remnants

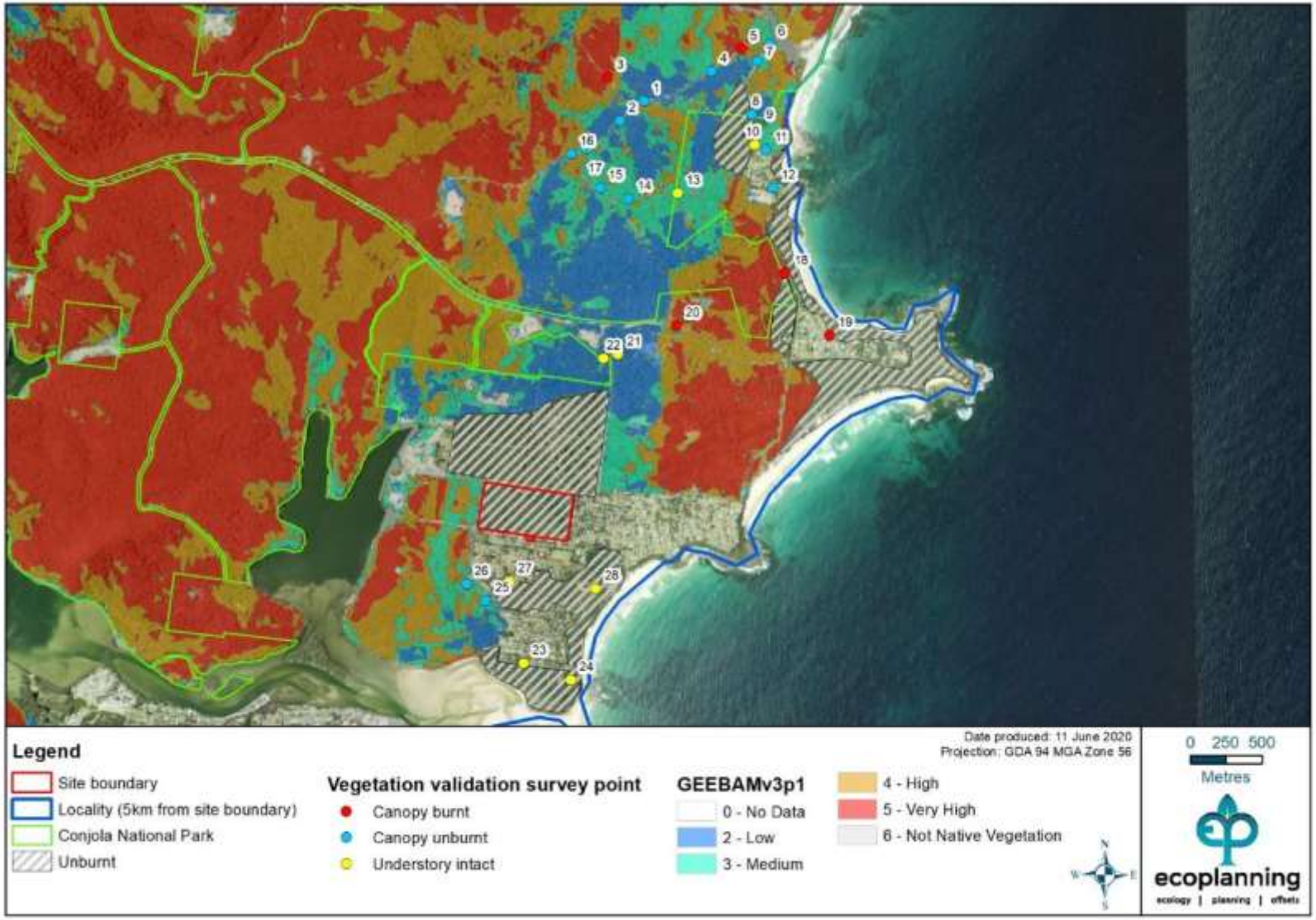

Figure 3.6: GEEBAM vegetation validation with photo ID (refer to Appendix C)

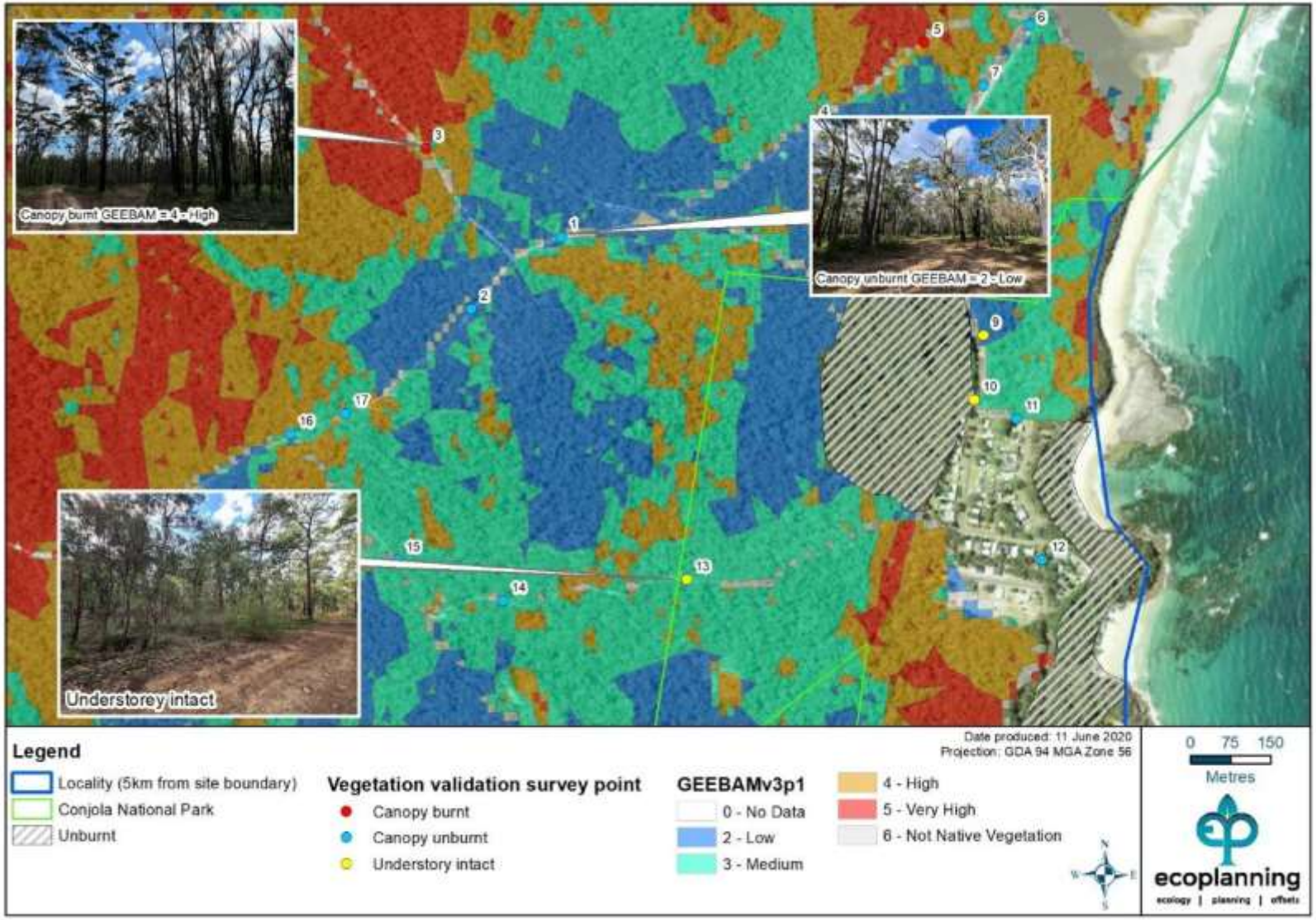

Figure 3.7: GEEBAM vegetation validation representative area

4 MNES assessment

The following sections contain assessments of the species that are the subject of this report, being:

- *Petauroides volans* (Greater Glider) (**Section 5**)
- *Pteropus poliocephalus* (Grey-headed Flying-fox) (**Section 6**)
- *Dasyurus maculatus maculatus* (South-east mainland population) (Spotted-tailed Quoll) (**Section 7**)
- *Isoodon obesulus obesulus* (Southern Brown Bandicoot) (eastern) (**Section 8**)
- *Lathamus discolor* (Swift Parrot) (**Section 9**)
- *Monarcha melanopsis* (Black-faced Monarch) (**Section 10**)

The assessment of each species considers whether the action on site constitutes an impact which is important, or notable, or of consequence, having regard to its context and intensity. In particular, the context of the recent bushfire event has been considered in applying the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DoE 2013), hereafter referred to as 'the MNES significant impact guidelines'. The assessment also considers whether the targeted survey effort for each species carried out by Ecoplanning is sufficient to determine the species' absence from the site, based on the published detectability studies for priority species found in Southwell (2020).

5 Greater Glider

5.1 Field survey

The minimum survey effort recommended to detect Greater Gliders in accordance with Southwell (2020) is five nights of spotlighting to achieve a detection probability of 0.97. Wintle et al. (2005) further states that the Greater Glider's strong eye-shine, propensity to stare at intruders, small home range size (ca. 2 ha), and relatively high population densities (>0.8 individuals/ha), increases the detectability of this species, with spotlighting being the preferred method of survey. Figure 2 of Wintle et al. (2005) is reproduced below to demonstrate the detectability curves and confidence intervals associated with a study conducted in Eden NSW (**Figure 5.1**). In the best detection conditions, the probability of detecting a Greater Glider if present rises to >0.80 after two surveys and >0.95 after four surveys.

Ecoplanning conducted four out of five surveys in favourable detection conditions – calm, moonless early night-time hours, with moderate, above average temperatures (as per Wintle et al 2005) (refer to **Table 5.1** and **Figure 5.2** for weather observations and astronomical information pertaining to the survey period). One survey (21 May 2020) was conducted after light rainfall and prior to a cold front moving through the area which brought high winds that continued into the following day. For the purposes of this assessment, this night of survey is considered to have poor detection conditions (Wintle et al. 2005). Notwithstanding, taking into account the 95% credible intervals on the mean estimates curve for probability of detection of Greater Gliders, it is considered that Ecoplanning's surveys on the site have between a 85% and 97% probability of detecting Greater Glider. Therefore, it was concluded that a population of the Greater Glider does not occupy the site.

In addition to Ecoplanning's surveys, supplementary surveys were undertaken led by ANU and again led by Gaia Research over a further period of five nights. Based on published detectability studies (Wintle et al. 2005), the overall survey effort for the site has a probability of detecting Greater Gliders of >97%.

NPWS surveys of Conjola National Park in 2020 post-bushfires included survey of 13 transects in Conjola National Park (NPWS pers. comm.). Only two Greater Gliders were detected, on Mondayong Road in the north of the park, which is greater than 10 km from the site. The GEEBAM maps the area traversed by Mondayong Road as Burnt Area Class 'Low' or greater along its entire length, with the majority of the area mapped 'Very High'.

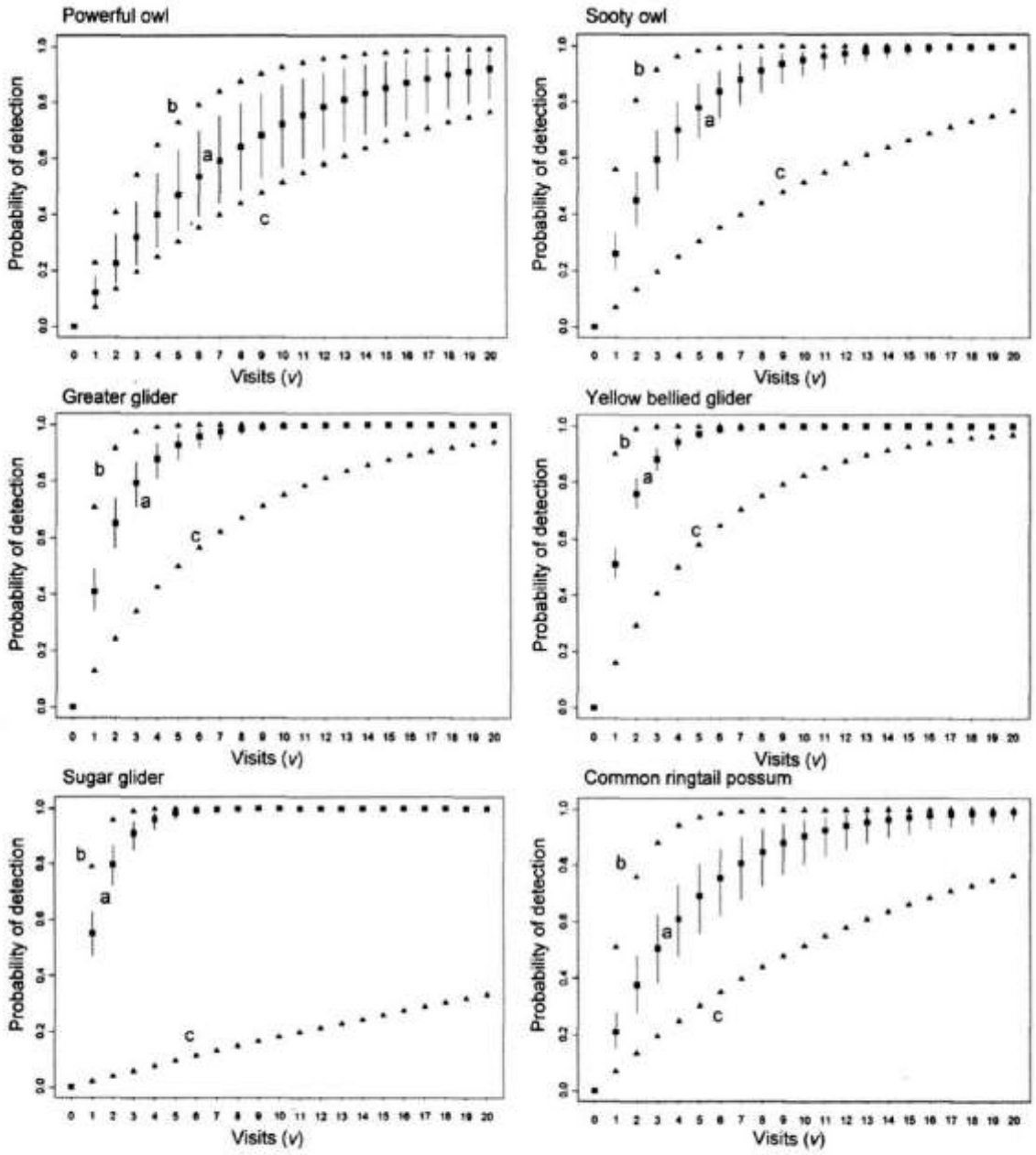

Fig. 2. Detectability curves for 6 species (powerful owl, sooty owl, greater glider, yellow-bellied glider, sugar glider and common ringtail possum) in the Eden region of SE Australia. Curves are based on single-visit detection probabilities estimated from 2001 survey data. Points represent the probability that each species will be detected after *v* visits to a given survey location. Vertical lines represent 95% credible intervals on the mean estimates (curve [a], described by the square symbols). The detectability curves described by solid triangles are based on estimates of the single-visit detection probability (*d*) for best (b) and worst (c) detection conditions encountered.

Figure 5.1: Figure 2 of Wintle et al (2005), which displays detectability curves for 6 fauna species, including Greater Glider

Table 5.1: Weather observations and astronomical information (Ulladulla, NSW)

Date	Temperature Min-Max (°C)	Rainfall (mm)	Wind Max gust (km/h)	Sunset	Moonrise - Moonset
14/5/2020	10.6 – 15.5	45.0	54	17:03	23:27 – 12:54
18/5/2020	12.2 – 18.8	0.6	24	17:01	02:17 – 14:53
19/5/2020	12.4 – 20.5	0	33	17:00	03:11 – 15:19
20/5/2020	15.5 – 23.6	0.8	46	16:59	04:07 – 15:46
21/5/2020	14.3 – 15.9	0.4	70	16:59	05:03 – 16:15
22/5/2020	9.9 – 15.7	25.2	67	16:58	06:00 – 16:47
31/5/2020	13.3 – 21.3	0.8	33	16:54	13:28 – 00:07
1/6/2020	12.8 – 20.2	0.6	52	16:54	14:01 – 01:15
2/6/2020	8.7 – 15.5	1.6	33	16:53	14:34 – 02:24
17/6/2020	No data	0.4	48	16:52	02:53 – 14:16
18/6/2020	No data – 16.7	0.2	28	16:52	03:50 – 14:47

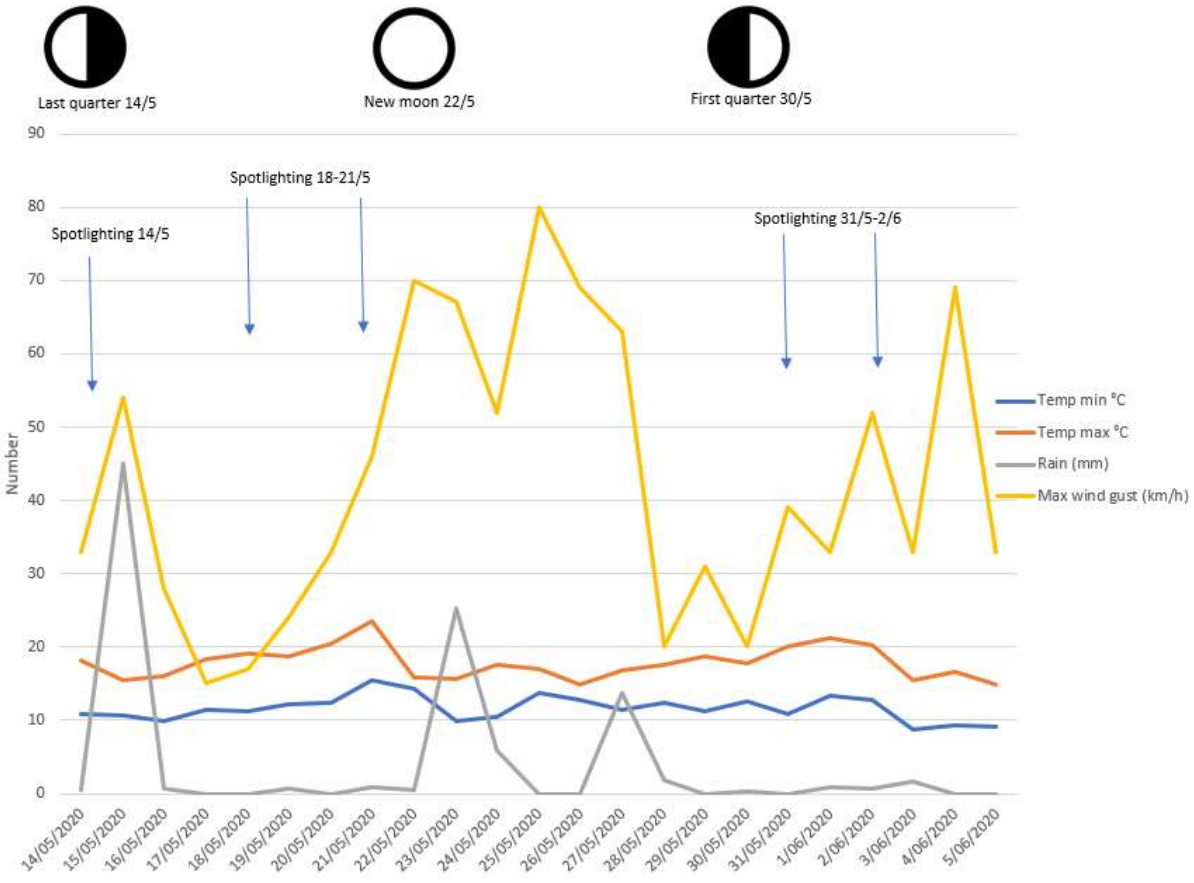

Figure 5.2: Weather conditions and lunar phases during spotlighting surveys

5.2 Previous records

5.2.1 Previous surveys of the site

Greater Gliders have been observed within the site in 2005 by BES (2006), which described this species only as, '*relatively abundant in suitable habitats elsewhere in the locality*'. BES (2006) does not provide further information with regard to Greater Glider occupancy of the site, as the species was not listed under state or Commonwealth legislation at the time of surveys.

5.2.2 BioNet records

Records of this species from Manyana (south of Bendalong Road including the forested lands immediately adjacent to the site) occurred in 2004, 2005, and 2008. Most records in the wider locality (5 km from the site) over this period occurred in 2005, in the North Bendalong area. The only reliable post-2010 record of this species in the Manyana-Bendalong area, or within approximately 5 km of the site, is from west of Pine Street, Bendalong in 2013. Since 2013, there is only one record of the species within 5 km of the site, in 2017, which is located on the edge of the site. Further interrogation of this record finds that it occurred during a one-month period in 2017 during which Swift Parrots, Southern Brown Bandicoots, and Greater Gliders were found on or within 50 m of the site. It is notable that outside of this one-month period, the Swift Parrot had never been recorded in the locality and the Southern Brown Bandicoot had not been recorded in the wild in the locality for the previous 25 years, the most recent record being from the Wildlife Rehabilitation Database, assumed to be a carer in Lake Conjola. The veracity of this record is unclear, with the following sighting notes in the BioNet: '*Encounter broad: Stranded/Unsuitable environment; Encounter narrow: Unsuitable environment'* assumed to be relating to the source of the record, which is the Wildlife Rehab Database and which does not relate to the actual location where the animal was found.

The reliability of the 2017 records are also known to be all from the same observer who lives nearby, and following review of these records by NSW OEH (data holder for BioNet Atlas of NSW Wildlife in 2018), the Southern Brown Bandicoot record had the '*source code changed from sighting to possible ID after review by experts and accountable officer*'. Given the veracity of the Southern Brown Bandicoot sighting and the coincidental timing of these additional sightings, combined with the species ecology (low dispersal ability) and Ecoplanning survey data, the Greater Glider record is considered unreliable.

With the exception of the potentially erroneous 2017 record, the pattern of Greater Glider records in the Manyana-Bendalong area indicates a marked decline in detection of this species from 2010 onwards. While the causes of a decline in detection of a species cannot be determined with certainty, as a number of factors could contribute to a lack of species records in the BioNet database, the decline in detection of Greater Gliders in the Manyana-Bendalong area is temporally similar to population declines in Booderee National Park (approx. 20 km to the north east) reported by Lindenmayer et al. (2011), which Lindenmayer et al. (2018) found could not be anticipated or explained by any clear mechanism.

The pattern of records described above indicates that Greater Gliders may have been common in the locality at the time of the original assessment of the site by BES (2006), however may have become less common in the locality and absent from the site in the intervening period irrespective of the effects of recent bushfires.

5.3 Habitat assessment

The site contains foraging habitat for Greater Gliders in the form of leaves of *Eucalyptus botryoides* and other eucalypt species (Kavanagh and Lambert 1990). Greater Gliders require hollows of a size range >15 cm, and may require 2-4 live den trees for every 2 ha of suitable forest (Eyre 2002). The site contains few, low-quality den trees in the form of tree hollows of a size-class greater than 15 cm (as estimated from ground level). A maximum of 15 trees are estimated to contain suitable denning habitat, across a site that is approximately 20 ha in size.

Recognising the different size classes of hollow entrances preferred by different species is important to evaluate the capacity of forest and woodland areas to cater for the needs of different species (Goldingay 2012). Generally, the Stringybark eucalypt species, Blackbutt, Bangalay, and Turpentine Tree that predominate on site do not produce hollows as readily as Gums (e.g. *Eucalyptus tereticornis* or *E. racemosa*) or some Angophora species. This is supported by observations of similar eucalypt species groups in other regions (Gibbons and Lindenmayer 2002). Most hollows found on site are in Blackbutt, and most are small hollows in dead branches or hollows at the base of smaller broken, dead branches, or fissures or crevices created by broken branches.

While the site was found to contain 51 HBTs containing a total of 56 tree hollows, during comprehensive systematic HBT surveys (Ecoplanning 2018), or approximately 2.8 hollows / ha, the density of tree hollows suitable for the Greater Glider (or other large arboreal fauna) is approximately 0.75 hollow / ha. Goldingay (2012) reports Greater Glider mean den use of 3.1 to 11 separate hollows, use of 4 to 6 dens per month, over a small home range of 1.2-4.1 ha, with larger home ranges recorded in Queensland of up to 19.3 ha. Typically, 4 to 20 different dens are used by individuals within their home range (Comport et al. 1996; Smith et al. 2007). In the Grafton/Casino area, Greater Gliders were found to be absent from sites with less than 6 tree hollows / ha (Smith et al. 1994) and in southern Queensland Greater Gliders were found to require at least 2–4 live den trees for every 2 ha of suitable forest habitat (Eyre 2002). Therefore, in consideration of this species' requirement for a large number of denning sites (tree hollows of a suitable size), the site constitutes poor-quality denning habitat.

5.4 Population significance

An 'important population' is defined under the *Matters of National Environmental Significance: Significant impact guidelines 1.1* (Department of Environment 2013) as a population that is necessary for a species' long-term survival and recovery. The guidelines enumerate several criteria for determining an important population, which are considered below in relation to the Greater Glider:

- *populations identified as such in recovery plans*

No Greater Glider populations are identified as 'important populations', or implied as such, in a published recovery plan for the species. Two Endangered Populations of this species are

listed under the NSW *Biodiversity Conservation Act 2016* (BC Act); the Greater Glider population in the Eurobodalla local government area and the Greater Glider population in the Seven Mile Beach National Park area. The Greater Glider population in the Manyana-Bendalong area is not part of either of these populations.

- *key source population for either breeding or dispersal*

The site does not represent a key source population for breeding or dispersal following the 2019-20 bushfires. A population of Greater Gliders does not currently occur on site and therefore cannot constitute a source for later dispersal into surrounding fire-affected lands. Moreover, the site contains a low number of suitable denning hollows for this species, particularly in consideration of the species' requirements for large hollows in large mature trees (Goldingay 2012) and requirement for access to cavities in a range of different trees as part of den-swapping behaviour (Lindenmayer et al. 2004). An estimate of the maximum number of suitable hollows present on site is 15, based on attributes described in Goldingay (2012). Therefore, the site is unlikely to be capable of supporting a source population for breeding or dispersal of Greater Gliders.

- *populations that are necessary for maintaining genetic diversity, and/or*

A population of Greater Gliders does not currently occur on site; therefore, the site does not contain a population that could maintain genetic diversity of this species. No genetic studies have been conducted on Greater Gliders in the Manyana-Bendalong area and, therefore the distinctiveness of the population occurring in the locality is unknown. However, based on the location of Manyana in the centre of the species' range, in an area of contiguous forests extending at least as far north as the Southern Highlands and south into Victoria, and in a location that is not known to be an area of refugia over evolutionary time scales, the likelihood that the locality contains a genetically distinct population segment of this species is low.

- *populations that are near the limit of the species range.*

Manyana is near the centre of the species' range. Greater Gliders occur across eastern Australia from the Windsor Tableland in north Queensland to central Victoria.

5.5 Habitat critical to survival of species

Habitat critical to the survival of a species or ecological community is defined under the *Matters of National Environmental Significance: Significant impact guidelines 1.1* (Department of Environment 2013) using a number of criteria, which are considered below in relation to the Greater Glider:

- *necessary for activities such as foraging, breeding, roosting, or dispersal*

The site is not currently utilised by Greater Gliders for foraging, breeding, roosting, or dispersal (refer to **Section 5.1** and **5.2**). While the site contains foraging resources for Greater Gliders, the resource available, leaves of eucalypt species, is abundant in the surrounding locality despite the extensive recent bushfires. The site contains only poor-quality roosting, or denning, habitat (refer to **Section 5.3**). In the absence of adequate denning habitat, the site is unlikely to support a breeding population. Contemporary surveys included survey of forested

lands adjacent to and surrounding the site and in the wider locality. Surveys failed to detect Greater Gliders. Moreover, the pattern of records described in **Section 5.2** indicates a possible decline in Greater Gliders in the locality. Therefore, Greater Gliders, if present, do not occur at high densities in the locality currently, and the potential for dispersal into the site from surrounding resource-limited areas of occupation is low. Therefore, the habitat on site does not represent habitat necessary for activities such as foraging, breeding, roosting, or dispersal.

- *necessary for the long-term maintenance of the species or ecological community (including maintenance of species essential to the survival of the species or ecological community, such as pollinators)*

The site is not currently occupied by a population of Greater Gliders (refer to **Section 5.1**). The long-term maintenance of the species within the locality is provided by extensive areas of habitat in the surrounding Conjola National Park. While much of the potential Greater Glider habitat in national park lands has been affected by the 2019-20 summer bushfires, over the long-term, the post-fire succession of vegetation communities in national park lands will provide habitat for the long-term maintenance of the species.

- *necessary to maintain genetic diversity and long term evolutionary development, or*

A population of Greater Gliders does not currently occur on site; therefore, the site does not contain a population that could maintain genetic diversity of this species. No genetic studies have been conducted on Greater Gliders in the Manyana-Bendalong area and therefore the distinctiveness of the population occurring in the locality is unknown. However, based on the location of Manyana in the centre of the species' range, in an area of contiguous forests extending at least as far north as the Southern Highlands and south into Victoria, and in a location that is not known to be an area of refugia over evolutionary time scales, the likelihood that the locality contains a genetically distinct population segment of this species is low.

- *necessary for the reintroduction of populations or recovery of the species or ecological community.*

Captive breeding populations of Greater Gliders are not well established and reintroduction programs are not likely to be undertaken in the near-term, or anywhere in the locality, specifically following the summer 2019-20 bushfires. Therefore, the site is not necessary for the reintroduction of populations or recovery of this species.

- *habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or*

No areas of critical habitat for this species are currently identified in a recovery plan.

- *habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.*

No areas of critical habitat for this species are currently listed on the Register of Critical Habitat.

5.6 Impact assessment

The Greater Glider was not listed under the EPBC Act at the time of BES (2006) assessments. Listing of this species as 'vulnerable' under the EPBC Act occurred 2 May 2016. This species was not listed under the TSC Act at the time of BES assessment, and still remains unlisted under the BC Act, when the TSC Act was repealed. Therefore, BES (2006) did not survey for or assess impacts to this species under any legislation.

To assess the likelihood of a significant impact to the Greater Glider, an assessment in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1* (DoE 2013) is required. In a letter prepared for the Commonwealth Dept. of Environment (Ecoplanning 2018a), an assessment against these guidelines concluded:

'A referral is not recommended for the Greater Glider, as:

- *the proposal would not adversely affect critical habitat*
- *the proposal is unlikely to cause the species to decline*
- *the proposal is unlikely to substantially interfere with the recovery of the species'*

In letter correspondence received on 14 August 2018 from the DoE, the Department did not '*consider a referral is warranted for potential impacts on MNES*'.

To determine if this assessment was still current following the Currowan fire, an additional assessment has been made based on site information contained in BES (2006) and Ecoplanning (2018a, 2018b and 2019b), as well as the current site survey and habitat assessment.

Under the EPBC Act, an action is considered likely to have a significant impact on a 'vulnerable' species if there is a real chance or possibility that it will impact an 'important population', which is defined as follows in DoE (2013), and discussed above. The criteria in the MNES Guidelines are as

- *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 species*
- *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, 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.*

Responses to each of these criteria are provided below.

- *Lead to a long-term decrease in the size of an important population of a species*

A population of this species does not currently occur on the site, as determined by systematic survey (refer to **Section 5.1**). A population were it to have occurred on site prior to the 2019-

20 bushfires, would not constitute an important population of this species as defined under Commonwealth guidelines (refer to **Section 5.4**). Therefore, the proposed action will not lead to a long-term decrease in the size of an important population of Greater Gliders.

- *Reduce the area of occupancy of an important population of a species*

The site is not currently occupied by Greater Gliders (refer to **Section 5.1**). The site has not previously supported an important population of Greater Gliders as defined under Commonwealth guidelines (refer to **Section 5.4**). Therefore, the proposed action will not reduce the area of occupancy of an important population of Greater Gliders.

- *Fragment an existing important population into two or more populations*

The proposed action will not fragment a population of Greater Gliders into two or more populations. The proposed action will expand the residential area of Manyana without creating additional barriers to movement to Greater Gliders or any other species within the wider landscape. Therefore, the proposed action will not fragment an existing population into two or more populations.

- *Adversely affect habitat critical to the survival of a species*

An assessment of habitat on site in relation to 'habitat critical to the survival of a species or ecological community' as defined in the MNES significant impact guidelines is provided in **Section 5.4**. The proposed action will not affect habitat critical to the survival of this species.

- *Disrupt the breeding cycle of an important population*

The site is not currently occupied by Greater Gliders (refer to **Section 5.1**). The site has not previously supported an important population, nor is it likely to support one in the future (refer to **Section 5.4**). The site contains a low number of denning hollows which could support a breeding population of Greater Gliders. Therefore, the proposed action will not disrupt the breeding cycle of an important population.

- *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposed action will remove approximately 17.18 ha of vegetation, comprising 5.39 ha of Bangalay Moist Woodland Open Forest and 10.79 ha of Northern Coastal Sands Shrub/Fern Forest, all of which is considered potential foraging and/or low-quality denning habitat for this species. It is notable that 3.45 ha of the total 20.4 ha of native vegetation is being retained onsite, which includes Greater Glider favoured food tree, *Eucalyptus botryoides*. The estimated area of occupancy of this species is 1,616,400 ha (TSSC 2016). The estimated overlap of the 2019-20 summer bushfires with this species' range is 29 % (DAWE 2020b). Despite the reduction in area of occupancy of this species caused by the 2019-20 summer bushfires, the removal of habitat on site is considered low by comparison to the broad extent of this species' habitat.

- *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

The proposal has the potential to result in the spread of weed species into retained areas of this species' habitat on site (the retained Bushland Reserve containing the Bangalay Paperbark Woodland EEC). The Flora and Fauna Management Plan (Ecoplanning 2019b) has been prepared to mitigate this impact. Notwithstanding, the impact of introduced weed species on this species or its habitat is considered to be minimal.

- *Introduce disease that may cause the species to decline, or*

The proposal is unlikely to result in the introduction of disease that may cause decline of Greater Glider. There is potential for disease caused by the soil-borne plant pathogen *Phytophthora cinnamomi* to occur in the study area as a result of the proposal. This pathogen could impact on the vegetation communities that could support foraging and breeding habitat for this species. Control of transportation of the pathogen would occur by controlling soil transportation into the study area. The Environmental Management Plan (Ecoplanning 2019a) and Flora and Fauna Management Plan (Ecoplanning 2019b) include measures to reduce the risk of introduction of soil-borne pathogens into the site. The proposal is, therefore, not likely to introduce disease that may cause this species to decline within the locality.

- *Interfere substantially with the recovery of the species.*

A population of Greater Gliders does not currently occur on the site (refer to **Section 5.1**). The site contains only poor-quality denning habitat for this species (refer to **Section 5.2**). The proposed action is, therefore, unlikely to interfere substantially with the recovery of this species in the locality following the 2019-20 summer bushfires.

5.7 Conclusion

Greater Gliders do not occur on site. The site does not support a population of Greater Gliders. The habitat found on site, while capable of supporting Greater Gliders, is not likely to support a population of Greater Gliders until such time as the local population, if a local population still occurs in the Manyana-Bendalong area including Conjola National Park, is recovering and expanding its range. Moreover, the habitat found on site represents poor-quality Greater Glider habitat due to the low availability of suitable hollows. The site is, therefore, not likely to represent an important area of future occupation for this species, given the availability of habitat elsewhere in the locality which is capable of supporting Greater Gliders following vegetation succession and recovery from the 2019-20 bushfire event.

Any recovery of the local population of this species is likely to occur relatively slowly, over a period of many years, owing to the species low reproductive rate (Henry 1984), low dispersal ability (Kavanagh & Webb 1989), and slow recovery following major disturbance (Kavanagh 2004). Therefore, it is likely that suitable habitats within Conjola National Park will have recovered to a condition capable of supporting Greater Gliders at such time when the local population is recovering and expanding spatially. Moreover, suitable habitats which were not significantly impacted by the Currowan fire were observed within Conjola National Park (refer to **Figure 3.6** and **Appendix C**) and off-site spotlighting surveys of these unburnt or low-intensity fire affected areas of Conjola National Park did not detect Greater Gliders. Therefore, these areas represent a suitable, intact area of future expansion for the species which does not appear to be currently occupied by a large population (based on failure to detect the

species over one night of survey). On this basis, the site is not likely to provide important habitat for this species in the interim time period during which fire-affected habitats in the locality recover from the Currowan fire.

Due to the lack of Greater Gliders on site, and the poor-quality habitat on site which is not significant to this species' recovery following the 2019-20 bushfires, a significant impact to this species is not likely to occur as a result of the proposed action and a referral is not recommended.

6 Grey-headed Flying-fox

6.1 Field survey

Small numbers (one individual heard on each of two night's survey) of Grey-headed Flying-foxes were recorded foraging on the site during nocturnal surveys. One dead Grey-headed Flying-fox was found opportunistically on site.

6.2 Previous records

6.2.1 Previous surveys of the site

BES (2006) did not record Grey-headed Flying-foxes on site.

6.2.2 BioNet Atlas records

Grey-headed Flying-foxes are recorded widely along the south coast of NSW, including the area from Ulladulla to Sussex Inlet, with records in the Manyana, Bendalong, and Lake Conjola areas. These records likely relate to sightings of foraging individuals or groups.

6.2.3 Roost camp records

The nearest roost camp record is at Yatte Yattah (DAWE 2020). No roost camps are found on site or in the wider locality.

6.3 Habitat assessment

The site contains foraging habitat in the form of flowering eucalypts, paperbarks, and other tree and shrub species. Trees such as Lilly Pilly (*Acmena smithii*) are found in the Bangalay Moist Woodland/Open Forest and provide fruits on which this species may feed. A roost camp is not currently found on site. Community liaison conducted during surveys indicates that the site is not known to have previously contained a roost camp. Individuals foraging on site likely roost in camps up to 20 to 50 km from the site (Van Dyck and Strahan 2008).

6.4 Population significance

Due to the high mobility and regular genetic exchange of Grey-headed Flying-foxes through the species' entire geographic range, all individuals are considered part of one population. The population is divided into spatially structured colonies (DoEE 2020). The site represents potential foraging habitat utilised by the local colony (roost camp) of Grey-headed Flying-foxes, likely individuals from the Yatte Yattah area or other nearby colonies. With respect to the definition of an important population under MNES significant impact guidelines, the individuals of the local population foraging site are assessed as follows:

- *populations identified as such in recovery plans*

The population in the Manyana area, or more broadly in the Shoalhaven LGA or surrounding region, has not been identified as an important population in recovery plans.

- *key source population for either breeding or dispersal*

The site is used only by foraging individuals and, therefore, does not support a key source population for either breeding or dispersal.

- *populations that are necessary for maintaining genetic diversity, and/or*

The entire population of Grey-headed Flying-foxes within Australia is likely to exchange genetic material owing to the species high dispersal capability, and the site is not likely to support a population that is necessary for maintaining genetic diversity of this species.

- *populations that are near the limit of the species range.*

Manyana is located near the centre of this widely occurring species' range.

6.5 Habitat critical to survival of species

The site does not represent habitat critical to the survival of this species. An assessment against critical habitat as defined in the MNES significant impact guidelines is provided below:

- *necessary for activities such as foraging, breeding, roosting, or dispersal*

The site is not necessary for breeding, roosting, or dispersal of this species. The site is utilised for foraging, however, large areas of foraging habitat occur in the locality, including areas of canopy unaffected by the Currowan fire (refer to **Figure 3.5**).

- *necessary for the long-term maintenance of the species or ecological community (including maintenance of species essential to the survival of the species or ecological community, such as pollinators)*

The site represents intermittently used foraging habitat for individuals occurring in the locality and is not necessary for the long-term maintenance of the species.

- *necessary to maintain genetic diversity and long term evolutionary development, or*

The site is not necessary for maintaining the genetic diversity and long term evolutionary development of this highly mobile, broadly ranging species.

- *necessary for the reintroduction of populations or recovery of the species or ecological community.*

The site does not contain habitat necessary for the reintroduction or recovery of this species. The surrounding locality contains suitable foraging habitat in the form of fruit and blossom producing canopy tree species unaffected by the 2019-20 bushfires.

- *habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or*

No habitat critical for the survival of this species has been identified in a recovery plan.

- *habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.*

No habitat critical for the survival of this species has been listed on the Register of Critical Habitat.

6.6 Impact assessment

To assess the likelihood of significant impact, the MNES significant impact guidelines have been applied and assessments made based on site information contained in BES (2006), Ecoplanning (2018a), Ecoplanning (2018b), and Ecoplanning (2019b) as well as the current site survey and habitat assessment. Responses to each of the criteria for determining significant impact on a vulnerable species are provided below.

- *Lead to a long-term decrease in the size of an important population of a species*

The removal of a relatively small area (when compared to the species broad range and high mobility) of intermittently used foraging habitat for this species is not likely to lead to a decrease in the size of the local population of this species. Moreover, the local population of this species does not constitute an important population (refer to **Section 6.4**).

- *Reduce the area of occupancy of an important population of a species*

While the site is intermittently utilised by foraging individuals of this species, the site is not likely to support an important population of this species. This species is likely to continue utilising retained vegetation on site and in the surrounding locality following development activity on the site. Therefore, the proposal will not reduce the area of occupancy of an important population of this species.

- *Fragment an existing important population into two or more populations*

The proposed action will not fragment a population of Grey-headed Flying-foxes into two or more populations.

- *Adversely affect habitat critical to the survival of a species*

An assessment of habitat on site in relation to 'habitat critical to the survival of a species' is provided in **Section 6.5**. The proposal will not affect habitat critical to the survival of this species.

- *Disrupt the breeding cycle of an important population*

The site is not occupied by a roost camp of this species. Breeding does not occur on site and the proposal will, therefore, not interrupt the breeding cycle of this species. Moreover, the site does not support an important population of this species (refer to **Section 6.4**).

- *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposed action will remove approximately 17.18 ha of vegetation. This broad ranging species is not likely to decline due to the removal of this small area of intermittently used foraging habitat.

- *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

The proposal has the potential to result in the spread of weed species into retained areas of vegetation on site, however, Ecoplanning (2019a) and Ecoplanning (2019b) specify mitigation measures to be implemented on site to mitigate this impact. Moreover, the establishment of weeds would not affect the canopy trees on which this species feeds such that this species would become unlikely to utilise the site or surrounding locality for foraging.

- *Introduce disease that may cause the species to decline, or*

There is potential for disease caused by the soil-borne plant pathogen *Phytophthora cinnamomi* to occur in the study area as a result of the proposal. This pathogen could impact on the vegetation communities that could support foraging and breeding habitat for this species. Control of transportation of the pathogen would occur by controlling soil transportation into the study area. The Environmental Management Plan (Ecoplanning 2019a) and Flora and Fauna Management Plan (Ecoplanning 2019b) include measures to reduce the risk of introduction of soil-borne pathogens into the site. The proposal is unlikely to result in the introduction of disease that may cause decline of this species.

- *Interfere substantially with the recovery of the species.*

The removal of a small area of intermittently used foraging habitat is not likely to interfere substantially with the recovery of this species.

7 Spotted-tailed Quoll

7.1 Field survey

Southwell (2020) recommends a minimum survey effort for Spotted-tailed Quolls of 1-4 remote cameras per km² deployed over 3 weeks to achieve a cumulative detection probability of >0.80; or, 12.6 camera-nights to achieve a detection probability of 0.95 when using 5 baited cameras. During 2018 and 2020 surveys, 9-10 remote cameras, an equivalent effort to 44 cameras per km², were deployed on site over a period totalling approximately 4.5 weeks, or approximately 300 camera-nights. Remote cameras were baited with universal bait modified by the addition of mushrooms or truffle oil. No Spotted-tailed Quolls were detected during the survey period.

Field surveys conducted for this assessment are sufficient to confirm that the site is not currently utilised by Spotted-tailed Quolls.

7.2 Previous records

7.2.1 Previous surveys of the site

Spotted-tailed Quolls have not been previously recorded on site.

7.2.2 BioNet Atlas records

One BioNet record exists for the Manyana area, in relation to community surveys and with an approximate record date in the mid-2000s. More recent records of this species occur north of the site in Berrara (approximately 6 km from site) in 2015 and on Bendalong Road near the intersection of Bendalong Mountain Road (approximately 5.5 km from site) in 2019. Based on these records, this species is likely to occur in the Conjola National Park area north of the site.

7.3 Habitat assessment

This species occurs across a wide range of habitat types (DoE 2016), including forests and woodlands such as those occurring on site. Hollow bearing trees and fallen logs were found on site and constitute potential den sites. Prey in the form of small rodents, dasyurids, bandicoots, and possums were recorded frequently on remote cameras on site.

7.4 Impact assessment

To assess the likelihood of significant impact, the MNES significant impact guidelines have been applied and assessments made based on site information contained in BES (2006), Ecoplanning (2018a), Ecoplanning (2018b), and Ecoplanning (2019b) as well as the current site survey and habitat assessment. Responses to each of the criteria for determining significant impact on an endangered species are provided below.

- *Lead to a long-term decrease in the size of a population*

The removal of a relatively small area (when compared to the species broad range and habitat preferences) of habitat which is not currently utilised by this species is not likely to lead to a decrease in the size of the local population of this species.

- *Reduce the area of occupancy of the species*

While the site could potentially be utilised this species, the site is not likely to support an important population of this species and the site does not currently support any Spotted-tailed Quolls. Due to this species' large home range (200–4000 ha) the site could only form a small part of the home range of any local individuals. This species is likely to continue utilising retained vegetation on site and in the surrounding locality following development activity on the site. Therefore, the proposal will not reduce the area of occupancy of an important population of this species.

- *Fragment an existing population into two or more populations*

The proposed action will not fragment a population of Spotted-tailed Quolls into two or more populations. The proposal will expand on the existing residential area of Manyana without creating barriers to movement in the wider landscape.

- *Adversely affect habitat critical to the survival of a species*

The proposal will not affect habitat critical to the survival of this species. The proposal will impact 20 ha of habitat which could only represent a small part of the home range of any individuals in the locality, and the staged impact will remove only a small proportion of the available intact habitat in the locality (refer to **Table 3.1**). Therefore, this habitat is not critical to the survival of any individuals of this species or the species more broadly.

- *Disrupt the breeding cycle of an important population*

The site is not currently utilised by this species. The proposal will impact a small area of habitat compared to the home range of this species. Therefore, the proposal will not disrupt the breeding cycle of this species.

- *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposed action will remove approximately 17.18 ha of vegetation. The home range of this species is from 200–4000 ha. The removal of habitat on site will not significantly impact any individuals occurring in the locality or the species more broadly such 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 critically endangered or endangered species' habitat*

The proposal has the potential to result in the spread of weed species into retained areas of vegetation on site, however Ecoplanning (2019a) and Ecoplanning (2019b) specify measures

to be implemented on site to mitigate this impact. Moreover, the establishment of weeds would not affect foraging or denning habitat for this species such that this species would become unlikely to utilise the site or surrounding locality.

- *Introduce disease that may cause the species to decline, or*

There is potential for disease caused by the soil-borne plant pathogen *Phytophthora cinnamomi* to occur in the study area as a result of the proposal. This pathogen could impact on the vegetation communities on site, however would be unlikely to cause this species' decline. Control of transportation of the pathogen would occur by controlling soil transportation into the study area. The Environmental Management Plan (Ecoplanning 2019a) and Flora and Fauna Management Plan (Ecoplanning 2019b) include measures to reduce the risk of introduction of soil-borne pathogens into the site. The proposal is unlikely to result in the introduction of disease that may cause decline of this species.

- *Interfere substantially with the recovery of the species.*

The removal of a small area of potential habitat that is not currently utilised by this species is not likely to interfere substantially with the recovery of this species.

8 Southern Brown Bandicoot (eastern)

8.1 Field survey

Applying the *Commonwealth Survey guidelines for Australia's threatened mammals* (DSEWPaC 2011), the following survey techniques were employed to detect the presence of Southern Brown Bandicoots on site:

- *daytime searches for potentially suitable habitat, such as areas with a dense understorey and thick groundcover, perhaps focussing on areas where fire has produced a mosaic of habitats that vary according to the time since burning (description of the survey technique and recommended effort is outlined in Section 3.1)*

Potentially suitable habitat was identified in the Bangalay Paperbark Woodland, Northern Coastal Sands Shrub/Fern Forest, and Bangalay Moist Woodland Open Forest on site. In particular, areas of Bangalay Moist Woodland Open Forest in the north east of the site have a dense groundcover of *Gahnia* spp., dense mesic understorey, and vine thickets considered likely to provide cover and diurnal shelter for bandicoot species.

- *daytime searches for signs of activity, including tracks, scats, nests and diggings (description of the survey technique and recommended effort is outlined in Section 3.2). However, where the southern brown bandicoot occurs in sympatry with other bandicoot species, direct detection techniques should be used to distinguish between the species*

Bandicoot diggings were observed frequently throughout the site; however, could not be used to identify bandicoots to species level. One bandicoot was observed as it flushed from dense *Gahnia* spp. in the north east of the site; however, this individual was sighted very briefly while in flight and could not be located as it moved rapidly into dense undergrowth. A positive identification could not be made on this basis.

- *spotlight surveys conducted according to the description of the technique and the recommended effort provided in Section 3.3.3*

Spotlighting surveys were conducted according to the recommended technique and effort. In addition to the observation noted above, one Long-nosed Bandicoot was sighted in a burnt area of crown lands 400 m to the south of the site.

- *baited camera traps using universal bait (description of the survey technique is outlined in Section 3.3.6) using one camera per hectare. Autumn is preferred, but can be year round if validated with supporting evidence. A minimum of two surveys, each of 14 day duration, should be conducted, timed at least one month apart and at least one undertaken following significant rainfall*

Camera traps were baited with universal bait which was also supplemented with truffle oil and mushrooms, in Autumn (March 2018 and May 2020).

Ten (10) camera traps were deployed across the eastern 2/3 of the site in Coastal Sands Shrub/Fern Forest and Bangalay Moist Woodland Open Forest, corresponding to the areas of

Stage 1 development impact and to greatest bandicoot activity observed respectively. While the recommended density of 1 camera per hectare was not achieved over the site as a whole, within the area of impact and most likely occupancy of bandicoots (based on observations of diggings, diurnal observation of a bandicoot flushed from dense *Gahnia* spp. tussocks, previous "possible ID" record from 1 The Companionway, Manyana in the BioNet database, and more suitable habitat in the form of denser understorey and groundcover), the camera density was approximately 1 camera per 1.3 ha.

Two separate camera trap deployments, in 2018 and 2020, were conducted and each was at least 14 days duration. Camera traps were in place from 12-29 March 2018, and again from 14-27 May 2020. This corresponds with the recommended Autumn period.

Camera traps were deployed in 2020 following significant rainfall – 45 mm rain fell in Ulladulla on 14 May 2020, 94 mm of rainfall over the 14 day period of camera deployment, 612.2 mm over the four month late summer-autumn period prior to camera deployment (source: BOM 2020).

- community liaison to detect the location of additional populations of the species

Community liaison informally undertaken during Ecoplanning surveys indicated that many local residents were aware of the presence of bandicoots in the locality, however identification to species level (i.e. Southern Brown Bandicoot versus Long-nosed Bandicoot) was not possible.

8.2 Previous records

8.2.1 Previous surveys of the site

This species has not been detected on site during previous surveys of the site.

8.2.2 BioNet Atlas records

The nearest reliable record of this species is from Nemingillah Ecology Centre in 1993, which is 3.5 km from the site. A contemporary record from the site at 1 The Companionway, Manyana, is recorded in BioNet Sighting Notes as '*Source code changed from sighting to possible ID after review by experts and accountable officer*.' Consultation with the accountable officer and further community liaison conducted by Ecoplanning has cast further doubt on the veracity of this record. Notwithstanding, using the precautionary approach and assuming presence based on this 2017 record, camera trapping surveys were conducted over a total of 29 nights during two separate trapping events and within 100 m of this record are considered sufficient to determine that Southern Brown Bandicoots are not present in the vicinity of this record, or anywhere on site, at the present date.

Other BioNet records of Southern Brown Bandicoot in the wider region include one record from Lake Conjola in 2015 and one from Ulladulla in 2017, both of which are sourced from the Wildlife Rehab Database and include the following Sighting Notes respectively, '*Encounter broad: Stranded/Unsuitable environment; Encounter narrow: Unsuitable environment*', and '*Encounter broad: Abandoned/Orphaned/Nestling; Encounter narrow: Abandoned/Orphaned*'. As such, the exact location from which the possible Southern Brown Bandicoot individuals have originated is unknown.

The current known range of the Southern Brown Bandicoot in NSW extends along the coastal fringe from the Hawkesbury River to the south east corner of the state. It primarily occurs in two areas – Ku-ring-gai Chase and Garigal National Park north of Sydney and the far south east corner of the state including Ben Boyd National Park, East Boyd State Forest, Nadgee Nature Reserve, Nadgee State Forest, South East Forest National Park, and Yambulla State Forest (DAWE 2020d). Naturally occurring NSW populations are not known to currently persist outside these two locations (Andrew Claridge, Senior Threatened Species Officer, Dept. Planning, Industry and Environment, 2018). Southern Brown Bandicoots have been reintroduced into Booderee National Park, approximately 20 km north of the site. They have been found to be successfully breeding at this site, however it is unlikely that individuals have moved great distances across the landscape (TSRH 2017), including significant barriers to movement such as Sussex Inlet and St Georges Basin. Therefore, the site is well outside the current known range of this species.

8.3 Habitat assessment

Potentially suitable habitat was identified in the Bangalay Paperbark Woodland, Northern Coastal Sands Shrub/Fern Forest, and Bangalay Moist Woodland Open Forest on site. In particular, areas of Bangalay Moist Woodland Open Forest in the north east of the site have a dense groundcover of *Lomandra* spp., *Gahnia* spp. and grasses, a dense mesic understorey, and vine thickets considered likely to provide cover and diurnal shelter for bandicoot species.

8.4 Impact assessment

To assess the likelihood of significant impact, the MNES significant impact guidelines have been applied and assessments made based on site information contained in BES (2006), Ecoplanning (2018a), Ecoplanning (2018b), and Ecoplanning (2019b) as well as the current site survey and habitat assessment. Responses to each of the criteria for determining significant impact on an endangered species are provided below.

- *Lead to a long-term decrease in the size of a population*

A population of his species does not currently occur on site. The proposal will not lead to a decrease in the size of a population.

- *Reduce the area of occupancy of the species*

The site is not currently occupied by this species. The proposal will not reduce the area of occupancy of this species.

- *Fragment an existing population into two or more populations*

The proposed action will not fragment a population of Southern Brown Bandicoots into two or more populations. The proposal will expand on the existing residential area of Manyana without creating barriers to movement in the wider landscape.

- *Adversely affect habitat critical to the survival of a species*

The proposal will not affect habitat critical to the survival of this species. The proposal will impact approximately 17.18 ha of habitat which is not currently utilised by these species. This species is not known to occur in the wider locality surrounding the site. Therefore, this habitat is not critical to the survival of any individuals of this species or the species more broadly.

- *Disrupt the breeding cycle of an important population*

The site is not currently utilised by this species. The proposal will impact a small area of habitat which is not currently occupied by this species. Therefore, the proposal will not disrupt the breeding cycle of this species.

- *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposed action will remove approximately 17.18 ha of vegetation. The habitat to be removed on site will not significantly impact the species such that the species is likely to decline, as no population is known to occur in the locality.

- *Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat*

The proposal has the potential to result in the spread of weed species into retained areas of vegetation on site, however Ecoplanning (2019a) and Ecoplanning (2019b) specify measures to be implemented on site to mitigate this impact. Moreover, the establishment of weeds would not affect foraging or denning habitat for this species such that this species would become unlikely to utilise the site or surrounding locality. The European Fox (*Vulpes vulpes*) and feral cat (*Felis catus*) are known key threats to this species (NPWS 2001; DEC 2006). Both these species are already established in the locality and European Foxes were recorded on site on the remote camera surveys.

- *Introduce disease that may cause the species to decline, or*

There is potential for disease caused by the soil-borne plant pathogen *Phytophthora cinnamomi* to occur in the study area as a result of the proposal. This pathogen could impact on the vegetation communities on site, however would be unlikely to cause this species' decline. Control of transportation of the pathogen would occur by controlling soil transportation into the study area. The Environmental Management Plan (Ecoplanning 2019a) and Flora and Fauna Management Plan (Ecoplanning 2019b) include measures to reduce the risk of introduction of soil-borne pathogens into the site. The proposal is unlikely to result in the introduction of disease that may cause decline of this species.

- *Interfere substantially with the recovery of the species.*

The removal of a small area of potential habitat that is not currently utilised by this species is not likely to interfere substantially with the recovery of this species.

9 Swift Parrot

9.1 Field survey

A total of 15.3 person-hours of bird census surveys targeting this species were undertaken in May-June 2020, as well as at least 16 days on site opportunistically recording bird species, which coincides with the period of non-breeding winter dispersal of this species into southeast Australia. Surveys targeted flowering *Eucalyptus globoidea* found on site, which was observed to attract large numbers of New Holland Honeyeaters, as well as frequent visitation by Little Wattlebirds and Rainbow Lorikeets. No other eucalypts on site were observed to be in flower at the time of surveys.

9.2 Previous records

9.2.1 Previous surveys of the site

Swift Parrots were not recorded on site by BES (2006) or in the surrounding locality during any previous surveys.

9.2.2 BioNet Atlas records

Only one Swift Parrot record exists in the locality (5 km radius). This record includes a note that the Swift Parrot was recorded in a mixed flock with Rainbow Lorikeets, despite Saunders & Heinsohn (2008) listing Rainbow Lorikeets as a competitor species which have a negative effect on the likelihood of Swift Parrot occurrence.

BioNet records for the wider region (60 km radius) show a pattern of Swift Parrot occurrence in the area immediately north of Bateman's Bay, however only widely scattered records north of Ulladulla (refer to **Figure 3.3**).

IBOC records

Records of sightings published by the Illawarra Bird Observers Club (IBOC) were reviewed, including a search for all records of Swift Parrots for all years between 2007 and 2019. IBOC reports contained no sightings in Manyana or within 5 km of the site. The May 2008 report mentions past locations for sightings at Primbee Dunes, Bass Point, Mt. Warrigal, Lake Heights and Warrawong. Other notable records include Bellambi Lagoon in 2005, Regal Heights Albion Park in 2008, and Bulli Hospital in 2017. This pattern of records does not indicate that the site or areas similar to the site may constitute important habitat for or may be frequently visited by Swift Parrots during intermittent non-breeding movements into the South Coast area.

Birdlife Australia records

Birdlife Australia's Woodland Birds for Biodiversity (WBFB) project conducts biannual nationwide surveys for Swift Parrots. Published reports for these surveys have been reviewed for all years between 2009 and 2019. WBFB reports contained no sightings in Manyana or within 5 km of the site. Extensive sightings reports and discussions within WBFB reports provide detailed observations and analysis of the occurrence of Swift Parrots on the South Coast of NSW. The pattern of occurrence of Swift Parrots on the South Coast, which coincides with the area defined as the Ulladulla to Merimbula Key Biodiversity Area (KBA), indicates that

areas of heavily flowering Spotted Gum (*Corymbia maculata*) are important for the Swift Parrot population during its non-breeding movement into mainland Australia. Woodland Birds for Biodiversity records for the year 2009 include 30 birds in Kiah near Eden, 6 birds in Tura Beach, 350 birds foraging and roosting between Bermagui and Narooma in Corunna State Forest, 60+ birds in Benandarah State Forest, 100+ birds in Mogo State Forest, 200-250 birds at Nelson's Beach Mimosa Rocks National Park, and 100 birds in Bermagui State Forest. In 2012, 500 birds were seen in the area between Bodalla and Kioloa and also in Boyne State Forest. In 2015, 750 birds were seen in Turlinjah and also in the Narooma area.

This pattern of records does not indicate that the site or surrounding locality may constitute an area of important foraging habitat for Swift Parrots during their irregular movements into the South Coast of NSW.

9.3 Habitat assessment

9.3.1 Site habitat assessment

Swift Parrots nest only in Tasmania; therefore, the site does not represent breeding habitat for this species. The site does not represent significant foraging habitat for Swift Parrots. Woodland Birds for Biodiversity records indicate that Spotted Gum, which does not occur on site, is the preferred feed tree for Swift Parrots during movements into the South Coast of NSW. Other regional winter flowering eucalypts including Grey Ironbark (*Eucalyptus paniculata*) and Swamp Mahogany (*Eucalyptus robusta*) are found on site in low numbers, *E. robusta* in the subcanopy of Bangalay Paperbark Woodland EEC and *E. paniculata* widely scattered in Northern Coastal Sands Shrub/Fern Forest and Bangalay Moist Woodland Open Forest (Note: *E. robusta* was not recorded by BES (2006) and the current survey could not locate this species on site. Ecoplanning (2019b) records this species however the record may be a misidentification of *Eucalyptus botryoides*). Neither species was observed flowering during surveys for Swift Parrot habitat carried out by Ecoplanning in May 2020. A small number (approximately five, only one of which was large, abundantly flowering, and was observed attracting large numbers of nectivores) of *Eucalyptus globoidea* were observed flowering on site. This species' flowering period is typically between February and September and it is not known to be a reliable winter-flowering food source for Swift Parrots.

The phenology of the Eucalypts observed presently flowering on site does not reliably overlap with the movement of Swift Parrots into mainland Australia. Eucalypts which occur on site, including *Eucalyptus globoidea*, *Eucalyptus eugenioides*, *Eucalyptus piperita*, *Eucalyptus racemosa*, and *Corymbia gummifera*, are not well-documented for visitation or known to be preferred feed trees of the Swift Parrot (Note: *E. piperita* and *E. racemosa* are not known to occur in habitats found on site. The BES (2006) record of this species may be a misidentification). The flowering phenology of these species does not reliably overlap with the occurrence of Swift Parrots in mainland Australia (refer to **Table 9.1** below).

Swift Parrot utilisation of *Eucalyptus pilularis* and *Eucalyptus botryoides* has been documented in sighting records, but these species are not known to be significant food sources for Swift Parrots. *Eucalyptus robusta*, the only known preferred feed tree having flowering phenology which overlaps with the movement of Swift Parrots into the mainland, occurs on site only sparsely in the sub-canopy of the Bangalay Paperbark Woodland EEC, which will be retained within the proposed development, and occupies only 0.92 ha of the site. Moreover, significant

areas of intact canopy were observed surrounding the site in the Manyana area and in Conjola National Park (refer to **Figure 3.5 – 3.7**). On this basis, it is considered that the site will rarely and not reliably produce flower during the period of the Swift Parrot's movements into the region.

Table 9.1: Flowering phenology of eucalypts on site

Species	Flowering phenology (source: Hornsby Shire Council Fact Sheets unless otherwise noted)
Corymbia gummifera	Flowers are generally produced in heavy events in late summer through early autumn
Eucalyptus botryoides	Summer, Autumn (source: Botanic Gardens of South Australia)
Eucalyptus eugenioides	Flowers through spring into early summer (highly variable), flowers are white
Eucalyptus globoidea	Flowers appear from February through to September. Flowering events on individual trees may be several years apart
Eucalyptus paniculata	Flowers through late autumn to summer (May-January). Does not flower every year
Eucalyptus pilularis	Flowering occurs between July and January but not reliably every year
Eucalyptus piperita	Flowering occurs in summer through December to January
Eucalyptus racemosa	Flowers generally from late winter into spring (highly variable)
Eucalyptus robusta	Flowering Period April – September (source: Northern Beaches Council)

The *National Recovery Plan for the Swift Parrot* (Saunders and Tzaros 2011) lists key tree species for Swift Parrots in mainland Australia. Of the key tree species identified in Table 2 of the recovery plan, *Eucalyptus robusta*, *Eucalyptus tereticornis*, and *Corymbia maculata* are listed in the Coastal Southern Rivers region. Birdlife (2014) describes the Swift Parrot as a '*rich patch*' specialist. Such species are described as '*dependent on high-yielding habitats*'. Based on the limited and possibly erroneous records of *Eucalyptus robusta* on site, and the limited occurrence of Eucalypts with suitable flowering phenology more broadly, the site is unlikely to represent a '*rich patch*' of nectar producing vegetation which could potentially support significant foraging behaviour of Swift Parrots.

9.3.2 Habitat critical to survival of species

The site does not represent habitat critical to the survival of this species. An assessment against criteria for determining critical habitat under the MNES significant impact guidelines is provided below.

- *necessary for activities such as foraging, breeding, roosting, or dispersal*

The site could potentially be used for foraging activities during winter non-breeding dispersal across mainland SE Australia, however the foraging resources available are low. An assessment against whether habitat on site represents critical habitat on the basis of foraging activity potentially occurring is presented in **Section 9.3.3**, with reference to priority habitat as defined in the *National Recovery Plan for the Swift Parrot*.

- *necessary for the long-term maintenance of the species or ecological community (including maintenance of species essential to the survival of the species or ecological community, such as pollinators)*

The site is not likely to be necessary for the long-term maintenance of the Swift Parrot population. Winter foraging activities in the region are not likely to be significantly affected by the loss of poor-quality foraging habitat on site, and Swift Parrots are likely to persist in the area as significant foraging resources will remain on site and areas of unburnt canopy vegetation in the locality.

- *necessary to maintain genetic diversity and long term evolutionary development, or*

The site is not likely to be necessary for the maintenance of genetic diversity in the Swift Parrot population. All individuals of this species are thought to constitute a single subpopulation (Garnett et al 2011). All breeding activity occurs in Tasmania. Therefore, the site is not necessary in relation to the continued genetic diversity or long term evolutionary development of the Swift Parrot.

- *necessary for the reintroduction of populations or recovery of the species or ecological community.*

The site is not likely to be necessary for the reintroduction of populations or the recovery of the species, due to the limited, poor-quality foraging habitat available. The foraging habitat available is likely to only be intermittently utilised by small numbers of individuals moving through the area. Due to the flowering phenology of the canopy species on site, the site is unlikely to reliably produce flower when Swift Parrots are moving through the area.

- *habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community.*

An assessment against whether habitat on site represents critical habitat on the basis of foraging activity potentially occurring provided in **Section 9.3.3** with reference to critical habitat as defined in the *National Recovery Plan for the Swift Parrot*.

9.3.3 Priority habitat

An assessment against whether the site contains 'priority habitat' as described in the *National Recovery Plan for the Swift Parrot* is presented below. As defined in the recovery plan, "Habitat critical to the survival of the Swift Parrot includes; those areas of priority habitat for which the Swift Parrot has a level of site fidelity or possess phenological characteristics likely to be of importance to the Swift Parrot or are otherwise identified by the recovery team." An assessment against criteria which the *National Recovery Plan for the Swift Parrot* uses to define Priority Habitat is provided below.

- *Used for nesting*

Swift Parrots breed only in Tasmania.

- *Used by large proportions of the Swift Parrot population*

Existing records (refer to **Section 9.2**) indicate that the site and surrounding locality are unlikely to be used by large proportions of the populations. Large movements of Swift Parrots have been recorded in the South Coast region only south of Ulladulla and only in association with large flowering events of Spotted Gum and ironbarks. Only a single bird has been observed in the Manyana locality. Further afield, the nearest record of a larger flock, 26 birds in Yatte Yattah, is approximately 8km from site with birds seen foraging in a paddock in *Eucalyptus tereticornis*, which is known to be a key tree species (Saunders and Tzaros 2011) and which does not occur on site.

Therefore, a significant body of regional survey shows that large proportions of the Swift Parrot population utilise Spotted Gums in the coastal area south of Ulladulla, however nowhere on site or in the surrounding locality.

- *Used repeatedly between seasons (site fidelity)*

Existing records (refer to **Section 9.2**) indicate that the site and surrounding locality are unlikely to be used repeatedly between seasons. Only one record of a single bird exists from the Manyana locality. Existing records show significant movements into the area south of Kioloa during the years 2009, 2012, and 2015. No Swift Parrots were recorded from the site or surrounding locality during these years, indicating that the site is not part of the areas of site fidelity in the broader region. No Swift Parrot records from approximately Ulladulla north to the Illawarra indicate a pattern of site fidelity anywhere in this region. Records in this region show only sporadic occurrence of Swift Parrots, generally single birds or small numbers, and no records of repeat visits of flocks to the same location across seasons.

Therefore, regional survey has shown site fidelity across several years in the coastal area south of Ulladulla in association with large flowering events of Spotted Gums. No repeat visits across seasons of Swift Parrots to the site or surrounding locality have been documented.

- *Used for prolonged periods of time (site persistence)*

Regionally, the Spotted Gum forests south of Ulladulla have been observed to be utilised by Swift Parrots over prolonged periods. Site persistence has not been recorded in the coastal area north of Ulladulla to the Illawarra, including the site and surrounding locality.

9.3.4 Conclusion

Assessment of the site with respect to characteristics used to define ‘critical habitat’ or ‘priority habitat’ reveals that the site does not contain significant habitat features for Swift Parrots, is not located in a region known to be important for Swift Parrots, and does not have a recorded pattern of visitation which would indicate the presence of significant habitat on site or in the surrounding area. Regardless of the impacts of the 2019-20 bushfires to the forests of the coastal region, the site is not likely to be utilised as a site of significant foraging or as a site of refugia for the Swift Parrot population. The site is not likely to contain large numbers of flowering eucalypts at a time coincident with Swift Parrot movements into the area and the site

has not supported significant Swift Parrot feeding behaviour as documented in any of the reviewed database or regional sources.

9.4 Impact assessment

MNES significant impact guidelines state that an action is considered likely to have a significant impact on a critically 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

The site provides small amounts of potential seasonal foraging resources which could be utilised by the Swift Parrot during winter migrations to SE mainland Australia. The loss of these foraging resources on site is not likely to lead to a long-term decrease in the size of the population, as significant foraging resources will be retained on site (3.45 ha including all of the Bangalay Paperbark Woodland EEC) and occur in areas unaffected by fire in in the locality and in the broader NSW South Coast region.

- Reduce the area of occupancy of the species

There is no evidence of current intermittent occupation of the site (ALA; Birdata; BioNet; IBOC 2007–2019; Birdlife 2009–2019). One record exists within 5 km of the site, of one individual in a mixed flock with Rainbow Lorikeets. In the broader NSW South Coast region, movements of large numbers of Swift Parrots into the region have been recorded in 2009, 2012, and 2015, all of which have been associated with mass flowering events of Spotted Gum in forests south of Ulladulla. Spotted Gum does not occur on site.

- Fragment an existing population into two or more populations

The proposed action will not fragment a population of this highly mobile species.

- Adversely affect habitat critical to the survival of a species

The site does not represent habitat critical to the survival of this species (refer to **Section 9.3.2**).

- *Disrupt the breeding cycle of a population*

Swift Parrots breed in Tasmania and no important courtship or breeding activity is known to occur on the Australian mainland. Therefore, the proposed action will not disrupt the breeding cycle of this species.

- *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposal will remove a small area of poor-quality seasonal foraging habitat for this species. However, this loss of habitat is highly unlikely to cause the species to decline. As assessed in **Section 9.3.2** and **9.3.3**, the habitat on site is not important for the survival of individuals foraging in the locality. Foraging resources will be retained on site and can be found in the significant areas of unaffected canopy in the surrounding Conjola National Park (refer to **Figure 3.5-3.7**). Thus, a decline in this species caused by insufficient foraging resources in the locality due to vegetation clearing on site is unlikely.

- *Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

The prevalence of Noisy Miners could potentially increase over time as a result of vegetation clearing creating edge habitats that this species prefers. Swift Parrots are known to be generally absent or scarce at sites dominated by large aggressive nectivores such as Noisy Friarbirds, Red Wattlebirds, and Bell Miners (Birdlife Australia 2014)

While the action will increase the risk of this species establishing in the retained Swift Parrot habitat on site, significant edge effects were operating in the area prior to the action occurring, as the surrounding residential area of Manyana and adjacent rural properties contribute to edge effects in the locality. Also, Noisy Miners were not detected on site, during surveys indicating that this invasive species is not currently established in this area and does not pose a significant threat to the Swift Parrot in the locality currently.

Considering the pre-existing risk of Noisy Miners establishing in the locality together with the low level of utilisation of habitats on site when assessed against critical habitat criteria (**Section 9.3.2**), the action is not likely to result in a significant impact.

- *Introduce disease that may cause the species to decline, or*

There is an increased risk of *Phytophthora cinnamomi* being introduced to the site through increased human activity, potentially causing dieback of native vegetation and a loss or reduction of foraging habitat. However, there is a significant pre-existing risk due to human activity in adjacent areas of Manyana. Considering the pre-existing risk of disease establishing together with the low level of utilisation of habitats on site when assessed against critical habitat criteria (**Section 9.3.2**), the action is not likely to result in a significant impact.

Psittacine Beak and Feather Disease is known to affect Swift Parrots. However, the action will not affect the prevalence of this disease in the Swift Parrot population.

- *Interfere with the recovery of the species.*

The action will not interfere with the recovery of this species. The foraging habitat removed from site, is not likely to be used by Swift Parrots as populations recover and a broader extent of coastal habitats become occupied by the species. However, significant foraging resources remain on site in retained Bangalay Paperbark Woodland EEC, in the locality, and in the broader NSW South Coast region.

10 Black-faced Monarch

10.1 Field survey

Current avifauna surveys were not undertaken within the period during which this migratory species occurs in the South Coast of NSW. Therefore, current surveys are not adequate to detect this species on site and the species is assumed to be present at suitable times of the year.

10.2 Previous records

10.2.1 Previous surveys of the site

This species was recorded on site by BES (2006) in the Bangalay Moist Woodland Open Forest in the north east of the site. BES (2006) reported potential breeding activity on site.

10.2.2 BioNet records

This species has been recorded frequently in the surrounding area, including eight BioNet records within 5 km of the site.

10.3 Habitat assessment

The site contains known breeding habitat for this species in the dense mesic understorey vegetation of Bangalay Moist Woodland Open Forest. The entire site constitutes potential foraging habitat for this insectivorous species.

10.4 Impact assessment

An assessment of this species under MNES significant impact guidelines and *Draft referral guideline for 14 birds listed as migratory species under the EPBC Act* (DoE 2015) is provided below.

- *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*

The site contains wet sclerophyll forest (Bangalay Moist Woodland/ Open Forest) which is likely to be used for breeding. The habitat on site does not support an ecologically significant proportion of the population, is not of critical importance to the species life-cycle stages, is not near the limit of the species' range, and is not within an area where the species is declining, and therefore is not considered important habitat for this species. The area of habitat for this species likely to result in a significant impact if affected is 260 ha to constitute national significance or 2,600 ha to constitute an internationally significant impact (DoE 2015). The area of habitat to be cleared on site, 17 ha, is well below these thresholds.

- *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*

The proposal will not result in any invasive species which are harmful to Black-faced Monarchs, such as Black Rat (*Rattus rattus*) or invasive vines, becoming established in the area.

- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*

The proposal will clear an area totalling 17 ha. Black-faced Monarchs are not known to occur in dense aggregations and the area of vegetation to be cleared cannot support an ecologically significant proportion of Black-faced Monarchs, which is defined as 460 individuals to be significant nationally and 4,600 individuals to be significant internationally (DoE 2015). Therefore, the proposed action will not seriously disrupt the lifecycle of an ecologically significant proportion of the population.

11 Conclusions

This assessment has been prepared to contemporise the results of prior assessments (Ecoplanning 2018a and 2018b) in light of the significant bushfire event in the summer of 2019-20. Species were selected for this assessment based on Ecoplanning (2018a) assessment of species with potential to occur on site coupled with species listed in DAWE (2020) *Provisional list of animals requiring urgent management intervention* and additional species considered potentially affected by bushfire in the locality.

To inform the assessment, Ecoplanning undertook the following targeted survey:

- Remote cameras deployed in two separate events
  - 9 cameras over 18 days in 2018
  - 10 cameras over 14 days in 2020
- Spotlighting over two separate survey periods
  - 14 person-hours over 5 nights
  - 85 person-hours over 3 nights using systematic transects
  - 15 person-hours over 2 nights
- Bird census 15 hours 20 minutes over 7 days
- Opportunistic bird survey over 16 days
- Nest box inspections
- Habitat assessment
- Vegetation validation of Burnt Area Mapping (GEEBAM) in locality

Surveys of the site were undertaken in 2018 and 2020 in accordance with Commonwealth guidelines in order to determine the likelihood of the target species' presence or absence at the site. Of the species surveyed, only Grey-headed Flying-fox were detected on site. Greater Glider, Southern Brown Bandicoot, and Spotted-tailed Quoll are confirmed to not currently be utilising or occupying the site. Swift Parrots, while not detected despite adequate surveys, cannot be discounted as potentially occurring on site on an intermittent basis due to regional records including a record adjacent to the site. Black-faced Monarchs were also not detected during survey, however Ecoplanning surveys were undertaken at the wrong time of year and this species is assumed to nest on site due to previous records (BES 2006).

The assessment found that the action ***will not significantly impact any MNES*** protected under the EPBC Act, as summarised in **Table 11.1** below.

Table 11.1: MNES assessment summary

Species	Assessment prior to 2019-20 bushfire (Ecoplanning 2018a)	Assessment post 2019-20 bushfire
Greater Glider	Not surveyed Assumed present **Key findings:** Population in locality not 'important population' Habitat on site not 'habitat critical to survival of species' Extensive suitable habitat in locality Referral not recommended	Surveyed Confirmed absent **Key findings:** Surveys provide >97% detection probability, no Greater Gliders detected The site is not utilised by a local population currently and is unlikely to be utilized over the time period during which habitat will be recovering from the 2019-20 bushfires Habitat on site not 'habitat critical to survival of species' Bushfires reduced suitable habitat in locality however estimate of 812 ha within 5 km radius of site remaining Referral not recommended
Grey-headed Flying-fox	Surveyed Assumed present **Key findings:** No roost camp Foraging habitat on site is also extensive in locality Referral not recommended	Surveyed Confirmed present **Key findings:** No roost camp Population in locality not 'important population' Habitat on site not 'habitat critical to survival of species' Bushfires reduced suitable foraging habitat in the locality however species is highly mobile and estimate of at least 812 ha within 5km radius of site remaining Referral not recommended

Species	Assessment prior to 2019-20 bushfire (Ecoplanning 2018a)	Assessment post 2019-20 bushfire
Spotted-tailed Quoll	Not surveyed Assumed present **Key findings:** Habitat on site not 'habitat critical to survival of species' Extensive habitat in the locality Referral not recommended	Surveyed Confirmed absent **Key findings:** Not detected Habitat on site not 'habitat critical to survival of species' Bushfires reduced habitat available in the locality however estimate of at least 812 ha within 5 km radius of site remaining Habitat on site only small portion of the potential home range of any individuals in the locality Referral not recommended
Southern Brown Bandicoot	Surveyed Confirmed absent **Key findings:** Not detected Population unlikely to occur in locality Referral not recommended	Surveyed Confirmed absent **Key findings:** Not detected Population unlikely to occur in locality Referral not recommended
Swift Parrot	Not surveyed Assumed present **Key findings:** Poor foraging habitat on site Habitat on site not 'habitat critical to survival of species' Significant foraging behaviour unlikely to occur on site Referral not recommended Foraging habitat extensive in the locality Referral not recommended	Surveyed Assumed present (previous record) **Key findings:** Poor foraging habitat on site Habitat on site not 'habitat critical to survival of species' Habitat on site not 'priority habitat' Significant foraging behaviour unlikely to occur on site despite reduction in available foraging habitat due to 2019-20 bushfires Estimate of at least 812 ha foraging habitat within 5km radius of site remaining Referral not recommended

Species	Assessment prior to 2019-20 bushfire (Ecoplanning 2018a)	Assessment post 2019-20 bushfire
Black-faced Monarch	Not surveyed Assumed present **Key findings:** Habitat retained on site and in locality Population on site not an ecologically significant proportion Referral not recommended	Not surveyed Assumed present **Key findings:** Habitat retained on site Habitat on site below significant impact thresholds Population on site not an ecologically significant proportion Referral not recommended

Regarding the impact of the action in the context of recent bushfires, the habitat found on site is not critical to the survival of any of the species assessed, or to the survival of a local population of these species. Moreover, the site is to be cleared in stages, with Stage 1 and associated APZs being cleared in 2020 (7.14 ha), Stage 2 (2.64 ha) in late 2021/ early 2022, and the remainder over 7-10 years. DPIE (2020) guidelines for assessment of burnt sites assume habitat features return to burnt sites after 2 years. On this basis, the majority of the site will not be cleared until after the surrounding bushland has recovered. Notwithstanding, the overall impact of the action on MNES is not significant in the context of recent bushfires

The assessment found that the action is not likely to have a significant impact on a matter protected under the EPBC Act. A referral for formal assessment and approval under the EPBC Act is not required, however a determination from the Commonwealth cannot be assured without referral.

12 References

Atlas of Living Australia (ALA) website https://www.ala.org.au/ Accessed May 2020

BES (2006). *Flora and Fauna Assessment – Proposed Subdivision, Lot 172 DP 755923 & Lot 823 DP 247285 Berringer Road and Cunjurong Point Road, Manyana*. BES (Bushfire and Environmental Services), St Georges Basin.

Birdlife Australia (n.d.) Birdata https://birdata.birdlife.org.au/ Accessed May 2020

Birdlife Australia (2009 – 2017) Regent Honeyeater & Swift Parrot survey update (reports reviewed 2009 through 2017). http://birdlife.org.au/projects/woodland-birds-for-biodiversity/latest-news-wl

Birdlife Australia (2014) *Swift Parrots and Regent Honeyeaters in the Lake Macquarie City Council area New South Wales: An Assessment of Status, Identification of High Priority Habitats and Recommendations for Conservation.* Prepared by Birdlife Australia for Lake Macquarie City Council.

Bureau of Meteorology (2020). Daily Weather Observations Ulladulla, NSW. Accessed at: http://www.bom.gov.au/climate/dwo/IDCJDW2138.latest.shtml

Comport, S. S., Ward, S. J., and Foley, W. J. (1996). Home ranges, time budgets and food tree use in a high density tropical population of greater gliders, *Petauroides volans* minor (Pseudocheiridae: Marsupialia). Wildlife Research 23, 401-419.

Department of Agriculture, Water and the Environment (DAWE) Wildlife And Threatened Species Bushfire Recovery Expert Panel (2020a). *Provisional list of animals requiring urgent management intervention*. Released on 20 March 2020.

Department of Agriculture, Water and the Environment (DAWE) Wildlife And Threatened Species Bushfire Recovery Expert Panel (2020b) *Rapid analysis of impacts of the 2019-20 fires on animal species, and prioritisation of species for management response* and supporting information, accessed at: https://www.environment.gov.au/biodiversity/bushfire-recovery/priority-animals on 26 May 2020.

Department of Agriculture Water and the Environment (DAWE) (2020c) EPBC Act Protected Matter Search tool. Accessed May 2020.

Department of Agriculture Water and the Environment (DAWE) (2020d) Species Profile and Threats Database (SPRAT). Accessed May 2020.

Department of the Environment (DoE) (2013) *Matters of National Environmental Significance: Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999.*

Department of the Environment (DoE) (2015). *The Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act.* Commonwealth of Australia 2015.

Department of the Environment (DoE) (2016). *Conservation Advice Lathamus discolour Swift Parrot*

Department of the Environment (DoE) (2020). National Flying-fox monitoring viewer. Accessed May 2020.

Department of Environment and Climate Change (DEC) (2006). *Southern Brown Bandicoot (Isoodon obesulus) Recovery Plan.* NSW DEC, Hurstville, NSW.

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2010). *Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2011). *Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*

eBird (n.d.) Species maps database. https://ebird.org/map/. Accessed May 2020

Ecoplanning (2018a). Re: Response to letter from Department of the Environment and Energy, regarding 182 lot sub-division, Berringer and Cunjurong Roads, Manyana. Letter to Jeff Bulfin, Precise Planning Pty Ltd, 17 April 2018.

Ecoplanning (2018b). Re: Response to the Department of the Environment and Energy requesting additional information regarding EPBC Act application to the 182 lot residential subdivision at Berringer and Cunjurong Point Roads, Manyana. Letter to Ghazi Sangari, Ozy Homes Pty Ltd, 27 July 2018.

Ecoplanning (2019a). Environmental Management Plan Lot 172 // DP 755923, Lot 823 // DP 247285, Berringer Road, Cunjurong Point Road and Sunset Strip, Manyana, NSW. Prepared for Precise Planning Pty Limited, on behalf of Ozy Homes.

Ecoplanning (2019b). Flora and Fauna Management Plan, Lot 172 // DP 755923 & Lot 823 DP // 247285, Berringer Road, Cunjurong Point Road and Sunset Strip, Manyana (v. 2.3). Prepared for Precise Planning.Eyre, T. J. (2002). Habitat preferences and management of large gliding possums in southern Queensland. Ph.D. thesis, Southern Cross University, Lismore.Goldingay, R. L. (2012). Characteristics of tree hollows used by Australian arboreal and scansorial mammals. Australian Journal of Zoology 59, 277-294.

Eyre, T. J. (2002). Habitat preferences and management of large gliding possums in southern Queensland. Ph.D. thesis, Southern Cross University, Lismore.

Garnett S. T., Szabo, J. K. & Dutson G. (2011). The Action Plan for Australian Birds 2010. CSIRO Publishing. Melbourne.

Gibbons, P. and Lindenmayer, D.B. (1997). Developing tree retention strategies for hollow-dependent arboreal marsupials in the wood production eucalypt forests of eastern Australia. Australian Forestry, 60, 29-45.

Goldingay, R. L. (2012). Characteristics of tree hollows used by Australian arboreal and scansorial mammals. Australian Journal of Zoology 59, 277-294

Henry, S. R. (1984). *Social organisation of the greater glider (Petauroides volans) in Victoria.* In Possums and Gliders (eds A. P. Smith & I. D. Hume), pp. 221-228. Surrey Beatty and Sons, Chipping Norton

Illawarra Bird Observers Club (IBOC) Sightings 2007 – 2019. Accessed at: https://www.iboc.com.au/sightings.html

Kavanagh, R.P. & Webb, G.A. (1989). Silvicultural Options for the Management of Wildlife Habitats in Southeast New South Wales. Unpublished report.

Kavanagh, R. P., & Wheeler, R. J. (2004). Home range of the greater glider *Petauroides volans* in tall montane forest of southeastern New South Wales, and changes following logging. In The Biology of Australian Possums and Gliders (eds R. L. Goldingay & S. M. Jackson), pp. 413-425. Surrey Beatty and Sons, Sydney.

Kavanagh, R. P. and Lambert, M. J. (1990). Food Selection by the Greater Glider, *Petauroides-Volans* - Is Foliar Nitrogen a Determinant of Habitat Quality. Wildlife Research 17, 285-299.

Lindenmayer, D. (2020). Affidavit of Professor David Lindenmayer AO in support of application for injunction affirmed on 25 May 2020. Manyana Matters v Ozy Homes

Lindenmayer, D. B., M. L. Pope, and R. B. Cunningham. (2004). Patch use by the greater glider (Petauroides volans) in a fragmented forest ecosystem. II. Characteristics of den trees and preliminary data on den-use patterns. Wildlife Research 31:569-577.

Lindenmayer, D. B., J. T. Wood, L. McBurney, C. MacGregor, K. Youngentob, and S. C. Banks. (2011). How to make a common species rare: A case against conservation complacency. Biological Conservation 144:1663-1672.

Lindenmayer, D. B., J. Wood, C. MacGregor, C. Foster, B. Scheele, A. Tulloch, P. Barton, S. Banks, N. Robinson, N. Dexter, L. S. O'Loughlin, and S. Legge. (2018). Conservation conundrums and the challenges of managing unexplained declines of multiple species. Biological Conservation 221:279-292.

Lyra-Jorge, M.C., Ciocheti, G., Pivello, V.R. et al. Comparing methods for sampling large- and medium-sized mammals: camera traps and track plots. European Journal of Wildlife Research 54, 739 (2008).

NSW Department of Environment and Conservation (DEC) (2006) *Southern Brown Bandicoot (Isoodon obesulus) Recovery Plan*. NSW DEC, Hurstville NSW.

NSW NPWS (2001). 'Southern Brown Bandicoot - 'A Recovery Package'.' CD Rom. NSW National Parks and Wildlife Service, Threatened Species Unit, Southern Directorate, Queanbeyan, NSW.

NSW Office of Environment and Heritage (OEH) (2020a). Atlas of NSW Wildlife. http://www.bionet.nsw.gov.au/. Accessed May 2020

NSW Office of Environment and Heritage (OEH) (2020b). Threatened Species Profiles. Accessed at: http://www.environment.nsw.gov.au/threatenedspecies/

Saunders, D.L. and Tzaros, C.L. (2011). *National Recovery Plan for the Swift Parrot Lathamus discolour*. Birds Australia, Melbourne.

Smith, G. C., Mathieson, M., & Hogan, L. (2007). Home range and habitat use of a low-density population of Greater Glider, *Petauroides volans* (Pseudocheiridae: Marsupialia), in a hollow-limiting environment. Wildlife Research 34, 472-483.

Smith, A. P., Moore, D. M., & Andrews, S. P. (1994). Fauna of the Grafton and Casino Forestry Study Areas description and assessment of forestry impacts. Report for State Forests of New South Wales. Austeco Environmental Consultants, Armidale.

Southwell, D. (2020) *Preliminary Draft – Design considerations for post natural disaster (fire) on-ground assessment of status of species, ecological communities, habitats and threats.* Dr Darren Southwell, The University of Melbourne, April 2020

Stojanovic, D., Webb, M., Alderman, R., Porfirio, L., Heinsohn, R. (2014). *Discovery of a novel predator reveals extreme but highly variable mortality for an endangered bird.* Divers. Distrib. 20, 1200–1207.

Threatened Species Recovery Hub (TSRH) (2017) Threatened species returning to Booderee National Park. Accessed at: http://www.nespthreatenedspecies.edu.au/news/threatened-species-returning-to-booderee-national-park

Threatened Species Scientific Committee (TSSC) (2016). Conservation Advice, *Petauroides volans* Greater Glider.

Wintle, B.A., Kavanagh, R.P., McCarthy, M.A., and Burgman, M.A. (2005). Estimating and dealing with detectability in occupancy surveys for forest owls and arboreal marsupials. Journal of Wildlife Management 69: 905-917.

Appendix A Staff CVs

Appendix B Species List

Table 12.1: Fauna species recorded

Scientific name	Common name	Notes
Mammalia		
Acrobates pygmaeus	Feathertail Glider	Observed during supplementary spotlighting surveys The only additional mammal species recorded during supplementary surveys and not previously recorded by Ecoplanning
Macropus giganteus	Eastern Grey Kangaroo	Frequently recorded in more open areas in the east of the site
Oryctolagus cuniculus	European Rabbit	Recorded in residential areas surrounding site. One dead rabbit found on site, possible recent predation
Perameles nasuta	Long-nosed Bandicoot	Frequently recorded on remote cameras in 2020 – 361 photos across 9 cameras
Petaurus breviceps	Sugar Glider	Heard calling to the north west of the site during Ecoplanning surveys. Observed during supplementary survey.
Pseudocheirus peregrinus	Common Ringtail Possum	Recorded only in retained Bangalay Paperbark Woodland on site Possible dreys recorded in Bangalay Moist Woodland Open Forest
Pteropus poliocephalus	Grey-headed Flying-fox	EPBC Act listed Vulnerable Few individuals heard on site during two nights of spotlighting surveys One dead individual found on site
Trichosurus vulpecula	Common Brushtail Possum	Most frequent record during spotlighting surveys
Vulpes vulpes	European Red Fox	Recorded on remote cameras in 2018 and 2020
Wallabia bicolor	Swamp Wallaby	Recorded in Bangalay Moist Woodland Open Forest

Scientific name	Common name	Notes
Families Rodentia and Dasyuridae	Non-target rodents and/or dasyurids	The most frequent record on remote cameras in 2020, totalling 9,311 photos across 10 cameras
Aves		
Acanthiza lineata	Striated Thornbill	Detected during bird census
Acanthiza nana	Yellow Thornbill	Detected during bird census
Acanthiza pusilla	Brown Thornbill	Detected during bird census
Acanthorhynchus tenuirostris	Eastern Spinebill	Detected during bird census
Aegotheles cristatus	Australian Owlet-nightjar	Detected during bird census
Alisterus scapularis	Australian King Parrot	Detected during bird census
Anthochaera carunculata	Red Wattlebird	Detected during bird census
Anthochaera chrysoptera	Little Wattlebird	Detected during bird census
Cacatua galerita	Sulphur-crested Cockatoo	Detected during bird census
Cacomantis flabelliformis	Fan-tailed Cuckoo	Opportunistic record – heard one afternoon only
Caligavis chrysops	Yellow-faced Honeyeater	Detected during bird census
Callocephalon fimbriatum	Gang-gang Cockatoo	BC Act listed Vulnerable 2 pairs recorded frequently on site, including foraging in Blackbutt and flying over the site. Detected during bird census
Chenonetta jubata	Australian Wood Duck	Detected during bird census
Climacteris erythrops	Red-browed Treecreeper	Detected during bird census
Colluricincla harmonica	Grey Shrike-thrush	Detected during bird census
Columba leucomela	White-headed Pigeon	Detected during bird census
Coracina novaehollandiae	Black-faced Cuckoo-shrike	Detected during bird census

Scientific name	Common name	Notes
Cormobates leucophaea	White-throated Treecreeper	Detected during bird census
Corvus coronoides	Australian Raven	Detected during bird census
Cracticus torquatus	Grey Butcherbird	Detected during bird census
Dacelo novaeguineae	Laughing Kookaburra	Detected during bird census
Daphoenositta chrysoptera	Varied Sittella	BC Act listed Vulnerable One individual recorded foraging in outer branches of eucalypts surrounding the previously cleared/disturbed area in the north of the site Detected during bird census
Eopsaltria australis	Eastern Yellow Robin	Detected during bird census
Falcunculus frontatus	Crested Shrike-tit	Detected during bird census
Gerygone mouki	Brown Gerygone	Detected during bird census
Glossopsitta pusilla	Little Lorikeet	BC Act listed Vulnerable Small numbers heard during one bird census survey. Detected during bird census
Gymnorhina tibicen	Australian Magpie	Detected during bird census
Leucosarcia melanoleuca	Wonga Pigeon	Detected during bird census
Macropygia phasianella	Brown Cuckoo-dove	Detected during bird census
Malurus lamberti	Variegated Fairy-wren	Detected during bird census
Manorina melanocephala	Noisy Miner	Detected during bird census
Meliphaga lewinii	Lewin's Honeyeater	Detected during bird census
Melithreptus lunatus	White-naped Honeyeater	Detected during bird census
Neochmia temporalis	Red-browed Finch	Detected during bird census
Ninox novaeseelandiae	Southern Boobook Owl	Detected during spotlighting surveys on site – heard
Pachycephala pectoralis	Golden Whistler	Detected during bird census
Pachycephala rufiventris	Rufous Whistler	Detected during bird census

Scientific name	Common name	Notes
Pardalotus punctatus	Spotted Pardalote	Detected during bird census
Phylidonyris novaehollandiae	New Holland Honeyeater	Detected during bird census
Platycercus elegans	Crimson Rosella	Detected during bird census
Podargus strigoides	Tawny Frogmouth	Spotlighting record adjacent to site
Psophodes olivaceus	Eastern Whipbird	Detected during bird census
Ptilonorhynchus violaceus	Satin Bowerbird	Detected during bird census
Rhipidura fuliginosa	Grey Fantail	Detected during bird census
Rhipidura leucophrys	Willie Wagtail	Detected during bird census
Sericornis frontalis	White-browed Scrubwren	Detected during bird census
Strepera graculina	Pied Currawong	Detected during bird census
Trichoglossus moluccanus	Rainbow Lorikeet	Detected during bird census
Tyto alba	Barn Owl	Detected during supplementary surveys – heard one call on site The only additional bird species recorded during supplementary surveys and not previously recorded by Ecoplanning
Vanellus miles	Masked Lapwing	Detected during bird census
Zanda funereus	Yellow-tailed Black-cockatoo	Detected during bird census
Zoothera lunulata	Bassian Thrush	Opportunistic record – heard one morning after rain
Zosterops lateralis	Silvereye	Detected during bird census
Amphibia		
Litoria tyleri	Tyler's Tree Frog	Heard
Litoria verreauxii	Whistling Tree Frog	Heard
Pseudophryne bibronii	Bibron's Toadlet	Heard
Reptilia		
Tiliqua scincoides	Blue-tongued Lizard	Observed

Appendix C Vegetation validation photos

DEFINITIONS OF CONDITION USED IN FIELD VALIDATION (UNIQUE ID CORRESPONDS TO NUMBERS SHOWN IN FIGURES 3.6 AND 3.7).
Canopy unburnt: no observable sign of fire damage in the canopy (e.g. burnt limbs) and no epicormic growth present as a result of fire damage.
Canopy burnt: observable signs of recent fire damage in the canopy (e.g. burnt limbs) and epicormic growth present.
Understory intact: no observable sign of fire damage in the ground layer, midstorey or canopy.

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
1		Canopy unburnt	2 - Low

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
2		Canopy unburnt	2 - Low

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
3		Canopy burnt	4 - High

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
4		Canopy unburnt	3 - Medium

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
5		Canopy burnt	4 - High

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
6		Canopy unburnt	3 - Medium

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
7		Canopy unburnt	4 - High

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
8		Canopy unburnt	2 - Low

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
9		Understory intact	2 - low

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
10		Understory intact	No data

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
11		Canopy unburnt	3 - Medium

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
12		Unburnt street trees	No data

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
13		Understory intact	3 - Medium

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
14		Canopy unburnt	3 - Medium

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
15		Canopy unburnt	3 - Medium

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
16		Canopy unburnt	3 - Medium

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
17		Canopy unburnt	3 - Moderate

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
18		Canopy burnt	No data

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
19		Canopy burnt	No data

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
20		Canopy burnt	4 - High
21	No image	Understorey intact	2 - Low

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
22		Understorey intact	2 - Low

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
23		Understorey intact	No data

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
24		Understorey intact	No data

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
25		Canopy unburnt	3 - Medium

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
26		Canopy unburnt	3- Medium

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
27		Understory intact	No data

Unique ID	Photo	Field Verified Condition	GEEBAMv3p1 class
28		Understorey intact	No data