AEP

ECOLOGY | BIOBANKING | OFFSETS | BUSHFIRE

ECOLOGICAL ASSESSMENT REPORT

FOR

RESIDENTIAL SUBDIVISION STAGES 5 & SUPERLOTS

AT

'RADCLIFFFE WYEE' HUE HUE ROAD, NSW

Prepared for: **WYEE LAND PTY LTD**

November 2018

Revision 1

AEP Ref 1732

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Document Control

Revision	Date	Description	Prepared	Reviewed	Approved
0	May 2015	Draft	C Anderson	G Oborn	G Oborn
1	5 November 2018	EAR to address LMCC RFI	D Neader	I Benson	B Johnson

EXECUTIVE SUMMARY

Anderson Environment & Planning (AEP) was commissioned by Wyee Land Pty Ltd (the proponent) to prepare an Ecological Assessment Report (EAR) over land off Hue Hue Road, Wyee. The approx. 88 hectare (ha) subject site is proposed to be developed into a residential subdivision and associated environmental protection areas in accordance with its zoning.

The subject site is predominantly covered by cleared pasture, though some significant areas of remnant and disturbed native forest vegetation mostly associated with drainage lines also occur.

As per Lake Macquarie City Council (Council) Vegetation Map Series (2016), native vegetation communities recorded within the subject site include "*Coastal Plains Scribbly Gum Woodland*", "*Swamp Mahogany Paperbark Forest*", and "*Alluvial Blue Gum – Spotted Gum Moist Forest*". The vegetation mapping presented within this report further breaks down these communities, and also includes an additional community type, namely "*Freshwater Wetland Complex*", found associated with Mannering Creek, a 3rd order watercourse that denotes the northern boundary of the subject site from west to east.

Swamp Mahogany Paperbark Forest and *Freshwater Wetland Complex* are commensurate with listed Endangered Ecological Community (EEC). The extent of disturbance to these communities from stream crossings would be; *Swamp Mahogany Paperbark Forest* approx. 0.3ha and *Freshwater Wetland Complex* approx. 0.15ha. However impacts would be mitigated by the rehabilitation of approx. 6ha of EEC vegetation associated with Mannering Creek under a Vegetation Management Plan (VMP) to guide rehabilitation.

Threatened flora species recorded on the subject site included *Angophora inopina* (Charmhaven Apple) and *Tetratheca juncea* (Black-eyed Susan).

A. inopina occurs commonly in the locality within *Coastal Plains Scribbly Gum Woodland* and associated communities. Of 292 *A. inopina* recorded in 2018 surveys, 140 occur within the development footprint and would be removed while 152 would be retained within rehabilitated VMP lands. *A. inopina* would also be propagated and planted under the VMP at a minimum 5:1 ratio within suitable Environmental Conservation zoned land (VMP lands) within the subject site ensuring a suitable outcome is achieved for this species.

In targeted 2018 survey *T. juncea* was recorded as a group of four small clumps within approx. 25m^2 area of *Coastal Plains Scribbly Gum Woodland* in the east of the site. This forest patch has been subject to past disturbance, and this possibly accounts for the sparsity of records. In the adjacent off-site lot with similar contiguous habitat and intact understorey, over 144 clumps were recorded in ecological study by Eco Logical Australia (ELA 2010). It can be considered unlikely that the loss of four clumps of the species from the development site would significantly affect the viability of the local population of the species.

Fauna species recorded were typical of those expected in this locality in this type of remnant, disturbed and somewhat fragmented habitat. Throughout the various surveys conducted and also via Atlas records, a total of 15 threatened fauna species have been identified from the subject site, which includes anecdotal records. These species included:

- Birds: *Tyto* Owl (probably Masked Owl), Black-necked Stork (1993 record), Glossy Black-Cockatoo, Little Lorikeet and Varied Sittella;
- Frogs: Wallum Froglet (2018 record), Green and Golden Bell Frog (1976 record);
- Mammals: Squirrel Glider, Tiger Quoll (anecdotal) and Koala (anecdotal); and
- Bats: Grey-headed Flying-fox, East-coast Freetail Bat, Large-eared Pied Bat, Eastern Bentwing-bat and Little Bentwing-bat.

In addition, other threatened fauna species known from previous records from the wider locality are also considered likely to utilise the subject site at times, and as such have been considered in impact assessment.

Potential for impacts on threatened species was considered in the rezoning process, and the zoning configuration arrived at was based on retaining adequate habitat and linkages for these species via the VMP. This zoning configuration would inform rehabilitation activities, maintenance and monitoring for all threatened species and vegetation communities. In particular, continued provision of adequate linkages for Squirrel Glider and *A. inopina* offsets would be key drivers of the VMP approach.

Based on the implementation of offsets and mitigation measures detailed in the VMP, assessments under the 7 part test have revealed that no significant impacts would result for the development as proposed. Appropriate rehabilitation targets and linked development staging as outlined within the VMP would be required to ensure impacts of significance do not result.

Assessment under SEPP 44 – Koala Habitat Protection revealed that areas of 'Potential Koala Habitat' exist within the subject site. An anecdotal record of Koala was noted for the subject site, but all field surveys conducted to date have not revealed any signs of Koalas or Koala activity. As such, the subject site would not constitute "Core Koala Habitat" as defined within the policy, and further provision of the policy would not apply to the subject site.

Consideration of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) revealed that impacts on Matters of National Environmental Significance (MNES) would occur, principally being the removal of 140 specimens of *A. inopina* over the course of the development. Given the retention of 152 of the trees and offset replanting within the site's VMP lands at a 5:1 ratio, it is not considered that impacts on the species would be significant.

General recommendations are included for consideration to minimise localised impacts on biodiversity in general as a result of the development. In addition, the detailed VMP prepared for this proposal would provide a working blueprint for environmental stewardship and long-term habitat improvement for threatened species within retained Environmental Conservation zoned lands (VMP lands) in the long term.

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1.0 Introduction

It is proposed that a residential subdivision be undertaken within land between Hue Hue Road and Bushells Ridge Road, Wyee (the subject site) having regard for its residential and environmental zoning:

- Stage 5 - creating 92 residential lots and 9 superlots for further subdivision under DA 2243/2017 and a lot for the VMP lands;
- Stages 6 to 13 - subdivision of the 9 superlots to create approximately 560 residential lots; and
- Associated roads, cycleways, stormwater basins, sports fields and related infrastructure.

Construction of roads including crossings of Mannering Creek and the south-north stream will occur within VMP lands.

At the request of Wyee Land Pty Ltd (the proponent), Anderson Environment & Planning (AEP) have undertaken necessary investigations to inform the production of a 7 part test assessment report addressing the proposed development.

Further to Council review of the original EAR and supplementary fieldwork thereafter, this revised EAR is specifically intended to indicate the likelihood of the proposed subdivision having a significant impact on threatened species or populations, or flora assemblages considered to constitute an EEC. In this regard, the report aims to recognise the relevant requirements of the *Environmental Planning and Assessment Act 1979* (EPA Act) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The purpose of this EAR is to:

- Describe ecological values of the study area;
- Explore the potential for threatened species to utilise the subject site; and
- Assess ecological impacts associated with the proposal against relevant legislation.

Potential ecological impacts on native species in general are also considered, as are recommendations for minimising environmental impacts arising from the proposal.

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

> Anderson Environment & Planning (2018). *Ecological Assessment Report for Radcliffe Wyee, a Proposed Residential Subdivision of Radcliffe Wyee at Hue Hue Road, Wyee NSW.* Unpublished report for Wyee Land Pty Ltd, Revision 1.

2.0 Site Particulars

- **Address** – 1431 Hue Hue Road, Wyee.
- **LGA** – Lake Macquarie.
- **Title Details –** Part Lots 172 & 173 DP 1212974 and Lot 212 DP 866347.
- **Area –** Approximately 88.7ha.
- **Zoning** – As per Council LEP 2014, the subject site contains land zoned R2 – Low Density Residential, E2 – Environmental Conservation and E3 – Environmental Management.
- **Ownership –** The subject site is owned by Saltro Developments Pty Ltd.
- **Proponent –** The development is proposed by Wyee Land Pty Ltd.
- **Current Land Use** – A rural residential dwelling is located in Lot 212 DP 866347 with associated agricultural purpose out-buildings. Predominantly cleared pasture previously utilised for grazing activity, with some remnant forest patches and riparian areas associated with Mannering Creek make up the majority of the site. There are three farm dams on the subject site. A Water Recycling Facility not related to this proposal lies within Lot 171 DP 1212974 and is zoned SP2 – Infrastructure.
- **Surrounding Land Use** – The subject site is bounded rural properties and the partially developed old Wyee subdivision to the east, Bushells Ridge Road and bushland to the south, and rural properties and remnant native vegetation to the west. The approved and associated subdivision (Stages 1-4) is currently under construction in adjoining land owned by Saltro Developments Pty Ltd to the north of Mannering Creek.

For the purposes of this assessment, the *subject site* is the area directly affected by the proposed development and includes VMP lands. The *study area* includes both the subject site and the wider locality included in searches that may be subject to indirect impacts from the vegetation clearing and development and hence are considered herewith.

Figure 1 depicts the extent of the subject site overlain on an aerial photograph of the study area.

D09175029

AEP

Title: Figure 1 - Site Location

Date: August 2018

Location: Land off Hue Hue Rd, Wyee

Client Wyee Land Pty Ltd

Our Ref: 1732

3.0 Proposed Development

It is proposed to develop the subject site having regard for its residential and environmental zoning:

- Stage 5 and Superlots - creating 92 residential lots and 9 superlots for further subdivision (DA 2243/2017) with a separate lot/s for the VMP lands;
- Stages 6 to 13 - subdivision of the 9 superlots to create approximately 560 residential lots; and
- Associated roads, cycleways, stormwater basins, sports fields and related infrastructure.

It is noted and considered in this EAR that construction includes crossings of Mannering Creek and the south-north watercourse would occur for roads and services would occur within VMP lands. Additionally, works would occur within the south-north watercourse identified as Coastal Wetland and Buffer listed under *State Environment Planning Policy (Coastal Management) 2018* (SEPP CM).

Areas subject to environmental protection and targeted rehabilitation works as part of the Stage 5 and Superlots proposal would include approx. 26.1ha of VMP lands including:

- The bed, banks and riparian zone of the 3rd order watercourse Mannering Creek;
- A vegetated drainage line mapped as a 1st order watercourse that runs from near the south-east boundary north and drains into Mannering Creek offsite to the east; and
- Additional rehabilitation within lands in the VMP lands adjacent to Mannering Creek would be undertaken to offset a similar amount of riparian vegetation in the south-west of the subject site that would be removed by the development.

Rehabilitation of a further approx. 4.3ha of E2 zoned land is subject to a separate approved VMP associated with Development Application for Stages 1 – 4 and is shown in **Figure 2**.

As part of the two associated developments, a total of 30.4ha of would be set aside for ecological conservation within the subject site (the VMP lands), which would include the creation of new habitat covering approx. 17.0ha and enhancement of existing habitat covering 13.4ha.

Figure 2 depicts the proposed development plan.

239240(5)-DA-002-D

THIS PLAN IS A PROPOSED SUBDIVISION OF LOT 212 D.P.866437 AND PART LOTS 172 AND 173, D.P.1212974.

EXISTING EASEMENTS
(A) EASEMENT FOR ELECTRICITY AND OTHER PURPOSES 15 WIDE & VARIABLE (D.P.1212974)
(B) RIGHT OF ACCESS 15 WIDE & VARIABLE (D.P.1212974)
(C) EASEMENT FOR WATER SUPPLY 15 WIDE (D.P.1212974)
(D) EASEMENT FOR WATER SUPPLY AND SEWERAGE SERVICES 22, 24, 27 WIDE & VARIABLE (D.P.1212974)

PROPOSED EASEMENTS
(E) RIGHT OF ACCESS 16 & 22 WIDE
(G) RIGHT OF ACCESS 23 WIDE & VARIABLE
(P) POSITIVE COVENANT
(R) RESTRICTION ON THE USE OF LAND

HUE HUE ROAD, WYEE

LOT YIELD LEGEND:

AREA	LOTS
STAGE 5 RESIDENTIAL	84
STAGE 5 DGE RESERVE	1
STAGE 5 WWPS	1
STAGE 5 PATHWAY	1
SUPERLOTS	10
RESIDUE	1
TOTAL LOTS:	98

HUE HUE ROAD
STAGE 4
STAGE 1
STAGE 3
STAGE 2
DA 1286 - 2015
PT. 5000 (488m²)
PLACE
AVENUE
LAWRENCE
JARVIS ROAD
FARMER AVENUE
ALABASTER ROAD
BATEUP ROAD
HODGES STREET
HODGES ST RD
COAST CENTRAL DRIVE
PATEMAN
APZ
BANK OF MANNERING CREEK IS BOUNDARY
PT. 5000 (6.766 ha)
E2 ZONE
(P)
(C)
PT. 5000 (16.47 ha) Total 29.52 ha
171 D.P.1212974
5096
FUTURE RECREATION AREA
4991 6.983 ha
(A)(B)
COAST CENTRAL (22 WIDE) DRIVE
SEE SHEET 2
(D)
McKINNON STREET
4993 6.318 ha.
4999 3.883 ha
(D)(E)
(A)(B)(D)(E)
(G)
4992 7.557 ha.
4994 4.901 ha.
4998 3.29 ha
PT. 5000 (6.29 ha)
(R)
4995 4.427 ha.
4996 6.651 ha.
E2 ZONE
4990 1.105 ha. RESERVOIR SITE
BUSHELLS RIDGE ROAD
PT. 5000 (611.2 m²)
PT. 5000 (1764 m²)
4997 6.579 ha.
DILLABILLA ROAD
N
adw johnson

• urban design • visualisation • development feasibility • surveying • town planning • social impact • economic analysis • superintendency • civil engineering • infrastructure • project management

drawing title: DA PLAN FOR STAGE 5 AND SUPERLOTS

location: RADCLIFFE, WYEE
council: Lake Macquarie
dwg ref: 239240(5)-DA-002-D
client: WYEE LAND PTY. LTD.

ver.	date	comment	surveyed	drawn	checked	pm
C	24/10/2018	AMEND SMALL LOT LAYOUT		RC	BS	ME
D	26/10/2018	REVERT BACK TO PREVIOUS RES. LOTS		RC	BS	ME

co-ordinate & level information:
CO-ORDINATE SYSTEM: MGA 56
ORIGIN OF CO-ORDINATES: P.M.23844
DATUM: A.H.D.
ORIGIN OF LEVELS: P.M.161498
CONTOUR INTERVAL:

scale (A1 original size): SCALE: 1:2500 (FULL)

page: 1 OF 2
Date of Surv

working beyond expectations

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Plotted By: Robert Cromarty Plot Date: 26/10/18 11:32:33AM Cad File: N:\239240\239240(5)\DRAWINGS\PLANNING\239240(5)-DA-002-D.DWG
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4.0 Scope and Purpose

Desktop and field investigations were carried out to adequately address Section 5A of the Environmental Planning & Assessment Act 1979 (known as the "7 part test"), and to satisfy the requirements of Council's *Flora & Fauna Survey Guidelines* (Version 4.2, Dec 2012).

Also afforded consideration were the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act), and relevant State Environmental Planning Policies (SEPPs), including SEPP CM – '*Coastal Management*' and SEPP 44 – '*Koala Habitat Protection*'.

This was achieved via background research and literature review, database searches, consultation, targeted ecological fieldwork and mapping, detailed habitat assessment, and ultimately impact assessment consideration against the type and form of development proposed.

Importantly, the subject site is part of a larger area known as the '*Wyee Local Environment Study (LES) Biodiversity Study Area*', which was subject to detailed ecological assessment in ELA 2010 as part of an investigation and rezoning process which resulted in the subject site being rezoned in its current configuration. ELA 2010 provided detailed baseline information relevant to the subject site, and has been utilised as a key reference resource in the assessment herewith.

ELA 2010 covered the entirety of the study area, plus additional areas to the east. Notably, it also included the results of works undertaken over the study area in 2008 by Travers Environmental (TE 2008). Both of these reports were commissioned by Council, and collectively these reports provided Council with sufficient information to assess and determine the rezoning proposal for the Wyee LES area. These reports provided baseline data for this report.

Additional survey was carried out to update this information. The focus of the recent works undertaken by AEP has been to validate or update the previous data, and to focus on the identified key issues for the subject site.

Collectively, the works meet the requirements of the *Lake Macquarie City Council Flora and Fauna Survey Guidelines* (Version 4.2, 2012).

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

Specifically, the scope of this study is to:

- Identify vascular plant species occurring within the site, including any threatened species listed under the BC Act or EPBC Act;

- Identify and map the extent of vegetation communities within the site, including any EEC listed under the BC Act or EPBC Act;
- Identify any fauna species, including threatened and migratory species, and populations or their habitats, which occur within the subject 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, populations or ecological communities (or their habitats) identified from the subject site; and
- Describe measures to be implemented to avoid, minimise, manage or monitor potential impacts of the development.

In addition to the survey work conducted within the subject site boundary and its immediate surrounds, consideration has been afforded to the wider locality, via database searches within 10km of the subject site and via appreciation of habitat areas that may be linked ecologically to the subject site. This has included consideration of Council's *Native Vegetation & Corridors Mapping (Map 3 - 2015).*

5.0 Study Certification and Licencing

This report was written by Dennis Neader BSc (Env. Geoscience), Chris Wark BSc (Ecology Hons) DipCALM, Ian Benson BEng (Civil) & GradDipSc (Ecology) and Craig Anderson BAppSc (EAM).

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, Ian Benson, 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 Survey Area;
- 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:

Ian Benson

Senior Ecologist

Anderson Environment & Planning

November 2018

6.0 Methods

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

The size of the subject site, the type of native vegetation and habitats remaining, the status of existing and proposed surrounding land use, the intense level of ecological investigation for the rezoning of the lands and the level and type of habitat linkages to other proximate bushland areas all were considered in formulating the methods employed and described below.

In particular, the previous ecological dataset generated for the study area (TE 2008 and ELA 2010) provided a baseline dataset, given the role this data played in the rezoning process conducted by Council over the subject site.

The assessment approach was tailored to undertake sufficient works to validate and where necessary supplement the existing dataset 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 subject site was assumed to ensure an overly conservative approach was employed.

6.1 Literature Review

Main information sources reviewed included:

- Eco Logical Australia (ELA 2010). *Biodiversity Study –Wyee LES.* Prepared for Lake Macquarie City Council, October 2010;
- Eco Logical Australia (ELA 2011). *Habitat Corridor Management Strategy – Wyee.* Prepared for Lake Macquarie City Council;
- Travers Environmental (2008). *Ecological Assessment: Lots 16 & 17 DP 870597, Lot 215 DP 860081, Lot 1 DP 785709 Hue Hue Road, Lot 212 DP 866347 Bushells Ridge Road, Lot 1 DP 244839 Digary Road, Wyee.* Report prepared for Lake Macquarie City Council;
- Aerial Photograph Interpretation (API) of the subject site and surrounding locality;
- *Lake Macquarie City Council Flora & Fauna Survey Guidelines* (Version 4.2, Dec 2012);
- OEH Threatened Species, Populations and Ecological Communities website (http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/); and

- AEP collective knowledge gained from previous ecological survey and assessment in study area and general south Lake Macquarie area over the past 20 years.

In addition, database searches were carried out, namely:

- Review of flora and fauna records held by the NSW Office of Environment & Heritage (OEH) Atlas of NSW Wildlife within a 10km radius of the subject site (August 2018); and
- Review of flora and fauna records held by the Commonwealth Department of Environment and Energy (DoE) Protected Matters Search within a 5km radius of the subject site (August 2018).

6.2 Field Survey

6.2.1 Vegetation Communities

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

- Review of the Lake Macquarie City Vegetation mapping prepared by Eastcoast Flora Survey (2016);
- Review of the vegetation mapping and vegetation plot data presented within ELA 2010;
- Aerial Photo interpretation (API) to identify any notable variations within the subject site;
- Consultation of 1:25,000 topographic map series for the area; and
- Subject site survey to ground truth the units identified above.

The final derived vegetation map was based on dominant species present in the canopy, shrub and ground layers. Vegetation community names were as per that utilised within ELA 2010, and related to the Eastcoast Flora Survey (2016) designations. 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 the derived vegetation communities to constitute EEC as listed under the BC Act and/or EPBC Act. The floristic composition, geomorphological characteristics and geographical extent were considered in this process.

6.2.2 Flora

Detailed floristics survey previously conducted on the subject site as presented within ELA 2010, which is included in **Appendix G** and which includes information from TE 2008, was adopted as a baseline for the subject site, including vegetation mapping, flora surveys, plots

and transects, and targeted threatened species searches. Such works were undertaken to meet the requirements set by Council in the rezoning assessment brief.

In addition to that baseline, a general flora survey was undertaken by AEP during recent subject site visits to produce a revised master flora species list for the subject site, to search specifically for threatened flora species known from the wider area, and to gather data necessary to both derive vegetation community type(s) and to meet relevant survey guidelines. Such works included:

- Identification of all vascular plant species encountered during fieldwork. Subject site coverage was both systematic, to ensure all key points of the subject site were checked, and randomised therein the Random Meander Technique (Cropper 1993) was utilised to maximise species encountered. A full list of all flora species recorded during fieldwork by all consultants is included as **Appendix A**. Survey effort is shown in **Figure 3;**

- Targeted searches, in areas of potentially suitable habitat, were undertaken for any threatened flora species previously recorded in the locality, noting the previous detailed searches carried out by other consultants had met all required seasonality coverage. Such species were identified via database searches and other sources; and

- Updated *A. inopina* census and *T. juncea survey* for the subject site.

6.2.3 Habitat

An assessment of the relative habitat values present within the subject site was carried out. This assessment focused primarily on the identification of specific habitat types and resources on the subject site favoured by known threatened species from the region. The assessment also considered the potential value of the subject site (and surrounds) for all major guilds of native flora and fauna.

The assessment was based on the specific habitat requirements of each threatened fauna species in regards to home range, feeding, roosting, breeding, movement patterns and corridor requirements. Consideration was given to contributing factors including topography, soil, light and hydrology for threatened flora and assemblages.

In particular, focus was put on documenting the presence of key habitat features such as tree hollows. Hollows are an important resource utilised by a variety of forest fauna, and are particularly relevant for several of the likely key threatened species in this locality. Vertebrate and invertebrate species use hollows as diurnal or nocturnal shelter sites, for rearing young, feeding, and thermoregulation, and to facilitate ranging behaviour and dispersal.

An updated HBT census was undertaken by AEP in 2018 within the subject site utilising the methodology of Hollow-bearing Tree (HBT) identification detailed 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 5 cm 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 1 m above the ground (this omits hollows in cut stumps or at the base of trees)".*

Trees with extensive splits suitable for Microbats were also counted as "small hollows" in the census.

6.2.4 Fauna

The detailed fauna survey work results previously gathered on the subject site by TE 2008 and ELA 2010 were adopted as a baseline for the subject site, for which all required fauna survey techniques were utilised and such works were undertaken to meet the requirements set by Council in the rezoning assessment brief.

In addition to that baseline, fauna surveys were undertaken by AEP during 2014 and 2018 by survey for threatened species, HBTs and to add to the knowledge pool for the subject site. Such works included targeted survey as well as opportunistic observations of fauna encountered either directly or indirectly during flora surveys carried out over several visits in 2018, as well as targeted nocturnal searches.

Incidental records of any fauna species observed during fieldwork were noted. This included opportunistic encounters (visual, call recognition) or secondary indications (scratches, scats, diggings, tracks etc.) of any resident or migratory species. Birds were identified by direct observation or by recognition of calls or distinctive features such as nests, feathers etc. 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, etc.

Frog and reptile searches were carried out in each of the habitat units present during subject site reconnaissance. Diurnal searches were made in areas of appropriate habitat. Such habitat included areas of thicker vegetation, in ground litter, near and under fallen timber, around piles of refuse, and wet / damp areas such as drainage lines, dams and areas of poor infiltration capacity and / or periodic inundation.

Physical frog searches were augmented by call recognition. Any calls unable to be clarified in the field were recorded for later comparison with commercially available recordings.

Fauna survey was carried out utilising techniques detailed below. Fauna survey effort is mapped in **Figure 3.** Fauna survey work was undertaken with reference to relevant guidelines and to add additional information to the generated Expected Fauna Species List generated from previous studies (**Appendix B**).

6.2.4.1

Bat Call Recording

Bat echolocation calls were recorded using one Anabat Detector within the subject site. Call recording was undertaken by active Anabat detection during nocturnal field surveys which were undertaken for a total of four nights. Transformed calls were analysed by AEP using commercially available software.

Avifauna Surveys

The presence of avifauna within the subject site was carried out via targeted diurnal and nocturnal survey as well as incidental observations during fieldwork.

6.2.4.2

For diurnal surveys, emphasis was placed on peak activity periods, i.e. early morning and late afternoon, to maximise chances of species encountered. Birds were identified by direct observation or by recognition of calls or distinctive features such as nests, feathers etc.

For nocturnal surveys, spotlighting attempted to identify any roosting birds during late afternoon, dusk and into darkness, and similar methods were employed as per diurnal surveys. Playback of nocturnal calls including Forest Owls and specifically Masked Owl and Powerful Owl was undertaken as per DECC (2004) guidelines over three evenings by two ecologists.

Herpetofauna Surveys

6.2.4.3

Specific herpetofauna (frog and reptile) searches were carried out in each of the habitat units present. Searches were made in areas of appropriate habitat. Such habitat included areas of thicker vegetation, in ground litter, near and under fallen timber, around piles of refuse, and wet / damp areas and areas of poor infiltration capacity and / or periodic inundation. Nocturnal survey for Wallum Froglet was undertaken and opportunistic encounters during all other phases of fieldwork were also noted.

6.2.4.4

Spotlighting

Spotlighting was undertaken over multiple nights within the subject site by two ecologists utilising suitable hand-held spotlights and headlamps. Given the relatively open nature of the subject site, a comprehensive survey was achieved, with all areas covered on foot.

6.2.4.5

Incidental Observations & Secondary Indications

Incidental records of any fauna species observed during fieldwork were noted. This included opportunistic sightings of secondary indications (scratches, scats, diggings, tracks, etc.) of any resident or migratory species. Searches were also conducted for whitewash, regurgitation pellets and prey remains from Owls, chewed fruit remains from frugivorous birds, etc.

6.2.5 Survey Dates, Times & Activity

Table 1 – AEP Field Survey Effort

Date	Time	Area of survey	Field Activity	Surveyors	Hrs:min
20/12/2014	09:00 – 11:30	Subject site	Initial site inspection & with proponent, surrounding land appraisal, EEC and threatened flora and fauna species search (TSS)	1	2:30
30/04/2014	11:00 – 16:20	Subject site	Traversal, botanical survey, vegetation mapping groundtruthing and TSS	1	5:15
04/05/2014	08:30 – 14:00	Subject site	Inspection with Council Ecologist, traversal, existing info validation, flora survey, TSS, veg map checks and fauna survey	1	5:30
15/05/2014	08:00 – 15:15	Subject site	Traversal, conservation zone area appraisals, botanical survey, veg map checks, fauna survey and TSS	1	7:15
14/05/2018	13:00 – 15:30	VMP Lands Mannering Creek	Inspection with client, surrounding, targeted *Angophora inopina (Ai)* HBT surveys and TSS.	2	5:00
28/06/2018	16:30 -19:00	Superlots 7, 8 & 9	Spotlighting, nocturnal survey and call playback and TSS.	2	5:00
04/07/2018	14:00 – 16:15	VMP Lands Mannering Creek	Inspection with Client, existing info validation, botanical survey, veg map checks, *A. inopina* survey, fauna survey and TSS.	3	6:45
10/07/2018	10:00 – 16:00	Superlots 7, 8 & 9	*Ai* and HBT surveys and TSS	2	12:00
11/07/2018	10:00 – 16:00	Subject site	*Ai* and HBT Census and TSS	2	12:00
17/07/2018	10:00 – 16:00	Subject site	*Ai* and HBT Census and TSS.	2	12:00
14/07/2018	Nocturnal	Superlot 9 dam	*Anabat* recording 3 nights	-	Remote
24/07/2018	10:00 – 16:00	Mannering Creek bed, banks and riparian zone	Inspection with Council Ecologists, traversal, existing info validation, botanical survey, *Ai,* HBTs and TSS.	1	6:00
31/07/2018	09:45 – 13:00	VMP Lands Stg. 5	*Ai,* HBTs and TSS.	1	3:15
09/08/2018	16:30 – 19:30	Superlots 7, 8 & 9	Spotlighting, nocturnal survey and call playback and incidentals , survey for Masked Owl and TSS	1	3:00
13/08/2018	15:30 - 20:00	Superlots 8 & 9	Spotlighting, nocturnal survey and quiet listening and call playback for Masked Owl and TSS	2	9:00
16/08/2018	20:30 – 21:00	Superlots 8 & 9	Nocturnal survey, quiet listening and call playback for Masked Owl and TSS	2	1:00
15/10/2018	11:00-16:30	Subject site in suitable habitat	*T. juncea* survey transects and TSS	2	11:00
18/10/2018	16:30-21:30	Subject site drainage lines	Nocturnal survey, quiet listening and call playback for Wallum Froglet and TSS ~ approx 20°C and immediately following downpour (approx. 15mm in 1 hour)	2	10:00
			Total Survey Hours		**106:30**

In addition to the above, survey work on the subject site by TE 2008 and as presented within ELA 2010 (including information from TE 2008) was adopted as a baseline for the subject site.

Table 2 – Flora Survey Effort vs. LMCC Flora & Fauna Survey Guidelines

Flora			
Level of Disturbance	**Activity**	**Minimum Survey Effort**	**Effort Undertaken**
Highly Disturbed Site/Area – Habitat Present. (while there are areas of high quality habitat within the proposed lot, the majority of the subject site is highly disturbed with a managed understorey)	Flora Survey – Subject site flora species inventory	A flora species inventory for the subject site	AEP 2018. Incidental records added to TE 2008 and ELA 2010 and AEP 2014 flora list. AEP (2018). Subject site survey in suitable habitat by transects for *A. inopina* and *T. juncea*

Table 3 – Fauna Survey Effort and LMCC Flora & Fauna Survey Guidelines

Fauna Group	Survey Technique	Survey Period	Minimum Survey Effort	Effort Undertaken and Comments
Birds				
Diurnal Birds	Formal Census	Not specified	Site >5 ha – minimum of 2 surveys	Bird surveys were undertaken on two visits to the subject site including incidental observations during all fieldwork.
Nocturnal Birds	Quiet listening on a ridge near suitable habitat	Late February to mid-August depending on species	Not specified	Quiet listening difficult on the subject site given the proximity to the M1 motorway. Quiet listening was attempted during all nocturnal survey work.
	Spotlighting	Not specified	2 nights spotlight search	Two observers surveyed suitable habitat within the subject site over three nights.
	Habitat Assessment	Not specified	HBTs mapped with species, number and size of hollows recorded	Full HBT survey conducted by AEP in areas where trees are to be removed with all relevant data recorded.
	Call Playback	Best undertaken outside breeding season (October to January depending on species)#	One point census/km2 repeated minimum of 3 visits on non-consecutive nights#	Call playback for all threatened forest owls was undertaken during four nights of nocturnal survey.

Fauna Group	Survey Technique	Survey Period	Minimum Survey Effort	Effort Undertaken and Comments
Mammals				
All Mammals	Spotlighting	Not specified	2 nights spotlight search	Two observers comprehensively surveyed the subject site over three nights of survey.
	Habitat Assessment	Not specified	Each habitat tree mapped with species, number and size of hollow recorded	Comprehensive HBT survey conducted with all relevant data record
	Remote Camera (preferred over trapping)	Any time of year	2 per veg. comm. or habitat type for 14 consecutive nights#	Detailed fauna survey work by TE 2008 and ELA 2010 were adopted as a baseline for the subject site, wherein all required fauna survey techniques were utilised and such works were undertaken to meet the requirements set by Council in the rezoning assessment.
Microchiropteran bats	Echolocation call – *Anabat* detection	Not specified. 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		Stagwatch undertaken during nocturnal survey. Two Anabat Express recorders deployed for a total of eight nights of Anabat recordings in addition to the previous survey work conducted at the subject site.
Reptiles				
Diurnal Searches	Habitat Searches	Not specified	Site <5 ha – 1 morning	Visuals, habitat searches, incidental observations conducted
Nocturnal Searches	Spotlight	Not specified	2 nights spotlight search	Two observers comprehensively surveyed the subject site over three nights of survey.
Amphibians				
Diurnal and nocturnal searches	Targeted searches	Not specified	If pond or stream is present - two separate searches on rainy nights in summer for amphibians	AEP 2018. Formal survey. Although most of the subject site is highly disturbed, targeted search within suitable habitat for Wallum Froglet and other threatened frogs was conducted during wet and warm weather. Incidental observations undertaken.

The above tables show that together with the extensive previous survey work conducted within the subject site the required survey guidelines have been met or exceeded and comprehensive coverage has been achieved during survey effort.

Where any doubt in regards to presence was noted for key fauna species (particularly forest owls, Squirrel Glider and hollow roosting Microbats), presence was assumed for impact assessment purposes. This effort and approach was considered suitably adequate for ecological assessment of the subject site and surrounding area.

Hue Hue Rd

Hue Rd

Muller Rd

Mannering Creek

Colleen Ln

Tullokan Rd

Waropara Rd

Pirama Rd

Karakunba Rd

Bushells Ridge Rd

Dillabirra Rd

Gorokan Rd

Murrawal Rd

Wyee Rd

Jabbarup Rd

Gosford Rd

Legend

N

W E

S

- Site Boundary
- Stages 1-4
- Anabat Express Location
- Diurnal survey transects
- Nocturnal survey transects
- Tetratheca juncea survey transect
- Wallum Froglet survey transects
- Watercourse

0 300

metres

AEP

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

Title: Figure 3 - Survey Effort

Date: October 2018

Location: Land off Hue Hue Rd, Wyee

Client: Wyee Land Pty Ltd

Our Ref: 1732

7.0 Results

7.1 Database Searches

Searches were undertaken of databases within a 10km radius of the subject site as per OEH (BC Act listings) & DoEE (EPBC Act listings) (**Table 4**). Note that any records considered erroneous, historic only, or obviously of no relevance to the subject site in regards to habitat (e.g. seabirds, marine species, etc.) have been omitted.

The potential for the listed threatened species to occur within the subject site is considered below. Detailed ecological profile descriptions of species can be found at: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/

Table 4 - Threatened Species Appraisal

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
Flora				
Acacia bynoeana (36)	Bynoe's Wattle	E	V	No sign of this species during multiple targeted surveys. Considered unlikely to occur.
Angophora inopina (2739)	Charmhaven Apple	V	V	292 records within subject site in 2018 survey by transects. 140 impacted by development. 152 these would be retained and 700 new specimens would be planted within VMP lands. **SUBJECT SPECIES**
Corunastylis sp. Charmhaven (96)		CE	CE	No sign of this species during multiple targeted surveys. Considered unlikely to occur.
Cryptostylis hunteriana (23)	Leafless Tongue-Orchid	V	V	No sign of this species during fieldwork, including targeted surveys during the flowering period. No previous records within the subject site. Habitat present is limited but some areas would be removed.
Eucalyptus camfieldii (1)	Camfield's Stringybark	V	V	No sign of this species during multiple targeted surveys. Considered unlikely to occur.
Eucalyptus parramattensis ssp. parramattensis (popn in Wyong & LMLGA) (29)	Parramatta Red Gum	E2		No sign of species during fieldwork despite several botanical surveys. Potential habitat would largely be protected within the riparian corridors.
Genoplesium insigne (22)	Variable Midge Orchid	CE	CE	No sign of this species during multiple targeted surveys. Considered unlikely to occur.
Grevillea parviflora ssp. Parviflora (36)	Small-flower Grevillea	V	V	No sign of this species during multiple targeted surveys. Considered unlikely to occur.
Maundia triglochinoides		V		No sign of this species during multiple targeted surveys. Considered unlikely to occur. Potential habitat would largely be protected within the riparian corridors.
Melaleuca biconvexa (174)	Biconvex Paperbark	V	V	No sign despite targeted survey. Potential habitat would be protected within the riparian corridors.

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
Persicaria elatior	Tall Knotweed	V	V	No sign of this species during several botanical surveys. Potential habitat would be protected within the riparian corridors.
Rutidosis heterogama (133)	Heath Wrinklewort	V	V	No sign of this species during multiple targeted surveys. Considered unlikely to occur.
Tetratheca juncea (248)	Black-eyed Susan	V	V	Four small clumps recorded within eastern Scribbly Gum Woodland in 2018. **SUBJECT SPECIES**
Birds				
Anthochaera phrygia	Regent Honeyeater	CE	CE	No sign of species during fieldwork and no local records within the last 20 years for this highly mobile species which could possibly utilise the subject site during flowering of feed tree species. While a small area of habitat containing several *E. robusta* would be removed, areas containing suitable winter foraging trees in this area would be retained and enhanced including supplementary *E. robusta* planting. **SUBJECT SPECIES**
Artamus cyanopterus cyanopterus (2)	Dusky Woodswallow	V		No sign of species during fieldwork. The subject site may offer some habitat opportunity for this species when in the area however an absence of records in the locality suggests they are not residents or regular seasonal migrants to the area. It is considered unlikely that the species would significantly impacted by the proposed development.
Callocephalon fimbriatum (3)	Gang-Gang Cockatoo	V		No sign of species during fieldwork. The subject site may offer some habitat opportunity for this species when in the area however an absence of records in the locality suggests they are not residents or regular seasonal migrants to the area. It is considered unlikely that the species would significantly impacted by the proposed development.
Calyptorhynchus lathami (23)	Glossy Black-Cockatoo	V		Recorded within the subject site. Could utilise the subject site for foraging on preferred feed trees (*Allocasuarina* spp.) and also suitable large hollows for nesting. Areas containing both of these resource attributes would be affected by development. **SUBJECT SPECIES**
Climacteris picumnus victoriae (1)	Brown Treecreeper	V		No sign of species during fieldwork. The subject site may offer some habitat opportunity for this species when in the area however an absence of records in the locality suggests they are not residents or regular seasonal migrants to the area. It is considered unlikely that the species would significantly impacted by the proposed development.
Daphoenositta chrysoptera (15)	Varied Sittella	V		Atlas Record within the subject site from 2007. The forested parts of the subject site would provide suitable habitat for this species, including potential

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
				nesting habitat. Whilst significant areas of habitat within the subject site would be retained and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Ephippiorhynchus asiaticus	Black-necked Stork	E		No sign of species during fieldwork, but a dated Atlas record from 1993 is noted for the subject site. Various parts of the low lying areas of the subject site would provide suitable habitat for this species. However, such areas would be retained and enhanced under the VMP.
Glossopsitta pusilla (14)	Little Lorikeet	V		Recorded flying over the subject site. The forested parts of the subject site would provide suitable seasonal foraging habitat for this species, and smaller hollows within the subject site may offer some potentially suitable nesting opportunities. Whilst significant areas of habitat within the subject site would be retained and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Haliaeetus leucogaster (13)	White-bellied Sea-Eagle	V		No sign of species during fieldwork. The forested parts of the subject site may provide potential nesting habitat for this species and Mannering Creek and the farm dams may provide marginal foraging habitat, some of which would be removed. **SUBJECT SPECIES**
Hieraaetus morphnoides	Little Eagle	V		No sign of species during fieldwork. The forested parts of the subject site would provide suitable habitat for this species, including potential nesting habitat in larger trees. Whilst significant areas of habitat within the subject site would be retained and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Ixobrychus flavicollis (1)	Black Bittern	V		No sign of species during fieldwork. Some parts of the low lying areas of the subject site would provide suitable habitat for this species. Such areas would be retained and enhanced as part of the development.
Lathamus discolor (2)	Swift Parrot	E	CE	No sign of species during fieldwork and no local records within the last 20 years for this highly mobile species which could possibly utilise the subject site during flowering of feed tree species. While a small area of habitat containing several *E. robusta* would be removed, areas containing feed trees in this area would be retained and enhanced, including supplementary *E. robusta* planting. **SUBJECT SPECIES**
Lophoictinia isura (1)	Square-tailed Kite	V		No sign of species during fieldwork. The forested parts of the subject site would provide suitable habitat for this species, including potential nesting habitat in larger trees. Whilst significant areas of habitat within the subject site would be retained

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
				and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Ninox strenua (10)	Powerful Owl	V		No sign of species during fieldwork. A mobile species, so could possibly occur and records known from the wider locality. Potential prey species present, and larger hollows would be impacted by the proposal. **SUBJECT SPECIES**
Pandion cristatus (1)	Eastern Osprey	V		No sign of species or its conspicuous nest during fieldwork. Subject site does not offer the preferred hunting habitat for this species, and hence is unlikely to be used.
Tyto novaehollandiae (9)	Masked Owl	V		A likely Masked Owl pellet and wash was found during fieldwork (*Dead Finish, 2018).* The species could not be positively identified following subsequent fieldwork, despite targeted searches. A mobile species and records known from the wider locality. Foraging habitat and, sub-optimal large hollows recorded would be removed by the development. **SUBJECT SPECIES**
Tyto tenebricosa (2)	Sooty Owl	V		No sign of species during fieldwork. A mobile species, so could possibly occur and records known from the wider locality. Potential prey species present, and some larger hollows also occur. Would preferentially utilise taller, denser creekline vegetation which would be retained.
Mammals				
Cercartetus nanus (3)	Eastern Pygmy-possum	V		2018 Atlas record in adjacent south bushland. No sign of species during current surveys, however, the forested parts of the subject site would provide suitable habitat for this species, including potential nesting/roosting habitat. Whilst significant areas of habitat within the subject site would be retained and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Recorded during previous surveys within the subject site as a "possible" record. Vegetated parts of the subject site and surrounds would offer suitable foraging habitat opportunities for this mobile species. Whilst significant areas of habitat within the subject site would be retained and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Dasyurus maculatus (3)	Spotted-tailed Quoll	V	E	Anecdotal record of this species from the subject site, however no sign of the species during various ecological surveys. Whilst significant areas of habitat within the subject site would be retained

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
				and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Falsistrellus tasmaniensis (15)	Eastern Falsistrelle	V		No sign of species during fieldwork. The forested parts of the subject site would provide suitable habitat for this species, including potential roosting habitat. Whilst significant areas of habitat within the subject site would be retained and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Kerivoula papuensis (2)	Golden-tipped Bat	V		No sign of species during fieldwork. The forested parts of the subject site would provide suitable habitat for this species, however the absence of species such as Yellow-throated Scrub-wren and Brown Gerygone limit roosting opportunities for the species. Whilst significant areas of habitat within the subject site would be retained and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Miniopterus australis (43)	Little Bentwing-bat	V		Recorded within the subject site. The forested parts of the subject site and surrounds would provide suitable habitat for this species, including potential nesting habitat. Whilst significant areas of habitat within the subject site would be retained and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Miniopterus schreibersii oceanensis (21)	Eastern Bentwing-bat	V		Recorded within the subject site. The forested parts of the subject site and surrounds would provide suitable foraging habitat for this species. Whilst significant areas of habitat within the subject site would be retained and enhanced, some areas of suitable habitat would be removed. No caves are present for roosting. **SUBJECT SPECIES**
Mormopterus norfolkensis (26)	Eastern Freetail Bat	V		Recorded within the subject site. The forested parts of the subject site and surrounds would provide suitable habitat for this species, including potential nesting habitat. Whilst significant areas of habitat within the subject site would be retained and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Myotis macropus (21)	Southern Myotis	V		No sign of species during fieldwork. The forested parts of the subject site would provide suitable roosting habitat for this species, particularly along favoured riparian areas. No caves or culverts suitable for roosting have been identified within the subject site. **SUBJECT SPECIES**
Petauroides volans (2)	Greater Glider	-	V	No sign of species during fieldwork. Species typically prefers tall moist forests which are absent

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
				from the subject site. Considered unlikely to occur or be affected by the proposed development.
Petaurus australis (8)	Yellow-bellied Glider	V		No sign of species during fieldwork. Potentially suitable habitat present in forested areas within the subject site. Would preferentially utilise taller, denser creekline vegetation which would be retained. **SUBJECT SPECIES**
Petaurus norfolcensis (53)	Squirrel Glider	V		Recorded within the subject site. Forested areas provide suitable foraging, denning and connected habitat for the local population. **SUBJECT SPECIES**
Phascolarctos cinereus (1)	Koala	V	V	Anecdotal record of this species from the subject site, however no sign of the species or its presence during various ecological surveys. Habitat resources and linkages would remain within the subject site for any Koalas visiting the area.
Pseudomys gracilicaudatus (2)	Eastern Chestnut Mouse	V		Few records and no sign of this species during fieldwork. Marginally suitable habitat occurs within denser lower lying areas of the subject site, which would be retained and enhanced.
Pteropus poliocephalus (25)	Grey-headed Flying-fox	V	V	Recorded foraging within the subject site. A mobile species, so could occur when suitable fruiting / flowering resources available within the subject site and in the locality. Subject site offers a small component of a much larger foraging range. No existing camp roosts are present, but parts of the subject site in the main creekline could have potential to be occupied in that regard. **SUBJECT SPECIES**
Saccolaimus flaviventris (2)	Yellow-bellied Sheathtail-bat	V		Not recorded during surveys, however the forested parts of the subject site and surrounds would provide suitable habitat for this species, including potential nesting habitat. Whilst significant areas of habitat within the subject site would be retained and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Scoteanax rueppellii (19)	Greater Broad-nosed Bat	V		2007 echolocation record within subject site but not recorded during recent surveys. However the forested parts of the subject site and surrounds would provide suitable habitat for this species, including potential nesting habitat. Whilst significant areas of habitat within the subject site would be retained and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Reptiles				
Hoplocephalus stephensii (1)	Stephen's' Banded Snake	V		No sign of this species to date. Some marginal potential in forested sections of the subject site. Whilst significant areas of habitat within the

Scientific Name	Common Name	BC Act	EPBC Act	Likelihood of Occurrence
				subject site would be retained and enhanced, some areas of suitable habitat would be removed. **SUBJECT SPECIES**
Frogs				
Crinia tinnula (3)	Wallum Froglet	V		This species was recorded by call (ELA 2010) and were heard calling in 2018 targeted survey in heavily vegetated north-south drainage line *Wyong Paperbark Swamp Forest – Melaleuca Scrub* variant. **SUBJECT SPECIES**
Litoria aurea	Green and Golden Bell Frog	E	V	Historic record (1976) of this species from the subject site. Unlikely to still be present in this broader locality (no sign during various subsequent surveys) over a broader area including the subject site due to well documented population decline. **SUBJECT SPECIES**
Litoria brevipalmata (2)	Green-thighed Frog	V		No sign of this species in fieldwork. Some marginal potential along forested sections of the main creekline, but such areas would be retained and enhanced.
Mixophyes iteratus	Giant Barred Frog	E	E	No sign of this species in fieldwork. Some marginal potential along forested sections of the main creekline, but such areas would be retained and enhanced.

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

CE: Critically Endangered; E: Endangered; E2: Endangered Population; V: Vulnerable;
(#): Denotes the number of Atlas records with a 10km radius of the subject site since 1/1/1998.

From the above, the following species in **Table 5** are considered as key subject species / indicator species for this subject site due to either being recorded within the subject site, potentially likely to forage and roost on the subject site, or the subject site potentially forms an important part of a local home range for resident species and some potential habitat would be removed.

Table 5 - Key Species Considered in Further Assessment

Scientific Name	Common Name	BC Act	EPBC Act
Plants			
Angophora inopina (2739)	Charmhaven Apple	V	V
Tetratheca juncea (248)	Black-eyed Susan	V	V
Birds			
Anthochaera phrygia	Regent Honeyeater	CE	CE
Calyptorhynchus lathami (23)	Glossy Black-Cockatoo	V	
Daphoenositta chrysoptera (15)	Varied Sittella	V	
Glossopsitta pusilla (14)	Little Lorikeet	V	
Haliaeetus leucogaster (13)	White-bellied Sea-Eagle	V	
Hieraaetus morphnoides	Little Eagle	V	
Lathamus discolor (2)	Swift Parrot	E	CE
Lophoictinia isura (1)	Square-tailed Kite	V	
Ninox strenua	Powerful Owl	V	
Tyto novaehollandiae	Masked Owl	V	
Mammals			
Cercartetus nanus (3)	Eastern Pygmy-possum	V	
Chalinolobus dwyeri	Large-eared Pied Bat	V	V
Dasyurus maculatus (3)	Spotted-tailed Quoll	V	E
Falsistrellus tasmaniensis (15)	Eastern Falsistrelle	V	
Kerivoula papuensis (2)	Golden-tipped Bat	V	
Miniopterus australis (43)	Little Bentwing-bat	V	
Miniopterus schreibersii oceanensis (21)	Eastern Bentwing-bat	V	
Mormopterus norfolkensis (26)	Eastern Freetail Bat	V	
Myotis macropus (21)	Southern Myotis	V	
Petaurus australis (8)	Yellow-bellied Glider	V	
Petaurus norfolcensis (53)	Squirrel Glider	V	
Pteropus poliocephalus (25)	Grey-headed Flying-fox	V	V
Saccolaimus flaviventris (2)	Yellow-bellied Sheathtail-bat	V	
Scoteanax rueppellii (19)	Greater Broad-nosed Bat	V	
Frogs			
Crinia tinnula	Wallum Froglet	V	
Litoria aurea	Green and Golden Bell Frog	E	V
Reptiles			
Hoplocephalus stephensii	Stephen's' Banded Snake	V	

V: Vulnerable; E: Endangered; CE: Critically Endangered
(#): Denotes the number of Atlas records with a 10km radius of the subject site since 1/1/1998.

These species are considered further in **Section 8**.

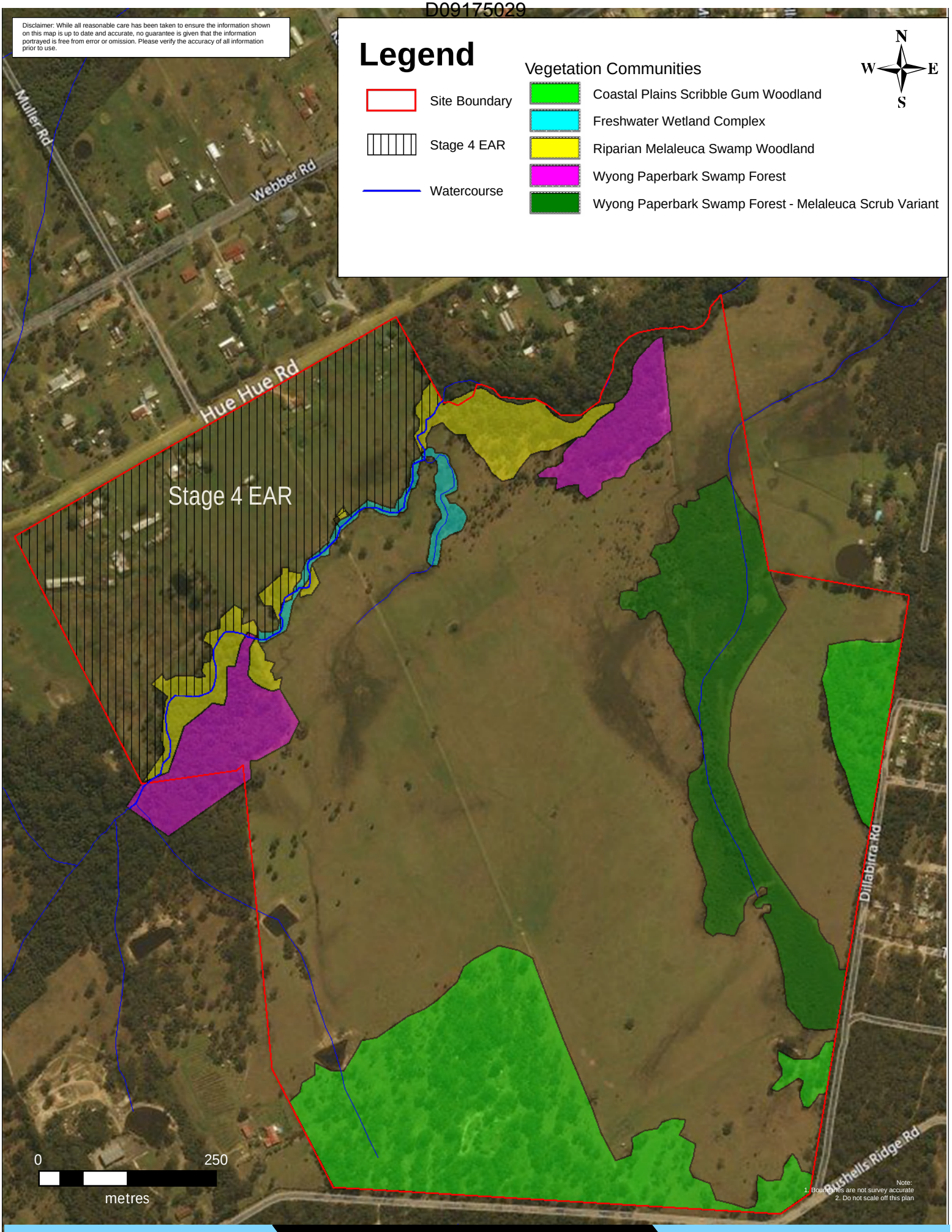
7.2 Vegetation Communities

Fieldwork was aimed at ground-truthing the vegetation mapping presented within ELA 2010.

As per Council Vegetation Map Series, vegetation communities include "*Coastal Plains Scribbly Gum Woodland", "Swamp Mahogany Paperbark Forest*", and "*Alluvial Blue Gum – Spotted Gum Moist Forest*". The vegetation community designations outlined below further breaks down these communities, and also includes an additional community type, namely "*Freshwater Wetland Complex".*

The map units presented within ELA 2010, and subsequently ground truthed and refined within the subject site by this study are outlined below. **Figure 4** shows the extent of these vegetation assemblages. The remainder of the subject site supports pasture grassland, with some farm dams noted.

D09175029



AEP

Title: Figure 4 - Vegetation Map

Date: August 2018

Location: Land off Hue Hue Rd, Wyee

Client Wyee Land Pty Ltd

Our Ref: 1732

7.2.1 Coastal Plains Scribbly Gum Woodland

Area – 14.3ha

Impact of Development – Removal of approx. 12.6ha of this community.

Coastal Plains Scribbly Gum Woodland occurs on higher ground as a patch along the eastern boundary, and as a larger vegetated hilltop and slopes along the southern boundary of Bushells Ridge Road. Shrub layer condition is variable, ranging from intact to noticeably modified and disturbed.

Indicative Species:

- Upper Stratum: *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum), *Corymbia gummifera* (Red Bloodwood), *E. capitellata* (Brown Stringybark). Lowe canopy consists of *Angophora inopina* (Charmhaven Apple), *Allocasuarina littoralis* (Black She-oak), *Syncarpia glomulifera* (Turpentine).
- Shrub Layer: *Banksia oblongifolia, B. spinulosa, Epacris pulchella, Hakea dactyloides, Isopogon anemonifolius, Lambertia formosa, Leptospermum trinervium.*
- Ground Cover: *Entolasia stricta, Themeda triandra, Lomandra obliqua, Panicum simile, Xanthorrhoea* sp.

7.2.2 Riparian Melaleuca Swamp Woodland

Area – Approx. 3.0ha

Impact of Development – No removal proposed. Area to be part of VMP lands subject to rehabilitation management.

Riparian Melaleuca Swamp Woodland occurs adjacent to freshwater wetland vegetation along the Mannering Creek riparian corridor. Condition is variable, ranging from intact to noticeably altered and largely cleared in the west. This community is commensurate with *Swamp Mahogany Paperbark Forest EEC* listed under the BC Act.

Indicative Species:

- Upper Stratum: *Syzygium smithii* (Lilly Pilly), *Eucalyptus amplifolia* (Cabbage Gum), *Angophora floribunda* (Rough-barked Apple), *E. robusta* (Swamp Mahogany).
- Shrub Layer: *Banksia oblongifolia, Callistemon citrinus, Melaleuca linariifolia, M. styphelioides.*
- Ground Cover: *Entolasia stricta, Adiantum aethiopicum, Lomandra longifolia, Gahnia clarkei, Oplismenus aemulus*.

7.2.3 Wyong Paperbark Swamp Forest

Area – 3.3ha

Impact of Development - A fringe area of approx. 0.09ha would be affected by development associated with the construction of the playfields. The remainder to be part of environmental conservation zone subject to rehabilitation management.

Wyong Paperbark Swamp Forest occurs adjacent to *Riparian Melaleuca Swamp Forest* within larger patch areas along the Mannering Creek riparian corridor. It is in good condition with relatively few weeds. This community is commensurate with *Swamp Mahogany Paperbark Forest EEC* listed under the BC Act.

Indicative Species:

Upper Stratum: *Eucalyptus robusta* (Swamp Mahogany), *Allocasuarina littoralis* (Black She-oak).

Shrub Layer: *Glochidion ferdinandi*, *Melaleuca sieberi*, *M. decora*, *M. nodosa*.

Ground Cover: *Entolasia stricta*, *Themeda triandra*, *Lomandra obliqua*, *Panicum simile*, *Xanthorrhoea* sp.

7.2.4 *Wyong Paperbark Swamp Forest – Melaleuca Scrub variant*

Area – 7.6ha.

Impact of Development – Approx. 0.20ha of this community would be impacted to facilitate construction of road and services access into Stages 12 and 13. The remainder of the community would be management as part of environmental conservation zone subject to rehabilitation management.

Wyong Paperbark Swamp Forest – Melaleuca Scrub variant, occurs along the vegetated drainage line that runs north-south. The community is very thick and in relatively good condition away from immediate edge affected areas. This community is commensurate with *Swamp Mahogany Paperbark Forest EEC* listed under the BC Act.

Indicative Species: As above, but with thicker shrub layer and less upper stratum and ground cover.

7.2.5 Freshwater Wetland Complex

Area – 0.84ha.

Impact of Development – Approx. 0.3ha of *Freshwater Wetland Complex* would be impacted for the construction of the road and services crossing of Mannering Creek.

Freshwater Wetland Complex occurs patchily within the Mannering Creek riparian corridor and immediate floodplain surrounds. Condition and floristic structure is variable, with cattle intrusion and trampling being a key past disturbance. This community is commensurate with Freshwater Wetlands on Coastal Floodplains Endangered Ecological Community listed under the BC Act.

Indicative Species:

- *Eleocharis sphacelata, Juncus subsecundus, Ludwigia peploides, Paspalum distichum, Persicaria decipiens, Philydrum lanuginosum, Typha orientalis, Triglochin microtuberosum.*

7.3 Flora

Flora surveys to date have resulted in the identification of over 185 species within the subject site. Approximately 20% of these species are exotics, principally garden escapees and opportunistic pasture species, and invasive weed species generally associated with riparian areas and managed pasture lands.

A full list of flora species identified by surveys conducted within the subject site is included in **Appendix A**.

7.4 Threatened Plants

Threatened flora species previously recorded within the subject site included *Angophora inopina* (Charmhaven Apple) and *Tetratheca juncea* (Black-eyed Susan). **Figure 5** shows the location of records within the subject site.

A. inopina, (pictured **below**) occurs commonly in the study area within *Coastal Plains Scribbly Gum Woodland* and associated communities. The proposed development would see 140 specimens removed by development (46%). However 152 specimens would be retained in VMP lands. Following discussions with Council, it is proposed to offset this removal by replanting and maintaining this species at a minimum 5:1 ratio (minimum 700 plantings monitored and maintained for at least 12 months following planting) in suitable habitat within subject site VMP lands as outlined within the VMP. *A. inopina* offset locations are suggested in **Figure 7**.

This offsetting approach should ensure a suitable outcome is achieved for this species. It is noted that this species is widespread in the local area and occurring relatively commonly in large numbers.

A. inopina census and cumulative impacts from development is shown below in **Table 6**.

Table 6 - Census and Cumulative Impacts of Stages upon *Angophora inopina*

Area	Number of *A. inopina* recorded	Number to be removed	Cumulative Removal	Number retained
Stage 5*	14	2	2	12
Stage 7#	2	2	4	0
Stage 6	13	13	17	0
Stage 8	6	6	23	0
Stage 9	49	49	72	0
Stage 10	10	10	82	0
Stage 11	12	12	94	0
Stage 12	4	4	98	0
Stage 13	42	42	140	0
VMP Conservation Lands	140	0	140	140
Total	**292**	**140**		**152**

*** 14 *A. inopina* in VMP lands adjoining Stage 5, one specimen definitely removed. Several others <10m of eastern road alignment require protection from construction impacts (as detailed in the VMP).**

 # Staging order is indicative, Stage 7 planned to be constructed before Stage 6.

Tetratheca juncea (pictured **below**) was previously recorded as a single clump in the eastern forest patch (TE 2008). No sign of this clump was found by ELA in 2010, however, four small clumps (<30cm width, as per LMCC 2012 survey guidelines) were recorded in targeted survey by AEP in October 2018. The location of these records is shown in **Figure 5.**

The site generally, including the eastern forest patch where *T. juncea* was recorded consists of a disturbed and modified understorey, which probably explains the sparsity of records within the subject site. Vegetation immediately to the east of the subject site and where *T. juncea* was recorded has a more intact understorey within similar habitat and over 144 clumps were reported by ELA (2010).

It is not considered that the potential loss of a four small clumps from the subject site would significantly affect the viability of the local population in lands to the east.

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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 portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

Legend

N
W E
S

- Site Boundary
- Stages 1-4
- Watercourse
- Stage 5+ VMP Lands
- Stage 1-4 VMP lands
- Coastal Management Sepp
- 100m buffer
- *Angophora inopina*
- Tyto sp. pellet
- Tetratheca juncea (Travers 2008)
- Wallum Froglet
- Tetratheca juncea 2018 (4 clumps)

Hue Hue Rd
Digary Rd
Mannering Creek
Waropara Rd
Pirama Rd
Tulkaba Rd
Karakunba Rd
Bushells Ridge Rd
Gosford Rd
Gorokan Rd
Murrawal Rd
Dillabirra Rd
Wyee

Stage 1
Stage 2
Stage 3
Stage 4
Stage 5
Stage 6
Stage 7
Stage 8
Stage 9
Stage 10
Stage 11
Stage 12
Stage 13
E3 - Public Recreation /Open space
Homestead and E2

0 200
metres

AEP

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

Title: Figure 5 - Ecological survey results
Date: October 2018
Location: Land off Hue Hue Rd, Wyee
Client: Wyee Land Pty Ltd
Our Ref: 1732

7.5 Habitat Assessment

The subject site offers some habitat features for native fauna as outlined below.

- **Trees** – the large trees within the subject site provide potential seasonal foraging resources for nectivorous, insectivorous and to a lesser extent, frugivorous species.

- **Hollows** –A wide range of hollow sizes could represent valuable resource for several guilds of native fauna, including birds, mammals, reptiles, amphibians and gliders. A total of 157 HBTs were mapped in 2018, and HBT species, diameter at breast height (dbh), hollow numbers and features recorded within the subject site along with detailed maps for the location of each tree. Approximately 140 of these HBTs would be removed as a result of the development. HBTs are summarised in **Tables 7 and 8** and **Figure 6**.

  These trees HBT density within the Coastal Plains Scribbly Gum Woodland community within the subject site and in the study area is notably high.

HBT summary and locations is provided as **Appendix F.**

Table 7 – Hollow-bearing Trees Removed by Development

Area	Number of HBTs in Stage	Number of Hollows			Number of hollows
		Small <5cm	Medium 5-15cm	Large >15cm	
Stage 5 & E3	7	16	2	1	19
Stage 6	6	4	10	3	17
Stage 7	2	1	1	0	2
Stage 8	16	29	18	9	56
Stage 9	51	56	43	34	133
Stage 10	10	19	17	6	42
Stage 11	42	31	52	22	105
Stage 12	2	3	0	2	5
Stage 13	4	3	10	1	14
Total number removed	**140**	**162**	**153**	**78**	**393**

Table 8 – Hollow-bearing Trees Retained in Conservation Lands

Area	Number of HBTs	Small <5cm	Medium 5-15cm	Lge >15cm	Number of hollows
Lot 212 DP 866437	11	14	9	7	30
Other VMP lands	6	10	10	0	20
Totals	**17**	**24**	**19**	**7**	**50**

- **Shrubs** – the shrub layer varies from open pasture to dense undergrowth areas providing potential cover and shelter for a range of fauna species. Most of the shrub layer lies within VMP lands that would be retained.

Legend

N
W E
S

- Site Boundary
- Stages 1-4
- Stage 5+VMP Lands
- Stage 1-4 VMP Lands
- Coastal Management Sepp
- 100m buffer
- Watercourse
- Hollow bearing tree

Hue Hue Rd
Digary Rd
Stage 1
Stage 4
Stage 4 EAR
Stage 2
Stage 3
E3 - Public Recreation /Open space
Stage 5
Stage 13
Stage 12
Stage 7
Stage 6
Stage 8
Stage 10
Stage 9
Stage 11
Homestead and E2
Mannering Creek
Waropara Rd
Pirama Rd
Tulkaba Rd
Karakunba Rd
Bushells Ridge Rd
Gosford Rd
Gorokan Rd
Murrawal Rd
Dillabirra Rd
Wyee
Pac Mwy

0 200
metres

AEP

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

Title: Figure 6 - Holllow bearing trees
Date: October 2018
Location: Land off Hue Hue Rd, Wyee
Client: Wyee Land Pty Ltd
Our Ref: 1732

- **Riparian Areas** – the riparian areas & floodplains associated with Mannering Creek and its tributaries were found in a highly variable condition, ranging from highly disturbed areas mostly devoid of vegetation and suffering erosion events, to reasonably intact EEC vegetation areas. These areas would provide habitat opportunities for a range of aquatic and terrestrial fauna that preferentially utilise such areas. Water availability is likely to be permanent.

- **Dams** - four main farm dams were noted within the subject site, and all support aquatic vegetation, albeit not of EEC designation due to their constructed nature and location away from the floodplain. These features would provide a water source for macropods and other native species within the subject site, and would provide some suitable habitat for herpetofauna species.

In summary, whilst approx. 13.1ha of scattered remnant native vegetation and cleared land within the subject site would be cleared, the remaining 26.1ha would be protected and rehabilitated within contiguous VMP lands.

Several threatened species have been recorded within the subject site, and there is potential for others to occur. The rezoning configuration resultant on the land has recognised these values, and consolidates, rehabilitates and protects quality habitat within the subject site that would provide long term opportunities for recruitment of native flora and fauna.

7.6 Fauna

Fauna surveys to date have identified 141 species within the study area, consisting of:

- Four frogs;
- 12 reptiles;
- 23 mammals (eight (8) exotic); and
- 91 birds (three (3) exotic).

Twelve (12) threatened fauna species were recorded within the subject site during various assessments (this report, previous surveys, Atlas records and anecdotal records), including:

- Glossy Black-Cockatoo – likely to be an irregular visitor to the subject site for foraging purposes as part of wider movements. Some marginal nesting habitat available in the form of HBTs.
- Varied Sittella – likely to be an irregular visitor to the subject site as part of wider movements. Nesting potential available.
- Little Lorikeet – wide moving species, likely to be an irregular visitor to the subject site when trees are flowering. Nesting potential available in HBTs.

- Large-eared Pied Bat – potential foraging habitat present on the subject site for local population. No roosting or maternity habitat (caves) present.
- Little Bentwing-bat – potential foraging habitat present on the subject site for local population. Roosting habitat present in the form of HBTs. No maternity habitat (caves) present.
- Eastern Bentwing-bat – potential foraging habitat present on the subject site for local population. No roosting or maternity habitat (caves) present.
- East-coast Freetail-bat – potential foraging habitat present on the subject site for local population. Roosting and breeding habitat present in the form of HBTs.
- Squirrel Glider – foraging and nesting habitat present, and (sub-optimal) habitat connections to larger offsite areas of habitat to the north and south.
- Grey-headed Flying-fox – likely to be a seasonal visitor when fruiting / flowering resources are available over the wider locality. Intact riparian areas may also offer potential camp sites.
- Wallum Froglet – recorded within subject site in heavy vegetation within north-south drainage line in 2009 and 2018, however potential habitat is absent around most of the riparian areas within the site. Rehabilitation under the VMP would increase opportunities for this species in the long term.
- Green and Golden Bell Frog – 1976 Atlas record noted. Likely that the local population has become extinct as has occurred across much of the species former range.
- Masked Owl – a large owl pellet was collected in fieldwork and reported as a probable *Tyto* Owl by Barbara Triggs of *Dead Finish Ecology.* Based on the habitat and size of the pellet it was deemed to possibly be Masked Owl. The pellet analysis is attached as **Appendix E.** Masked Owl would likely to be an irregular visitor to the subject site for foraging purposes as part of wider movements, and some of this habitat would be removed along with marginal nesting habitat available in the form of HBTs.

Other notable species, including some more mobile (flying, gliding) threatened species are also considered to possibly utilise the subject site on an intermittent basis as part of a larger home range. Such species are considered further in following Sections.

An Expected Fauna Species List has been generated for the subject site and is included as **Appendix B**, with fauna species recorded during fieldwork noted therein.

8.0 Key Species Considerations

Following all of the works outlined in previous sections, species identified for further consideration have been categorised into guilds. By considering these species and their lifecycle needs, many other species are also inadvertently considered as well in identifying key features. The analysis in **Table 9** below considers key lifecycle features for each guild of species in more detail, and assists in informing the subsequent 7 part test assessment.

Table 9 – Key Species Analysis

Guild	Key Habitat	Impacts
Plants including: *Angophora inopina* *Tetratheca juncea*	Dry woodland / open forest habitat	*A. inopina* occurs widely in sporadic patches in suitable habitat within the-subject site, and occurs in large numbers in the study area as well as the immediately locality including adjacent lands. Development would result in the removal of approx. 140 specimens over nine development stages. 152 specimens would be retained and a further approx. 700 specimens would be planted out and maintained until fully established within VMP lands. Four small clumps of *T. juncea* were recorded in 2018. The adjacent lot to the east has previously recorded over 140 clumps. Development would remove the clumps.
Nectivorous Birds including: Regent Honeyeater Little Lorikeet Swift Parrot	Foraging Resources	The subject site supports a variety of flowering trees and shrubs that would offer some seasonally suitable resources, particularly *Eucalyptus robusta* (Swamp Mahogany) which flowers in winter when Swift Parrots and Regent Honeyeaters are most likely to be within the locality. The Little Lorikeet is less 'seasonal' in movement, and would access suitable foraging resources when available Whilst habitat including several *E. robusta* would be impacted by the proposal, existing *E. robusta* would be protected and supplementary planting undertaken in VMP lands.
	Roosting and Nesting	All species could potentially utilise the subject site for nocturnal roosting when in the locality. Potential nesting would likely be limited to Little Lorikeet, which could utilise suitable small hollows occurring within the subject site in this regard. Swift Parrots only breed in Tasmania, and Regent Honeyeaters have not been recorded nesting in immediate coastal habitats, so such activity is considered unlikely.
	Connectivity	Given the high mobility of these species, the subject site is considered viably connected to other potential habitat areas within the wider landscape matrix.
Glossy Black-Cockatoo	Foraging Resources	Areas of the subject site supporting Black She-Oak would offer suitable periodic foraging resources for Glossy Black-Cockatoo.
	Roosting & Nesting	Suitable areas of roosting and nesting habitat are available in the form of forest areas (roosting) and HBTs (nesting).
	Connectivity	Given the high mobility of the species, the subject site is considered viably connected to other potential habitat areas within a wider landscape matrix.
Varied Sittella	Foraging Habitat	Suitable foraging resources are present for Varied Sittella in forested areas.
	Roosting & Nesting	Suitable roosting and nesting habitat is present for all species.

Guild	Key Habitat	Impacts
	Connectivity and Patch Size	Given the relative mobility of this species, the subject site is considered viably connected to other potential habitat areas within a wider landscape matrix. The subject site supports native vegetation that is fragmented into smaller areas by previous clearing. Woodland birds tend to prefer larger patch areas, such as those occurring to the south. The subject site is unlikely to be preferentially utilised over such areas by any local populations.
Raptors including: White-bellied Sea-Eagle Little Eagle Square-tailed Kite	Foraging Habitat	Suitable foraging resources present for all species, including open pasture areas, riparian habitats and forested areas of the subject site.
	Roosting & Nesting	Suitable roosting and nesting habitat present in the form of larger trees, particularly within riparian areas.
	Connectivity and Patch Size	Given the high mobility of these species, the subject site is considered viably connected to other potential habitat areas within a wider landscape matrix.
Forest Owls including: Masked Owl Powerful Owl	Large Hollows	Numerous large hollows recorded, although micro-habitats associated with potential nesting hollows appeared sub-optimal.
	Roosting	Forest Owls may either roost in large tree hollows, or within a suitable tree, often associated with thick vegetation / creeklines. Parts of the subject site, and particularly the retained Mannering Creek corridor, would offer potential in this regard.
	Foraging Habitat	Forested parts of the subject site contain suitable prey species such as possums, gliders, rats, antechinus and bandicoots, recorded during field survey.
	Home Range	Forest Owls have a large home range, foraging principally within 2km of their nest site to meet their hunting requirements. If utilised, the subject site would likely constitute a small component of a larger home range within the wider locality.
Eastern Pygmy-possum	Foraging Habitat	Forested areas of the subject site would offer suitable foraging resources for this largely nectivorous species.
	Shelter & Nesting	Tree hollows preferred, numerous potentially suitable present.
	Connectivity and Patch Size	Tends to occupy small home ranges, so subject site could offer a complete home range. (Sub-optimal) links to offsite habitat areas are available in several directions, but particularly to the south.
Gliders including: Yellow-bellied Glider Squirrel Glider	Nest Hollows	Suitably sized hollows occur within the subject site to offer potential nest sites for both species.
	Foraging Habitat	Species require access to suitable areas for seasonal foraging, and feed on nectar, pollen, plant exudates (e.g. wattle and eucalypt sap), invertebrates, and lerp (sugary exudate from insects), and rarely small vertebrates such as nestling birds. A good supply of nectar in winter seems important. The subject site contains a variety of flowering trees and shrubs, and stands of larger trees that would offer such resources. The VMP conservation lands contain numerous mature *E. robusta* that would offer such resources, including winter nectar. Many more nectivorous shrubs and trees including supplementary *E. robusta* would be planted in conservation lands under the VMP.
	Connectivity and Patch Size	Given the presence of habitat areas within the subject site with (sub-optimal) connections to offsite areas of habitat, it is considered that suitable home range and connectivity exists to maintain viable populations. Squirrel Gliders have been confirmed to be present and mitigation measures are included in the VMP to restore connectivity to VMP lands within the subject site.

Guild	Key Habitat	Impacts
Microbats including: Large-eared Pied Bat Eastern Falsistrelle Golden-tipped Bat Little Bentwing-bat Eastern Bentwing-bat East-coast Freetail-bat Southern Myotis Yellow-bellied Sheathtail-bat Greater Broad-nosed bat	Roosting & Maternity Habitat	The presence of numerous hollow bearing trees leaves little doubt that suitable micro-bat roosting habitat is available for species that utilise such features. No caves or other similar structures were identified for species requiring such features for roosting / maternity habitat.
	Foraging Habitat	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. Southern Myotis feed over open water, the subject site provides foraging habitat for this species in the form of farm dams and pools within Mannering Creek.
Grey-headed Flying-fox	Roost Camp Areas	No roost camp is present within the subject site. It is considered that the subject site, as with many other forested patches, would have some potential to be utilised as a roost camp, particularly the riparian areas.
	Foraging	The subject site offers suitable seasonal foraging potential as witnessed by the previous record within the subject site. Given the species' high mobility (up to 50km from camp for foraging at night), continued seasonal visits would be expected.
Frogs including: Wallum Froglet Green & Golden Bell Frog	Habitat	Wallum Froglet is restricted to freshwater swamps in lowland coastal areas and are found in associated vegetation communities such as heath, sedgeland and woodland on nutrient-poor sandy soils. Acidic swamps and lakes in these areas provide essential breeding habitat for wallum-dependent frog species. The species was heard calling from the north-south vegetated drainage line by ELA (2010) and AEP (2018). Green and Golden Bell Frogs inhabit marshes, dams and stream-sides, particularly those containing bulrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby, and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney and Hunter region, occur in highly disturbed areas. A small amount (approx. 0.45ha) of habitat would be impacted by the road and infrastructure crossing works.
Stephens' Banded Snake	Habitat	This nocturnal species resides in rainforest, eucalypt forests and rocky areas below 900m AHD. Shelters in tree hollows or similar crevices, and hunts at night for frogs, lizards, birds and small mammals. Forested areas of the subject site would provide suitable habitat for this species.

9.0 7 Part Test Assessment

Section 5A of the *Environmental Planning & Assessment Act 1979* (EP&A Act) lists seven factors that must be considered in determining the significance of potential impacts of proposed activities on threatened species, populations, ecological communities and/or their habitats as listed within the *Biodiversity Conservation Act 2016* (BC 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 (SIS) is required to accompany a development application.

For the purposes of the 7 part test assessment, the **subject site** is the area directly affected by proposed development / vegetation clearing. The **study area** includes both the subject site and adjacent habitat areas that may be subject to indirect impacts from the vegetation clearing and development.

(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

The proposed development involves the removal of approx. 13.1ha of native vegetation, of which approx. 12.2ha is *Coastal Plains Scribbly Gum Woodland.* The removal would occur in a staged fashion as development progresses over several years. This habitat contains threatened flora species (*Angophora inopina* and *Tetratheca juncea*) and offers suitable foraging and nesting / roosting habitat for other threatened species that have either been recorded within the subject site or are considered to have a reasonable likelihood of occurring on the subject site.

Offset propagation, planting and maintenance of >700 *A. inopina* would ensure a suitable outcome for this species in the long term.

The remaining vegetation within the subject site occurs in association with riparian corridors and associated floodplains, and such, areas would be retained within the proposed development. These areas would be subjected to rehabilitation and management programs as detailed within an approved Vegetation Management Plan written by a suitably qualified ecologist. Such works would lead to gains in vegetation coverage and condition, improved geomorphology of streams, installation of key habitat features such as ground habitat, nest boxes and roosting hollows, and provision of viable long-term habitat connections for native species through and across the subject site to proximate habitat areas.

Plants:

The development as proposed would result in the removal of 140 specimens of *Angophora inopina.*

As a component of the VMP, suitable offset replanting areas have been identified within conservation zones within the subject site, and it is proposed to propagate plants from local provenance seed and replant these species at a minimum 5:1 offset ratio. These trees would be monitored and maintained until they reach a self-sustaining size as determined by the Project Ecologist / Bush Regeneration Contractor.

Combining the proposed offset planting with the retention of existing specimens within the subject site in conservation zones, and the abundance of this species in the wider locality, it is not considered likely that the local occurrence of *A. inopina* would be placed at risk of extinction or be significantly impacted by the development.

The development as proposed would result in the removal of four small clumps of *Tetratheca juncea.* The clumps occur immediately adjacent to an offsite population of at least 140 clumps and substantial populations are also known in the wider locality.

Based on this, it is considered unlikely that the removal of the *T. juncea* would lead to a significant impacted from the development or place the local population at risk of extinction. Further discussion on the impact to *T. juncea* is included in **Section 16.**

Nectivorous Birds:

Given the absence of any specific evidence of continued use of, or residence within the subject site, and the retention and rehabilitation of the more preferentially favoured habitat types within the subject site, it is not considered that the Little Lorikeet, Regent Honeyeater or Swift Parrot would be significantly impacted by the development.

As Little Lorikeets nest in tree hollows, it is considered an important safeguard measure that pre-clearance surveys of HBTs are carried out within areas proposed to be cleared, and that the Project Ecologist is on hand during all clearing works to rescue any potentially affected native fauna. In addition, the retention of hollow-bearing trees within the study area is highly encouraged where practical. Supplementary nest boxes are to be installed in appropriate densities at a ratio of one hollow replaced for every hollow removed by the development within the retained vegetation within the subject site prior to clearing works for each stage to provide additional roosting locations for any displaced fauna. Furthermore, rehabilitation works within the retained vegetation are proposed to improve the quality of habitat therein for native species in general.

Glossy Black-Cockatoo:

Given the absence of any specific evidence of continued use of, or residence within the subject site, and the relative abundance of suitable habitat within the wider locality, it is not considered likely that the Glossy Black-Cockatoo would be significantly impacted upon by the development. Given that these species nest in tree hollows, it is considered an important safeguard measure that pre-clearance surveys of HBTs are carried out within areas proposed to be cleared, and that the Project Ecologist is on hand during clearing to rescue

any potentially affected native fauna. Supplementary nest boxes are proposed as per the recommendation for Little Lorikeet.

Varied Sittella:

Given the absence of any specific evidence of continued use of, or residence within the subject site, and the relative abundance of suitable habitat within the wider locality including preferred larger intact habitat areas, it is not considered likely that the Varied Sittella would be significantly impacted upon by the development.

Raptors:

Given the absence of any specific evidence of use of, or residence within the subject site, and the relative abundance of habitat within the wider locality for these highly mobile species, it is not considered likely that the White-bellied Sea-Eagle, Little Eagle or Square-tailed Kite would be significantly impacted upon by the development.

Forest Owls:

While a possible record of Masked Owl occurred in fieldwork, given the absence of evidence of roosting and / or nesting despite targeted survey within the subject site, and the relative abundance of habitat within the wider locality for these highly mobile species, it is not considered likely that Forest Owls would be significantly impacted upon by the development. Further discussion on the impact to Forest Owls is included in **Section 14.**

Given that these species nest in tree hollows, it is considered an important safeguard measure that pre-clearance surveys of HBTs are carried out within areas proposed to be cleared, and that a supervising ecologist is on hand during clearing to rescue any potentially affected native fauna. Supplementary nest boxes are proposed as per the recommendation for Little Lorikeet.

Eastern Pygmy Possum:

Given the absence of any specific evidence of use of, or residence within the subject site, and the relative abundance of habitat within the wider locality for this species, it is not considered likely that the Eastern Pygmy Possum would be significantly impacted upon by the development. Given that this species nests in tree hollows, it is considered an important safeguard measure that pre-clearance surveys of HBTs are carried out within areas proposed to be cleared, and that a supervising ecologist is on hand during clearing to rescue any potentially affected native fauna. Supplementary nest boxes are proposed as per the recommendation for Little Lorikeet.

Gliders:

Of particular relevance for this subject site is the connectivity across the subject site for Squirrel Gliders in a north-south direction. At present the main north-south linkage

incorporates an area of *Coastal Plains Scribbly Gum Woodland* in the east of the subject site that is slated for clearing and development in later stages of the proposal. In association with Council, a strategy has been generated that shifts the long-term movement corridor to the west into the north-south drainage line. This area presently has some breaks in vegetation, and also has some sections that are devoid of trees that would be suitable for gliding movement.

As such, a VMP has been crafted to specifically addresses the movement and habitat needs of the Squirrel Glider, and would involve targeted tree planting to close up identified gaps, and also utilise shorter term beneficial measures such as installation of gliding poles at key points and installation of suitably sized nest boxes for denning and cover. The planned rehabilitation of the corridor in a temporal sense is reflected in the proposed staging of the development, which sees the existing eastern corridor area being the last part of the subject site to be cleared and developed. Under the VMP performance criteria clearing would not be able to occur until it has been clearly demonstrated that the alternative corridor linkage is viable and sustainable.

Supplementary nest boxes are to be installed in appropriate densities at a ratio of one hollow replaced for every hollow removed by the development within the retained vegetation within the subject site prior to clearing works for each stage to provide additional roosting locations for any displaced fauna.

Provided that the adopted VMP is instigated and meets the set habitat and connectivity rehabilitation goals, then the local population of Squirrel Gliders should not be significantly affected such that they are placed at risk of extinction.

Yellow-bellied Gliders tend to be relatively conspicuous when present, and it is considered unlikely that the ecological surveying to date would have missed this species if present. In any case, the measures outlined for Squirrel Gliders would be applicable to Yellow-bellied Gliders as well.

As Gliders nest in tree hollows, it is considered an important safeguard measure that pre-clearance surveys of HBTs are carried out within areas proposed to be cleared, and that a supervising ecologist is on hand during all clearing works to rescue any potentially affected native fauna. In addition, the retention of hollow-bearing trees within the study area is highly encouraged where practical.

Further discussion on the impact to Squirrel Gliders is included in **Section 15.**

Microbats:

For the cave dwelling species, namely Large-eared Pied Bat and Eastern Bentwing-bat, the subject site is foraging habitat only. Foraging habitat would remain on site post development. It is considered unlikely that these species would be significantly impacted by the proposed development.

For the hollow dwelling species, there is potential for individuals to be impacted upon by clearing of HBTs. However, given the abundance of HBTs in the locality and the proposal to install supplementary roost boxes, it is considered very unlikely that any local population of these species is solely dependent on the resources within the subject site in the areas proposed to be cleared. As such, it is considered unlikely that the development as proposed would significantly impact any local population of these species.

Given that these species nests in tree hollows, it is considered an important safeguard measure that pre-clearance surveys of HBTs are carried out within areas proposed to be cleared, and that the Project Ecologist is on hand during clearing to rescue any potentially affected native fauna.

Grey-headed Flying-fox:

Given the absence of any specific evidence of continued use of, or residence within the subject site, and the relative abundance of habitat within the wider locality for this highly mobile species, and the continued availability of potential resources post development, it is not considered likely that the Grey-headed Flying-fox would be significantly impacted upon by the development.

Frogs:

The area of habitat where the Wallum Froglet was identified, and the extent of potentially suitable habitat occurring within the subject site would be retained in its entirety except for roadworks, with removal of approx. 0.45ha of habitat (vegetation within the alignment is narrower and is less dense), and enhanced and expanded via the rehabilitation works outlined within the VMP.

Design of appropriate engineering erosion and sedimentation controls within environmental plans for works would ensure that drainage into the Wallum Froglet habitat is of a suitable standard to maintain the natural environment present. Given such, it is not considered likely that the Wallum Froglet would be significantly impacted upon by the development.

The historic record of the Green & Golden Bell Frog (1976) for the subject site is noted, however, given the lack of any other records since this time, it is considered very unlikely that the species still exists within the subject site, or most likely within the study area or broader locality. Areas of suitable habitat would remain post development within the conserved riparian zones. Given such, it is not considered likely that the Green and Golden Bell Frog would be significantly impacted upon by the development.

Stephens' Banded Snake:

Given the absence of any specific evidence of use of, or residence within the subject site, and the relative abundance of habitat within the wider locality for this species, and the continued

availability of potential resources post development, it is not considered likely that Stephens' Banded Snake would be significantly impacted upon by the development.

Given that this species utilises tree hollows, it is considered an important safeguard measure that pre-clearance surveys of HBTs are carried out within areas proposed to be cleared, and that the Project Ecologist is on hand during clearing to rescue any potentially affected native fauna.

(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 likely to be present.

(c) in the case of an endangered ecological community (EEC), 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

Two vegetation communities identified within the subject site, namely *Freshwater Wetland Complex* and *Swamp Mahogany Paperbark Forest* are commensurate with EECs. There would be minor impacts to both EECs.

A maximum of 0.3ha of *Freshwater Wetland Complex* would be impacted by construction of the crossing of Mannering Creek. There is approx. 0.8ha of mapped *Freshwater Wetland Complex* within the subject site, leading to small permanent reduction in the occurrence of the community within the subject site. Proposed rehabilitation works within the riparian corridor under the VMP would improve the condition of the remnant patch as well as the hydrology of Mannering Creek and its tributaries, leading to improved stream health for the creek and increases in this community over time under the VMP.

As such the local occurrence of *Freshwater Wetland Complex* is considered unlikely to be placed at risk of extinction proved that the works proposed within the VMP are implemented.

Approx. 0.3ha of *Swamp Mahogany Paperbark Forest* is proposed to be removed as part of the proposed development. This includes 0.15ha to be removed for the construction of the

playing fields and 0.15ha for the construction of the road access into Stages 12 and 13. There is approx. 15.3ha of mapped SMPF within the subject site, with the proposed works leading to a 1.6% reduction in the occurrence of the community within the subject site.

Given extensive re-establishment of this EEC in planned rehabilitation works proposed within the VMP lands and the small amount of EEC vegetation to be removed is considered unlikely the local occurrence of *Swamp Mahogany Paperbark Forest* would be placed at risk of extinction proved that the works proposed within the VMP are implemented.

(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 proposed development involves the removal of approx. 13ha of native vegetation, largely being *Coastal Plains Scribbly Gum Woodland*. This community is not a threatened entity. The removal would occur in a staged fashion as development progresses over several years.

There would be a net gain in EEC vegetation in the order of via the implementation of the VMP to undertake revegetation works within the VMP lands, particularly around Mannering Creek.

This vegetation offers suitable habitat resources for many native species, including some of the threatened fauna species as discussed above.

(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, and

The development as proposed would contribute to habitat loss and fragmentation as a result of native vegetation clearing. These impacts are proposed to be mitigated by implementation of a priority-targeted rehabilitation and management regime within VMP lands that would see corridor mitigation measures in the south-north watercourse implemented before any clearing of the approx. 12.2ha of tenuously connected *Coastal Plains Scribbly Gum Woodland* in the south of the site. Overall connectivity would be improved in the long-term by concentrated effort on rehabilitating the Mannering Creek and south-north corridors via the VMP.

A core focus of these works would be to ensure that viable connectivity for key species such as the Squirrel Glider is maintained long term through the subject site.

(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 threatened species or EECs in this locality. The development however would contribute to habitat loss and fragmentation within the wider locality, albeit that long-term gains in corridor and quality of vegetation coverage therein would be achieved within conservation zoned areas.

(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

The development as proposed would contribute to habitat clearing and fragmentation, and may increase exposure to human hazards (e.g. vehicle strike for Masked Owl). These processes are nominated threats within the *Recovery Plan for Large Forest Owls* (DEC 2006).

No relevant Threat Abatement Plans have been developed that would apply to the subject site or proposed development.

(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 key threatening processes (KTPs):

- *Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands*

Works as proposed within this development would have beneficial outcomes in regards to this process noting that a first-order watercourse is proposed to be removed as part of the proposed subdivision (shown in **Figure 4**). The loss of this highly modified and disturbed watercourse would be mitigated by the offset of approx. 1.0ha of vegetated riparian zone added to the VMP lands adjoining Mannering Creek.

- *Anthropogenic Climate Change*

The development as proposed would 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 would involve the removal of approx. 13ha of native vegetation. This loss is a direct contribution to this KTP, and contributes to incremental habitat loss in the locality. However, the proposed rehabilitation program set by the VMP for the conservation areas on the subject site should long term result in a net gain in vegetation.

- *Infection of frogs by amphibian chytrid causing the disease chytridiomycosis*

There is potential for development of the subject site to inadvertently introduce *Chytrid* fungus into the subject site. Given the recorded presence of Wallum Froglet within the subject site, it is recommended that appropriate hygiene controls are designed and implemented for all construction related activity to limit such potential.

- *Infection of native plants by Phytophthora cinnamomi and Myrtle rust*

There is potential for development of the subject site to inadvertently introduce *Phytophthora cinnamomi* (Phytophthora root rot*)* and *Puccinia psidii* (Myrtle Rust) into the subject site, which may lead to infection and degradation of retained and adjacent vegetation areas. As such, it is recommended that appropriate controls are designed and implemented for all construction related activity to limit such potential.

- *Loss of hollow bearing trees*

Approx. 393 hollows within 140 hollow-bearing trees would be lost as a result of the proposed development. To reduce impacts, a 1:1 nest box and salvageable hollow tree installation program is proposed within the retained conservation zones.

Longer term the maturing conservation zones would offer additional hollow development opportunities.

- *Removal of dead wood and dead trees*

The development as proposed would remove areas that contain some dead wood and dead trees. Consideration could be given to relocating dead wood into retained conservation areas.

- *Invasion and spread of aggressive weed species (several listed).*

Parts of the subject site support numerous weed infestations, including Priority Weeds. As such it would be necessary to address this problem in the VMP lands. To that end the VMP for the subject site would detail programs aimed at weed removal and native ecotone restoration.

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

10.0 SEPP 44 Assessment

Schedule 2 of State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) lists tree species which are considered indicators of potential Koala habitat as they are known to be utilised as feed trees by Koalas. The presence of any of these tree species on a subject 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 has identified the presence of two Schedule 2 listed tree species, namely *Eucalyptus robusta* (Swamp Mahogany) and *E. haemastoma* (Broad-leaved Scribbly Gum).

E. robusta occurs in scattered clumps within riparian areas of the subject site. All specimens would be retained within the development, and planting of the species is detailed within the VMP for the subject site.

E. haemastoma occurs within significant numbers in higher elevated areas of the subject site in Coastal Plains Scribbly Gum Woodland. The majority of these areas are proposed to be developed.

As such, it was necessary to consider the potential presence of 'Core Koala Habitat' (CKH).

CKH is defined in the SEPP as:

> *"an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population".*

Ecological field surveys across the subject site have not revealed any signs of Koalas or indications of their presence. An anecdotal record of a Koala within the subject site some years back from a local resident is unable to be confirmed.

Atlas Data reveals a record from within 10km in 2012, and two records from the 1980s.

Based on the absence of evidence within the subject site from recent ecological surveys and the paucity of historical records, it is clear that the subject site would not constitute CKH as defined by the SEPP.

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

11.0 SEPP CM Assessment

State Environment Planning Policy (Coastal Management) 2018 (SEPP CM) was introduced in April 2018, replacing and repealing the following SEPPs:

- State Environmental Planning Policy No 14—Coastal Wetlands;
- State Environmental Planning Policy No 26—Littoral Rainforests; and
- State Environmental Planning Policy No 71—Coastal Protection.

Whilst the study area was not previously mapped as any of the repealed SEPPs, the proposal works include land identified as *Wetland* and *Buffer* under SEPP CM. However, given that this is a modification to a previous DA, they are exempt from SEPP CM *Designated Development* provisions under transitional arrangements for the CM Act legislation.

However a Controlled Activity Approval from NSW DPI – Water for the works would be required for works within 40m of a watercourse (the crossings of Mannering Creek and the south-north watercourse).

Notwithstanding the above the following is provided as guidance to minimise the impacts of works proximate the SEPP CM lands.

The objectives of SEPP CM are to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the NSW *Coastal Management Act 2016* (CM Act) including the management objectives for each coastal management area, by managing development in the coastal zone and protecting the environmental assets of the coast, establishing a framework for land use planning to guide decision making in the coastal zone, and mapping the extent of these lands.

SEPP CM **s2.1** requires that a proposed development would not significantly impact on:

> *"(a) the biophysical, hydrological or ecological integrity of the adjacent coastal wetland; or*
>
> *(b) the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland."*

Provided adequate erosion and sedimentation controls are installed prior to construction commencing, and regularly inspected and maintained (weekly or after rain events) during construction works, it is unlikely that environmentally sensitive land (ESL) would be subject to indirect impacts.

Approx. 7.7ha of a mapped drainage line running roughly south to north through the subject site is identified as *Coastal Wetland* under SEPP CM. Protection and rehabilitation of SEPP CM lands within the subject site would be assured through the approved VMP for the development of Stages 5 and Superlots. Prior to the commencement of any works,

implementation of erosion and sedimentation controls detailed in construction plans for the development would be designed to mitigate impacts on SEPP CM Wetland and Buffer lands.

The location of SEPP CM lands are shown in **Figure 5.**

12.0 EPBC Act Assessment

A search was conducted in August 2018 of Matters of National Environmental Significance (MNES) as relevant to the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act). The following MNES are considered in this assessment.

World Heritage Properties:

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

National Heritage Places:

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

Great Barrier Reef Marine Park:

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

Commonwealth Marine Areas:

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

Threatened Ecological Communities:

The Protected Matters Search revealed that the vulnerable ecological community "*Subtropical and Temperate Coastal Saltmarsh*" was found to be likely to occur within the search area (10km radius from the subject site). However, this ecological community does not occur within the subject site, and none of the other vegetation communities present would qualify as a TEC.

Threatened Species:

Threatened species listed within the EPBC Act that have been recorded within the subject site during fieldwork, from previous database records, or from local anecdotal information include:

Angophora inopina	Charmhaven Apple
Tetratheca juncea	Black-eyed Susan
Chalinolobus dwyeri	Large-eared Pied Bat

Pteropus poliocephalus	Grey-headed Flying-fox
Dasyurus maculatus	Tiger Quoll
Phascolarctos cinereus	Koala
Litoria aurea	Green and Golden Bell Frog

The development as proposed would result in the removal of 140 specimens of *Angophora inopina.*

As a component of the VMP, suitable offset replanting areas would be identified within conservation zones, and it is proposed to propagate plants from local provenance seed and to replant and maintain these species to 'established' status at a minimum 5:1 offset ratio within the subject site VMP lands.

Areas of suitable habitat for the species would be rehabilitated and protected within VMP lands. The offset and mitigation actions along with the retention of approx. 153 existing specimens within the subject site in conservation zones, and the relative abundance of this species in the wider locality, means it is unlikely that this species would be significantly impacted by the development.

The development as proposed would result in the removal of four small clumps of *Tetratheca juncea.* These clumps occur within the subject site occur within contiguous habitat on an adjacent property of which the population comprises of at least 140 clumps. Other substantial populations are also known in the immediate locality.

Reference to the EPBC Act 1999 *T. juncea* referral guidelines showed it is not considered likely that this species would be significantly impacted by the development and EPBC referral is not required.

For the Large-eared Pied Bat, the subject site is foraging habitat only. Foraging habitat would remain on site post development. This species would not be significantly impacted by the proposed development.

Given the absence of any specific evidence of continued use of, or residence within the subject site by the Grey-headed Flying-fox, and the relative abundance of habitat within the wider locality for this highly mobile species, and the continued availability of potential resources post development, it is not considered likely that the species would be significantly impacted upon by the development.

Tiger Quoll and Koala are included due to anecdotal records of past presence on the subject site, as is the Green and Golden Bell Frog due to a historical record. Given the absence of any specific evidence of continued use of, or residence within the subject site by these species, the relative abundance of habitat within the wider locality for these mobile species, and the continued availability of potential resources post development it is not considered likely that they would be significantly impacted upon by the development.

Other EPBC listed species such as *Anthochaera phrygia* (Regent Honeyeater) and *Lathamus discolor* (Swift Parrot) were also assessed as having some potential to visit the subject site, but the resources therein are either proposed to be retained and enhanced (riparian areas) or are not considered preferred foraging resources in a broader context. Such areas have not been mapped as "High Value" habitat for these species in the Lower Hunter (Roderick et al., 2013). As such it is not considered that the development of this land as proposed is likely to significantly impact these species.

Migratory Species:

A number of EPBC listed migratory species have some potential to visit the subject site on an irregular basis. However, 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:

Consideration of the EPBC Act revealed that impacts on MNES would occur, principally being the removal of 140 specimens of *Angophora inopina*. Given the retention of the majority of the trees, relative abundance of the species in the locality, and the offset replanting of *A. inopina* at a 5:1 ratio within VMP lands, it is not considered that impacts on the species would be significant.

However, the proponent should consider the need to engage with Department of Environment and Energy to ensure the proposed approach is suitable.

13.0 Vegetation Corridor Assessment

Review of Council's Native Vegetation & Corridors mapping (2015) reveals that the study area is predominately mapped as Land parcels with no corridors present. A Vegetation Corridor Assessment was undertaken in ELA 2010 as part of the rezoning process through LMCC. Corridor proposals were put forward within that report and have been utilised to develop the corridor plans outlined below.

The proposal provides for the rehabilitation and enhancement of two corridors as part of VMP works. The first corridor runs east/west along the northern boundary with VMP works increasing vegetative cover, providing supplementary glider poles and weeding and revegetation of areas of non-native vegetation.

The second corridor runs north/south through VMP lands, connecting to the east/west corridor. Current connectivity is limited by patches of open ground/water and low tree height. Extensive VMP works would include the installation of glider poles, planting of canopy trees in identified gaps in canopy alongside other rehabilitation works to improve the width and quality of retained corridors.

The final vegetated corridor width of both corridors is likely to be in the order of 80m wide and as such it is considered the proposal would actually significantly enhance corridor connectivity within the study area in the long term.

14.0 Forest Owl Assessment

Reference to the LMCC *Interim Lake Macquarie Large Forest Owl Planning and Management Guidelines* (2014) provide guidelines on determining the significance of development impacts.

For the purposes of assessing development application under Section 5A of the EP&A Act, a significant impact on large forest owls according to the Guidelines is shown in **Table 10** below.

Table 10 – Forest Owl Assessment

Assessment Criteria	Proposed Development
Encroaches within 100m of confirmed nest trees	No known nest tree within 100m of subject site.
and/or	
Encroaches within 50m of confirmed breeding roost trees	No known breeding roost trees within 50m of the subject site.
and/or	
Severs vegetation connectivity between a confirmed nest and/or breeding roost tree and adjoining large forest owl habitat	No confirmed nest and/or breeding roost tree connectivity severed by removal of vegetation within this proposal. Vegetation corridors would be enhanced as per the Stage 5 and Superlots VMP (2018).
and/or	
Affects connectivity corridors such that prey species are significantly impacted	As above, connectivity would be enhanced via proposed development works under the VMP.
Cumulative impacts - >5ha of large forest owl habitat on land zoned residential, within 2km of a confirmed nest tree where: home range extent habitat within the area has already been reduced to less than 500ha.	No confirmed nest tree and habitat within the wider locality and habitat patch size >500ha.

As can be seen above, significant impact on large forest owls are unlikely to occur based on the assessment criteria within the Guidelines.

15.0 Squirrel Glider Assessment

Further to the 7-part test, the potential for the proposed development to have 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 11** below.

Table 11 - Squirrel Glider - Vegetation Corridor Assessment

Assessment Criteria	Proposed Development
An area of Squirrel Glider habitat of more than 4ha would be cleared.	Proposal would remove approx. 12.5ha.
and/or	
More than 1ha of habitat would be cleared and the habitat patch size would be reduced to less than 4ha.	More than 1ha of habitat to be removed but patch size would not be reduced to less than 4ha
and/or	
There is greater than 5% loss of habitat patches with an area of more than 10ha.	Patch size would be reduced by about 0.03% due to the large area of habitat currently present to the south.
and/or	
Habitat connectivity to a habitat patch would be lost, or narrowed to a width that is not suitable for maintaining in the long term.	Connectivity would be improved by tree planting and glider poles along the north/south creek line on the eastern side of the subject site and east/west along Mannering Creek as part of LMCC approved corridor design for the subdivision of the subject site.
In addition to the above	
Specific planning guidelines for Wyee population	Development would improve connectivity and corridors within conserved land within the Wyee area.

As can be seen in **Table 11**, a significant impact on Squirrel Glider would occur based on the assessment criteria within the Guidelines – area of more than 4ha would be cleared. Full details of planting, revegetation and rehabilitation works are detailed in the Stage 5 and Superlots VMP (AEP, 2018).

15.1 Offset Measures

The development would result in the clearing of approx. 13.0ha of Squirrel Glider habitat and as such triggers as a significant impact. To offset this impact an area of land totalling 26.1ha has been set aside as E2 – Environmental Conservation, within which 13.1ha of pasture land would be rehabilitated as Squirrel Glider habitat and the remaining 13.0ha would be enhanced with extensive planting of preferred Squirrel Glider feed trees. This is in addition to the 4.3ha of contiguous VMP lands associated development of Stages 1-4 to the north.

Under the VMP, approx. 60 Nest boxes suitable for Squirrel Glider would be established in Squirrel Glider corridor (average 2/ha) prior to any clearing of approx. 12.5ha of habitat in the south of the subject site. This would ensure that while construction and restoration is being undertaken there is sufficient denning habitat available.

Current corridors running north/south and east/west within the subject site would be enhanced with glider poles and planting of preferred native species. This would reduce habitat fragmentation within the locality by enhancing and rehabilitating key conceptual linkages between Major habitat fragments as set out in the Wyee Squirrel Glider Review

A summary of Offset Measures is contained in **Table 12** below.

Table 12 - Summary of Wyee offsets

Stage	Identified ESL in Wyee West Area Plan	*A. inopina* removed	*A. inopina planted*	VMP Lands area (ha)	Hollows			Squirrel Glider & Connectivity		Canopy trees	Comments
					To be replaced at 1:1 Small <5cm	To be replaced at 1:1 - Med 5-15cm	To be replaced at 1:1 Large >15cm	Glider Poles Mannering Creek	Glider Poles SEPP CM	include SG Tree Species planting in identified gaps	
5*	No	2	**10**	0	3	0	0	Survey identified corridor for Glider Pole locations. Glider Poles to be to be designed into batters and all poles to be installed as part of Stage 5 works.		Survey for and planting canopy species in all corridors as part of Stage 5 VMP works	Rehabilitation of Mannering Creek crossing buffer lands to commence on completion of construction works
7#	No	2	**10**	1.0	1	1	0	None		*E. robusta* on top of banks	VRZ Rehab of offset watercourse 1.0ha
6	YES	13	**65**	1.6	4	10	2	Glider poles installed in Stage 5 works before any ESL clearing		*E.robusta, E. capitellata* or *E. haemostoma according to habitat*	Glider Poles, established canopy trees, established *A. inopina* and **ALL** Nest Boxes installed before clearing ESL
8	YES	6	**30**	5.6	28	18	9	Glider poles installed before any ESL clearing		*E. robusta, E. capitellata* and *E. haemostoma according to habitat*	Glider Poles, established canopy trees, established *A. inopina* and ALL Nest Boxes installed before clearing ESL
9	YES	49	**245**	8.8	56	43	34				
10	YES	10	**50**	4.9	19	17	6				
11	YES	12	**60**	3.5	31	52	22				
12	YES	4	**20**	1.6	3	0	2				
13	YES	42	**210**	2.7	3	10	1				
E3	No	0	**0**		16	2	1	None			Commence adjoining E2 lands after construction of fields
Total		**140**	**700**	**29.7**	**164**	**153**	**77**				
* a number close to road buffers, to be confirmed in detailed design				# Indicative staging. Stage 7 will be developed before Stage 6. Other stages may be prioritised				** Planted *A. inopina* will be nurtured, monitored & replaced where required			

16.0 *Tetratheca juncea* Assessment

T. juncea was previously recorded as a single clump in the eastern forest patch (TE 2008). Four small clumps were recorded in the same area in 2018 targeted survey. The development as proposed would result in the removal of four small clumps of *T. juncea.*

This eastern forest patch has been subject to past disturbance, and this potentially accounts for the sparsity of records. In an adjacent lot with intact understorey within similar contiguous habitat, over 144 clumps were recorded by ELA 2010

Under both the *EPBC Act 1999* and LMCC *Tetratheca juncea* guidelines it is considered unlikely that the loss of the four small clumps of the species from the development site would significantly affect the viability of the local population of the species.

17.0 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 subject site:

- Rehabilitation of retained VMP lands and SEPP CM lands would be detailed in the approved VMP for Stages 1-4 (north side of Mannering Creek) and a new VMP being prepared for Stages 5 and Superlots (south side of Mannering Creek). These VMPs include staged weed control programs, installation of glider poles to improve connectivity for threatened Squirrel Gliders, planting and of approx. 700 *Angophora inopina*, planting other endemic native species at appropriate densities and monitoring which would informing long-term maintenance works.;

- An appropriately detailed Construction Environmental Management Plan (CEMP) would be generated that includes measures to protect retained trees and habitat areas from direct or indirect construction related impacts, and would make specific reference to the requirements set by the VMP. Erosion and sedimentation controls would be detailed in the CEMP to limit offsite movement of contaminants into VMP lands, SEPP CM lands drainage lines and supply waters of Mannering Creek;

- Pre-clearance surveys of areas containing hollow-bearing trees would be undertaken in an attempt to identify any hollows occupied, and appropriate measures would be devised to minimise impacts on resident fauna prior to felling;

- Required clearing of any vegetation on site should be supervised by the Project Ecologist to ensure any displaced native fauna can be taken into care and dealt with appropriately. In particular, clearing of the southern hilltop area containing numerous HBTs should be undertaken carefully under the instruction of the Project Ecologist;

- Felled trees, on-ground logs, rocks and other rich potential habitat won from clearing and construction works would be retained to be strategically placed and utilised as habitat and fauna furniture in conservation lands within the subject site;

- Installation of a variety of nest box sizes and types within the retained environmental conservation areas should occur at a ratio of minimum 1:1 to offset the loss of hollows elsewhere within the subject site. Any felled sections of trees found to be hollow should likewise be utilised in this fashion where feasible. The monitoring and replacement of nest boxes as required would be detailed in the VMP works program;

- Appropriate landscaping within the developed areas should be encouraged to provide resources for native fauna, particularly birds via suitable flowering 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.

18.0 References

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Appendix A – Flora Species List

FLORA SPECIES LIST

The following list includes all species of vascular plants observed within the subject site during fieldwork. It should be noted that such a list cannot be considered comprehensive, but rather indicative of the flora present on the subject 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. Any 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 *Biodiversity Conservation Act 2016*(BC 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 BC Act,
(EV) = Vulnerable Species listed under the EPBC Act 1999

Family	Scientific Name	Common Name
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair
	Cheilanthes sieberi ssp. sieberi	Mulga Fern
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed
Anthericaceae	*Tricoryne simplex*	
Apiaceae	*Actinotus minor*	Lesser Flannel Flower
	Centella asiatica	Pennywort
	Hydrocotyle peduncularis	
Apocynaceae	*Parsonsia straminea*	Common Silkpod
Araceae	*Gymnostachys anceps*	Settlers Flax
Asparagaceae	*Asparagus asparagoides*	Bridal Creeper
	Asparagus plumosus	Climbing Asparagus Fern
Arecaceae	*Syagrus romanozaffinia**	Cocos Palm
Aspleniaceae	*Asplenium flabellifolium*	Necklace Fern
Asteraceae	*Ageratina adenophora**	Crofton Weed
	*Bidens pilosa**	Cobbler's Pegs
	Cassinia uncata	Cassinia
	*Cirsium vulgare**	Spear Thistle
	*Conyza bonariensis**	Flaxleaf Fleabane
	*Gamochaeta calviceps**	Cudweed
	*Hypochaeris radicata**	Catsear
	*Onopordum acanthium ssp. acanthium**	Scotch Thistle
	Ozothamnus diosmifolius	White Dogwood
	*Senecio madagascariensis**	Fireweed
	*Taraxacum officinale**	Dandelion
Azollaceae	*Azolla pinnata*	Azolla
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern
	Doodia aspera	Rasp Fern
Bignoniaceae	*Jacaranda mimosifolia**	Jacaranda
	Pandorea pandorana ssp. pandorana	Wonga Wonga Vine
Caprifoliaceae	*Lonicera japonica**	Japanese Honeysuckle
Casuarinaceae	*Allocasuarina littoralis*	Black She Oak
	Allocasuarina torulosa	Forest Oak
Celastraceae	*Maytenus silvestris*	Narrow-leaved Orangebark
Commelinaceae	*Commelina cyanea*	Creeping Christian
Convolvulaceae	*Dichondra repens*	Kidney Weed
	Polymeria calycina	
Cyperaceae	*Cyperus appressa*	Tall Sedge
	*Cyperus congestus**	
	Cyperus polystachyos	
	Fimbristylis dichotoma	Common Fringe-rush

Family	Scientific Name	Common Name
	Gahnia clarkei	Tall Saw-Sedge
	Lepidosperma laterale	
	Schoenus apogon	Fluke Bogrush
Davalliaceae	*Nephrolepis cordifolia**	Fishbone Fern
Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Dicksoniaceae	*Calochlaena dubia*	Common Ground Fern
Dilleniaceae	*Hibbertia linearis*	
	Hibbertia riparia	Erect Guinea-flower
	Hibbertia scandens	Twining Guinea Flower
Dioscoreaceae	*Dioscorea transversa*	Native Yam
Epacridaceae	*Epacris microphylla*	Coral Heath
	Leucopogon microphyllus	
	Styphelia laeta	Five-corners
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush
	Glochidion ferdinandi	Cheese Tree
	Phyllanthus hirtellus	Thyme Spurge
Fabaceae (Faboideae)	*Bossiaea heterophylla*	Variable Bossiaea
	Bossiaea obcordata	Heart-leaved Bossiaea
	Daviesia alata	
	*Erythrina crista-galli**	Cockspur Coral Tree
	*Erythrina X sykesii**	Coral Tree
	Glycine microphylla	Small-leaf Glycine
	Gompholobium pinnatum	Pinnate Wedge Pea
	Hardenbergia violacea	False Sarsaparilla
	Kennedia rubicunda	Dusky Coral Pea
	Pultenaea elliptica	
	*Trifolium repens**	White Clover
Fabaceae (Mimosoideae)	*Acacia echinula*	Hedgehog Wattle
	Acacia irrorata	Green Wattle
	Acacia linearifolia	Narrow-leaved Wattle
	Acacia longifolia	Sydney Golden Wattle
	Acacia suavelons	Sweet-scented Wattle
	Acacia terminalis	Sunshine Wattle
Goodeniaceae	*Goodenia hederacea ssp. hederacea*	Ivy Goodenia
Iridaceae	*Crocosmia X crocosmiiflora**	Montbretia
	Patersonia sericea	Purple Silky-Flag
	*Romulea rosea var. australis**	Onion Grass
Juncaceae	*Juncus continuus*	
	Juncus subsecundus	
	Juncus usitatus	Common Rush
Lauraceae	*Cassytha glabella*	

Family	Scientific Name	Common Name
	*Cinnamomum camphora**	Camphor Laurel
Lobeliaceae	*Pratia purpurascens*	Whiteroot
Lomandraceae	*Lomandra longifolia*	Mat Rush
	Lomandra multiflora subsp. multiflora	Many-flowered Mat-rush
	Lomandra obliqua	Fish Bones
Loranthaceae	*Amyema cambagei*	Swamp Oak Mistletoe
	Muellerina spp.	A Mistletoe
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry
	Geitonoplesium cymosum	Scrambling Lily
Malvaceae	*Hibiscus heterophyllus*	Native Rosella
	*Sida rhombifolia**	Paddy's Lucerne
Menispermaceae	*Stephania japonica*	Snake Vine
Myrsinaceae	*Rapanea variabilis*	Muttonwood
Myrtaceae	*Angophora costata*	Smooth-barked Apple
	Angophora floribunda	Rough-barked Apple
	***Angophora inopina* (V, EV)**	**Charmhaven Apple**
	Baeckea virgata	Heath Myrtle
	Callistemon salignus	Willow Bottlebrush
	Corymbia gummifera	Red Bloodwood
	Corymbia maculata	Spotted Gum
	Eucalyptus amplifolia	Cabbage Gum
	Eucalyptus capitellata	Brown Stringybark
	Eucalyptus haemastoma	Broad-leaved Scribbly Gum
	Eucalyptus robusta	Swamp Mahogany
	Leptospermum polygalifolium	Lemon-scented Tea Tree
	Leptospermum trinervium	Slender Tea Tree
	Melaleuca decora	Snow-in-Summer
	Melaleuca linariifolia	Flax-leaved Paperbark
	Melaleuca nodosa	Ball Honeymyrtle
	Melaleuca thymifolia	Thyme Honey Myrtle
	Melaleuca styphelioides	Prickly-leaved Paperbark
	Micromyrtus ciliata	Fringed Heath Myrtle
	Syncarpia glomulifera	Turpentine
	Syzygium smithii	Lilly Pilly
Ochnaceae	*Ochna serrulata**	Mickey Mouse Plant
Oleaceae	*Ligustrum lucidum**	Large-leaved Privett
	*Ligustrum sinense**	Small-leaved Privett
	Notelaea longifolia	Large Mock Olive
Orchidaceae	*Dipodium punctatum*	Hyacinth Orchid
Oxalidaceae	*Oxalis corniculata**	Creeping Oxalis
	Oxalis perennans	

Family	Scientific Name	Common Name
Phormiaceae	*Dianella caerulea var. producta*	
Pittosporaceae	*Billardiera scandens*	Apple Berry
	Bursaria spinosa var. spinosa	Blackthorn
	Pittosporum revolutum	Rough Fruit Pittosporum
	Pittosporum undulatum	Sweet Pittosporum
Plantaginaceae	*Plantago lanceolata**	Lamb's Tongue
Poaceae	*Andropogon virginicus**	Whisky Grass
	Aristida ramosa var. ramosa	Purple Wiregrass
	*Arundo donax**	Giant Reed
	Axonopus affinis	Narrow-leaved Carpet Grass
	Cymbopogon refractus	Barbed Wire Grass
	Cynodon dactylon	Common Couch
	Echinopogon caespitosus var caespitosus	Tufted Hedgehog Grass
	*Ehrharta erecta**	Panic Veldtgrass
	Entolasia marginata	Bordered Panic
	Entolasia stricta	Wiry Panic
	Eragrostis brownii	Browns Lovegrass
	Imperata cylindrica var. major	Blady Grass
	Joycea pallida	Silvertop Wallaby Grass
	Microlaena stipoides var. stipoides	
	Oplismenus aemulus	Basket Grass
	*Paspalum dilatatum**	Paspalum
	Paspalum distichum	Water Couch
	*Pennisetum clandestinum**	Kikuyu Grass
	Poa affinis	
	*Setaria parviflora**	Slender Pigeon Grass
	Themeda australis	Kangaroo Grass
Polygalaceae	*Comsperma ericinum*	Matchheads
	Persicaria decipiens	Spotted Knotweed
	Persicaria hydropiper	Water Pepper
	Persicaria lapathifolia	Pale Knotweed
	Persicaria strigosa	Spotted Knotweed
	*Rumex sp**	Dock
Proteaceae	*Banksia paludosa*	Swamp Banksia
	Banksia serrata	Old Man Banksia
	Grevillea sericea	Pink Spider Flower
	Hakea bakeriana	
	Hakea dactyloides	Broad-leaved Hakea
	Hakea sericea	Needlebush
	Isopogon anemonifolius	Broad-leaf Drumsticks
	Lambertia formosa	Mountain Devil

Family	Scientific Name	Common Name
	Persoonia lanceolata	Lance Leaf Geebung
	Persoonia levis	Broad-leaved Geebung
	Petrophile pulchella	Conesticks
	Petrophile sessilis	Conesticks
Ranunculaceae	*Clematis aristata*	Old Man's Beard
Rosaceae	*Rubus fruticosus sp. agg**	Blackberry
Rubiaceae	*Morinda jasminoides*	Sweet Morinda
	*Richardia spp. **	
Rutaceae	*Zieria laevigata*	Smooth Zieria
Sapindaceae	*Dodonaea triquetra*	Common Hop Bush
Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell
Smilaceae	*Smilax australis*	Lawyer Vine
	Smilax glyciphylla	Sweet Sarsaparilla
Thelypteridaceae	*Christella dentata*	Binung
Thymelaeaceae	*Pimelea linifolia*	Rice Flower
Tremandraceae	***Tetratheca juncea* (V, EV)**	**Black-eyed Susan**
Verbenaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum
	*Lantana camara**	Lantana
	*Verbena bonariensis**	Purple Top
Violaceae	*Viola hederacea*	Ivy-leaved Violet
Xanthorrhoeaceae	*Xanthorrhoea media.*	Forest Grass-tree
	Xanthorrhoea spp.	A Grass-tree

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 subject site attributes and location.

"●"-species observed or indicated by scats, tracks etc. on, over or near the subject site during recent surveys by the various field investigations undertaken by Travers Environmental (2008), Eco Logical Australia Pty Ltd (2010), Eco Logical Australia Pty Ltd (2011), and AEP (2014, 2015 & 2018).

* - Introduced species

? - Unconfirmed record, anecdotal records etc.

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

Threatened species listed under the Biodiversity Conservation Act 2016 (BC Act), the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) or the Nature Conservation Act 2014 (NC Act) are indicated in **bold font**.

Family Name	Presence	*Scientific Name*	Common Name
Birds			
Phasianidae - True Quails	•	*Coturnix pectoralis*	Brown Quail
Family Anatidae - Ducks, Swans and Geese		*Anas castanea*	Chestnut Teal
		Anas platyrhynchos	*Mallard
	•	*Anas superciliosa*	Pacific Black Duck
	•	*Chenonetta jubata*	Wood Duck
		Cygnus atratus	Black Swan
Podicipedidae - Grebes		*Tachybaptus novaehollandiae*	Australasian Grebe
Anhingidae – Darter		*Anhinga melanogaster*	Australian Darter
Phalacrocoridae - Cormorants	•	*Phalacrocorax sulcirostris*	Little Black Cormorant
	•	*Phalacrocorax varius*	Little Pied Cormorant
Pelecanidae- Pelican		*Pelecanus conspicillatus*	Australian Pelican
Ardeidae - Herons, Egrets and Bitterns		*Ardea alba*	Great Egret
	•	*Ardea ibis*	Cattle Egret
	•	*Ardea intermedia*	Intermediate Egret
	•	*Ardea pacifica*	White-necked Heron
		Egretta garzetta	Little Egret
	•	*Egretta novaehollandiae*	White-faced Heron
		Ixobrychus flavicollis	**Black Bittern**
		Nycticorax caledonicus	Nankeen Night Heron
Threskiornithidae - Ibises and Spoonbills		*Platalea flavipes*	Yellow-billed Spoonbill
		Platalea regia	Royal Spoonbill
	•	*Threskiornis molucca*	Sacred Ibis
	•	*Threskiornis spinicollis*	Straw-necked Ibis
Ciconiidae – Storks	?	***Ephippiorhynchus asiaticus***	**Black-necked Stork**
Accipitridae - Osprey, Hawks, Eagles and Harriers	•	*Accipiter fasciatus*	Brown Goshawk
	•	*Accipiter cirrhocephalus*	Collared Sparrowhawk
		Accipiter novaehollandiae	Grey Goshawk
		Aquila audax	Wedge-tailed Eagle
		Aviceda subcristata	Pacific Baza
		Circus approximans	Swamp Harrier
	•	*Elanus notatus*	Black-shouldered Kite
		Haliaeetus leucogaster	**White-bellied Sea-Eagle**
		Haliastur sphenurus	Whistling Kite
		Hieraaetus morphnoides	**Little eagle**
		Milvus migrans	Black Kite
Falconidae - Falcons		*Falco berigora*	Brown Falcon
	•	*Falco cenchroides*	Nankeen Kestrel
	•	*Falco longipennis*	Australian Hobby
		Falco peregrines	Peregrine Falcon

Family Name	Presence	*Scientific Name*	Common Name
Rallidae - Crakes, Rails and Gallinules		*Fulica atra*	Eurasian Coot
		Gallinula tenebrosa	Dusky Moorhen
		Gallirallus philippensis	Buff-banded Rail
	•	*Porphyrio porphyrio*	Purple Swamphen
		Porzana fluminea	Australian Spotted Crake
		Porzana pusilla	Baillon's Crake
		Porzana tabuensis	Spotless Crake
		Rallus pectoralis	Lewin's Rail
Scolopacidae - Snipes, Godwits, Curlews, Sandpipers and Stints		*Gallinago hardwickii*	Latham's Snipe
Charadriidae - Plovers, Dotterels and Lapwings		*Charadrius melanops*	Black-fronted Dotterel
		Erythrogonys cinctus	Red-kneed Dotterel
	•	*Vanellus miles*	Masked Lapwing
Laridae – Gulls and terns		*Larus novaehollandiae*	Silver Gull
Columbidae - Pigeons, Doves		*Columba leucomela*	White-headed Pigeon
		Columba livia	*Feral Pigeon
	•	*Geopelia humeralis*	Bar-shouldered Dove
		Leucosarcia melanoleuca	Wonga Pigeon
		Lopholaimus antarcticus	Topknot Pigeon
		Macropygia amboinensis	Brown Cuckoo-Dove
	•	*Ocyphaps lophotes*	Crested Pigeon
		Phaps chalcoptera	Common Bronzewing
	•	*Streptopelia chinensis*	*Spotted Dove
Cacatuidae - Cockatoos and Corellas	•	*Cacatua galerita*	Sulphur-crested Cockatoo
	•	*Cacatua roseicapilla*	Galah
	•	*Cacatua sanguinea*	Little Corella
	•	*Cacatua tenuirostris*	Long-billed Corella
	•	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo
	•	***Calyptorhynchus lathami***	**Glossy Black-Cockatoo**
Psittacidae - Parrots, Rosellas and Lorikeets	•	*Alisterus scapularis*	King Parrot
	•	***Glossopsitta pusilla***	**Little Lorikeet**
	•	*Glossopsitta concinna*	Musk Lorikeet
		Platycercus elegans	Crimson Rosella
	•	*Platycercus eximius*	Eastern Rosella
	•	*Psephotus haematonotus*	Red-rumped Parrot
	•	*Trichoglossus chlorolepidotus*	Scaly-breasted Lorikeet
	•	*Trichoglossus haematodus*	Rainbow Lorikeet
Cuculidae – Cuckoos		*Chrysococcyx basalis*	Horsefield's Bronze-Cuckoo
		Chrysococcyx lucidus	Shining Bronze-Cuckoo
		Cuculus pallidus	Pallid Cuckoo
		Cuculus pyrrhophanus	Fan-tailed Cuckoo

Family Name	Presence	*Scientific Name*	Common Name
		Cuculus variolosus	Brush Cuckoo
		Eudynamis scolopacea	Common Koel
	•	*Scythrops novaehollandiae*	Channel-billed Cuckoo
Centropodidae - Pheasant Coucal		*Centropus phasianinus*	Pheasant Coucal
Tytonidae - Barn Owls		*Tyto alba*	Barn Owl
		Tyto novaehollandiae	**Masked Owl**
	•	***Tyto spp.***	**A Tyto Owl**
Strigidae - Owls		*Ninox novaeseelandiae*	Southern Boobook
		Ninox strenua	**Powerful Owl**
Podargidae – Frogmouths	•	*Podargus strigoides*	Tawny Frogmouth
Caprimulgidae - Nightjars		*Eurostopodus mystacalis*	White-throated Nightjar
Aegothelidae - Owlet Nightjars	•	*Aegotheles cristatus*	Australian Owlet Nightjar
Apodidae – Swifts		*Apus pacificus*	Fork-tailed Swift
		Hirundapus caudacutus	White-throated Needletail
Alcedinidae - River Kingfishers		*Ceyx azurea*	Azure Kingfisher
Halcyonidae - Tree Kingfishers	•	*Dacelo novaeguineae*	Laughing Kookaburra
	•	*Todiramphus sancta*	Sacred Kingfisher
Meropidae - Bee-eaters		*Merops ornatus*	Rainbow Bee-eater
Coraciidae – Rollers		*Eurystomus orientalis*	Dollarbird
Climacteridae – Treecreepers	•	*Cormobates leucophaea*	White-throated Treecreeper
Maluridae - Fairy-Wrens and Emu-Wrens		*Malurus assimilis*	Variegated Fairy-Wren
	•	*Malurus cyaneus*	Superb Fairy-Wren
		Stipiturus malachurus	Southern Emu-Wren
Pardalotidae - Pardalotes, Gerygones, Scrubwrens, Heathwrens and Thornbills	•	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill
	•	*Acanthiza lineata*	Striated Thornbill
	•	*Acanthiza nana*	Yellow Thornbill
	•	*Acanthiza pusilla*	Brown Thornbill
		Acanthiza reguloides	Buff-rumped Thornbill
		Gerygone mouki	Brown Gerygone
			White-throated Gerygone
	•	*Pardalotus punctatus*	Spotted Pardalote
	•	*Pardalotus striatus*	Striated Pardalote
	•	*Sericornis frontalis*	White-browed Scrubwren
		Smicrornis brevirostris	Weebill
Meliphagidae - Honeyeaters	•	*Anthrochaera carunculata*	Red Wattlebird
	•	*Acanthorhynchus tenuirostris*	Eastern Spinebill
	•	*Anthrochaera chrysoptera*	Little Wattlebird
	•	*Entomyzon cyanotus*	Blue-faced Honeyeater
	•	*Lichenostomus chrysops*	Yellow-faced Honeyeater
	•	*Lichmera indistincta*	Brown Honeyeater

Family Name	Presence	*Scientific Name*	Common Name
	•	*Manorina melanocephala*	Noisy Miner
	•	*Manorina melanophrys*	Bell Miner
	•	*Meliphaga lewinii*	Lewin's Honeyeater
		Melithreptus brevirostris	Brown-headed Honeyeater
		Melithreptus lunatus	White-naped Honeyeater
	•	*Myzomela sanguinolenta*	Scarlet Honeyeater
	•	*Philemon corniculatus*	Noisy Friarbird
		Phylidonyris novaehollandiae	New Holland Honeyeater
	•	*Phylidonyris nigra*	White-cheeked Honeyeater
		Plectorhyncha lanceolata	Striped Honeyeater
Petroicidae - Robins and Jacky Winter	•	*Eopsaltria australis*	Eastern Yellow Robin
		Microeca leucophaea	Jacky Winter
	•	*Petroica rosea*	Rose Robin
Family Cinclosomatidae - Whipbird and Quail-thrushes	•	*Psophodes olivaceus*	Eastern Whipbird
Family Neosittidae - Sittella	**A**	***Daphoenositta chrysoptera***	**Varied Sittella**
Family Pachycephalidae - Whistlers, Shrike-tit and Shrike-thrushes	•	*Colluricincla harmonica*	Grey Shrike-thrush
		Falcunculus frontatus	Crested Shrike-tit
	•	*Pachycephala pectoralis*	Golden Whistler
	•	*Pachycephala rufiventris*	Rufous Whistler
Family Dicruridae - Monarchs, Flycatchers, Fantails, Drongo and Magpie-Lark		*Dicrurus megarhynchus*	Spangled Drongo
	•	*Grallina cyanoleuca*	Magpie-lark
		Monarcha melanopsis	Black-faced Monarch
		Myiagra rubecula	Leaden Flycatcher
	•	*Rhipidura fuliginosa*	Grey Fantail
	•	*Rhipidura leucophrys*	Willie Wagtail
		Rhipidura rufifrons	Rufous Fantail
Family Campephagidae - Cuckoo-shrikes and Trillers	•	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike
		Coracina papuensis	White-bellied Cuckoo-shrike
		Coracina tenuirostris	Cicadabird
Family Oriolidae - Orioles and Figbird	•	*Oriolus sagittatus*	Olive-backed Oriole
	•	*Sphecotheres viridus*	Australasian Figbird
Family Artamidae - Wood-swallows, Butcherbirds, Magpie and Currawongs		*Artamus leucorhynchus*	White-breasted Woodswallow
	•	*Cracticus nigrogularis*	Pied Butcherbird
	•	*Cracticus torquatus*	Grey Butcherbird
	•	*Gymnorhina tibicen*	Australian Magpie
	•	*Strepera graculina*	Pied Currawong
Family Corvidae - Crows, Raven	•	*Corvus coronoides*	Australian Raven
Family Corcoracidae - Mudnest-builders		*Corcorax melanorhamphos*	White-winged Chough

Family Name	Presence	*Scientific Name*	Common Name
Family Ptilnorhynchidae - Bowerbirds		*Ptilinorhynchus violaceus*	Satin Bowerbird
Family Motacillidae - Pipits and Wagtails	•	*Anthus novaseelandiae*	Australian Pipit
Family Passeridae - Sparrows, Grassfinches, Mannikins	•	*Aegintha temporalis*	Red-browed Firetail
		Lonchura castaneothorax	Chestnut-breasted Mannikin
		Passer domesticus	*House Sparrow
	•	*Poephila bichenovii*	Double-barred Finch
		Poephila guttata	Zebra Finch
Family Dicaeidae - Flowerpeckers	•	*Dicaeum hirundinaceum*	Mistletoebird
Family Hirundinidae - Swallows and Martins	•	*Cecropis ariel*	Fairy Martin
		Cecropis nigricans	Tree Martin
	•	*Hirundo neoxena*	Welcome Swallow
Family Pycnonotidae - Bulbuls		*Pycnonotus jocosus*	*Red-whiskered Bulbul
Family Sylvidae - Old World Warblers		*Acrocephalus australis*	Australian Reed-Warbler
		Cisticola exilis	Golden-headed Cisticola
		Megalurus gramineus	Little Grassbird
	•	*Megalurus timoriensis*	Tawny Grassbird
Family Zosteropidae - White-eyes	•	*Zosterops lateralis*	Silvereye
Family Sturnidae - Starlings and Mynas	•	*Acridotheres tristis*	*Common Myna
	•	*Sturnus vulgaris*	*Common Starling
Amphibians			
Family Myobatrachidae - 'Southern' Frogs	•	*Crinia signifera*	Common Eastern Froglet
	•	***Crinia tinnula***	**Wallum Froglet**
	•	*Limnodynastes dumerilii*	Eastern Banjo Frog
		Limnodynastes ornatus	Ornate Burrowing Frog
	•	*Limnodynastes peronii*	Striped Marsh Frog
	•	*Limnodynastes tasmaniensis*	Spotted Grass Frog
		Mixophyes iteratus	**Giant Barred Frog**
		Pseudophryne bibronii	Brown Toadlet
		Pseudophryne coriacea	Red-backed Toadlet
	•	*Uperolia fusca*	Dusky Toadlet
		Uperoleia laevigata	Smooth Toadlet
Reptiles			
Family Chelidae - Tortoises	•	*Chelodina longicollis*	Eastern Snake-necked Tortoise
Family Gekkonidae - Geckoes		*Diplodactylus vittatus*	Wood Gecko
		Oedura lesueurii	Lesueur's Velvet Gecko
		Phyllurus platurus	Southern Leaf-tailed Gecko
		Underwoodisaurus milii	Thick-tailed Gecko
		Lialis burtonis	Burton's Snake-lizard

Family Name	Presence	*Scientific Name*	Common Name
Family Pygopodidae - Legless Lizards		*Pygopus lepidopus*	Common Scaly-foot
Family Agamidae - Dragons	•	*Amphibolurus muricatus*	Jacky Lizard
	•	*Physignathus lesuerii*	Eastern Water Dragon
	•	*Pogona barbata*	Eastern Bearded Dragon
Family Varanidae - Monitors		*Varanus varius*	Lace Monitor
Family Scinidae - Skinks		*Carlia tetradactyla*	Southern Rainbow Skink
		Carlia vivax	Tussock Rainbow Skink
		Cryptoblepharus virgatus	Wall Lizard
		Ctenotus robustus	Striped Skink
		Ctenotus taeniolatus	Copper-tailed Skink
		Cyclodomorphus casuarinae	Oak Skink
		Egernia cunninghami	Cunningham's Skink
	•	*Egernia major*	Land Mullet
			Eastern Ranges rock-skink
		Egernia saxatilis	Black Rock Skink
		Egernia striolata	Tree Skink
		Egernia whitii	White's Skink
	•	*Eulamprus quoyii*	Eastern Water Skink
		Eulamprus tenuis	Bar-sided forest-skink
		Hemisphaeriodon gerrardii	Pink-tongued Lizard
	•	*Lampropholis delicata*	Grass Skink
	•	*Lampropholis guichenoti*	Garden Skink
		Lygisaurus foliorum	Iridescent littler-skink
		Pseudomoia platynota	Red-throated Skink
	•	*Saiphos equalis*	Three-toed Skink
		Saproscincus mustelina	Weasel Skink
	•	*Tiliqua scincoides*	Eastern Blue-tongued Lizard
Family Typhlopidae - Blind Snakes		*Ramphotyphlops nigrescens*	
		Ramphotyphlops proximus	
		Ramphotyphlops wiedii	
Family Boidae - Pythons		*Morelia spilota*	Carpet (Diamond) Python
Family Colubridae		*Boiga irregularis*	Brown Tree Snake
		Dendralaphis punctulata	Green Tree Snake
Family Elapidae - Venomous Snakes		*Cacophis squamulosus*	Golden Crowned Snake
	•	*Demansia psammophis*	Yellow-faced Whip Snake
	•	*Pseudechis porphyriacus*	Red-bellied Black Snake
		Pseudonaja textilis	Eastern Brown Snake
		Rhinoplocephalus nigrescens	Eastern Small-eyed Snake
Mammals			
Family Tachyglossidae	•	*Tachyglossus aculeatus*	Echidna

Family Name	Presence	*Scientific Name*	Common Name
Family Ornithorhynchidae - Platypus		*Ornithorhynchus anatinus*	Platypus
Family Peramelidae - Bandicoots		*Isoodon macrourus*	Northern Brown Bandicoot
Family Phascolarctidae - Koala	**?**	***Phascolarctos cinereus***	**Koala**
Family Vombatidae - Wombats		*Vombatus ursinus*	Common Wombat
Family Petauridae - Gliders	•	*Petaurus breviceps*	Sugar Glider
	•	***Petaurus norfolcensis***	**Squirrel Glider**
Family Pseudocheiridae - Ringtail Possums and Greater Glider	•	*Pseudocheirus peregrinus*	Common Ringtail Possum
Family Acrobatidae - Feathertail Glider		*Acrobates pygamaeus*	Feathertail Glider
Family Phalangeridae - Brushtail Possums	•	*Trichosurus vulpecula*	Common Brushtail Possum
Family Macropodidae - Kangaroos, Wallabies	•	*Macropus giganteus*	Eastern Grey Kangaroo
	•	*Macropus rufogriseus*	Red-necked Wallaby
		Wallabia bicolor	Swamp Wallaby
Family Pteropodidae - Fruit Bats	•	***Pteropus poliocephalus***	**Grey-headed Flying-fox**
		Pteropus scapulatus	Little Red Flying-fox
Family Rhinolophidae - Horseshoe-bats		*Rhinolopus megaphyllus*	Eastern Horseshoe-bat
Family Emballonuridae - Sheathtail Bats		***Saccolaimus flaviventris***	**Yellow-bellied Sheathtail-bat**
Family Molossidae - Freetail Bats	•	***Mormopterus norfolkensis***	**East-coast Freetail-bat**
		Mormopterus sp.	Eastern Freetail-bat
			White-striped Freetail-bat
Family Vespertilionidae - Plain-nosed Bats	•	***Chalinolobus dwyeri***	**Large-eared Pied Bat**
		Chalinolobus gouldi	Gould's Wattled bat
		Chalinolobus morio	Chocolate Wattled Bat
		Falsistrellus tasmaniensis	**Eastern Falsistrelle**
	•	***Miniopterus australis***	**Little Bentwing-bat**
	A	***Miniopterus schreibersii***	**Eastern Bentwing-bat**
		Myotis macropus	**Southern Myotis**
		Nyctophylus geoffroyi	Lesser Long-eared Bat
		Nyctophilus gouldii	Gould's Long-eared Bat
		Nycticeius greyii	Little Broad-nosed Bat
		Scoteanax rueppellii	**Greater Broad-nosed Bat**
		Scotorepens orion	Eastern Broad-nosed Bat
		Vespadelus darlingtoni	Large Forest Bat
		Vespadelus pumilus	Eastern Forest Bat
		Vespadelus regulus	Southern Forest Bat
	•	*Vespaledus vulturnus*	Little Cave Bat
Family Muridae - Rodents		*Hydromys chrysogaster*	Water Rat

Family Name	Presence	*Scientific Name*	Common Name
	•	*Mus musculus*	*House Mouse
		Rattus fuscipes	Southern Bush Rat
	•	*Rattus lutreolus*	Swamp Rat
	•	*Rattus rattus*	*Black Rat
Family Canidae	•	*Vulpes vulpes*	*Fox
	•	*Canis familiaris*	*Dog
Family Felidae	•	*Felis catus*	*Cat
Family Leporidae		*Lepus capensis*	*European Hare
	•	*Oryctolagus cuniculus*	*Rabbit
Family Suidae	?	*Sus scrofa*	*Feral Pig
Family Bovidae		*Capra hircus*	*Goat

Appendix C – Bat Call Identification Report

AEP Bat Call Analysis

Site Name: Stage 5 + and Superlots

AEP Reference Number: 1732

Date: 07/09/2018

Method

Analysis of bat echolocation calls was undertaken using AnalookW software. Identification was carried out utilising Pennay et al. (2004) along with comparison from recorded reference calls associated with the Sydney Basin.

Reference calls used were obtained from the NSW database and AEP confirmed bat call collection.

Call sequences were identified and a confidence rating given to each call Table 1. While every effort has been made to definitively identify each sequence, calls that were too short (less than three pulses) were not analysed and tagged as unknown.

Certain microbat species have similar call frequencies, call shape and other characteristics which can make identification to a particular species impossible using just call analysis. Where it was not possible to differentiate calls due to similar call characteristics the call was marked as species group.

Table 1: Confidence ratings of bat call sequences	
Confidence	Description
Definite	Call has been identified to a particular species and could not be confused with another species.
Probable	Call has been identified to a particular species, with a low chance that it could be confused with another species.
Possible	Call has been identified to a particular species, but there is a moderate chance of confusion with another species.
Species group	Call could not be identified as a particular species due to call characteristics (poor quality/short sequence, bat species with overlapping frequencies, etc).
Unknown	Noise files or call sequences that are too short or of very poor quality.

Differentiation of species with similar calls

Separation of species with similar calls is possible using particular call characteristics, a short description of characteristics used to distinguish species is included in Table 2. Note that it is not always possible to separate similar calls and is affected by the length and quality of recorded calls.

Table 2 – Call characteristics used to differentiate species	
Species	Characteristic
Miniopterus australis/ Vespadelus pumilus	Differences in frequency or presence of a down-sweeping tail indicating *M. australis*.
Chalinolobus morio/ Vespadelus sp.	Presence of a down-sweeping tail on majority of calls indicated *C. morio*.
Myotis macropus/ Nyctophilus spp.	*M. macropus* differentiated based on calls with initial slope >400 OPS and pulse intervals <75ms. Secondary characters used include central kink and slope variances between pulses.

Results

96 call sequences were recorded of which 52 were analysable (not short calls or noise files). 49 calls were able to be identified to species and 3 others to species group (Table 3). Species that were identified definitively include:

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

Bats that are likely to be on site but could not be definitively identified (ie those that were classified as possible or within a species group) include:

- *Nyctophilus geoffroyi* (Lesser Long-eared Bat)
- *Nyctophilus gouldi* (Gould's Long-eared Bat)
- *Myotis macropus* (Large-footed Myotis)
- *Vespadelus pumilus* (Eastern Forest Bat)
- *Vespadelus vulturnus* (Little Forest Bat)
- *Chalinolobus morio* (Chocolate Wattled Bat)

While all care has been taken it should be noted that certain bat species are difficult to identify by bat call and others may not have been recorded by the detectors. It is therefore recommended that a habitat assessment should be used in conjunction with this analysis to determine the likely occurrence of other bat species.

Table 3 – Bat call analysis (number of calls per detector)		
	Anabat 1 (14/6 – 16/6)	Anabat 2 (14/6 – 16/6)
DEFINITE		
Miniopterus australis		48
PROBABLE		
Miniopterus australis		1
SPECIES GROUPS		
Vespadelus pumilus / *Vespadelus vulturnus*	1	
Vespadelus vulturnus / *Vespadelus pumilus* / *Chalinolobus morio*		1
Myotis macropus / *Nyctophilus* geoffroyi / *Nyctophilus gouldi*	1	
UNKNOWN		
Noise files	35	9
TOTAL	**37**	**59**

Sample Time vs Frequency graphs

A sample call for each bat species, that was identified (definitive/probable), is included below.

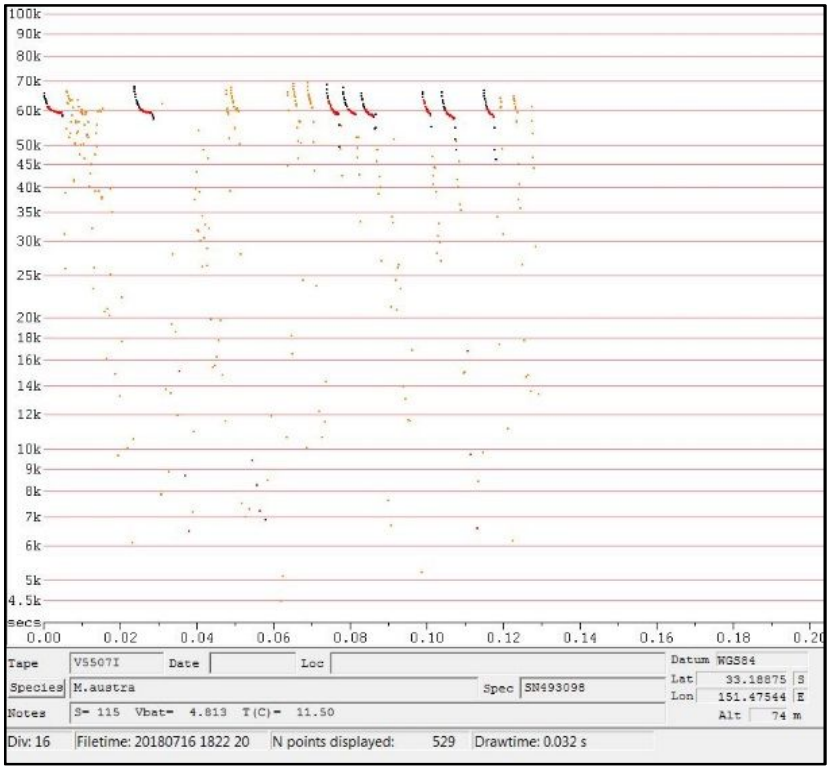


Figure 1 – Miniopterus australis definite call

Appendix D – Subject Site Photographs

Aerial photo of stage 5 and superlots site (above) and of riparian vegetation within VMP Lands to be rehabilitated under a VMP for the subject site (below)

Examples of disturbed creekline which would be subject to rehabilitation under the proposed VMP (above), and looking east across Stage 5 development area to proposed rehabilitation of north/south watercourse and vegetation corridor. Stages 12, 13 in the distance (below).

View north over Stages 7 and 8 and 1st order watercourse (above), and view south to hilltop ESL vegetation to be removed as part of later staged works (below).

Example of farm dam (above), and north-south drainage line (below).

Specimens of *Angophora inopina*.

Appendix E – *Dead Finish Ecology* Pellet Analysis

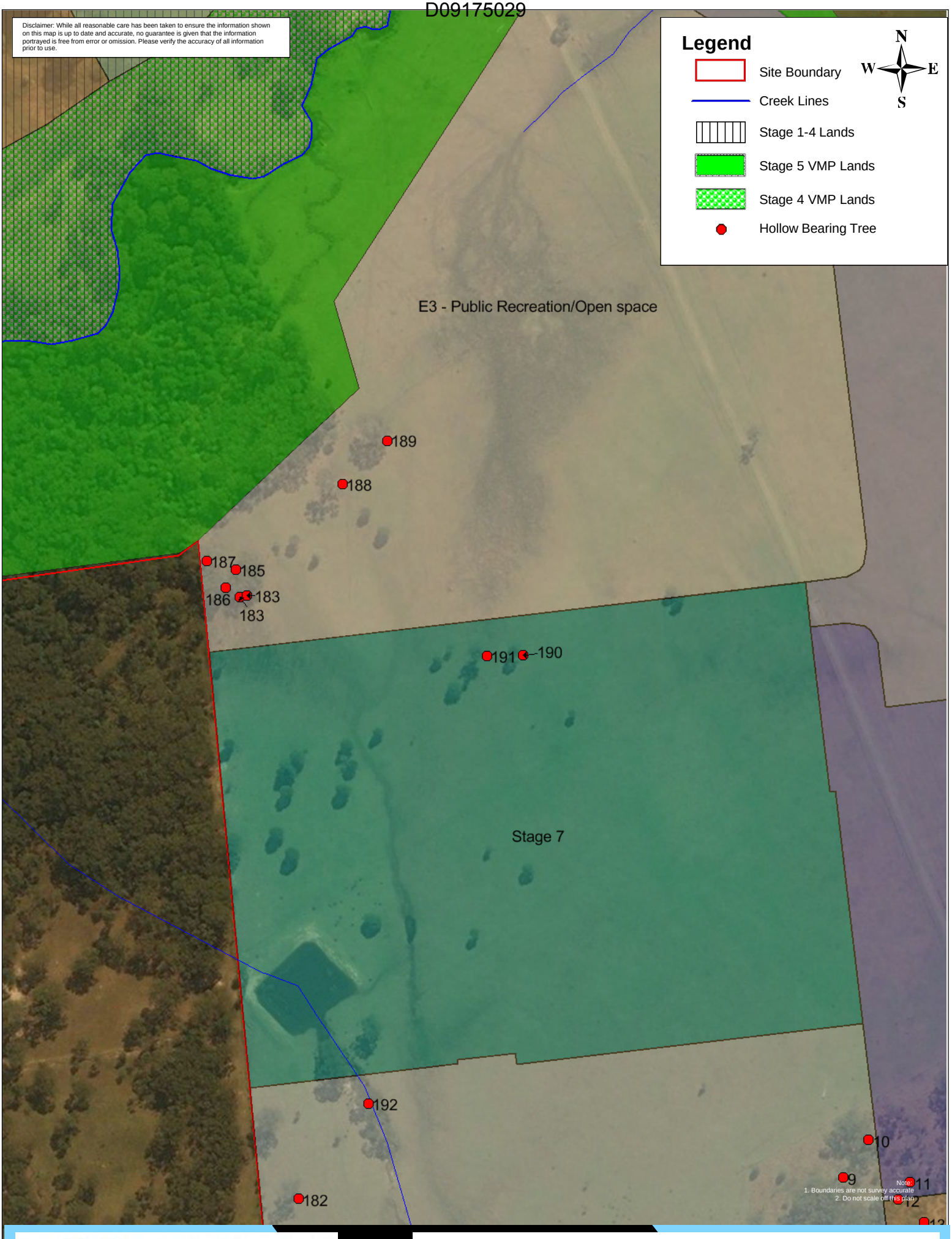
D09175029

Pellet analysis		AEP Ref:1732		
No.	**Location**	**Sample**	**Mammal ID - definite**	**Mammal ID - probable**
1	Wyee region	Owl pellet *	Rattus rattus	
Probably from a *Tyto* species of owl - either Sooty Owl or Masked Owl.				

Analysis by	
Barbara Triggs	
"Dead Finish"	
1 Dukes Road	
03 51580445	
btriggs@skymesh.com.au	
Genoa VIC 3891	
ABN 22 527 625 138	
Date	6/08/2018
Ref 6235	

Appendix F – Hollow Bearing Tree Locations

D09175029



AEP

Title: Stage 5 + Superlots HBT part 1

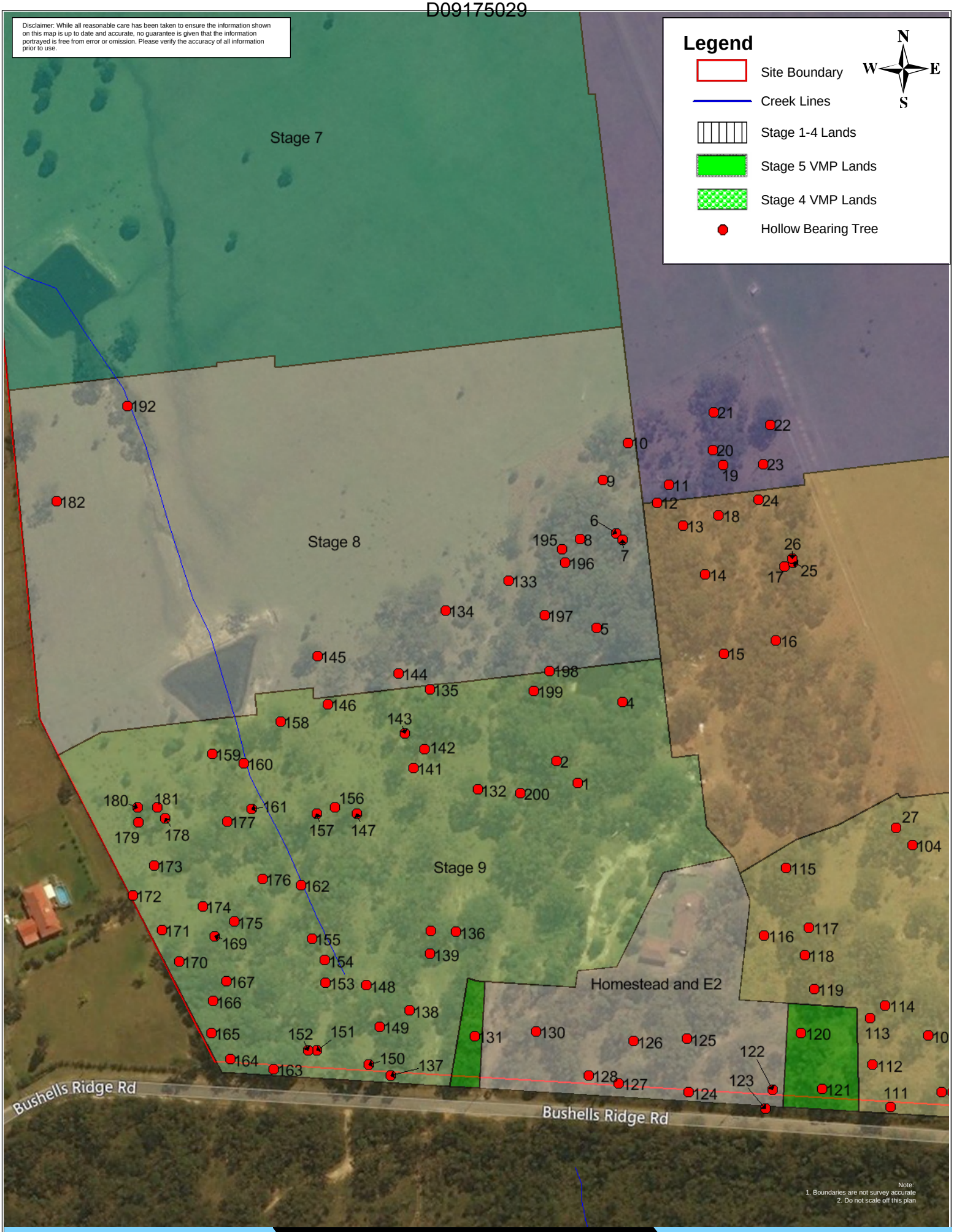
Date: Aug 2018

Location: Wyee

Client: Wyee Land Pty Ltd

Our Ref: 1372

D09175029



AEP

Title: Stage 5 + Superlots HBT Part 2

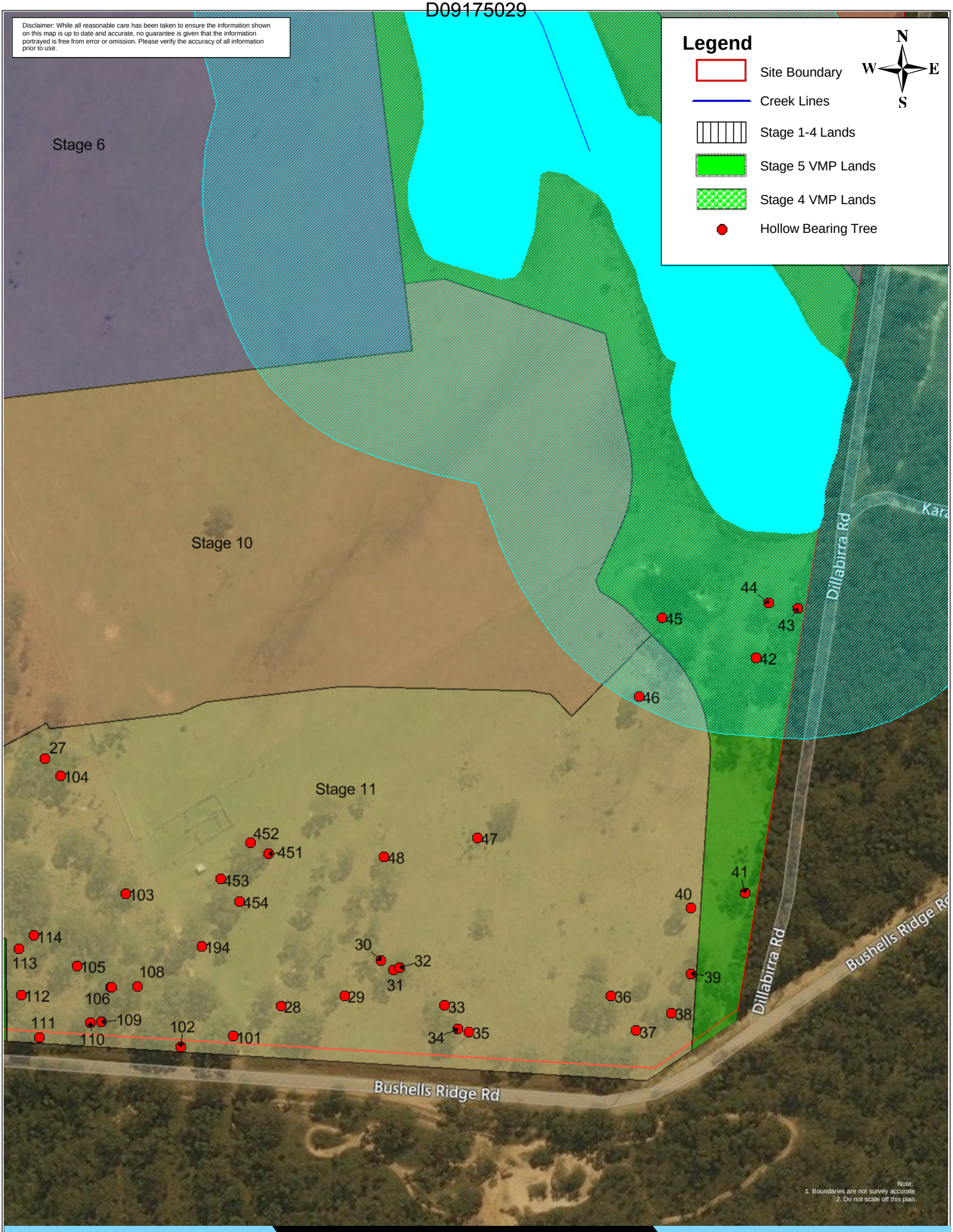
Date: Aug 2018

Location: Wyee

Client: Wyee Land Pty Ltd

Our Ref: 1732

D09175029



AEP

Title: Stage 5 + Superlots HBT Part 3

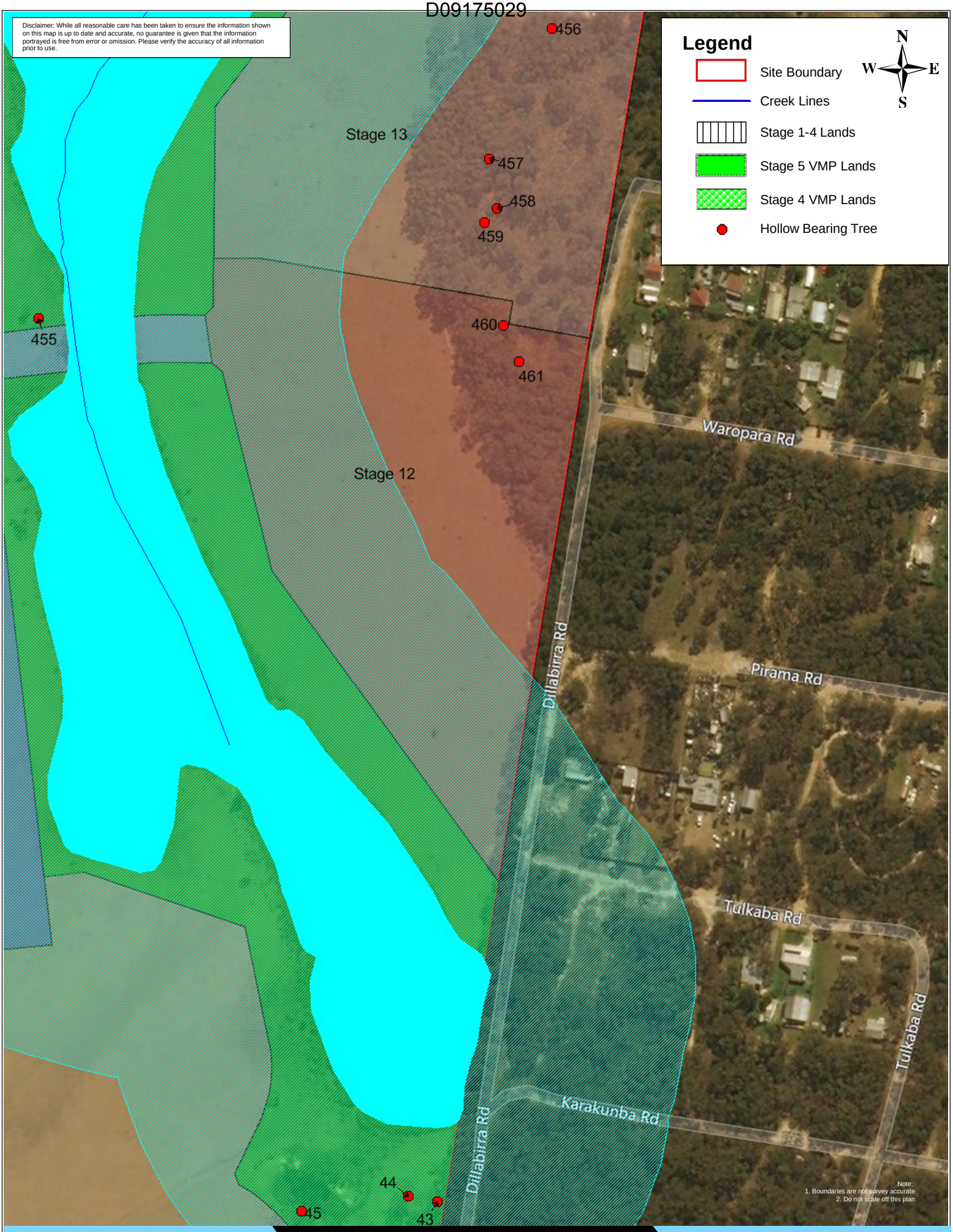
Date: Aug 2018

Location: Wyee

Client: Wyee Land Pty Ltd

Our Ref: 1732

D09175029



AEP

Title: Stage 5 + Superlots HBT Part 4

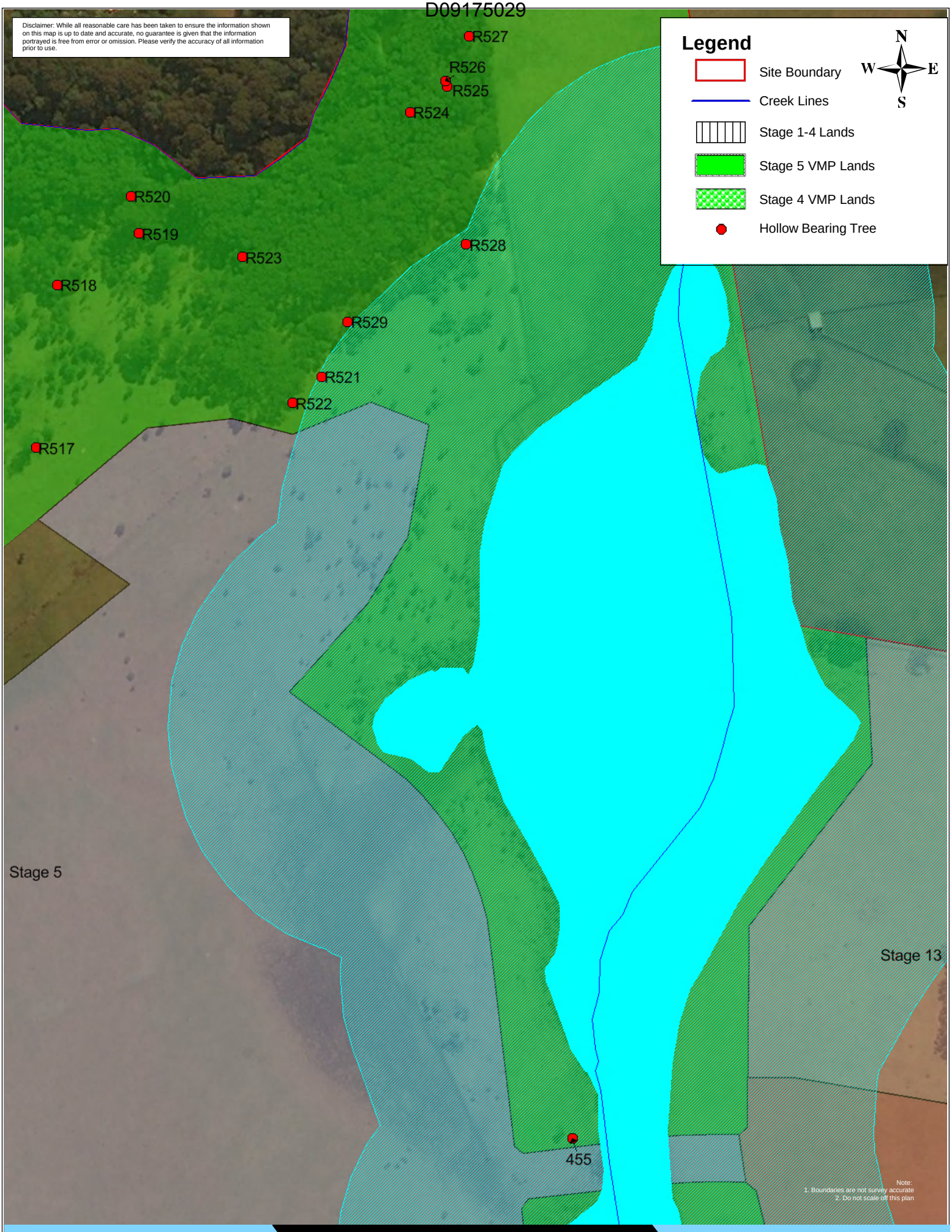
Date: Aug 2018

Location: Wyee

Client: Wyee Land Pty Ltd

Our Ref: 1732

D09175029



AEP

Title: Stage 5 + Superlots HBT Part 5

Date: Aug 2018

Location: Wyee

Client: Wyee Land Pty Ltd

Our Ref: 1732