



**ECOLOGICAL ASSESSMENT
REPORT**

FOR

REZONING PROPOSAL

AT

**40 RAYFORD STREET & 19 DAYDAWN
AVENUE, WARNERS BAY, NSW**

Prepared for: PULVER COOPER & BLACKLEY

June 2017

AEP Ref 1495



EXECUTIVE SUMMARY

Anderson Environment & Planning was commissioned by Pulver Cooper & Blackley to undertake an Ecological Assessment Report to accompany a rezoning application for part of lands at 40 Rayford Street (Lot 6 DP 814499), Warners Bay and 19 Daydawn Avenue (Lot 100 DP 1173625), Warners Bay. It is proposed to rezone parts of the land from E2 – Environmental Conservation to R2 – Low-density Residential. Anderson Environment & Planning have undertaken required investigations to inform the production of a 7 part test assessment addressing the proposal.

The subject site to be rezoned to is approx. 5.8ha of the 12.9ha study area (both Lots). The subject site is generally cleared, however approx. 1.13ha of disturbed remnant vegetation remains, of which up to 0.98ha will require removal as part of the proposed development. Existing R2 lands within the study area totals 0.4ha, with the residue 6.7ha zoned E2 to be conserved in accordance with Lake Macquarie City Council (LMCC) *East Munibung Hill Area Plan*.

Remnant vegetation within the study area was deemed to constitute a highly disturbed variant of Hunter Valley Moist Forest. This community is not listed as a threatened community under either the NSW TSC Act or Commonwealth EPBC Act.

No threatened plant species were recorded within the subject site and such species are unlikely to occur therein given the extent of previous vegetation clearing and anthropogenic disturbance.

Fauna species recorded were typical of those found in this habitat and those commonly associated with cleared lands and semi-isolated, disturbed remnant vegetation. One threatened microbat species, *Miniopterus australis* (Little Bent-winged Bat) was recorded during fieldwork, and there is potential for other threatened species to utilise the subject site as part of a larger home range.

Assessment under Section 5A of the EP&A Act (the '7 part test') found that the proposal was highly unlikely to result in a significant impact upon listed threatened entities, and consideration of the EPBC Act revealed that no impacts on Matters of National Environmental Significance are expected, and as such there is no need to refer the proposal to the Commonwealth.

General recommendations to minimise localised impacts on biodiversity in general as a result of the development of the site are included for consideration.



TABLE OF CONTENTS

1.0	Introduction.....	1
2.0	Site Particulars.....	2
3.0	Proposed Development.....	4
4.0	Scope and Purpose.....	6
5.0	Study Certification and Licencing	7
6.0	Methods.....	8
6.1	Literature Review	8
6.2	Field Survey.....	9
7.0	Results.....	14
7.1	Database Searches	14
7.2	Flora	20
7.3	Vegetation Communities	25
7.4	Threatened Flora.....	26
7.5	Habitat Assessment.....	26
7.6	Fauna.....	26
8.0	Key Species Considerations.....	28
9.0	7 Part Test Assessment	30
10.0	EPBC Act Assessment.....	35
11.0	Squirrel Glider Assessment	37
12.0	SEPP 44 Koala Assessment.....	38
13.0	Recommendations.....	39
14.0	References	40

Tables

Table 1 – Field Survey Effort.....	12
Table 2 – LMCC minimum effort for highly disturbed site with habitat present.....	12
Table 3– Threatened Species Appraisal.....	14
Table 4 - Key Species Considerations	28
Table 5 - Squirrel Glider - Vegetation Corridor Assessment.....	37

Figures

Figure 1 – Site Location	3
Figure 2 – Indicative development plan	5
Figure 3 - Vegetation Communities and Habitat Tree Locations	27

Appendices

Appendix A – Flora Species List
Appendix B – Expected Fauna Species List
Appendix C – Echo Ecology Anabat Report
Appendix D – Habitat Tree Details
Appendix E – Author CVs



1.0 Introduction

It is proposed to rezone part of lands at 40 Rayford Street, Warners Bay (Lot 6 DP 814499), and 19 Daydawn Avenue, Warners Bay (Lot 100 DP1173625), from E2 – Environmental Conservation to R2 – Low-density Residential. At the request of Pulver Cooper & Blackley (the proponent), Anderson Environment & Planning (AEP) have undertaken required investigations to inform the production of an Ecological Assessment Report (EAR) including a 7 part test assessment addressing the proposal.

The subject site to be rezoned to is approx. 5.8ha of the 12.9ha study area (both Lots). The subject site is generally cleared, however approx. 1.13ha of disturbed remnant vegetation remains, of which up to 0.98ha will require removal as part of the proposed development. Existing R2 lands within the study area totals 0.4ha, with the residue 6.7ha zoned E2 to be conserved in accordance with Lake Macquarie City Council (LMCC) *East Munibung Hill Area Plan*.

While the land is currently zoned E2 Environmental Conservation under the *Lake Macquarie Local Environmental Plan 2014*, LMCC's current Lifestyle 2030 Strategy identifies that the land is in a growth and expansion corridor, however does not include a specific recommendation to rezone the land for residential purposes. LMCC does not typically rezone E2 Environmental Conservation land as this is inconsistent with their planning policies, however it is noted that the *East Munibung Hill Area Plan* identified that part of the site may be suitable for development subject to scenic quality, environmental and geotechnical constraints.

This EAR is specifically intended to indicate the likelihood of the rezoning having a significant effect on threatened species individuals or populations, or flora assemblages considered to constitute an Endangered Ecological Community (EEC). In this regard, the report aims to recognise the relevant requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act), the *Threatened Species Conservation Act 1995* (TSC Act) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

For the purposes of referencing, this document should be referred to as:

Anderson Environment & Planning (2017). *Ecological Assessment Report for Rezoning Proposal at 40 Rayford Street & 19 Daydawn Avenue, Warners Bay, NSW*. Unpublished report for Pulver Cooper & Blackley, Newcastle, NSW.



2.0 Site Particulars

- **Proposal Location** – Parts of 40 Rayford Street and 19 Daydawn Avenue, Warners Bay, NSW.
- **LGA** –Lake Macquarie.
- **Title Details** – Lot 6 DP 814499 (Lot 6).
 Lot 100 DP 1173625 (Lot 100).
- **Subject site** – comprises the area proposed for rezoning, and occupies the downslope eastern portion of Lot 6 (approx. 4.8ha) and the eastern portion of Lot 100 (approx. 1.0ha) which adjoins the southern boundary of Lot 6. The subject site totals approx. 5.8ha.
- **Study area** – Comprises the subject site and the remainder of the parent lots. The study area comprises approx. 12.9ha.
- **Locality** - refers to surrounding lands in the general Warners Bay district within an approx. 10 kilometre radius of the site.
- **Zoning** – As per *Lake Macquarie Local Environmental Plan 2014*, the majority of Lot 6 and the entirety of Lot 100 are currently zoned E2 – Environmental Conservation. A small area (approx. 0.38ha) in the southeast of Lot 6 is zoned R2 – Low-density Residential and is the subject of a separate subdivision DA.
- **Current Land Use** – The study area presents as a mosaic of long-term anthropogenic management and influence; including cleared and seeded grazing pasture, scattered highly disturbed remnant vegetation, apiaries, orchards, gardens planted with exotic flora species, and a dam with fringing vegetation. Recent under-scrubbing has also occurred as part of bushfire hazard reduction measures around the existing homestead. An unmapped though well-established 1st order watercourse runs west to east near the southern boundary of 40 Daydawn Street towards Lake Macquarie and will be retained along with a 20m wide Vegetated Riparian Zone (VRZ) as required under the *NSW Water Management Act 2000* (WM Act) (DPI 2012).
- **Surrounding Land Use** – Lands to the east and south include existing homesteads associated with the suburb of Warners Bay. Land to the north and west is zoned E2 and is included within LMCCs *East Munibung Hill Area Plan*. This land consists of some remnant native vegetation, but areas have been subject to anthropogenic disturbance and management for agricultural and grazing purposes.






Figure 1 depicts the extent of the site overlain on an aerial photograph of the locality.

Disclaimer: While all reasonable care has been taken to ensure the information shown on this map is up to date and accurate, no guarantee is given that the information



Legend

Study Area

-  Lot 6 DP 814499
-  Lot 100 DP 1173625
-  Subject Site
-  Cadastre
-  1st Order Watercourse (Indicative)



Note:
1. Boundaries are not survey accurate
2. Do not scale off this plan

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P 0418 681 581 E CRAIG@ANDERSONEP.COM.AU

Title: Figure 1 - Site Location

Location: Warners Bay

Client: PCB

Date: 21.6.17

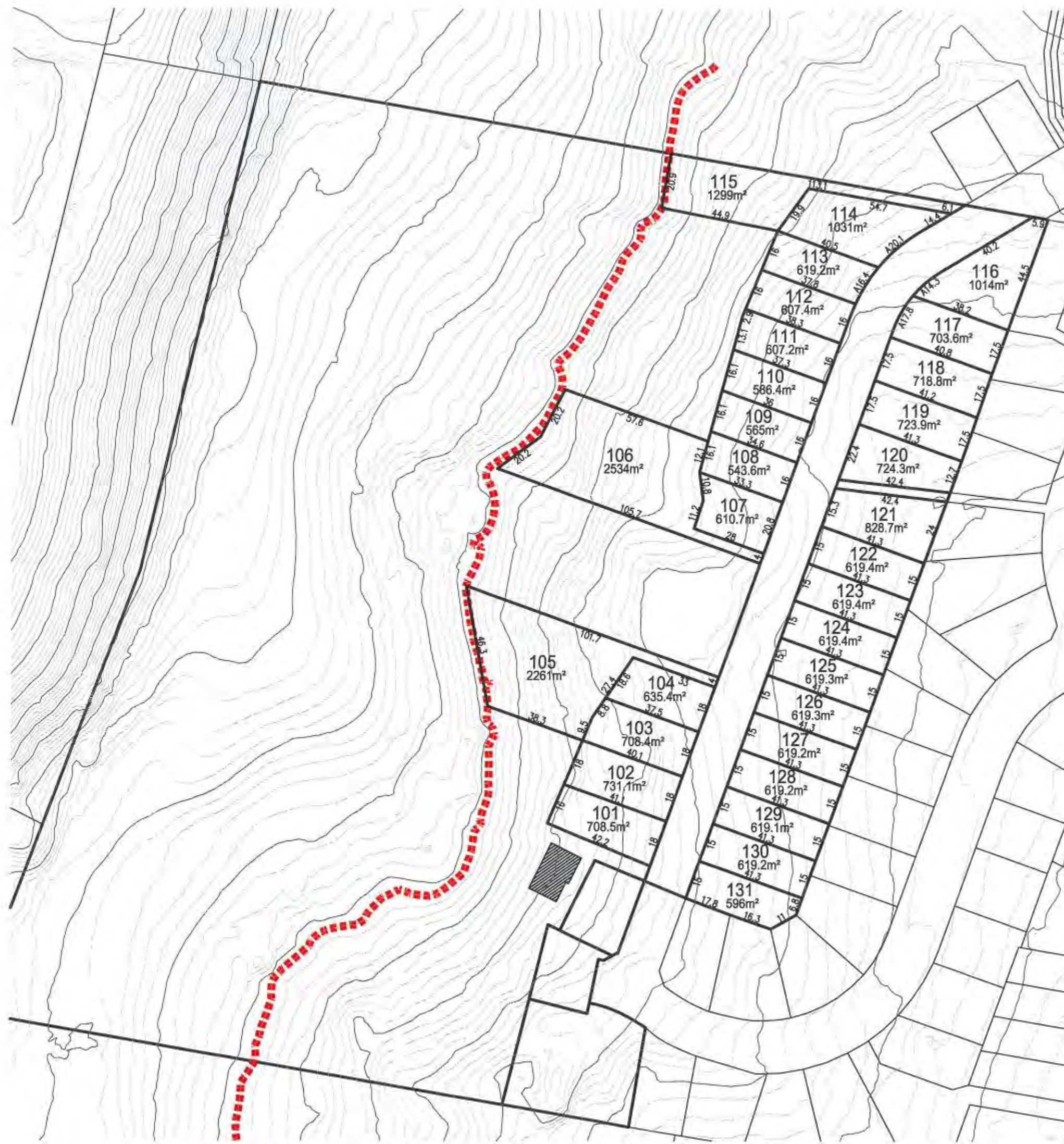
Our Ref: 1495

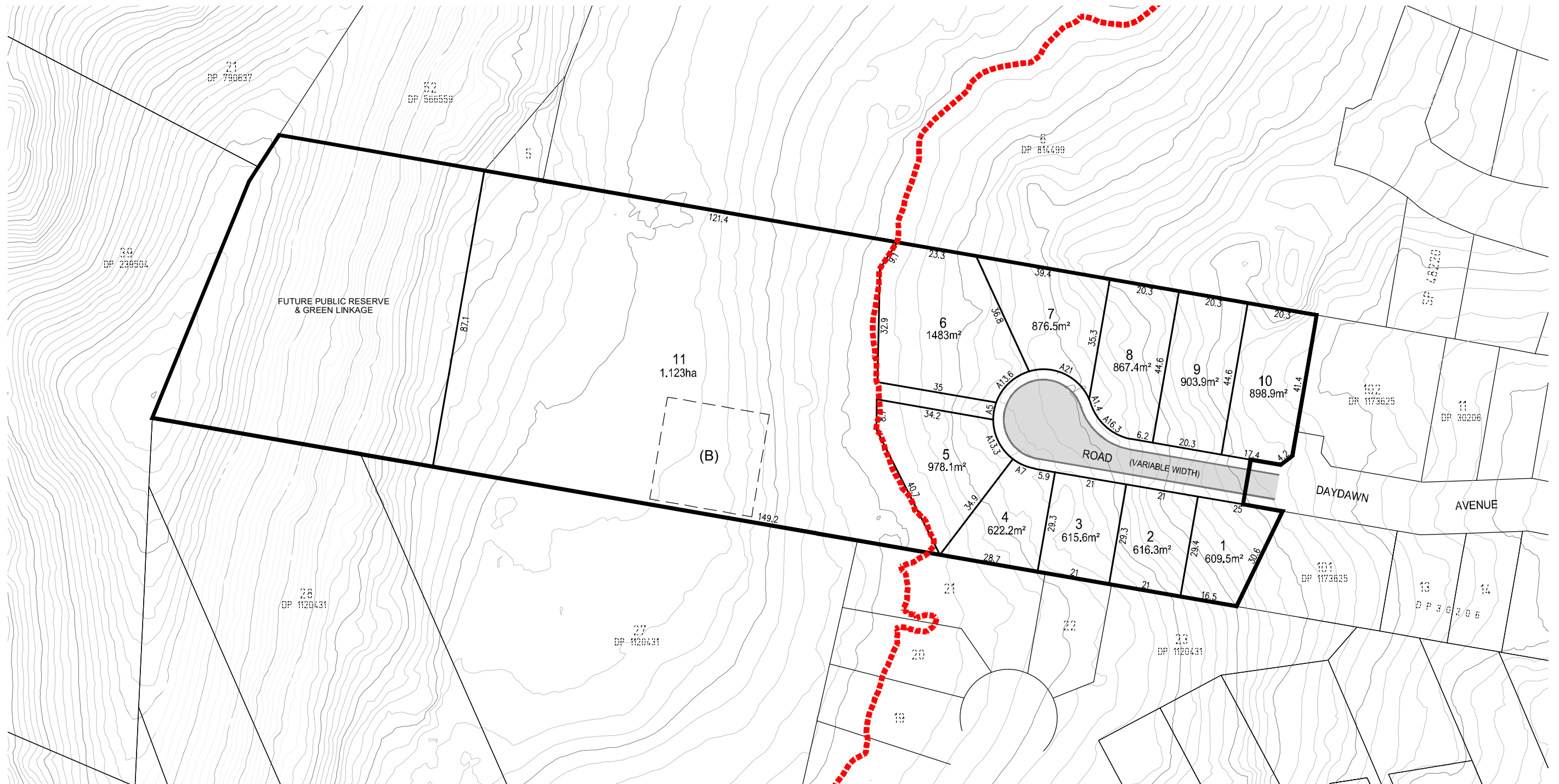


3.0 Proposed Development

The proposal involves the rezoning of approx. 5.8ha of land to allow for the development of approximately 26 residential housing lots, ranging from approx. 500m² to 2260m², subject to final subdivision design. The proposed development would include ancillary infrastructure such as roads and stormwater management.

Figure 2 depicts a preliminary development plan for the subject site.





■■■■■■■■■■ CONTOUR RL 54
(B) PROPOSED BUILDING ENVELOPE

10 5 0 10 20 30 40
Horizontal Scale 1:600 (A1)
1:1200 (A3)
14/06/2014 - 16/155



4.0 Scope and Purpose

Investigations were carried out on site and via literature / database searches to gather information required to adequately address Section 5A of the *Environmental Planning & Assessment Act 1979* (EP&A Act; known as the “7 part test”), and to satisfy the requirements of LMCC Flora & Fauna Survey Guidelines (Version 4.2, 2012).

Also afforded consideration were the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act), State guidelines including NSW OEH - NSW Guide to Surveying Threatened Plants (2016), State Environmental Planning Policies (SEPPs), namely SEPP 44 – ‘Koala Habitat Protection’ and relevant Council guidelines including LMCC *Tetratheca juncea* Planning and Management Guidelines (2014) and LMCC Squirrel Glider Planning and Management Guidelines (2015);

Impact assessment was undertaken with due reference to the “Threatened Species Assessment Guidelines” (DECC, 2009).

Specifically, the scope of this study covers:

- Identify vascular plant species occurring within the site, including any threatened species listed under the TSC Act or EPBC Act;
- Identify and map the extent of vegetation communities within the site, including any EEC’s listed under the TSC Act or EPBC Act;
- Identify any fauna species, including threatened and migratory species, and populations or their habitats, which occur within the site and are known to occur in the wider locality;
- Assess the potential of the proposed development to have a significant impact on any threatened species, population or ecological community (or their habitats) identified within the study area; and
- Describe measures to be implemented to avoid, minimise, manage or monitor potential impacts of the proposal.

In addition to the survey effort conducted within the subject site and wider study area, consideration has been afforded to the wider locality, via database searches within 10km of the site and via appreciation of habitat areas that may be linked ecologically to the site.

This EAR has been produced utilising background research, literature review, database searches, consultation, targeted ecological fieldwork, mapping, detailed habitat assessment, and ultimately, impact assessment consideration against the type and form of the proposal.



5.0 Study Certification and Licencing

This report was written by Lucy Knutson BSc, Dennis Neader BSc and Joel Stibbard BSc of Anderson Environment & Planning.

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence SL101313;
- Animal Research Authority (Trim File No: 14/600(2)) issued by NSW Agriculture; and
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 14/600(2)) issued by NSW Agriculture.

Certification:

As the principal author, I, Joel Stibbard, make the following certification:

- The results presented in the report are, in the opinion of the principal author and certifier, a true and accurate account of the species recorded, or considered likely to occur within the subject site;
- Commonwealth, state and local government policies and guidelines formed the basis of project surveying methodology, unless specified departures from industry standard guidelines are justified for scientific and/or animal ethics reasons; and
- All research workers have complied with relevant laws and codes relating to the conduct of flora and fauna research, including the *Animal Research Act 1995*, *National Parks and Wildlife Act 1974* and the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes.

Principal Author and Certifier:

JOEL STIBBARD

Ecology / GIS Manager

Anderson Environment & Planning

June 2017



6.0 Methods

The field surveys for the subject site have been prepared and performed with due recognition of the *LMCC Flora & Fauna Survey Guidelines* (Version 4.2, 2012) with reference to *NSW Guide to Surveying Threatened Plants*, NSW Office of Environment and Heritage (2016).

The size of the site, the type of native vegetation and habitats remaining, the status of existing and proposed surrounding land use, and the level and type of habitat linkages to other proximate bushland areas all were considered in formulating the methodology employed and described below.

The assessment approach was tailored to undertake sufficient works to ensure that legislative requirements were met relating to threatened species and native species in general for the proposed specific development.

To ensure a robust impact assessment approach, where any potential doubt remained over species impact, presence within the study area was assumed to ensure an overly conservative approach was employed.

Note that all survey works targeted the subject site, however considerations for the wider study area are provided within this assessment where appropriate.

6.1 Literature Review

Primary information sources reviewed included:

- Aerial Photograph Interpretation (API) of the site and surrounding locality;
- LMCC Flora & Fauna Survey Guidelines (Version 4.2, 2012)
- OEH Threatened Species, Populations and Ecological Communities website (<http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/>); and
- Collective knowledge gained from previous ecological survey and assessment in the Warners Bay area over the past 20 years.

In addition, database searches were carried out, namely:

- Search and review of flora and fauna sighting records in the OEH Atlas of NSW Wildlife within 10km of the subject site; and
- Protected Matters Search within a 5km radius of the study area held by the Commonwealth Department of the Environment and Energy, summarising Matters of National Environmental Significance that may occur in, or may relate to the study area.

Note that records considered erroneous, historic, or obviously of no relevance to the site in regards to habitat (e.g. seabirds, marine species etc.) were omitted.



6.2 Field Survey

6.2.1 Vegetation Communities

Vegetation was surveyed utilising a variety of methods, as outlined below:

- Review of the vegetation mapping for the area by Eastcoast Flora Survey (March 2016);
- Review of API to identify any obvious notable variations within the study area;
- Consultation of 1:25,000 topographic map series for the area;
- Study area inspection to ground truth the unit(s) identified by API; and
- Fieldwork, including floristic inventory within the study area (see below).

The final derived vegetation map was based on the Eastcoast Flora Survey mapping and subsequent ground-truthing of the mapping by fieldwork. The dominant species composition, structural and physical attributes were all considered when assigning the best fit community type.

Consideration was given to the potential for derived vegetation community(s) to constitute EEC, as listed under the TSC Act and/or EPBC Act. Study area floristic composition, geomorphological characteristics and geographical extent were considered in this process.

6.2.2 Flora

A general flora survey was undertaken to produce a flora species list for the study area, to conduct targeted searches within the subject site specifically for threatened flora species known from the wider locality, and to gather data necessary to both derive vegetation community type and to meet the survey guidelines of relevant authorities. Survey works included:

- Identification of all vascular plant species encountered during fieldwork. Coverage by standard plot or transect was deemed unnecessary due to the lack of understorey vegetation caused by the management of ground cover within the study area. Adequate survey coverage was achieved by recording all species found in walkovers within the study area and follow-up incidental observations during fieldwork; and
- Targeted searches in areas of potentially suitable habitat were undertaken within the subject site for threatened flora species identified by literature searches.

The highly disturbed nature of the study area permitted this methodology to achieve adequate coverage therein. A full inventory of flora species recorded during fieldwork is included as **Appendix A**.



6.2.3 Habitat

An assessment of the relative habitat values present within the study area was carried out. This focused primarily on the identification of specific habitat types and resources favoured by identified threatened species from the region. The assessment also considered the potential value of the study area and locality for major guilds of native flora and fauna.

For threatened flora species and assemblages, consideration was given to limiting factors including geology, soil, topography, aspect and micro-climate. For threatened fauna, assessment was based on the specific habitat requirements of species in regards to home range, feeding, roosting, breeding, ranging patterns and corridor requirements.

Particular focus was placed on documenting the presence of key fauna habitat features, such as hollow bearing trees (HBTs), and fissures in tree bark. These features can provide habitat for cavity-dependent fauna including microbats, gliders and other arboreal mammals, reptiles, amphibians as well as some bird species.

Hollows of all sizes are an important resource that can be utilised by a variety of forest fauna, and are particularly relevant for several key threatened species likely to occur in the locality. Vertebrate and invertebrate species use hollows as diurnal or nocturnal shelter sites, for rearing young, feeding, thermoregulation, and to facilitate ranging behaviour and dispersal. Hollows, especially large deep hollows >45cm diameter suitable for forest owls and their prey, can take many decades to develop (DEC, 2006).

The survey design incorporated appropriate sampling methodologies in these habitats, although they were considered at best marginal. HBTs were mapped within the subject site utilising the methodology of tree hollow identification set by OEH in the *BioBanking Field Plot Methodology* (Feb 2009), namely:

"A hollow is only recorded if: (a) the entrance can be seen; (b) the minimum entrance width is at least 5cm across; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); and (d) the hollow is at least 1m above the ground (this omits hollows in cut stumps or at the base of trees)".

A table of HBTs is attached in **Appendix D**.

6.2.4 Fauna

Given the proposed rezoning area occurs within a highly disturbed mosaic lacking understorey vegetation and ground habitat (litter, logs, rocks etc), active intrusive fauna survey methods (i.e. physical trapping) were deemed unnecessary under relevant guidelines and hence not utilised. Targeted survey work was still conducted however, and included:

- Seven Scout-guard White-flash (SG 562-C) motion sensor cameras deployed within the study area. The camera field-of-view areas were baited with a variety of different lures, which at various deployment locations included combinations of tuna, sardines, universal bait (rolled oats, honey and peanut butter), dog food and sugar water (water,



honey and vanilla essence). The camera traps were deployed for four nights, resulting in a total of 28 functioning camera trap nights;

- Bat echolocation calls were recorded for four nights between dusk and dawn using Anabat Detector within the study area. Recordings were analysed by Echo Ecology utilising Analook commercial software;
- Avifauna surveys. Birds were identified by direct observation, by recognition of calls, any sightings of secondary distinctive features such as nests, feathers etc. during fieldwork;
- Herpetofauna (frog and reptile) searches. Searches were made in areas with appropriate habitat. Such habitat is limited within the study area to edges of the dam, and the vegetated riparian zone (VRZ) of the 1st order watercourse; and
- Incidental records of fauna species observed during fieldwork were noted. This included searches for secondary indications (scratches, scats, diggings, tracks etc.) that may indicate resources for resident or migratory species. Searches were also conducted for whitewash, regurgitation pellets and prey remains from Owls, chewed Casuarinaceae cones from Black-Cockatoos, chewed fruit remains from frugivorous birds, koala scats etc.

The location of motion sensor camera and Anabat deployments within the study area is provided in **Figure 3**.



6.2.5 Survey Dates, Times & Activities

Table 1 – Field Survey Effort

Date	Time	Field Activity
10/10/2016	9:00am -11:30am	1 person - Site familiarisation, <i>Tetratheca juncea</i> survey, habitat assessment and incidental flora and fauna survey.
15/05/2017	2:00pm – 6.:30 pm	2 people - Site familiarisation, Anabat deployment, flora species list compilation, habitat assessment and incidental fauna survey, dusk survey of habitat trees and camera traps deployed with suitable baits (5 for arboreal and 2 for terrestrial fauna)
16/05/2017	5:45pm – 7:00pm	1 person - After dark habitat survey for nocturnal fauna, spotlight search of study area and incidental fauna survey.
19/05/2017	11:30am – 3:30pm	2 people - Camera and Anabat retrieval, flora species list compilation and incidental fauna survey.

The above survey methodology is considered to provide sufficient understanding of the biodiversity of the study area, given the disturbed nature of the vegetation assemblages therein.

In addition, by applying rigorous habitat assessment to more mobile species with OEH Atlas records within the locality, it was ensured that all possible use of the study area and wider site by notable species was considered, and hence accommodated within subsequent biodiversity assessment and management recommendations.

The minimum survey effort recommended by LMCC and corresponding survey effort by AEP is detailed in **Table 2** below.

Table 2 – LMCC Recommended Minimum Effort for ‘Highly Disturbed Site - Habitat Present’.

Survey Type	Recommended Survey Effort	Fieldwork Undertaken
Flora	Flora Survey: A flora species inventory (list) of the site	Threatened species search for <i>Tetratheca juncea</i> plus site flora inventory performed. 10 person hours. Flora Species List is attached as Appendix A .
Fauna	General: 2 nights spotlight search	2 nights spotlighting from dusk until dark survey of habitat trees – total of 6 person hours. An expected fauna list is attached as Appendix B .
	Pond or steam present: Specific searches for <i>Crinia tinnula</i> on 2 nights + 1 diurnal search	1 person - After dark habitat survey for nocturnal fauna, spotlight search of study area and incidental fauna survey. An expected fauna list is attached as Appendix B .
	Reptile diurnal search: Site <5 ha – 1 morning	Total of 6 person hours. An expected fauna list is attached as Appendix B .
	Diurnal bird census: Site <5 ha – 1 morning	Total of 6 person hours. An expected fauna list is attached as Appendix B .
	Mapping of all habitat trees: Each habitat tree mapped with species, number and size of hollow recorded	Trees with habitat features for arboreal fauna were GPS tagged and species, size and type of habitat recorded. Habitat trees are shown in Figure 3 . A habitat tree register is attached as Appendix C .



	<p>Anabat: 2 all-night recordings + 2 nights stagwatch - if very good bat roosts are present, it is recommended that detector time is doubled to 4 all-night recordings or 4 hrs of unattended detector on 2 separate evenings, including the first 2hrs after dusk and targeting potential roost sites</p>	<p>4 nights' continuous recording in suitable habitat, and 2 nights spotlighting. Anabat report is attached as Appendix C.</p>
	<p>Stagwatch habitat trees: 2 nights stagwatch</p>	<p>2 nights spotlighting from dusk until dark survey of habitat trees – total of 6 person hours. An expected fauna list is attached as Appendix B.</p>



7.0 Results

7.1 Database Searches

Searches were undertaken of databases within a 10km radius of the study area for TSC Act listings and 5km radius for EPBC Act listings. Note that any records considered erroneous, historic only, or obviously of no relevance to the site in regards to habitat (e.g. seabirds, marine species etc.) were omitted.

The potential for listed threatened species to occur within the site is considered in **Table 3** below.

Detailed ecological profiles of threatened species can be found at:

<http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/>

Table 3– Threatened Species Appraisal

Scientific Name	Common Name	TSC Act	EPBC Act	No of Bionet Atlas records	Likelihood of Occurrence (EPBC comments in italics where recorded in EPBC search)
Plants					
<i>Angophora inopina</i>	Charmhaven Apple	V	V	555	Requires open woodland with a dense shrub understorey on deep white sandy soils over sandstone. No suitable habitat and unlikely to remain undetected by survey within the highly disturbed and open site. Considered unlikely to occur.
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V	NL	81	Grows in dry sclerophyll forest on the coast and adjacent ranges. Unlikely to remain undetected by survey within the small and disturbed site and is considered unlikely to occur.
<i>Grevillea parviflora</i> <i>subsp. parviflora</i>	Small-flower Grevillea	V	V	49	Grows in heathy associations or shrubby woodland, in sandy or light clay soils usually over shale substrate. No habitat within site. Unlikely to remain undetected by survey within the highly disturbed and open site and is considered unlikely to occur.
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	2	Grows in damp places, often near streams; Project will remove a small amount of suitable habitat. Unlikely to remain undetected by survey within the highly disturbed and open site. Considered unlikely to occur.
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E1	V	3	Grows in subtropical and littoral rainforest on sandy soils. Unlikely to remain undetected by survey within the highly disturbed and open site. Considered unlikely to occur.
<i>Tetradlea juncea</i>	Black-eyed Susan	V	V	1273	.Not recorded despite targeted surveys during flowering period. Unlikely to remain undetected within the highly disturbed, grazed and open site. Considered unlikely to occur.



Scientific Name	Common Name	TSC Act	EPBC Act	No of Bionet Atlas records	Likelihood of Occurrence (EPBC comments in italics where recorded in EPBC search)
Birds					
<i>Anthochaera phrygia</i>	Regent Honeyeater	E4	CE	1	Single Atlas record and no sign of this species during fieldwork. This highly mobile species could possibly occur during winter flowering of the few <i>Corymbia maculata</i> trees within study area, however frequent use of the site by resident, territorial "edge effect" birds such as Noisy Miner and Noisy Friarbird would likely preclude regular use (Roderick et al, 2013). Seasonal resources within larger patches of habitat are available in the wider locality. Considered unlikely to be affected to any notable degree by the proposal.
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V	NL	2	Records >3km away. Primarily inhabit dry, open eucalypt forests and woodlands with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. Very occasionally in moist forest. Some suitable habitat within the highly disturbed and open site. Considered unlikely to be affected by the proposal.
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	NL	1	Found in tall mountain forests and heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. Site would therefore represent winter foraging habitat only and therefore the species is considered unlikely to be affected by the proposal.
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	NL	7	Sparse Atlas records all >2km away from subject site. Requires rough-barked species and mature smooth-barked gums with dead branches. Limited potential foraging habitat within site. Considered unlikely to be affected by the proposal
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	V	E	NR	Requires dense, low vegetation including heath and open woodland with a heathy understorey. No habitat on site. Considered unlikely to occur.
<i>Epthianura albifrons</i>	White-fronted Chat	V	NL	3	Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. Limited amount of extremely marginal foraging habitat to be removed by the proposal. Considered unlikely to occur or to be impacted by the proposal.



Scientific Name	Common Name	TSC Act	EPBC Act	No of Bionet Atlas records	Likelihood of Occurrence (EPBC comments in italics where recorded in EPBC search)
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	NL	2	Limited records, but one adjacent to site. No sign of species during fieldwork. Species could possibly utilise numerous small hollows within mature eucalypt trees within the study area for roosting and nesting, and limited winter foraging resources would be available from Spotted Gums. SUBJECT SPECIES
<i>Grantiella picta</i>	Painted Honeyeater	V	V	NR	Inhabits Weeping Myall, Brigalow, Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Resources (marginal) available for this nomadic species in the wider study area, which will not be affected by the proposal. Considered unlikely to occur or to be impacted by the proposal.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	NL	12	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. No suitable habitat on site. Considered unlikely to be impacted by the proposal.
<i>Hieraaetus morphnoides</i>	Little Eagle	V	NL	2	Occupies open eucalypt forest, woodland or open woodland. Limited foraging habitat on site. Considered unlikely to be impacted by the proposal to any notable degree.
<i>Lathamus discolor</i>	Swift Parrot	E1	CE	2	No sign of this species during fieldwork. This highly mobile species could possibly occur during winter flowering of the few <i>Corymbia maculata</i> trees within study area. Seasonal resources within larger patches of habitat are available in the wider locality. Considered unlikely to be affected to any notable degree by the proposal.
<i>Ninox connivens</i>	Barking Owl	V	NL	2	No sign of this species despite targeted fieldwork. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Records sparse within the Lower Hunter and the species is considered unlikely to occur.
<i>Ninox strenua</i>	Powerful Owl	V	NL	41	Many records, including one in adjoining Munibung Hill area. No sign of species during fieldwork despite targeted surveys. Few large hollows within subject site, and habitat trees for prey could represent part of wider home range. SUBJECT SPECIES
<i>Pandion cristatus</i>	Eastern Osprey	V	NL	12	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes where they feed on fish over open water. Species considered unlikely to be affected by the proposal.



Scientific Name	Common Name	TSC Act	EPBC Act	No of Bionet Atlas records	Likelihood of Occurrence (EPBC comments in italics where recorded in EPBC search)
<i>Petroica boodang</i>	Scarlet Robin	V	NL	2	Lives in dry eucalypt forests and woodlands, with open and grassy understorey with few scattered shrubs and abundant logs and fallen timber are important components of its habitat. The subject site contains very limited habitat, and the highly disturbed nature of the small patch size makes it unlikely to constitute important habitat.
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V	NL	1	Occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. Subject site contains very limited habitat, and the small patch size makes it unlikely to constitute important habitat.
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V	NL	1	Occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. Subject site contains very limited habitat, and the small patch size makes it unlikely to constitute important habitat.
<i>Tyto novaehollandiae</i>	Masked Owl	V	NL	11	Several records within 2km of subject site. Fieldwork revealed the study area contains a variety of prey available; small arboreal mammals and terrestrial mammals. Few large hollows within site, and habitat trees for prey could represent part of wider home range foraging habitat for this species. SUBJECT SPECIES
<i>Tyto tenebricosa</i>	Sooty Owl	V	NL	3	Fieldwork revealed study area contains a variety of prey; small arboreal mammals and terrestrial mammals, however species prefers moist well vegetated gully forests, which are lacking from the site.
Mammals					
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	NL	2	Recorded <1km from subject site in 2011. Small amount of potential foraging habitat within subject site. Subject site contains very limited and isolated habitat, and the small patch size makes it unlikely to constitute important habitat.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	2	Very limited amount of potential foraging habitat within study area, but no caves or overhangs for roosting and nesting. The open nature of the small subject site makes it unlikely to constitute utilised habitat.
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll (SE mainland population)	V	E	4	Nearest Atlas record >3km from subject site. Although the subject site could constitute a small part of a foraging home range, the highly open, disturbed and fragmented nature and small patch size of the study area makes it unlikely to constitute utilised habitat.



Scientific Name	Common Name	TSC Act	EPBC Act	No of Bionet Atlas records	Likelihood of Occurrence (EPBC comments in italics where recorded in EPBC search)
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	NL	1	Atlas record <1km from subject site. Not recorded in field or echolocation surveys. Prefers moist habitats, with trees taller than 20 m. Very limited amount of potential habitat within subject site. The disturbed nature and small patch size of the study area makes it unlikely to constitute important habitat. SUBJECT SPECIES
<i>Miniopterus australis</i>	Little Bent-winged Bat	V	NL	69	Fifteen records over two nights in echolocation surveys, and numerous Atlas records within 1km. Small hollows and fissures on site would provide roosting habitat and vegetated areas would provide foraging habitat. SUBJECT SPECIES
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-winged Bat	V	NL	51	Several Atlas records within 500m of subject site. Not recorded in field or echolocation surveys. No caves or tunnels available for roosting, however the existing homestead may provide roosting opportunities for individuals.
<i>Mormopterus norfolkensis</i>	Eastern coastal Free-tailed Bat	V	NL	16	Multiple Atlas records including one in adjacent site. The subject site could represent a small amount of foraging and roosting habitat as part of a wider range. SUBJECT SPECIES
<i>Myotis macropus</i>	Southern Myotis	V	NL	2	One record from 2006 within 500m of subject site. Small hollows and fissures on site would provide roosting habitat however foraging habitat limited to small dam. SUBJECT SPECIES
<i>Petauroides volans</i>	Greater Glider	NL	V	NR	Requires a variety of eucalypt species for seasonal foraging and abundant hollows for nesting. The open, disturbed and fragmented nature and small patch size of the study area makes it unlikely to occur.
<i>Petaurus australis</i>	Yellow-bellied Glider	V	NL	2	Two records >3km of subject site. No signs of site use observed in fieldwork. The subject site could represent a small amount of foraging and roosting habitat for this highly mobile species. Considered unlikely to occur or for the site to constitute important habitat.
<i>Petaurus norfolkensis</i>	Squirrel Glider	V	NL	68	Several previous records adjacent to sight but all prior to 2006. Not recorded in fieldwork despite targeted efforts. The subject site could represent a small amount of foraging and roosting habitat for this highly mobile species. SUBJECT SPECIES



Scientific Name	Common Name	TSC Act	EPBC Act	No of Bionet Atlas records	Likelihood of Occurrence (EPBC comments in italics where recorded in EPBC search)
<i>Phascolarctos cinereus</i>	Koala	V	V	2	Records >3km away. No sign of species during fieldwork. The SEPP 44 schedule 2 listed preferred feed tree <i>Eucalyptus punctata</i> (Grey Gum) was recorded on site. Highly urbanised nature of the locality and lack of recent records makes it unlikely to constitute utilised habitat. Further consideration provided in Section 12 .
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	40	Several records within 1km of subject site. The subject site represents limited foraging habitat, and a lack of dense canopy habitat makes the subject site highly unlikely to constitute potential roosting habitat.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	NL	1	Single Atlas record 4km away. Not recorded during echolocation surveys. The subject site represents very limited amount of foraging and roosting habitat. SUBJECT SPECIES
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	NL	9	One record within 2km of subject site. Not recorded in echolocation surveys. However, the subject site could represent a very limited amount of foraging and roosting habitat. SUBJECT SPECIES
<i>Vespertilio troughtoni</i>	Eastern Cave Bat	V	V	3	Cryptic cave-roosting species. Small amount of potential foraging habitat within subject site. The small patch size of the highly disturbed study area makes it unlikely to constitute utilised habitat.
Endangered Ecological Communities					
Central Hunter Valley Eucalypt Forest and Woodland		NL	CE	NR	Community may occur in area. Field surveys have determined that this community does not occur and is highly unlikely to have occurred previously. Fieldwork confirmed the vegetation on site to constitute a highly disturbed variant of Hunter Valley Moist Forest (MU12 - Bell, 2015). No other vegetation communities present would constitute a Threatened Ecological Community.

Table Key - Status (TSC Act & EPBC Act):

- CE: Critically Endangered (EPBC Act)
- E: Endangered (EPBC Act)
- E1: Endangered (TSC Act)
- E4: Critically Endangered (TSC Act)
- NL: Not Listed (EPBC Act & TSC Act)
- NR: No records (TSC Act)
- V: Vulnerable (EPBC Act & TSC Act)

From the above, the following species are considered key subject or indicator species for the subject site due to being recorded on site, potentially likely to forage and roost or nest on the site, the site potentially forms an important part of a local home range for resident specimens and some potential habitat will be removed by the proposal.



Scientific Name

Common Name

<i>Glossopsitta pusilla</i>	Little Lorikeet
<i>Ninox strenua</i>	Powerful Owl
<i>Tyto novaehollandiae</i>	Masked Owl
<i>Petaurus norfolcensis</i>	Squirrel Glider
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle
<i>Miniopterus australis</i>	Little Bent-winged Bat
<i>Mormopterus norfolkensis</i>	Eastern Coastal Free-tailed Bat
<i>Myotis macropus</i>	Southern Myotis
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat

Detailed assessment of these and other potential threatened entities is provided in the following sections.

7.2 Flora

Flora surveys identified 107 species within the study area, with 48 of those exotic species (approx. 45%). A full list of flora species identified by surveys conducted within the study area is included in **Appendix A**.

Fieldwork revealed the subject site understorey was highly and almost completely disturbed, and was dominated by noxious weeds, pasture grasses and other rank weeds. No listed threatened flora were recorded within the study area and given the extent of previous vegetation clearing and anthropogenic disturbance generally within the study area and wider locality such species are considered unlikely to occur.

Vegetation within the subject site was divided into five assemblages:

- Cleared / Disturbed Areas** – The majority of the study area presented as open areas, subject to heavy grazing and contained pasture grasses and weeds including *Cynodon dactylon* (Common Couch), *Paspalum dilatatum* (Paspalum), *Chloris gayana* (Rhodes Grass), *C. virgata* (Feathertop Rhodes Grass) and *Melinis minutiflora* (see **Plates 1, 2, 3 & 5**) Other areas included an exotic shrub layer of *Ligustrum sinense* (Small-leaf Privet) and the native but invasive *Pittosporum undulatum* (Sweet Pittosporum) along with other garden escapees; however much of these areas have been recently removed following active weed management works on the site.
- Remnant Native Canopy Patches** – Small patches of grazed land where canopy is present, *Corymbia maculata* (Spotted Gum) is the dominant eucalypt species, along with *Eucalyptus acmenoides* (White Mahogany) and *E. punctata* (Grey Gum), along with *Allocasuarina torulosa* (Forest Oak) and *Syncarpia glomulifera* ssp. *glomulifera*



(Turpentine). Occasional shrub species recorded included *Leptospermum polygalifolium* (Tantoon), *Lophostemon confertus* (Brush Box), *Acacia falcata* and *Melaleuca stypheloides* (Prickly-leaved Tea Tree), although *Ligustrum sinense* (Small-leaf Privet) and other weed species dominated native species in the shrub layer (see **Plate 1**);

- **1st Order Watercourse Vegetated Riparian Zone** - Mature *Corymbia maculata* (Spotted Gum), *Eucalyptus acmenoides* (White Mahogany), *E. paniculata* (Grey Ironbark), *E. punctata* (Grey Gum), along with *Allocasuarina torulosa* (Forest Oak), *Syncarpia glomulifera* ssp. *Glomulifera* (Turpentine) *Archontophoenix cunninghamiana* (Bangalow Palm) and *Livistona australis* (Cabbage Tree Palm). Understorey species included *Pittosporum undulatum* (Sweet Pittosporum), along with understorey species *Dichondra repens* (Kidney Weed), *Adiantum hispidulum* (Rough Maidenhair) and *Cheilanthes sieberi* (Rock Fern). *L. sinense* and other rank weeds dominated the banks of the VRZ (see **Plate 3**);
- **Dam** – The dam supports a narrow band of fringing vegetation, consisting mostly of invasive exotic species; *Agave americana* (Century Plant), *Alternanthera philoxeroides* (Alligator Weed), *Ricinus communis* (Castor Oil Plant), dominating scattered remnant native shrubs *Acacia longifolia* and *Pittosporum undulatum* (Sweet Pittosporum), along with understorey species *Adiantum hispidulum* (Rough Maidenhair), *Cheilanthes sieberi* (Rock Fern), *Juncus usitatus* (Common Rush). The dam included aquatic vegetation including *Schoenoplectus validus* (River Clubrush) and mats of *Azolla pinnata* (Red Azolla) (see **Plate 4**); and
- **Remnant Native Vegetation Patch** - One patch of remnant native vegetation in moderate condition, of approx. 1400m² which lies in the south-east corner of Lot 100, had a mature assemblage of the above canopy species, along with a regenerating understorey of native shrubs including *Glochidion ferdinandi* var. *ferdinandi* (Cheese Tree), *Acacia irrorata* (Green Wattle), *A. falcata*, *A. longifolia* and *A. implexa* (Hickory Wattle). Native groundcovers included *Aristida vagans*, (Threeawn Speargrass), *Dianella caerulea* var *producta* (Blue Flax-lily) *Pratia purpurascens* (Whiteroot) and *Lomandra longifolia* (Spiny-headed Mat-rush). AEP understands some of the regenerating natives in this area were planted (pers. comm). Understorey exotic species were also vigorously regenerating and included *Chloris gayana* (Rhodes Grass), *Ehrharta erecta* (Panic Veldtgrass), *Paspalum dilatatum* (Paspalum), *Pennisetum clandestinum* (Kikuyu), *Sporobolus africanus* (Parramatta Grass), *Lantana camara* (Lantana) *Verbena bonariensis* (Purpletop), *Bidens pilosa* (Cobbler's Pegs) and *Conyza bonariensis* (Flax-leaf Fleabane) (see **Plate 6**). Much of this community had been subject to thinning and/or understorey management as part of 10/50 bushfire hazard reduction allowances around the existing homestead in the area.



Plate 1. Study area with subject site in foreground, looking west along the north boundary and showing highly disturbed and managed pasture lands with patches of scattered canopy trees and absence of understorey vegetation. Munibung Hill is in the background.



Plate 2 –Subject site Lot 6 looking south from north boundary fence showing highly disturbed and managed pasture lands with absence of understorey vegetation, the existing residence on Lot 6 in the background, and residential development along the eastern boundary on the left.



Plate 3. Subject site (Lot 6) looking towards the vegetated riparian zone associated with the 1st order watercourse, showing intact native canopy species with understorey vegetation dominated by Privet species.



Plate 4. – The dam with existing residence on Lot 6 in background right.



Plate 5. – Lot 100 subject site looking east from Munibung Hill, showing apiaries, vegetated riparian zone on left, managed grasslands and remnant native vegetation in the south-east corner of the subject site on the right.



Plate 6. – Remnant native patch in Lot 100 in the south-east corner of the subject site, with regenerating native vegetation and mature eucalypts with habitat features.



7.3 Vegetation Communities

Fieldwork has revealed that the majority of the subject site exists in a highly disturbed state, is almost totally cleared of native shrub and understorey layers, and presents mostly as exotic seeded pasture and weedy grassland, apart from isolated patches, the largest of which (approx. 1400m²) lies in the south-east corner of Lot 100 with mature eucalypt species, mainly *Corymbia maculata* (Spotted Gum) species. This area had a regenerating understorey of native shrubs including *Glochidion ferndinandi* var. *ferndinandi* (Cheese Tree), *Acacia irrorata*, *A. longifolia* and *A. implexa*, and native groundcovers including *Aristida vagans*, (Threeawn Speargrass), *Dianella caerulea* var. *producta* (Blue Flax-lily) *Pratia purpurascens* (Whiteroot) and *Lomandra longifolia* (Spiny-headed Mat-rush). Understorey exotic species were vigorously regenerating and included *Chloris gayana* (Rhodes Grass), *Ehrharta erecta* (Panic Veldtgrass), *Paspalum dilatatum* (Paspalum), *Pennisetum clandestinum* (Kikuyu), (Kikuyu Grass), *Sporobolus africanus* (Parramatta Grass), *Lantana camara* (Lantana) *Verbena bonariensis* (Purpletop), *Bidens pilosa* (Cobbler's Pegs) and *Conyza bonariensis* (Flax-leaf Fleabane).

Vegetation within the study area was deemed to constitute a disturbed variant of Hunter Valley Moist Forest (Unit 12) (Eastcoast Flora, 2016). This community does not constitute a threatened or endangered ecological community under either the TSC Act or EPBC Act.

Remaining areas of the subject site include grazed pasture, with paddock trees dotted throughout and an understorey of grasses and exotic shrubs. Species identified within the development footprint were dominated by exotics, including *Solanum mauritianum* (Wild Tobacco), *Rubus fruticosus* agg. (Blackberry complex), *Ligustrum lucidum* (Large-leaf Privet), *Ligustrum sinense* (Small-leaf Privet), *Pennisetum clandestinum* (Kikuyu), *Sporobolus africanus* (Parramatta Grass) and *Stenotaphrum secundatum* (Buffalo Grass).

Fifty seven (57) native flora species were encountered, but given the absence of shrub layer, the highly managed nature of the development footprint being subject to a mosaic of long-term anthropogenic land use, the majority of the study area was not deemed to constitute a native vegetation community, except for vegetation along the western boundary of the study area. This area presents as a solid 'wall' of mature noxious weeds below remnant native vegetation of similar canopy composition to that identified within the subject site.

A search of the EPBC database revealed *Central Hunter Valley Eucalypt Forest and Woodland EEC* has the potential to occur in the (5km radius) locality. Field surveys determined that this community does not occur and is highly unlikely to have occurred previously.

A Vegetation Map is provided in **Figure 3** and photographs of the subject site vegetation are provided in **Plates 1 to 6**.



7.4 Threatened Flora

No listed threatened plants were recorded within the study area. The highly disturbed and managed nature of the subject site make it unlikely that threatened flora species would be present.

7.5 Habitat Assessment

The site offers habitat features for native fauna as outlined below:

- **Trees** – mature canopy trees within the study area could provide potential seasonal foraging resources for nectivorous, insectivorous and to a lesser extent, frugivorous species;
- **Hollows** - Vertebrate and invertebrate species use hollows, crevasses and peeling bark for; diurnal or nocturnal shelter sites, rearing young, feeding, thermoregulation, and to facilitate ranging behaviour and dispersal. Nine HBTs were identified within the subject site and another three HBTs were recorded within the vegetation adjoining the subject site in the south-east of the lot (noting HBT surveys were not conducted in areas west of the rezoning area). HBTs were stagwatched on dusk, with no emerging fauna observed. The location of HBTs is shown in **Figure 3** and a description is provided in **Appendix D**.
- **Shrubs** - generally absent within the subject site due to highly managed understorey, and were intact (i.e. VRZ) it was dominated by exotics, particularly *Ligustrum* species.
- **Patch Size and Connectivity** – The subject site is tentatively connected to larger patches of forest to the west via disturbed vegetation along the boundary of both lots. The vegetated section in the south-west of the study area presents as a solid 'wall' of mature noxious weeds that directly adjoins offsite native vegetation on the east-facing slopes of Munibung Hill E2.

In summary, although highly disturbed, the subject site does provide potential habitat for fauna species. The approx. 0.98ha of remnant vegetation within the subject site likely to be removed or modified following rezoning includes a number of mature native canopy species that could provide potential habitat for arboreal and terrestrial mammals and numerous bird species reliant upon available resources therein. However, the small size of remnant patches within the subject site is only likely to form part of the home range for any given species, and habitat connectivity with these patches is tenuous.

7.6 Fauna


Fauna surveys identified 52 vertebrate species within the subject site, consisting of ten mammals, one reptile, two amphibians and 39 birds. Six of the mammals and three birds were exotic. Species recorded were typical of the disturbed and managed vegetation assemblages that occur within the subject site.


An Expected Fauna Species List was generated for the site and is included as **Appendix B**. Fauna species recorded during fieldwork are noted therein.

Disclaimer: While all reasonable care has been taken to ensure the information shown on this map is up to date and accurate, no guarantee is given that the information


Legend



Study Area

 Lot 6 DP 814499



 Lot 100 DP 1173625


 Subject Site

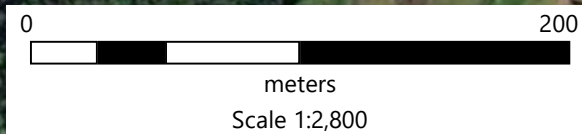
 Hunter Valley Moist Forest

 1st Order Watercourse
 Vegetated Riparian Zone (VRZ) (to be retained)

Survey Effort

 Motion Sensor Camera
 Anabat

 Hollow-bearing Tree



ANDERSON
ENVIRONMENT & PLANNING

P 0418 681 581 E CRAIG@ANDERSONEP.COM.AU



Title: Figure 3 - Survey, Vegetation and Habitat

Location: Warners Bay

Client: PCB

Date: 21.6.17

Our Ref: 1495

Notes:
1. Boundaries are not survey accurate
2. Do not scale from plan



8.0 Key Species Considerations

Following works outlined in previous sections, species identified for further consideration have been categorised into guilds for simplicity of assessment.

By considering these species and their lifecycle needs, many other species are also inadvertently considered as well in identifying key features. The analysis below considers key lifecycle features for each guild of species in more detail, and assists in informing the **7 part test assessment** in **Section 9** and the **EPBC Act Assessment** in **Section 10**.

Table 4 - Key Species Considerations

Species	Key Habitat Feature	Comment
Nectivorous Birds including: Little Lorikeet	Foraging Resources	The subject site contains a number of mature <i>Corymbia maculata</i> trees that could provide winter resources for small nectivorous birds, which will be removed as a result of the proposal. Other seasonal resources within larger patches of connected habitat are available in the wider locality.
	Roosting and Nesting	The site supports numerous HBTs, which offer potential roosting and nesting habitat for small birds. Regular use of the site by resident, territorial “edge effect” birds such as Noisy Miner and Noisy Friarbird may reduce potential utilisation for this purpose.
	Connectivity	Given the high mobility of Little Lorikeet, the site is considered viably connected to other potential habitat areas within the Munibung Hill patch and wider landscape matrix.
Forest Owls including: Powerful Owl Masked Owl	Roosting and Nesting	The subject site offers mature tall eucalypts for roosting and several sub-optimal hollows potentially large enough for nesting, which may be removed as a result of the proposal. E2 lands in the west of the study area provide larger amounts of habitat with tall mature eucalypts which could provide more suitable habitat for forest owls.
	Prey Species	The subject site contains suitable prey species such as Possum species, as evidenced by field survey results. Small terrestrial fauna was recorded within the study area for Masked Owl.
	Home Range	Forest Owls have a large home range, foraging principally within 2 km of their nest site to meet their hunting requirements. If utilised, the site would be a small component of a larger home range within the wider locality.
Gliders including: Squirrel Glider	Roosting and Nesting	A number of mature trees with suitably sized nesting and roosting habitat within the subject site may be removed by the proposal.
	Foraging	Require access to suitable seasonal foraging habitat for this omnivorous species. The subject site contains a limited variety of vegetation that would offer such resources.
	Home Range & Connectivity	Subject site provides connectivity between R2 zoned vegetation in south-east of study area (subject to separate subdivision DA) and vegetation on Munibung Hill, however connectivity reliant upon paddock trees and disturbed patches in the west of the study area.



Species	Key Habitat Feature	Comment
Microbats including: Eastern False Pipistrelle Little Bent-winged Bat Eastern Coastal Free-tailed Bat	Roosting and Maternity Habitat	A number of hollows and habitat recorded within the subject site could represent roosting or maternity habitat, and other undetected small hollows and areas of exfoliating bark may also provide intermittent roosting habitat. No caves or other suitable structures were identified for species requiring such habitat for roosting or nesting.
Yellow-bellied Sheath-tail-bat Greater Broad-nosed Bat Southern Myotis	Foraging	Whilst the various microbat species have differing micro-habitat preferences for foraging habitat, they all seek insects in and around forested areas, and may also at times forage around proximate developed areas. The vegetated parts of the subject site would provide potential flyways for microbat species. The existing dam provides some limited foraging habitat for Southern Myotis.



9.0 7 Part Test Assessment

Section 5A of the EP&A Act lists seven factors that must be taken into account in determining the significance of potential impacts of proposed activities on threatened species, populations, ecological communities and/or their habitats as listed within the TSC Act.

The 7 part test is used to determine whether there is likely to be a significant impact, and thus whether a Species Impact Statement is required to accompany a development application.

For the purposes of the 7 part test assessment:

- **Subject site** - the area within which direct impacts of the proposed development (the disturbance footprint) will occur;
- **Study area** - all of Lot 6 and Lot 100, including the subject site; and
- **Locality** – the proximate area surrounding the subject site, of approx. 10km radius.

(a) *in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*

Nectivorous Birds:

Impacts upon the Little Lorikeet as a result of the proposal may include the removal of an intermittent foraging resource during canopy flowering periods, and the removal of hollows therein that provide potential nesting habitat. However, given the absence of any specific evidence of continued utilisation or residence within the subject site for the species, and the relatively small amount of habitat to be removed, it is not considered likely that the Little Lorikeet will be significantly impacted upon by the proposal.

Forest Owls:

Although hollows were identified within the subject site, including several large hollows, they only provide limited potential as nesting resource for large Forest Owls given the nature of the hollows (i.e. some low to the ground or exposed to the elements), high levels of disturbance within surrounding vegetation and proximity to residential areas. Furthermore, the open nature of the disturbed vegetation and consistent human activity associated with the area limits the suitability of the study area to provide potential diurnal roosts for Forest Owls (outside of the VRZ which is to be retained under the proposal). As a result, the study area would best represent foraging habitat only, with prey species including Possums and terrestrial mammals identified as occurring therein. Coupled with the absence of any specific evidence of continued utilisation or residence within the study area and the relative abundance of habitat within the wider locality for these highly mobile



species, the removal of a small amount of foraging habitat is not considered likely to significantly impact upon a local population of the Powerful Owl or Masked Owl.

Squirrel Glider:

The Squirrel Glider was not recorded within the subject site during recent surveys, however records exist within connected vegetation in the locality (albeit dated) and potential roosting and foraging habitat exists therein.

The proposed rezoning area occurs between a small patch of vegetation (0.35ha) in the south-east of the study area (zoned R2 and subject to its own subdivision DA) and that tentatively connected to the west upon Munibung Hill and beyond. Although the rezoning is likely to remove some vegetation that links these habitat patches, the 1st order watercourse and associated 20m wide Vegetated Riparian Zone (VRZ) will be retained as 'waterfront land' under the WM Act (DPI 2012), effectively allowing for connectivity between the south-east patch (assuming it is not developed itself in the future) and areas to the west to persist. The lack of recent records, small amount of habitat to be removed, and retention of connectivity suggests it is highly unlikely that the proposal will place a local population of Squirrel Glider at risk of extinction. Further consideration is provided in **Section 11**.

Despite this, all efforts should be made to minimise the removal of potential habitat for the Squirrel Glider, in particular hollow-bearing trees, during final subdivision design following the rezoning process. In addition, the removal of any hollow-bearing trees should be mitigated via the installation of nest boxes suitable as roosting habitat for the species within the retained VRZ or other suitable areas of E2 lands in the west of the study area.

Microbats:

Echolocation recordings identified the Little Bent-winged Bat as occurring on the site, while potential habitat and local records exist for other microbat species including Eastern False Pipistrelle, Eastern Coastal Free-tailed Bat, Yellow-bellied Sheath-tail-bat, Southern Myotis and Greater Broad-nosed Bat. All of these species could potentially occupy existing hollows, fissures and exfoliating bark within the mature trees of the subject site, and foraging habitat within and surrounding forested areas constitute foraging habitat for all but the Southern Myotis, which may forage above the existing dam.

Habitat within the site is viably connected with the vegetated surrounds (particularly to the west), all of which represent potential habitat for these species. As a result, given the potential habitat for these species in the locality, it is considered very unlikely that any local population of threatened microbat species are solely dependent on the resources within the study area for their persistence. As such, it is considered unlikely that the development as proposed will significantly impact any local population of these species.

Despite this, all efforts should be made to minimise the removal of potential habitat for microbat species, in particular hollow-bearing trees, during final subdivision design. In addition, the removal of any hollow-bearing trees should be mitigated via the installation of nest boxes suitable as roosting habitat for these species.



(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

No endangered populations were recorded, or are likely to be present.

(c) in the case of an endangered ecological community, whether the action proposed:

- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or***
- (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction***

No Endangered Ecological Communities were identified on or within the study area.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The arboreal habitat that will be removed could constitute a small part of a larger network of habitat resources for some threatened species.

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

The proposed rezoning area occurs between a small patch of vegetation (0.35ha) in the south-east of the study area (zoned R2 and subject to its own subdivision DA) and that tentatively connected to the west upon Munibung Hill and beyond. Although the rezoning is likely to remove some vegetation that links these habitat patches, the 1st order watercourse and associated 20m wide Vegetated Riparian Zone (VRZ) will be retained as 'waterfront land' under the WM Act (DPI 2012), effectively allowing for connectivity between the south-east patch (assuming it is not developed itself in the future) and areas to the west to persist.



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

As outlined above, the habitat present is not considered of significance for long term survival of any threatened species or EEC in this locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No critical habitat is present.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

No relevant Recovery or Threat Abatement Plans have been developed that would apply to the study area, construction activities or the proposal.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

The development has potential to contribute to the following KTP's:

- Anthropogenic Climate Change

The development as proposed will contribute in a small way to the processes causing Anthropogenic Climate Change via the removal of forest vegetation which acts as a carbon sink. It is not considered the contribution to this KTP in this instance is of a notable magnitude.

- Clearing of native vegetation

The development as proposed will involve the removal of approx. 1.08ha of native vegetation. This loss is a direct contribution to this KTP, and contributes to incremental habitat loss in the locality.

- Infection of native plants by *Phytophthora cinnamomi*

There is potential for development of the site to inadvertently introduce *P. cinnamomi* into the site, which may lead to infection and degradation of retained and adjacent vegetation areas. As such, it is recommended that appropriate controls are put in place for all construction related activity to limit such potential.



- Loss of Hollow-bearing Trees.

Nine (9) existing HBTs occur in the subject site and may require removal as a result of the proposed rezoning. To mitigate impacts, retention of HBTs within the final subdivision layout wherever possible is encouraged.

- Removal of dead wood and dead trees

The development as proposed will remove areas that contain dead wood and dead trees. Consideration should be given to relocating larger and/or more significant habitat features such as hollow logs and likely den sites into retained areas.

- Invasion and spread of aggressive weed species

Large areas of the site already support numerous weed species, and it will be necessary to address this problem in retained vegetation areas and the VRZ.

Education of future residents will also be important to ensure that retained areas are not mistreated, resulting in exacerbation of the weed problem.



10.0 EPBC Act Assessment

A Protected Matters Search of an area of 5km radius of the subject site was conducted in May 2017 for Matters of National Environmental Significance as relevant to the Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act). The following Matters of National Significance are considered in this assessment.

World Heritage Properties:

The site is not a World Heritage area, and is not in close proximity to any such area.

National Heritage Places:

The site is not a National Heritage place, and it is not in close proximity to and such places.

Wetlands of International Significance (declared Ramsar Wetlands):

The site is not proximate to any wetlands of international significance.

Great Barrier Reef Marine Park:

The site is not part of, or within close proximity to, the Great Barrier Reef Marine Park.

Commonwealth Marine Areas:

The site is not part of, or within close proximity to, any Commonwealth Marine Area.

Threatened Ecological Communities:

The Protected Matters Search revealed that the listed Endangered Ecological Communities; “*Central Hunter Valley Eucalypt Forest and Woodland*”, may occur within the 5km radius search area surrounding the subject site. Field surveys have determined that this community does not occur and is highly unlikely to have occurred previously. No other vegetation communities present would constitute a Threatened Ecological Community.

Threatened Species:

No threatened species listed in the EPBC Act have been recorded within the study area during fieldwork, from previous database records, or from local anecdotal records.

The limited number and sporadic nature of records close to the subject site appear to reflect opportunistic rather than regular use of habitat that could be considered of importance to any threatened species. The lack of undisturbed assemblages, long history of anthropogenic disturbance and absence of suitable habitat within the small and disturbed site support this view.

Given the small size of the patches of vegetation to be removed as a result of the proposal and levels of disturbance therein, it is considered unlikely the proposal will significantly impact any threatened species.

Migratory Species:

A number of EPBC listed migratory species have potential to utilise the site on an irregular basis. The limited number and sporadic nature of records close to the subject site appear

to reflect opportunistic rather than regular use of any habitat considered of importance to any threatened species.

It is not considered that the development of this land as proposed is likely to significantly affect the availability of potential habitat for such mobile species, or disrupt migratory patterns.

EPBC Act Assessment Conclusion:

No Matters of National Significance (specifically in this instance threatened species, threatened ecological communities or listed migratory species) are expected to be impacted upon significantly as a result of the proposal.



11.0 Squirrel Glider Assessment

Further to the 7-part test, the potential for the proposed development to have a significant impact upon any Squirrel Glider population in the locality was assessed against LMCC *Draft Squirrel Glider Planning and Management Guidelines* (2015). The assessment is summarised in **Table 4** below.

Table 5 - Squirrel Glider - Vegetation Corridor Assessment

Assessment Criteria	Proposed Development
An area of Squirrel Glider habitat of more than 4ha will be cleared.	Less than 1ha of potential Squirrel Glider habitat will be removed or modified as part of the proposed development. The remainder of the subject site is cleared and managed lands.
and/or	
More than 1ha of habitat will be cleared and the habitat patch size will be reduced to less than 4ha.	Patch size in the study area will be reduced by <1ha, and the patch size that includes vegetated areas of Munibung Hill will remain >4ha
and/or	
There is greater than 5% loss of habitat patches with an area of more than 10ha.	The removal or modification of <1ha of highly disturbed vegetation within a patch of >100ha represents less than 1% of the patch size available for a local Squirrel Glider population.
and/or	
Habitat connectivity to a habitat patch will be lost, or narrowed to a width that is not suitable for maintaining in the long term.	Connectivity to the small south-eastern patch will persist within the 20m wide mature VRZ that will be protected in the long-term as riparian vegetation.

As can be seen in **Table 4**, significant impact on Squirrel Glider is unlikely to occur based on the assessment criteria within the Guidelines. However, adopting the following recommendations from LMCC *Draft Squirrel Glider Planning and Management Guidelines* (2015) in the construction plans will ameliorate and mitigate potential adverse effects on the species:

- Providing replacement habitat & nest boxes in retained vegetation (e.g. the VRZ) on a 'one box-for-one hollow removed' basis suitable for small arboreal fauna (with potential to be used by other small native fauna including Microbats), in consultation with a suitably experienced and qualified ecologist;
- Where nest boxes are to be installed, rear entry nest boxes are preferred for Squirrel Glider, at a height of 3 – 5m above ground to allow ease of periodic inspection and maintenance. One nest box on rough barked trees is preferred, generally with a south orientation. Boxes should be securely attached with features that will not restrict tree growth. Relocation of natural hollows should be considered where these are to be removed from a site;
- RTA guidelines suggest box spacing of 60 – 100m for squirrel gliders (NSW Roads and Traffic Authority 2011); and
- Nest boxes are not considered suitable long-term due to their limited life, but instead should provide supplementary habitat coupled with long-term increase in habitat via the rehabilitation of E2 lands within the west of the study area.



12.0 SEPP 44 Koala Assessment

Schedule 2 of SEPP 44 lists tree species which are considered indicators of potential Koala habitat as they are known preferred Koala feed trees. The presence of any of these tree species on a site proposed for development triggers the requirement for an assessment of the study site for 'Potential Koala Habitat' (PKH).

PKH is defined in the SEPP as:

"areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component."

Vegetation survey identified a small number of the SEPP 44 - Schedule 2 listed Koala feed tree *Eucalyptus punctata* (Grey Gum) within the subject site. As the species does not constitute greater than 15% of canopy, the subject site is subsequently considered not to constitute Potential Koala Habitat under SEPP 44.

As such, no further provision of the policy would apply to the site.



13.0 Recommendations

The following general recommendations are made for consideration to minimise localised impacts on biodiversity in general as a result of the development of the site:

- Remnant native vegetation with habitat features for native fauna should be retained where possible, and protected during construction by physical protection barriers;
- With known presence of Microbats and numerous habitat trees for other fauna within the subject site, a suitably qualified and trained Field Ecologist should be consulted prior to commencement of clearing to mark any habitat trees;
- Habitat trees should be felled following clearing of non-habitat trees and remain *in situ* a minimum of 48 hours to allow fauna to disperse to retained vegetation nearby;
- A suitably qualified and trained Field Ecologist should supervise clearing of marked habitat trees, and inspect after felling, to manage any fauna injured or dislocated by the works
- Felled sections of trees found to be hollow should be utilised as habitat in remnant vegetation areas where feasible;
- Nest boxes should be installed on a 'one box-for-one hollow removed' basis in suitable habitat within suitable remnant vegetation to offset loss of habitat for hollow-dependent fauna;
- Implementation of 'best-practice' erosion and sedimentation controls to limit impacts of construction upon the study area as detailed in the *Blue Book*;
- Groundwater and water contamination issues encountered during works should be managed referencing the *Blue Book* - Chapter 5.4 – "*Regular Site Drainage Works*";
- Appropriate landscaping within developed areas should be encouraged to provide resources for native fauna, particularly birds via suitable habitat trees and shrubs; and
- Incoming residents should be appropriately educated on the value of the retained environmental conservation areas, and should be made aware of the negative impacts of green waste dumping, uncontrolled run-off, incremental incursion etc.



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Appendix A – Flora Species List



FLORA SPECIES LIST

The following list includes all species of vascular plants observed on site during fieldwork. It should be noted that such a list cannot be considered comprehensive, but rather indicative of the flora present on the site. It can take many years of flora surveys to record all of the plant species occurring within any area, especially plant species that are only apparent in some seasons such as Orchids.

A number of species cannot always be accurately identified during a brief survey, generally due to a lack of suitable flowering and/or fruiting material. Frequent removal of ground litter, and hence lack of samples of buds, leaves and fruits on the ground further complicated field attempts to fully identify mature eucalypt trees. Such species are identified as accurately as possible, and are indicated in the list as thus:

- specimens that could only be identified to genus level are indicated by the generic name followed by the abbreviation “sp.”, indicating an unidentified species of that genus;
- specimens for which identification of the genus was uncertain are indicated by a question mark (“?”) placed in front of the generic, which is followed by the abbreviation “sp.” and;
- specimens that could be accurately identified to genus level, but could be identified to species level with only a degree of certainty are indicated by a (“?”) placed in front of the epithet.

Authorities for the scientific names are not provided in the list. These follow the references outlined below.

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Names of families and higher taxa follow a modified Cronquist System (1981).

Introduced species are indicated by an asterisk “*”.

Threatened species listed under the *Threatened Species Conservation Act 1995* (TSC Act) or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are indicated in **bold font** and marked as:

(V) = Vulnerable Species listed under the TSC Act

(E) = Endangered Species listed under the TSC Act

(EV) = Vulnerable Species listed under the EPBC Act 1999

(EE) = Endangered Species listed under the EPBC Act 1999



Family Name	Scientific Name	Common Name
Acanthaceae	<i>Pseuderanthemum variabile</i>	Pastel Flower
Adiantaceae	<i>Adiantum hispidulum</i>	Rough Maidenhair
	<i>Cheilanthes sieberi</i>	Rock Fern
Agavaceae	<i>Agave americana</i> *	Century Plant
Alliaceae	<i>Nothoscordum gracile</i> *	Onion Weed
Amaranthaceae	<i>Alternanthera philoxeroides</i> *	Alligator Weed
Anacardiaceae	<i>Mangifera indica</i> *	Mango Tree (Kensington Pride)
Apiaceae	<i>Hydrocotyle bonariensis</i> *	Kurnell Curse / Pennywort
Araceae	<i>Monstera deliciosa</i> *	Fruit Salad Plant
Arecaceae	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm
	<i>Livistona australis</i>	Cabbage Tree Palm
Asparagaceae	<i>Asparagus aethiopicus</i> *	Asparagus Fern
Aspleniaceae	<i>Asplenium australasicum</i>	Birds Nest Fern
Asteraceae	<i>Ageratina adenophora</i> *	Crofton Weed
	<i>Bidens pilosa</i> *	Cobbler's Pegs
	<i>Conyza bonariensis</i> *	Flax-leaf Fleabane
	<i>Conyza parva</i> *	Fleabane
	<i>Hypochaeris radicata</i> *	Flatweed
	<i>Senecio madagascariensis</i> *	Fireweed
	<i>Sonchus spp.</i> *	Sowthistle
Azollaceae	<i>Azolla pinnata</i>	Red Azolla
Blechnaceae	<i>Blechnum nudum</i>	Fishbone Water Fern
	<i>Doodia aspera</i>	Prickly Rasp Fern
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Vine
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak
	<i>Allocasuarina torulosa</i>	Forest Oak
Commelinaceae	<i>Commelina cyanea</i>	Scurvy Weed, Native Wandering Jew
Convolvulaceae	<i>Calystegia marginate</i>	-
	<i>Dichondra repens</i>	Kidney Weed
Cyperaceae	<i>Cyperus eragrostis</i> *	Umbrella Sedge
	<i>Gahnia spp.</i>	
	<i>Schoenoplectus validus</i>	River Clubrush
Davalliaceae	<i>Nephrolepis cordifolia</i> *	Fish-bone Fern
Dennstaedtiaceae	<i>Histiopteris incisa</i>	Bat's Wing Fern
Dicksoniaceae	<i>Calochlaena dubia</i>	Rainbow Fern
Euphorbiaceae	<i>Ricinus communis</i> *	Castor Oil Plant
Fabaceae (Faboideae)	<i>Kennedia rubicunda</i>	Dusky Coral Pea
	<i>Trifolium spp.</i> *	A Clover
	<i>Vicia monantha subsp. monantha</i> *	
	<i>Vicia spp.</i> *	Vetch
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>	
	<i>Acacia irrorata</i>	Green Wattle
	<i>Acacia implexa</i>	Hickory Wattle
	<i>Acacia longifolia</i>	
	<i>Acacia obtusifolia</i>	Blunt-leaf Wattle
Fabaceae/Cesalpinoideae	<i>Senna pendula var. glabrata</i> *	-
Fabaceae/faboideae	<i>Glycine microphylla</i>	Small-leaf Glycine
	<i>Hardenbergia violacea</i>	False Sarsparilla



Family Name	Scientific Name	Common Name
Geraniaceae	<i>Geranium spp.*</i>	Geranium cultivar
Lauraceae	<i>Cinnamomum camphora*</i>	Camphor Laurel
Juncaceae	<i>Juncus usitatus</i>	Common Rush
Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Mat-rush
	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily
Menispermaceae	<i>Sarcopetalum harveyanum</i>	Pearl Vine
Myrtaceae	<i>Acmena smithii</i>	Lillypilly
	<i>Corymbia maculata</i>	Spotted Gum
	<i>Eucalyptus acmenoides</i>	White Mahogany
	<i>Eucalyptus punctata</i>	Grey Gum
	<i>Eucalyptus umbra</i>	Broad-leaved White Mahogany
	<i>Leptospermum polygalifolium</i>	Tantoon
	<i>Lophostemon confertus*</i>	Brush Box
	<i>Melaleuca stypheloides</i>	Prickly-leaved Tea Tree
	<i>Syncarpia glomulifera ssp.glomulifera</i>	Turpentine
Ochnaceae	<i>Ochna serrulata*</i>	Mickey Mouse Plant
Oleaceae	<i>Ligustrum lucidum*</i>	Large-leaved Privet
	<i>Ligustrum sinense*</i>	Small-leaved Privet
Orchidaceae	<i>Dendrobium spp.</i>	
Oxalidaceae	<i>Oxalis spp.*</i>	-
Phormiaceae	<i>Dianella caerulea var. producta</i>	Blue Flax Lily
Phyllanthaceae	<i>Glochidion ferdinandi var. ferdinandi</i>	Cheese Tree
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum
Plantaginaceae	<i>Plantago lanceolata*</i>	Ribwort
	<i>Plantago spp.*</i>	Plantain
Poaceae	<i>Andropogon virginicus*</i>	Whisky Grass
	<i>Aristida vagans</i>	Threeawn Speargrass
	<i>Axonopus fissifolius*</i>	Narrow-leaved Carpet Grass
	<i>Chloris gayana*</i>	Rhodes Grass
	<i>Chloris virgata*</i>	Feathertop Rhodes Grass
	<i>Cymbopogon refractus</i>	Barbed Wire Grass
	<i>Cynodon dactylon</i>	
	<i>Ehrharta erecta*</i>	Panic Veldtgrass
	<i>Hyparrhenia hirta*</i>	Coolatai Grass
	<i>Melinis minutiflora*</i>	Molasses Grass
	<i>Melinis repens</i>	
	<i>Oplismenus aemulus</i>	Basket Grass
	<i>Oplismenus hirtellus</i>	
	<i>Oplismenus imbecillis</i>	-
	<i>Panicum simile</i>	Two Colour Panic
	<i>Panicum sp.</i>	-
	<i>Paspalum dilatatum*</i>	Paspalum
	<i>Paspalum distichum</i>	Water couch
	<i>Pennisetum clandestinum*</i>	Kikuyu, Kikuyu Grass
	<i>Sporobolus africanus*</i>	Parramatta Grass
	<i>Stenotaphrum secundatum*</i>	Buffalo Grass



Family Name	Scientific Name	Common Name
Polygonaceae	<i>Persicaria decipiens</i>	Slender Knotweed
Polypodiaceae	<i>Platynerium superbum</i>	Staghorn
Primulaceae	<i>Anagallis arvensis</i> *	Scarlet Pimpernel
Rosaceae	<i>Rubus fruticosus agg.</i> *	Blackberry complex
Salicaceae	<i>Salix babylonica</i> *	Willow
Smilacaceae	<i>Smilax australis</i>	Lawyer Vine
Solanaceae	<i>Solanum mauritianum</i> *	Wild Tobacco
	<i>Solanum nigrum</i>	Blackberry Nightshade
Sterculiaceae	<i>Brachychiton acerifolius</i>	Flame Tree
Verbenaceae	<i>Lantana camara</i> *	Lantana
	<i>Verbena bonariensis</i> *	Purpletop



Appendix B – Expected Fauna Species List



EXPECTED FAUNA SPECIES LIST

The following list includes fauna species that could be reasonably expected to occur within the study area at some point, given site attributes and location.

“●”- species observed or indicated by scats, tracks etc. on, over or near the site during the various field investigations undertaken by AEP (2017).

* - Introduced species

? - Unconfirmed record, anecdotal records etc.

A - NSW Atlas of Wildlife record of threatened species for the site.

Threatened species listed under the *Threatened Species Conservation Act 1995* (TSC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are indicated in **bold font**.



Family	Presence	Scientific Name	Common Name
Birds			
Phasianidae		<i>Coturnix pectoralis</i>	Stubble Quail
		<i>Coturnix ypsilophora</i>	Brown Quail
Anatidae		<i>Anas castanea</i>	Chestnut Teal
		<i>Anas gracilis</i>	Grey Teal
		<i>Anas platyrhynchos*</i>	Mallard
		<i>Anas rhynchotis</i>	Australasian Shoveler
		<i>Anas superciliosa</i>	Pacific Black Duck
		<i>Aythya australis</i>	Hardhead
		<i>Biziura lobata</i>	Musk Duck
	•	<i>Chenonetta jubata</i>	Australian Wood Duck
		<i>Cygnus atratus</i>	Black Swan
		<i>Malacorhynchus membranaceus</i>	Pink-eared Duck
Podicipedidae		<i>Poliocephalus poliocephalus</i>	Hoary-headed Grebe
		<i>Tachybaptus novaehollandiae</i>	Australasian Grebe
Columbidae		<i>Chalcophaps indica</i>	Emerald Dove
		<i>Columba leucomela</i>	White-headed Pigeon
		<i>Columba livia*</i>	Rock Dove
		<i>Geopelia humeralis</i>	Bar-shouldered Dove
		<i>Geopelia striata</i>	Peaceful Dove
		<i>Leucosarcia melanoleuca</i>	Wonga Pigeon
		<i>Macropygia amboinensis</i>	Brown Cuckoo-Dove
		<i>Ocyphaps lophotes</i>	Crested Pigeon
		<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove
		<i>Ptilinopus superbus</i>	Superb Fruit-Dove
	•	<i>Streptopelia chinensis*</i>	Spotted Turtle-Dove
Podargidae		<i>Podargus strigoides</i>	Tawny Frogmouth
Caprimulgidae		<i>Eurostopodus mystacalis</i>	White-throated Nightjar
Aegothelidae		<i>Aegotheles cristatus</i>	Australian Owlet-nightjar
Apodidae		<i>Hirundapus caudacutus</i>	White-throated Needletail
Procellariidae		<i>Ardenna tenuirostris</i>	Short-tailed Shearwater
Anhingidae		<i>Anhinga novaehollandiae</i>	Australasian Darter
Phalacrocoracidae		<i>Microcarbo melanoleucos</i>	Little Pied Cormorant
		<i>Phalacrocorax carbo</i>	Great Cormorant
	•	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant
		<i>Phalacrocorax varius</i>	Pied Cormorant
Pelecanidae		<i>Pelecanus conspicillatus</i>	Australian Pelican
Ciconiidae		<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork
Ardeidae	•	<i>Ardea ibis</i>	Cattle Egret
	•	<i>Ardea intermedia</i>	Intermediate Egret
		<i>Ardea modesta</i>	Eastern Great Egret
		<i>Ardea pacifica</i>	White-necked Heron
		<i>Butorides striatus</i>	Striated Heron
		<i>Egretta garzetta</i>	Little Egret
	•	<i>Egretta novaehollandiae</i>	White-faced Heron
		<i>Ixobrychus flavicollis</i>	Black Bittern
		<i>Nycticorax caledonicus</i>	Nankeen Night Heron
Threskiornithidae		<i>Platalea regia</i>	Royal Spoonbill



Family	Presence	Scientific Name	Common Name
	•	<i>Threskiornis molucca</i>	Australian White Ibis
		<i>Threskiornis spinicollis</i>	Straw-necked Ibis
Accipitridae		<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk
		<i>Accipiter fasciatus</i>	Brown Goshawk
		<i>Accipiter novaehollandiae</i>	Grey Goshawk
		<i>Aviceda subcristata</i>	Pacific Baza
		<i>Circus approximans</i>	Swamp Harrier
		<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle
		<i>Haliastur indus</i>	Brahminy Kite
		<i>Haliastur sphenurus</i>	Whistling Kite
		<i>Hieraaetus morphnoides</i>	Little Eagle
		<i>Milvus migrans</i>	Black Kite
		<i>Pandion cristatus</i>	Eastern Osprey
Falconidae		<i>Falco berigora</i>	Brown Falcon
		<i>Falco cenchroides</i>	Nankeen Kestrel
		<i>Falco longipennis</i>	Australian Hobby
Rallidae	•	<i>Fulica atra</i>	Eurasian Coot
		<i>Gallinula tenebrosa</i>	Dusky Moorhen
		<i>Gallirallus philippensis</i>	Buff-banded Rail
		<i>Lewinia pectoralis</i>	Lewin's Rail
	•	<i>Porphyrio porphyrio</i>	Purple Swamphen
Recurvirostridae		<i>Himantopus himantopus</i>	Black-winged Stilt
		<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet
Charadriidae		<i>Charadrius mongolus</i>	Lesser Sand-plover
		<i>Elseya melanops</i>	Black-fronted Dotterel
		<i>Erythronyx cinctus</i>	Red-kneed Dotterel
		<i>Vanellus miles</i>	Masked Lapwing
Jacaniidae		<i>Irediparra gallinacea</i>	Comb-crested Jacana
Scolopacidae		<i>Arenaria interpres</i>	Ruddy Turnstone
		<i>Calidris acuminata</i>	Sharp-tailed Sandpiper
		<i>Calidris ferruginea</i>	Curlew Sandpiper
		<i>Calidris ruficollis</i>	Red-necked Stint
		<i>Gallinago hardwickii</i>	Latham's Snipe
		<i>Limosa lapponica</i>	Bar-tailed Godwit
		<i>Tringa glareola</i>	Wood Sandpiper
Laridae		<i>Tringa stagnatilis</i>	Marsh Sandpiper
		<i>Chroicocephalus novaehollandiae</i>	Silver Gull
		<i>Hydroprogne caspia</i>	Caspian Tern
Cacatuidae		<i>Thalasseus bergii</i>	Crested Tern
	•	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo
	•	<i>Cacatua sanguinea</i>	Little Corella
		<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo
		<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo
Psittacidae	•	<i>Eolophus roseicapillus</i>	Galah
	•	<i>Alisterus scapularis</i>	Australian King-Parrot
		<i>Glossopsitta concinna</i>	Musk Lorikeet
		<i>Glossopsitta pusilla</i>	Little Lorikeet
		<i>Lathamus discolor</i>	Swift Parrot



Family	Presence	Scientific Name	Common Name
		<i>Platycercus elegans</i>	Crimson Rosella
	•	<i>Platycercus eximius</i>	Eastern Rosella
		<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet
	•	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet
Centropodidae		<i>Centropus phasianinus</i>	Pheasant Coucal
Cuculidae		<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo
		<i>Cacomantis pallidus</i>	Pallid Cuckoo
		<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo
		<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo
		<i>Cuculus optatus</i>	Oriental Cuckoo
		<i>Eudynamis orientalis</i>	Eastern Koel
		<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo
Strigidae		<i>Ninox connivens</i>	Barking Owl
		<i>Ninox novaeseelandiae</i>	Southern Boobook
		<i>Ninox strenua</i>	Powerful Owl
Tytonidae		<i>Tyto javanica</i>	Eastern Barn Owl
		<i>Tyto novaehollandiae</i>	Masked Owl
		<i>Tyto tenebricosa</i>	Sooty Owl
Alcedinidae	•	<i>Dacelo novaeguineae</i>	Laughing Kookaburra
		<i>Todiramphus sanctus</i>	Sacred Kingfisher
Coraciidae		<i>Eurystomus orientalis</i>	Dollarbird
Climacteridae	•	<i>Cormobates leucophaea</i>	White-throated Treecreeper
Ptilonorhynchidae	•	<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird
Maluridae	•	<i>Malurus cyaneus</i>	Superb Fairy-wren
		<i>Malurus lamberti</i>	Variegated Fairy-wren
Acanthizidae		<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill
		<i>Acanthiza lineata</i>	Striated Thornbill
		<i>Acanthiza nana</i>	Yellow Thornbill
		<i>Acanthiza pusilla</i>	Brown Thornbill
		<i>Acanthiza reguloides</i>	Buff-rumped Thornbill
		<i>Gerygone levigaster</i>	Mangrove Gerygone
		<i>Gerygone mouki</i>	Brown Gerygone
		<i>Gerygone olivacea</i>	White-throated Gerygone
		<i>Sericornis frontalis</i>	White-browed Scrubwren
Pardalotidae	•	<i>Pardalotus punctatus</i>	Spotted Pardalote
		<i>Pardalotus striatus</i>	Striated Pardalote
Meliphagidae	•	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill
	•	<i>Anthochaera carunculata</i>	Red Wattlebird
	•	<i>Anthochaera chrysoptera</i>	Little Wattlebird
		<i>Anthochaera phrygia</i>	Regent Honeyeater
	•	<i>Caligavis chrysops</i>	Yellow-faced Honeyeater
		<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater
		<i>Epthianura albifrons</i>	White-fronted Chat
		<i>Lichenostomus melanops</i>	Yellow-tufted Honeyeater
		<i>Lichmera indistincta</i>	Brown Honeyeater
	•	<i>Manorina melanocephala</i>	Noisy Miner
	•	<i>Manorina melanophrys</i>	Bell Miner
	•	<i>Meliphaga lewinii</i>	Lewin's Honeyeater



Family	Presence	Scientific Name	Common Name
		<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater
		<i>Melithreptus lunatus</i>	White-naped Honeyeater
		<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater
		<i>Nesoptilotis leucotis</i>	White-eared Honeyeater
		<i>Philemon citreogularis</i>	Little Friarbird
	•	<i>Philemon corniculatus</i>	Noisy Friarbird
		<i>Phylidonyris niger</i>	White-cheeked Honeyeater
		<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater
		<i>Plectorhyncha lanceolata</i>	Striped Honeyeater
		<i>Ptilotula fuscus</i>	Fuscous Honeyeater
Psophodidae		<i>Cinclosoma punctatum</i>	Spotted Quail-thrush
	•	<i>Psophodes olivaceus</i>	Eastern Whipbird
Neosittidae		<i>Daphoenositta chrysoptera</i>	Varied Sittella
Campephagidae		<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike
		<i>Coracina tenuirostris</i>	Cicadabird
Pachycephalidae		<i>Colluricincla harmonica</i>	Grey Shrike-thrush
	•	<i>Pachycephala pectoralis</i>	Golden Whistler
		<i>Pachycephala rufiventris</i>	Rufous Whistler
Oriolidae		<i>Oriolus sagittatus</i>	Olive-backed Oriole
	•	<i>Sphecotheres vieilloti</i>	Australasian Figbird
Artamidae		<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow
		<i>Artamus leucorhynchus</i>	White-breasted Woodswallow
		<i>Artamus superciliosus</i>	White-browed Woodswallow
		<i>Cracticus nigrogularis</i>	Pied Butcherbird
	•	<i>Cracticus tibicen</i>	Australian Magpie
	•	<i>Cracticus torquatus</i>	Grey Butcherbird
	•	<i>Strepera graculina</i>	Pied Currawong
Dicruridae		<i>Dicrurus bracteatus</i>	Spangled Drongo
Rhipiduridae	•	<i>Rhipidura albiscapa</i>	Grey Fantail
	•	<i>Rhipidura leucophrys</i>	Willie Wagtail
		<i>Rhipidura rufifrons</i>	Rufous Fantail
Corvidae	•	<i>Corvus coronoides</i>	Australian Raven
Monarchidae	•	<i>Grallina cyanoleuca</i>	Magpie-lark
		<i>Monarcha melanopsis</i>	Black-faced Monarch
		<i>Myiagra cyanoleuca</i>	Satin Flycatcher
		<i>Myiagra inquieta</i>	Restless Flycatcher
		<i>Myiagra rubecula</i>	Leaden Flycatcher
		<i>Symphysichrus trivirgatus</i>	Spectacled Monarch
Corcoracidae		<i>Corcorax melanorhamphos</i>	White-winged Cough
Petroicidae	•	<i>Eopsaltria australis</i>	Eastern Yellow Robin
		<i>Microeca fascians</i>	Jacky Winter
		<i>Petroica boodang</i>	Scarlet Robin
		<i>Petroica rosea</i>	Rose Robin
Cisticolidae		<i>Cisticola exilis</i>	Golden-headed Cisticola
Acrocephalidae		<i>Acrocephalus australis</i>	Australian Reed-Warbler
Megaluridae		<i>Megalurus gramineus</i>	Little Grassbird
		<i>Megalurus timoriensis</i>	Tawny Grassbird
Timaliidae		<i>Zosterops lateralis</i>	Silvereye



Family	Presence	Scientific Name	Common Name
Hirundinidae	•	<i>Hirundo neoxena</i>	Welcome Swallow
		<i>Petrochelidon ariel</i>	Fairy Martin
		<i>Petrochelidon nigricans</i>	Tree Martin
Sturnidae	•	<i>Sturnus tristis</i> *	Common Myna
	•	<i>Sturnus vulgaris</i> *	Common Starling
Nectariniidae		<i>Dicaeum hirundinaceum</i>	Mistletoebird
Estrildidae		<i>Lonchura castaneothorax</i>	Chestnut-breasted Mannikin
		<i>Lonchura punctulata</i> *	Nutmeg Mannikin
	•	<i>Neochmia temporalis</i>	Red-browed Finch
		<i>Taeniopygia bichenovii</i>	Double-barred Finch
Passeridae		<i>Passer domesticus</i> *	House Sparrow
Motacillidae		<i>Motacilla alba lugens</i>	Black-backed Wagtail
Fringillidae		<i>Carduelis carduelis</i> *	European Goldfinch
Amphibians			
Bufonidae		<i>Rhinella marina</i> *	Cane Toad
Hylidae		<i>Litoria caerulea</i>	Green Tree Frog
		<i>Litoria dentata</i>	Bleating Tree Frog
	•	<i>Litoria fallax</i>	Eastern Dwarf Tree Frog
		<i>Litoria freycineti</i>	Freycinet's Frog
		<i>Litoria latopalmata</i>	Broad-palmed Frog
		<i>Litoria nasuta</i>	Rocket Frog
		<i>Litoria peronii</i>	Peron's Tree Frog
		<i>Litoria phyllochroa</i>	Leaf-green Tree Frog
		<i>Litoria tyleri</i>	Tyler's Tree Frog
Myobatrachidae		<i>Litoria verreauxii</i>	Verreaux's Frog
	•	<i>Crinia signifera</i>	Common Eastern Froglet
		<i>Limnodynastes peronii</i>	Brown-striped Frog
		<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog
		<i>Pseudophryne bibronii</i>	Bibron's Toadlet
		<i>Pseudophryne coriacea</i>	Red-backed Toadlet
		<i>Uperoleia fusca</i>	Dusky Toadlet
		<i>Uperoleia laevigata</i>	Smooth Toadlet
		<i>Uperoleia tyleri</i>	Tyler's Toadlet
Reptiles			
Chelidae		<i>Chelodina longicollis</i>	Eastern Snake-necked Turtle
Scincidae		<i>Bellatorias major</i>	Land Mullet
		<i>Cryptoblepharus virgatus</i>	Cream-striped Shinning-skink
		<i>Ctenotus robustus</i>	Robust Ctenotus
		<i>Ctenotus taeniolatus</i>	Copper-tailed Skink
		<i>Cyclodomorphus michaeli</i>	Mainland She-oak Skink
		<i>Egernia cunninghami</i>	Cunningham's Skink
	•	<i>Eulamprus quoyii</i>	Eastern Water-skink
		<i>Hemiergis decresiensis</i>	Three-toed Earless Skink
		<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink
		<i>Lampropholis guichenoti</i>	Pale-flecked Garden Sunskink
		<i>Saiphos equalis</i>	Three-toed Skink
		<i>Tiliqua scincoides</i>	Eastern Blue-tongue



Family	Presence	Scientific Name	Common Name
Agamidae		<i>Amphibolurus muricatus</i>	Jacky Lizard
		<i>Intellagama lesueurii</i>	Eastern Water Dragon
		<i>Pogona barbata</i>	Bearded Dragon
		<i>Rankinia diemensis</i>	Mountain Dragon
Varanidae		<i>Varanus gouldii</i>	Gould's Goanna
		<i>Varanus varius</i>	Lace Monitor
Colubridae		<i>Dendrelaphis punctulatus</i>	Common Tree Snake
		<i>Pantherophis guttatus*</i>	American Corn Snake
Elapidae		<i>Demansia psammophis</i>	Yellow-faced Whip Snake
		<i>Furina diadema</i>	Red-naped Snake
		<i>Hemiaspis signata</i>	Black-bellied Swamp Snake
		<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake
		<i>Pseudonaja textilis</i>	Eastern Brown Snake
Mammals			
Ornithorhynchidae		<i>Ornithorhynchus anatinus</i>	Platypus
Tachyglossidae		<i>Tachyglossus aculeatus</i>	Short-beaked Echidna
Dasyuridae		<i>Antechinus flavipes</i>	Yellow-footed Antechinus
		<i>Antechinus stuartii</i>	Brown Antechinus
		<i>Dasyurus maculatus</i>	Spotted-tailed Quoll
		<i>Sminthopsis murina</i>	Common Dunnart
Peramelidae	•	<i>Isoodon macrourus</i>	Northern Brown Bandicoot
		<i>Perameles nasuta</i>	Long-nosed Bandicoot
Vombatidae		<i>Vombatus ursinus</i>	Common Wombat
Burramyidae		<i>Cercartetus nanus</i>	Eastern Pygmy-possum
Petauridae		<i>Petaurus australis</i>	Yellow-bellied Glider
		<i>Petaurus breviceps</i>	Sugar Glider
		<i>Petaurus norfolcensis</i>	Squirrel Glider
Pseudocheiridae	•	<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum
Acrobatidae		<i>Acrobates pygmaeus</i>	Feathertail Glider
Phalangeridae	•	<i>Trichosurus vulpecula</i>	Common Brushtail Possum
Macropodidae		<i>Macropus giganteus</i>	Eastern Grey Kangaroo
		<i>Macropus rufogriseus</i>	Red-necked Wallaby
		<i>Wallabia bicolor</i>	Swamp Wallaby
Pteropodidae		<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox
Rhinolophidae		<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe-bat
Emballonuridae		<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat
Molossidae		<i>Austronomus australis</i>	White-striped Freetail-bat
		<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat
		<i>Mormopterus ridei</i>	Eastern Free-tailed Bat
Vespertilionidae		<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat
		<i>Chalinolobus gouldii</i>	Gould's Wattled Bat
		<i>Chalinolobus morio</i>	Chocolate Wattled Bat
		<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle
	•	<i>Miniopterus australis</i>	Little Bentwing-bat
		<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat
		<i>Myotis macropus</i>	Southern Myotis
		<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat
		<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat



Family	Presence	Scientific Name	Common Name
		<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat
		<i>Scotorepens orion</i>	Eastern Broad-nosed Bat
		<i>Vespadelus darlingtoni</i>	Large Forest Bat
		<i>Vespadelus pumilus</i>	Eastern Forest Bat
		<i>Vespadelus regulus</i>	Southern Forest Bat
		<i>Vespadelus troungtoni</i>	Eastern Cave Bat
		<i>Vespadelus vulturnus</i>	Little Forest Bat
Muridae		<i>Melomys cervinipes</i>	Fawn-footed Melomys
		<i>Mus musculus</i> *	House Mouse
		<i>Rattus fuscipes</i>	Bush Rat
		<i>Rattus lutreolus</i>	Swamp Rat
	•	<i>Rattus rattus</i> *	Black Rat
Canidae	•	<i>Canis lupus</i> *	Dingo, domestic dog
	•	<i>Canis lupus familiaris</i> *	Dog
		<i>Vulpes vulpes</i> *	Fox
Felidae	•	<i>Felis catus</i> *	Cat
Leporidae		<i>Lepus capensis</i> *	Brown Hare
	•	<i>Oryctolagus cuniculus</i> *	Rabbit
Equidae		<i>Equus asinus</i> *	Donkey
	•	<i>Equus caballus</i> *	Horse
Suidae		<i>Sus scrofa</i> *	Pig
Bovidae		<i>Bos taurus</i> *	European cattle
		<i>Capra hircus</i> *	Goat
		<i>Ovis aries</i> *	Sheep (feral)
Cervidae		<i>Cervus sp.</i> *	Deer



Appendix C – Echo Ecology Anabat Report



**ECHO
ECOLOGY**

Bat Call Identification

Warners Bay, NSW

Prepared for
Anderson Environment & Planning

Job Reference BC_AND23 - June 2017

This report has been prepared to document the analysis of digital ultrasonic bat echolocation calls received from a third party. The data was not collected by the author and as such no responsibility is taken for the quality of data collection or for the suitability of its subsequent use.

This report was authored by

A handwritten signature in black ink, appearing to read 'Anna McConville'.

Dr Anna McConville

PhD, B.Env.Sc.

Contents

1.0	Introduction	2
2.0	Methods	2
2.1	Characteristics Used to Differentiate Species	3
3.0	Results	3
4.0	Sample Calls	4
5.0	References	4

List of Tables

Table 3-1: Results of bat call analysis (number of passes per site per night)	4
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List of Figures

Figure 4-1: <i>Miniopterus australis</i> definite call	4
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1.0 INTRODUCTION

This report has been commissioned by Anderson Environment and Planning to analyse bat echolocation call data (Anabat, Titley Electronics) collected from Warners Bay, NSW. Data was provided electronically to the author. This report documents the methods involved in analysing bat call data and the results obtained only.

2.0 METHODS

The identification of bat echolocation calls recorded during surveys was undertaken using AnalookW (Chris Corben, Version 4.2n) software. The calls were recorded using Div Ratio 8. The identification of calls was undertaken with reference to Pennay et al. (2004) and through the comparison of recorded reference calls from the Sydney Basin. Reference calls were obtained from the NSW database and from the authors personal collection.

Each call sequence ('pass') was assigned to one of five categories, according to the confidence with which an identification could be made, being:

- Definite - Pass identified to species level and could not be confused with another species
- Probable - Pass identified to species level and there is a low chance of confusion with another species
- Possible - Pass identified to species level but short duration or poor quality of the pass increases the chance of confusion with another species
- Species group - Pass could not be identified to species level and could belong to one of two or more species. Occurs more frequently when passes are short or of poor quality
- Unknown - Either background 'noise' files or passes by bats which are too short and/or of poor quality to confidently identify.

Call sequences that were less than three pulses in length were not analysed and were assigned to 'Unknown' and only search phase calls were analysed. Furthermore, some species are difficult to differentiate using bat call analysis due to overlapping call frequencies and similar shape of plotted calls and in these cases calls were assigned to species groups.

The total number of passes (call sequences) per unit per night was tallied to give an index of activity.

It should be noted that the activity levels recorded at different sites may not be readily able to be compared. Activity levels should not be compared among species as different species have different detectability due to factors such as call loudness, foraging strategy and call identifying features. Activity comparisons among sites are dependent on many variables which need to be carefully controlled during data collection and statistically analysed. Influential variables include wind, rain, temperature, duration of recording, season, detector and microphone sensitivity, detector placement, weather protection devices etc.

Nomenclature follows the Australian Chiroptera taxonomic list described by Reardon et al. (2015).

2.1 Characteristics Used to Differentiate Species

Miniopterus australis was differentiated from *Vespadelus pumilus*, by characteristic frequency or the presence of a down-sweeping tail on pulses.

3.0 RESULTS

A total of 194 call sequences were recorded, of which 15 call sequences were able to be analysed (ie were not 'noise' files or bat calls of short length). Of the bat calls, 15 call sequences (100 %) were able to be confidently identified (those classified as either definite or probable identifications) to species level (Table 3-1). Species recorded confidently within the site include:

- *Miniopterus australis* (Little Bent-winged Bat)

It should be noted that additional bat species may be present within the site but were not recorded by the detectors (or are difficult to identify by bat call) and habitat assessment should be used in conjunction with these results to determine the likelihood of occurrence of other bat species.

Table 3-1 below summarises the results of the bat call analysis.

Table 3-1: Results of bat call analysis (number of passes per site per night)

IDENTIFICATION	Anabat 15/05/2017	Anabat 16/05/2017	Anabat 17/05/2017	Anabat 18/05/2017
DEFINITE				
<i>Miniopterus australis</i>	13	2	-	-
UNKNOWN				
'Noise' files	54	91	16	2
Unknown	8	5	3	-
TOTAL	75	98	19	2

4.0 SAMPLE CALLS

A sample of the calls actually identified from the site for each species is given below.



Figure 4-1: *Miniopterus australis* definite call

5.0 REFERENCES

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Appendix D – Habitat Tree Details



A total of nine (9) hollow-bearing / habitat trees have been identified within the subject site, with an additional three (3) observed within the patch of vegetation zoned R2 in the south-east of the study area. Note that no survey was conducted within vegetation zoned E2 that will be conserved as part of the proposal.

Tree ID	Species	DBH	Hollows				Northing	Easting	Location
			S	M	L	Other			
H01	<i>Corymbia maculata</i>	1	1	1	1	Multiple splits/fissures in trunk (microbat)	372589	6351587	Lot 100 Remnant Vegetation Patch
H02	<i>Corymbia maculata</i>	1.1	2	0	1		372583	6351535	Lot 100 Remnant Vegetation Patch
H03	<i>Corymbia maculata</i>	0.7	2	0	0		372560	6351530	Lot 100 Remnant Vegetation Patch
H04	Stag	1.0	0	0	1	Large terminal hollow @2m	372559	6351529	Lot 100 Remnant Vegetation Patch
H05	<i>Eucalyptus punctata</i>	0.8	0	2	0		372558	6351528	Lot 100 Remnant Vegetation Patch
H06	Stag	0.5	0	1	0		372571	6351542	Lot 100 Remnant Vegetation Patch
H07	<i>Corymbia maculata</i>	0.6	2	1	0		372554	6351546	Lot 100 Remnant Vegetation Patch
H08	<i>Eucalyptus punctata</i>	0.5	0	1	0	Arboreal termite mound with entrance	372619	6351668	Lot 6 (outside subject site)
H09	<i>Eucalyptus punctata</i>	0.7	1	0	0	Arboreal termite mound with entrance	372590	6351643	Lot 6 (outside subject site)
H10	<i>Corymbia maculata</i>		1	0	0	Fissures and bark (microbat)	372636	6351683	Lot 6 (outside subject site)
H11	<i>Corymbia maculata</i>	0.4	0	2	0	Multiple fissures in trunk (microbat)	372578	6351627	Lot 6
H12	<i>Corymbia maculata</i>	1	0	2	0		372601	6351812	Lot 6
dbh-diameter at breast height in metres		Total Hollows	9	10	3				



Appendix E – Author CVs



CRAIG ANDERSON

Curriculum Vitae

An environmental professional with over 20 years experience providing high level ecological services, advice, strategic direction and management for sectors such as land development, infrastructure, conservation, government, legal, mining and quarrying.

Personal Details

Full Name: Craig John Anderson
Date of Birth: 5 November 1971
Postal Address: PO Box 210, ADAMSTOWN NSW 2289
Email: craig@andersonep.com.au
Phone Mobile: 0418 681 581

Qualifications

- Bachelor of Applied Science (Environmental Assessment & Management) University of Newcastle, New South Wales (1994).
- Currently completing a Graduate Diploma in Archaeological Heritage through University of New England (one subject to complete).

Licencing

- NSW Scientific Investigation Licence SL101313.
- NSW Animal Research Authority.
- Accredited Biobanking Assessor No. 0150.

Further Education & Training (select summary)

- Biobank and Biocertification Assessors Training Course.
- Animal Ethics Training (University of Newcastle / NSW DPI).
- RFS / PIA NSW Consulting Planners Bushfire Training.
- Bush Regeneration Training.
- NSW Driver's Licence: Car (Class "C"). Experienced 4WD operator.
- Occupational Health & Safety Training, including legal compliance requirements of Officers (Standard 11 & S1,S2,S3) / Green Card.
- + various other vocational environmental and computer based training sessions.



Fields of Special Competence

- Production and peer review of detailed environmental impact assessment documentation. Author and / or Manager of hundreds of ecological / environmental / bushfire / historical heritage / archaeological heritage / strategic & statutory planning documents over approximately 20 years of environmental work.
- Detailed ecological field survey, covering all aspects of terrestrial and aquatic flora and fauna.
- Expert witness legal representation.
- Ecological Management Planning, ranging from individual species to full ecosystem management.
- Project Management and delivery of complex projects, including projects worth more than \$100M.
- Project Management (including areas outside environmental sphere).
- Environmental Due Diligence processes for both asset procurement and divestment.
- Management and co-ordination of teams producing EIA documentation.
- Identification of strategic approval pathways and key project risk evaluation and management.
- Extensive experience in conflict resolution, impact mediation and outcome negotiation on large scale and contentious projects.
- Detailed knowledge of land and infrastructure development processes.
- Detailed knowledge of coal mining development and operational processes.

Professional Affiliations / Memberships (past and present)

- Hunter Bird Observers Club (HBOC). Current member of Records Appraisal Committee, previous elected Committee Member.
- Society for Growing Australian Plants (SGAP).
- Hunter Coal Environment Group (HCEG).
- NSW Minerals Council (NSWMC), including Executive Committee Meetings representation.
- Queensland Resources Council (QRC).
- Bird Observers Club of Australia (BOCA).
- Ecological Consultants Association of NSW (ECA). Involved in the initial formulation of the Association. Served two terms as an elected Councillor.
- Urban Development Institute of Australia (UDIA).
- Planning Institute of Australia (PIA).
- Australasian Bat Society (ABS).
- Frog and Tadpole Study Group (FATS).
- Society of Frogs and Reptiles (SOFAR).
- Society for Growing Australian Plants (SGAP).
- Hunter Heritage Network (HHN).



Employment History

2013-present

Director / Principal Consultant

Anderson Environment & Planning, Newcastle

Providing consulting services to land, property, mining industry, legal, government. Covering ecological, project management, environmental, planning services, advices, strategy and representation.

2012-present

Director

Habitat Indoor / Outdoor Living, Furniture, Homewares & Design, Newcastle

Well known retailer servicing high end of market for indoor and outdoor furniture and homewares, interior and landscape design, curtain and blind services, specimen plant supply etc.

2010-2012

General Manager Sustainable Development

Cockatoo Coal Ltd, Coal Mining Company,
Newcastle / Sydney / Brisbane

Employed by emerging coal company to establish regional offices & build staff workforce and business systems to deliver projected growth. Oversaw and managed all aspects of the Sustainable Development portfolio (encompassing Environmental Compliance & Approvals, External Affairs, Health & Safety, and GIS) and the 20+ staff therein, maintained relationships with key business partners including high profile Korean and Japanese companies, actively managed and oversaw all aspects of SD for all company projects, assisted the Board and top tier management when required in relation to assessing and delivering business opportunities, and managing risk. Included overseeing the progression of up to six EIS'S and related processes for new and/or expanded mining projects, some with capital values exceeding \$1 Billion.

2009 – 2010

Independent Environmental Expert

Donaldson Conservation Trust

Appointed by Donaldson Coal as the Independent Environmental Expert to oversee the planning and implementation of environmental programs governed by the Trust. The Donaldson Conservation Trust was established to address a Condition of Consent for the Abel Coal Mine in the Lower Hunter Valley.

2010

Principal - Environment

RPS, Development Consultants, Newcastle

Providing high level ecological services to key mining, government and land development clients.

2006 – 2009

Manager Environment Group

RPS HSO, Development Consultants, Newcastle

(Company sold to UK listed Company RPS in Nov 2006)

Managing the growth and development of the Environment Group. Providing project management, planning and environmental services to key mining, land development and government clients. Interface and business development activities with the wider global RPS Group.



2001 – 2006

Manager Environment Group / Director

Harper Somers O'Sullivan, Development Consultants, Newcastle.

(Company Director & shareholder as of July 2003)

Established & grew the Environment Group of the business, and co-managed and grew the operation from 20 staff to a business of 50+ staff. Managed environmental portfolio on many significant projects for a wide variety of clients in Australia and New Zealand. Ran the successful due diligence process and sale of the business to UK listed Company RPS.

2000 – 2001

Senior Ecologist & NSW Projects Manager

Wildthing Environmental Consultants, Salt Ash.

Managed all staff and key projects for the business in association with owners. Actively contributed to significant growth in size and turnover of the business. Services covered a wide variety of ecological, environmental, planning and heritage related commissions.

1996 – 1999

Ecologist

Wildthing Environmental Consultants, Salt Ash.

Undertook and managed numerous ecological and other environmental related projects throughout Australia. Played a key role in the growth in standing, size, turnover and client roster of the Company.

1995 – 1996

Ecologist / Environmental Officer

Pulver Cooper & Blackley, Engineers & Surveyors, Newcastle.

Undertook a variety of environmental, surveying and mapping related works for land development and construction projects.

1995

Environmental Officer / Cadastral Survey Assistant

Kel Nagle Cooper & Associates, Golf Course Design & Construction Newcastle.



JOEL STIBBARD Curriculum Vitae

Joel is an environmental professional with a diverse background of research and monitoring experience in both terrestrial and aquatic environments. He has focussed over the past 6 years in providing terrestrial ecological consultancy services to a range of clients in the public and private sector, and is highly proficient in flora and fauna survey methodologies, environmental reporting and GIS systems.

Personal Details

Full Name: Joel Ryan Stibbard
Date of Birth: 20 October 1981
Postal Address: PO Box 210, ADAMSTOWN NSW 2289
Email: joel@andersonep.com.au
Phone Mobile: 0417 282 685

Qualifications

- Bachelor of Science (Ecology and Zoology) University of Queensland (2004).
- Currently completing a Masters in Environmental Management through University of Queensland (two subjects to complete).

Licencing

- NSW Scientific Investigation Licence SL101313.
- NSW Animal Research Authority.

Further Education & Training (select summary)

- NSW Driver's Licence: Car and Motorcycle (Class "C" and "R"). Experienced 4WD operator.
- Occupational Health & Safety Training.
- Mapinfo Professional Training.
- PADI Divemaster (now expired) and current Rescue Diver.
- PADI recognised Coral Reef Monitoring Training.
- + various other vocational environmental and computer based training sessions.

Fields of Special Competence

- Production of detailed environmental impact assessment documentation. Author of multiple ecological / environmental documents over 6+ years of consultancy work.
- High proficiency in the interpretation, manipulation and presentation (mapping) of spatial data through the utilisation of Geographic Information Systems (GIS).
- Detailed ecological field survey, covering all aspects of terrestrial and aquatic flora and fauna.



- Ecological Management Planning.

Professional Affiliations / Memberships (past / present)

- Hunter Bird Observers Club (HBOC).
- Birdlife Australia.
- Ecological Consultants Association of NSW (ECA).

Relevant Employment History

2015-present

Ecology / GIS Manager

Anderson Environment & Planning, Newcastle

Currently employed by Anderson Environment & Planning to assist in the provision of consulting services to land, property, mining industry, legal and government sectors. Covering ecological, project management, environmental, planning services, advices, strategy and representation.

2012-2015

Ecologist

RPS, Newcastle

Employed as an ecological consultant at a well-established consultancy during high demand periods of mine expansion works, and maintained employment following the mining downturn as a result of efficiency, versatility and professionalism. Was involved in and was Team Leader of a wide range of ecological surveys, and was responsible for the provision of various documentation including Ecological Assessment Reports, Management Plans and Strategic Assessments. Was responsible for managing and maintaining all GIS data for the ecology and bushfire team, and the production of report-quality maps for all projects.

2011-2012

Ecologist

Australasian Resource Consultants (AARC), Brisbane

Employed by local consultancy to undertake flora and fauna surveys for the burgeoning mine expansion sector. Responsible for conducting and reporting on environmental assessments as part of the Environmental Impact Assessment (EIA) process. Gained valuable experience in flora and fauna survey and identification, and utilising GIS at a professional level.



2010 – 2011

Casual Ecologist

Environmental Ground Water and Air Consultants (EGC), Brisbane

Employed as a casual ecologist during Masters' studies to assist in flora and fauna surveys on Curtis Island, off Gladstone in Queensland. Works included fauna habitat mapping and threatened flora surveys to inform the development proposal of two large LNG plants on the island. These works provided valuable experience in fieldwork techniques, along with an insight into the professional reality of ecological consultancy.

Relevant Ecological Experience

2007 - 2008

Researcher

Global Vision International (GVI), Mexico and Reef Check Australia, Townsville

Volunteer Coral Reef Monitoring Researcher on both the Meso-American Barrier Reef in Mexico (4 months) and the Great Barrier Reef in Queensland (6 months). Responsible for running and implementing dive trips to various reefs and managing teams of volunteers to ensure rigorous data was collected within tight timeframes and testing weather conditions.

2006 – 2007

Researcher

Kalahari Meerkat Project, South Africa

Volunteer Behavioural Researcher on a collaborative project between Cambridge University, England and the University of Zurich in Switzerland for 12 months. Involved collecting large amounts of behavioural data for several Meerkat groups in a small group of researchers for a variety of backgrounds and in isolated environments.



IAN BENSON

Curriculum Vitae

Ian works with AEP in the role of ecologist. He is an experienced bird watcher and a regular participant in wader surveys. Ian has previously had a successful career as a project manager with a local geotechnical engineering firm. His background in project management and soil sciences combined with his ecological knowledge is utilised in a diverse array of applications in his current role.

Qualifications

- Graduate Diploma in Science (Ecology) University of New England (2014).
- Bachelor Engineering (Civil) University of Newcastle (2008).

Further Education & Training (select summary)

- NSW Class C Driver's Licence. Experienced 4WD operator.
- Occupational Health & Safety Training.
- Rail Industry Worker.
- ARTC Safety Induction for Contractors (NSW).
- ARTC Hunter Bulk Terminal Induction.

Fields of Special Competence

- Ecological field survey, covering terrestrial and aquatic flora and fauna.
- Highly proficient at avifauna surveys, including challenging wetland and shorebird environs.
- Project Management.
- Soil science.

Professional Affiliations / Memberships (past / present)

- Hunter Bird Observers Club (HBOC).
- Graduate Member of The Institution of Engineers Australia in the Civil College.



Relevant Employment History

2016-present

Ecologist

Anderson Environment & Planning, Newcastle

Currently employed by Anderson Environment & Planning to assist in the provision of consulting services to land, property, mining industry, legal and government sectors. Covering ecological, project management, environmental, planning services, advices, strategy and representation.

2012-2016

Project Manager

Douglas Partners, Newcastle

As a project manager with Douglas Partners I was responsible for proposal and tender preparation, planning, implementation and reporting of geotechnical and geo-environmental investigations for a broad range of projects including site classification, foundations, pavements, bridges and slope stability. I was required to liaise with clients regarding project requirements, project goals and deadlines. I was responsible for the development and implementation of Work Health and Safety Plans as well as Environmental Plans and documentation. This included the development of safe work procedures, safety inspections on site and implementing improved safety procedures with staff. I was responsible for ensuring projects were completed on time and on budget whilst meeting the clients' expectations and achieving quality assurance standards.

2008-2012

Geotechnical Engineer

Douglas Partners, Newcastle

AS a geotechnical engineer for Douglas Partners I was involved in the planning and implementation of geotechnical investigations for a wide range of development in the Hunter Valley area. I was primarily involved in site supervision of geotechnical investigations using drilling rigs for boreholes, truck mounted cone penetration testing and test pit excavations using excavators and backhoes. My role also included site inspections involving the assessment of conditions for piles, piers and shallow footings. I also undertook site walkovers for assessment of mine subsidence and slope stability.

2007-2008

Undergraduate Geotechnical Engineer

Douglas Partners, Newcastle

Whilst an undergraduate engineer with Douglas Partners I experienced a broad range of practice areas and developed a diverse range of engineering skills.

Relevant Ecological Experience

2013 - Current

Bird Surveyor

Hunter Bird Observers Club

Volunteer survey work for Hunter Bird Observers Club for regular wader and water bird counts and Tomago and Kooragang Island.



DENNIS NEADER

Curriculum Vitae

Dennis works with AEP in the role of ecologist. He is an experienced bird watcher and a regular participant in the Stepping Stone Program Bird Surveys in the Upper Hunter Valley. Dennis has previously had a varied career as an environmental scientist, contaminated land consultant and bush regenerator with local firms. His background in project management and bush regeneration, combined with his ecological knowledge is utilised in a diverse array of applications in his current role.

Qualifications

- Bachelor of Science (Environmental Geoscience) University of Newcastle (2011).
- Graduate Diploma in Environmental Management University of Newcastle (2 subjects to complete) (2014).

Further Education & Training (select summary)

- NSW Class HR Driver's Licence.
- Experienced 4WD operator.
- Senior First Aid.
- Occupational Health & Safety Training.
- High Risk NSW Elevated Work Platform, Dogging and Light Forklift Truck.
- Open Water PADI Dive Certificate.
- Bush Regeneration and Seed Collection.
- Non-Friable Asbestos Removal.

Fields of Special Competence

- Ecological field survey, covering terrestrial and aquatic flora and fauna.
- Avifauna surveys, including challenging wetland and bushland environs.
- Project Management.
- Bush Regeneration.
- Contaminated Land – Asbestos Identification and Removal.

Professional Affiliations / Memberships (past / present)

- Hunter Bird Observers Club (HBOC).
- Birdlife Australian.
- Society for Growing Australian Plants.



Relevant Employment History

2016-present

Ecologist

Anderson Environment & Planning, Newcastle

Currently employed by Anderson Environment & Planning to assist in the provision of consulting services to land, property, mining industry, legal and government sectors. Covering ecological, project management, environmental, planning services, advices, strategy and representation.

2014-2016

Environmental Scientist

JM Environments, Newcastle

As an environmental scientist with JM Environments, I was responsible for ecological surveys and reporting, water and air quality monitoring, calibration and maintenance of monitoring equipment, contaminated land Phase 1, 2 and 3 assessments, Remediation Action Plan preparation and project management, development of safe work procedures and safety inspections on site. I was responsible for ensuring projects were completed on time and on budget whilst meeting clients' expectations and achieving quality assurance standards.

2010 – 2014

Environmental Technician

AECOM, Newcastle

Landscape Function Analysis surveys and reporting, water quality monitoring air quality monitoring.

2010 – 2014

Contract GIS Technician

Geodata, Newcastle

Data entry and interpretation of cadastral survey information into GeoCadaastre and MapInfo software.

2006 – 2010

Coal Superintending

ALS & SGS Newcastle

Coal sampling, superintending and testing, sampling and data entry. Accurate, timely product processing and data entry of coal quality and analysis.

Pre 2006-

Rigging, crane dogman, including outages and construction at major mine and building sites, self-employed in print industry.



Relevant Ecological Experience

2011 – Current

Bird Surveys

Hunter Bird Observers Club, Avifauna Baseline Surveys on Broughton Island.

CVA Newcastle and Trees in Newcastle – Bird surveys in Hunter Valley for Hunter Valley Stepping Stones Project Great Eastern Ranges 2014-2017.

NPWS - Endangered population survey and banding of Gould's Petrel on Cabbage Tree Island off Port Stephens.

2008 – Current

Bush Regeneration, Plant ID and Seed Collection

CVA Newcastle and Trees in Newcastle.

Blueys Beach DuneCare – Mid Coast Council Bush Regeneration.

2010

Volunteer Coral Reef Research

University of Newcastle on Lady Elliot Island Queensland.



LUCY KNUTSON

Curriculum Vitae

An environmental science and management graduate majoring in ecology. Extensive knowledge of Australian flora and fauna. Skilled in GIS, environmental planning, impact and flora and fauna assessment processes as well as report writing and technical analysis. Experience within the catchment management and water science field with a detailed understanding of water quality, catchment and environmental protection issues. Practical experience in ecological restoration, regeneration and land management. Extensive experience in the field having volunteered for a range of different projects and roles.

Qualifications

- Bachelor of Environmental Science and Management (Ecosystems and Biodiversity) University of Newcastle, New South Wales (2017).
- Electronic Accounting, TAFE NSW (2009).
- Business Management, TAFE NSW (2008).
- Hospitality Operations, TAFE NSW (2003).

Employment History

April 2017 – Current	Ecologist Anderson Environment & Planning, Newcastle.
2009 – Current	Store Manager Ramjet Assortments, Newcastle.
2013 – Current	Retail Assistant Too Cool for School, Newcastle.
2012–2013	Manager Kamel Restaurant and Bar, Melbourne
2011–2012	Manager Guanabana Designs, Newcastle

Relevant Ecological Experience



- Water - Environmental Science Internship, Hunter Water Corporation, Water Resource Planning.
- Park Ranger (Wildlife Sector), Blackbutt Reserve, Newcastle City Council.
- Field Work Assistant, School of Environmental and Life Sciences, University of Newcastle.
- Treasurer, Newcastle University Student Environmental Club.
- Landcare, Newcastle group, Bush regeneration and land management.
- Navdanya Conservation Biodiversity Farm, Dehra Dun, India.