Warrah Property Developments Pty Ltd

Biodiversity Certification of Lots 21, 22, 23 & 24, DP 714096, Warrah Road, Bangalee

Biodiversity Certification Assessment Report December 2020

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Executive Summary

The primary objectives of this study were to measure the potential likely impacts of the proposed biodiversity certification/rezoning and subsequent occupation of Lot 21,22, 23 and 24 Warrah Rad Bangalee on biodiversity, including threatened species, migratory species, and endangered populations and ecological communities or their habitats. Among the objectives has been determining the most appropriate mitigation measures to be incorporated into design to avoid, minimise and then offset the potential adverse impacts on the natural environment, as required by the Biodiversity Conservation Act 2016 and the associated biodiversity offsets scheme. The unavoidable biodiversity impacts were offset through the calculation credits for ecosystems and species, where that native vegetation and species habitat proposed is to be removed or impacted. Along with the required offsetting, other mitigation and environmental management measures have also been identified which could be implemented during the various stages of the development to further minimise impacts on native biota and their habitats, where possible.

The biodiversity assessment involved a detailed review of existing information (including previous flora and fauna reports and wildlife databases, where available), discussions with local wildlife experts, and dedicated flora and fauna field surveys, including terrestrial habitat assessments and targeted searches for threatened species. Field investigations were conducted throughout the study area and the locality as part of the assessment.

A relatively large number of plants and animals were recorded across Lot 21, 22, 23 and 24 including; more than 233 plants, and 179 vertebrates were recorded in eight different ecological communities (as defined through the Biodiversity Assessment Method (BAM). This included: one endangered terrestrial orchid (the Brittle Midge Orchid); six threatened birds (Square-tailed Kite, Glossy Black-cockatoo, Gang-gang Cockatoo, Little Lorikeet, Swift Parrot and Varied Sittella); and 12 threatened mammals (Eastern Pygmy Possum, Yellow-bellied Glider; Grey-headed Flying-fox, Yellow-bellied Sheathtail Bat, East Coast Freetail Bat, Large-eared Pied Bat, Eastern Cave Bat, Little Bentwing Bat, Eastern Bent-wing Bat, Southern Myotis, Eastern False Pipistrelle and Greater Broad-nosed Bat).

Lot 24 and the adjoining lots have been the subject of several biodiversity assessments. Beginning with conservation significance assessment of portions of the lot in 2007/8 by Alison Hunt and Associates (AHA 2008). Biosis Research was engaged in 2010 to conduct further conservation assessments across the entire lot. Lots 21, 22, and 23 adjacent, have been less intensively surveyed, but all are included in the current BCAR.

OMVI Ecological was engaged to assess all the previous information and conduct new detailed assessment of the lot in 2011 (OMVI 2011), 2015 and 2016 (OMVI 2016). The bulk of the surveys conducted for the BCAR have resulted from the detailed surveys in 2015 and 2016. With targeted threatened species surveys and the revision of the biometric plots undertaken in subsequent years.

The final conservation significance of the lot resulting from the OMVI (2016) assessment was then reviewed in detail by NGH (2017). The results of the assessment were then subject to assessment by the joint regional planning committee who determined to approve the re-zoning in line with the outcomes of the conservation significance through a Biodiversity Certification Assessment (BCA) of the development area with those areas considered of high conservation value explicitly excluded from the development and proposed to be sub-divided into three large lots, with the majority of these lots subject to a biodiversity stewardship agreements, this conserving those conservation values in perpetuity. The proposed three BSA lots represent 54 percent of the current study area.

As part of the iterative design of the planning proposal, the area covered by the current Biodiversity Certification Assessment Area (BCAA) aims to include only the areas of the existing lots 21, 22, 23 and

24 that have lower biodiversity value. The entire area covered by the 4 lots is approximately 79.7 hectares. The BCAR area cover 24.72 hectares and the proposed biodiversity stewardship lots are approximately 42.9 hectares. The remaining area (12.1 ha) occurs in an existing powerline and high-pressure gas pipeline easement, which will be retained and managed as it is currently. The residual unavoidable impacts of the project were calculated in accordance with the BAM using the Biodiversity Assessment Method Calculator (BAMC).

The majority of native vegetation across the of the BCAA (24.7 ha) was determined to be varying condition PCT 1082 or Red Bloodwood - Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion (22.15 ha), including derived native grasslands which formed the existing grazed paddocks and services easement recorded a vegetation integrity score of 13.3 (5.32 ha). The remaining 2.6 hectares harboured cleared lands (1.91 ha) and PCT 662 or Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion.

As part of the BOS calculations, all vegetated portions of the BCAA were assumed to provide foraging habitat, if only transiently, for all the threatened species recorded in the study area as well as species not recorded but have the potential to occur, such as the Dusky Woodswallow, Little Bent-winged bat, Powerful Owl and Masked Owl. All have been incorporated for foraging habitat loss in the ecosystem credit calculations for the 17.49 ha vegetation zones D1, D2 and D4 (i.e., the area of the BCAA with a vegetation integrity score above 17). The loss or modification of the vegetation with integrity scores below 17 do not require a further calculation of ecosystem credits as dictated by s 3.1.1.3 of BAM

The resulting ecosystem requirement for the loss of vegetation zone D1, D2 and D4 equated to 421 ecosystem credits for PCT 1082, and 11 of PCT 662 or a similar PCT within the Sydney Basin bioregion.

No threatened flora, threatened flora populations or ecological communities listed on the schedules of the *NSW Biodiversity Conservation Act 2016,* or the *Commonwealth Environment Protection and Biodiversity Conservation Act* 1999 were recorded. Therefore, no threatened flora species were included in species credit calculations.

Following detailed and repeated seasonal surveys, no breeding habitat for any threatened species was recorded in the BCAA. However, given that four species credit species were recorded nearby the BCAA and the prescriptions relating to foraging habitat under BAM dictated that potential habitat within a defined distance to potential roosting or foraging habitat be included in the biodiversity offset calculations.

All PCT 1082 and 662 within 200 metres of open water greater than 3 m or the defined foraging habitat for the Southern Myotis, was included in species credit calculations (3.38 ha). Similarly, as prescribed the potential roosting sites for both the Large-eared Pied Bat and Eastern Cave Bat within 2 kilometres of the study area were mapped. Given the proximity of such suitable habitat, the entire BCAA is potential (22.81 ha) foraging for these species credit species and credits were derived for the potential loss of this habitat.

Similarly, the 14.34 ha (both PCT 1082 and 662) was assumed to be habitat for the Eastern Pygmy Possum. These rules of BAM have resulted in the species credit requirement of:

- 477 - Eastern Pygmy Possum;
- 106 - Southern Myotis credits;
- 914 - Large-eared Pied Bat credits; and
- 914 - Eastern Cave Bat credits.

There were no other candidate species and no likely serious and irreversible impacts likely as a result of this BCA, due to the absence of defined breeding habitat for any conservation dependant species, absence of any EEC, threatened population or important biodiversity area.

The Australian Government has formally endorsed the NSW Biodiversity Offsets Scheme through the EPBC Act Condition-setting policy and finalised amendments to the Assessment Bilateral Agreement. Therefore, with approval under the BC Act, no further assessment is required under the *Commonwealth Environment Protection & Biodiversity Conservation Act 1999* and a referral to the Commonwealth Environment Minister is not necessary.

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Report Definitions

Assessor – the person accredited under the BC Act and who has been engaged by the proponent.

Averted loss - the gain in vegetation and habitat condition that arises from managing the proposed land as an offset compared to the probable future vegetation condition if the land was left unmanaged.

Avoid – measures taken by a proponent such as careful site selection or action taken through the design, planning, construction and operational phases of the development to completely avoid impacts on biodiversity values, or certain areas of biodiversity.

BAM – Biodiversity Assessment Methodology

BM Act – the Biodiversity Assessment Conservation Act 2016

BC Regulation – the Biodiversity Conservation Regulation 2017

Biodiversity credit report – the report produced by the Credit Calculator that sets out the number and class of the biodiversity credits required to offset the remaining adverse impact on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site.

BCAR – Biodiversity Certification Assessment Report – the report that must be prepared in accordance with BAM and submitted as part of a development application.

Biodiversity Values Map – is established according to clause 7.3 of the BC Regulation. Development within an area identified on the map requires assessment using BAM

BioNet Atlas – the OEH database of flora and fauna records. The Atlas contains records of plants, mammals, birds, reptiles, amphibian, some fungi, some invertebrates (such as insects and snails listed under the BC Act) and some fish.

BioNet TBPDC (TBPDC) - BioNet Threatened Biodiversity Profile Data Collection. A database of threatened biodiversity held and maintained by DPIE which hold information such as: threatened species profiles, survey method and timing required under BAM.

Connectivity – the measures of the degree to which an area(s) of native vegetation is linked with other areas of vegetation.

Credits –

** Ecosystem credits – a measurement of the value of threatened ecological communities, threatened species habitat for species that can be reliably predicted to occur with a PCT, and PCT's generally. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.*

** Species credits – are threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for species credits*

Credit Calculator – the computer program that provides decision support to assessors and proponents by applying the BAM, in particular by using the data required to be entered and the equations (as prepared by OEH) to calculate the number and class of biodiversity credits required to offset the impacts of a development or created at a biodiversity stewardship site.

Development - the use of land, the subdivision of land, the erection of a building, the carrying out of a work, the demolition of a building or work and any other matter referred to in s26 of the EP&A Act and which is controlled by an environmental planning instrument.

Derived Vegetation – PCT's that have changed to an alternate stable state as a consequence of land management practices since European settlement. Derived communities can have one or more structural components of the vegetation entirely removed or severely reduced (e.g., overstorey of grassy woodland) or have developed new structural components where they were previously absent (e.g., shrubby mid-storey in an open woodland system).

EEC – Endangered Ecological Community as scheduled on the NSW BC Act and/or Commonwealth EPBC Act

Impacts -

** Direct impacts - are those that directly affect habitat and individuals, usually within the footprint of the proposal. They include, but are not limited to, clearing and habitat removal.*

** Indirect impacts - occur when project-related activities affect resources in a manner other than a direct loss of the resource. Indirect impact may include but are not limited to: killing the species through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, shade/shelter, increased soil salinity, promotion of erosion, provision of suitable seed bed for exotic weed invasion, or increased human activity within or directly adjacent to sensitive habitat areas.*

LGA – Local Government Area

Local occurrence - means the biota that occurs within the locality.

Local population –

** Fauna: is the local population of resident fauna comprising those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas that are known or likely to occur in the subject site from time to time, connected through clear habitat linkages across the landscape.*

** Flora: is the local population comprising those individuals occurring in the subject site or the cluster of individuals that extend into habitat adjoining and contiguous with the subject site that could reasonably be expected to be cross-pollinating with those in the study area.*

Locality - is an area within a 10 km radius of the subject site.

Native vegetation - Native vegetation is defined under s. 60B of the Local Land Services Amendment Act 2016 as follows:

1. *For the purposes of this Part, native vegetation means any of the following types of plants native to New South Wales:*
   a) *trees (including any sapling or shrub or any scrub)*
   b) *understorey plants*
   c) *groundcover (being any type of herbaceous vegetation)*
   d) *plants occurring in a wetland.*
2. *A plant is native to New South Wales if it was established in New South Wales before European settlement. The regulations may authorise conclusive presumptions to be made of the species of plants native to New South Wales by adopting any relevant classification in an official database of plants that is publicly accessible.*
3. *For the purposes of this Part, native vegetation extends to a plant that is dead or that is not native to New South Wales if:*
   a) *the plant is situated on land that is shown on the native vegetation regulatory map as category 2 –vulnerable regulated land; and*
   b) *it would be native vegetation for the purposes of this Part if it were native to New South Wales.*
4. *For the purposes of this Part, native vegetation does not extend to marine vegetation (being mangroves, seagrasses or any other species of plant that at any time in its life cycle must inhabit water other than fresh water). A declaration under section 14.7 of the Biodiversity Conservation Act 2016 that specified vegetation is or is not marine vegetation also has effect for the purposes of this Part.*

OoW – NSW Office of Water within the Department of Primary Industries

PCT- Plant Community Type

Proposal **-** is the development, activity or action proposed.

Precautionary principle - If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reasoning for postponing measures to prevent

environmental degradation. In the application of the principle… decisions should be guided by: (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and (ii) an assessment of risk-weighted consequence of various options.

Region – is an area approximating the Shoalhaven Local Government Area but restricted to the Sydney Basin Bioregion.

Retirement of credits – the retirement of biodiversity credits from a biodiversity stewardship site secured by a biodiversity stewardship agreement

Risk of extinction - is the likelihood that the local population of the species or local occurrence of the endangered population or ecological community will become extinct either in the short term, medium term or long-term as a result of direct or indirect impacts on the viability of that population and includes changes to the ecological function of communities.

SCC – Shoalhaven City Council

Study Area – all of Lots 21, 22, 23 and 24 as well as adjoining areas covered by surveys to assess all potential impacts on the local biota as well as the reference sites surveyed to encompass habitat values locally.

Subject site - is the areas of Lots 21, 22, 23 and 24 and any additional areas that are likely to be affected by the proposal, either directly or indirectly.

TEC – Threatened Ecological Community, as scheduled on the NSW BC Act and/or Commonwealth EPBC Act

Vegetation class – a level of classification of vegetation communities defined in Keith (2004). There are 99 vegetation classes in NSW

Vegetation formation – a broad level of vegetation classification as defined in Keith (2004). There are 16 vegetation 16 vegetation formation and sub-formation in NSW.

Vegetation integrity – the condition of native vegetation assessed for each vegetation zone against the benchmark for the PCT.

Vegetation zone – a relatively homogenous area of native vegetation on a development site, land to be biodiversity certified or a biodiversity stewardship site that is the same PCT and broad condition state.

Viable - is the capacity to successfully complete each stage of the life cycle under normal conditions.

Stage 1 – Biodiversity Assessment

1. Introduction

1.1 Background

1.1.1 Description of the study area

The study area is at the end of Warrah Rd, North Nowra and is legally described as Lot 21, 22, 23 and 24 DP 714096. It is irregular in shape and has an area of approximately 79.7 hectares. An aerial photo of the site, and its local context, is shown in Figure 1-1.

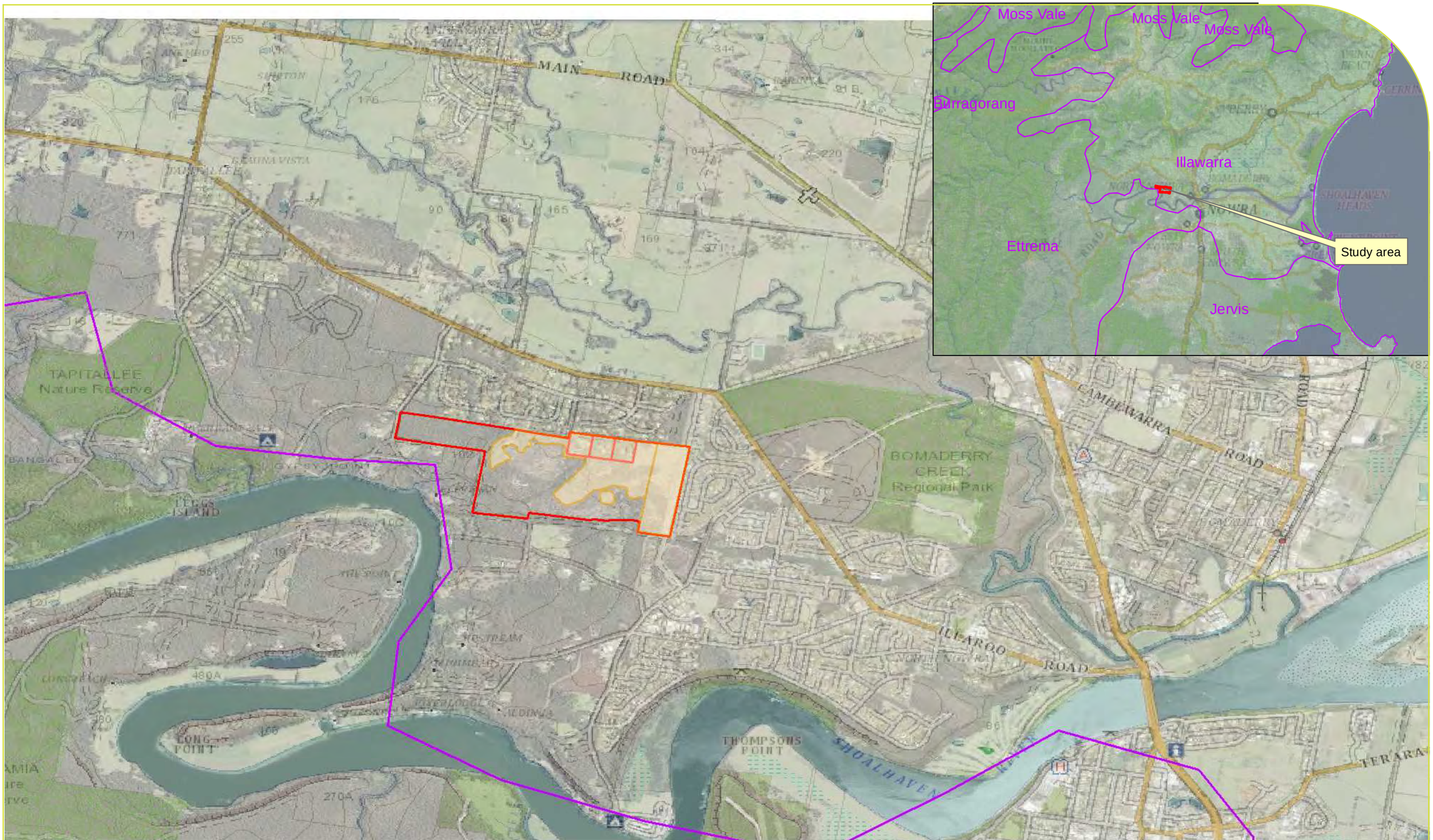
Currently the site is undulating to gently sloping and is traversed by four drainage lines. The eastern half of the site is gently sloping with steeper slopes located towards the centre of the site. The eastern part of the site drains into two gullies / creeks which drain west towards Shoalhaven River, which is located approximately 250 metres from the south western site boundary. A well-defined creek gully traverses the middle of the site in a north south direction. This gully receives overland flow from the developed upstream catchment and drains south into the Shoalhaven River. The site is largely vegetated with native eucalypt woodland. Parts of the site have been cleared previously for quarries, fire and access trails, agricultural use and an electricity easement in the east. Other signs of disturbance include refuse dumping and some weed invasion.

1.1.2 Description of Biodiversity Certification Assessment Area

The Biodiversity Certification Assessment Area (BCAA) is approximately 24.7 hectares of the study area encapsulating all of Lot 21, 22 23 and only a portion of lot 24 (Figure 1-2). The BCAA has been derived from previous determinations of the conservation significance of the land and the presence and or absence of threatened species, endangered ecological communities of other conservation values. Where, the areas with higher conservation value were excluded and those with less constraint was included in the BCAA. The entire BCAA is the subject of this assessment report and the areas and values contained, or assumed to contain are the subject of offset calculations in the Biodiversity Assessment Method Calculator (BAMC) for ecosystem and species credits.

1.1.3 Description of the Services Easement or “retained land”

An existing services easement runs through lot 24 down the eastern boundary. The easement has a high-pressure gas pipeline and high voltage powerline running north south and the residual has been set aside for the potential future western bypass of Bomaderry and Nowra (Figure 1-2). Much of this area has previously been cleared (approximately 12.1 ha). The easement was included in the biodiversity surveys but is excluded from the Biodiversity Certification Assessment Area (BCAA). This area will be referred to in the following report as ‘retained land’. No biodiversity credits are calculated for this area and any future development within the services easement will require an additional assessment.



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Legend

- Biocertification Area
- IBRA Sub-regions
- Study area
- OEH estate

Date: 15/12/2020

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Map Grid: Map Grid of Australia Zone 56

1:25,000

0 220 440 880 1,320 1,760 Meters

Figure 1-1: Location of the study area in a regional context

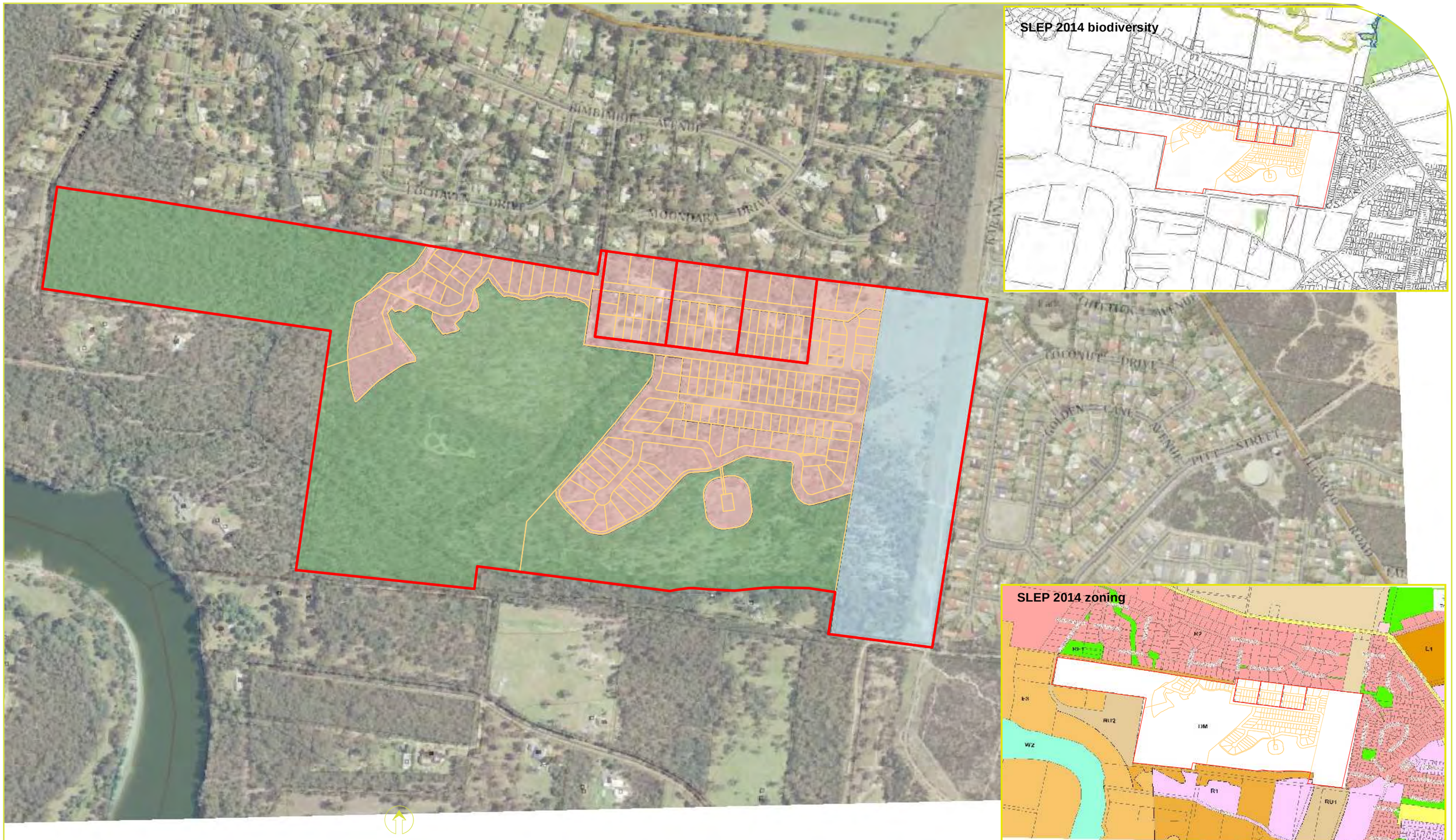


Figure 1-2: Current rezoning layout, including BCAA and proposed BSA lots.

1.1.4 Description of the proposed biodiversity stewardship agreement lots

The residual of lot 24, approximately 42.9 hectares, outside of the BCAA is proposed to be sub-divided into three lots, with each then conserved with a biodiversity stewardship agreement (BSA). All three lots have a small area for a dwelling along with an asset protection zone extracted (as assessed under this BCAR and included in the BCAA) and the residual conserved with a defined conservation management plan and annual payments for the management actions in perpetuity. The third does not have a defined area or build envelope. The biodiversity stewardship assessment reports for each lot are currently being completed. The credits created as part of this agreement will be first retired for the current BCAR.

1.2 Landscape features

1.2.1 Biogeographical, Botanical and Zoogeographic Region

The study area is located in the Illawarra sub-region of the Sydney Basin Interim Biogeographic Regionalisation of Australia (IBRA) bioregion (Commonwealth Department of the Environment, Water, Heritage and Arts (DEWHA, 2009).

1.2.2 Mitchell Landscape

The study area falls wholly within the Nowra-Durras Coastal Slopes Mitchell Landscape.

1.2.3 Areas of geological significance and soil hazard features

The Subject site does not contain areas of geological significance or soil hazard features.

1.2.4 Rivers and streams

Currently the site is undulating to gently sloping and is traversed by four drainage lines. The eastern half of the site is gently sloping with steeper slopes located towards the centre of the site. The eastern part of the site drains into two gullies / creeks which drain west towards Shoalhaven River, which is located approximately 250 metres from the south western site boundary. A well-defined creek gully traverses the middle of the site in a north south direction. This gully receives overland flow from the developed upstream catchment and drains south into the Shoalhaven River. The site is largely vegetated with native eucalypt woodland. Parts of the site have been cleared previously for quarries, fire and access trails, agricultural use and an electricity easement in the east. Other signs of disturbance include refuse dumping and some weed invasion.

1.2.5 Wetlands

Nine wetlands in the Sydney Basin Bioregion are regarded as being bio-regionally significant (Australian Terrestrial Biodiversity Assessment 2002). None will be directly or indirectly impacted by the current proposal.

1.2.6 Corridors and connectivity

At broad scale the vegetation present within the study area forms a component of an east-west corridor and potential fauna linkage between Morton National Park (to the west) and Seven Mile Beach National Park (to the east) primarily along the Shoalhaven River. This corridor is partially fragmented by urban development in the Locality including through Bangalee, North Nowra and Nowra. However, the east-west

Shoalhaven River corridor is characterised by extensive agriculture supporting very little native tree cover between Nowra and Shoalhaven Heads, thus limiting the movement of biotic vectors past Bomaderry to the east (Figure 1-3).

The major habitat corridors within the Shoalhaven / Illawarra region occur to the south, west and north of the study area and incorporate a number of national parks, nature reserves and state forests. To the west of the study area, Morton National Park provides a wildlife corridor from Fitzroy Falls in the north to the Budawang National Park west of Ulladulla in the south. Further habitat linkages occur via Budderoo National Park, Macquarie Pass National Park, Barren Grounds Nature Reserve and the Cambewarra Range Nature Reserve. The Illawarra Regional Environmental Plan No. 1 identifies a regional wildlife corridor linking Saddleback Mountain and Barren Grounds Nature Reserve (south-west of Kiama) with Morton National Park. This regional wildlife corridor extends along the western side of the study area and incorporates well vegetated land in the foothills of the escarpment in the areas of Foxground, Broughton Village, Budgong, Buangla, Barringella and Yallwal. Similarly, based on the mapping provided in the South Coast Regional Conservation Plan, the study area appears to be outside or on the edge of the important wildlife corridors also broadly mapped (SCRCP 2010) and is outside the JBREP IREP Illawarra Regional Environmental Plan Wildlife Corridor

The BCAA and proposed BSA lots fall into a broadly vegetated corridor from Morton National Park to Jervis Bay National Park to the south east that incorporates other conservation reserves and State Forest. Vegetation present to the south of the Shoalhaven River (including Wogamia Nature Reserve and Triplarina Nature Reserve) creates a localised north-south corridor with the vegetation present in the Subject Site, which may be used by highly mobile species not impeded by the presence of natural barriers.

The vegetation within the western part of study area, is indirectly connected with the vegetation present in the broader Locality. This comprises conservation reserves within the proximity of the Study Area, such as Tapitallee Nature Reserve and Cambewarra Range Nature Reserve. The connectivity between vegetation in the eastern part of the study area, or BCAA is largely limited and disjunct, which the result of existing roads and residential areas of North Nowra and Bangalee. The urban landscape would limit faunal dispersal for less mobile mammal species, but would not significantly affect the movement of highly mobile species (e.g., birds). The unnamed creek lines and riparian vegetation present within the study area would also provide corridors for fish and amphibian species.

All previous assessments of the conservation significance (AHA, 2006, Biosis 2010, OMVI 2016) have highlighted that the southern creekline (effectively the southern boundary of the lot) forms an important local wildlife corridor and given the presence of the SCRCP, this creekline is recorded as a High Conservation Value (HCV) wildlife corridor. There is effective termination of this corridor resulting from lands set aside of the future western bypass corridor, power line and high-pressure gas easements. Beyond the easement is a residential subdivision built in the 1980's which has little to no native remnant vegetation.

The critical corridor in the locality in terms of ecological conservation is the link along the Shoalhaven River. This corridor is currently vegetated and is mostly protected land (SLEP 2014 zoning) and links the habitat of most species discussed in this report between Morton National Park and the associated escarpment reserves to Bomaderry Creek and then intermittently to Seven Mile Beach and the Jervis Bay coastal national parks to the south. In this regard the western portion of Lot 24 in the current study area is important to retain to maintain a wide corridor along an almost north south corridor along the Shoalhaven River. Notwithstanding this, the preservation of all creeklines in a vegetated form, will assist to limit the impacts of waters exiting the surrounding residential areas of Bangalee and North Nowra, and improve water quality to the Shoalhaven.

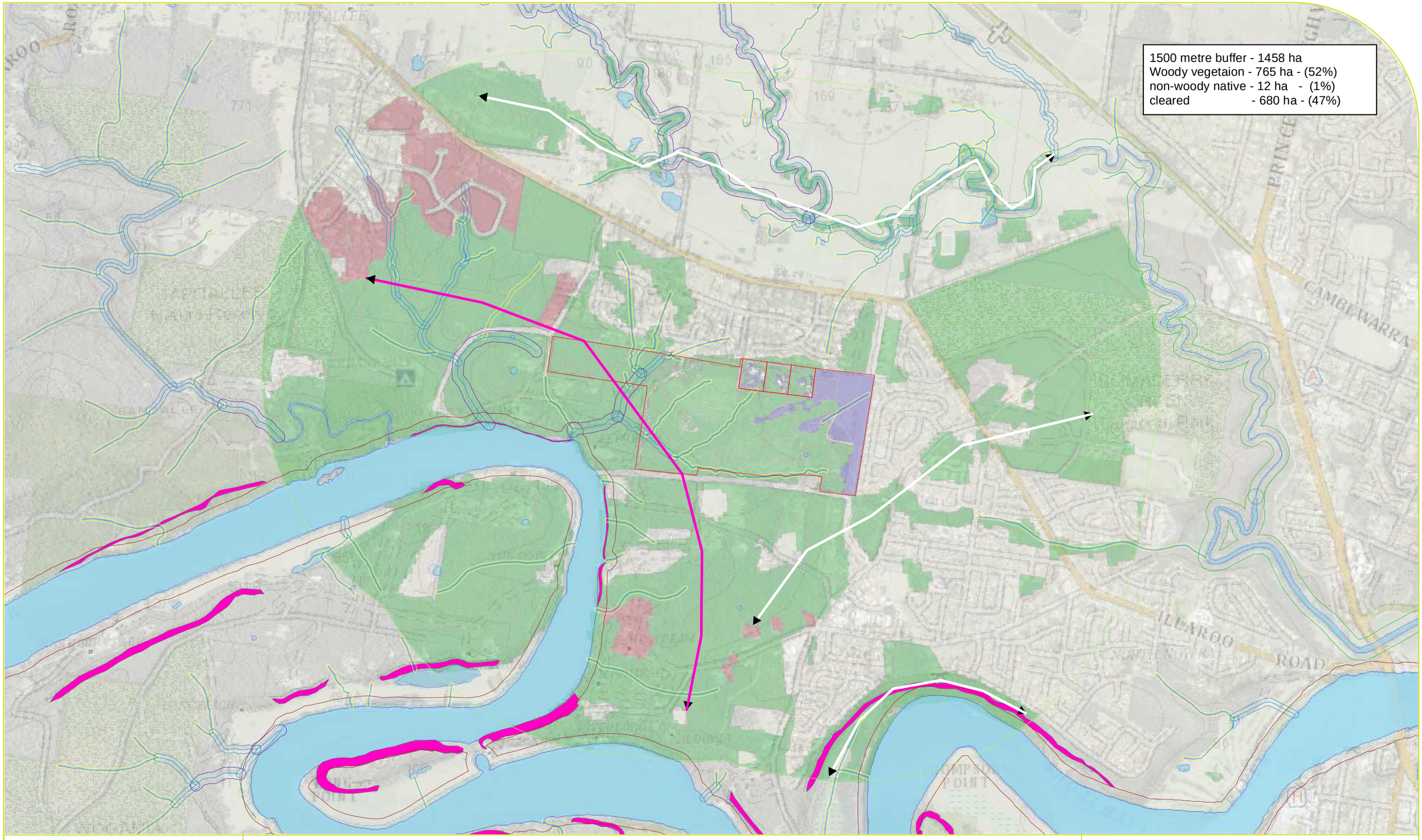


Figure 1-3: Landscape assessment, landscape features of the study area and 1500m buffer

As such, the connectivity of all lands within study area in relation to the adjacent lands has been considered for each species, where mobility, vectors of pollination or gene movement have been assessed for each and incorporated into the current assessment.

1.2.7 Site Context

Method applied

The site-based method has been applied to this development.

Percent native vegetation cover in the landscape

The current percent native vegetation cover in the landscape was assessed in a Geographic Information System (GIS) using aerial imagery sourced from SIX Maps, and extant vegetation mapping for the locality, including the Vegetation of the South East (Tozer at al 2010) and Shoalhaven City Council LEP mapping (2002) which forms the basis of the more recent Biometric Vegetation mapping OEH (2013), which was most recently updated on the 21 August 2019 (see Figure 1-3). The accuracy of each dataset was examined by scrutinising the mapped layer dataset against recent aerial photography and also through groundtruthing the vegetation not mapped in these vegetation mapping datasets, and by rapidly examining grassland and treed areas within the 1500m buffer. The results of this analysis are shown in Table 2 and Figure 1-3.

Table 1: Native vegetation cover calculations within the 1500 metre buffer (including the study area).

VEGETATION	AREA WITHIN THE BCAA (% OF VEGETATION WITHIN 1500M BUFFER)	AREA WITHIN THE 1500M BUFFER (% OF 1500M BUFFER)
Native Woody Vegetation	17.49 ha (2 %)	765.63 ha (52%)
Native – non-woody vegetation	5.32 ha (44.70 %) #	11.96 (0.8%) #
Cleared (no native vegetation)	1.91 ha (0%)	680.41 (46.67%)

Not all grassland within the 1500m buffer could be accessed, most in private ownership. Native vegetation status in many areas could not be determined.

Patch size

The majority of the subject site does contain intact native vegetation which is connected to larger expanses of forested land, national parks estate and conserved crown lands. For all intact native vegetation in the BCAA, the patch size was recorded as the maximum >100 ha. Conversely, the derived grasslands, which were not intact were given a patch size of 0 ha as dictated by BAM.

Rocky cliff lines and overhangs

There were no rocky cliffs, overhangs, caves, mine adits or built structures within the study area, however there are steep sandstone banks within the monolith sandstone cliffs and gorges of Morton National Park to the west and the rocky cliff lines of the Shoalhaven River to the south would provide numerous caves, and rock piles overhangs and caves. There are several cliff lines along the Shoalhaven River and Bomaderry Creek within 2 km of the study area. All have been mapped in accordance with the BAM (Figure 3-9) later in this document.

Areas of Outstanding biodiversity value

There are no areas of outstanding biodiversity value declared by the Minister in close proximity of the current proposal. Similarly, there is no critical habitat recorded nor was any recorded during the site surveys.

2. Methods

2.1 Database and literature view

A review of relevant databases and literature sources included:

- OMVI Ecological (2016) Ecological Constraints Assessment of Lot 24 Warrah Road, Bangalee. Report prepared for Southbank Land P/L and Huntingdale Developments P/L
- NGH Environmental (2015) Peer Review of Biodiversity Studies: Warrah Road, North Nowra 49462E (D14/308516)
- OMVI (2011a) Review of conservation significance of lands at Warrah Road, North Nowra. Report prepared for Huntingdale Developments Pty Ltd and Southbank Land Pty Ltd by OMVI, October 2011.
- OMVI (2011b) Review of Hollow Bearing Tree Assessment of lands at Warrah Road. Report prepared for Huntingdale Developments Pty Ltd and Southbank Land Pty Ltd by OMVI, May 2011.
- Biosis (2011) Lot 24 Warrah Road, North Nowra, Hollow Bearing Tree Survey. Report prepared for Southbank Land Pty Ltd and Huntingdale Developments Pty Ltd by Biosis Research, April 2011.
- Biosis (2010) Flora and Fauna Assessment and Constraints Analysis. Report prepared for Southbank land Pty Ltd by Biosis Research, September 2010.
- AHA (2008) Threatened Biodiversity Survey and Assessment, Nowra Bomaderry Structure Plan. Report prepared for Shoalhaven City Council by Allison Hunt and Associates, May 2008.
- NSW OEH: BioNet Atlas (most recently accessed February 2020);
- DEE *Protected Matters Search Tool* covering Threatened Species and Communities, and Migratory and Other Species under the EPBC Act (most recently accessed February 2020);
- SCC (2002) State of the Environment maps – Vegetation. Accessed online May 2015 at: https://www.shoalhaven.nsw.gov.au/Planning-amp-Building/Maps-online.
- Published vegetation mapping such as the SCIVI mapping conducted by Tozer *et al. 2010,* which have compiled vegetative information relation to the vegetation types and communities of the subject site and surrounds.
- Shoalhaven City Council LEP mapping (2002)
- Biometric Vegetation mapping OEH (2013) – updated in August 2019.

2.2 Identifying subject species / communities

2.2.1 Plant Community Types

Following close examination of all sources of information, as listed above, boundaries described by previous assessments (AHA 2008 and Biosis 2011) and broadscale mapping datasets for the locality, such as Tozer et al. (2010); Mills and Jakeman (2010) and mapping of TECs by Alison Hunt and Associates (AHA Ecology 2010), were ground-truthed and assessed under the biobanking assessment methodology (2015 - 2016). Where the biometric vegetation database was used to separate homogeneous vegetation types, the vegetation mapping was later verified and generally agreed upon by an independent reviewer (NGH 2017).

The vegetation typing was then reassessed in accordance with NSW BioNet Vegetation Classification, plant Community types (PCTs). New BAM plot were completed at the same point as the original BBAM plots. Plant community types were assigned and vegetation zone boundaries re-examined. The results are given in section 3.1 below.

2.2.2 Threatened ecological communities

Eighteen (18) Threatened Ecological Communities (TEC) are listed within Nowra district and surrounding Shoalhaven LGA (BioNet, Tozer *et al.* 2010) which are of potential relevance to the current locality or have been listed as potentially relevant in database searches for the locality. None were recorded or are likely to occur within the subject site.

2.2.3 Flora

Of the forty-three (43) threatened flora species known from the locality or within a 10-kilometre radius of the study area [the 'locality'] (those recorded in the atlas of wildlife or EPBC protected maters database) (see Table 3), two (2) were recorded in the study area and another two (2) were recorded as planted specimens outside their known distribution and an additional five (5) were determined to have the potential to occur, based on habitat present. The results are summarised below in Table 2. The remaining thirty-four (34) are species that have habitat requirements that do not occur on or nearby the study area.

2.2.4 Fauna

A desktop study was carried out in order to assess existing information about the faunal assemblages around Nowra. This study included examination of the OEH and DEE databases of fauna and threatened fauna species and a review of previous studies undertaken by OMVI Ecological as well as discussions with relevant faunal experts who had conducted surveys in the locality. Similarly, the species predicted from habitat or PCT surrogates from the BAM Calculator were included in the assessment.

Of the eighty (80) threatened fauna species known from the locality or within a 10-kilometre radius of the study area [the 'locality'] (those recorded in the atlas of wildlife or EPBC protected maters database) (see Table 4), fourteen (14) of which were recorded (with varying degrees of certainty) in the study area and another additional ten (10) were determined to have the potential to occur if only transiently, based on habitat present. The results are summarised below in Table 2 below. The remaining fifty-six (56) are species that have habitat requirements that do not occur on or nearby the study area.

2.2.5 Other species unlikely to occur

There is a range of other threatened species that rely on conditions not present in the subject site such as marine sands, dune vegetation, coastal saltmarsh, large open water, hanging swamps, open water and extensive wetlands. These species are considered highly unlikely to occur due to the complete absence of suitable habitat.

2.2.6 Threatened Populations (BC Act 2016; EPBC Act 1999)

The literature and database interrogation determined that no threatened populations are likely to be present in the study area.

2.2.7 Critical Habitat (BC Act 2016; EPBC Act 1999)

The literature and database interrogation determined that no defined or listed critical habitat is likely to be present in the study area.

Table 2: Threatened species and their likelihood of occurring within the study area, following detailed surveys

Count	Species	Status*	Credit Type	SAII Entity	Recorded previously in locality	Predicted by PCT	Potential habitat in BCAA	Likelihood of species occurring within BCAA	Recorded in survey	Survey Month	Survey met Minimum requirements
Flora											
1	Bynoe's Wattle *Acacia bynoeana*	E, V1	Species	NO	NO	NO	marginal	NO	NO	All year	YES
2	Downy Wattle *Acacia pubescens*	V, V1	Species	NO	YES	NO	YES	UNLIKELY	NO	All year	YES
3	Sunshine Wattle *Acacia terminalis ssp terminalis*	E, E1	Species	NO	NO	NO	YES	NO	NO	All year	YES
4	Dense Cord-rush *Baloskion longipes*	V, V1	Species	NO	NO	NO	NO	NO	NO	All year	YES
5	Deane's Boronia *Boronia deanei*	V, V1	Species	NO	NO	NO	NO	NO	NO	All year	YES
6	Budawangs Cliff-heath *Budawangia gnidioides*	V. V1	Species	NO	NO	NO	NO	NO	NO	All year	YES
7	Thick Lip Spider Orchid *Caladenia tessellata*	E, V1	Species	YES	NO	NO	YES	UNLIKELY	NO	Sept-Oct	YES
8	Pretty Beard Orchid *Calochilus pulchellus*	E	Species	YES	NO	NO	marginal	UNLIKELY	NO	Oct-Nov	YES
9	Sand spurge *Chamaesyce psammogeton*	E	Species	NO	NO	NO	NO	NO	NO	All year	YES
10	Leafless Tongue Orchid *Cryptostylis hunteriana*	V, V1	Species	NO	YES	YES	YES	POSSIBLE	NO	Nov-Jan	YES
11	White-flowering Wax Plant *Cynanchum elegans*	E. E1	Species	NO	NO	NO	NO	UNLIKELY	NO	All year	YES
12	Australian Saltgrass *Distichlis distichophylla*	E	Species	NO	YES	NO	NO	NO	NO	Nov-March	YES
13	Albatross Mallee *Eucalyptus langleyi*	V	Species	YES	YES	YES	YES	UNLIKELY	NO	All year	YES
14	Wallangarra White Gum *Eucalyptus scoparia*	E, V1	Species	YES	NO	NO	NO	YES#	YES	All year	YES
15	Ettrema Mallee *Eucalyptus sturgissiana*	E	Species	NO	YES	NO	NO	UNLIKELY	NO	All year	YES
16	Brittle Midge Orchid *Genoplesium baueri*	V	Species	YES	YES	YES	YES	YES	YES	Feb-March	YES
17	Large Midge Orchid *Genoplesium superbum*	E	Species	YES	NO	NO	YES	NO	NO	Feb-March	YES
18	East Lynne Midge Orchid *Genoplesium vernale*	V, V1	Species	NO	NO	NO	marginal	NO	NO	Nov-Dec	YES
19	Wingless Raspwort, Square Raspwort *Haloragis exalata subsp. exalata*	V1	Species	NO	NO	NO	NO	NO	NO	All year	YES
20	*Hibbertia stricta subsp. furcatula*	E	Species	NO	YES	YES	YES	POSSIBLE	NO	Oct-Jan	YES
21	*Illawarra Irene Irenepharsus trypherus*	E, E1	Species	NO	NO	NO	Marginal	UNLIKELY	NO	Dec-April	YES
22	Biconvex Paperbark *Melaleuca biconvexa*	V, V1	Species	NO	YES	NO	YES	NO	NO	All year	YES

Count	Species	Status*	Credit Type	SAII Entity	Recorded previously in locality	Predicted by PCT	Potential habitat in BCAA	Likelihood of species occurring within BCAA	Recorded in survey	Survey Month	Survey met Minimum requirements
23	Deane's Paperbark *Melaleuca deanei*	V, V1	Species	NO	NO	NO	YES	NO	NO	All year	YES
24	Spiked Rice-flower Pimelea spicata	E1	Species	NO	NO	NO	NO	NO	NO	All year	YES
25	Jervis Bay Leek Orchid *Prasophyllum affine*	E, E1	Species	YES	YES	NO	NO	NO	NO	Nov only	YES
26	Villous Mint-bush *Prostanthera densa*	V, V1	Species	NO	NO	NO	NO	NO	NO	All year	YES
27	Seaforth Mint-bush *Prostanthera marifolia*	CE, CE1	Species	YES	YES#	NO	NO	NO	NO	All year	YES
28	Budawangs Wallaby Grass *Plinthanthesis rodwayi*	E, V1	Species	YES	NO	NO	NO	NO	NO	Nov-Feb	YES
29	Illawarra Greenhood *Pterostylis gibbosa*	E, E1	Species	NO	NO	YES	marginal	UNLIKELY	NO	Sept-Oct	YES
30	Waterfall or Pretty Orchid *Pterostylis pulchella*	V, V1	Species	YES	NO	NO	NO	NO	NO	Feb-April	YES
31	*Pterostylis vernalis*	CE1	Species	YES	NO	NO	marginal	POSSIBLE	NO	Aug-Oct	YES
32	*Pterostylis ventricosa*	CE	Species	YES	YES	NO	YES	POSSIBLE	NO	March-May	YES
33	Budawangs Bush-pea *Pultenaea baeuerlenii*	V. V1	Species	NO	NO	NO	NO	NO	NO	Oct-Dec	YES
34	Eastern Underground Orchid *Rhizanthella slateri*	E1	Species	YES	NO	NO	YES	UNLIKELY	NO	Sept-Nov	YES
35	Scrub Turpentine *Rhodamnia rubescens*	CE	Species	YES	YES	YES	NO	NO	NO	All year	YES
36	*Magenta Lilly Pilly Syzygium paniculatum*	E, V1	Species	NO	YES	YES	YES	YES#	NO	April-June	YES
37	*Solanum celatum*	E	Species	NO	NO	NO	YES	UNLIKELY	NO	Aug-Nov	YES
38	Austral Toad-flax *Thesium australe*	V, V1	Species	NO	NO	NO	NO	NO	NO	Nov-Feb	YES
39	Nowra Heath-myrtle Triplarina nowraensis	E1	Species	NO	NO	YES	marginal	UNLIKELY	NO	All year	YES
40	Narrow-leafed Wilsonia *Wilsonia backhousei*	V	Species	NO	YES	NO	NO	NO	NO	All year	YES
41	Round-leaved Wilsonia *Wilsonia rotundifolia*	E	Species	NO	YES	NO	NO	NO	NO	All year	YES
42	Wollemi Pine *Wollamia nobilis*	CE, CE1	Species	YES	NO	NO	NO	YES#	YES	All year	YES
43	Bomaderry Zieria Zieria baeuerlenii	E, E1	Species	YES	YES	NO	YES	POSSIBLE	NO	All year	YES
44	Warty Zieria *Zieria tuberculata*	V, V1	Species	YES	NO	NO	NO	NO	NO	All year	YES
Invertebrates											
1	Giant Dragonfly *Petalura gigantea*	E	Species	YES	NO	NO	NO	NO	NO	Dec-Jan	YES
Amphibians											
6	Giant Burrowing Frog *Heleioporus australiacus*	V, V1	Species	NO	YES	YES	limited	POSSIBLE	NO	Sept-May	YES
7	Red-crowned Toadlet *Pseudophryne australis*	V	Species	NO	NO	YES	NO	NO	NO	All year	YES

Count	Species	Status*	Credit Type	SAII Entity	Recorded previously in locality	Predicted by PCT	Potential habitat in BCAA	Likelihood of species occurring within BCAA	Recorded in survey	Survey Month	Survey met Minimum requirements
8	Green and Golden Bell Frog *Litoria aurea*	E, V1	Species	NO	YES	NO	NO	NO	NO		
9	Littlejohn's Tree Frog *Litoria littlejohni*	V, V1	Species	NO	NO	NO	NO	NO	NO	July-Nov	YES
10	Stuttering Frog *Mixophyes balbus*	E, V1	Species	YES	NO	YES	YES	UNLIKELY	NO	Sept-March	YES
Reptiles											
11	Broad-headed Snake *Hoplocephalus bungaroides*	E, V1	Species/ Ecosystem	YES	NO	YES	NO	NO	NO	Aug-Sept	YES
12	Rosenberg's Goanna *Varanus rosenbergi*	V	Ecosystem	N/A	NO	YES	NO	NO	NO	N/A	N/A
Birds											
13	Freckled Duck *Stictonetta naevosa*	V	Ecosystem	N/A	NO	NO	NO	NO	NO	N/A	N/A
14	Blue-billed Duck *Oxyura australis*	V	Ecosystem	N/A	NO	NO	NO	NO	NO	N/A	N/A
15	Black-necked Stork *Ephippiorhynchus asiaticus*	E	Ecosystem	N/A	NO	NO	NO	NO	NO	N/A	N/A
16	Black Bittern *Ixobrychus flavicollis*	V	Ecosystem	N/A	NO	NO	NO	UNLIKELY	NO	N/A	N/A
17	Australasian Bittern *Botaurus poiciloptilus*	V	Ecosystem	N/A	NO	NO	NO	UNLIKELY	NO	N/A	N/A
18	Square-tailed Kite *Lophoictinia isura*	V	Species/ Ecosystem	NO	YES	YES	YES	YES	YES	Sept-Jan	YES
19	Eastern Osprey *Pandion cristatus*	V	Species/ Ecosystem	NO	YES	NO	NO	UNLIKELY	NO	April-Nov	YES
20	Little Eagle *Hieraaetus morphnoides*	V	Species/ Ecosystem	NO	YES	YES	YES	POSSIBLE	NO	Aug-Oct	YES
21	Spotted Harrier *Circus assimilis*	V	Ecosystem	N/A	YES	NO	NO	UNLIKELY	NO	N/A	N/A
22	Black-tailed Godwit *Limosa cristates*	V	Species/ Ecosystem	NO	YES	NO	NO	NO	NO	N/A	YES
23	Terek Sandpiper *Xenus cinereus*	V	Species/ Ecosystem	NO	YES	NO	NO	NO	NO	N/A	YES
24	Curlew Sandpiper *Calidris ferruginea*	E	Species/ Ecosystem	YES	YES	NO	NO	NO	NO	N/A	YES
25	Broad-billed Sandpiper *Limicola falcinellus*	V	Species/ Ecosystem	NO	YES	NO	NO	NO	NO	N/A	YES
26	Comb-crested Jacana *Irediparra gallinacea*	V	Ecosystem	N/A	NO	NO	NO	NO	NO	N/A	N/A
27	Bush Stone-curlew *Burhinus grallarius*	E	Species	NO	NO	NO	NO	NO	NO	All year	YES
28	Australian Painted Snipe *Rostratula australis*	V	Ecosystem	N/A	NO	NO	NO	NO	NO	N/A	N/A
29	Sooty Oystercatcher *Haematopus fuliginosus*	V	Species	NO	NO	NO	NO	NO	NO	All year	YES
30	Pied Oystercatcher *Haematopus longirostris*	E	Species	NO	NO	NO	NO	NO	NO	All year	YES
31	Lesser Sand Plover	V	Species/	NO	NO	NO	NO	NO	NO	N/A	N/A

Count	Species	Status*	Credit Type	SAII Entity	Recorded previously in locality	Predicted by PCT	Potential habitat in BCAA	Likelihood of species occurring within BCAA	Recorded in survey	Survey Month	Survey met Minimum requirements
	Charadrius mongolus		Ecosystem								
32	Hooded Plover *Thinornis rubricollis*	CE, V1	Species/ Ecosystem	YES	NO	NO	NO	NO	NO	Sept-March	YES
33	Little Tern *Sternula albifrons*	E	Species/ Ecosystem	NO	NO	NO	NO	NO	NO	Sept-March	YES
34	Australian Fairy Tern *Sternula nereis nereis*	V1	Species	NO	NO	NO	NO	NO	NO	Sept-Feb	YES
35	Sooty Tern *Onychoprion fuscata*	V	Species	NO	NO	NO	NO	NO	NO	July-March	YES
36	Bush Stone-curlew *Burhinus grallarius*	V	Species	NO	YES	NO	NO	NO	NO	All year	YES
37	Superb Fruit Dove *Ptilinopus superbus*	V	Ecosystem	N/A	NO	NO	NO	NO	NO	N/A	N/A
38	Glossy Black-Cockatoo *Calyptorhynchus lathami*	V	Species/ Ecosystem	NO	YES	YES	YES	YES	YES	April-Aug	YES
39	Gang-gang Cockatoo *Callocephalon fimbriatum*	V	Species/ Ecosystem	NO	YES	YES	YES	YES	YES	Oct-Jan	YES
40	Little Lorikeet *Glossopsitta pusilla*	V	Ecosystem	NO	YES	YES	YES	YES	YES	N/A	N/A
41	Swift Parrot *Lathamus discolor*	E, E1	Species/ Ecosystem	YES	YES	YES	limited	YES	YES	N/A	N/A
42	Orange-bellied Parrot *Neophema chrysogaster*	CE, CE1	Species	YES	NO	NO	NO	UNLIKELY	NO	All year	YES
43	Turquoise Parrot *Neophema pulchella*	V	Ecosystem	N/A	YES	YES	NO	UNLIKELY	NO	N/A	N/A
44	Eastern Ground Parrot *Pezoporus wallicus*	V	Species	NO	YES	NO	NO	NO	NO	All year	YES
45	Powerful Owl *Ninox strenua*	V	Species/ Ecosystem	NO	YES	YES	YES – limited	POSSIBLE	NO	May-Aug	YES
46	Barking Owl *Ninox connivens*	V	Species/ Ecosystem	NO	NO	YES	NO	UNLIKELY	NO	May-Dec	YES
47	Sooty Owl *Tyto tenebricosa*	V	Species/ Ecosystem	YES	YES	NO	limited	UNLIKELY	NO	April-Aug	YES
48	Masked Owl *Tyto novaehollandiae*	V	Species/ Ecosystem	NO	YES	YES	limited	POSSIBLE	NO	May-Aug	YES
49	Eastern Bristlebird *Dasyornis brachypterus*	E, V1	Species	NO	YES	NO	NO	NO	NO	Sept-May	YES
50	Regent Honeyeater *Anthochaera phrygia*	E, E1	Species/ Ecosystem	YES	YES	YES	limited	UNLIKELY	NO	N/A	N/A
51	White-fronted Chat *Epthianura albifrons*	V	Ecosystem	N/A	YES	NO	NO	NO	NO	N/A	N/A
52	Flame Robin *Petroica phoenicea*)	V	Ecosystem	N/A	YES	YES	limited	UNLIKELY	NO	N/A	N/A
53	Scarlet Robin *Peterocia boodang*	V	Ecosystem	N/A	YES	YES	limited	UNLIKELY	NO	N/A	N/A
54	Pink Robin *Petroica rodinogaster*	V	Ecosystem	N/A	YES	NO	limited	UNLIKELY	NO	N/A	N/A
55	Varied Sittella *Daphoenositta chrysoptera*	V	Ecosystem	N/A	YES	YES	YES	YES	YES	N/A	N/A
56	Olive Whistler *Pachycephala olivacea*	V	Ecosystem	N/A	YES	YES	NO	UNLIKELY	NO	N/A	N/A

Count	Species	Status*	Credit Type	SAII Entity	Recorded previously in locality	Predicted by PCT	Potential habitat in BCAA	Likelihood of species occurring within BCAA	Recorded in survey	Survey Month	Survey met Minimum requirements
57	Dusky Woodswallow *Artamus cyanopterus cyanopterus*	V	Ecosystem	N/A	YES	YES	NO	YES	YES	N/A	N/A
Bats											
58	Grey-headed Flying-fox *Pteropus poliocephalus*	V, V1	Species/ Ecosystem	NO	YES	YES	YES	YES	YES	Oct-Dec	YES
59	Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	V	Ecosystem	N/A	YES	YES	YES	YES	YES	N/A	N/A
60	Eastern Coastal Freetail-bat *Micronomus norfolkensis*	V	Ecosystem	N/A	YES	YES	YES	YES	YES	N/A	N/A
61	Large-eared Pied Bat *Chalinolobus dwyeri*	V, V1	Species	YES	YES	YES	YES	YES	YES	Nov-Jan	YES
62	Eastern False Pipistrelle *Falsistrellus tasmaniensis*	V	Ecosystem	N/A	YES	YES	YES	POSSIBLE	YES	N/A	N/A
63	Little Bent-winged Bat *Miniopterus australis*	V	Species/ Ecosystem	YES	YES	YES	YES	POSSIBLE	NO	Dec-Feb	YES
64	Large Bent-winged Bat *Miniopterus orianae oceanensis*	V	Species/ Ecosystem	YES	YES	YES	YES	YES	YES	Dec-Feb	YES
65	Southern Myotis *Myotis macropus*	V	Species		YES	YES	YES	POSSIBLE	NO	Oct-March	YES
66	Greater Broad-nosed Bat *Scoteanax rueppellii*	V	Ecosystem	N/A	YES	YES	YES	POSSIBLE	YES	N/A	N/A
67	Eastern Cave Bat *Vespadelus troughtoni*	V	Species	YES	NO	NO	YES	YES	YES	Nov-Jan	YES
68	Golden-tipped Bat *Phoniscus papuensis*	V	Ecosystem	N/A	NO	NO	NO	NO	NO	All year	YES
Other Mammals											
69	Spotted-tailed Quoll *Dasyurus maculatus*	E, E1	Ecosystem	N/A	YES	YES	limited	UNLIKELY	NO	N/A	N/A
70	Brush-tailed Phascogale Phascogale tapoatafa	V	Species	NO	YES	NO	limited	UNLIKELY	NO	Dec-June	YES
71	White-footed Dunnart *Sminthopsis leucopus*	V	Species	NO	YES	NO	limited	UNLIKELY	NO	Oct-Dec	YES
72	Southern Brown Bandicoot *Isoodon obesulus obesulus*	E, E1	Species	NO	YES	NO	limited	UNLIKELY	NO	All year	YES
73	Koala *Phascolarctos cinereus*	V	Species/ Ecosystem	NO	YES	YES	NO	UNLIKELY	NO	All year	YES
74	Eastern Pygmy Possum *Cercartetus nanus*	V	Species	NO	YES	YES	YES	YES	YES	Oct-March	YES
75	Yellow-bellied Glider *Petaurus australis*	V	Ecosystem	N/A	YES	YES	YES	YES	YES	N/A	N/A
76	Squirrel Glider *Petaurus norfolcensis*	V	Species	NO	YES	YES	YES	UNLIKELY	YES	All year	YES
77	Greater Glider Petauroides volans	EP (Eurobodalla and Seven Mile Beach)	Species	NO	YES	NO^	YES	YES	YES	All year	YES
78	Long-nosed Potoroo	V, V1	Species	NO	YES	YES	NO	UNLIKELY	NO	All year	YES

Count	Species	Status*	Credit Type	SAII Entity	Recorded previously in locality	Predicted by PCT	Potential habitat in BCAA	Likelihood of species occurring within BCAA	Recorded in survey	Survey Month	Survey met Minimum requirements
	Potorous tridactylus										
79	Parma Wallaby *Macropus parma*	V	Species	NO	NO	NO	NO	NO	NO	All year	YES
80	Brush-tailed Rock Wallaby *Petrogale penicillata*	E, V1	Species	YES	YES	YES	NO	NO	NO	All year	YES
81	Eastern Chestnut Mouse *Pseudomys gracilicaudatus*	V	Ecosystem	N/A	NO	NO	NO	NO	NO	N/A	N/A
82	Smoky Mouse *Pseudomys fumeus*	E, E1	Species	YES	NO	NO	NO	NO	NO	Sept-April	YES
83	New Holland Mouse *Pseudomys novaehollandiae*	V1	Ecosystem	N/A	NO	NO	NO	UNLIKELY	NO	N/A	YES

Status
V =vulnerable, E = endangered, CE = critically endangered under the NSW BC Act
V1= Vulnerable, E1= Endangered, CE1 = critically endangered under the Commonwealth EPBC Act.
Local records - based on actual sightings/records from the OEH Atlas of Wildlife. Other species potentially recorded or habitat present gathered from the EPBC protected matters search.
Likelihood of species occurring within study area:
No= no suitable habitat on site, or surrounding site; Unlikely = suitable habitat recorded within subject site yet no records exist within close proximity to the subject site with; Possibly = recorded in the locality, suitable habitat recorded within study area); Yes = recorded within study area.
Shaded rows= species possibly occurring based on previous surveys and analysis along with recent local records.
^ Greater Glider, only recorded as endangered population from the Seven Mile Beach National Park.

2.3 Field Surveys

Specific targeted surveys for potentially occurring threatened species were conducted with reference to *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* - working draft (DECC 2004), published species credit species survey guidelines (DECC 2009, OEH 2018, DPIE 2020) and as prescribed in BAM (OEH 2017) and the survey guides produced for certain taxa.

2.3.1 Plant community types

Biometric quadrats

In 2015/16 all vegetation zones were assessed by using the required biometric plots. The plots were used to collect site information, which was used to determine the condition of each vegetation zone under the then ratified Biobanking Methodology. Plot and transect surveys utilised 400 m2 (20 m x 20 m) floristic plots nested within 1000 m2 (20 m x 50 m) biometric plots, quantitatively measuring 10 site attributes and replicated for each vegetation zone as required by the methodology.

Plots were distributed between vegetation zones derived from the community mapping and based on disturbance history. The number of plots in most cases exceeded the minimum number of plots required by the Biobanking Assessment Methodology. In all twenty-seven (27) plots were sampled within Lots 21, 22, 23 and 24. A summary of the information and details of the species information collected can be found in the Conservation Significance Assessment (OMVI 2016). Since the enactment of the Biodiversity Conservation Act and associated Biodiversity Assessment Method, the way in which this information is collected has changed, and all 25 plots (along with additional plots) were required to be re-surveyed. Details on the methods used to re-survey along with the location and number are given below.

Re-surveyed - Vegetation Integrity Plots

Quantitative data on species richness were collected from standardised 1m x 1m and 20 x 20 (nested in 20x 50m) quadrats (1000m2) replicated across each vegetation association and condition class, where required. Quadrat data was used to determine the floristic composition and structure of vegetation associations, and the ecological condition of the vegetation including disturbances and weed abundance. Data noted in each sample plot included:

- dominant species in each structural layer;
- heights of structural layers (i.e., canopy, sub-canopy, shrub and groundcovers);
- a cover abundance of each species in all strata;
- landscape features (i.e., slope, gully, aspect etc);
- leaf litter coverage;
- soil features (soil type, rocks, organic matter etc);
- geographical coordinates;
- species richness and abundance;
- an inventory of all species in the plot;
- the presence and abundance of weed species;
- the condition of the vegetation including past and present disturbances such as fire, grazing, logging, etc; and
- the presence, abundance and geographic coordinates of rare and threatened plants species.

The number of plots required was first assessed based on the size and location of the PCTs across the study area. Each vegetation zone was targeted using the required number of plots irrespective of pseudo-

replication or proximity of other related plots as is required by BAM. A list of the plots undertaken in each PCT and zone is given below in Table 3.

Table 3: Vegetation Integrity Plots

VEG ZONE	PCT ID	PCT NAME	CONDITION	AREA (HA)	PLOTS REQUIRED	PLOTS SURVEYED	PLOT NAMES
Biodiversity Certification Assessment Area							
D1-21, D1-22, D1-23 & D1-24	1082	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash and heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin	moderate	13.67	3	4	SG1, SG2, SG3, SG9
D2-21 & D2-24			poor	3.15	2	2	Mound 1 Mound 2
D3			DNG	5.32	2	2	GL1, GL5
D4-24	662	Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin	moderate	0.67	1	1	MMH1
Cleared land (tracks and bare earth, driveways, buildings etc.)			n/a	1.91	-	-	-
			Total	**24.72**	**7**	**8**	

2.3.2 Flora

Targeted Searches

Specific searches for plant species of conservation significance known from the locality were conducted for all 'conspicuous' species (large distinctive species observable year-round), using the Random Meander method (Cropper 1993), across all potential habitat, within the subject site and other areas within the study area, for the given targeted taxa.

Inconspicuous species such as the perennial terrestrial orchids, such as the Leafless Tongue Orchid (*Cryptostylis hunteriana*) or Brittle Midge Orchid (*Genoplesuim bauerii*) were undertaken by systematically walking along parallel transects 3-5 metres apart, through areas of suitable and potential habitat (including marginal habitat) across the entire study area.

Targeted Leafless Tongue Orchid

Surveys for the Leafless Tongue orchid (*Cryptostylis hunteriana*) were undertaken by systematically walking along parallel transects 3-5m apart, through areas of suitable habitat across the entire study area (Figure 2-1). These targeted surveys were timed to coincide with the known local flowering time for the species, through examining local reference sites at Tomerong and Manyana (south of the Study Area).

Flowering at the Manyana reference site was recorded (surveyed weekly) from the 7th December 2015 through to mid-February 2016. Another more exposed reference site on Turpentine Road at Tomerong was also examined on the 10th December. Flowering at this site was also evident, but this population appeared to have commenced flowering at least two weeks prior, given the spent flowers observed (see Appendix D for reference site photographs).

Accordingly, surveys across all suitable habitat in lot 24 were conducted on the 15th and 18th of December 2015 over 24 person hours, during the known flowering period.

Figure 2-1: PCT and targeted vegetation survey effort across the study area

Brittle Midge Orchid and Pterostylis ventricosa

Surveys for the Brittle Midge Orchid (*Genoplesium baueri*) and *Pterostylis ventricosa* were undertaken by systematically walking along parallel transects 3-5m apart, through areas of suitable habitat across the entire study area (Figure 2-1). These targeted surveys were conducted during the known local flowering time for both species. A reference site near Bomaderry Creek Regional Park (north east of the Study Area) was examined for flowering Midge orchid prior to the survey. A reference site for P. ventricosa was examined in St Georges Basin prior to surveys (see Appendix D for reference site photographs). Flowering was recorded for both species prior to survey. The subsequent site surveys were conducted over 5 days (1-3, 9 and 30th March 2016) over 34 person hours.

Other species

During all flora survey and many of the fauna surveys, threatened plant species were also targeted, especially during or within the known flowering periods of candidate species. Preferred habitat for threatened species was targeted during all surveys.

Flora survey effort

Originally surveyed in detail using the Biobanking Assessment Methodology and the draft threatened species survey guidelines (DEC 2004), new surveys were required following the ratification of the Biodiversity Conservation Act. With the new BC Act, new legislated survey methods must be followed. The former BBAM plots did not record the required information and needed to be re-surveyed. The targeted threatened species surveys were conducted less than 5 years ago and therefore are suitable to use in this BCAR in accordance with the rules of BAM. Details of the surveys effort and timing is given below in Table 7. BBAM and BAM biometric plots and general floristics by Brendan Ryan and expert botanist Gary Leonard. The majority of targeted terrestrial orchid surveys and other threatened plant parallel transects were conducted by Brendan Ryan.

Table 4: Flora and PCT survey effort conducted across the study area

DATE	METHOD	EFFORT (PERSON HRS)	TARGET SPECIES
September 2011 Surveys			
01/09/2011	Vegetation condition and classification	4	All flora species
	Random Meander surveys	3	All flora species
12/09/2011	Vegetation condition and classification	4	All flora species
	Random Meander surveys	3	All flora species
23-27 Nov 2015	Fauna surveys – opportunistic flora surveys	88 hrs	All flora species
December 2015 surveys			
01/12/2015	Fauna surveys – opportunistic flora surveys	7 hrs	All threatened flora
15/12/2015	Targeted threatened species surveys-parallel transect & random meander	6 hrs	*Cryptostylis hunteriana*
16/12/2015	Targeted threatened species surveys-parallel transect & random meander	6 hrs	*Cryptostylis hunteriana*
17/12/2015	Targeted threatened species surveys-parallel transect & random meander	6 hrs	*Cryptostylis hunteriana*
18/12/2015	Targeted threatened species surveys-parallel transect & random meander	6 hrs	*Cryptostylis hunteriana*
February 2016 surveys			
11/02/2016	Targeted threatened species surveys-parallel transect & random meander	1 hr	All threatened flora
	Community mapping and random meander surveys	2 hrs	All flora species
	BBAM plots	5 hrs	All flora species
12/02/2016	Targeted threatened species surveys-parallel transect & random meander	1 hr	All threatened flora

Date	Method	Effort (person hrs)	Target Species
	Community mapping and random meander surveys	1 hr	All flora species
	BBAM plots	6 hrs	All flora species
March 2016 surveys			
01/03/2016	Targeted threatened species surveys-parallel transect & random meander	6 hrs	*G. baueri* & *P. ventricosa*
02/03/2016	Targeted threatened species surveys-parallel transect & random meander	6 hrs	*G. baueri* & *P. ventricosa*
03/03/2016	Targeted threatened species surveys-parallel transect & random meander	6 hrs	*G. baueri* & *P. ventricosa*
09/03/2016	Targeted threatened species surveys-parallel transect & random meander	8 hrs	*G. baueri* & *P. ventricosa*
30/03/2016	Targeted threatened species surveys-parallel transect & random meander	2 hrs	*G. baueri* & *P. ventricosa*
	BBAM plots	6	All flora species
May 2016 surveys			
2-6 May 2016	Fauna surveys – opportunistic flora surveys	90 hrs	All flora species
20/05/2016	Opportunistic flora surveys and habitat searches	5 hrs	All flora species
April 2018 surveys			
06/04/2016	Targeted threatened species surveys-parallel transect & random meander	1 hr	All threatened flora
	20x20 m Stem count plots	6 hrs	All flora species
April 2019 surveys			
03/04/2019	Targeted threatened species surveys-parallel transect & random meander	2 hrs	All threatened flora
	20x20 m Stem count plots	5 hrs	All flora species
October 2019 surveys			
16/10/2019	Revisit BBAM plots to conduct BAM plots	7 hrs	All flora species
18/10/2019	Revisit BBAM plots to conduct BAM plots	7 hrs	All flora species
April 2020 surveys			
24-04-20	*Genoplesium baueri* population survey	1 hr	*G. baueri*

2.3.3 Fauna

Amphibians

Diurnal surveys

Diurnal surveys of any suitable habitat for amphibians were undertaken. Surveys included a search for basking individuals within vegetation around water bodies or watercourses found on site and listening for any calling individuals. Searches were conducted for at least one person-hour per area of appropriate habitat. Incidental records of other frog species heard or sighted during the inspections were also recorded.

A dip-net was used to search for tadpoles, and sweeps were taken in pools across the study area. The microhabitats netted included areas of open water, around emergent vegetation, woody debris or overhanging banks. The number of sweeps taken was proportional to the size of the waterbody, and the complexity of the habitat and vegetation structure. For example, more sweeps were taken in large ponds with open water.

Each pool was surveyed once, with survey effort varying between five and 15 minutes. A visual inspection of waterbodies for tadpoles was also undertaken while dip-netting, particularly in areas of clear, shallow open water. Dip netting was also conducted following spotlight surveys of several pools. The spotlight enables surveyors a clear view of tadpoles and where in the water column they are resting (key diagnostic feature) before disturbance. Individual tadpoles can then be targeted using the net. All tadpoles captured were identified using Anstis (2002).

Bait traps

Bait trapping is a non-destructive sampling technique. All but introduced pest species are returned unharmed to the water. Five bait traps were deployed over four nights along the southern creekline in November 2015 and May 2016. The collapsible rectangular bait traps are, approximately, 350 mm long x 200 mm wide with two entrances at each end of the trap that funnel into a 45 mm aperture. The traps are made from a 3 mm mesh and were baited with a luminescent light stick as an attractant. The luminescent attractant will lure fish Myobatrachidae and Hylidae frog species throughout the water column. Traps were deployed in shallow water habitats close to the bank edge of available pools, with at least 10mm of the trap above the water in case air breathing animals were captured.

Tadpoles and other species captured were identified and released at the point of capture. The tadpoles of the Giant Burrowing Frog and Stuttering Barred Frog can take between 12 to 18 months to metamorphose; therefore, tadpoles would be present from recent breeding events in spring through to the previous late summer or autumn (i.e., 2014).

Spotlight Streamside Surveys and Call Playback

Spotlight surveys for frogs involved searching for active and/or calling frogs in areas of suitable habitat, if present at each of the survey sites. The central dams and other pools along the creeklines were specifically targeted for amphibians, and searches were carried out along the water's edge and in aquatic and riparian vegetation (where present) along the banks to a distance of 5 to 10 m. Individuals of all frog species seen and/or heard calling during the searches were identified in accordance with Cogger (2000) and Robinson (1993).

At selected sites, call playback surveys started with an initial listening period of 15 minutes and then calls of local threatened frog species were broadcast for five minutes. This was then followed by a 10-minute listening period. After the listening period the immediate area was scanned using a spotlight. Following the completion of the call play back survey, streamside surveys continued.

Spotlighting and call playback for frogs was conducted on at least two nights each sampling period in November 2015 and May 2016. A 1000 lumen (or higher) head mounted spotlight, with light spreading and dimming capability was used during the spotlighting surveys. Opportunistic searches for tadpoles and adult frogs of all species were undertaken throughout the survey period (see above).

Road and track transects

During wet weather, mild to heavy rain, or immediately following heavy rain, the numerous tracks across the study area were walked with a spotlight in order to scan the open tracks and verges for frogs. These weather conditions suit the large sit and wait predatory frogs, like Giant Burrowing Frog or the Barred frogs (*Mixophyes* sp.). The warm and very humid conditions allow the frogs to wait in the open for passing prey. This also allows for easy spotting of these larger species as well as the smaller frogs moving across the tracks. A Ledlenser H14R rechargeable 1000 lumen headlamp (or similar) was used during the road transects undertaken.

Red Crowned Toadlet

One target species readily surveyed for in daylight hours is the Red-crowned Toadlet. Recorded in very specific habitats, examinations of ephemeral sandstone gullies were undertaken across the study area and more widely in the locale, where such habitat is observed. No suitable exposed sandstone gullies were recorded in the study area but were recorded south toward the Shoalhaven River. In suitable habitat, call elicitation surveys were conducted. Surveys start with a quiet listening period of 5 minutes then a loud

noise is created by clapping or shouting. Another 5-minute listening period followed. Any frog calls resulting were identified by either call identification or by searching for the frog for visual identification. This technique elicits a response call from male *Pseudophryne* species including the Red-crowned Toadlet.

Tadpole surveys

Giant Burrowing Frog and Stuttering Frog

Creek beds and surrounding sclerophyll forest were surveyed on nocturnal spotlighting and call playback and road transect as described above. Diurnal searches for these frogs and tadpoles, habitat searches, and listening for calling individuals, were also undertaken across the study area throughout the periods of the survey. Calls of the Giant Burrowing Frog and Stuttering Frog were also played during the surveys in November and March. Calls were played through portable speaker at the same or similar volume to a frog of these species.

Herpetofauna

General herpetofauna surveys involved traversing the subject site and surrounds, examining the habitats present for herpetofauna, turning rocks, logs and other debris as well as spotlighting surveys for nocturnally active species such as frogs and geckos. The aims of the survey were to identify potential habitat for threatened herpetofauna species that might occur in the locality. Potentially occurring herpetofauna targeted for the habitat examination included target species identified in the Atlas of Wildlife. These included frog species: Giant Burrowing Frog, Littlejohn's Tree Frog, and the Stuttering Frog.

Survey techniques employed targeted all frog and reptile species potentially occurring within the study area, and included:

- diurnal searches for sheltering or basking frogs and reptiles;
- rock, log and debris rolling;
- listening for frog calls diurnally and nocturnally;
- active shelter searches; and
- nocturnal spotlighting surveys.

Herpetofauna (frogs and reptiles) habitat assessments and searches were conducted during the November 2015 and May 2016. General herpetofauna surveys involved traversing the study area and surrounds, examining the habitats present for herpetofauna, turning rocks, logs and other debris as well as spotlighting surveys for nocturnally active species such as frogs and geckos. The aims of the survey were to identify potential habitat for threatened herpetofauna species that might occur in the locality and to select locations within the study area suitable for targeted surveys and placement of traps and targeted nocturnal and diurnal surveys. Herpetofauna targeted for the habitat examination included target species identified by Biosis and AHA during their previous surveys and the BioNet Atlas. These included: Rosenberg's Goanna, Giant Burrowing Frog, Green and Golden Bell Frog, Red-crowned Toadlet, Littlejohn's Tree Frog, and the Stuttering Frog.

Survey techniques employed targeted all frog and reptile species potentially occurring within the study area, and included:

- diurnal searches for sheltering or basking frogs and reptiles;
- rock, log and debris rolling;
- listening for frog calls diurnally and nocturnally;
- active shelter searches;
- nocturnal spotlighting; and
- nocturnal call playback for threatened frog species.

Fossorial Reptiles

Surveys of the subject site and study area were undertaken for all fossorial reptiles. This involved rock rolling and searching under logs, fallen bark and other debris. Daily temperature generally did not exceed 25˚C during the survey periods. Rocks, logs and debris were replaced to sustain habitat integrity.

Representative surveys were conducted in the wider locality to ascertain species activity and habitat suitability. This involved determining the extent of potentially suitable habitat from aerial photographs or other means, and ground-truthing selected sites to validate habitat suitability, condition and extent. The sites sampled shall be used to provide context in relation to the habitat affected by the action proposed.

Rosenberg's Goanna

Rosenberg's Goanna inhabits heath, open forest, and woodland and lays its eggs in termitaria (termite mounds). Surveys of the subject site, study area and locality were undertaken for termite mounds (termitaria). This involved searching the entire study area for termitaria. Representative sampling of the locality for termitaria involved the use of transects in selected locations. The number of termitaria recorded was used to provide local representation of this habitat feature the potential breeding habitat affected by the action proposed. Each termitary observed was examined for possible recent damage caused by Rosenberg's Goanna, fresh termite patching of mounds, scratch marks and scats were also recorded if present.

Avifauna

Diurnal Birds

Diurnal bird surveys involved traversing the entire study area on foot with the aim to identify particular species. Three morning bird surveys were conducted between 0730 and 0900 during each seasonal survey in November 2015 and May 2016, with a cumulative list of all birds recorded throughout the rest of the days and evening also recorded. Birds were identified by observation with binoculars, in accordance with Pizzey and Knight (2012), and/or by call identification.

Diurnal bird surveys also included searches for habitat features of relevance for particular threatened species. This included searching for evidence of feeding, such as cracked seed, cones, nuts from Gang-gang Cockatoos, (orts) chewed she-oak cones from the Glossy-black Cockatoo and signs of bird presence, such as pellets, whitewash, nests etc.

Nocturnal birds

A nocturnal survey was conducted across the lots over three nights each in November 2015 and May 2016 utilising, an initial listening period, stag watching, spotlighting and call playback surveys. Species specifically targeted included: Powerful Owl (*Ninox strenua*), Masked Owl (*Tyto novaehollandiae*), Barking Owl (*Ninox connivens*) and Sooty Owl (*Tyto tenebricosa*) on the three nights in November 2015 and three nights in May 2016. Surveys involved playing calls for five minutes followed by a listening period of five minutes (undertaken separately for each species), and a final listening period of approximately 10 minutes.

Nocturnal surveys generally began at 1800 and were completed by 2300, apart from two nights, one in November 2015 and one in May 2016 that extended until sunrise the following morning. Nocturnal surveys included more than 84 person hours of the two survey periods.

Call playback

Call playback surveys were conducted for the Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Masked Owl (*Tyto novaehollandiae*) and Sooty Owl (*Tyto tenebricosa*) over two nights in November 2015, and two nights in May 2016. Surveys involved playing calls for five minutes followed by a listening period of five minutes (undertaken separately for each species), and a final listening period of approximately 10 minutes.

Nesting surveys and stag watching

Stag watching included a subset of trees bearing hollows that were considered suitable for roosting and denning by threatened owls and mammals or micro-bats. The trees or group of hollow-bearing trees were watched at dusk for emerging animals. Initially hollows were assessed for suitability using characters such as tree size and species, and the size, shape and number of hollows. Signs such as owl excreta or claw marks on trees or around hollows provided additional information regarding the utilisation of certain tree hollows.

Each surveyor targeted one or more hollows in a single tree for stag watching, but at the same time monitored several other trees in the vicinity by listening for vocalisations or other sounds of animals emerging from hollows within these trees. The stage watches conducted also utilised an Anabat unit to detect any ultrasonic calls from waking or existing microbats.

Observation sessions commenced at sunset and continued for a further one to one and a half hours. During this period, hollows were carefully observed, with a pair of 20x50 binoculars and a spotlight on hand to aid species identification. All fauna activity at hollows was recorded during that period.

Spotlighting

Spotlighting surveys involved traversing the study area on foot, using a hand-held spotlight to detect nocturnal birds. Observation sessions were conducted on three nights each season (November and May) after sun down and continued until at least 2300 hrs. Spotlighting was conducted with the use of a pair of 20x50 binoculars and a Ledlenser H14R 1000 lumen headlight or 100W hand-held spotlight.

Glossy Black Cockatoo feeding surveys

During the November 2015 surveys, 5-10 metre parallel transects were conducted by two surveyors across the entire lot targeting mature fruiting Allocasuarina for evidence of GBC feeding, in the form of clearly identifiable GBC orts *Allocasuarina* spp. cones (primarily Forest Oak, *A. torulosa*, Black Sheoak, *A. littoralis*). Any orts were recorded using a non-differential GPS, and the age and type of foraging estimated.

The ground beneath all mature male Allocasuarina trees were searched for orts, distinctive cone remnants that feeding Glossy Black-Cockatoos leave underneath the tree after stripping the cone of seeds. Orts vary in their persistence within the environment, and change colour with age. The relative type of foraging was recorded as either:

1. Foraging; more than 100 orts which were completely chewed and was clearly animals taking time to remove all seed in the cone
2. Investigative; generally, less than 100 orts, only partially chewed, where animals appear to be only investigating seed content/suitability.

The relative age of the orts was also recorded, where general categories where ort colour and condition:

1. whitish-green – fresh, >1 week
2. red-brown – > 1 month
3. brownish-grey – > 3 months
4. grey – old; 3-6 months

The colour gives us an idea of the age of the orts, and thus how recently the birds have been in the area indicating not only the relative distribution of the species but the frequency of habitat use across the site. The records were then mapped across the study area using ArcGIS ver.10 (ESRI).

Mammalian Fauna

Diurnal Mammals

During surveys of the subject site, diurnal mammal searches were conducted in areas of potential habitat across the study area, with emphasis on searches for scats, tracks, burrows, diggings, scratching or pads.

Specific searches were conducted for habitats or resources of relevance for those threatened fauna species known from the general region, or species, which might be anticipated to occur given the vegetation communities and habitats present. Opportunistic records of all fauna species observed were maintained throughout the survey period, and an inventory was compiled of all species recorded during the current investigations.

Elliott ground and tree trapping

Targeted Elliott A trapping was replicated over two seasons November (23-27th) and May 2016 (2-6th), using platform traps and ground-based traps, using the same four transect each session (Figure 12).

Seventy-five (75) Type A Elliott traps (90 x 100 x 330 mm) were set on the ground and on platforms (2-3 metres above the ground) along 4 transects (Figure 12). Each vegetation type present across the study area was targeted; with one transect in the open grazed grassland in the north east, one along the creekline in the south west, one in the far west shrubby woodland and the other in wet melaleuca woodland also along the creek in the east. Apart from the grazed woodland transect, traps were spaced at 20-30 m intervals. Two traps were placed at each point with one on the ground under cover and the other on a platform, fixed to suitable tree. Each trap was baited with a mixture of peanut butter, honey and rolled oats and a handful of unbleached paper towel was added to provide insulation for trapped animals.

Because of the absence of ground cover and the presence of grazing cattle, the open woodland transects in the north east woodland, consisted of a longer transect of 15 traps, all placed on platforms at least 3 metres above the ground.

The traps were left in place for four consecutive nights yielding a 300-trap night effort for each session. Traps were checked each morning soon after sunrise. All captured animals (except Petaurus sp.) were identified quickly and with minimal handling, prior to release. All gliders captured were placed into calico bags, examined, weighed, measured and released in the evening of capture back at the capture point.

The low, shrubby woodland in the west aimed at targeting the Eastern Pygmy-possum were placed lower approximately 2 metres above the ground. The entrance and the trunk of the tree of each platform trap were sprayed with honey diluted in water as an attractant.

Platform traps were secured with rubber bands onto mounts that are attached to the trunk of large trees (DBH > 100mm) at heights ranging from approximately two to three metres above ground level. The trap

mounts consisted of 500mm long softwood planks bolted onto a steel angle bracket. These mounts were then screwed onto the tree trunk at an incline to facilitate drainage. Platform were installed in November 2015 and remained in place until the conclusion of the surveys in May 2016.

Arboreal Mammals

Spotlight searches were done throughout the site for nocturnally active mammals, (including birds and herpetofauna), including dedicated listening periods for fauna vocalisations. These were carried out on three nights each session in November 2015 and May 2016. Species were identified by observation under spotlight or by call identification.

The surveys involved walking along a number of tracks and through the forested habitat throughout the study area, targeting a range of habitats. A Ledlenser H14R 1000 lumen headlight or 100W hand-held spotlight was used to illuminate mammals. Walked transects were undertaken along existing tracks (Figure 2-2) and along watercourses. Surveys commenced after dusk or immediately after the targeted stag watching surveys.

Mammals and nocturnal birds were identified by observation under spotlight or by vocalisations heard whilst spotlighting. Identifications were in accordance with Menkhorst & Knight, (2004) and Pizzey and Knight (2004).

Targeted Yellow-bellied Glider occupation surveys

Early evening and late evening periods were used to listen and track Yellow-bellied Gliders in and out of Lot 24. Sites on Crams Road and other location in the south west of the lot were chosen to locate dens site and the movement of Yellow-bellied Gliders across the locality. Two surveyors began stag watching in differing locations separated by at least 200 metre aimed at triangulating calls and to judge animals' movement following their emergence. One entire night (20:00 to 6:00 EST) in the November surveys and numerous hours over both sessions were mostly dedicated to tracking Yellow-bellied Gliders across the south-western creekline area.

Targeted foraging evidence of Gliders

To better understand the utilisation of the locality by Yellow-bellied Gliders, 5-10 metre parallel transects were conducted by two surveyors across the entire lot in November 2015 targeting Acacia, Corymbia and Eucalypt trees with notching as the result of gliders foraging for manner or sap. The incisions can generally be differentiated from other marks caused by burrowing insects, fungal and other infections by the chewing around the incision, claw marks in the bark around the incisions and the incised nature of the notch rather than a protruded mark or a spilt in the cambium layer. Yellow-bellied Gliders are known to create a range of different shaped incisions depending on the species of tree targeted, such as 'y' or 'v' shapes which concentrate the exudates at the point.

Conversely, the smaller gliders will use incisions created by Yellow-bellied Gliders as well as other gliders. Trees that provide a good supply of sap that is more palatable for some reason, (e.g., soil chemistry, topography) will be revisited throughout the year and are thought to be guarded by the occupying family groups. Territorial ranges are maintained by these groups and there would likely be some intra and inter-specific competition for such resources through the year where ranges of the differing species overlap (Lindenmayer 2002, Rowston and Catterall, 2004).

Any trees with glider notching were recorded using a non-differential GPS, and the age and type of notching estimated.

The relative type of foraging was recorded as either:

1. most likely Yellow-bellied Gliders: typical large ‘v’ or ‘y’ notching;
2. large vertical or horizontal notching possibly Yellow-bellied Gliders
3. Glider notches: small vertical or horizontal notching, species of Petaurus undeterminable

The relative age of the notches was also recorded:

5. Very old, many years since use and completely overgrown;
6. Old, closed over and no recent usage
7. Recent, evidence of use in last year
8. Current, recent use, sap bleeding.

Mammal call playback

The calls of the Yellow-bellied Glider and Squirrel Glider were broadcast on at least two nights of each seasonal session. Broadcasts were projected through a 15W TOA megaphone from appropriate habitat within the study area. The call playback location was chosen to maximise the likelihood of target species detecting the experimental call, and to obtain coverage of relevant habitats throughout the study area. Calls of each species were broadcast for five minutes, followed by a listening period of 15 minutes.

Stag Watches

As described above for nocturnal birds, the hollow-bearing trees chosen based on their suitability for roosting and denning fauna, including arboreal mammals and microbats. These were watched from before dusk for emerging animals. Initially hollows were assessed for suitability using characters such as tree size and species, and the size, shape and number of hollows. Signs such as owl excreta or claw marks on trees or around hollows provided additional information regarding the utilisation of certain tree hollows.

Each surveyor targeted one or more hollows in a single tree for stag watching, but at the same time monitored several other trees in the vicinity by listening for vocalisations or other sounds of animals emerging from hollows within these trees.

Observation sessions commenced at sunset and continued for a further one hour to one and a half hours. During this period hollows were observed with the aid of binoculars and spotlights where necessary to facilitate confidence in the data.

Microchiropteran Bats

Ultrasonic Anabat Detection

ANABAT echolocation recording was used to target microchiropteran bats across the study area. During the seasonal survey periods the echolocation calls of insectivorous bats were recorded using two Anabat SD2 units (Titley Electronics, Ballina NSW), for four full evenings each in November 2015 and May 2016. Calls are recorded to compact flash (CF) memory cards for later computer analysis.

ANABAT detectors were therefore deployed for a total 16 trap night across the study area, between November and March, thus exceeding the minimum survey effort required for all target species (OEH 2018).

Both detectors were calibrated and set to operate at the same sensitivity level (7, the maximum is 10) and division ratio of 8 (minimum is 4, maximum 32) as the static unit. The two static detectors were orientated at a 45-degree angle on a tree stump or similar facing openings or flyways, creeklines or other suitable

foraging habitat across the study area. The hand-held unit was sometimes also used initially for targeting hollow-bearing trees during stag watching and then used throughout the walked spotlighting transect across the study area, and angled toward any bat observed or heard to record as much of the call as possible, before being placed at the northern static point.

Biosis' bat call analyst Amy Rowles interpreted all bat calls recorded during all surveys. Nomenclature for bats followed that of Churchill (2010).

Calls collected during the field survey were identified using zero-crossing analysis and Analook software by visually comparing call traits with reference calls taken from a call guide. No reference calls were collected during the survey. The *Bat calls of NSW: Region based guide to the echolocation calls of microchiropteran bats* (2004), was used as a guide to call analysis. Due to the lack of local reference calls, high level of intraspecific variability and interspecific overlap in call characteristics, a conservative approach was taken when analysing calls.

A call was defined as a sequence of three or more consecutive pulses of similar frequency. Pulses separated from another sequence by a period of five seconds were considered to be separate calls. Scattered sequences, where intermittent pulses were not separated by more than five seconds, were recognised as a single pass. Where constant activity was recorded, a single pass was defined as 15 seconds (i.e., one full display screen comprising as an Anabat sequence file). Although this method underestimates the number of bat passes when there is continuous activity, the standard unit of time remains consistent (Law *et al*., 1998; Law *et al*., 1999). Due to variability in the quality of calls and the difficulty in distinguishing some species each call was assigned a confidence rating, (see Mills *et al.,* 1996 and Duffy *et al.,* 2000) as summarised below.

Some insectivorous bat species have distinctive echolocation calls that are unlikely to be confused with those of other species. In other bat species, calls may overlap in both frequency and structure, making identification problematic. The degree of confidence attached to call identifications also depends on the quality of the recorded call and the activity of the bat at the time of recording. In some instances, a particular species may be identified with confidence, while at other times its identification will be less certain. For the purposes of this report, echolocation call identifications have been categorised with regard to certainty of identification:

- C Definite Identification - no possibility of confusion of calls with those of other bat species.
- P Probable Identification - little possibility of confusion of calls with those of other bat species.
- Po Possible Identification - likelihood of confusion with other species, but possible identification based on calls.

Harp trapping

Two harp traps were placed over four nights each session, at six separate locations across the study area (Figure 2-2) in November 2015 and May 2016. Each trap site was located either along an access track through forest or in a creek gully within the subject site or immediately adjacent. The harp traps were checked between 21:00 and 23:00 and again at sunrise. Individuals not immediately released (evening check) were retained for identification and released the following evening. All individuals captured were identified to species, their sex recorded, measured and then released.

Harp traps were therefore deployed for a total 16 trap nights across the study area, between November and March, thus exceeding the minimum survey effort required for all target species (OEH 2018).

Roost Habitat Identification

Incidental records of potential roost habitat for threatened bat species were recorded. This was based on the presence of hollow bearing trees and caves/overhangs or indirect evidence of bat presence, such as guano, recorded during the regular surveys.

Remote cameras

Ten (10) remote cameras were each deployed at two separate sites (November 2015 and May 2016) stratified across the study area, sampling each vegetation type. Each camera was armed for a minimum of 15 days/nights in each location (Figure 2-2). The use of remotely activated cameras has been found to be an affective technique in surveying for such species with higher time and cost effectiveness (Glen & Dickman 2003; Claridge *et. al.* 2010, Vic DSE 2011).

The remote cameras used in this survey were Professional Reconyx colour and infra-red trail cameras (Reconyx™ RC60/HO RapidFire Covert Color IR). Each unit has a "no glow" high output infrared night vision with light filtering technology (LFT) with a range of 50 feet. Images are captured in full 1080P high definition in a widescreen format. Cameras captured colour images by day and infrared monochrome images by night.

To increase the likelihood of obtaining photographs of all fauna species, cameras were set on maximum sensitivity and the 'trail-mode' setting where five rapid photographs per trigger are taken in quick succession (RapidFire™), thereby facilitating identification of animals triggering the camera. Camera units were set to operate for 24 hrs per day/night. Images were stored on 16GB Compact Flash cards and were downloaded using the Reconyx proprietary MapView software.

Camera stations consisted of a camera unit, cable-locked for security to a tree trunk such that the sensor was approximately 30-40cm above the ground. Each camera unit was located approximately 1.5 m from a bait station, which acted as an attractant to draw animals into the detection field of the camera's sensor. To attract both omnivorous and carnivorous species, baits consisted of a rubber sponge soaked in a mixture of truffle oil and fish sauce, placed in a perforated and capped 40mm PVC pipe which was then pegged to the ground.

Vegetation that might obscure the camera's view of any animal investigating the bait was cleared from the site.

Animals captured on digital images were identified with reference to appropriate field guides and, if needed, by consultation with other experienced researchers.

Habitat assessments and surveys for fauna signs

Habitat assessments were carried out in the form of diurnal transects undertaken throughout the subject site to identify potential habitats and specific resources for fauna and particularly for threatened species. Walked transects were conducted across the entire area to assess the potential fauna habitat attributes. Additional surveys were aimed at searching for signs of a number of fauna groups and habitat features that could be targeted during diurnal and nocturnal transects.

Transects included searching for:

- trees with bird nests or other potential fauna roosts;
- burrows, dens and warrens;
- ground or arboreal termitaria;
- sap-feeding notches on trees;
- distinctive scats or latrine sites (of particular relevance for the Tiger Quoll), white wash and regurgitated pellets under roost sites, tracks or animal remains;
- evidence of activity such as scratches and diggings;
- stags and tree-hollows that provide potential roost sites for bats, owls, and other hollow-dependant species; and
- caves or similar constructed features (e.g., storm drains) that provide potential roost sites for microchiropteran bats.

Any scats, owl pellets or other remains found on site between 2011 and 2020 surveys were analysed by Brendan Ryan or Ben Lewis.

Hollow-bearing tree surveys

A detailed assessment of survey of hollow-bearing tree has been previously undertaken by AHA (2008) and Biosis Research (2011), with a review of the information collected also having been previously completed (OMVI 2011a).

Fauna survey effort

Details of specific survey techniques and survey effort for target species are provided below and summarised in Table 8. All surveys were undertaken within the 5-year limit of surveys in accordance with BAM.

Table 5: Fauna species survey effort conducted across the study area

DATE	METHOD	EFFORT	TARGET SPECIES
November 2015 Surveys			
23/11/2015	General fauna surveys and habitat searches	6 hrs	All fauna species
	Diurnal birds (afternoon)	2 hrs	All avifauna
	Spotlighting	6 hrs	All nocturnal fauna
	Stag watching	2 hrs	Arboreal Mammal and birds
	Call playback	2 hrs	Threatened frogs, birds and mammals
	ANABAT detection	2 t/n	Microchiropteran bats
	Streamside surveys / dip netting and spotlighting	2 hrs	fish, frogs and tadpoles
	Remote cameras	10 t/n	All vertebrate fauna
	Platform and ground Elliot traps	75 t/n	Ground and arboreal mammals
	bait traps	5 t/n	fish and tadpoles
	harp traps	2 t/n	Microchiropteran bats
24/11/2015	General fauna surveys and habitat searches	4 hrs	All fauna species
	Diurnal birds (morning)	2 hrs	All avifauna
	Rock rolling and targeted herpetofauna surveys	2 hrs	All herpetofauna
	Diurnal birds (afternoon)	2 hrs	All avifauna
	Spotlighting	9 hrs	All nocturnal fauna
	Stag watching	2 hrs	Arboreal Mammal and birds
	Call playback	2 hrs	Threatened frogs, birds and mammals
	ANABAT detection	2 t/n	Microchiropteran bats
	Streamside surveys / dip netting and spotlighting	1 hr	fish, frogs and tadpoles

Date	Method	Effort	Target Species
	Remote cameras	10 t/n	All vertebrate fauna
	Platform and ground Elliot traps	75 t/n	Ground and arboreal mammals
	bait traps	5 t/n	fish and tadpoles
	harp traps	2 t/n	Microchiropteran bats
25/11/2015	General fauna surveys and habitat searches	2hrs	All fauna species
	Diurnal birds (morning)	2 hrs	All avifauna
	Rock rolling and targeted herpetofauna surveys	4 hrs	All herpetofauna
	Spotlighting	16 hrs	All nocturnal fauna
	Stag watching	2 hrs	Arboreal Mammal and birds
	Call playback	2 hrs	Threatened frogs, birds and mammals
	ANABAT detection	2 t/n	Microchiropteran bats
	Streamside surveys / dip netting and spotlighting	2 hr	fish, frogs and tadpoles
	Remote cameras	10 t/n	All vertebrate fauna
	Platform and ground Elliot traps	75 t/n	Ground and arboreal mammals
	bait traps	5 t/n	fish and tadpoles
	harp traps	2 t/n	2 t/n
26/11/2015	General fauna surveys and habitat searches	2 hrs	All fauna species
	Diurnal birds (morning)	2 hrs	All avifauna
	Rock rolling and targeted herpetofauna surveys	4 hrs	All herpetofauna
	Spotlighting	6 hrs	All nocturnal fauna
	Stag watching	3 hrs	Arboreal Mammal and birds
	Call playback	2 hrs	Threatened frogs, birds and mammals
	ANABAT detection	2 t/n	Microchiropteran bats
	Streamside surveys / dip netting and spotlighting	3 hr	fish, frogs and tadpoles
	Remote cameras	10 t/n	All vertebrate fauna
	Platform and ground Elliot traps	75 t/n	Ground and arboreal mammals
	bait traps	5 t/n	fish and tadpoles
	harp traps	2 t/n	2 t/n
27/11/2015	General fauna surveys and habitat searches	6 hrs	All fauna species
	Diurnal birds (morning)	2 hrs	All avifauna
	Rock rolling and targeted herpetofauna surveys	2 hrs	All herpetofauna
December 2015 surveys			
01/12/2015	General fauna surveys and habitat searches	7 hrs	All fauna species
15/12/2015	General fauna surveys and habitat searches	6 hrs	All fauna species
	retrieve remote cameras	19 t/n	All vertebrate fauna
16/12/2015	General fauna surveys and habitat searches	6 hrs	All fauna species
17/12/2015	General fauna surveys and habitat searches	6 hrs	All fauna species
18/12/2015	General fauna surveys and habitat searches	6 hrs	All fauna species
February 2016 surveys			
11/02/2016	On site doing flora surveys opportunistic fauna	8 hrs	All fauna species
12/02/2016	On site doing flora surveys opportunistic fauna	8 hrs	All fauna species
March 2016 surveys			
01/03/2016	On site doing flora surveys opportunistic fauna	6 hrs	All fauna species
02/03/2016	On site doing flora surveys opportunistic fauna	6 hrs	All fauna species
03/03/2016	On site doing flora surveys opportunistic fauna	6 hrs	All fauna species
09/03/2016	On site doing flora surveys opportunistic fauna	8 hrs	All fauna species
30/03/2016	On site doing flora surveys opportunistic fauna	8 hrs	All fauna species
May 2016 surveys			
02/05/2016	General fauna surveys and habitat searches	8 hrs	All fauna species

DATE	METHOD	EFFORT	TARGET SPECIES
	Diurnal birds (afternoon)	2 hrs	All avifauna
	Spotlighting	6 hrs	All nocturnal fauna
	Stag watching	2 hrs	Arboreal Mammal and birds
	Call playback	2 hrs	Threatened frogs, birds and mammals
	ANABAT detection	2 t/n	Microchiropteran bats
	Streamside surveys / dip netting and spotlighting	2 hrs	fish, frogs and tadpoles
	Remote cameras	10 t/n	All vertebrate fauna
	Platform and ground Elliot traps	75 t/n	Ground and arboreal mammals
	bait traps	5 t/n	fish and tadpoles
	harp traps	2 t/n	Microchiropteran bats
03/05/2016	General fauna surveys and habitat searches	4 hrs	All fauna species
	Diurnal birds (morning)	2 hrs	All avifauna
	Rock rolling and targeted herpetofauna surveys	2 hrs	All herpetofauna
	Diurnal birds (afternoon)	2 hrs	All avifauna
	Spotlighting	8 hrs	All nocturnal fauna
	Stag watching	1 hr	Arboreal Mammal and birds
	Call playback	2 hrs	Threatened frogs, birds and mammals
	ANABAT detection	2 t/n	Microchiropteran bats
	Streamside surveys / dip netting and spotlighting	1 hr	fish, frogs and tadpoles
	Remote cameras	10 t/n	All vertebrate fauna
	Platform and ground Elliot traps	75 t/n	Ground and arboreal mammals
	bait traps	5 t/n	fish and tadpoles
	harp traps	2 t/n	2 t/n
04/05/2016	General fauna surveys and habitat searches	2 hrs	All fauna species
	Diurnal birds (morning)	2 hrs	All avifauna
	Rock rolling and targeted herpetofauna surveys	2 hrs	All herpetofauna
	Spotlighting	16 hrs	All nocturnal fauna
	Stag watching	3 hrs	Arboreal Mammal and birds
	Call playback	3 hrs	Threatened frogs, birds and mammals
	ANABAT detection	2 t/n	Microchiropteran bats
	Streamside surveys / dip netting and spotlighting	2 hr	fish, frogs and tadpoles
	Remote cameras	10 t/n	All vertebrate fauna
	Platform and ground Elliot traps	75 t/n	Ground and arboreal mammals
	bait traps	5 t/n	fish and tadpoles
	harp traps	2 t/n	2 t/n
05/05/2016	General fauna surveys and habitat searches	3 hrs	All fauna species
	Diurnal birds (morning)	2 hrs	All avifauna
	Rock rolling and targeted herpetofauna surveys	3 hrs	All herpetofauna
	Spotlighting	6 hrs	All nocturnal fauna
	Stag watching	2 hrs	Arboreal Mammal and birds
	Call playback	3 hrs	Threatened frogs, birds and mammals
	ANABAT detection	2 t/n	Microchiropteran bats
	Streamside surveys / dip netting and spotlighting	2 hrs	fish, frogs and tadpoles
	Remote cameras	10 t/n	All vertebrate fauna
	Platform and ground Elliot traps	75 t/n	Ground and arboreal mammals
	bait traps	5 t/n	fish and tadpoles
	harp traps	2 t/n	2 t/n
06/05/2016	General fauna surveys and habitat searches	6 hrs	All fauna species
	Diurnal birds (morning)	2 hrs	All avifauna

DATE	METHOD	EFFORT	TARGET SPECIES
	Rock rolling and targeted herpetofauna surveys	2 hrs	All herpetofauna
20/05/2016	Retrieve remote cameras	14 t/n	All vertebrate fauna
	General fauna surveys and habitat searches	5 hrs	All fauna species
April 2018 surveys			
06/04/2016	On site doing flora surveys opportunistic fauna	7 hrs	All fauna species
April 2019 surveys			
03/04/2019	On site doing flora surveys opportunistic fauna	7 hrs	All fauna species
October 2019 surveys			
16/10/2019	On site doing flora surveys opportunistic fauna	7 hrs	All fauna species
18/10/2019	On site doing flora surveys opportunistic fauna	7 hrs	All fauna species
April 2020 surveys			
24/04/20	On site doing flora surveys opportunistic fauna	1 hr	All fauna species

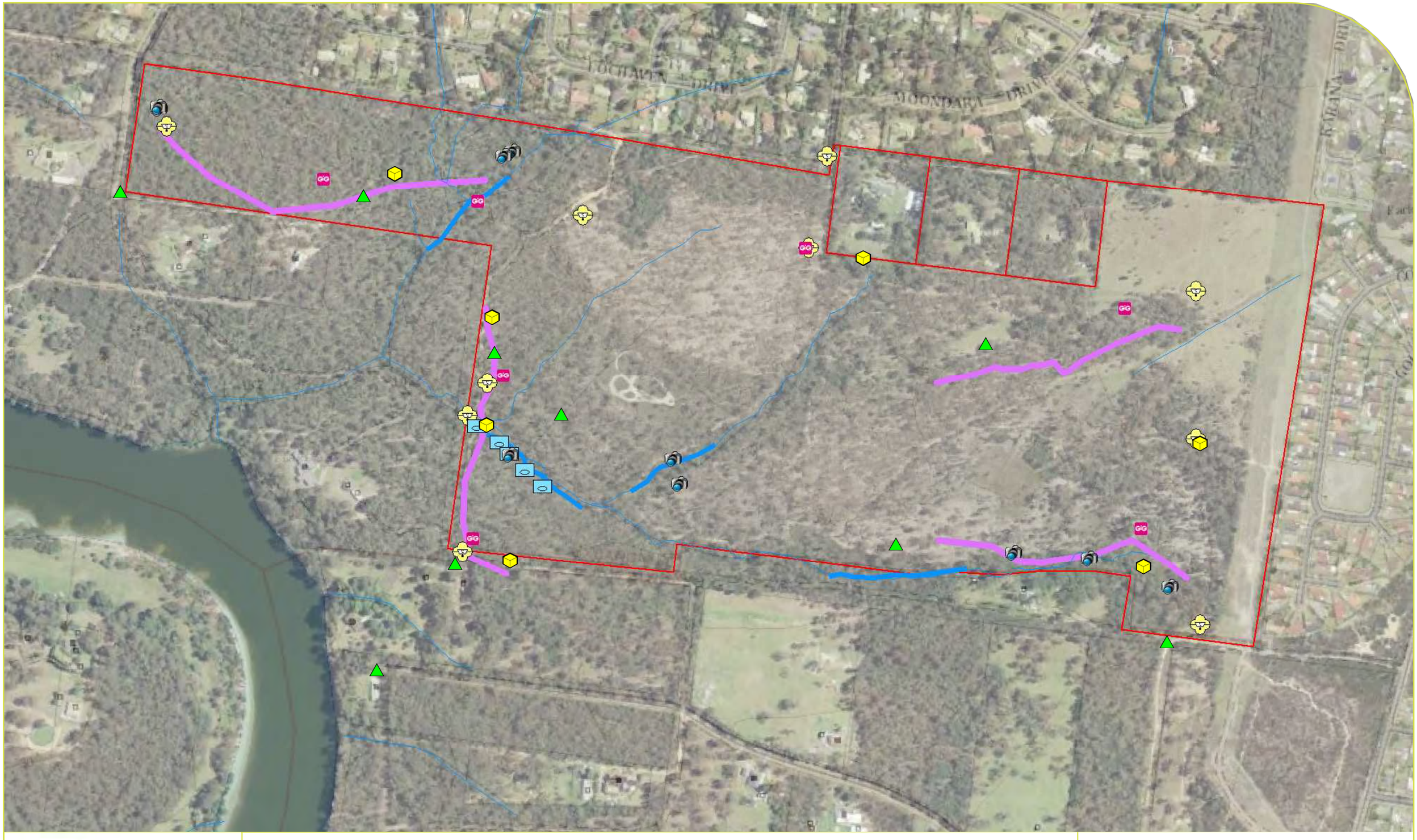


Figure 2-2: Targeted fauna survey effort across the study area.

3. Results

3.1 Resulting Plant Community types

Careful consideration of the previous mapping was used to initially distinguish the vegetation types across the lot (Figure 3-1). Following the collection of detailed plot species lists along with situation, topography and soil type was then used to determine the best fit vegetation type in accordance with the latest vegetation mapping for the site (OMVI 2016). While these vegetation zones used biometric vegetation type for later analysis the Biobanking calculator, PCTs were chosen similarly for this BCAR and input into the BAMC. The initial vegetation typing and its justification are provided in detail in the conservation significance assessment (OMVI 2016). The same assessment details the process of determining the plant communities, including a detailed review of diagnostic species, topography, soil type and extent. The differentiation of vegetation zones was then applied based on these PCTs as well as historical disturbance, current and past management regimes (Figure 3-2). The PCT's and vegetation zoning was reviewed and accepted through an independent review (NGH 2017).

A description of each vegetation zones within the BCA area and retained land is provided below and the distribution of each vegetation zone (see Table 3) is shown in Figure 3-3.

3.1.1 Biodiversity Certification Area

Vegetation Zone D1 - good condition PCT 1082
(Includes D1-21, D1-22, D1-23, and D1-24)

Mapped as Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash and heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin from the BioNet Vegetation Classification database and conforms to PCT 1082. Similar to Shoalhaven Sandstone Forest as mapped and described by Tozer et al (2010) locally (Figure 3-1), PCT 1082 in good condition occurred over approximately 13.67 hectares of the BCAA (Figure 3-3)

The canopy is between 10 and 15 metres and dominated by Hard-leaved Scribbly Gum (*Eucalyptus sclerophylla*), Red Bloodwood (*Corymbia gummifera*) with Grey Gum (*Eucalyptus punctata*) and Sydney Peppermint (*Eucalyptus piperita*) being sub dominants throughout. There is a midstorey of regenerating canopy species and Black She-oak (*Allocasuarina littoralis*) and Old-man Banksia (*Banksia serrata*).

The shrub stratum of the community is variable and ranges from sparse to patches of moderate cover. Generally, the shrub stratum of is 1 to 2 metres and dominated by Common Aotus (*Aotus ericoides*), Hairpin Banksia (*Banksia spinulosa* var *spinulosa*), Needlebush (*Hakea sericea*), Mountain Devil (*Lambertia formosa*), Slender Tea-tree (*Leptospermum trinervium*), Narrow-leaved Geebung (*Persoonia linearis*), Heath Phyllota (*Phyllota phylicoides*) and *Platysace linearifolia*. There are some dense stands of Tick Bush (*Kunzea ambigua*) in the central area and other locations of previous disturbance. The groundcovers are dominated by native grasses, herbs and sedges and species richness is high. Dominant species throughout are Oat Speargrass (*Anisopogon avenaceus*), Curly Wig (*Caustis flexuosa*), *Cyathochaeta diandra*, Bordered Panic (*Entolasia marginata*), Wiry Panic (*Entolasia stricta*), Brown's Lovegrass (*Eragrostis brownii*), Forest Goodenia (*Goodenia hederacea* ssp *hederacea*), Variable Sword-sedge (Lepido*sperma laterale*), Leafy Purple-flag (Patersonia *glabrata*) and Kangaroo Grass (*Themeda triandra*).

source Tozer et al 2010

source OEH biometric 2013 (updated 2019)

SCIVI vegetation types

- Coastal Sand Forest
- Coastal Sandstone Ridgetop Woodland
- Coastal Warm Temperate Rainforest
- Currambene-Batemans Lowlands Forest
- Estuarine Fringe Forest
- Floodplain Swamp Forest
- Illawarra Gully Wet Forest
- Morton Mallee-Heath
- Riverbank Forest
- Shoalhaven Sandstone Forest
- South Coast Lowland Swamp Woodland
- Southern Lowland Wet Forest

Plant Community Type

- Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion
- Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion
- Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
- Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion
- Grey Gum - Blue-leaved Stringybark open forest on gorge slopes, southern Sydney Basin Bioregion and north east South Eastern Highlands Bioregion
- Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion
- Red Bloodwood - Grey Gum shrubby open forest on shale-sandstone interface of the lower Shoalhaven valleys, southern Sydney Basin Bioregion
- Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
- River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion
- Spotted Gum - Blackbutt shrubby open forest on the coastal foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion
- Spotted Gum - Grey Ironbark - Woollybutt grassy open forest on coastal flats, southern Sydney Basin Bioregion and South East Corner Bioregion
- Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion
- Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
- Sydney Peppermint - Spotted Gum - Lilly Pilly wet forest in gullies of the coastal foothills, northern South East Corner Bioregion and southern Sydney Basin Bioregion

OMVI ECOLOGICAL

Legend

- Lot 24
- OEH Estate

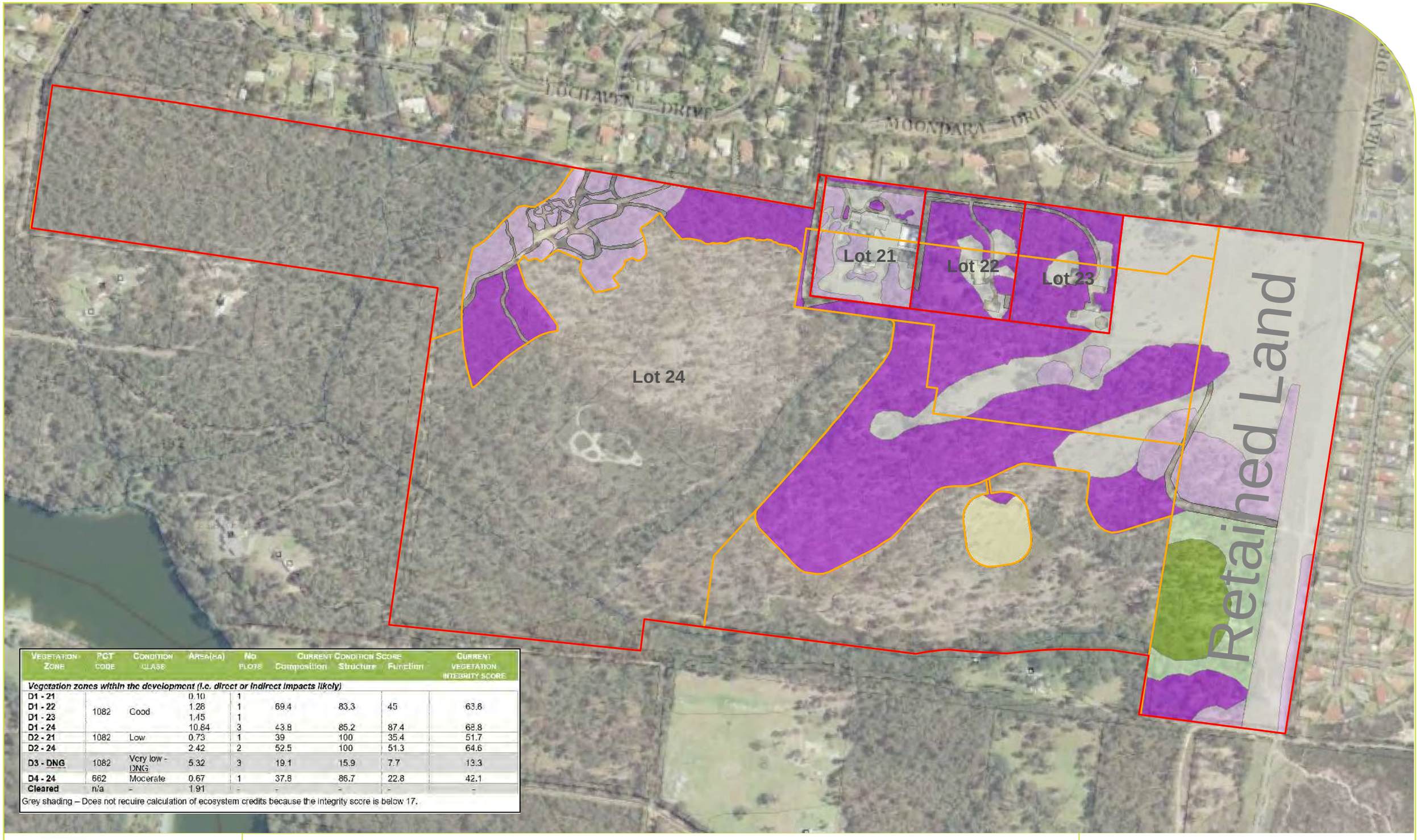
Date: 15/12/2020

Map Projection: Universal Transverse Mercator
Hortizontal Datum: Geodetic Datum of Australia 1994
Map Grid: Map Grid of Australia Zone 56

1:25,000

0 220 440 880 1,320 1,760 Meters

Figure 3-1: Vegetation communities recorded across the locality



Vegetation Zone	PCT code	Condition class	Area(ha)	No plots	Current Condition Score Composition	Structure	Function	Current vegetation integrity score
Vegetation zones within the development (i.e. direct or indirect impacts likely)								
D1 - 21	1082	Good	0.10	1	69.4	83.3	45	63.8
D1 - 22			1.26	1				
D1 - 23			1.45	1				
D1 - 24			10.84	3	43.8	85.2	87.4	68.8
D2 - 21	1082	Low	0.73	1	39	100	35.4	51.7
D2 - 24			2.42	2	52.5	100	51.3	64.6
D3 - DNG	1082	Very low - DNG	5.32	3	19.1	15.9	7.7	13.3
D4 - 24	662	Moderate	0.67	1	37.8	86.7	22.8	42.1
Cleared	n/a	-	1.91	-	-	-	-	-

Grey shading – Does not recuire calculation of ecosystem credits because the integrity score is below 17.

OMVI ECOLOGICAL

Legend

- Study area
- Proposed zone boundaries

Plant Community Type - condition

- 1082 - Good
- 1082 - Low
- 1082 DNG - very low
- 662 - Moderate
- 1079 - Good
- 1206 - Moderate
- Tracks and heavily distrubed

Date: 15/12/2020

Map Projection: Universal Transverse Mercator
Hortizontal Datum: Geodetic Datum of Australia 1994
Map Grid: Map Grid of Australia Zone 56

1:4,500

0 40 80 160 240 320 Meters

Figure 3-2: Plant Community Types recoreded across the Biodiversity Certification Area

Vegetation Zone	PCT code	Condition class	Area (ha)	No plots	Current Condition Score: Composition	Structure	Function	Current Vegetation Integrity Score
Vegetation zones within the development (i.e. direct or indirect impacts likely)								
D1 - 21	1062	Good	0.10	1	69.4	83.3	45	63.8
D1 - 22			1.28	1				
D1 - 23			1.45	1				
D1 - 24			10.84	3	43.8	85.2	87.4	68.8
D2 - 21	1062	Low	0.73	1	39	100	35.4	51.7
D2 - 24			2.42	2	52.5	100	51.3	64.6
D3 - DNG	1062	Very low - DNG	5.32	3	19.1	15.9	7.7	13.3
D4 - 24	662	Moderate	0.67	1	37.8	86.7	22.8	42.1
Cleared	n/a	-	1.91	-	-	-	-	-

Grey shading – Does not require calculation of ecosystem credits because the integrity score is below 17.

OMVI ECOLOGICAL

Legend

Study area

Proposed zoning boundaries

Vegetation Zones

D1 - 21
D1 - 22
D1 - 23
D1 - 24
D2 - 21
D2 - 24
D3 - 21
D3 - 22
D3 - 23
D3 - 24
D4 - 24
no native

Date: 30/03/2021

Map Projection: Universal Transverse Mercator
Hortizontal Datum: Geodetic Datum of Australia 1994
Map Grid: Map Grid of Australia Zone 56

1:4,500

0 40 80 160 240 320 Meters

Figure 3-3: Vegetation Zones across Lots 21, 22, 23 and 24.

Weed species density and species richness is low in this community even in the more disturbed areas. Weed infestation are primarily confined to disturbed edges such as along the services easement, within the existing large lot residential area (lot 21-23) and along the northern edge of Lot 24 as well as the intergrade with very low condition PCT 1082 in vegetation zone D3. The weed suite in the Scribbly-Gum Woodland is mainly composed of exotic perennial grasses and herbs with a minor woody weed infestation in the drainage line below Warrah Road.

Historical and ongoing disturbances have impacted the structure and composition to varying degrees across the other areas in the BCA. There are also numerous tracks, trails and bike tracks. PCT 1082 was graded into relatively homogenous zones, based on similarly of species type and cover as well as the disturbance history in accordance with the BAM.

Vegetation Zone D2 - low condition PCT 1082
(Includes D2-21 and D2-24)

Following detailed analysis of the species present and the likely distribution of vegetation communities' pre-European occupation, through GIS interpretation, much of the eastern grassland along the powerline easement would have conformed to a Scribbly Gum Woodland vegetation type, possibly with slightly higher densities of other associated canopy trees such as *E. punctata and E. pilularis,* given the slightly deeper and more humic soils. The regrowth shrubland, as described in the AHA and Biosis reports suggested floristically this was simply an area disturbed previously through removal of the canopy stratum and now is in a state of regeneration.

Four large refuse piles occur within the lot, three in the eastern portions of the site, and one which was considerably larger on the mid-northern edge of the lot approximately opposite Lochaven Drive (Figure 3-3).

The three mounds in the east were a mixture of building rubble, sandstone boulders and scree as well as soil and other debris. The source of this material is unknown; however, the sandstone appears to be Nowra Sandstone so has most likely been sourced locally. A regenerating canopy of almost solely *E. sclerophylla* occurred across these mounds, with a sparse but diverse shrub and ground layer, which did include more mesic species such as Native peach (*Trema tomentosa*) and Wonga-wonga Vine (*Pandorea pandorana*), Common Silkpod (*Parsonsia straminea*).

The large series of mounds in the mid-north of the lot were mostly comprised of concrete and steel from demolished industrial structures, possibly the old meat works buildings. Weed densities were much higher in this area and the mounds and other material have since become part of an elaborate motor cycle track in this part of the site. Native species occurring conformed mostly to Scribbly Gum Woodland or that community present on top of where this material has been dumped.

The disturbed PCT 1082 in VZ D2 occupied 3.15 hectares combining the mound areas and regenerating shrubland in the east.

Vegetation Zone D3 - very poor condition PCT 1082
(Includes all derived native grassland across the BCAA)

A Closed Grassland dominated by exotic perennial grasses and introduced annual and perennial herbs is present in the north-east and east of the BCAA. The derived grassland was determined to be a very degraded form of the adjacent PCT 1082. This vegetation type covered approximately 5.32 hectares of the BCAA.

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Vegetation Zone D4 - moderate condition PCT 662

Morton Mallee Heath was recorded as a small patch of open sedgeland or shrubland in the east of Lot 24 near the existing farm dam. Another patch of similar vegetation was recorded near the centre of Lot 24, which has also become an extension of the motorbike track to the north, presumably because of the open heath vegetation type, with no trees.

Morton Mallee Heath as described by Tozer et al (2010), is most similar to Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin or PCT 662. The patches of this vegetation type covered approximately 2.6 hectares of the entire study area.

The disturbed PCT 662 in VZ D4, covers approximately 0.67 hectares and is the site proposed for a building envelope and 35 metre asset protection zone for the eastern BSA lot (Figure 3-3).

3.1.2 Plant Community Type Integrity Scores

After entering all the recorded plot attributes from across the study area, and subject site, the BAMC has summarised the vegetation integrity scores of each vegetation zone across the study area (Table 6). The integrity scores then derive the credits required to offset this development proposal under BOS (BC Act).

Table 6: Resulting vegetation integrity scores (as calculated in the BAMC).

Vegetation Zone	PCT code	Condition class	Area(ha)	No plots	Current Condition Score			Current vegetation integrity score
					Composition	Structure	Function	
Vegetation zones within the development (i.e., direct or indirect impacts likely)								
D1 - 21	1082	Good	0.10	1	69.4	83.3	45	63.8
D1 - 22			1.28	1				
D1 - 23			1.45	1				
D1 - 24			10.84	3	43.8	85.2	87.4	68.8
D2 - 21	1082	Low	0.73	1	39	100	35.4	51.7
D2 - 24			2.42	2	52.5	100	51.3	64.6
D3 - DNG	1082	Very low - DNG	5.32	3	19.1	15.9	7.7	13.3
D4 - 24	662	Moderate	0.67	1	37.8	86.7	22.8	42.1
Cleared	n/a	-	1.91	-	-	-	-	-

Grey shading – Does not require calculation of ecosystem credits because the integrity score is below 17.

3.1.3 Vegetation zones

Seven (7) vegetation zones were derived for the Biodiversity Certification Assessment Area (see Table 6 and Figure 3-3). Each one was derived as separate units based on the vegetation type and condition as well as the proposed outcome under the current residential development proposal as well as being separated by lot (Table 6).

3.1.4 Use of local data

Use of local data is not proposed.

3.1.5 Threatened Ecological Communities

The *BC Act* and *EPBC Act* provide for the listing of Threatened Ecological Communities (TEC). Eighteen (18) TECs are listed within Nowra-Bomaderry district and surrounding Shoalhaven LGA (BioNet, Tozer *et al.* 2010, OEH 2014) which are of potential relevance to the current locality. No TEC has been or was recorded in the study area or BCA area.

3.2 Flora

Targeted surveys were conducted for all potentially threatened and rare flora species across the study area between 2011 and 2020, with varying effort for each taxon, depending on the objectives of the given study. Table 7 highlights the survey type and effort undertaken and result for all flora species across the BCA area and the entire study area.

From all surveys conducted to date four threatened species have been recorded across the study area. Three, within the BCA area: Wallangarra White-gum Magenta Lilly Pilly and Wollemi Pine, were all recorded as planted specimens in existing gardens on Lot 22 and 23. The fourth, the Brittle Midge Orchid was recorded outside the BCAA (Figure 3-4).

3.2.1 Species credits species

There are four predicted species credit species: Albatross Mallee (*Eucalyptus langleyi*), Bauer's Midge Orchid (*Genoplesium baueri*), *Hibbertia stricta* subsp. *furcatula*, Nowra Heath Myrtle (*Triplarina nowraensis*). An additional three (3) threatened species were recorded as planted specimens: Wallangarra White Gum (*Eucalyptus scoparia*), Magenta Lilly Pilly (*Syzygium paniculatum*) and Wollemi Pine (*Wollemia nobilis*) (Figure 3-4).

Surveys conducted across the study area, did not record any the Albatross Mallee, *Hibbertia stricta* subsp. *furcatula* or the Nowra Heath Myrtle. An assessment for any potentially occurring threatened plants are summarised in Table 2. Surveys for all threatened flora were conducted in accordance with the timing and methods stipulated in TBPDC, surveys guidelines and BAM.

Given the absence of naturally occurring candidate flora species, none have been included for credit calculation for the BCAA.

Brittle Midge Orchid (*Genoplesium baueri*)

Surveys have been conducted for this species by both AHA (2008) and Biosis (2010) as part of their respective assessments and the property has been examined in previous years, specifically for this species by local orchids experts, Alan Stephenson and Terry Barrett in 2014 (Alan Stephenson *pers. comm.*) during the local flowering period. No individuals were found during any of the previous surveys

There is one record from the Atlas of wildlife for this species from 2006 which is recorded within Lot 24, the location which was closely examined during the recent surveys failed to locate an individual. Surveys during the flowering period in March/April 2016 recorded seven individuals (seven flowers) along a central creek within the three proposed BSA lots. Follow-up surveys for these populations recorded seven individuals in April 2020 from the same location and none from the BioNet Atlas location.

No individuals were recorded in the BCA area, therefore are not included in the candidate species credit calculation for this BCAR. The orchid will be included in the proposed central BSA lot credit calculations.

Wallangarra White Gum (*Eucalyptus scoparia*)

Occurs in Queensland and reaches its southern limit in NSW. In NSW, it is known from only three locations near Tenterfield, including Bald Rock National Park. The species is found in open eucalypt forest and woodland on well-drained granite hilltops, slopes and rocky outcrops.

Widely planted across NSW as a landscaping species, 10 individuals were recorded planted along the entry road to the existing dwelling in lot 22 (Figure 3-4). The BCAA is outside the known natural distribution and the species and therefore the BCA will not adversely affect the lifecycle of a natural population of the species. Further, the Wallangarra White Gum is an SAII entity, should the BCA and future development of this area for residential purposes, the loss of these individuals will not impact a natural population of this species. The loss of a planted individuals of unknown provenance outside the natural distribution is not inconsistent with documented recovery planning or threatened abatement.

It was therefore not included in species credit calculations.

Magenta Lilly Pilly (*Syzygium paniculatum*)

The Magenta Lilly Pilly is a widely cultivated species available as an ornamental and garden plant but is endemic to NSW. Occurring on the South Coast, Central Coast and North Coast in the Great Lakes, Dungog, Lake Macquarie, Wyong, Gosford, Canterbury, Sutherland and Shoalhaven LGAs. The south coast populations of the species are a disjunct occurrence, with no records between Towra Point and Jervis Bay (Mills 1996).

Mills and Jakeman (2010) comments that this species "…*is rare on the South Coast, where it has a very patchy distribution: the species occurs in widely scattered locations, usually in small stands of littoral rainforest*." AHA (2010) mapped patches of littoral rainforest in various parts of Jervis Bay, including Vincentia and Hyams beach.

No rainforest occurs in or near the study area and the main indicator species of rainforest PCTs were absent. One planted cultivar was recorded during the surveys. This individual is not a naturally occurring specimen therefore the proposed BCA will not adversely affect the lifecycle of a natural population of the species.

The Magenta Lilly Pilly was therefore not included in species credit calculations.

Wollemi Pine (*Wollemia nobilis*)

The specimen observed as a planted likely to be sourced from either the Royal Botanic Gardens, Queensland Forestry Research Institutes or the Birkdale Nursery in Queensland. A critically endangered species known to naturally occur within a 4km radius west of Sydney, there are now several hundred thousand clones planted across Australia and internationally. The BCAA is outside the known natural distribution and the species and therefore the BCA will not adversely affect the lifecycle of a natural population of the species. Further, the Wollemi Pine is an SAII entity, should the BCA and future development of area for residential purposes result in the loss of this clone, it will not impact a natural population of this species. The loss of a planted individual, outside the natural distribution is not inconsistent with documented recovery planning or threatened abatement.

It was therefore not included in species credit calculations.

3.2.2 Other species unlikely to occur

There is a range of other threatened species that rely on conditions not present in the subject site such as coastal saltmarsh, large open water and sedge lands, hanging swamps, waterfalls or marine habitats. These species are considered highly unlikely to occur due the complete absence of suitable habitat.

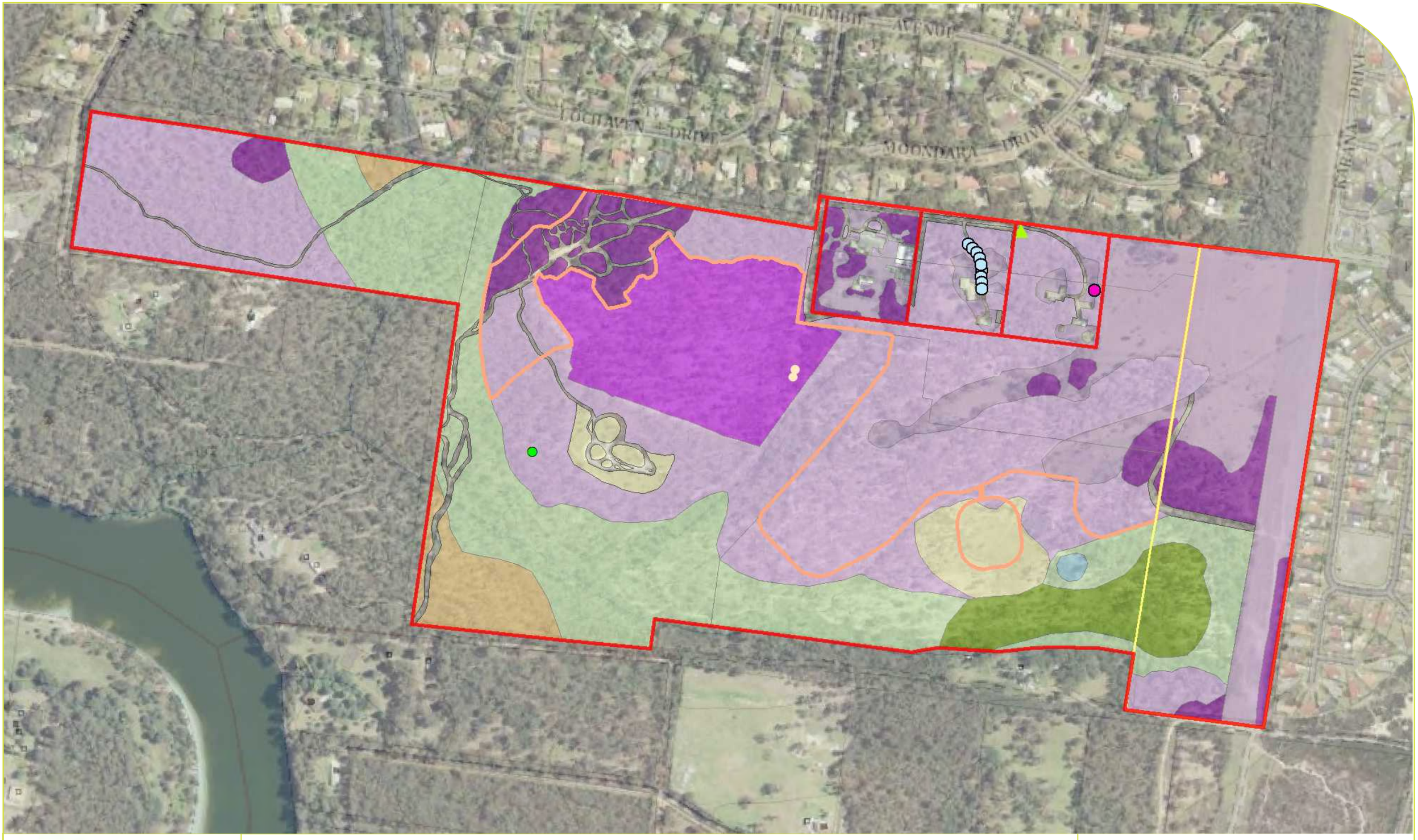

Figure 3-4: Conservation dependant flora recorded in the study area.

3.2.3 Use of local data

The use of local data is not proposed.

3.2.4 Expert reports

Expert reports have not been used as part of this BCAR.

3.2.5 Fauna

A total of one hundred and seventy-nine (179) terrestrial vertebrate species have been recorded across the study area over all surveys since 2007, one hundred and thirty-nine (139) of these were recorded during the current surveys. Species recorded in the cumulative list were comprised of: one hundred and three (103) birds, four of which were introduced species; forty-nine (49) mammals, twenty-two (22) of which were microchiropteran bats; fourteen (14) amphibians, ten (10) reptiles and three (3) fish (see Table 25).

Amphibians

Fourteen (14) relatively common amphibian species have been recorded, with varying degrees of certainty across the lot (locality) during all survey periods. See Table 25 for the full list of species and which study each was recorded. A number of these species, such as the Eastern Froglet (*Crinia signifera*), Striped Marsh Frog (*Limnodynastes peronii*) and Peron's Tree Frog (*Litoria peronii*), are thought to be relatively common and widespread being often recorded in a wide variety of habitats throughout eastern NSW. However, species such as the Bibron's Toadlet (*Pseudophryne bibronii*) and Great Barred Frog (*Mixophyes fasciolatus)* are dependent on specific habitats with less anthropogenic disturbance such as along the southern and central creeklines. Haswell's Froglet (*Paracrinia haswellii*) were similarly recorded in the drainage lines of the study area and appeared to be relatively common.

Reptiles

Nine (9) reptile species were recorded in the study area, the Dark-flecked Garden Skink (*Lampropholis delicata*), was recorded amongst leaf litter across the study area, a single Jacky Lizard (*Amphibolurus muricatus*) and Copper-tailed Skink (*Ctenotus taeniolatus*) were recorded in the eastern sandstone outcropping and several Eastern Water Skinks (*Eulamprus quoyii*) were recorded along the unformed roads to the north and east of the subject site. Lace monitors (*Varanus varius*) were recorded on site and in the neighbouring residential properties. No threatened reptiles or evidence of their presence has been recorded across the site during the current or previous surveys. See Table 25 for the full list of species and which study each was recorded.

Birds

The bird diversity across the study area was moderate considering the timing and length of the surveys. This is likely to be a result of the proximity to the local national parks estate and the Shoalhaven River. A total of one hundred and three (103) species have been recorded with varying degrees of certainty across the study area and locality.

The generic nectivorous species recorded included wattlebirds, honeyeaters, spinebills and parrots. Dedicated insectivorous species included Thornbills, Pardalotes, Whistlers and Thrushes. Introduced species occupying the weed and edge effected habitats across the site include the Common Starling (*Sturnus vulgaris*), Blackbird (*Turdus merula*) and Common Myna (*Acridotheres tristis*).

Predatory bird species, such as the Kookaburra (*Dacelo novaeguineae*), Australian Magpie (*Gymnorhina tibicen*) and Australia Raven (*Corvus coronoides*) were recorded searching for prey from vantage points of the forested vegetation of the study area. While several raptors and Southern Boobooks were recorded in the study area during the various surveys, no nest for birds of prey were recorded. The Squaretail kite (*Lophoictinia isura*) was recorded foraging over the northern edge and surrounding residential lots of Bangalee/north Nowra in May 2016 and again in 2019. The Squaretail Kite is listed as vulnerable on the BC Act. Other threatened bird species recorded throughout the surveys included: Glossy Black-cockatoo (*Calyptorhynchus lathami*); Gang-gang Cockatoo (*Callocephalon fimbriatum*) and Varied Sittella (*Daphoenositta chrysoptera*). See Table 25 for the full list of species and which study each was recorded.

Mammals

A total of forty-nine (49) mammals were recorded across the study area during the current and previous surveys, with varying degrees of certainty. Apart from the grazing cattle, seven (7) were introduced species. There were forty-one (41) native mammal species, including twenty-two (22) microchiropteran bat species (Table 25).

One megachiropteran Bat, the Grey-headed Flying Fox, has been previously recorded in the locality (Figure 10-2) and was recorded flying above the study area during the site surveys. The Grey-headed Flying Fox is listed as a vulnerable species under both the BC Act and the Commonwealth EPBC Act. This species feeds on a variety of fruiting and flowering plants, including the fruits of native figs and palms and the blossoms of eucalypts, angophoras, tea-trees and banksias. Grey-headed Flying Foxes roost in large camps which are commonly located in vegetation with a dense canopy in gullies in close proximity to water. The flowering eucalypts and other trees of the lots and within the adjacent properties are likely to provide foraging for this species, as it was recorded feeding on in the reference sites, periodically when the species is present (seasonal annual migrant to the Nowra/Bomaderry area) and resources are available. The subject site does not contain a known camp site for this species and only limited potential foraging. A nearby seasonal camp occurs in Bomaderry Regional Park to the west of the study area.

Seventeen (17) threatened mammals have been recorded in the locality during the current of past surveys, with varying degrees of certainty. Including: The Eastern Pygmy Possum (*Cercartetus nanus*); Yellow-bellied Glider (*Petaurus australis*); Squirrel Glider (*Petaurus norfolcensis*); Grey-headed Flying Fox (*Pteropus poliocephalus*); and nine (9) threatened microchiropteran bats. It should be noted that the Squirrel Glider, Yellow-bellied Sheathtail Bat and Little Bent-wing Bat have not been recorded despite targeted surveys since 2007.

3.2.6 Ecosystem credit species

There are several predicted threatened species from the BAM calculator (Table 7) for PCT 1082 and PCT 662. Given the vegetation integrity score for all the derived grassland across the site was below 17 no ecosystem credits calculations are required and therefore no ecosystem species credits are included.

There are a number of known locally occurring species that also have the potential have the potential to occur if only transiently and that were not predicted on PCT presence alone. Please refer to the (Appendix C) for the results of assessing habitat suitability for species in relation to the Threatened Biodiversity Data Collection, local data sources, other published and un-published documents as well as from the assessors own qualified determination based on habitat availably/suitability.

Of the seventy (70) threatened species known from the locality twelve (12) were possibly recorded in the study area (Table 7) and eleven (11) have the potential to occur if only transiently, due to its known distribution within the North Nowra, Bangalee area. The remaining forty-seven (47) are either marine,

pelagic species or species that have habitat requirements that do not occur on or nearby the study area or were simply not recorded during the targeted surveys and/or no suitable habitat was present.

Table 7: Predicted and potential threatened fauna species, predicted based on PCTs present. No dedicated surveys are required for these species.

Species	Conservation status	Sensitivity to gain class	Justification for inclusion or exclusion of species	Associated Vegetation zone	Area of Habitat impacted
Included in assessment for ecosystem credits					
Little Eagle	Vulnerable	Moderate Sensitivity	assumed present	Zone D1, D2 & D4 (combined)	17.49 ha
Square-tailed Kite (foraging)	Vulnerable	Moderate Sensitivity	recorded	Zone D1, D2 & D4 (combined)	17.49 ha
Glossy Black-Cockatoo (foraging)	Vulnerable	High Sensitivity	recorded	Zone D1, D2 & D4 (combined)	17.49 ha
Gang-gang Cockatoo (Foraging)	Vulnerable	Moderate Sensitivity	recorded	Zone D1, D2 & D4 (combined)	17.49 ha
Little Lorikeet (foraging)	Vulnerable	High Sensitivity	recorded	Zone D1, D2 & D4 (combined)	17.49 ha
Swift Parrot	Endangered	Moderate Sensitivity	recorded	Zone D1, D2 & D4 (combined)	17.49 ha
Barking Owl (foraging)	Vulnerable	Moderate	assumed present	Zone D1, D2 & D4 (combined)	17.49 ha
Powerful Owl	Vulnerable	High Sensitivity	Known from neighbouring area.	Zone D1, D2 & D4 (combined)	17.49 ha
Masked Owl (foraging)	Vulnerable	High Sensitivity	assumed present	Zone D1, D2 & D4 (combined)	17.49 ha
Regent Honeyeater (foraging)	Critically Endangered	High Sensitivity	assumed present	Zone D1, D2 & D4 (combined)	17.49 ha
Varied Sittella	Vulnerable	Moderate Sensitivity	recorded	Zone D1, D2 & D4 (combined)	17.49 ha
Dusky Woodswallow	Vulnerable	Moderate Sensitivity	assumed present	Zone D1, D2 & D4 (combined)	17.49 ha
Scarlet Robin	Vulnerable	Moderate	assumed present	Zone D1, D2 & D4 (combined)	17.49 ha
Flame Robin	Vulnerable	Moderate	assumed present	Zone D1, D2 & D4 (combined)	17.49 ha
Greater Broad-nosed Bat (foraging)	Vulnerable	High Sensitivity	Possibly recorded via ANABAT. Assumed present.	Zone D1, D2 & D4 (combined)	17.49 ha
Eastern Coastal Freetail-bat	Vulnerable	High Sensitivity	Possibly recorded via ANABAT. Assumed present.	Zone D1, D2 & D4 (combined)	17.49 ha
Little Bent-winged bat (foraging)	Vulnerable	High Sensitivity	assumed present	Zone D1, D2 & D4 (combined)	17.49 ha
Large Bent-winged Bat (foraging)	Vulnerable	High Sensitivity	Possibly recorded via ANABAT. Assumed present.	Zone D1, D2 & D4 (combined)	17.49 ha
Eastern False Pipistrelle (foraging)	Vulnerable	High Sensitivity	Possibly recorded via ANABAT. Assumed present.	Zone D1, D2 & D4 (combined)	17.49 ha
Yellow-bellied Sheathtail-bat	Vulnerable	High Sensitivity	assumed present	Zone D1, D2 & D4 (combined)	17.49 ha
Grey-headed Flying-fox (foraging)	Vulnerable	High Sensitivity	recorded	Zone D1, D2 & D4 (combined)	17.49 ha
Yellow-bellied Glider	Vulnerable	High Sensitivity	assumed present	Zone D1, D2 & D4 (combined)	17.49 ha
Spotted-tailed Quoll	Vulnerable	High Sensitivity	assumed present	Zone D1, D2 & D4 (combined)	17.49 ha
Excluded from credit calculations					
Broad-headed Snake (foraging)	Endangered	High	Not recorded by any means during surveys.	n/a	n/a
Rosenberg's Goanna	Vulnerable	Moderate	Not recorded by any means during surveys.	n/a	n/a
Turquoise Parrot	Vulnerable	High	Not recorded by any means during surveys.	n/a	n/a
Olive Whistler	Vulnerable	Moderate	Not recorded by any means during surveys.	n/a	n/a
Long-nosed Potoroo			Not recorded by any means during surveys.	n/a	n/a
Greater Glider	EP	High Sensitivity	Outside of EP geographic area and not recorded in the BCAA	n/a	n/a
Koala (foraging)	Vulnerable	High Sensitivity	Not recorded by any means during surveys.	n/a	n/a

Shaded rows – species either recorded on site or assumed present.

3.2.7 Species credit species (Candidate Species)

Detailed targeted seasonal surveys, conducted from 2015 till 2020 form the basis of the inclusion of candidate species (see Figure 3-5 for threatened species recorded) but the assumption of presence or absence is also based on the absence of necessary habitat components or habitat constraints, in accordance with BAM sections 6.4.1.10 and 6.4.1.17. Surveys for candidate fauna species were conducted in accordance with the timing and methods stipulated in *TBPDC* and surveys guidelines and BAM. For those species that have been excluded, the justification is also provided below and summarised in Table 8. Where species not predicted by a PCT have been included in Ecosystem credit calculations, the same species haves also been included as a candidate species or species credits species (where applicable).

Glossy Black-cockatoo

In the Shoalhaven their distribution is widespread but occurs primarily on the coastal plain where stands of the feed tree Black Oak (*Allocasuarina littoralis*) occurs. The species is largely absent from rainforest, tall open forest and heathland. In the Tapitallee area Glossy Black Cockatoos feed on Black Oaks beside Illaroo Rd, Bangalee Reserve and the Budgong area (Daly 2012); the formed road verges throughout the Bangalee and North Nowra area as well as being frequently seen in the mature Allocasuarina surrounding the North Nowra Water Tank on the corner of Pitt Road (OMVI 2012, B. Ryan *pers obs*.). Little is known about the population size within the Shoalhaven or locality but a number of breeding locations for this species have been documented (e.g., Blackers et al 1984; Barrent et al 2004, GHD 2006, OMVI 2012, Ted *pers. comm*. from Daly 2012).

A regular water source is also considered to be important for most local groups, where preferred those water sources are visited regularly in the morning before foraging and in the evening following forging activity. A near-permanent pool in a small creek west of Gypsy Point road is a known local water hole for resident birds and is within a conservation area, established as part of a residential development off Tallimba Road. At least one pair of Cockatoos, are regularly seen in this area (west of Gypsy Pt Road) and studies targeting the movement and likely breeding and roost site for this pair (OMVI 2012) determined that the nest tree was within or adjacent to Bangalee Scout Camp to the west. Roosting was also recorded in the same study along the Shoalhaven River on Lot 4 at Gypsy Point.

These records are likely to represent individuals from the wider Nowra 'population' which considering the extent of suitable habitat across the Shoalhaven and the relative connectivity of this habitat, they are likely to be individuals of a much wider population across the South Coast region (Figure 10-2).

While all the vegetation communities recorded in the study area support a midstorey of She-oaks, the historical disturbance throughout the study area, from past activities such as grazing, under-scrubbing, has reduced the amount of mature She-oaks present. However, one of the greatest impacts to this foraging resource across the lot has been fire. As recorded in the previous assessments in the locality (AHA 2008) bush fires had had a large impact on foraging resources for this species. As a consequence of recent fires, a large percentage of the site now does not support mature She-oaks, suitable or preferred by Glossy Black-Cockatoos. Only areas not affected by the fires, such as the ecotone between the two main vegetation types in the study area appear to support the mature trees with observed foraging (Figure 3-6). It is also apparent that foraging resources exist on vegetated lands in the surrounding forested and peri-urban landscape, as evidence of foraging as well as sightings of individuals resulted from other local surveys (OMVI 2012, NGH 2012) and from targeted surveys of the local street verges in the current surveys (Figure 3-6).

The targeted surveys over successive years within the study area (2007-2020) have recorded individuals on one occasion (2019), the site appears to be used only semi-regular foraging expeditions (few orts records – see Figure 3-6.).

Table 8: Candidate threatened fauna species (Species credits) included and excluded from assessment.

SPECIES	CONSERVATION STATUS	SENSITIVITY TO GAIN CLASS	HABITAT CONSTRAINTS / GEOGRAPHIC LIMITATIONS OCCURRING?	SURVEY	RECORDED IN BCAA	JUSTIFICATION FOR INCLUSION OR EXCLUSION OF SPECIES	ASSOCIATED VEGETATION ZONE (AREA)
Included in assessment for species credits (Confirmed candidate species).							
Eastern Pygmy Possum	Vulnerable	High Sensitivity	-	See table 5	NO	Assumed present in all forested PCT 1082 with intact midstorey	All of VZs D1 and D4 (14.34 ha)
Southern Myotis	Vulnerable	Moderate (foraging) High (breeding)	Hollow bearing trees Pat of the site is within 200 m of riparian zone No bridges, caves or artificial structures within 200 m of riparian zone	See table 5	NO	No breeding habitat present. Foraging habitat with 200m of open water does occur.	2.40 ha of VZ D1 – 24; 0.31 ha of VZ D2-24 and all of VZ D4 (0.67 ha)
Eastern Cave Bat	Vulnerable	Moderate (foraging) Very High (breeding)	Is within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels or adits	See table 5	NO	All of BCAA is within 2km of potential roost caves. No breeding habitat present.	All of VZ D1, D2, D3 & D4 (22.81 ha)
Large-eared Pied Bat	Vulnerable	Moderate (foraging) Very High (breeding)	Is within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels or adits	See table 5	NO	All of BCAA is within 2km of potential roost caves. No breeding habitat present.	All of VZ D1, D2, D3 & D4 (22.81 ha)
Excluded from assessment for species credits							
Regent Honeyeater (Breeding)	Critically Endangered	High Sensitivity	-	See table 5	NO	Not recorded during targeted surveys	-
Green and Golden Bell Frog	Endangered	High Sensitivity	Site does not have semi-permanent/ephemeral wet areas. Is within 1km of wet areas or Swamps as is within 1km of swamp or waterbodies.	See table 5	NO	The species was not recorded on or near the study area.	-.
Red-crowned Toadlet	Vulnerable	Moderate sensitivity		See table 5	NO	No small order streams with suitable sandstone gullies present, not recorded during surveys.	-
Gang-gang Cockatoo (Breeding)	Vulnerable	High Sensitivity	-	See table 5	YES (foraging)	Not recorded during the breeding season. Not recorded foraging in the BCAA. No breeding habitat present.	-
Glossy Black-Cockatoo (Breeding)	Vulnerable	High Sensitivity	-	See table 5	YES (foraging)	Detailed surveys across the study area did not record any breeding habitat.	-
Masked Owl (Breeding)	Vulnerable	High Sensitivity	-	See table 5	NO	Species not recorded during seasonal surveys. No evidence of owl roosting or breeding recorded.	-
Powerful Owl (Breeding)	Vulnerable	High Sensitivity	-	See table 5	NO	Known breeding hollow in locality (territorial species). Species not recorded during seasonal surveys. No evidence of owl roosting or breeding recorded.	-
Swift Parrot (Breeding)	Endangered	Moderate Sensitivity	-	See table 5	YES (foraging)	No breeding habitat available. Species does not breed in the BCAA.	-

Species	Conservation status	Sensitivity to gain class	Habitat constraints / geographic limitations occurring?	Survey	recorded in BCAA	Justification for inclusion or exclusion of species	Associated Vegetation zone (area)
Square-tailed Kite (Breeding)	Vulnerable	Moderate Sensitivity	-	See table 5	YES (foraging)	No stick nests recorded in the study area during repeated surveys. None recorded in locality. N breeding habitat present.	-
Little Eagle (Breeding)	Vulnerable	Moderate Sensitivity	-	See table 5	NO	No stick nests recorded in the study area during repeated surveys. None recorded in locality.	-
Pink Robin	Vulnerable	High Sensitivity	-	See table 5	NO	Species not recorded during surveys; Site to degraded to provide habitat for species.	-
Squirrel Glider	Vulnerable	High Sensitivity	-	See table 5	NO	Species not recorded during surveys, despite previous records. Detailed surveys conducted highlight the possible mis-identification in these previous studies. Species not present.	-
Koala (Breeding)	Vulnerable	High Sensitivity	-	See table 5	NO	No evidence of species recorded during surveys. Species not present.	-
Eastern Bentwing-bat (Breeding)	Vulnerable	Very High Sensitivity	-	See table 5		No caves, hollows or other suitable roosting present on or within 200m of the subject site. 150km from nearest known breeding cave.	-
Little Bentwing-bat (breeding)	Vulnerable	High Sensitivity	-	See table 5	NO	No caves, hollows or other suitable roosting present on or within 200m of the subject site. 150km from nearest known breeding cave.	-
Grey-headed Flying-fox (Breeding)	Vulnerable	High Sensitivity	-	See table 5	YES (foraging)	Foraging habitat present. No camps on site. No other suitable breeding habitat present	-
Additional species not predicted but known from the locality (all excluded from credit calculations based on the absence of habitat in the development area)							
Eastern Osprey (breeding)	Vulnerable	Moderate Sensitivity	-	See table 5	NO	Site to degraded to provide habitat for species.	-.
White-bellied Sea-eagle (breeding)	Vulnerable	High Sensitivity		See table 5	NO	No foraging present in the subject site. No nests observed on or near study area. Not overserved during surveys, No breeding habitat present	-

Shaded rows – species either recorded on site or assumed present.

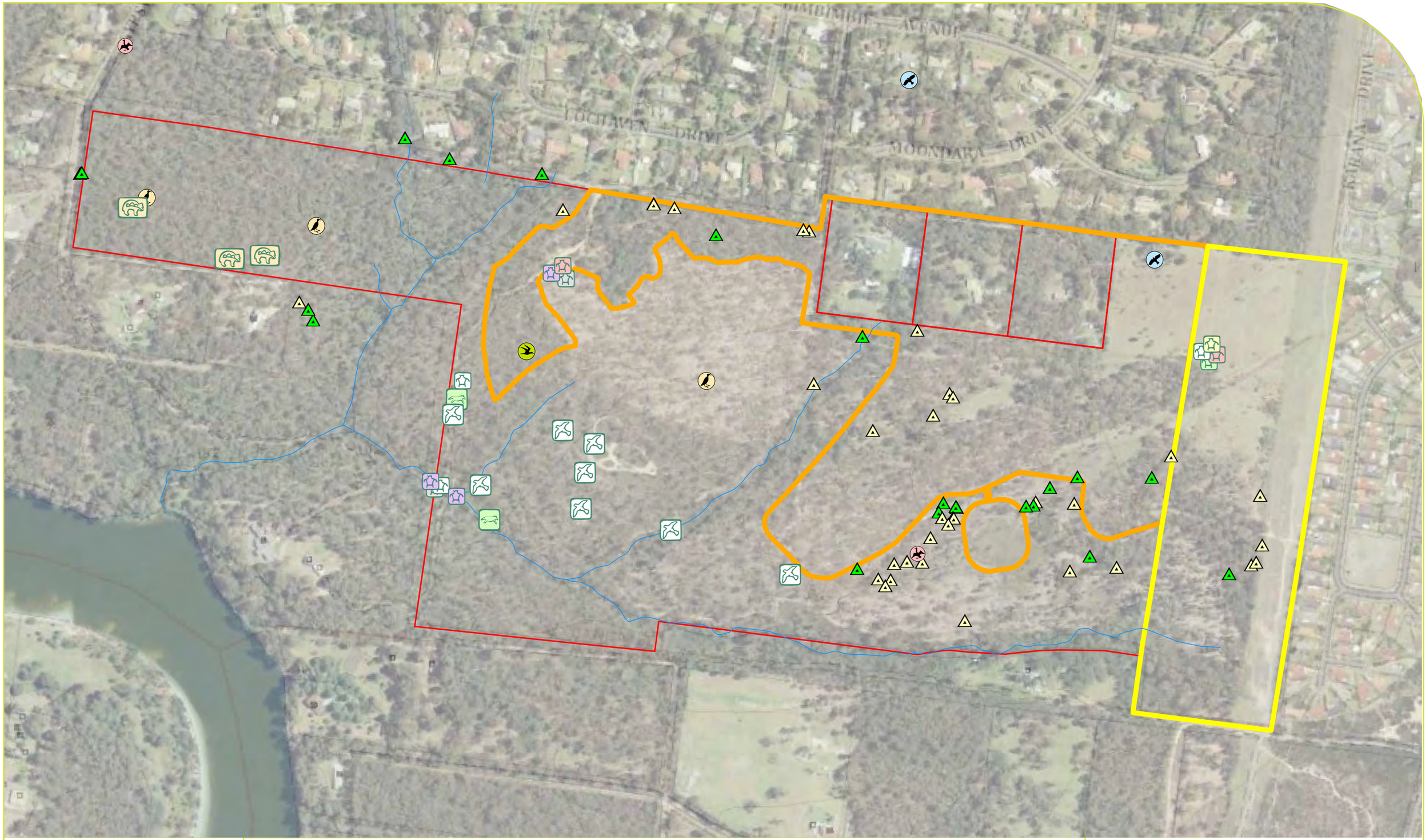

Figure 3-5: Threatehed fauna recorded across the study area.

The study area is therefore likely to be a part of a larger home range of some locally occurring individuals. Possibly the pair targeted during moment studies in 2011/12 (OMVI 2012)

Moreover, given the absence of foraging evidence on the site during the past surveys (AHA 2008, Biosis 2010, OMVI 2011 and NGH 2015) the suitability of the foraging resources is improving post fire. Given the last major impacting fire was 2003, the subsequent 17 years has seen the extent and maturity of the Allocasuarina increase which has also seemingly resulted in an increase of Glossy Black-cockatoo activity across the study area.

During the targeted Glossy Black-cockatoo foraging surveys in November 2015, more than 55 trees were recorded with evidence of Glossy Black-cockatoo activity in the study area and in adjacent lots and crown land. 21 were recorded as active foraging and 34 were recorded as being investigative sampling of the cones only (Table 9). Three trees were recorded as having been visited more than a single time. The trees recorded with orts were given an age category and the ages recorded suggest that an individual or individuals frequent the site, at least infrequently.

Table 9: Summary Glossy Black-cockatoo foraging evidence recorded across the study area

Ort category	Ort Age category				Total
	>1mth + >6mths	>1mth	> 3mth	> 6mth	
foraging	2	6	5	8	**21**
Investigation	1	11	8	14	**34**
Total	**3**	**17**	**13**	**22**	**55**

The largest fruit bearing trees were recorded on the boundary of Lot 24 were in the paper road easement along the northern boundary, in the Powerline easement in the south-east corner of the lot as well as in the neighbouring properties and the road verges in the surrounding residential areas (Figure 3-6).

It is therefore evident that the resources for Glossy Black-cockatoo, while currently are not regularly used, are becoming a part of the foraging resources for locally occurring cockatoos and over time will become more important for certain individuals. However, currently the majority of the study area represents marginal foraging habitat, with some secondary habitat with mature Allocasuarina present, which is irregularly used.

Individuals are known to regularly visit foraging, and watering habitat immediately west of Gypsy Point road and individuals are regularly observed in Bomaderry Creek area, and adjacent residential lands supporting Allocasuarina, such as the North Nowra water tank. Orts were recorded along Crams road in the AHA (2007) surveys as well as during the current investigations, therefore there is likely to be another family group or pair south of the site. Given the ability of the species to forage widely in any given environment, any of these known groups could be responsible for the orts recorded locally.

Given the number of re-visits and the sparse scattering across the lot and the general number seen beneath any given tree (Table 9), it appears that the site is not frequently used but is a part of an extended foraging range of one or two birds. It is unlikely to represent breeding habitat.

While there was very little foraging evidence in the BCAA, the Glossy Black Cockatoo (a dual credit species) was assumed to be present across the forested portions and included in the ecosystem credit calculations. Given the absence of any breeding activity (pairs observed during breeding, fledglings or any nesting behaviour) and that individuals were only seen on one occasion (October 2019) despite many hours of survey across the study area, it highly unlikely that the BCAA represent breeding habitat for the Glossy Black-cockatoo. As such the Glossy Black-cockatoo was not included in species credit calculations.

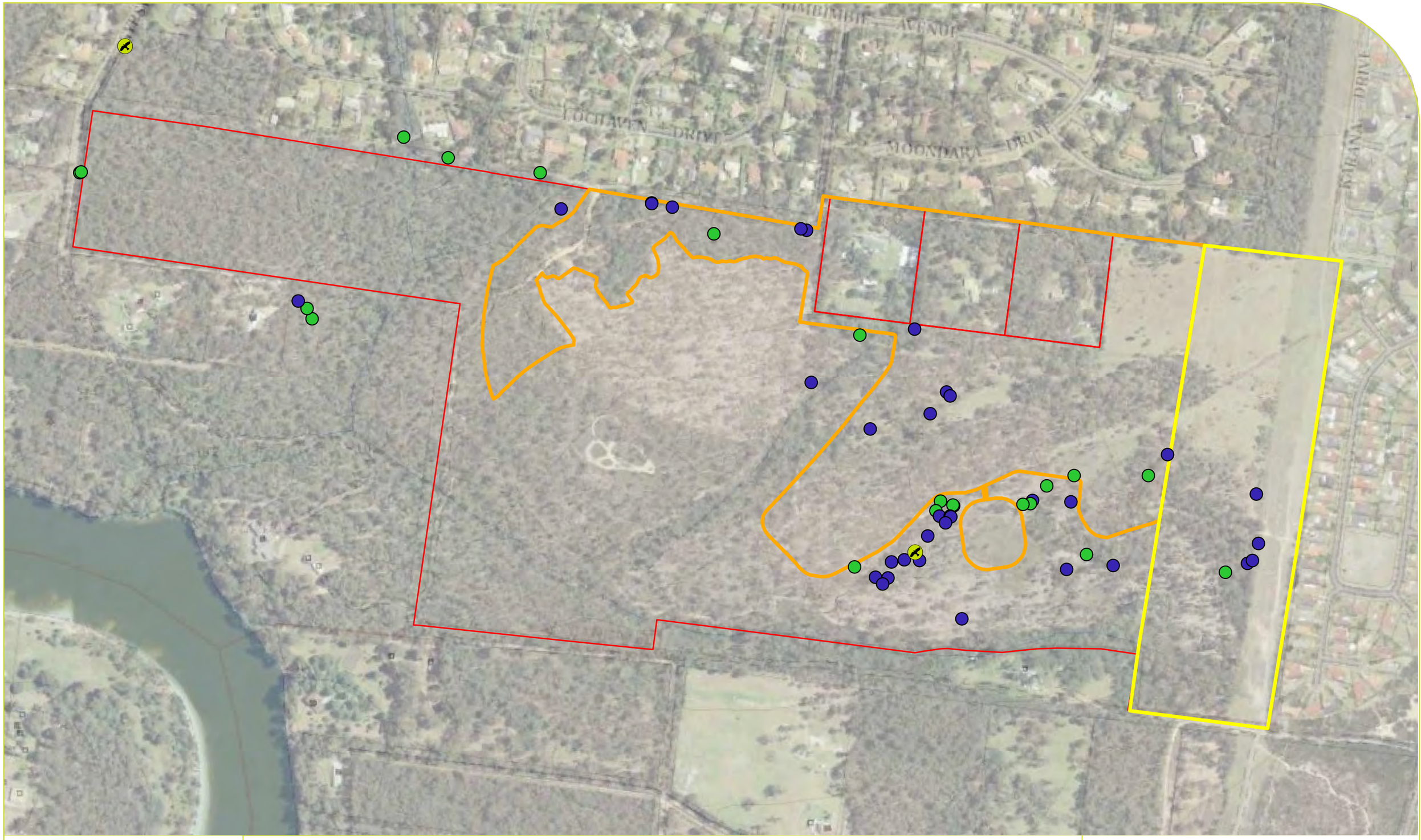

Figure 3-6: Habitat of the Glosyy Black-cockatoo recorded across the study area

Gang-gang Cockatoo

The Gang-gang Cockatoo (*Callocephalon fimbriatum*) is sedentary or seasonally nomadic (also part-migratory in Autumn-Spring) and occurs in single pairs to small flocks. It is found in tall mountain forest and woodlands, especially mature wet sclerophyll forests in summer. In winter, it moves to lower altitudes occupying drier more open eucalypt forests and woodlands including and urban areas such as Berry, Nowra and Bomaderry.

The Gang-gang Cockatoo was recorded during the Biosis surveys (2010) along Crams Road but not during the AHA Crams Road IA surveys (2006). There is only one additional record of this species within the Study Area: from 2006 with approximate 1km accuracy.

A pair was recorded flying across the site in November 2015, and again in December 2015. On both occasions, the pair was not recorded foraging and were flying west to east during morning surveys.

Despite the scant records there is nevertheless suitable foraging habitat for the species throughout the study area in the form of seeds-capsules of eucalypts, acacia pods and invertebrate within the canopy.

There were no nesting cockatoos and only three sightings recorded across the study area despite numerous hours of survey over multiple years. Nevertheless, the woodland habitat across the lot, represent foraging habitat for the species on its seasonal migration and hence all the forested portions of the BCAA were included as foraging habitat for credit calculations. Suitable foraging and breeding habitat for this species occurs widely within the locality, particularly in Cambewarra Nature Reserve, Budgong and Budderoo National Parks and more so in Morton National Park further to the west. Similarly, potential foraging habitat is common and widespread in the region, including the coastal national parks to the east, forested agricultural lands and even retained trees in developed urban area.

Based on the survey results and habitat modelling the DECC (2005) suggest that the individuals which have been recorded in the study area are likely to members of the population to the north and the same population found within the Budgong/Morton NP area. DECC (2005) suggests that this population remains secure and is unlikely to suffer significant declines under current land management practices due to the extent of the habitat conserved in National Parks and Catchment Lands.

Gang-gangs undergo seasonal altitudinal migration from high forests to lower areas during winter. During summer, Gang-gangs are found in tall mountain forests and woodlands, with dense shrubby understoreys. In winter, Gang-gangs will move to lower altitudes into drier, more open forests and woodlands. Despite the occurrences of some breeding on the coastal plain, most of the more suitable breeding habitat is in tall forests at higher altitudes such as in Kanangra-Boyd and southern Blue Mountains NPs (DECC 2005) and Morton National Park to the surrounding the study area.

There is suitable foraging habitat for the species throughout the study area in the form of seeds-capsules of eucalypts, acacia pods and invertebrate within the canopy. No individuals were recorded seeking hollows, occupying hollows or displaying breeding behaviour. There were no juvenile birds or recent fledglings recorded or any courtship behaviour recorded. Therefore, the BCAA is unlikely to represent breeding habitat but all the forest areas were included as foraging habitat for the Gang-gang Cockatoo in the credit calculations. It was not included for species credit calculations

Swift Parrot

The Swift Parrot breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW it mostly occurs on the coast and south west slopes**.** Breeding habitat is therefore unlikely to occur in the BCAA.

Favoured feed trees within the BCAA include winter flowering species such as Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Thin-leaved Stringybark (*E. eugenioides*) and Grey Ironbark (*E. paniculata*). Other species including Blackbutt (*E. pilularis*) and Sydney Blue Gum (*E saligna*) would also be suitable sources for lerps, another known food source for the Swift Parrot.

Powerful Owl

This species requires large areas of forest or woodland habitat in which to breed and forage but is also known to hunt over fragmented landscapes. The Powerful Owl is recorded regularly throughout the Shoalhaven. A breeding pair is known from Bangalee Reserve (Daly 2012), and another potential pair (possibly the same pair) regularly roost and breed in a lot west of Gypsy Point Road only 550 metres north-west of the study area but more than 1 kilometre from the BCAA (OMVI 2012) (Figure 3-7).

A roosting area and breeding hollow for this resident pair of Powerful Owls has been well documented since at least 2005 and have been monitored every year since 2011 (B. Ryan, *pers obs.*). Given the home range of a resident pair of Powerful Owls the whole locality is likely to represent foraging habitat. Breeding was observed in the same nest tree during 2005, 2006, 2007, 2008 (BES 2008) and 2011 and 2012 (OMVI 2012) and again in 2013-2019 (B. Ryan *pers obs.*). There have been a number of associated roost trees located in or near adjoining drainage lines within 200m of the nest tree. The core breeding area for these owls includes the nest tree and all identified roosting trees, all of which is outside of the current study area.

No evidence of Powerful Owls has been recorded in the BCAA during surveys conducted between 2009 to 2020 (AHA 2009, Biosis 2011, OMVI 2016 and the current surveys). Therefore, the Powerful Owl was included as an ecosystem credit species for all forested portions of the BCAA but was not included as in species credit calculations due to the absence of breeding habitat and the fact that the known nest is more than 1 kilometre away in accordance with *TBPDC* and BAM.

Eastern Pygmy Possum

From the records collected across the locality it appears that habitat for the Eastern Pygmy Possum centres on the PCT 1082 with a dense heathy understorey, as has been recorded near recent atlas records and other sources including: west of Gypsy Point Road, Bangalee Scout Camp and Bomaderry Creek Regional Park (OMVI 2012, NGH 2012, EcoLogical 2011). The dense heathy understorey of these areas provides foraging resources and the numerous hollow bearing Hard-leaved Scribbly Gum would provide sheltering resources. With infrequent fire and low human disturbance, PCT 1082 in the locality forms a low emergent *E. sclerophylla* woodland with a dense shrub layer including potential food resources such as *Banksia spinulosa, B. serrata, B. oblongifolia* and *B. ericifolia* as well as Mountain devil (*Lambertia formosa*) and Grevillea species. There is only a shallow skeletal soil over sandstone and a relatively dense ground cover or grasses and sedges.

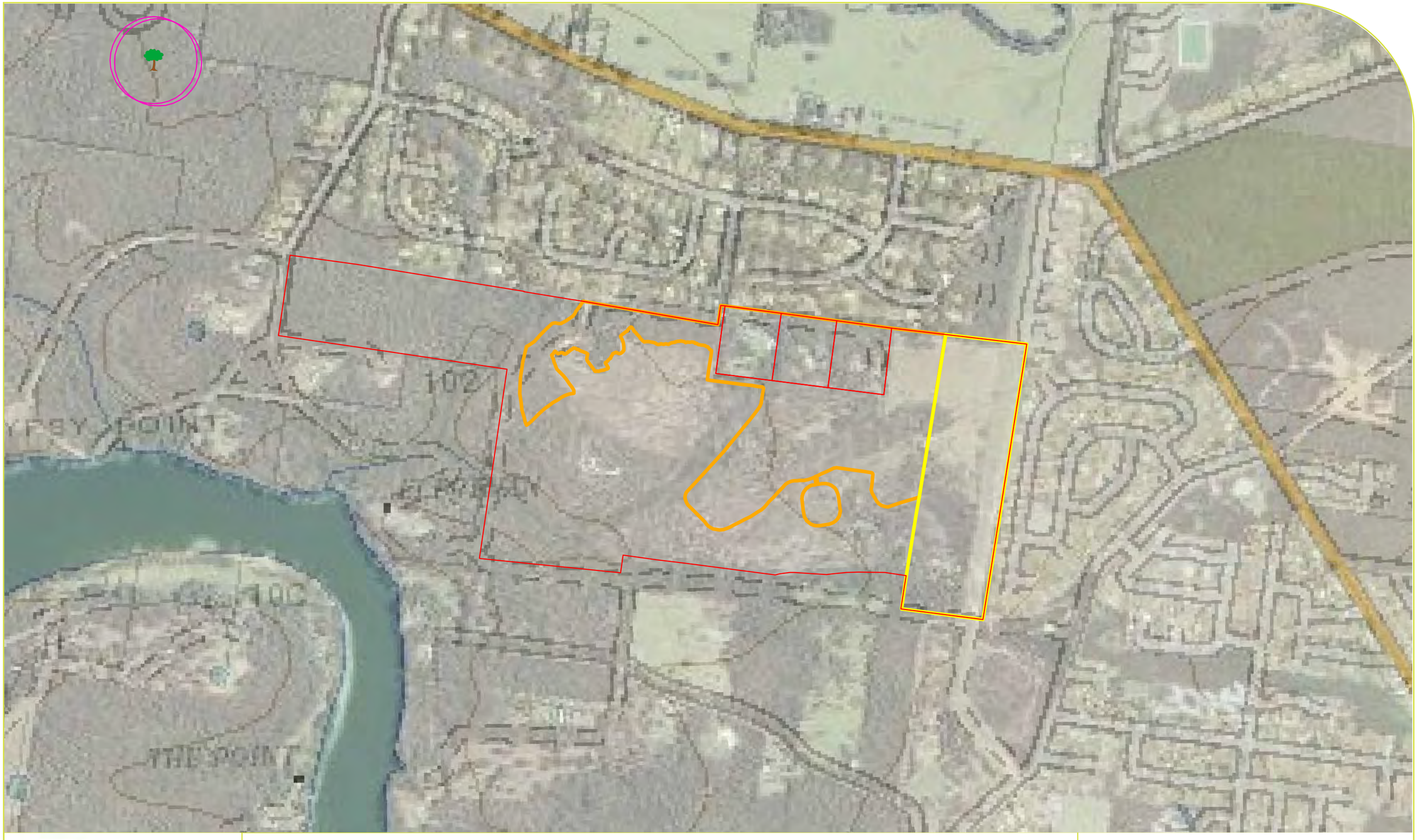

Figure 3-7: Habitat of the Powerful Owl recorded across the study area

Due to historical impacts (human and wildfire) the same community type east of the western finger has lost the dense understorey and therefore apparently habitat quality suitable for the Eastern Pygmy Possum. There were no captures despite a similar survey effort. Similarly, the PCT 662, 1079 nor 1206 recorded any captures and no individuals were observed. The suitability of these PCTs for the Eastern Pygmy-possum due to the paucity of understorey foraging resources, is therefore limited. The habitat for this species over most of the BCAA appears to be sub-optimal due to the disturbance history, which has resulted in sparse understorey and lack of shelter and foraging resources.

Nevertheless, species credits for Eastern Pygmy Possum have been calculated for good and moderate condition PCT 1082 and moderate condition PCT 662 in the BCAA (Figure 3-8). The area assumed for the Eastern Pygmy Possum, species polygon covers all of vegetation zones D1 (in lots 21, 22 23 and 24) along with D4 or 14.34 hectares; 0.67 ha of PCT 662 and 13.67 ha of PCT 1082.

Grey-headed Flying-fox

There are two temporary/semi-permanent camps in the locality, and a number of recent records of the species foraging (Figure 10-2).

In Nowra the Grey-headed Flying-fox 'season' appears to commence from anywhere beginning in August with the peak activity and number in January. Again, this will be dependent on flowering resources. In 2008/9 bats did not arrive in Nowra until late October. However, in 2011/12 they were recorded as early as late August and September, and more recently a southward movement of the camps permanency has been recorded, with recent camps such as Bomaderry recorded with bats all year round and new camps, such as near Batemans Bay shopping centre being established. This period of occupancy at Bomaderry therefore overlaps with the breeding season and young animals are sometimes recorded in the Shoalhaven during the dispersal period.

Table 10: Known Grey-headed Flying-fox camps in the region and recorded breeding at these camps along with distance to the subject site

Location	Months of occupation	Recorded Breeding	Distance from Subject site
Bomaderry Creek Regional Park	In recent years - All year #	Yes – young recorded	3km
Budgong	?	No	9km
Kangaroo Valley	September - March	No	12 km
Berry (Kentia Crescent & Sabal Close)	September - March	No	13.5 km
Comerong Island	September - March		18km
Jamberoo	September - March	Yes – young recorded	29km
Tomerong	September - March	no	23km
Bewong Creek	September - March	no	24km
Conjola NP – Sussex Inlet	September - March	no	32km
Conjola NP – Bendalong Valley	September - March	no	40km
Yatte Yattah NR	All year round	Yes – young recorded	48km
Mt Kembla	September - March	no	>50km (55km)
Kioloa + Cockwhy Creek	April-June#	no	>50km (75km)
Figtree (recent last few years)	November-February	no	>50km (52km)
Austinmer/Thirroul	November-February	no	>50km (78km)

only winter populations known
All information gathered from all relevant literature including newsletters etc from wildlife carer groups in the region. Detailed information about all camps could not be sourced or qualified

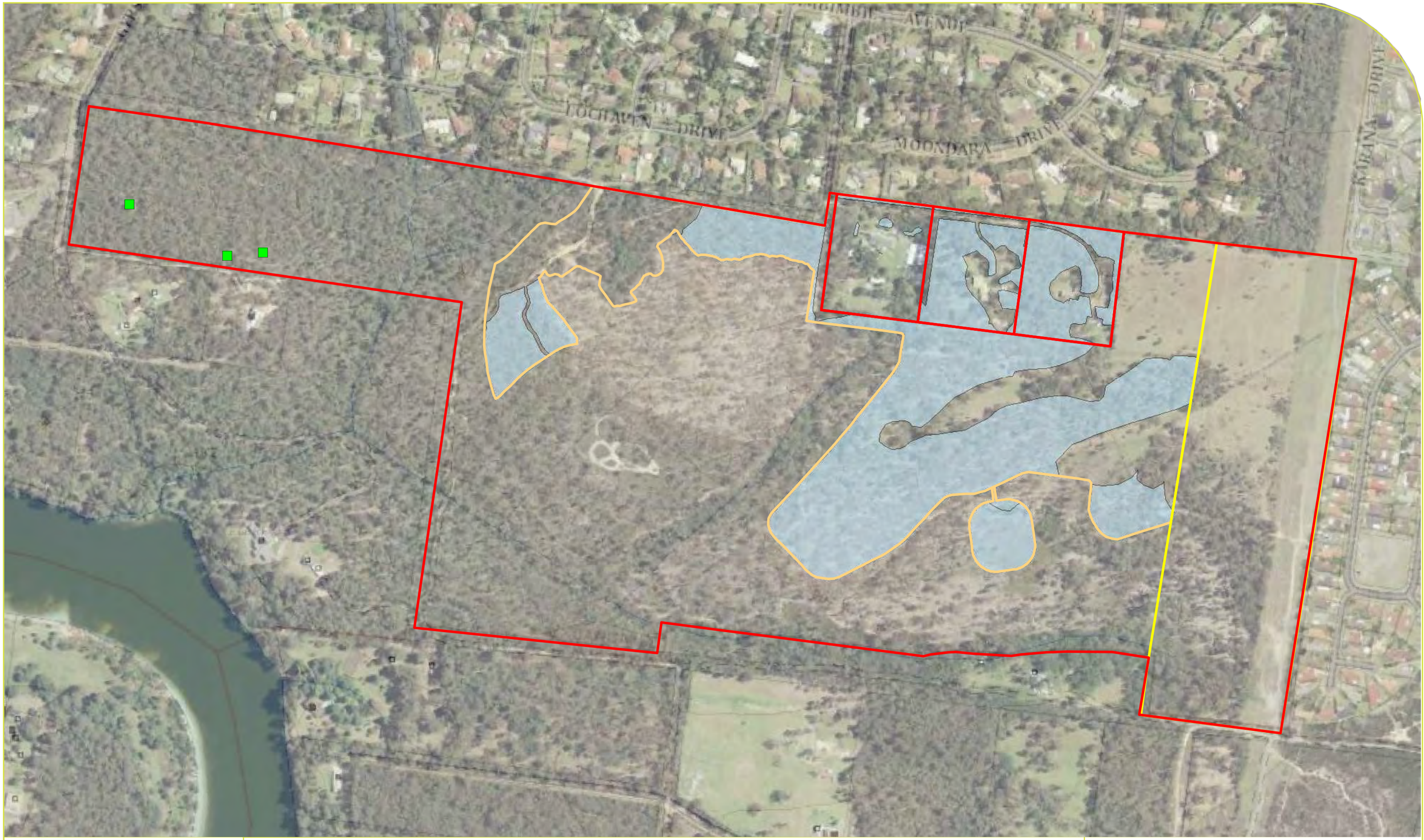

Figure 3-8: Eastern Pygmy Possum species polygon.

The nearest known roost site for the species is approximately 2-3 km west of the study area along Bomaderry Creek, and has a long history of use by the Grey-headed Flying-fox. The seasonal numbers of Grey-headed Flying-fox at this roost are estimated at around 17,000 and have reached up to 30,000 in the past (G Hawkins – Wildlife Rescue South Coast). The study area is known to contain suitable habitat for the Grey-headed Flying-fox and this species is likely to forage widely within the study area when the canopy species are in flower the animals have migrated from northern permanent camps. There are neither camps nor suitable diurnal roosts within the study area.

The Grey-headed Flying-fox was recorded flying over the study area during the field surveys during the AHA surveys in 2007 and in the November 2015 site surveys. Individuals are mostly likely moving from the nearby Bomaderry Creek summer roost camp. The mature forest in locality, the proximity of the seasonally occupied camp site in Bomaderry Creek and presence of suitable foraging throughout the Nowra Bomaderry area as well as the relatively contiguous remnant vegetation throughout the locality, which includes gardens and residential areas, the study area would provide some foraging habitat for the species.

The Grey-headed Flying-fox is a highly mobile and wide-ranging species, readily adaptable to novel habitat. The forested habitat across the BCAA represents suitable forging habitat in close proximity to a known breeding colony and therefore has conservation significance. While unlikely to represent dedicated breeding habitat, the species has been included in ecosystem credit calculations for all forested vegetation zones within the BCAA, including D1, D2 and D4. Due to the absence of roosting habitat or camps, it was not included as a species credit species.

Large-eared Pied Bat

The Large-eared Pied Bat (*Chalinolobus dwyeri*) is predominantly a cave roosting species that also utilise man-made structures, including drains, bridges, tunnels and mines (Dwyer, 1995). There were no caves, mine adits or built structures that could serve as roosting habitat for the cave roosting species, however the steep sandstone banks within the monolith sandstone cliffs and gorges of Morton National Park to the west or the cliff lines along the Shoalhaven River would provide numerous caves, and rock piles for these species. These species are highly unlikely to roost within the study area; however, this species was recorded foraging with lot 24 in 2010 and 2015/16 via Anabat recordings and one was captured in May 2016 in a Harp trap south of the lot on an access road off Crams Road close to the Shoalhaven River (Figure 3-5).

The closest rocky slopes or cliff lines suitable for potential roosts occur in the deeply incised banks of Bomaderry Creek to the east; along the Shoalhaven River to the east (near the highway bridge and west toward Budgong; cliff lines along the escarpment to the west and north including, Browns Mountain and Red Rocks Reserve, Cambewarra Mountain and the escarpment surrounding Kangaroo Valley). The former gold mines within Yalwal State Forest to the south may also represent suitable roosting for this species (Figure 3-9).

The assumption for this assessment was that this species is likely to utilise the forest and woodland across the lot for foraging only. Considering this and the availability of foraging resources within the wider locality, the woodland and forest vegetation in the BCAA is unlikely to represent a breeding habitat for the species. Therefore, because the Large-eared Pied Bat is a species credit species only, foraging habitat within 2km of rocky habitat is potential foraging habitat and credits have been calculated (Figure 3-9). The area assumed for the Large-eared Pied Bat, species polygon covers all of vegetation zones D1, D2, D3 and D4 as all are within 2 kilometres of potential roost site along the Shoalhaven in accordance with the *TBPDC* and BAM (Figure 3-9)

No evidence of breeding was recorded, there are no caves, adits or other roosting habitat within 100 metres therefore it has been determined that there is no breeding habitat for the species present. Moreover, it unlikely to represent a SAII given that no breeding habitat will be impacted.

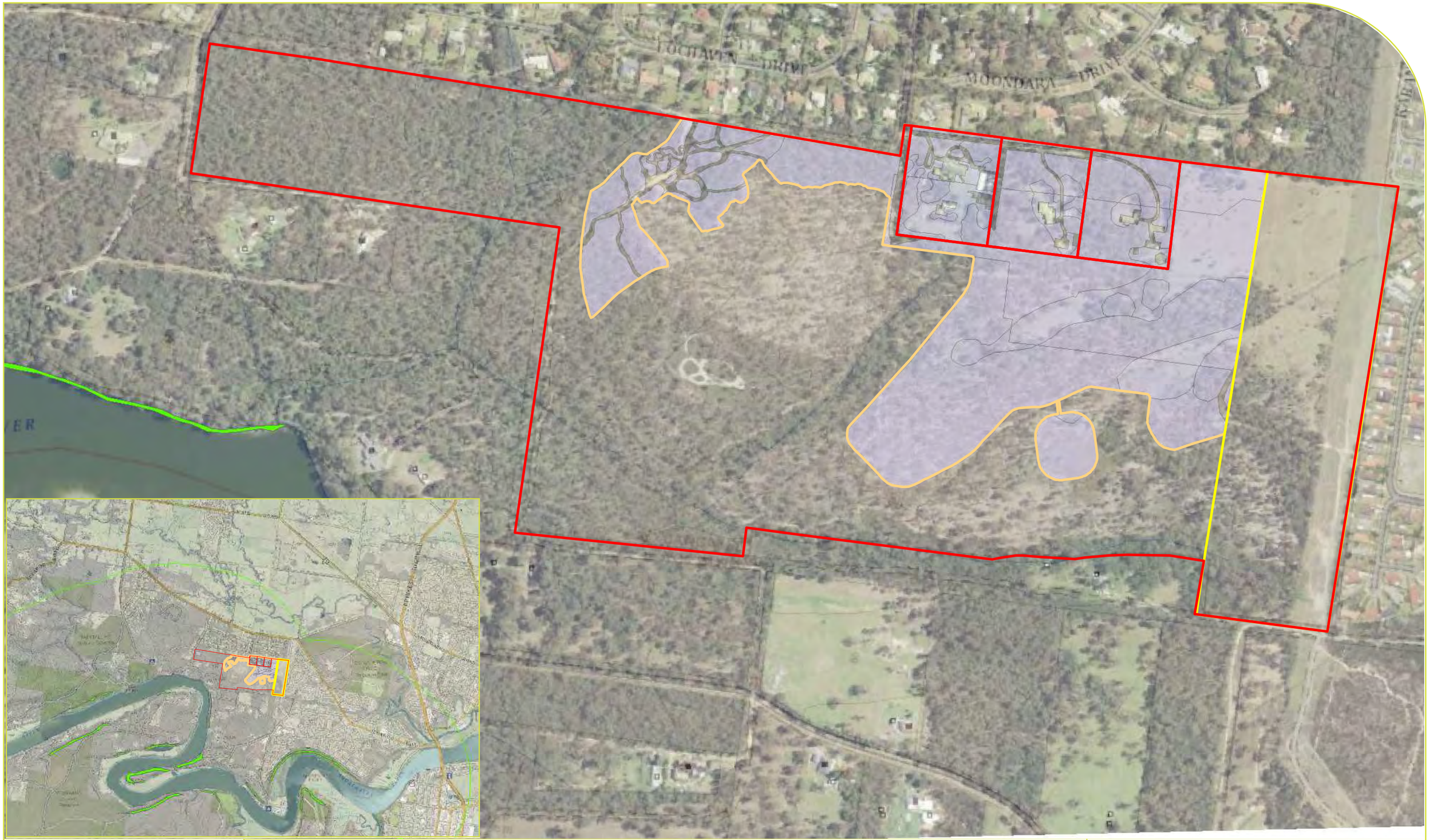

Figure 3-9: Cave roosting bat habitat within 2km of the BCAA (i.e. Large-eared Pied Bat and Eastern Cave Bat species polygons)

Eastern Cave Bat

The Eastern Cave Bat (*Vespadelus troughtoni*) is known to roost under corrugated iron in roof cavities, and the overhangs of large sandstone caves usually containing a dome at the rear, for both regular daily roosts as well for maternity roosting (Law et al 2005). They have also been recorded roosting in disused mine workings. It is unlikely the species uses tree hollows for roosting. A number of roosts are used by any bat, and they appear to switch between roosts often. Colonies have been recorded from 50 – 500 individuals (Law et al 2005). Movements between roosts are anywhere between 1 to near 4 km

The assumption for this assessment was that this species is likely to utilise the forest and woodland across the lot for foraging only. Considering this and the availability of foraging resources within the wider locality, the woodland and forest vegetation in the BCAA is highly unlikely to represent a significant portion of the foraging habitat for the species.

The assumption for this assessment was that this species is likely to utilise the forest and woodland across the lot for foraging only. Considering this and the availability of foraging resources within the wider locality, the woodland and forest vegetation in the BCAA is unlikely to represent a breeding habitat for the species. Therefore, because the Eastern Cave Bat is a species credit species only, foraging habitat within 2km of rocky habitat is potential foraging habitat and credits have been calculated (Figure 3-9). The area assumed for the Eastern Cave Bat species polygon covers vegetation zones D1, D2, D3 and D4 as all are within 2 kilometres of potential roost site along the Shoalhaven River in accordance with the *TBPDC* and BAM (Figure 3-9)

No evidence of breeding was recorded, there are no caves, adits or other roosting habitat within 100 metres therefore it has been determined that there is no breeding habitat for the species present. Moreover, it unlikely to represent a SAII given that no breeding habitat will be impacted.

Southern Myotis

With a definite Anabat recording in 2010, an 'either' call recorded in 2015 and numerous local records on the wildlife atlas (Figure 10-2), the Southern Myotis is likely to occur in the locality and utilise suitable open water habitat or potential above water or near water roosting habitat in the study area. No suitable maternity roost sites (e.g., caves) were recorded in the study area but possible roost sites occur in surrounding river-side escarpment and along the Shoalhaven River (Figure 3-9).

The creeklines and small farm dam on the study site provide potential foraging habitat for this species. The farm dam exists in a degraded state as a result of livestock access, and water quality appeared poor at the time of survey. The creeklines with water, harboured suitable fish and invertebrate prey species and are likely to represent the only foraging habitat for the Southern Myotis. The assumption for this assessment was that this species is likely to utilise this habitat and forested areas within 200 metres as prescribed in BAM (Figure 3-10).

The study site does not contain any caves, mines or overhangs near or above water and is consequently unlikely to provide preferred roosting or maternity sites for the Southern Myotis. Whilst tree-hollows, particularly over handing the creeks and open water on the study area may provide temporary roost sites for this species, they are not considered a primary or critical roosting resource for the Southern Myotis.

There is no breeding habitat in the BCAA. The area assumed for the Southern Myotis, species polygon covers 3.38 hectares within vegetation zones D1, D2 and D3 within 200 metres of open water habitat in accordance with the *TBPDC* and BAM.

Figure 3-10: Southern Myotis habitat (habitat within 200m of open water)

Stage 2 – Impact Assessment

4. Avoiding Impacts

4.1.1 Locating a project to avoid and minimise impacts on vegetation and habitat

The site inspections and surveys conducted for this BDAR for the proposed BCA has been conducted in stages and over several years. Initially at the preliminary stages of the re-zoning and in order to minimise impacts on the environment and biodiversity. The studies and conservation significance assessments were carried out to determine the extent and condition of native vegetation, the habitat features and proximity to any threatened species habitat features as well as the likelihood of any prescribed impacts including any potential significant and irreversible impacts (assessed under the former Threatened Species Conservation Act). Previous assessments completed by AHA in 2009, Biosis in 2009/10, then by OMVI in 2011/12 refined the biodiversity constraints of the area, with varying target areas with a specific aim of determining the suitability of re-zoning for residential purposes. As a result of differing opinion on the conservation significance of the land, a more detailed conservation assessment was conducted by OMVI in 2015/16. The surveys for this study included repeated seasonal surveys for threatened plants and animals across the study area and the adjacent lots. All the information was then assessed and reviewed independently by NGH in 2017. The resulting information was then put to the NSW Planning to forward the rezoning of the lots. This biodiversity certification assessment has been produced to measure the unavoidable impacts of the re-zoning and of the future residential development before NSW planning.

The numerous and often varied results of these studies have led to a succession of design modifications to reduce potential impacts as well as aided in a balanced design with maintains of potentially improves biodiversity values. With the recent change in biodiversity legislation in NSW, the results of all previous surveys and conservation assessment have been collated to are provided (along with new surveys) to fulfil the new requirements of BAM for a Biocertification under the BC Act. A summary of the measures and amendments made to reduce impacts on biodiversity are given below in Table 17.

Table 11: Locating a project to avoid and minimise impacts on vegetation and habitat

APPROACH	HOW ADDRESSED	JUSTIFICATION
Locating the project in areas where there are no or low biodiversity values	Areas of with low biodiversity values have been selected for the BCAA (i.e., the proposed residential development).	The BCAA has been located in the area of lowest biodiversity value (cleared or previously impacted areas).
Locating the project in areas where the native vegetation or threatened species habitat is in the poorest condition	Areas of cleared land where the vegetation/habitat is in the poorest condition have been selected.	The BCAA has been located wherever possible the vegetation/habitat with the lowest conservation significance as determined in OMVI 2016. Rocky areas were avoided as were intact forest or riparian forest/woodland of areas with good quality habitat (based on repeated targeted surveys).
Locating the project in areas that avoid habitat for species and vegetation in high threat categories (e.g., an EEC or CEEC or SAII species), indicated by the biodiversity risk weighting for a species	The study area did not contain an EEC or breeding habitat for any SAII entities. The best potential habitat for all conservation dependant species was recorded in the proposed Stewardship lots associated with the creeks and all of which is outside the direct impact.	The proposed development has been located in the poorest condition (cleared, grazed paddock) far from remnant vegetation.
Locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained	The subject site has been able to completely avoid any impediments to connectivity.	All the creeks and their associated vegetated riparian zones (VRZs) are proposed to be wholly contained and conserved in the proposed Biodiversity Stewardship Agreement lots. The BCAA area Is adjacent to existing residential areas and aims to retain the better more intact habitat and buffered creeks and other potential movement corridors from the future residential developments.

4.1.2 Designing a project to avoid and minimise impacts on vegetation and habitat

Following the results collected from the multiple surveys as well as other factors the layout and design of the proposed BCAA or future residential area has changed several times and now is limited to mostly lower conservation significant land (as assessed in OMVI 2016). The BCAA area includes all services

and bushfire asset protection (Figure 1-3) and excludes creeks and riparian zones (as defined under the WM Act). The proposals approach to avoid and minimise impacts on vegetation and biodiverse values are summarised below in Table 12. The comparison of the areas within the BCAA as compared to total area of all the lots combined is given in Table 13.

Table 12: Designs implemented to avoid and minimise impacts on vegetation and biodiversity habitat

APPROACH	HOW ADDRESSED	JUSTIFICATION
Reducing the clearing footprint of the project	The BCAA has been placed in a previously disturbed areas with lower biodiversity values.	The BCAA has been positioned to avoid any clearing of remnant intact vegetation as far as possible.
Locating ancillary facilities in areas where there are no biodiversity values	The entire development proposed, including ancillary facilities, has been designed to fit within the areas of lower biodiversity values of the BCAA.	Placement of the BCAA has resulted in the use of land with limited biodiversity values.
Locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e., areas that have a lower vegetation integrity score)	The BCAA, including ancillary facilities, has been designed to fit within areas where the native vegetation or threatened species habitat is in the poorest condition.	The BCAA proposed, including ancillary facilities, has been located in a highly degraded and grazed paddock with low vegetation integrity scores (i.e., 5.1).
Locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (e.g., an EEC or CEEC, or SAII)	The BCAA, including ancillary facilities, has been situated where the vegetation is in the poorest condition and has the lowest habitat value. It does not contain and EEC or breeding habitat for an SAII entity.	The development proposed, including ancillary facilities, has been located in cleared, grazed paddock far from remnant vegetation as possible.
Avoiding impacts on corridors that enable species and genetic material to move across the landscape.	The BCAA was designed to avoid all areas of habitat connectivity.	The development proposed has been strategically placed in a location where no current habitat connectivity exists.
Ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat within the three proposed Stewardship Sites.	The BCAA assessed herein as removed completely. Outside of the BCAA, vegetation, including all the creeks and majority of better-quality habitat will be managed in perpetuity under the three proposed BSAs. This will include ongoing weed and feral animal controls, fencing and disturbed lands remediation. Therefore, there would be future improvement with management actions.	The placement of the proposed BCAA has avoided breeding habitat and potential corridors and the majority of recorded threatened species habitat. Areas outside the BCAA are to be retained to avoid impacts to the remnant woodland/ forest in the creek VRZs and key species habitat recorded locally under three funded and perpetually managed BSAs.

Table 13: Areas of PCTs within the BCAA compared to the study area (i.e., all of lots 21,22,23,24 and the services easement)

PCT	Area in hectares (percent of total)		
	BCAA	"retained"	Total
1082	16.82 (41%)	24.01 (59%)	40.83 ha
1082 DNG (including non-native grassland)	5.32 (45%)	6.58 (55%)	11.90 ha
662	0.67 ha (26%)	1.89 (74%)	2.56 ha
1079	0	15.91 (100%)	15.91 ha
1206	0	3.11 (100%)	3.11 ha
694	0	2.18 (100%)	2.18 ha
tracks and cleared	1.91 ha (62%)	1.19 (38%)	3.10 ha
Total	**24.72 (31%)**	**54.11 (69%)**	**79.59 ha**

5. Assessment of Impacts

5.1 Impacts on regulatory mapping

While the BCAA does not impact directly on areas mapped as biodiversity values on the Biodiversity Values map. The proposal will remove more than 23.6 hectares of 'native vegetation' under the rulings of BAM, BOS is triggered and these areas MUST be offset through the Biodiversity Assessment Method, credit calculation and retirement.

5.2 Direct vegetation and habitat removal

Measures of mitigation and amelioration have been included to minimise impacts on all locally occurring biota, however, apart from the specific placement of the BCAA, designed to minimise vegetation loss; impacts have been considered and assessed as the loss of an open modified vegetation, including existing gardens, house and paddocks. The loss of this vegetation has been considered and assessed, where required for each conservation dependant species across the subject site.

The direct impacts of the development on:

- native vegetation is outlined in Table 14
- threatened species and threatened species habitat is outlined in Table 15.

Direct impacts including the rezoning and future residential development are shown on Figure 5-1. Areas not requiring an offset, due to being outside of direct or indirect impacts, or if the zones have an integrity score less than 17, are shown in Figure 5-2.

Table 14: Direct impacts to native vegetation

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct Impact
1082 - DNG	Highly disturbed grassland derived from Red Bloodwood - Hard leaved Scribbly Gum, Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	South East Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	5.32 ha
1082 - poor condition *	Disturbed and modified Red Bloodwood - Hard leaved Scribbly Gum, Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion			3.15 ha
1082 – good condition *	Red Bloodwood - Hard leaved Scribbly Gum, Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion			13.67 ha
662 – moderate condition	Banksia – Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion	Sydney Montane Heaths	Heathlands	0.67 ha
Cleared Land	No vegetation – cleared tracks, and other open cleared land.	n/a	n/a	1.91 ha
			Total	24.72 ha

Figure 5-1: Impacts requiring offset

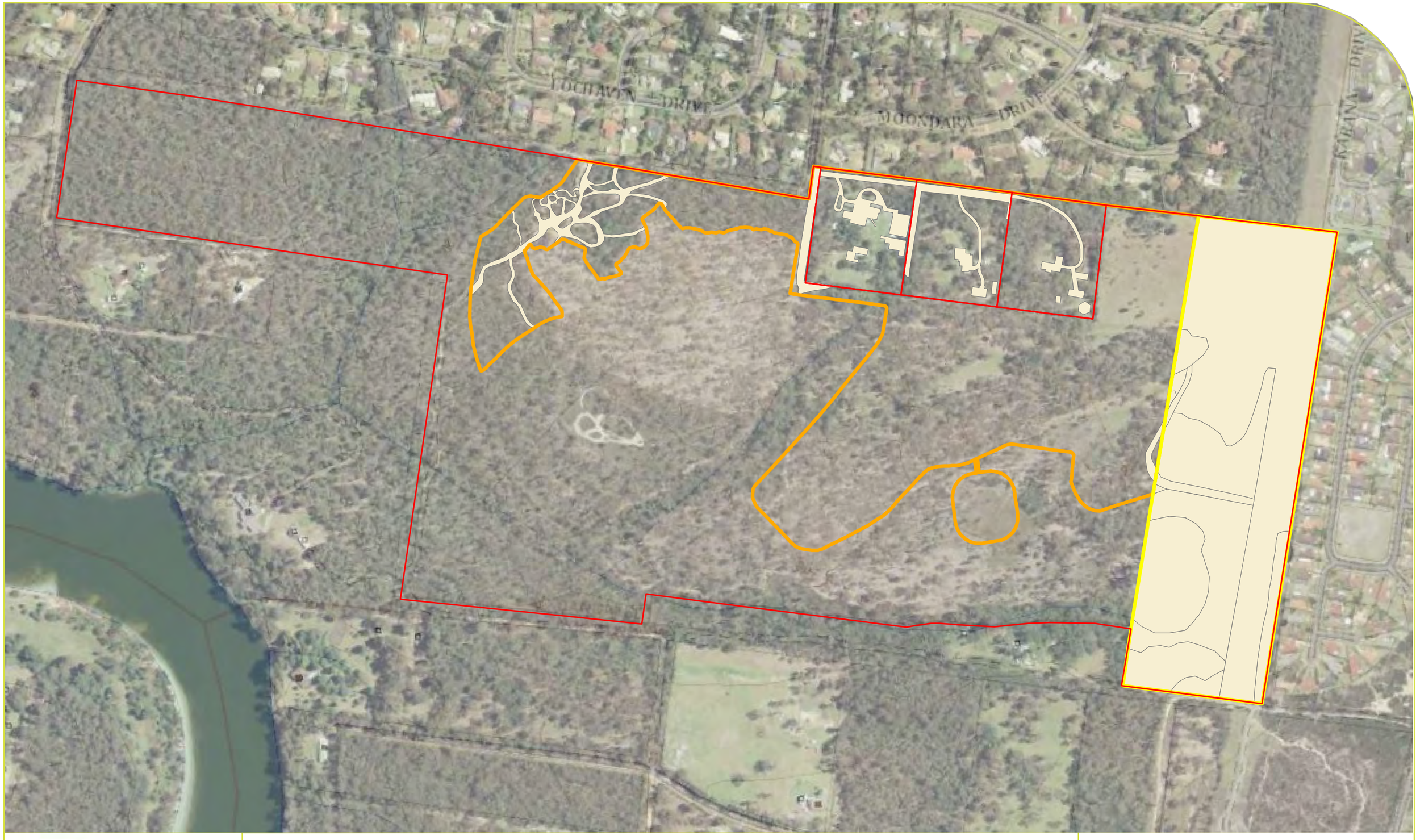

Figure 5-2: Impacts not requiring offset.

Table 15: Direct impacts on threatened species and threatened species habitat

SPECIES	DIRECT IMPACTS	STATUS	HABITAT AREA (HA)
Ecosystem credit species			
Little Eagle	loss or modification of foraging habitat	V	17.49 ha: 16.82 of PCT 1082 and 0.67 ha of PCT 662
Square-tailed Kite		V	
Gang-gang Cockatoo		V	
Glossy Black-cockatoo		V	
Little Lorikeet		V	
Swift Parrot		V	
Barking Owl		V	
Masked Owl		V	
Powerful Owl		V	
Regent Honeyeater		V	
Varied Sittella		V	
Dusky Woodswallow		V	
Scarlet Robin		V	
Flame Robin		V	
Eastern False Pipistrelle		V	
Eastern Coastal Freetail-bat		V	
Large Bent-winged-bat		V	
Little Bent-winged-bat		V	
Yellow-bellied Sheathtail-bat		V	
Greater Broad-nosed Bat		V	
Grey-headed Flying-fox		V	
Yellow-bellied Glider		V	
Spotted-tailed Quoll		V	
Species credit species			
Eastern Pygmy Possum	loss or modification of foraging habitat	V	14.34 of PCT 1082 and 662 (i.e., all of VZs D1 and D4)
Southern Myotis		V	3.38 ha (All forest and heathland habitat with 200 m of open water)
Large-eared Pied-bat		V	22.81 ha of PCT 1082 and 662 within 2km of potential roosting habitat
Eastern Cave Bat		V	22.81 ha of PCT 1082 and 662 within 2km of potential roosting habitat

5.2.1 Future Vegetation Integrity scores

After entering all the recorded plot attributes from across the study area, and subject site, the BAM calculator has summarised the future vegetation integrity scores for each vegetation zone across the study area after the removal of all vegetation post removal for the rezoning and future residential sub-division (Table 16). The future integrity scores then derive the credits required to offset this development proposal under BOS (BC Act).

Table 16: Future vegetation integrity scores (as calculated in the BAM calculator)

VEGETATION ZONE	PCT CODE	AREA (HA)	FUTURE CONDITION SCORES Composition	Structure	Function	CURRENT VEGETATION INTEGRITY (VI) SCORE	CHANGE IN VI SCORE	TOTAL CHANGE IN VI SCORE?
Vegetation zones within the development (i.e., direct or indirect impacts likely)								
D1 – 21	1082	0.1	0	0	0	63.8	-63.8	63.8
D1 – 22		1.28						
D1 – 23		1.45						
D1 – 24		10.84	0	0	0	68.8	-68.8	68.8
D2 - 21	1082	0.73	0	0	0	51.7	-51.7	51.7
D2 - 24		2.42	0	0	0	64.6	-64.6	64.6
D3	1082	5.32	0	0	0	13.3	-13.3	13.3
D4 – 24	662	0.67	0	00		42.1	-42.1	42.1

Grey shading – Does not require calculation of ecosystem credits because the integrity score is below 17.

5.2.2 Justification for future integrity scores

It has been assumed for this calculation, that all vegetation, leaf litter cover and habitat will be lost for the BCAA, where all values are reduced to zero.

5.2.3 Runoff and Sedimentation

There is little potential for impacts on the adjacent lot's construction from runoff and sedimentation if proper management measures are implemented. The study area is surrounded by urban lots and two roadways. Management measures would be defined by the construction planning documents.

5.2.4 Alteration of Light, Noise and Dust Levels

Noise and light impacts differ during the construction and 'operational' phases of such developments. For example, noise will be varied in type and intensity during the construction of the dwelling and other infrastructure but more consistent and associated with occupation once complete. Artificial noise and light levels are likely to increase during construction and when the new dwelling is occupied. However, this is likely to be minimal and within similar bounds to that seen from the existing dwelling and that form the neighbouring residential properties.

5.3 Indirect Impacts

Table 17 summarises the potential indirect impacts associated with the proposed BCA and future residential development.

Table 17: Indirect Impacts

INDIRECT IMPACT	PROJECT PHASE	NATURE	EXTENT	FREQUENCY	DURATION	TIMING
Sedimentation and contaminated and/or nutrient rich run-off	Construction / operation	Runoff during construction works or in operational phase	Sedimentation and runoff into nearby creeks and the Shoalhaven River	During heavy rainfall or storm events	During rainfall events	Short-term impacts
Noise, dust or light spill	Construction / operation	Noise and dust created from machinery No night works proposed so no light spill	Adjacent vegetation	Daily, during construction works; sporadically thereafter	Throughout project period	Short-term impacts
Inadvertent impacts on adjacent habitat or vegetation	Construction / operation	Damage to adjacent habitat or vegetation	Adjacent vegetation	Daily, during construction and operational phases	Throughout project period	Potentially long-term impacts
Transport of weeds and pathogens from the site to adjacent vegetation	Construction / operation	Spread of weed seed and pathogens from incoming machinery and equipment	Potential for spread into nearby habitat	Daily, during construction and operational phases	Throughout project period	Potentially long-term impacts
Vehicle strike	Construction / operation	Potential for native fauna to be struck by working machinery and moving vehicles	Within access roads and within subject site	Daily, during construction and operational phases	Throughout project period	Potentially long-term impacts
Trampling of threatened flora species	Construction / operation	No threatened flora species present	N/A	N/A	N/A	N/A
Injury or death of protected fauna	Construction / operation	Removal of habitat in vegetation adjacent to subject site	Throughout study area	Potential to occur at any time during construction or operational phases	Throughout life of project	Potentially short-term impacts
Increase in predatory species populations	Construction / operation	Potential for an increase in predatory species if pet dogs or cats brought onto the subject site	Throughout the study area	Potential to occur at any time during construction or operational phases	Throughout life of project	Potentially long-term impacts
Increase in pest animal populations	Construction / operation	Potential for an increase in pest animal populations associated with human habitation	Close to subject site	Likely to occur gradually after new dwellings become occupied	During operational phase of project	Potentially long-term impacts

5.4 Prescribed biodiversity impacts

Prescribed impacts are those that may affect biodiversity values in addition to, or instead of, impacts from clearing vegetation. These impacts may be difficult to quantify or offset as they often affect biodiversity values that are irreplaceable. Consequently, avoiding or minimising such impacts is critical. Prescribed impacts are listed in the BC Regulation (cl. 6.1) and are discussed below.

5.4.1 Karst, caves, crevices, cliffs and other geological features

No karst systems, caves, cliffs or other geological features were recorded in the subject site and none will be impacted by the development.

5.4.2 Mine adits, tunnels, bridges and other man-made habitat features

No mines, adits, tunnels, large culverts, bridges or other man-made habitat features were recorded in the study area and none will be impacted by the development.

5.4.3 Ground rocks, imbedded or partially imbedded rocks or fossorial habitat

There were no substantial woody or rocky ground habitat recorded in the BCAA. No imbedded or partially imbedded rocks or other substantial fossorial habitat will be impacted by the biocertification. Wherever possible the proposed BCA has been altered to minimise any and all impacts to the environment and specifically rocky habitat, rock shelves and other ground rocks. Where these values could not be avoided the offset derived herein (from BAMC) aims to mitigate for the residual impacts (Figure 5-1). There are no other prescribed biodiversity impacts likely.

5.4.4 Non-native vegetation

There will be a resulting loss in some planted gardens and planted trees, some of which are listed threatened species (see section 3.2.1). The removal of these elements is not likely to represent a large loss of resources for and fauna and given most of this vegetation is readily sourced from local nurseries, the loss of nursery cultivars or non-endemic plantings should not create reduce local biodiversity values. None of the trees within the gardens were old enough to harbour hollows, and there is an abundance of similar resources in the surrounding residential landscape.

5.4.5 Impacts associated with fragmentation and creating barriers for vector movement (i.e., habitat connectivity)

Habitat fragmentation can impose a range of potential adverse impacts on native flora and fauna, including a reduction in dispersal and reproductive success of both plants and animals within the fragment, decline in populations as a result of increased predation by introduced species or native species not normally found in the community, and an increased probability of chance events (e.g., fire) reducing population numbers below critical levels required for their survival.

- Larger vegetation stands are generally considered to be of higher conservation significance than smaller stands on the basis of the relationship between habitat area and species richness. In general, larger fragments tend to be more biodiverse given that:
- larger fragments contain a greater sample of the original habitat and hence are likely to sample a greater range of biota than smaller fragments;
- larger fragments are able to support larger population sizes and therefore more species are able to maintain viable populations in larger areas than in smaller areas; and
- larger areas are likely to contain a more diverse range of habitats for flora and fauna, with the number of species reflecting the diversity of available habitats.

The proposal is located within an already historically modified rural / urban landscape, and the proposed BCA is unlikely to greatly increase fragmentation. Potential migration pathways for many faunae along the riparian areas locally will not be impeded, given that all the creeks are within the proposed three BSAs.

The BCA is therefore unlikely to greatly increase habitat fragmentation or create a barrier to fauna movement locally. Nevertheless, as part of the BOS and requirement for credit retirement, potential impacts of the landscape level including fragmentation are incorporated into the credit calculations.

5.4.6 Fauna mortality due to vehicle or turbine strike

Numerous new roads and new driveways are likely in the future if the BCA is approved and a residential sub-division development is approved. These new roads will increase local traffic and will create novel barriers to fauna movement and increase the local mortality potential. The addition of new houses and more glass will also increase the potential for fauna mortality due to window strike. The extent to which the additional roads, additional vehicular traffic or increased built structures will impact on local fauna is difficult to determine, however, given that the BCAA is in and utilises existing residential areas, with in the North Nowra/Bangalee area, the increases are not likely to be significantly more than current exists.

5.4.7 Hydrological Changes

No creek lines or defined drainage lines would be impacted. Some surface and sub surface drainage will be impacted but the water management proposed in the current design would account for these alterations.

5.4.8 Ground Water Dependant Ecosystems.

There were no ground water dependant ecosystems recorded in the BCAA. The local creeks will not be impacted directly but are likely to receive more water from the hard surfaces of the future residential development. The quality and flows are likely to be managed appropriately with any stormwater management approved by SCC. The area has already been modified through the creation of a stormwater channel which receives the storm water of North Nowra and has been the site of previous stock yard and agricultural pursuits. The modification to already disturbed lands will not impact any ground water dependant ecosystems.

5.5 Serious and irreversible Impacts

The removal or modification of 24.7 hectares of extensively disturbed vegetation will not greatly impact any conservation dependant biota (as discussed above): and therefore, is highly unlikely to result in serious or irreversible impacts.

No part of the BCAA supported caves or other suitable roosting habitat for the Eastern Cave Bat or Large-eared Pied Bat. There were no such structures within 100 metres of the BCAA and it is highly unlikely that breeding habitat therefore occurs. Therefore, the biocertification of this area is unlikely to result in a significant or irreversible impact on either the Eastern Cave Bat or Large-eared Pied Bat. Moreover, given the requirement to retire 914 species credits for each species somewhere else in NSW, the security of potential foraging and/or breeding habitat will be adequately offset further lessening the likelihood of an SAII for either species.

Stage 3 – Improving Biodiversity Values

6. Mitigating and managing Impacts

The following impact mitigation and amelioration are proposed as possible measures incorporated into the development planning to reduce the immediate impacts of the vegetation loss as a result of the future residential development following the completion of the rezoning, where approved. The measures are aimed and mitigating or managing potential impacts before, during and after construction are summarised in Table 18 and detailed below.

Table 18: Measures proposed to mitigate and manage impacts

MEASURE	RISK BEFORE MITIGATION	RISK AFTER MITIGATION	ACTION	OUTCOME	TIMING	RESPONSIBILITY
Sediment barriers or sedimentation ponds to control the quality of water released from the site into the receiving environment	Moderate	Minor	Manage exposed soil surfaces; sediment and erosion control on works; silt nets downslope from workings	Control of erosion and sedimentation	Duration of the project	Project Manager
Daily/seasonal timing of construction and operational activities to reduce impacts of noise	Minor	Negligible	Daily timing of construction activities is recommended in accordance with Table 1 of Interim Noise Guidelines (2009): - Monday to Friday 7.00am to 6.00pm - Saturday 8.00am to 1.00pm - No work on Sunday or public holidays	Noise impacts associated with the development will be managed in accordance with guidelines.	For the duration of construction works	Project Manager
Daily/seasonal timing of construction and operational activities to reduce impacts of light spill	Minor	Negligible	Operating times will only occur during daylight hours, and night lights will not be used	Light impacts associated with construction and operation will be avoided as works will occur during daylight hours	For the duration of the project	Project Manager
Adaptive dust monitoring programs to control air quality	Moderate	Minor	Dust suppression measures	Mitigate dust created during construction/operation	For the duration of the project	Project Manager
Displacement, death or injury of resident fauna	Minor	Negligible	Avoid clearing works in summer/autumn during breeding period for resident fauna	Impacts to fauna during breeding/nesting predominately avoided	Prior to and during removal of forest/woodland vegetation	Project Manager
Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas	Moderate	Minor	All machinery/equipment cleaned prior to entering/exiting the Subject site No weeds on the Subject site listed under the NSW *Biosecurity Act 2015* were found during the field survey. Future weed infestations should be managed/removed by a qualified Bush Regenerator	Prevent the spread of weeds or pathogens	Duration of project	Project manager
Staff training and site briefing to communicate environmental features to be protected and measures to be implemented	Minor	Negligible	All staff working on the development will undertake an environmental induction as part of their site familiarisation. Site briefings should be updated based on phase of the work. This induction can be included as part of the overall site induction and should include items such as: 1. Site environmental procedures (vegetation management, adjacent to site, sediment and	All staff entering the development are fully aware of all environmental aspects relating to the development and know what to do in case of any environmental emergencies	To occur for all staff entering / working at the development and when environmental issues become apparent	Project Manager, all staff

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
			erosion control, hygiene protocols) 2. What to do in case of environmental emergency (chemical spills, fire, injured fauna) 3. Key contacts in case of environmental emergency			
Development of control measures to regulate activity in vegetation and habitat adjacent to residential development	Moderate	Minor	Installation of signage to indicate No Go zones, rubbish disposal guidance, prohibition of wood collection, prohibition from lighting fires, prohibition of disturbance to vegetation outside of the Development Site, and pest and disease management	Protection of flora and fauna surrounding the development.	Prior to the commencement of construction	Client

6.1 Avoidance of impacts on native vegetation and fauna habitat

The proposed BCAA has undergone several iterations, mostly aimed at reducing impacts on the environment and specifically biodiversity values. The proposal is now confined entirely to the areas of the lots previously determined to have lower conservation value (OMVI 2016). There will be some vegetation and some species habitat loss. The higher conservation value land is proposed to be protected in perpetuity and conserved under three separate stewardship agreements. Residual impacts are the subject of this BCAR and the calculation of the type and number of biodiversity credits to be retired to offset this residual loss.

6.2 Riparian Buffers and Wildlife Corridors

All defined creeks across the study area along with their associated riparian forest are buffered from the BCAA. Each provides terrestrial and aquatic habitat, functions as a wildlife corridor and the existing riparian vegetation along it is the best condition vegetation in the wider study area. All the creeks are therefore proposed to be retained and managed for conservation under a the three proposed BSAs.

The current BCAA does not impact on the vegetation or functioning of the creeks or their tributaries nor the Shoalhaven River.

6.3 Sediment Controls

A comprehensive Erosion and Sediment and Control Plan (ESCP) should be developed and rigorously implemented during the works to protect water quality, native fish and fish habitat. The ESCP should be developed in accordance with the requirements of the NSW Department of Housing publication – Managing Urban Stormwater: Soils and Construction (1998) and any other policies produced to guide the construction of dams or water storage ponds.

6.4 Water Quality Management

A Water Quality Management Plan should also be developed and implemented throughout the construction process. The WQMP should ensure that procedures are in place to prevent water quality impacts from the construction activities. The WQMP should address the appropriate storage and bunding of fuels, oils and chemicals, the refuelling of plant and equipment, the use of materials over-water, and emergency response procedures to minimise water quality impacts following incidents or spills.

7. Impact Summary

7.1 Serious and Irreversible Impacts (SAII)

As discussed in detail above there are no SAIIs likely, no threatened flora, populations or ecological communities will be impacted by the proposed BCA and no breeding habitat for threatened species is likely to be impacted.

7.2 Impacts requiring offsets

7.2.1 Ecosystem credits

The impacts of the development not requiring offset for native vegetation are outlined in section 4 and area shown in Figure 5-1. Vegetation Zone D3 (5.32 ha) with an integrity score of less than 17, was still entered into the BAMC for transparency. Accordingly, this zone did not derive an ecosystem credit requirement.

The impact of 16.82 ha of PCT 1082 (VZ D1 and D2) within the future development footprint (including APZs) with a vegetation integrity score of greater than 17 will require the retirement of 421 credits of PCT 1082 or a similar PCT. This assumes the complete loss of all vegetation within the 24.72-hectare BCAA

The impact of 0.67 ha of PCT 662 (VZ D4) within the future development footprint (including APZs) with a vegetation integrity score of greater than 17 will require the retirement of 11 credits of PCT 662 or a similar PCT. This assumes the complete loss of all vegetation within the 24.72-hectare BCAA. The area requiring impact offset is shown in Figure 5-1.

7.2.2 Future integrity score of Zones D1-4.

The loss of all vegetation within the BCAA is assumed for this BCAR and BAMC calculations, despite some areas that will simply be modified for asset protection purposes. The future integrity scores for zones D1, D2, D3 and D4 are therefore zero (0), where VZ D3 does not require a credit offset because the low integrity score of 13.3. VZ D1 (13.67 ha) was calculated with a minus 69 change in vegetation integrity; VZ D2 (3.15 ha) a minus 64.5 change; VZ D 3 (5.32 ha) a minus 13.1 change and VZ D4 (0.67 ha) a minus 42.1.

7.2.3 Species Credits

Eastern Pygmy Possum was recorded in the western forest of lot 24. It has therefore been assumed to occur within the intact forest of the BCAA or all of VZs D1 in lots 21.22, 23 and 24. The 14.34 hectares derived 477 Eastern Pygmy Possum credits (13.67 of PCT 1082 and 0.67 of PCT 662).

Three species of microbat are assumed to be present within the forested portions of the BCAA: As required in BAM, all possible habitat within 200 metres of open water (greater than 3m wide) and where Southern Myotis has been recorded or is assumed to be present must be incorporated for the calculations of Myotis credits. 3.38 hectares of forest and heath was determined to be within 200 metres of the southern creekline (with suitable open pools) and the farm dam within lot 24. This included 0.67 ha of pct 662 and 2.71 ha of PCT 1082. 106 Southern Myotis credits were calculated for these areas.

Due to the recorded presence of Large-eared Pied Bat and the presence of cliff lines and rocky screes, there are suitable roosting locations for this cave roosting bat. All areas of the development which is suitable foraging habitat with 2 kilometres of the roosting habitat must be incorporated in credit calculations. All native vegetation within the BCAA was within 2 km of cliffs (Figure 3-9), including 16.82 ha of PCT 1082 in VZs D1 and D2, 0.67 ha of PCT 662 in VZ D4, as well as the 5.32 ha derived grassland

(VZ D3) is therefore foraging habitat for the Large-eared Pied Bat in accordance with the TBPDC and BAM. Similarly, the Eastern Cave Bat was potentially recorded via ultrasonic call recording in November 2015 and is therefore assumed to be present in accordance with BAM for all the same Vegetation zones listed above for the Large-eared Pied Bat. The BAMC resulted in 914 Large-eared Pied Bat species credits and 914 Eastern Cave Bat species credits.

7.3 Credit Summary

The clearing assumed as a total loss across the proposed BCA of the 24.72-hectare area including cleared lands, DNG (5.32 ha), the poor condition disturbed PCT 1082 (3.15 ha) and the good condition PCT 1082 (13.67 ha). This includes areas proposed for residential lots, services and also asset protection. The DNG scored a vegetation integrity value of 13.3, therefore did not require an offset and did not calculate an ecosystem credit in BAMC. The future integrity score for all Vegetation zones: D1 (combined); D2 (combined), D3 and D4 were assumed to be 0. The calculated integrity loss in BAMC was -63.8 and -68.8 for D1; -51.7 and -64.6 for D2; -13.3 for D3 and -42.1 for D4. BAMC derived a credit requirement of 421 ecosystem credits for the loss of 16.82 ha of PCT 1082 and 11 ecosystem credits for the loss of 0.67 ha of PCT 662.

Eastern Pygmy Possum was assumed to be present within all the forest and heathland within the BCAA, despite the absence of species following targeted surveys. 477 species credits have been calculated for the 14.34 ha of moderate and good condition PCT 662 and 1082 assumed habitat for the Eastern Pygmy Possum.

Three microbats, recorded with varying degrees of certainty during the site surveys were assumed as species being impacted and species credit were calculated for the potential loss of foraging habitat: Eastern Cave Bat (*Vespadelus troughtoni*); Large-eared Pied Bat (*Chalinolobus dwyeri*) and Southern Myotis (Myotis adversus). No breeding habitat for these species is likely to be impacted. All forest and heathland BCAA lost or modified within 200m of open water bodies were mapped as habitat for the Southern Myotis (Figure 3-10) and vegetated lands of the BCAA within 2 km of suitable cliff lines and rocky scree slopes (potential roosting for cave bats), is mapped as foraging habitat for the Eastern Cave Bat and Large Pied Bat. The loss of 22.81 ha equates to 914 Large-eared Pied Bat credits, 953 Eastern Cave Bat credits. The assumed 3.38 ha within 200m of open water bodies in the BCAA, which forms habitat for the Southern Myotis and equates to 106 Southern Myotis credits.

The required ecosystem credits can be obtained from, Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts IBRA sub-regions or any IBRA subregion that is within 100 kilometres of the outer edge of the impacted site. See Appendix D for details.

Species credits must be sourced from the same candidate species', being the Eastern Pygmy Possum, Large-eared Pied Bat, Eastern Cave Bat and Southern Myotis. These credits can be sourced NSW wide.

Table 19: Cost breakdown per lot (as calculated in the BAMC)

Vegetation Zone	PCT code	Area (ha)	Ecosystem Credits	Species Credits			
				Eastern Pygmy Possum	Eastern Cave Bat	Large-eared Pied Bat	Southern Myotis
D1 – 21	1082	0.10	2	3	5	5	0
D1 – 22		1.28	31	41	61	61	0
D1 – 23		1.45	35	46	69	69	0
D1 – 24		10.84	280	373	560	560	82
D2 - 21	1082	0.73	14	0	28	28	0
D2 - 24		2.42	59	0	117	117	10
D3 - 21	1082	0.76	0	0	53	53	0
D3 - 22		0.34					
D3 - 23		0.33					
D3 - 24		3.89					
D4 - 24	662	0.69	11	14	21	21	14
		Total	**432**	**477**	**914**	**914**	**106**

Grey shading – Does not require calculation of credits because the integrity score is below 17.

7.4 Indicative Credit costs

The four-hundred and thirty-two (432) required ecosystem credits have been estimated through the BOPC at $2,638.80 per credit for PCT 1082 and $10,261.00 per credit for PCT 662. The estimated total ecosystem credit price for the 432 credits required therefore is $1,346,186.18 including GST (Appendix B).

Nine-hundred and fourteen (914) species credits for both the Eastern Cave Bat and Large-eared Pied Bat are also estimated in the BAMC. Also based on the assumption that the Southern Myotis (*Myotis adversus*) is present within the forested portions of the BCAA that is within 200 metres of open water, one-hundred and six (106) Southern Myotis species credits are required. All three bats have an estimated credit price of $974.69 per credit (including risk premium and administration costs). For both the Eastern Cave Bat and Large-eared Pied Bat, 914 credits equal $890,863.95 and for the Southern Myotis, 106 credits are $103,316.83.

Similarly, based on the assumption that Eastern Pygmy Possum also occurs with the forested portions of the BCAA, 477 credits are required. With administration costs and a 20.69% risk premium the BOPC estimates that the Eastern Pygmy Possum at $677.71 per credit or $323,265.36 for 477 credits.

The combined the total estimate of species credits required is $2,429,141.10 (including GST). The combined ecosystem and species credit price are therefore $3,775,327.28 including GST.

7.5 Retirement of credits

The required credit retirement will be sourced firstly from the proposed BSA lots and any residual credits required will be then sourced from the open market or through a Biodiversity Trust payment.

8. Conclusion

This report summarises the biological environment of on Lots, 21, 22, 23 and 24 DP 714096, Warrah Road, Bangalee, and assesses the potential effects on threatened species, migratory species, and endangered populations and ecological communities or their habitats, of a BCA for re-zoning the lots for future residential development. This BCAR follows several independent assessments on the conservation significance of biodiversity values with the lots, which were all aimed to determining the level and type of development the lots would sustainably support.

This BCA will be subject to the approval of the NSW Department of Planning Industry and Environment.

As part of the iterative design of the planning proposal, the area covered by the current BCAA aims to include only the areas of the lots that have lower biodiversity value. The residual will be conserved in perpetuity under three separate proposed Biodiversity Stewardship Agreements. The entire area covered by the 4 lots is approximately 79.7 hectares. The BCAA covers 24.7 hectares and the three proposed BSA areas over 42.9 hectares. The remaining area (12.1 ha) occurs in an existing powerline and high-pressure gas pipeline easement, which is 'retained land'. This area will remain unimpacted by the current BCA.

The majority of native vegetation across the of the BCAA (24.7 ha) was determined to be varying condition PCT 1082 or Red Bloodwood - Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion (22.15 ha), including derived native grasslands which formed the existing grazed paddocks and services easement recorded a vegetation integrity score of 13.3 (5.32 ha). The remaining 2.6 hectares harboured cleared lands (1.91 ha) and PCT 662 or Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion.

The BCAA was designed to incorporate areas with historical impacts such as refuse dumping, motor bike tracks, artificial drains, existing residential dwellings, gardens and open paddocks which were the site of a former stock sale yards. These historical impacts have degraded the ecological values and have resulted in areas being unsuitable for most species of conservation significance recorded on the site.

Nevertheless, as part of the BOS calculations, the all vegetated portions of the BCAA were assumed to provide foraging habitat, if only transiently, for all the threatened species recorded in the study area as well as species not recorded but have the potential to occur, such as the Dusky Woodswallow, Little Bent-winged bat, Powerful Owl and Masked Owl. All have been incorporated for foraging habitat loss in the ecosystem credit calculations for the 17.49 ha vegetation zones D1, D2 and D4 (i.e., the area of the BCAA with a vegetation integrity score above 17). The loss or modification of the vegetation with integrity scores below 17 do not require a further calculation of ecosystem credits as dictated by s 3.1.1.3 of BAM

The resulting ecosystem requirement for the loss of vegetation zone D1, D2 and D4 equated to 421 ecosystem credits for PCT 1082, and 11 of PCT 662 or a similar PCTs within the Sydney Basin bioregion.

No threatened flora, threatened flora populations or ecological communities listed on the schedules of the *NSW Biodiversity Conservation Act 2016,* or the *Commonwealth Environment Protection and Biodiversity Conservation Act* 1999 were recorded in the BCAA. Therefore, no threatened flora species were included in species credit calculations.

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Following detailed and repeated seasonal surveys, no breeding habitat for any threatened species was recorded in the BCAA. However, given that four species credit species were recorded nearby the BCAA and the prescriptions relating to foraging habitat under BAM dictated that potential habitat within a defined distance to potential roosting or foraging habitat be included in the biodiversity offset calculations.

All PCT 1082 and 662 within 200 metres of open water greater than 3 m or the defined foraging habitat for the Southern Myotis, was included in species credit calculations (3.38 ha). Similarly, as prescribed the potential roosting sites for both the Large-eared Pied Bat and Eastern Cave Bat within 2 kilometres of the study area were mapped. Given the proximity of such suitable habitat, the entire BCAA is potential (22.81 ha) foraging for these species credit species and credits were derived for the potential loss of this habitat.

Similarly, the 14.34 ha (both PCT 1082 and 662) was assumed to be habitat for the Eastern Pygmy Possum. These rules of BAM have resulted in the species credit requirement of:

- 477 Eastern Pygmy Possum credits
- 106 Southern Myotis credits;
- 914 Large-eared Pied Bat credits; and
- 914 Eastern Cave Bat credits.

There were no other candidate species and no likely serious and irreversible impacts likely as a result of this BCA, due to the absence of defined breeding habitat for any conservation dependant species, absence of any EEC, threatened population or important biodiversity area.

All potentially occurring federally listed threatened species were considered under the administrative guidelines for determining significance under the *Commonwealth Environment Protection & Biodiversity Conservation Act 1999*, has concluded that the development proposal is unlikely to have a significant impact on matters of National Environmental Significance and a referral to the Commonwealth Environment Minister is not necessary.

9. Additional information

9.1 Licensing

OMVI Ecological is licensed to undertake all flora and fauna surveys for the proposal under the following licenses

- OEH Scientific License SL100051 (expiry 31 July 2020);
- NSW DPI office of NSW T&I Animal Care and Ethics Committee approval number 20/269 (expiry 21 March 2023)
- NSW Biodiversity Assessor Accreditation (BAAS18046)

9.2 Staff Qualifications

This report, including all calculations and analysis, was prepared by Brendan Ryan based on field surveys conducted by Brendan Ryan, Gary Leonard and Ben Lewis with respect to this assessment.

Qualifications of the recent surveys are presented in Table 20, below.

Table 20: Qualifications of the surveyors/assessors

Name	Company	Qualifications	Years' experience	Role
Brendan Ryan	OMVI Ecological	BSc, MSc	22 years ecological consulting, over 24 years ecological surveys	Fauna surveys; targeted threatened flora surveys; targeted threatened fauna surveys; Biometric plot surveys; Vegetation community mapping; data analysis and reporting
Gary Leonard	Botanist	Masters of Science (in prep) Diploma of Education National Diploma of Horticulture Horticulture Certificate	Over 40 years working as a horticulturist, environmental consultant and teacher	Vegetation classification and community mapping; biometric plot surveys.
Ben Lewis	Lewis Ecological	B.A.Sc. (Honours)	22 years ecological consulting, over 24 years ecological surveys	Fauna surveys; targeted threatened fauna surveys

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Appendix A

Flora and Fauna Lists

Table 21: Flora List for the Subject site

SCIENTIFIC NAME	COMMON NAME	AHA - 2007					Biosis - 2010						OMVI – 2015 - 2020							
		1	2	3	4	Total	1	2	3	4	5	Total	1	2	3	4	5	6	7	Total
*Plantago lanceolata**	Lamb's Tongues*		x		x	x														
Adiantum aethiopicum	Common Maidenhair Fern				x	x	x		x			x	x	x	x	x				x
Cheilanthes sieberi	Mulga Fern						x		x			x			x					x
Xanthosia pilosa		x			x	x		x	x			x								
Nyssanthes erecta													x							x
Actinotus helianthi	Flannel Flower				x	x														
Actinotus minor	Lesser Flannel Flower				x	x														
Centella asiatica	Indian Pennywort								x		x	x	x		x	x	x	x	x	x
*Hydrocotyle bonariensis**					x	x														
Hydrocotyle peduncularis	Shinning Pennywort						x				x	x	x							x
Hydrocotyle tripartita																	x	x		x
Platysace linearifolia	Narrow-leaf Platysace		x			x								x			x		x	x
Marsdenia rostrata	Common Milk Vine								x			x								
Marsdenia suaveolens															x					x
Parsonsia straminea	Common Silkpod										x	x			x				x	x
*Asparagus (syn Protasparagus) aethiopicus**	Asparagus Fern*																x			x
Bulbine bulbosa	Native Leek													x						x
*Ageratina adenophora**	Crofton Weed								x			x								
*Bidens pilosa**	Cobbler's Pegs*				x	x													x	x
Calotis cuneifolia	Purple Burr-daisy												x				x			x
*Cirsium vulgare**	Spear Thistle*				x	x					x	x					x			x
*Conyza bonariensis**	Tall Fleabane*															x				x
Conyza sp	Fleabane										x	x								
Coronidium oxylepis									x			x								
Euchiton involucratus	Star Cudweed															x				x
*Hypochaeris radicata**	Flatweed*												x			x	x	x	x	x
Leucanthemum vulgare	Ox-eye Daisy																		x	x
Olearia tomentosa	Toothed Daisy Bush			x		x	x					x								
Ozothamnus diosmifolius	Rice Flower							x	x			x								
Pseudognaphalium luteoalbum	Jersey Cudweed															x				x
*Senecio madagascariensis**	Fireweed*								x			x				x			x	x
Vernonia cinerea var. cinerea	Vernonia		x		x	x											x			x
Bauera rubioides	River Rose	x			x	x			x			x								
Pandorea pandorana	Wonga-wonga Vine																		x	x
Blechnum cartilagineum	Gristle Fern												x							x
Brunoniella australis	Blue Trumpet						x					x								
Allocasuarina littoralis	Black She-oak		x		x	x	x	x	x	x		x	x	x		x	x		x	x
Allocasuarina torulosa															x					x
*Alternanthera pungens **	Khaki weed*															x			x	x
Hypericum gramineum	Small St Johns Wort												x		x	x	x			x
Hypericum japonicum																x				x
Burchardia umbellata	Milkmaids															x			x	x
Dichondra repens	Kidney Weed			x	x	x			x			x	x	x	x		x			x
Dichondra. sp. A	Kidney Leaf																		x	x
Ceratopetalum gummiferum	Christmas Bush				x	x	x					x								
Cyathea australis	Rough Tree-fern								x			x								
Baumea rubiginosa	Soft Twig-rush			x		x							x	x						x

SCIENTIFIC NAME	COMMON NAME	AHA - 2007					Biosis - 2010						OMVI – 2015 - 2020							
		1	2	3	4	Total	1	2	3	4	5	Total	1	2	3	4	5	6	7	Total
Baumea teretifolia	Twig-rush												x	x	x			x		x
Bolboschoenus caldwellii													x							x
Caustis flexuosa	Curly Wig	x	x		x	x		x				x					x			x
Cyathochaeta diandra								x				x					x			x
Cyperus brevifolius	Mullumbimby couch															x				x
*Cyperus eragrostis**	Umbrella Sedge*										x	x								
Cyperus gracilis	Slender Flat-sedge															x				x
Cyperus polystachyos																		x		x
Cyperus sanguinolentus																x		x		x
Eleocharis sphacaelata	Tall Spike-rush															x				x
Fimbristylis dichotoma	Common Fringe-sedge			x		x														
Gahnia clarkei			x	x	x	x														
Gahnia sieberiana													x	x	x					x
Gahnia sp.	Saw-sedge								x			x								
Gahnia subaequiglumis																		x		x
Isolepis inundata																		x		x
Lepidosperma laterale	Variable Sword-sedge	x	x		x	x	x	x	x			x	x	x	x		x	x	x	x
Lepidosperma urophorum														x			x	x	x	x
Ptilothrix deusta	A Sedge										x	x								
Schoenoplectus validus													x				x			x
Schoenus brevifolius	A bog-rush												x							x
Schoenus ericetorum													x							x
Schoenus melanostachys									x		x	x								
Pteridium esculentum	Common Bracken			x		x							x				x			x
Calochlaena dubia	Rainbow Fern								x			x	x							x
Drosera auriculata													x							x
Drosera peltata	A sundew																	x		x
Drosera spatulata				x		x												x		x
Epacris longiflora			x		x	x														
Epacris microphylla				x	x	x		x				x		x			x	x		x
Epacris pulchella	NSW Coral Heath							x		x		x								
Lissanthe strigosa	Peach Heath												x		x	x			x	x
Monotoca scoparia									x			x								
Amperea xiphoclada var. xiphoclada	Broom Spurge			x	x	x														
Breynia oblongifolia	Coffee Bush						x					x								
Homalanthus populifolius	Bleeding Heart		x	x		x														
Aotus ericoides	Common Aotus			x		x		x				x								
Bossiaea buxifolia															x					x
Bossiaea heterophylla	Variable Bossiaea				x	x		x				x								
Bossiaea obcordata	Spiny Bossiaea				x	x			x			x					x			x
Daviesia alata					x	x														
Daviesia corymbosa					x	x														
Daviesia leptophylla					x	x														
Daviesia ulicifolia	Gorse Bitter Pea		x			x	x					x								
Desmodium varians	Variable Tick-trefoil																		x	x
Dillwynia floribunda																	x			x
Dillwynia sericea																		x		x
Glycine clandestina	Love Creeper				x	x							x		x		x		x	x
Glycine microphylla	Small-leaf Glycine						x					x								

SCIENTIFIC NAME	COMMON NAME	AHA - 2007					Biosis - 2010						OMVI – 2015 - 2020							
		1	2	3	4	Total	1	2	3	4	5	Total	1	2	3	4	5	6	7	Total
Glycine tabacina	Love Creeper		x			x	x		x			x	x				x			x
Gompholobium glabratum			x			x														
Gompholobium grandiflorum	Large Wedge-pea	x				x		x				x								
Gompholobium pinnatum	Pinnate Wedge Pea		x		x	x			x			x								
Gompholobium uncinatum	Red Wedge Pea							x				x								
Hardenbergia violacea	Twining Pea				x	x			x			x								
Hibbertia aspera	Rough Guinea-flower							x	x			x		x						x
Hibbertia diffusa	Wedge Guinea Flower								x			x								
Hibbertia empertrifolia								x				x		x	x		x		x	x
Hibbertia riparia					x	x			x			x								
Hibbertia scandens	Climbing Guinea Flower												x							x
Hibbertia sp.	Guinea-flower		x			x			x			x								
Kennedia rubicinda	Dusky Coral-pea																	x		x
Mirbelia rubiifolia	Heath Mirbelia							x				x								
Mirbelia speciosa		x	x		x	x														
Platylobium formosum	Handsome Flat-pea				x	x			x			x					x			x
Pultenaea daphnoides	Large-leaf Bush-pea										x	x					x			x
Pultenaea linophylla	Halo Bush-pea										x	x					x			x
Pultenaea retusa									x			x					x			x
Pultenaea villosa								x				x								
Zornia dyctiocarpa																	x			x
*Centaurium erythraea**	Common century*															x				x
Dampiera stricta					x	x														
Goodenia hederacea var. hederacea	Variable-leaved Goodenia	x			x	x	x	x	x			x	x		x		x			x
Goodenia paniculata	Branched Goodenia			x	x	x							x		x		x	x		x
Scaevola ramosissima											x	x	x							x
Haemodorum corymbosum		x	x		x	x														
Gonocarpus micranthus	Creeping Raspwort												x					x		x
Gonocarpus tetragynus	Poverty Raspwort								x			x								
Gonocarpus teucrioides	Germander Raspwort															x				x
Patersonia glabrata	Leafy Purple Flag	x			x	x	x	x	x			x					x			x
Patersonia sericea	Silky Purple Flag				x	x								x	x		x			x
*Juncus cognatus**																x				x
Juncus continuus													x						x	x
Juncus planifolius													x			x				x
Juncus subsecundus	Finger Rush															x				x
Juncus usitatus	Rush										x	x				x				x
Chloanthes stoechadis					x	x														
Hemigenia purpurea															x					x
Cassytha glabella	Devils Twine	x			x	x														
Dianella caerulea	Blue Flax-lily	x			x	x			x			x	x	x			x		x	x
Dianella caerulea var. producta	Blue Flax-lily				x	x	x		x			x								
Tricoryne elatior	Yellow Rush-lily													x	x		x			x
Lindsaea linearis	Screw Fern	x			x	x		x				x					x			x
Lindsaea microphylla	Lacy Wedge-fern								x			x		x						x
Lobelia dentata	Wavy Lobelia																	x		x
Pratia purpurascens	Whiteroot						x	x	x			x	x		x	x	x	x	x	x
Mitrasacme polymorpha																	x			x
Brachychiton acerifolius	Illawarra Flame Tree														x					x

SCIENTIFIC NAME	COMMON NAME	AHA - 2007					Biosis - 2010						OMVI – 2015 - 2020							
		1	2	3	4	Total	1	2	3	4	5	Total	1	2	3	4	5	6	7	Total
*Sida rhombifolia**	Paddy's Lucerne*								x		x	x				x	x			x
Acacia binervata	Two-veined Hickory				x	x	x					x			x		x			x
Acacia filicifolia	Fern-leaved Wattle		x	x		x														
Acacia floribunda	White Sally Wattle		x			x					x	x		x						x
Acacia irrorata					x	x							x	x			x		x	x
Acacia longifolia	Sydney Golden Wattle				x	x	x		x			x								
Acacia mabelliae																x				x
Acacia mearnsii	Black Wattle				x	x					x	x								
Acacia melanoxylon	Blackwood												x							x
Acacia mucronata					x	x														
Acacia obtusifolia	blunt leaf wattle												x	x			x			x
Acacia suaveolens	Sweet Wattle				x	x		x				x								
Acacia terminalis	Sunshine Wattle				x	x	x	x	x			x								
Acacia ulicifolia	Prickly Moses	x	x	x	x	x	x	x	x			x								
Myrsine variabilis	Muttonwood												x							x
Acmena smithii															x					x
Angophora floribunda	Rough-barked Apple								x			x								
Baeckea brevifolia	Short-leaved Heath-myrtle							x				x								
Callistemon linearis	Narrow-leaved Bottlebrush							x	x			x								
Calytrix tetragona	Common Fringe-myrtle	x				x														
Corymbia gummifera	Red Bloodwood		x		x	x	x	x	x			x		x	x		x		x	x
Corymbia maculata	Spotted Gum						x		x			x			x					x
Eucalyptus agglomerata					x	x		x				x		x						x
Eucalyptus eugenioides	Thin-leaved Stringybark						x					x			x					x
Eucalyptus globoidea	White Stringybark				x	x							x	x		x	x		x	x
Eucalyptus paniculata subsp. paniculata	Grey Ironbark				x	x														
Eucalyptus pilularis					x	x														
Eucalyptus piperita	Sydney Peppermint				x	x	x		x			x	x	x		x			x	x
Eucalyptus punctata	Grey Gum				x	x		x	x			x	x	x	x		x			x
Eucalyptus saligna complex	Blue Gum						x					x	x		x					x
Eucalyptus sclerophylla	Hard-leaf Scribbly Gum	x	x		x	x		x	x	x		x		x			x		x	x
Eucalyptus sp.											x	x								
Kunzea ambigua	Tick Bush				x	x	x	x	x	x		x	x	x	x	x	x	x	x	x
Leptospermum arachnoides															x					x
Leptospermum continentale					x	x														
Leptospermum juniperinum	Prickly Tea-tree							x				x								
Leptospermum morrisonii	Tea-tree			x		x								x				x	x	x
Leptospermum polygalifolium	Yellow Tea-tree							x		x	x	x	x	x		x	x		x	x
Leptospermum trinervium	Flaky-barked Tea-tree		x		x	x		x	x	x		x		x			x			x
Melaleuca ericifolia	Swamp Paperbark				x	x														
Melaleuca linariifolia	Flax-leaved Paperbark			x		x			x			x	x	x	x			x		x
Melaleuca nodosa																		x		x
Melaleuca styphelioides	Prickly-leaved Tea Tree				x	x	x					x		x						x
Melaleuca thymifolia	Thyme Honey-myrtle				x	x		x				x	x					x		x
Micromyrtus ciliata	Fringed Heath-myrtle																	x		x
Sannantha pluriflora											x	x		x						x
Syncarpia glomulifera subsp. glomulifera	Turpentine										x	x	x	x	x				x	x
Acianthus excertus	Mosquito Orchid																			x
Acianthus fornicatus	Pixie Caps								x			x								x

SCIENTIFIC NAME	COMMON NAME	AHA - 2007					Biosis - 2010						OMVI – 2015 - 2020							
		1	2	3	4	Total	1	2	3	4	5	Total	1	2	3	4	5	6	7	Total
Acianthus sp.	A mosquito orchid																			x
Caleana major	Large Duck Orchid				x	x														
Calochilus gracillimus	Slender Beard Orchid	x				x														
Calochilus paludosus	Red Beard Orchid				x	x														
Calochilus sp.	Bearded Orchid																			x
Corunastylis woollsii																				x
Corybas sp	Helmet Orchid								x			x								
Cryptostylis erecta	Bonnet Orchid			x	x	x							x							x
Cryptostylis subluata				x		x		x				x					x			x
Cymbidium suave	Snake Flower							x				x								
Diuris sulphurea	Tiger Orchid				x	x														
Eriochilus cucullatus	Pink Autumn Orchid																			x
Genoplesium baueri																				x
Genoplesium oligantha																				x
Genoplesium pumila																				x
Pterostylis sp.															x					x
Oxalis chnoodes											x	x								
Oxalis corniculata											x	x	x							x
Oxalis perennans	Oxalis															x	x		x	x
Glochidion ferdinandi	Cheese Tree										x	x			x					x
Phyllanthus hirtellus	Thyme Spurge		x		x	x		x	x			x			x					x
Poranthera ericifolia								x				x								
Poranthera microphylla	-			x	x	x														
Micrantheum ericoides																	x			x
Billardiera scandens subsp. scandens	Apple Berry		x		x	x	x	x				x	x				x		x	x
Pittosporum revolutum	Rough-fruit Pittosporum																			x
Pittosporum undulatum	Sweet Pittosporum																			x
*Andropogon virginicus**	Whiskey Grass*			x	x	x			x	x	x	x	x			x	x		x	x
Anisopogon avenaceus	Oat Spear Grass						x	x	x			x		x	x		x		x	x
Aristada ramosa	Three-awn Spear-grass													x			x			x
Aristada vagans	Three-awn Spear-grass	x	x		x	x										x				x
Austrostipa pubescens		x	x		x	x														
Austrostipa ramosissima	Stout Bamboo Grass																	x		x
*Axonopus fissifolius**	Narrow-leafed Carpet Grass*								x		x	x				x			x	x
*Cortaderia selloana**	Pampas grass*																		x	x
Cymbopogon refractus	Barbed Wire Grass												x							x
Cynodon dactylon	Couch										x	x				x			x	x
*Digitaria ciliaris**	Summergrass *												x			x	x			x
Digitaria parviflora	Small Flowered Finger-grass																x			x
Digitaria ramularis									x			x								
Echinopogon caespitosus	Tufted Hedgehog Grass		x		x	x							x	x			x		x	x
Echinopogon ovatus	Forest Hedgehog Grass						x					x				x	x			x
Eleusine indica	Crowsfoot Grass																		x	x
Elymus scaber																	x			x
Entolasia marginata	Bordered Panic				x	x	x	x	x			x								
Entolasia stricta	Wiry Panic	x	x		x	x		x	x	x		x	x	x	x		x	x	x	x
Eragrostis brownii	Brown's Love Grass					x	x	x	x			x					x	x		x
*Eragrostis cilianensis**	Stinkgrass*															x				x
Eragrostis leptostachya	Paddock Lovegrass										x	x	x	x		x	x		x	x

SCIENTIFIC NAME	COMMON NAME	AHA - 2007					Biosis - 2010						OMVI – 2015 - 2020							
		1	2	3	4	Total	1	2	3	4	5	Total	1	2	3	4	5	6	7	Total
Hemarthria uncinata var uncinata	Matgrass								x			x								
Imperata cylindrica	Blady Grass						x		x			x	x				x			x
Microlaena stipoides	Weeping Meadow Grass						x	x	x		x	x	x	x	x	x	x		x	x
Oplismenus aemulus	Basket Grass		x	x		x													x	x
Oplismenus imbecillis	Basket Grass						x					x			x		x		x	x
Panicum simile	Two Colour Panic	x	x		x	x		x	x			x								
Paspalidium distans																	x			x
*Paspalum dilatatum**	Paspalum*															x			x	x
Paspalum distichum	Water couch													x			x			x
Paspalum urville	Vasey Grass	x	x		x	x										x				x
*Pennisetum clandestinum**	Kikuyu*							x	x			x				x			x	x
Poa sieberiana									x			x								
Rytidosperma tenuius	Wallaby Grass		x		x	x									x		x	x		x
*Setaria gracilis**	Slender Pigeon Grass*						x		x			x				x			x	x
*Sporobolus africanus**	Parramatta Grass*	x			x	x	x	x	x			x				x				x
*Sporobolus fertilis**	Giant Parramatta Grass*															x			x	x
Themeda australis	Kangaroo Grass										x	x								
Themeda triandra	Kangaroo Grass												x	x	x	x	x			x
*Acetosa sagittata**	Turkey Rhubarb*																		x	x
Comesperma ericinum	Pyramid Flower	x			x	x														
Persicaria decipiens	Spotted Knotweed						x		x			x								
Rumex brownii	Swamp Dock								x			x								
*Anagallis arvensis**	Scarlet Pimpernel										x	x								
Banksia integrifolia																x				x
Banksia marginata					x	x														
Banksia paludosa														x			x			x
Banksia serrata	Saw Banksia	x			x	x		x				x					x			x
Banksia spinulosa var. spinulosa	Hair-pin Banksia	x			x	x		x	x			x		x			x			x
Grevillea linearifolia																				x
Hakea dactyloides	Broad-leaved Hakea							x			x	x		x			x			x
Hakea salicifolia	Willow-leaved Hakea									x	x	x		x						x
Hakea sericea	Bushy Needlebush				x	x	x	x		x	x	x		x	x	x	x		x	x
Hakea teretifolia																				x
Isopogon anemonifolius	Narrow-leaf drumsticks																			x
Isopogon anethifolius					x	x														
Lambertia formosa	Mountain Devil	x			x	x		x	x			x		x			x			x
Leucopogon juniperinus	Juniper Beard-heath						x			x		x					x			x
Leucopogon lanceolatus	Lance-leaf Beard-heath								x			x			x					x
Lomatia ilicifolia	Holly Lomatia																x			x
Persoonia levis	Broad-leaved Geebung							x				x								
Persoonia linearis	Narrow-leaved Geebung	x	x		x	x	x		x			x		x	x		x		x	x
Persoonia mollis																	x		x	x
Petrophile pulchella											x	x								
Petrophile sessilis					x	x			x			x								
Telopea speciosissima																				x
Clematis aristata	Old Man's Beard														x				x	x
Ranunculus inundatus															x					x
Ranunculus plebeius															x					x
Baloskion fimbriatum	Fringed Cord-rush												x							x

SCIENTIFIC NAME	COMMON NAME	AHA - 2007					Biosis - 2010						OMVI – 2015 - 2020							
		1	2	3	4	Total	1	2	3	4	5	Total	1	2	3	4	5	6	7	Total
Empodisma minus	Spreading rope-rush													x			x			x
Hypolaena fastigiata																		x		x
Leptocarpus tenax					x	x														
Lepyrodia scariosa								x	x			x					x			x
Pomaderris discolor	Pomaderris						x		x	x		x								
Pomaderris elliptica														x						x
Pomaderris intermedia					x	x					x	x								
Rubus moluccanus																			x	x
*Rubus ulmifolius**	Blackberry							x	x			x								
Opercularia aspera	Coarse Stinkweed								x			x								
Opercularia diphylla	-										x	x	x	x	x		x			x
Pomax umbellata	Pomax				x	x								x	x		x		x	x
Richardia stellaris							x					x								
Choretrum candollei	White Sour Bush				x	x														
Dodonaea triquetra	Common Hop Bush			x	x	x	x		x			x		x	x				x	x
Veronica plebeia	Trailing Speedwell																x			x
Selaginella uliginosa													x					x		x
Smilax glyciphylla	Sweet Sarsaparilla												x							x
Stylidium graminifolium	Grass Trigger-plant		x			x														
Pimelea linifolia	Slender Rice-flower						x					x		x						x
Typha domingensis	Narrow-leaved Cumbungi				x	x														
Trema tomentosa	Native Peach																		x	x
*Lantana camara**	Lantana*																x		x	x
*Verbena bonariensis**	Purpletop*						x		x			x				x				x
Verbena rigida	Veined Verbena				x	x										x				x
Viola banksii													x							x
Viola hederacea	Native Violet												x	x			x			x
Viola sieberana	Tiny Violet													x						x
Lomandra confertifolia subsp. rubiginosa	Mat-rush								x			x							x	x
Lomandra cylindrica			x		x	x														
Lomandra filiformis	Wattle Mat-rush		x			x	x					x	x				x			x
Lomandra glauca			x		x	x			x			x					x			x
Lomandra gracilis	A mat-rush						x					x		x			x		x	x
Lomandra longifolia	Spiny-headed Mat-rush				x	x	x		x			x	x	x	x		x		x	x
Lomandra multiflora	Many-flowered Mat-rush																x			x
Lomandra obliqua	Fish Bones	x	x		x	x	x	x	x			x				x	x		x	x
Xanthorrhoea concava	A grass tree																x			x
Xanthorrhoea media																				x
Xanthorrhoea resinifera (resinosa)																				x
Macrozamia communis	Burrawang						x					x		x	x					x
Wollemia nobilis#	Wollemi Pine #															x				x
Grevillea macleyiana #	Jervis Bay Grevillea															x				x
Eucalyptus scoparia#	Wallangarra White Gum															x				x
Syzigium paniculata #	Magenta Lilly Pilly															x				x
	Totals	**28**	**39**	**22**	**100**	**124**	**51**	**56**	**84**	**12**	**35**	**154**	**66**	**60**	**53**	**56**	**94**	**31**	**62**	**237**

KEY

* not indigenous to Shoalhaven LGA

\# species of conservation significance

Vegetation type

from Biosis (2010)

1 Spotted Gum Woodland

2 Scribbly Gum Woodland

3 Grey Gum Woodland

OMVI (current)

1 PCT 1206

2 PCT 1079

3 PCT 694

SCIENTIFIC NAME	COMMON NAME	AHA - 2007					Biosis - 2010						OMVI – 2015 - 2020							
		1	2	3	4	Total	1	2	3	4	5	Total	1	2	3	4	5	6	7	Total
from AHA (2007) 1- SQRBW 2- SGOW 3- Grey Gum 4- Incidentals							4 Shrubland 5 Closed Grassland						4 PCT 1082 (DNG) 5 PCT 1082 (moderate) 6 PCT 662 7 PCT 1082 (disturbed)							

Table 22: BAM plots surveyed, including location and position.

COUNT	PLOT NO.	PCT	VEG ZONE	CONDITION	ZONE	LATITUDE	LONGITUDE	BEARING	EEC?
1	GL1	1082	D3	very low – Derived native grassland	56	277542	6140975	240	no
2	GL2	1082	D3	very low – Derived native grassland	56	277859	6141047	15	no
3	GL3	1082	D3	very low – Derived native grassland	56	277889	6140956	20	no
4	GL4	1082	D3	very low – Derived native grassland	56	277915	6140798	30	no
5	GL5	1082	D3	very low – Derived native grassland	56	277721	6141142	351	no
6	Mound 1	1082	D2	poor – highly modified/disturbed	56	277070	6141176	235	no
7	Mound 2	1082	D2	poor – highly modified/disturbed	56	277745	6140837	22	no
8	SLP1	1082	D2	poor – highly modified/disturbed	56	277889	6140869	300	no
9	SG1	1082	D1	moderate to good condition	56	277757	6140972	240	no
10	SG2	1082	D1	moderate to good condition	56	277500	6141010	12	no
11	SG3	1082	D1	moderate to good condition	56	277326	6140762	230	no
12	SG4	1082	D1	moderate to good condition	56	277304	6141059	193	no
13	SG5	1082	D1	moderate to good condition	56	277262	6141091	259	no
14	SG6	1082	D1	moderate to good condition	56	277147	6140974	290	no
15	SG7	1082	D1	moderate to good condition	56	277133	6141069	275	no
16	SG8	1082	D1	moderate to good condition	56	276583	6141168	15	no
17	SG9	1082	D1	moderate to good condition	56	277493	6141164	280	no
18	MMH1	662	D4	moderate	56	277577	6140747	270	no
19	MMH2	662	D4	moderate	56	277010	6140884	315	no
20	GG1	1079	B1 – outside BCAA	moderate to good condition	56	277457	6140684	270	no
21	GG2	1079	B1 – outside BCAA	moderate to good condition	56	276910	6140795	285	no
22	GG3	1079	B1 – outside BCAA	moderate to good condition	56	276788	6141163	15	no
23	M1	694	B2 – outside BCAA	moderate to good condition	56	277815	6140642	250	no
24	M2	694	B2 – outside BCAA	moderate to good condition	56	277747	6140686	252	no
25	M3	694	B2 – outside BCAA	moderate to good condition	56	277649	6140681	270	no
26	S1	1206	B3 – outside BCAA	moderate to good condition	56	276721	6141288	290	no
27	S2	1206	B3 – outside BCAA	moderate to good condition	56	276805	6140748	300	no

Shaded rows = plots used in BAMC

Table 23: Vegetation integrity data (Composition and Structure) recorded in the BAM plots

PLOT NO.	COMPOSITION						STRUCTURE					
	TREE	SHRUBS	GRASS	FORBES	FERNS	OTHER	TREE	SHRUBS	GRASS	FORBS	FERNS	OTHER
GL1	0	0	6	5	0	0	0	0	20	8	0	0
GL2	0	1	5	3	0	0	0	0.1	23.2	6.5	0	0
GL3	0	5	5	3	0	0	0	16.5	8.5	3.1	0	0
GL4	4	3	4	2	0	0	15	23.1	14.1	2.2	0	0
GL5	1	4	5	2	0	0	5	12	8.8	1.5	0	0
Mound 1	4	7	7	7	1	4	30	23.8	23	5.2	0.2	3.9

Mound 2	4	6	8	6	1	3	56.1	50.6	2.5	3.3	2	0.7
SLP1	2	8	4	3	0	0	15	46.4	7	4.1	0	0
SG1	5	2	9	8	1	2	64	6	76	25.1	2	7
SG2	2	4	8	10	0	2	45	18.5	44	11.9	0	2.2
SG3	2	5	9	2	0	0	30	10.1	54.6	0.3	0	0
SG4	4	10	11	6	0	0	50	15.9	43	9	0	0
SG5	3	13	8	5	2	1	37	16	21.3	0.7	2	0.2
SG6	4	11	9	0	0	0	41	26.2	39	0	0	0
SG7	3	12	8	4	0	2	42	31.5	39.5	3.4	0	3.2
SG8	4	14	5	4	0	0	91	78	17	11	0	0
SG9	6	10	8	6	0	1	38.3	27.1	13.1	3.1	0	0.1
MMH1	0	5	5	8	1	0	0	100	13	19.4	4	0
MMH2	0	4	8	2	0	0	0	86	26	3	0	0
GG1	4	7	12	2	0	0	34	72.4	59.4	0.4	0	0
GG2	4	9	7	4	0	0	90	66	30	10	1	0
GG3	6	19	6	6	2	1	72	88	30	23	6	5
M1	5	6	9	9	1	1	48.1	91.1	54.5	11.8	6	0.4
M2	3	6	8	11	3	4	80	21.5	15	1.8	4.5	2.6
M3	4	5	10	12	3	2	26	49	42	6.8	5.5	2.1
S1	3	8	5	6	1	0	22	55	31	17	2	5
S2	9	7	6	8	1	6	94	32	51	20	3	16

Shaded rows = plots used in BAMC

Table 24: ***Vegetation integrity data (Function) recorded in the BAM plots***

PLOT NO.	HBTS	LITTER COVER	FALLEN LOGS	REGENERATION	TRES STEMS SIZE							HIGH THREAT WEED
					>5cm	5-9 cm	10-19 cm	20 – 29 cm	30-49 cm	50 – 79 cm	80 cm +	
GL1	0	14	3.5	no	0	0	0	0	0	0	0	0.1
GL2	0	22	0	no	0	0	0	0	0	0	0	9
GL3	0	16	0	no	0	0	0	0	0	0	0	14
GL4	0	23	0	no	0	0	0	0	0	0	0	3
GL5	0	17	7	yes	5	6	5	0	0	0	0	0
Mound 1	0	21	9	yes	+200	23	17	7	7	0	0	0
Mound 2	2	51	8	yes	7	34	25	13	11	1	1	1
SLP1	0	24	1	yes	5	0	2	3	2	0	0	2
SG1	3	94.6	15	yes	15	2	9	13	19	9	1	1
SG2	3	68.5	31	yes	2	1	11	9	6	2	1	0
SG3	8	68	19	yes	0	4	10	17	3	4	0	0
SG4	3	68	36	yes	9	6	6	11	17	0	0	0
SG5	6	47	16	yes	+75	13	3	4	2	2	2	0
SG6	3	26	9	yes	+90	3	10	9	5	2	0	0
SG7	0	34	4	yes	+80	12	14	16	2	1	0	0
SG8	7	6	5	yes								0
SG9	1	94.8	1	yes	4	29	16	15	11	0	0	0.4
MMH1	0	22	0	yes	+50	10	1	0	0	0	0	0
MMH2	0	22	7	no	0	1	2	1	0	0	0	0
GG1	2	4	27.5	yes	42	4	2	3	0	0	1	1
GG2	2	4	37	yes								0
GG3	5	0	43	yes								4
M1	0	42	2	yes	+35	29	20	17	2	0	0	0
M2	1	66.6	13	yes	+150	14	25	17	5	1	0	0

Plot No.	HBTs	Litter Cover	Fallen Logs	Regeneration	Tres stems size							High Threat Weed
					>5cm	5-9 cm	10-19 cm	20 – 29 cm	30-49 cm	50 – 79 cm	80 cm +	
M3	0	37	8	yes	+110	30	32	11	4	0	0	0
S1	0	0	28	yes								0
S2	4	4	11	yes								0

Shaded rows = plots used in BAMC

Table 25: Fauna List for the Study area. Recorded at the study area unless otherwise stated.

Count	Scientific Name	Common Name	AHA (Crams Rd IA, 2008)	Biosis (Lot 24, 2010)	OMVI (Lot 24, 2011)	OMVI (Lots 21 - 24 2015 -2020)
	Fish					
1	*Gobiomorphus australis*	Striped Gudgeon				O - trap
2	*Anguilla reinhardtii*	long-finned eel				O
3	*Retropinna semoni*	Australian Smelt				O - trap
	Total	**3**	**0**	**0**	**0**	**3**
	Amphibians					
1	*Crinia signifera*	Common Eastern Froglet	W	W	W	W
2	*Limnodynastes dumerilii*	Eastern Pobblebonk	W			
3	*Limnodynastes peronii*	Striped Marsh Frog	W	W	W	
4	*Limnodynastes tasmaniensis*	Spotted Marsh Frog			W	W
5	*Mixophyes fasciolatus*	Great Barred Frog				O - trap
6	*Litoria citropa*	Blue Mts. Tree Frog			O	
7	*Litoria peronii*	Peron's Tree Frog	W	W	W	W
8	*Litoria jervisiensis*	Jervis Bay Tree Frog	W			
9	*Litoria verreauxii*	Whistling Tree Frog		W		
10	*Litoria dentata*	Bleating Tree Frog			O	W
11	*Paracrinia haswellii*	Red-groined Froglet			W	W
12	*Pseudophryne bibroni*	Bibrons toadlet		W		
13	*Litoria fallax*	Eastern Dwarf Tree Frog	W		W	
14	*Uperoleia tyleri*	Tyler's Toadlet			W	
	Totals	**14**	**6**	**5**	**9**	**6**
	Reptiles					
1	*Ctenotus sp.*	Ctenotus			O	
2	*Ctenotus taeniolatus*	Copper-tailed Skink				O
3	*Ctenotus robusta*	Robust Skink				O
4	*Eulamprus quoyii*	Eastern Water Skink			O	O
5	*Lampropholis delicata*	Dark-flecked Garden Sun-skink		O	O	O
6	*Saproscincus mustelina*	Weasel Skink			O	
7		Skink?	O			
8	*Amphibolurus muricatus*	Jacky Lizard			O	
9	*Intellagama lesueurii*	Eastern Water Dragon				O
10	*Varanus varius*	Lace Monitor	O		O	O
11	*Pseudechis porphyriacus*	Red-bellied Black Snake			O	O
	Totals	**10**	**2**	**1**	**7**	**7**
	Birds					
1	*Gallus gallus**	Domestic Chicken*			W	eggs
2	*Cygnus atratus*	Black Swan		O		
3	*Phalacrocorax carbo*	Great Cormorant			O	
4	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	O	O		
5	*Falco berigora*	Brown Falcon		O		O

Count	Scientific Name	Common Name	AHA (Crams Rd IA, 2008)	Biosis (Lot 24, 2010)	OMVI (Lot 24, 2011)	OMVI (Lots 21 - 24 2015 -2020)
6	*Lophoictinia isura*	**Squaretail Kite**				**O**
7	*Accipiter cirrocephalus*	Collared Sparrowhawk				O
8	*Turnix varia*	Painted Button-quail			O	
9	*Vanellus miles*	Masked Lapwing			O	
10	*Streptopelia chinensis**	Spotted Turtle-Dove *		O	O	O
11	*Lopholaimus antarcticus*	Topknot Pigeon		O		
12	*Phaps chalcoptera*	Common Bronzewing	O	O	O	O
13	*Phaps elegans*	Brush Bronzewing				O
14	*Leucosarcia melanoleuca*	Wonga Pigeon		O	O	O
15	*Columba leucomela*	White-headed Pigeon	O		W	O
16	*Ocyphaps lophotes*	Crested Pigeon		O	O	O
17	*Macropygia ambioinensis*	Brown Cuckoo-Dove				W
18	*Geopelia striata*	Peaceful Dove				O
19	*Geopelia humeralis*	Barred-shouldered Dove				O
20	*Calyptorhynchus lathami*	**Glossy Black-cockatoo**	**O**		**O - offsite**	**Orts**
21	*Calyptorhynchus funereus*	Yellow-tailed Black-cockatoo	O		O	
22	*Callocephalon fimbriatum*	**Gang-gang Cockatoo**		**O**		**O - flyover**
23	*Eolophus roseicapillus*	Galah	O	O	O	O
24	*Cacatua galerita*	Sulphur-crested Cockatoo	O	O	W	O
25	*Cacatua sanguinea*	Little Corella				O
26	*Glossopsitta pusilla*	**Little Lorikeet**				**O**
27	*Lathamus discolor*	**Swift Parrot**				**O**
28	*Trichoglossus haematodus*	Rainbow Lorikeet	O	O	O	O
29	*Alistreus scapularis*	King Parrot			O	O
30	*Platycercus elegans*	Crimson Rosella	O	O	O	O
31	*Platycercus adscitus eximius*	Eastern Rosella	O	O	O - Offsite	
32	*Chalcites minutillus*	Shinning Bronze Cuckoo				O
33	*Cacomantis flabelliformis*	Fantailed Cuckoo	O		O	O
34	*Eudynamys orientalis*	Eastern Koel				O
35	*Scythrops novaehollandiae*	Channel-billed Cuckoo				O
36	*Ninox boobook*	Southern Boobook		W		W
37	*Podargus strigoides*	Tawny Frogmouth			O	
38	*Aegotheles cristatus*	Australian Owlet Nightjar				W
39	*Hirundapus caudacutus*	White-throated Needletail	O			
40	*Todiramphus sanctus*	Sacred Kingfisher				O
41	*Dacelo novaeguineae*	Laughing Kookaburra	O	O	O	O
42	*Eurystomus orientalis*	Dollarbird	O			
43	*Merops orna*	Rainbow Bee-eater				O
44	*Menura novaehollandiae*	Superb Lyrebird			W - offsite	
45	*Cormobates leucophaeus*	White-throated Treecreeper	O	W	O	O
46	*Malurus cyaneus*	Superb Fairy-wren	O	O	O	O
47	*Malurus lamberti*	Variegated Fairy-wren	O	O	O	
48	*Pardalotus punctatus*	Spotted Pardalote		W	O	O
49	*Pardalotus striatus*	Striated Pardalote		W	O	O
50	*Pycnoptilus floccosus*	Pilot bird		W		
51	*Sericornis frontalis*	White-browed Scrubwren		O	O	O
52	*Sericornis magnirostris*	Large-billed Scrubwren		W		
53	*Gerygone mouki*	Brown Gerygone		W	O	O
54	*Acanthiza pusilla*	Brown Thornbill		W	O	O

Count	Scientific Name	Common Name	AHA (Crams Rd IA, 2008)	Biosis (Lot 24, 2010)	OMVI (Lot 24, 2011)	OMVI (Lots 21 - 24 2015 -2020)
55	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill			O	
56	*Acanthiza nana*	Yellow Thornbill			O	O
57	*Anthochaera chrysoptera*	Little Wattle		O	O	O
58	*Anthochaera carunculata*	Red Wattle	O	O	O	O
59	*Philemon corniculatus*	Noisy Friarbird	O		O	O
60	*Manorina melanocephala*	Noisy Miner		O	O	O
61	*Meliphaga lewinii*	Lewin's Honeyeater		W	O	O
62	*Lichenostomus chrysops*	Yellow-faced Honeyeater		O	O	O
63	*Lichenostomus leucotis*	White-eared Honeyeater	O	W	O	O
64	*Lichenostomus melanops*	Yellow-tufted Honeyeater			O	O
65	*Melithreptus brevirostris*	Brown-headed Honeyeater		W	O	O
66	*Melithreptus lunatus*	White-naped Honeyeater			O	O
67	*Phylidonyris novaehollandiae*	New Holland Honeyeater	O	O	O	
68	*Phylidonyris niger*	White-cheeked Honeyeater	O			
69	*Acanthorhynchus tenuirostris*	Eastern Spinebill	O	O	O	O
70	*Myzomela sanguinolenta*	Scarlet Honeyeater		W		O
71	*Microeca fascinans*	Jacky Winter	O	O		
72	*Eopsaltria australis*	Eastern Yellow Robin	O	W	O	O
73	*Psophodes olivaceus*	Eastern Whipbird	W	W	W	O
74	*Daphoenositta chrysoptera*	**Varied Sittella**		**W**		**O**
75	*Pachycephala pectoralis*	Golden Whistler		W	W	O
76	*Pachycephala rufiventris*	Rufous Whistler		W	O	O
77	*Colluricincla harmonica*	Grey Shrike-thrush		O	O	O
78	*Oriolus sagittatus*	Olive-backed Oriole				O
79	*Myiagra rubecula*	Leaden Flycatcher				O
80	*Myiagra inquieta*	Restless Flycatcher			O	O
81	*Myiagra cyanoleuca*	Satin Flycatcher				O
82	*Monarcha melanopsis*	Black-faced Monarch				O
83	*Rhipidura leucophrys*	Willie Wagtail		O	O	O
84	*Rhipidura albiscapa*	Grey Fantail	O	O	O	O
85	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	O	O	O	O
86	*Coracina papuensis*	White-bellied Cuckoo-shrike				O
87	*Coracina tenuirostris*	Cicada Bird		W		O
88	*Cracticus torquatus*	Grey Butcher		W	O	O
89	*Grallina cyanoleuca*	Magpie-lark		O	O	O
90	*Corcorax melanorhamphos*	White-winged Cough				O
91	*Gymnorhina tibicen*	Australian Magpie	O	O	O	O
92	*Strepera graculina*	Pied Currawong		O	O	O
93	*Corvus coronoides*	Australian Raven	O		O	O
94	*Corvus tasmanicus*	Forest Raven		O		
95	*Corvus orru*	Torresian Crow				O
96	*Ptilonorhychus violaceus*	Satin Bowerbird			O	O
97	*Neochmia temporalis*	Red-browed Finch		W	O	O
98	*Dicaeum hirundinaceum*	Mistletoebird			O	O
99	*Hirundo neoxena*	Welcome Swallow			O	O
100	*Zozterops lateralis*	Silvereye			O	O
101	*Turdus merula**	Blackbird*				O
102	*Sturnus vulgaris**	Common Starling*			O	O
103	*Acridotheres tristis**	Common Myna *		O	O	O

Count	Scientific Name	Common Name	AHA (Crams Rd IA, 2008)	Biosis (Lot 24, 2010)	OMVI (Lot 24, 2011)	OMVI (Lots 21 - 24 2015 -2020)
	Totals	**103**	**30**	**54**	**64**	**83**
	Mammals					
1	*Tachyglossus aculeatus*	Echidna			Tr	O
2	*Antechinus sp.*	Unidentified Antechinus		Sc		
3	*Antechinus stuartii*	Brown Antechinus	O	T		O - trap
4	*Perameles nasuta*	Long-nosed Bandicoot		Tr	Tr	W
5	*Vombatus ursinus*	Common wombat	O	Sc	Tr	O
6	*Trichosurus sp.*	A brushtail	O			
7	*Trichosurus vulpecula*	Brushtail Possum	O	O	Sc	O
8	*Cercartetus nanus*	**Eastern Pygmy Possum**				**O - trap**
9	*Acrobates pygmaeus*	Feather-tail Glider				O - captured
10	*Petaurus breviceps*	Sugar glider	O?	O		O - trap
11	*Petaurus norfolcensis*	**Squirrel Glider**	**O**			
12	*Petaurus australis*	**Yellow-bellied Glider**	**feed tree**	**W**	**feed tree**	**O**
13	*Petauroides volans*	Greater Glider	O			
14	*Pseudocherirus peregrinus*	Ringtail Possum			Tr	O
15	*Macropus giganteus*	Eastern Grey Kangaroo		O	O	O
16	*Macropus rufogriseus*	Red-necked Wallaby	O	O	O	O
17	*Wallabia bicolor*	Swamp Wallaby		O	O	O
18	*Pteropus poliocephalus*	**Grey-headed Flying-fox**	**O**			**W**
19	*Rhinolophus megaphyllus*	Eastern Horseshoe Bat	A(D)?	A(D)		A(D)
20	*Tadarida australis*	White-striped Freetail-bat		W		A(D)
21	*Saccolaimus flaviventris*	**Yellow-bellied Sheathtail Bat**	**A(Pr)**			
22	*Mormopterus ridei (Sp. 2 from Adams)*	Eastern Freetail Bat		A(D)		
23	*Mormopterus norfolkensis*	**East coast Freetail Bat**	**A(Po)**	**A(D)**		**A(D)**
24	*Mormopterus spp.*	Unidentified Freetail Bat		A(D)		
25	*Chalinolobus dwyeri*	**Large-Eared Pied Bat**		**A(D)**		**O -Harp**
26	*Chalinolobus gouldii*	Gould's Wattled Bat	A(D)?	A(D)		A(D)
27	*Chalinolobus morio*	Chocolate Wattled Bat		A(D)		O -Harp
28	*Vespadelus darlingtoni*	Large Forest Bat		A(D)		A(D)
29	*Vespadelus pumilus*	Eastern Forest Bat				A(Po)
30	*Vespadelus regulus*	Southern Forest Bat		A(D		
31	*Vespadelus troughtoni*	**Eastern Cave Bat**				**A(Po)**
32	*Vespadelus vulturnus*	Little Forest Bat		A(D)		O -Harp
33	*Miniopterus australis*	**Little Bentwing Bat**	**A(Po)?**			
34	*Miniopterus orianae oceanensis*	**Eastern Bentwing Bat**		**A(D)**		**A(D)**
35	*Myotis macropus*	**Southern Myotis**		**A(D)**		**A(Either)**
36	*Falsistrellus tasmaniensis*	**Eastern False Pipistrelle**	**A(Po)**			**A(Either)**
37	*Scoteanax rueppellii*	**Greater Broad-Nosed Bat**	**A(Po)**	**A(D)**		**A(Either)**
38	*Scotorepens orion*	Eastern Broad-nosed Bat		A(D)		A(Either)
39	*Nyctophilus geoffroyi*	Lesser Long-eared Bat		A(Po)		O -Harp
40	*Nyctophilus gouldii*	Gould's Long-eared Bat				O -Harp
41	*Rattus rattus* *	Black Rat*				O, Camera
42	*Rattus fuscipes*	Bush Rat	O	O		O-Trap
43.	*Mus musculus* *	House Mouse *	O			O-Trap
44	*Vulpes vulpes**	Red Fox *		Sc	Tr	O
45	*Oryctolagus cuniculus**	European Rabbit *		Sc	O	O
46	*Lepus eurpeaus**	European Hare *				O
47	*Bos taurus**	Cattle – domestic *				O

Count	Scientific Name	Common Name	AHA (Crams Rd IA, 2008)	Biosis (Lot 24, 2010)	OMVI (Lot 24, 2011)	OMVI (Lots 21 - 24 2015 -2020)
48	*Sus scrofa**	Feral Pig*			Tr	Sc, Tr
49	*Cervus sp.**	Deer*			Tr	Sc, Tr
	Totals	**49**	**19**	**29**	**13**	**40**
	Total vertebrates	**179**	**57**	**88**	**93**	**139**

Key

Bold = Threatened species
#= **Native species not endemic to locality**
*** = Introduced species**
V= vulnerable on the BC Act
M=migratory on the EPBC Act

Record
O = observed
W = Heard
T = Track or Trace
Sc = Scat
A = Anabat: Po – possible; Pr – probable; D – definite; E – either

Appendix B

Credit Reports

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id
00020990/BAAS18046/20/00020992

Proposal Name
Lots 21 22 23 24 Warrah Road Bangalee NSW 2541

BAM data last updated *
19/11/2020

Assessor Name
Brendan Ryan

Assessor Number
BAAS18046

BAM Data version *
32

Proponent Name(s)
Warrah Property Developments Pty Ltd

Report Created
05/12/2020

BAM Case Status
Open

Assessment Revision
0

Assessment Type
Biocertification

Date Finalised
To be finalised

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Chalinolobus dwyeri / Large-eared Pied Bat
Vespadelus troughtoni / Eastern Cave Bat

Additional Information for Approval

PCTs With Customized Benchmarks

PCT
No Changes

BAM Biodiversity Credit Report (Variations)

Predicted Threatened Species Not On Site

Name
Hoplocephalus bungaroides / Broad-headed Snake
Neophema pulchella / Turquoise Parrot
Pachycephala olivacea / Olive Whistler
Phascolarctos cinereus / Koala
Varanus rosenbergi / Rosenberg's Goanna

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Not a TEC	22.9	426	14	440.00
662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion	Not a TEC	0.7	0	11	11.00

662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Sydney Montane Heaths This includes PCT's: 636, 662, 708, 709, 814, 816, 844, 1665	Sydney Montane Heaths <50%	662_Moderate_24	No	11	Illawarra,Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Heathlands	Tier 4 or higher threat status	662_Moderate_24	No	11	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Good_21	Yes	2	Illawarra,Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Good_22	Yes	31	Illawarra,Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Good_23	Yes	35	Illawarra,Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Good_24	Yes	299	Illawarra,Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Low_21	No	14	Illawarra,Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Low_24	Yes	59	Illawarra,Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_DNG_All	No	0	Illawarra,Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1082_Good_21	Yes (including artificial)	2	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1082_Good_22	Yes (including artificial)	31	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1082_Good_23	Yes (including artificial)	35	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1082_Good_24	Yes (including artificial)	299	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1082_Low_21	No	14	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1082_Low_24	Yes (including artificial)	59	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1082_DNG_All	No	0	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Cercartetus nanus / Eastern Pygmy-possum	**1082_Good_21, 1082_Good_22, 1082_Good_23, 1082_Good_24, 662_Moderate_24**	15.1	503.00
Chalinolobus dwyeri / Large-eared Pied Bat	**1082_Good_21, 1082_Good_22, 1082_Good_23, 1082_Good_24, 1082_Low_21, 1082_Low_24, 1082_DNG_All, 662_Moderate_24**	23.6	953.00
Myotis macropus / Southern Myotis	**1082_Good_24, 1082_Low_24, 662_Moderate_24**	3.4	106.00
Vespadelus troughtoni / Eastern Cave Bat	**1082_Good_21, 1082_Good_22, 1082_Good_23, 1082_Good_24, 1082_Low_21, 1082_Low_24, 1082_DNG_All, 662_Moderate_24**	23.6	953.00

Credit Retirement Options

Like-for-like options

	Spp	IBRA region
Cercartetus nanus/ Eastern Pygmy-possum	**Cercartetus nanus**/Eastern Pygmy-possum	Any in NSW

Cercartetus nanus/ Eastern Pygmy-possum	**Variation options**		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Chalinolobus dwyeri/ Large-eared Pied Bat	Spp	IBRA region	
	Chalinolobus dwyeri/Large-eared Pied Bat	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Myotis macropus/ Southern Myotis	Spp	IBRA region	
	Myotis macropus/Southern Myotis	Any in NSW	

Myotis macropus/ Southern Myotis	**Variation options**		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Vespadelus troughtoni/ Eastern Cave Bat	Spp	IBRA region	
	Vespadelus troughtoni/Eastern Cave Bat	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna		Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id 00020990/BAAS18046/20/00020992	Proposal Name Lots 21 22 23 24 Warrah Road Bangalee NSW 2541	BAM data last updated * 19/11/2020
Assessor Name Brendan Ryan	Assessor Number BAAS18046	BAM Data version * 32
Proponent Names Warrah Property Developments Pty Ltd	Report Created 05/12/2020	BAM Case Status Open
Assessment Revision 0	Assessment Type Biocertification	Date Finalised To be finalised

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Chalinolobus dwyeri / Large-eared Pied Bat
Vespadelus troughtoni / Eastern Cave Bat

Additional Information for Approval

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
Hoplocephalus bungaroides / Broad-headed Snake
Neophema pulchella / Turquoise Parrot
Pachycephala olivacea / Olive Whistler
Phascolarctos cinereus / Koala
Varanus rosenbergi / Rosenberg's Goanna

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Not a TEC	22.9	426	14	440
662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion	Not a TEC	0.7	0	11	11

662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Sydney Montane Heaths This includes PCT's: 636, 662, 708, 709, 814, 816, 844, 1665	Sydney Montane Heaths <50%	662_Moderate_24	No	11	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Good_21	Yes	2	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Good_22	Yes	31	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Good_23	Yes	35	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Good_24	Yes	299	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Low_21	No	14	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_Low_24	Yes	59	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	South East Dry Sclerophyll Forests This includes PCT's: 716, 879, 891, 892, 901, 932, 946, 1082, 1084, 1146, 1147, 1148, 1149, 1150, 1151, 1154, 1155, 1157, 1158, 1160, 1161, 1322, 1338, 1339, 1340	South East Dry Sclerophyll Forests <50%	1082_DNG_All	No	0	Illawarra, Ettrema, Jervis, Moss Vale, Sydney Cataract and Northern Basalts. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

BAM Biodiversity Credit Report (Like for like)

Species	Vegetation Zone/s	Area / Count	Credits
Cercartetus nanus / Eastern Pygmy-possum	**1082_Good_21, 1082_Good_22, 1082_Good_23, 1082_Good_24, 662_Moderate_24**	15.1	503.00
Chalinolobus dwyeri / Large-eared Pied Bat	**1082_Good_21, 1082_Good_22, 1082_Good_23, 1082_Good_24, 1082_Low_21, 1082_Low_24, 1082_DNG_All, 662_Moderate_24**	23.6	953.00
Myotis macropus / Southern Myotis	**1082_Good_24, 1082_Low_24, 662_Moderate_24**	3.4	106.00
Vespadelus troughtoni / Eastern Cave Bat	**1082_Good_21, 1082_Good_22, 1082_Good_23, 1082_Good_24, 1082_Low_21, 1082_Low_24, 1082_DNG_All, 662_Moderate_24**	23.6	953.00

Credit Retirement Options

Like-for-like credit retirement options

	Spp	IBRA subregion
Cercartetus nanus / Eastern Pygmy-possum	**Cercartetus nanus /** Eastern Pygmy-possum	Any in NSW

Chalinolobus dwyeri / Large-eared Pied Bat	Spp	IBRA subregion
	Chalinolobus dwyeri / Large-eared Pied Bat	Any in NSW
Myotis macropus / Southern Myotis	Spp	IBRA subregion
	Myotis macropus / Southern Myotis	Any in NSW
Vespadelus troughtoni / Eastern Cave Bat	Spp	IBRA subregion
	Vespadelus troughtoni / Eastern Cave Bat	Any in NSW

BAM Candidate Species Report

Proposal Details

Assessment Id 00020990/BAAS18046/20/00020992	Proposal Name Lots 21 22 23 24 Warrah Road Bangalee NSW 2541	BAM data last updated * 19/11/2020
Assessor Name Brendan Ryan	Report Created 05/12/2020	BAM Data version * 32
Assessor Number BAAS18046	Assessment Type Biocertification	BAM Case Status Open
Assessment Revision 0	Date Finalised To be finalised	

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List of Species Requiring Survey

Name	Presence	Survey Months
Cercartetus nanus Eastern Pygmy-possum	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Chalinolobus dwyeri Large-eared Pied Bat	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Myotis macropus Southern Myotis	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?

BAM Candidate Species Report

Vespadelus troughtoni Eastern Cave Bat	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?

Threatened species assessed as not on site

Refer to BAR for detailed justification

Common name	Scientific name	Justification in the BAM-C
Albatross Mallee	Eucalyptus langleyi	Geographic limitations
Barking Owl	Ninox connivens	Refer to BAR
Bauer's Midge Orchid	Genoplesium baueri	Refer to BAR
Broad-headed Snake	Hoplocephalus bungaroides	Refer to BAR
Brush-tailed Rock-wallaby	Petrogale penicillata	Refer to BAR
Gang-gang Cockatoo	Callocephalon fimbriatum	Refer to BAR
Giant Burrowing Frog	Heleioporus australiacus	Refer to BAR
Glossy Black-Cockatoo	Calyptorhynchus lathami	Refer to BAR
Grey-headed Flying-fox	Pteropus poliocephalus	Refer to BAR
Hibbertia stricta subsp. furcatula	Hibbertia stricta subsp. furcatula	Refer to BAR
Koala	Phascolarctos cinereus	Refer to BAR
Large Bent-winged Bat	Miniopterus orianae oceanensis	Habitat constraints
Leafless Tongue Orchid	Cryptostylis hunteriana	Refer to BAR
Little Bent-winged Bat	Miniopterus australis	Habitat constraints
Little Eagle	Hieraaetus morphnoides	Refer to BAR
Long-nosed Potoroo	Potorous tridactylus	Refer to BAR
Masked Owl	Tyto novaehollandiae	Refer to BAR
Nowra Heath Myrtle	Triplarina nowraensis	Geographic limitations
Powerful Owl	Ninox strenua	Refer to BAR
Red-crowned Toadlet	Pseudophryne australis	Refer to BAR

Regent Honeyeater	Anthochaera phrygia	Refer to BAR
Square-tailed Kite	Lophoictinia isura	Refer to BAR
Squirrel Glider	Petaurus norfolcensis	Refer to BAR
Stuttering Frog	Mixophyes balbus	Refer to BAR
Swift Parrot	Lathamus discolor	Refer to BAR

BAM Credit Summary Report

Proposal Details

Assessment Id
00020990/BAAS18046/20/00020992

Proposal Name
Lots 21 22 23 24 Warrah Road
Bangalee NSW 2541

BAM data last updated *
19/11/2020

Assessor Name
Brendan Ryan

Report Created
05/12/2020

BAM Data version *
32

Assessor Number
BAAS18046

BAM Case Status
Open

Date Finalised
To be finalised

Assessment Revision
0

Assessment Type
Biocertification

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Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion											
8	662_Moderate_24	Not a TEC	42.1	42.1	0.67			High Sensitivity to Potential Gain	1.50		11
										Subtotal	**11**

Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion											
1	1082_Good_21	Not a TEC	63.8	63.8	0.1			High Sensitivity to Potential Gain	1.50		2
2	1082_Good_22	Not a TEC	63.8	63.8	1.3			High Sensitivity to Potential Gain	1.50		31
3	1082_Good_23	Not a TEC	63.8	63.8	1.4			High Sensitivity to Potential Gain	1.50		35
4	1082_Good_24	Not a TEC	68.8	68.8	11.6			High Sensitivity to Potential Gain	1.50		299
5	1082_Low_21	Not a TEC	51.7	51.7	0.73			High Sensitivity to Potential Gain	1.50		14
6	1082_Low_24	Not a TEC	64.6	64.6	2.4			High Sensitivity to Potential Gain	1.50		59
7	1082_DNG_All	Not a TEC	13.3	13.3	5.3			High Sensitivity to Potential Gain	1.50		0
										Subtotal	**440**
										Total	**451**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits
Cercartetus nanus / Eastern Pygmy-possum (Fauna)								
1082_Good_21	63.8	63.8	0.1	Vulnerable	Not Listed	2	False	3
1082_Good_22	63.8	63.8	1.3	Vulnerable	Not Listed	2	False	41
1082_Good_23	63.8	63.8	1.4	Vulnerable	Not Listed	2	False	46

1082_Good_24	68.8	68.8	11.6	Vulnerable	Not Listed	2	False	399
662_Moderate_24	42.1	42.1	0.67	Vulnerable	Not Listed	2	False	14
							Subtotal	**503**
Chalinolobus dwyeri / Large-eared Pied Bat (Fauna)								
1082_Good_21	63.8	63.8	0.1	Vulnerable	Vulnerable	3	True	5
1082_Good_22	63.8	63.8	1.3	Vulnerable	Vulnerable	3	True	61
1082_Good_23	63.8	63.8	1.4	Vulnerable	Vulnerable	3	True	69
1082_Good_24	68.8	68.8	11.6	Vulnerable	Vulnerable	3	True	599
1082_Low_21	51.7	51.7	0.73	Vulnerable	Vulnerable	3	True	28
1082_Low_24	64.6	64.6	2.4	Vulnerable	Vulnerable	3	True	117
1082_DNG_All	13.3	13.3	5.3	Vulnerable	Vulnerable	3	True	53
662_Moderate_24	42.1	42.1	0.67	Vulnerable	Vulnerable	3	True	21
							Subtotal	**953**
Myotis macropus / Southern Myotis (Fauna)								
1082_Good_24	68.8	68.8	2.4	Vulnerable	Not Listed	2	False	82
1082_Low_24	64.6	64.6	0.31	Vulnerable	Not Listed	2	False	10
662_Moderate_24	42.1	42.1	0.67	Vulnerable	Not Listed	2	False	14
							Subtotal	**106**
Vespadelus troughtoni / Eastern Cave Bat (Fauna)								
1082_Good_21	63.8	63.8	0.1	Vulnerable	Not Listed	3	True	5
1082_Good_22	63.8	63.8	1.3	Vulnerable	Not Listed	3	True	61
1082_Good_23	63.8	63.8	1.4	Vulnerable	Not Listed	3	True	69
1082_Good_24	68.8	68.8	11.6	Vulnerable	Not Listed	3	True	599
1082_Low_21	51.7	51.7	0.73	Vulnerable	Not Listed	3	True	28

1082_Low_24	64.6	64.6	2.4	Vulnerable	Not Listed	3	True	117
1082_DNG_All	13.3	13.3	5.3	Vulnerable	Not Listed	3	True	53
662_Moderate_24	42.1	42.1	0.67	Vulnerable	Not Listed	3	True	21
							Subtotal	**953**

Biodiversity payment summary report

Assessment Id	Payment data version	Assessment Revision	Report created
00020990/BAAS18046/20/00020992		0	05/12/2020

Assessor Name	Assessor Number	Proposal Name	BAM Case Status
Brendan Ryan	BAAS18046	Lots 21 22 23 24 Warrah Road Bangalee NSW 2541	Open

Assessment Type	Date Finalised
Biocertification	To be finalised

PCT list

Price calculated	PCT common name	Credits
Yes	**1082 -** Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	440
Yes	**662 -** Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion	11

Species list

Price calculated	Species	Credits
Yes	***Cercartetus nanus*** (Eastern Pygmy-possum)	503
Yes	***Chalinolobus dwyeri*** (Large-eared Pied Bat)	953
Yes	***Myotis macropus*** (Southern Myotis)	106

Yes	***Vespadelus troughtoni*** (Eastern Cave Bat)	953

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

IBRA sub region	PCT common name	Threat status	Offset trading group	Risk premium	Administrative cost	Methodology adjustment factor	Price per credit	No. of ecosystem credits	Final credits price
Illawarra	**1082 -** Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	No	South East Dry Sclerophyll Forests <50%	19.12%	$85.73	2.0849	$2,638.80	440	$ 1,161,071.76
Illawarra	**662 -** Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion	No	Sydney Montane Heaths <50%	19.12%	$333.37	1.3074	$ 10,261.00	11	$112,871.05

Subtotal (excl. GST)	**$1,273,942.81**
GST	**$127,394.28**
Total ecosystem credits (incl. GST)	**$1,401,337.09**

Species credits for threatened species

Biodiversity payment summary report

Species profile ID	Species	Threat status	Price per credit	Risk premium	Administrative cost	No. of species credits	Final credits price
10155	***Cercartetus nanus*** (Eastern Pygmy-possum)	Vulnerable	$495.24	20.6900%	$80.00	503	$340,885.69
10157	***Chalinolobus dwyeri*** (Large-eared Pied Bat)	Vulnerable	$741.31	20.6900%	$80.00	953	$928,876.75
10549	***Myotis macropus*** (Southern Myotis)	Vulnerable	$741.31	20.6900%	$80.00	106	$103,316.83
10829	***Vespadelus troughtoni*** (Eastern Cave Bat)	Vulnerable	$741.31	20.6900%	$80.00	953	$928,876.75

Subtotal (excl. GST)	**$2,301,956.02**
GST	**$230,195.60**
Total species credits (incl. GST)	**$2,532,151.62**
Grand total	**$3,933,488.71**

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00020990/BAAS18046/20/00020992	Lots 21 22 23 24 Warrah Road Bangalee NSW 2541	19/11/2020
Assessor Name	**Report Created**	**BAM Data version ***
Brendan Ryan	05/12/2020	32
Assessor Number	**Assessment Type**	**BAM Case Status**
BAAS18046	Biocertification	Open
Assessment Revision		**Date Finalised**
0		To be finalised

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Barking Owl	Ninox connivens	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Dusky Woodswallow	Artamus cyanopterus cyanopterus	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
		662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
		662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion
Eastern False Pipistrelle	Falsistrellus tasmaniensis	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Flame Robin	Petroica phoenicea	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

Gang-gang Cockatoo	Callocephalon fimbriatum	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Glossy Black-Cockatoo	Calyptorhynchus lathami	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Greater Broad-nosed Bat	Scoteanax rueppellii	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Grey-headed Flying-fox	Pteropus poliocephalus	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Large Bent-winged Bat	Miniopterus orianae oceanensis	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
		662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion
Little Bent-winged Bat	Miniopterus australis	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Little Eagle	Hieraaetus morphnoides	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
		662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion
Little Lorikeet	Glossopsitta pusilla	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
		662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion
Masked Owl	Tyto novaehollandiae	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Powerful Owl	Ninox strenua	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

Regent Honeyeater	Anthochaera phrygia	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Scarlet Robin	Petroica boodang	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Spotted-tailed Quoll	Dasyurus maculatus	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
		662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion
Square-tailed Kite	Lophoictinia isura	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
		662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion
Swift Parrot	Lathamus discolor	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Varied Sittella	Daphoenositta chrysoptera	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
		662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion
Yellow-bellied Glider	Petaurus australis	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

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

Common Name	Scientific Name	Plant Community Type(s)
Broad-headed Snake	Hoplocephalus bungaroides	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

Grey-headed Flying-fox	Pteropus poliocephalus	662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion
Koala	Phascolarctos cinereus	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Olive Whistler	Pachycephala olivacea	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
Regent Honeyeater	Anthochaera phrygia	662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion
Rosenberg's Goanna	Varanus rosenbergi	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
		662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion
Turquoise Parrot	Neophema pulchella	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion
		662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion

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

Refer to BAR for detailed justification

Common Name	Scientific Name	Justification in the BAM-C
Broad-headed Snake	Hoplocephalus bungaroides	Refer to BAR
Koala	Phascolarctos cinereus	Refer to BAR
Olive Whistler	Pachycephala olivacea	Refer to BAR
Rosenberg's Goanna	Varanus rosenbergi	Refer to BAR
Turquoise Parrot	Neophema pulchella	Refer to BAR

BAM Vegetation Zones Report

Proposal Details

Assessment Id
00020990/BAAS18046/20/00020992

Assessment name
Lots 21 22 23 24 Warrah Road Bangalee NSW 2541

BAM data last updated *
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Assessor Name
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Report Created
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Assessor Number
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Assessment Type
Biocertification

BAM Case Status
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Assessment Revision
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Date Finalised
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Vegetation Zones

#	Name	PCT	Condition	Area	Minimum number of plots	Management zones

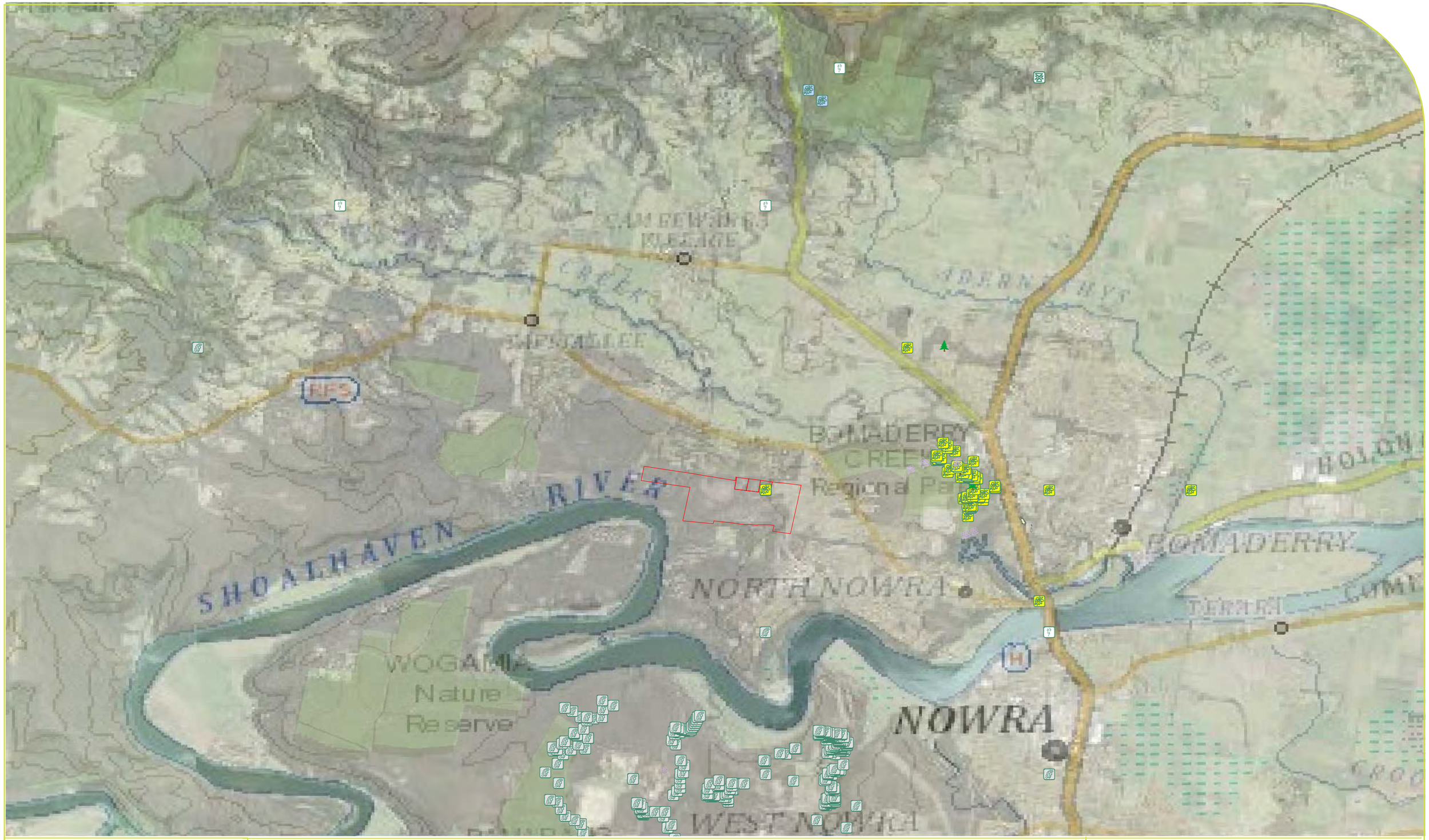
1	1082_Good_21	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Good_21	0.1	1	
2	1082_Good_22	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Good_22	1.28	1	
3	1082_Good_23	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Good_23	1.45	1	
4	1082_Good_24	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Good_24	11.6	3	
5	1082_Low_21	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Low_21	0.73	1	

6	1082_Low_24	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	Low_24	2.42	2	
7	1082_DNG_All	1082-Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	DNG_All	5.32	3	
8	662_Moderate_24	662-Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion	Moderate_24	0.67	1	

Appendix C

BioNet Atlas data

Figure 10-1 and Figure 10-2 below show the NSW BioNet Atlas data within a 10-kilomtre radius of the BCAA. The relevant species are discussed in section 2 of this BCAR.



Legend

- Study area
- Shoalhaven State Forests
- NPWS_Estate

Threatened Flora

- Acacia pubescens
- Cryptostylis hunteriana
- Eucalyptus langleyi
- Genoplesium baueri
- Hibbertia stricta subsp. furcatula
- Lastreopsis hispida
- Pterostylis gibbosa
- Pterostylis vernalis
- Solanum celatum
- Syzygium paniculatum
- Triplarina nowraensis
- Zieria baeuerlenii
- Zieria tuberculata

OMVI ECOLOGICAL

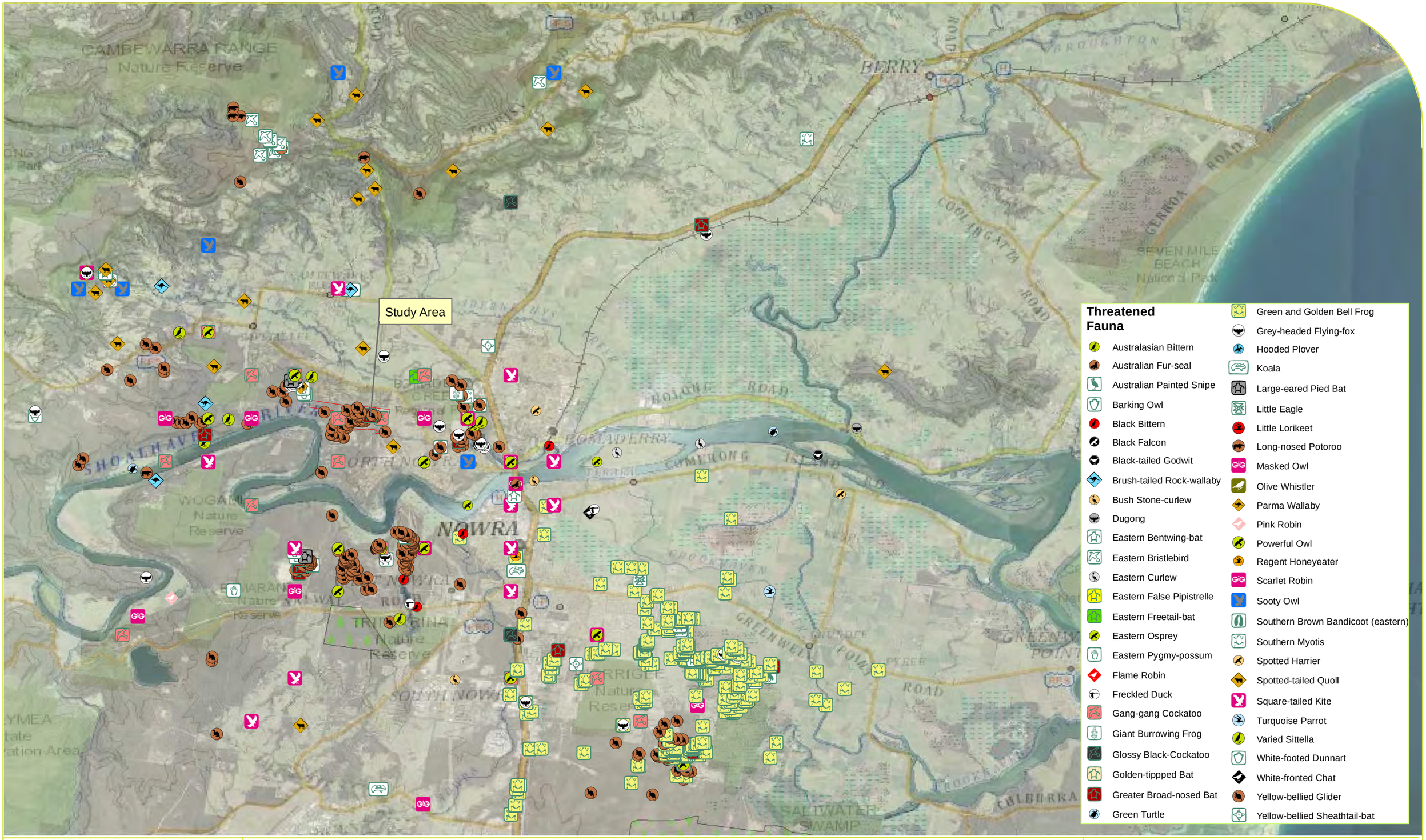
Date: 15/12/2020

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Map Grid: Map Grid of Australia Zone 56

1:45,796

0 405 810 1,620 2,430 3,240 Meters

Figure 10-1: Threatened Flora recorded within a ten kilometre radius of the Study Area (BioNet Atlas accessed November 2020).



Threatened Fauna

- Australasian Bittern
- Australian Fur-seal
- Australian Painted Snipe
- Barking Owl
- Black Bittern
- Black Falcon
- Black-tailed Godwit
- Brush-tailed Rock-wallaby
- Bush Stone-curlew
- Dugong
- Eastern Bentwing-bat
- Eastern Bristlebird
- Eastern Curlew
- Eastern False Pipistrelle
- Eastern Freetail-bat
- Eastern Osprey
- Eastern Pygmy-possum
- Flame Robin
- Freckled Duck
- Gang-gang Cockatoo
- Giant Burrowing Frog
- Glossy Black-Cockatoo
- Golden-tippped Bat
- Greater Broad-nosed Bat
- Green Turtle
- Green and Golden Bell Frog
- Grey-headed Flying-fox
- Hooded Plover
- Koala
- Large-eared Pied Bat
- Little Eagle
- Little Lorikeet
- Long-nosed Potoroo
- Masked Owl
- Olive Whistler
- Parma Wallaby
- Pink Robin
- Powerful Owl
- Regent Honeyeater
- Scarlet Robin
- Sooty Owl
- Southern Brown Bandicoot (eastern)
- Southern Myotis
- Spotted Harrier
- Spotted-tailed Quoll
- Square-tailed Kite
- Turquoise Parrot
- Varied Sittella
- White-footed Dunnart
- White-fronted Chat
- Yellow-bellied Glider
- Yellow-bellied Sheathtail-bat

OMVI ECOLOGICAL

Legend

- Study area
- Shoalhaven State Forests
- NPWS_Estate

Date: 15/12/2020

Map Projection: Universal Transverse Mercator
Hortizontal Datum: Geodetic Datum of Australia 1994
Map Grid: Map Grid of Australia Zone 56

1:90,220

0 800 1,600 3,200 4,800 6,400 Meters

Figure 10-2: Threatened Fauna recorded within a ten kilometre radius of the Study Area (BioNet Atlas accessed November 2020)

Appendix D

Site Photographs.

Selection of Terrestrial Orchids recorded during the surveys

Genoplesium baueri

Genoplesium oligantha

Genoplesium pumila

Corunastylis woollsii

Genoplesium baueri

Dipodium variegatum

Cryptostylis subulata

Petalochilus pictus

Thelymitra arenaria

Acianthus excertus

Cryptostylis erecta

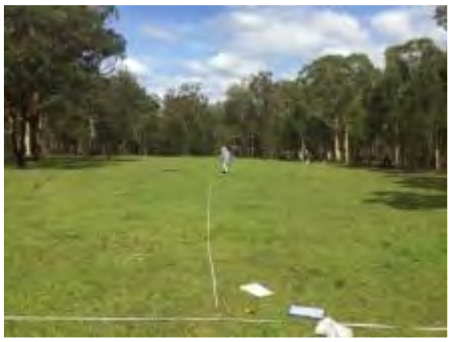
Eriochilus cucullatus

Selection of Biometric plots

Good condition PCT 1082

PCT 1082

Low condition PCT 1082 regenerating shrubland



Very low condition PCT 1082

PCT 1082

Very low condition PCT 1082

PCT 662

Very low condition PCT 1082

Low condition PCT 1082 with – industrial waste mounds

Good condition PCT 1082

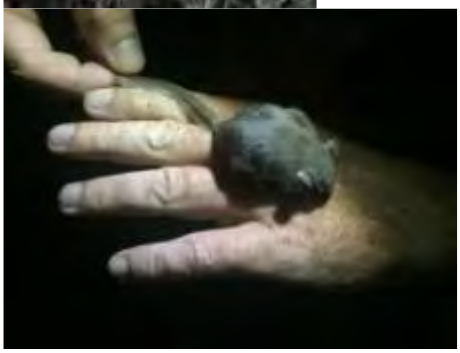
Selections of Sugar Gliders captured

Sugar Glider being released

Old Yellow-bellied Glider notches on Grey Gum

Current used Glider incisions

Other fauna observed or captured



Feathertail Glider

Blue tongue Lizard

Large-eared Pied Bat

Common Bronzewing

Eastern Yellow Robin

Blue Mountains Tree Frog

Selection of the remote camera photographs

Swamp Wallaby

Red-necked Wallaby

Eastern Grey Kangaroo

Brushtail Possum

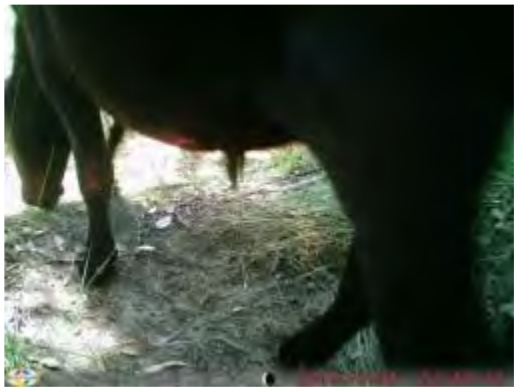
Ringtail Possum

Brown Antechinus

Wombat

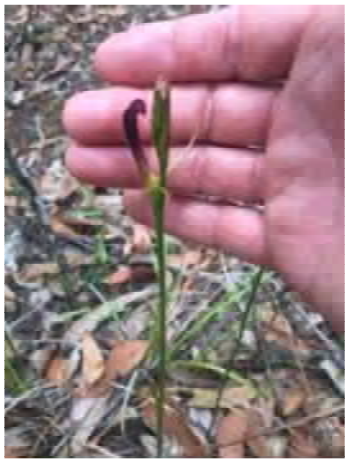
Lace Monitor

Feral/domestic animals recorded on camera



Reference Site Photographs

***G. baueri* at the Bomaderry reference site**



C. hunteriana flowering at Manyana reference site.

C. hunteriana flowering at Tomerong reference site.

C. hunteriana flowering at Manyana reference site.

P. ventricosa flowering at a Conjola reference site

P. ventricosa flowering at a Sussex Inlet reference site

Appendix E

Climate details recorded for the locality for the 2015 - 2020 surveys.

Table 26: Daily Weather Observations for Nowra, New South Wales for the 2015/2016 surveys (Copyright 2003 Commonwealth Bureau of Meteorology).

Observations were drawn from Nowra RAN Air Station AWS (station 068072).

Date	Minimum temp (°C)	Maximum temp (°C)	Rainfall (mm)	Direction of max wind gust	Speed of max wind gust (km/h)	Time of max wind gust	9am relative humidity (%)	3pm relative humidity (%)
November 2015								
23-11-15	14.3	23.2	0	SE	43	10:38	69	67
24-11-15	14	26	0	E	39	14:24	64	57
25-11-15	15.3	34.9	0	NW	44	13:39	36	8
26-11-15	13.4	32.6	0	WNW	96	11:30	20	21
27-11-15	10.7	22.1	0.2	NE	44	12:42	59	63
December 2015								
01-12-15	14.7	38	0	SSE	52	19:45	32	13
02-12-15	15.1	19.6	0.4	SSE	48	13:02	86	47
03-12-15	13.2	21.8	0	NE	30	12:21	60	49
04-12-15	10.8	24.7	0	ENE	37	13:53	58	47
05-12-15	10.6	27.7	0	E	33	12:50	58	47
06-12-15	14	28	0	ENE	31	12:44	61	52
07-12-15	16.2	24.1	0.6	E	31	13:51	89	59
08-12-15	17.4	27.4	0.4	NE	30	12:02	79	72
09-12-15	20	35.8	0	NW	50	3:25	48	27
10-12-15	18.9	27.4	0	ENE	39	12:57	65	63
11-12-15	19.7	33.3	0	WNW	76	13:12	62	9
12-12-15	15.2	21.9	0	ESE	35	13:32	66	46
13-12-15	14.4	26.5	0	NE	48	14:08	62	55
14-12-15	13.2	30	0	E	33	11:31	60	32
15-12-15	13.9	29	0	ESE	31	11:16	67	73
16-12-15	17.2	22.9	1	SSE	43	9:03	94	77
17-12-15	14.6	27.8	13.4	E	44	13:48	65	57
18-12-15	15.2	33.8	0	E	33	12:22	58	34
February 2016								
11-02-16	19.2	28	0	E	35	15:13	79	58
12-02-16	17.3	28.3	0				78	60
March 2016								
01-03-16	18.4	27.6	0.8	ENE	35	16:11	89	61
02-03-16	16.1	31.2	0	E	28	14:21	77	55
03-03-16	18.1	30.9	0	SE	31	14:52	69	52
09-03-16	17.9	31.5	0	E	26	12:40	68	55
30-03-16	15.7	25.9	11	WNW	39	12:29	87	54
May 2016								
02-05-16	11.4	22.3	0	WNW	44	6:21	37	30
03-05-16	11	23.5	0	WNW	57	10:49	47	30
04-05-16	12.6	22	0	SE	35	12:51	51	63
05-05-16	9.1	23.2	0	NNW	31	3:36	51	47
06-05-16	9.9	25.8	0	NW	37	2:38	51	33
07-05-16	9.6	25.2	0	NW	22	9:34	61	47
08-05-16	11.7	19.4	0	NE	20	23:26	94	90
09-05-16	15.4	21.4	20.4	NW	59	19:47	99	91
10-05-16	16.8	22.3	0.4	NW	72	9:18	53	49
11-05-16	12.1	18.1	0	WNW	63	19:18	50	44
12-05-16	14.3	21.4	0	W	57	12:51	54	51
13-05-16	10	24	0	WNW	56	2:38	52	37
14-05-16	12.7	26.6	0.2	WNW	39	2:39	56	20
15-05-16	8.4	25	0	WNW	65	14:17	48	32
16-05-16	11.3	22.9	0	NE	39	15:56	62	56
17-05-16	7.9	25.3	0	W	72	11:21	44	24
18-05-16	7.9	20.2	0	NW	43	17:42	64	37
19-05-16	9.4	20.7	0	W	57	12:14	48	38
20-05-16	14.7	22.8	0	WNW	56	0:31	56	59
April 2018								
06-04-18	19	25	0	SE	19	14:00	94	73
April 2019								
03-04-19	11.5	27.3	0	NNE	26	02:55	81	55
October 2019								
16-10-19	13.2	24.5	0	WSW	54	18:03	79	70
18-10-19	7.7	26.1	0	WNW	52	15:40	37	12
April 2020								
24-04-20	13.9	27.5	0.2	W	39	01:14	44	30