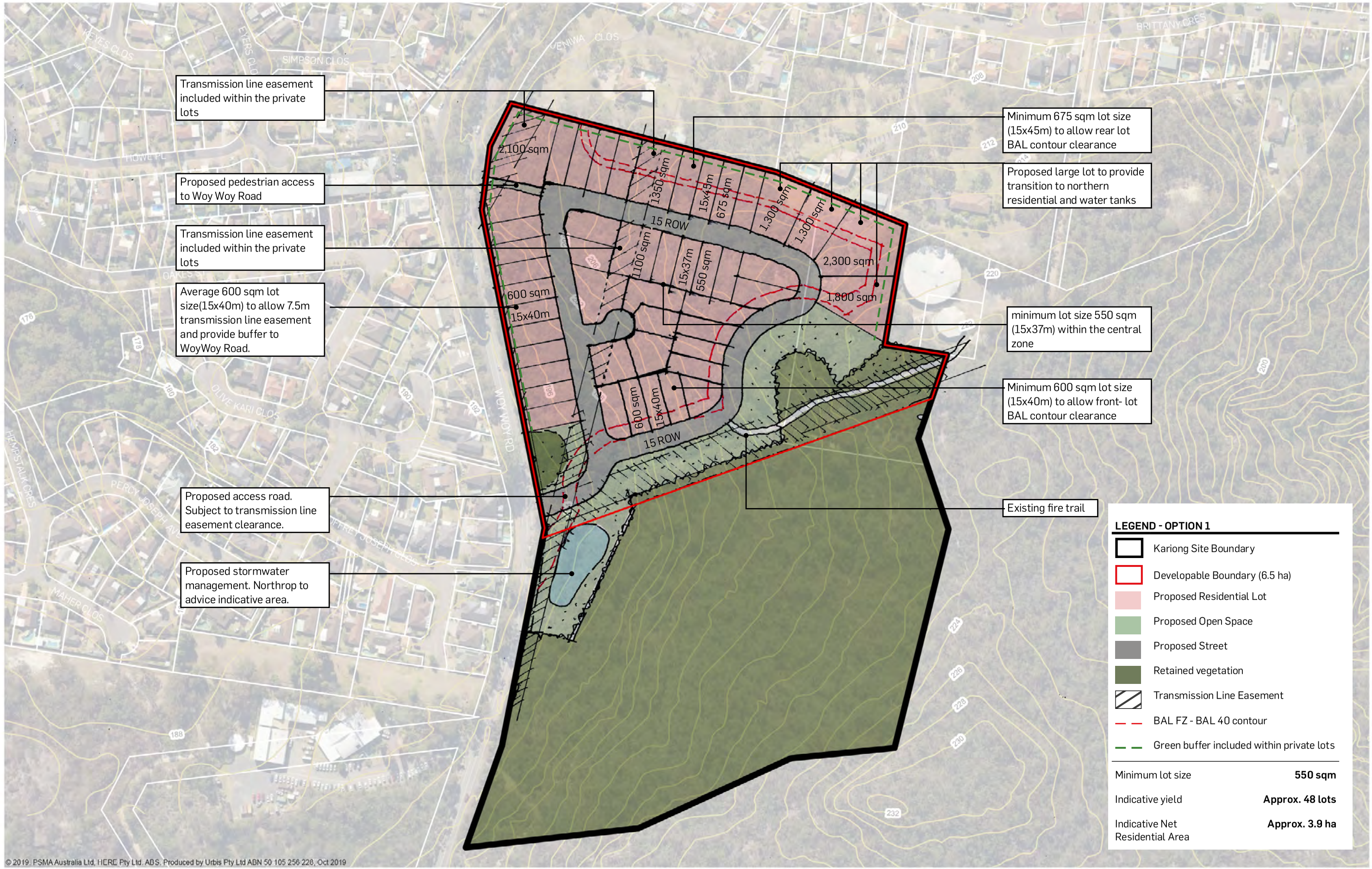

URBIS

DARKINJUNG LOCAL ABORIGINAL LAND COUNCIL - KARIONG PLANNING PROPOSAL

INDICATIVE CONCEPT PLAN - OPTION 1 - WITH NORTH SOUTH ELECTRICAL EASEMENT

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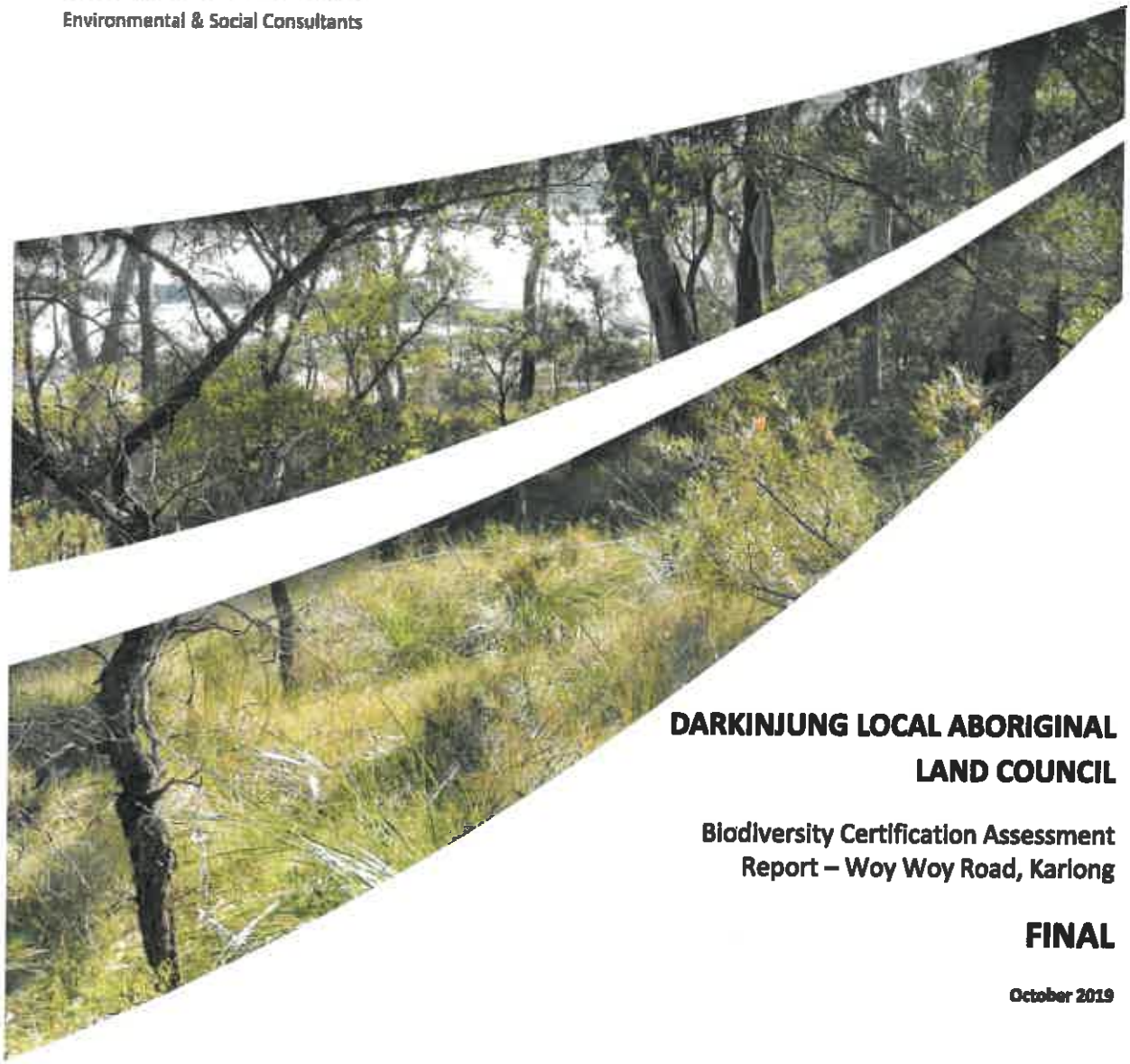
DATE: 31 OCT 2019

JOB NO: P12199

Attachment 2

umwelt
Environmental & Social Consultants



DARKINJUNG LOCAL ABORIGINAL LAND COUNCIL

Biodiversity Certification Assessment Report – Woy Woy Road, Kariong

FINAL

October 2019

DARKINJUNG LOCAL ABORIGINAL LAND COUNCIL

Biodiversity Certification Assessment Report – Woy Woy Road, Kariong

PRELIMINARY DRAFT

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Darkinjung Local Aboriginal Land Council

Project Director:	Barbara Crossley
Project Manager:	Les Seddon
Technical Project Director:	Allison Riley
Technical Project Manager:	Ryan Parsons
Report No.	4567/R07
Date:	October 2019

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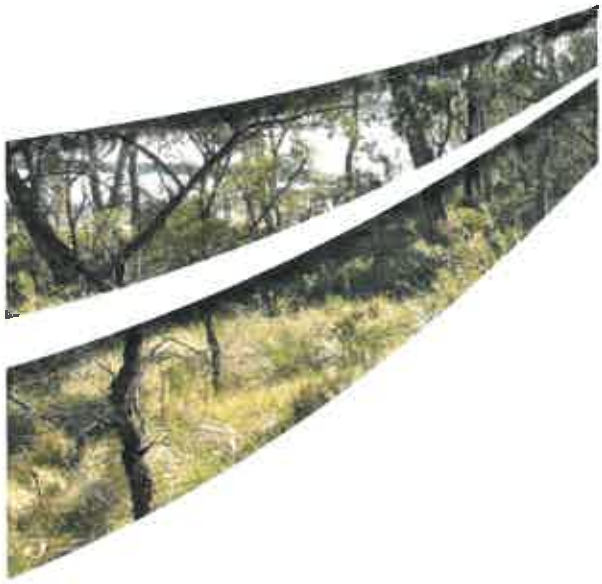
Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
1	Allison Riley	3 September 2019	Allison Riley	3 September 2019
Final	Allison Riley	10 October 2019	Allison Riley	10 October 2019



Executive Summary

Darkinjung Local Aboriginal Land Council (Darkinjung) is seeking to lodge a planning proposal for the rezoning and subdivision of a site located at Lot 512 and Lot 513 DP 727686, Kariong NSW, for the purposes of a residential housing development. This will involve the subdivision of the site into 71 residential housing lots, and the development of necessary ancillary infrastructure such as internal roadways, sewerage and stormwater management.

The Development Footprint is located along Woy Woy Road Kariong, NSW in the Central Coast Local Government Area. The Development Footprint covers an area of approximately 6.1 hectares (ha) and is surrounded by a mosaic of intact native vegetation, residential dwellings and Woy Woy Road to the west.

This Biodiversity Certification Assessment Report (BCAR) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) on behalf of Darkinjung to assess the potential biodiversity impacts of the proposed development in accordance with the BAM.

Surveys of the Development Footprint identified three Plant Community Types (PCTs) and native fauna habitats being:

- 2.5 ha of PCT1641 Dwarf Apple Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast (Good Condition)
- 2.7 ha of PCT1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast (Good Condition)
- 0.6 ha of PCT 1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast (Good Condition)

Following the application of avoidance and mitigation measures, the BAM assessment identified the following biodiversity credits required to offset the impacts of the Project:

- 75 ecosystem credits for PCT1641 Dwarf Apple Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast (Good Condition)
- 70 ecosystem credits for PCT1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast (Good Condition)
- 7 ecosystem credits for PCT 1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast (Good Condition)
- 6 species credits for flora species *Callistemon linearifolius,* 9 species credits for *Darwinia glaucophylla,* 195 species credits for *Hibbertia procumbens* and 101 species credits for *Hibbertia puberula.*
- 195 species credits for eastern pygmy possum, 141 species credits for large- eared pied bat and 31 species credits for southern myotis.

Darkinjung is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of biodiversity values as a result of the Project as required under the *Biodiversity Conservation Act 2016*. This will be undertaken using one or more of the following options:

- The establishment and retirement of credits within a Stewardship site
- Securing required credits through the open credit market and/or
- Payments to the Biodiversity Conservation Fund.

Glossary

BCAR	Biodiversity Certification Assessment Report
BAM	Biodiversity Assessment Methodology
BC Act	NSW *Biodiversity Conservation Act 2016*
CEEC	Critically Endangered Ecological Community
Development Footprint	The total impact zone associated with the Project.
DoEE	Commonwealth Department of the Environment and Energy
DNG	Derived Native Grasslands
Ecosystem credit	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at an offset site.
EEC	Endangered Ecological Community
EP	Endangered Population
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDEs	Groundwater-dependent Ecosystems
GIS	Geographical Information System
IBRA	Interim Biogeographic Regionalisation for Australia (Version 7)
LGA	Local Government Area
MGA	Map Grid of Australia
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
PMST	Protected Matters Search Tool
Species credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection database.
Strahler Stream Order	Classification system that gives a waterway an 'order' according to the number of tributaries associated with it.
TEC	Threatened Ecological Community
TBDC	Threatened Biodiversity Data Collection
VIS	Vegetation Information System

Table of Contents

Figures

Tables

Appendices

1 Introduction

Darkinjung Local Aboriginal Land Council (Darkinjung) is seeking to lodge a planning proposal for the rezoning of a site located at Lot 512 and Lot 513 DP 727686, Kariong NSW, for the purposes of a residential housing development. Following rezoning the intent is to subdivide the site into residential housing lots, and the development of necessary ancillary infrastructure such as internal roadways, sewerage and stormwater management.

The Development Footprint is located along Woy Woy Road Kariong, NSW (refer to **Figure 1.1** and **Figure 1.2**) in the Central Coast Local Government Area (LGA). The Development Footprint covers an area of approximately 6.1 hectares (ha) and is surrounded by a mosaic of intact native vegetation, residential dwellings to the north and west, and Woy Woy Road to the west.

This Biodiversity Certification Assessment Report (BCAR) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) to assess the potential biodiversity impacts of the residential subdivision in accordance with the Biodiversity Assessment Method (BAM) and the *Biodiversity Conservation Act 2016*. It provides the findings of the biodiversity assessment of the proposed rezoning and residential subdivision. It addresses the specific requirements of the BAM (OEH 2017a).

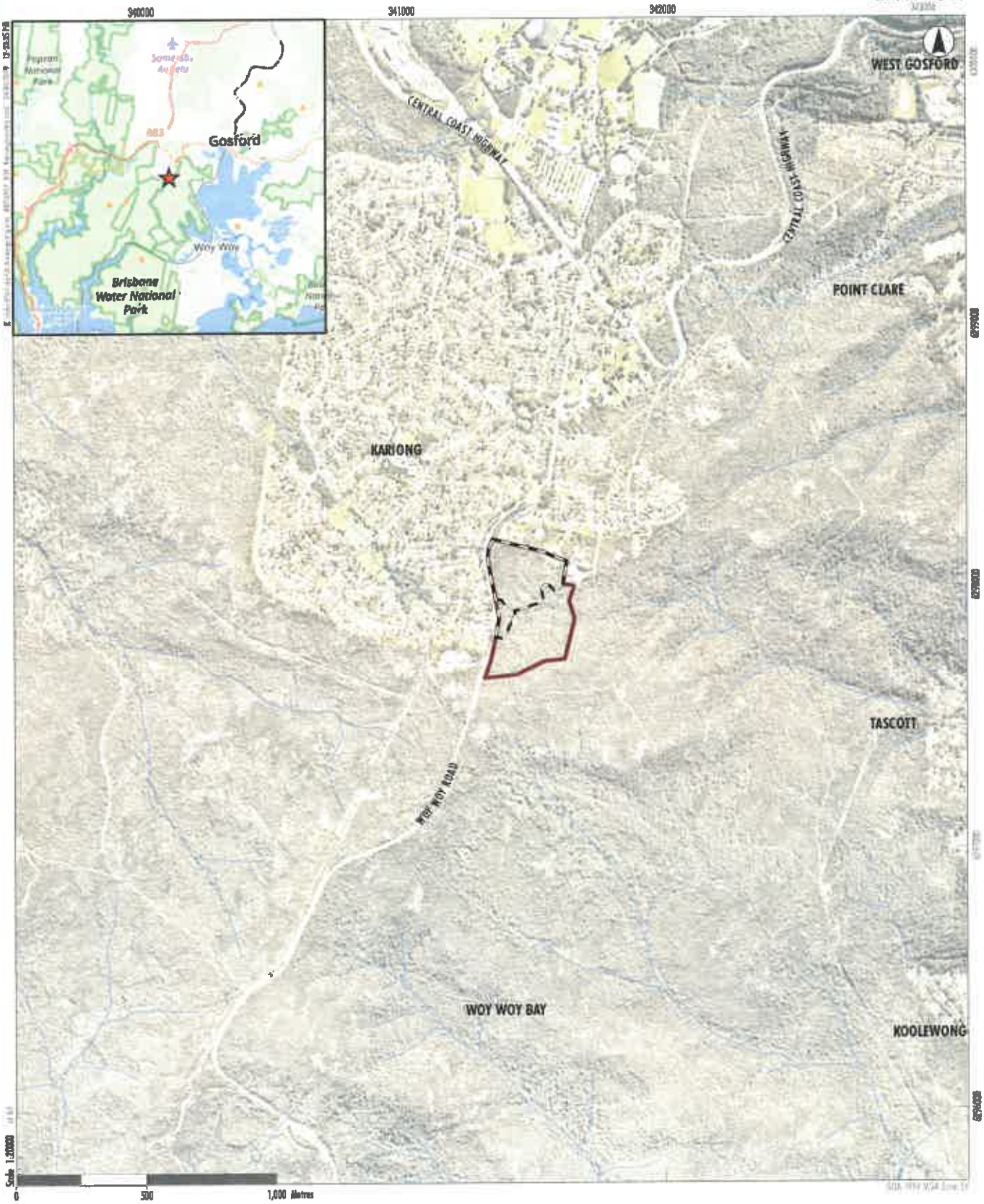
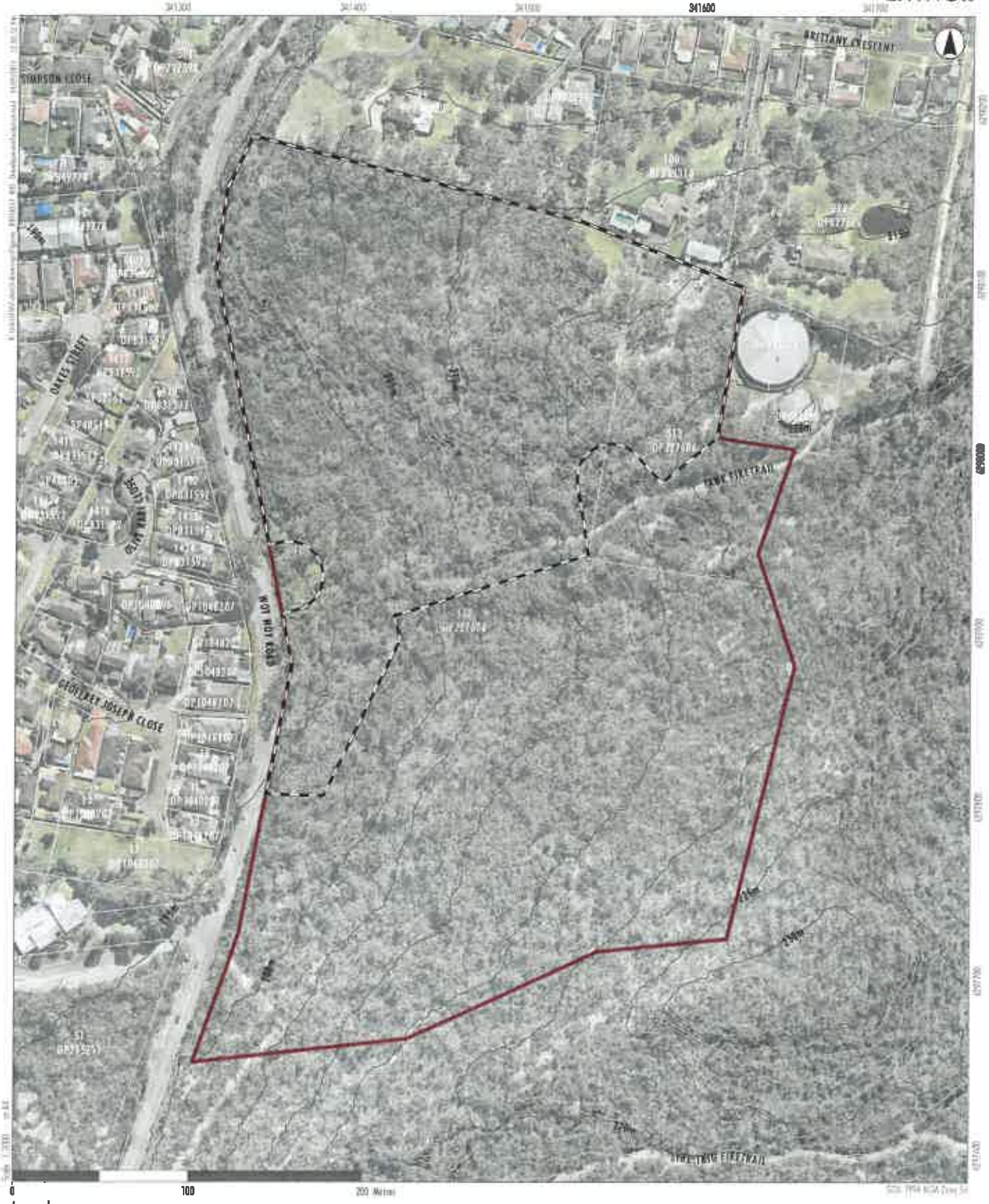


FIGURE 1.1

Locality Plan

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)



Legend

- Development Footprint
- Lots 512 & 513 DP 727686

Contours (1m)

- Minor Contours
- Major Contours
- Lot Boundaries

FIGURE 1.2

Development Footprint

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

1.1 Development Footprint Information

The Development Footprint will be subjected to a range of disturbances as described below and in **Section 5.0**.

The Development Footprint entirely comprises remnant vegetation adjacent to existing disturbances such as residential land and major roadways. Intact vegetation is generally in moderate to good condition. Some areas, such as along roads, contain small outbreaks of exotic plant species and disturbances such as rubbish. Landscape details of the Development Footprint are detailed in **Table 1.1** below.

Table 1.1 Development Footprint Location in the Landscape

Development Footprint Location in the Landscape	
IBRA Bioregion	Sydney Basin
IBRA Subregion	Pittwater
Mitchell Landscape	Gosford – Cooranbong Coastal Slopes
LGA	Central Coast
Development Footprint Size	6.1 hectares
Assessment Type	Site-based
Lot and DP	Lot 512 and 513 DP 727686

1.2 Local Ecological Context

The Development Footprint is located in the Central Coast region (refer to **Figure 1.2**). The locality is occupied by residential areas, with substantial intact vegetation extending to the south and west of the site as part of the Brisbane Water National Park. Woy Woy Road is located immediately to the west of the site providing transport routes northward and southward, contributing to vegetation fragmentation and a barrier to movement of flora and less mobile fauna.

Where there is remnant native vegetation in the locality, a number of Threatened Ecological Communities (TECs) are known to occur including *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC* listed under the BC Act, *Coastal Upland Swamps in the Sydney Basin Bioregion EEC* and *Subtropical and Temperate Coastal Saltmarsh EEC* listed under both the BC and EPBC Acts. Where there is suitable habitat a range of threatened flora species are known to occur in the wider locality (within a 10 kilometre (km) radius of the site) including spreading guinea flower (*Hibbertia procumbens*), Somersby mintbush (*prostanthera junonis*), *Darwinia glaucophylla*, biconvex paperbark (*Melaleuca biconvexa*) and *Grevillea shiressii*. Records of threatened fauna species occur around the locality, including within the intact vegetated areas to the south of the site, and within Brisbane Water National Park. Records include red- crowned toadlet (*Pseudophryne australis*), giant burrowing frog (*Heleioporus australiacus*), powerful owl (*Ninox strenua*) and eastern pygmy possum (*Cercartetus nanus*).

1.3 Key Resources, Policies and Documents

The following key resources, policies and documents were used during the preparation of this BCAR for the proposed development:

- Biodiversity Assessment Method Order 2017 (OEH 2017a)
- Biodiversity Assessment Method Operational Manual (Stage 1) (OEH 2018a)
- Biodiversity Assessment Calculator, accessed September 2019
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities –Working Draft (DEC 2004)
- BioNet Atlas of NSW Wildlife database and mapping tool (OEH 2019a), accessed September 2019
- Threatened Biodiversity Data Collection (TBDC) (OEH 2019b), accessed September 2019
- Vegetation Information System (VIS) Classification Database (OEH 2019c), accessed September 2019
- NSW Guide to Surveying Threatened Plants (OEH 2016) and
- Department of the Environment and Energy (DoEE) Protected Matters Search Tool (DoEE 2019), accessed March 2019.

1.4 Report Preparation

This BCAR was prepared by Philippa Fagan (Ecologist), with review and technical direction from Ryan Parsons (Principal Ecologist) and Allison Riley (NSW Ecology Manager). Field surveys were undertaken by a range of Umwelt ecologists.

Table 1.2 below outlines the details of the Accredited BAM Assessors involved in the survey, calculations and reporting for the Project.

Table 1.2 Accredited BAM Assessors and their Role on this Project

Name	Assessor ID	Role
Allison Riley *NSW Ecology Manager*	BAAS17042	Review and technical direction
Ryan Parsons *Principal Ecologist*	BAAS17048	Review and technical direction
Philippa Fagan *Ecologist*	BAAS18117	BCAR preparation Field Surveys

2 Methods

2.1 Landscape Features and Site Context

Landscape features such as IBRA bioregions, IBRA subregions and NSW Mitchell Landscape regions, native vegetation extent within a 1500 metre (m) buffer area, cleared areas, rivers, streams, wetlands and connectivity features were identified within the Development Footprint where appropriate in accordance with Section 4.2 of the BAM (OEH 2017a) (refer to **Figure 2.1**).

The 'Site Context' of the Development Footprint is calculated by assessing the native vegetation cover and patch size within the Development Footprint in accordance with Section 4.3 of the BAM (OEH 2017a).

2.2 Native Vegetation Assessment

2.2.1 Literature and Database Review

A review of previous documents and reports relevant to the Project was undertaken. The information obtained was used to inform survey design and was also used to assist in the assessment of potentially occurring threatened and migratory species, endangered populations (EPs) and TECs.

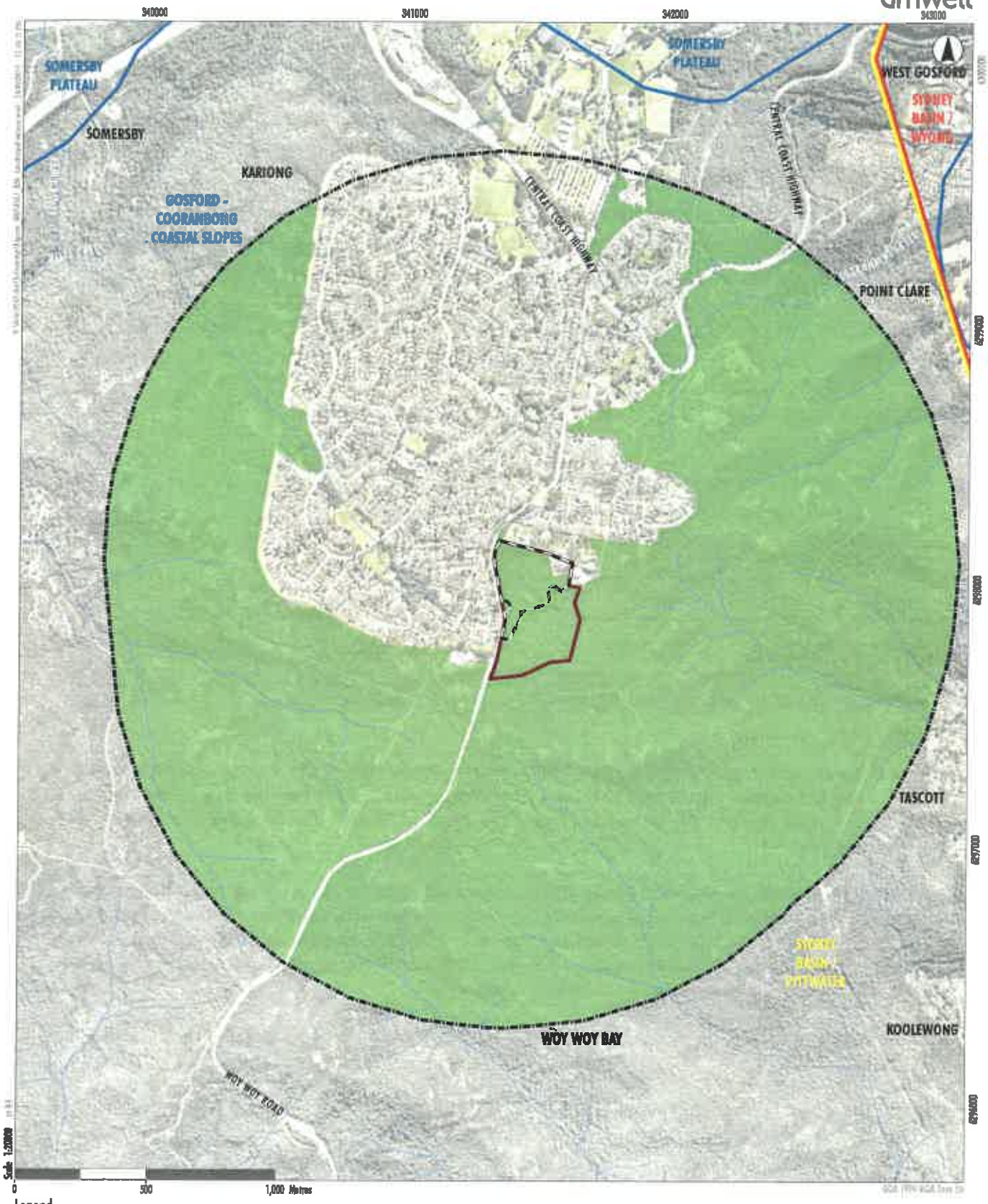
Relevant documents included:

- Conacher Consulting (2016) Ecological Investigation Report Lot 512 DP 727686 & Lot 513 DP 727686 Woy Woy Road Kariong.
- Vegetation Mapping of Gosford LGA (Bell 2004)
- Threatened Biodiversity Data Collection (OEH 2019b) reporting for known/predicted threatened communities in the Wyong IBRA subregion
- VIS Classification Database (OEH 2019c), accessed September 2019
- DoEE Protected Matters Search Tool for known/predicted EPBC Act-listed TECs, accessed March 2019 (DoEE 2019).

2.2.2 Floristic and Vegetation Integrity Survey

Floristic and vegetation integrity surveys were undertaken over the following survey periods:

- 27 to 28 August 2018
- 18 and 31 October 2018
- 23 to 24 January 2019
- 27 March 2019
- 1 and 2 April 2019.



Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- 1500m Site Buffer
- Watercourses
- Mitchell Landscape Boundaries
- Native Vegetation Mapping

IBRA Region / Sub Region

- Sydney Basin / Pittwater
- Sydney Basin / Wyong

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

FIGURE 2.1

Landscape Features

A total of five BAM plots and two rapid vegetation assessments were conducted within the Development Footprint during the surveys undertaken for this assessment (refer to Figure 2.2). Floristic and vegetation integrity data was collected in accordance with minimum requirements under the BAM (OEH 2017a).

Table 2.1 outlines the floristic survey effort in the Development Footprint.

Table 2.1 Adequacy of Floristic and Vegetation Integrity Survey in the Development Footprint

Veg. Zone	Plant Community Type (PCT) *Condition Class*	Area in the Development Footprint (ha)	Number of Floristic and Vegetation Integrity Plots	
			Required	Completed
1	1641 – Dwarf Apple – Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast *Good Condition*	2.51	2	2
2	1642 – Scribbly Gum – Red Bloodwood _ Old Man Banksia heathy woodland of southern Central Coast *Good Condition*	2.67	2	2
3	1699 – Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast *Good Condition*	0.63	1	1
-	Other/cleared	0.29	0	0
TOTAL		**6.1**	**5**	**5**

At each floristic and vegetation integrity plot, data was recorded according to Section 5 of the BAM (OEH 2017a). This involved setting out 20 x 50 m, 20 x 20 m and 1 x 1m plots. The location of each plot was recorded using a hand-held GPS with accuracy of ± 5 m. The Map Grid of Australia (MGA) coordinate system was used.

At each plot/transect, roughly 45 to 60 minutes was spent searching for all vascular flora species present within the 20 x 20 m plot. Searches of each 20 x 20 m plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, which usually supported well over half of the species present, however the composition of any shrub, mid-storey, canopy and emergent layers were also thoroughly examined.

For each flora species recorded in the plot, the following data was collected in accordance with Table 2 of the BAM (OEH 2017a):

- stratum/layer in which the species occurs
- growth form
- scientific name and common name
- cover and
- abundance.

At each vegetation integrity plot the following attributes were recorded in accordance with the BAM (OEH 2017a) to determine the condition of the vegetation zone:

- ***Composition*** - native plant species richness by growth form (within the 20 x 20 m plot)
- ***Structure*** – estimate foliage cover of native and exotic species by growth form (within the 20 x 20 m plot)
- ***Function*** (within the 20 x 50 m plot) including, number of large trees, presence or otherwise of tree stem size classes, presence or otherwise of canopy species regeneration, length of fallen logs, percentage cover for litter (recorded from five 1 x 1 m plots), number of trees with hollows and high threat exotic cover.

2.2.3 Targeted and Meandering Transects

Targeted transects for threatened flora species were conducted during the months of August, October and January, targeting the flowering periods of prospective threatened species. Transects were walked by two ecologists in parallel traverses ten metres apart in suitable habitat, during which the vegetation was continually searched for threatened species. Further details on the timing of these transects is provided in **Section 2.3**. Opportunistic records of threatened species were also recorded during vegetation integrity surveys in March and April 2019.

Meandering transects were walked across much of the Development Footprint particularly during fauna habitat assessments and targeted fauna surveys. Opportunistic sampling of vegetation was undertaken along these transects, particularly searches for threatened and/or otherwise significant species, endangered populations and TECs. Meandering transects enable floristic sampling across a much larger area than plot-based survey, especially where the number of plots is limited.

Meandering transects provided invaluable information on spatial patterns of vegetation that informed vegetation community mapping of the Development Footprint.

2.2.4 Digital Aerial Photograph Interpretation

Digital imagery (aerial photographs) of the Development Footprint was viewed prior to and after vegetation survey to identify spatial patterns in vegetation, land use and landscape features. These informed field survey design and implementation, ecological assessment and vegetation community mapping of the Development Footprint.

Vegetation communities in the Development Footprint were mapped on-screen overlaying the May 2018 high resolution aerial photographs. Mapping was undertaken using the Manifold System 8.0 GIS and ESRI ArcMaps 10.6.

2.2.5 Plant Identification and Nomenclature Standards

All vascular plants recorded or collected within plots and on meandering transects were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002). Where known, changes to nomenclature and classification have been incorporated into the results. Updated taxonomy has been derived from PlantNET (Botanic Gardens Trust 2019).

Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

For herbaceous and graminoid species, such as those belonging to the families Asteraceae, Orchidaceae, Cyperaceae and Poaceae, the allocation of specimens to sub-specific levels was affected by the availability of adequate flowering or fruiting material. In this case specimens are forwarded to the National Herbarium of New South Wales if they were considered to be of potential significance or importance.

2.2.6 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Development Footprint. Vegetation mapping involved the following key steps:

- preliminary review of digital airborne imagery to explore vegetation distribution patterns as dictated by change in canopy texture, tone and colour, as well as topography
- predicting the distribution of particular vegetation communities based on understanding the distribution of PCTs (OEH 2019c) and plant communities as described by Conacher Consulting (2016).
- ground-truthing of the vegetation map based on survey effort, and
- revision of vegetation community floristic delineations based on plot data.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata.

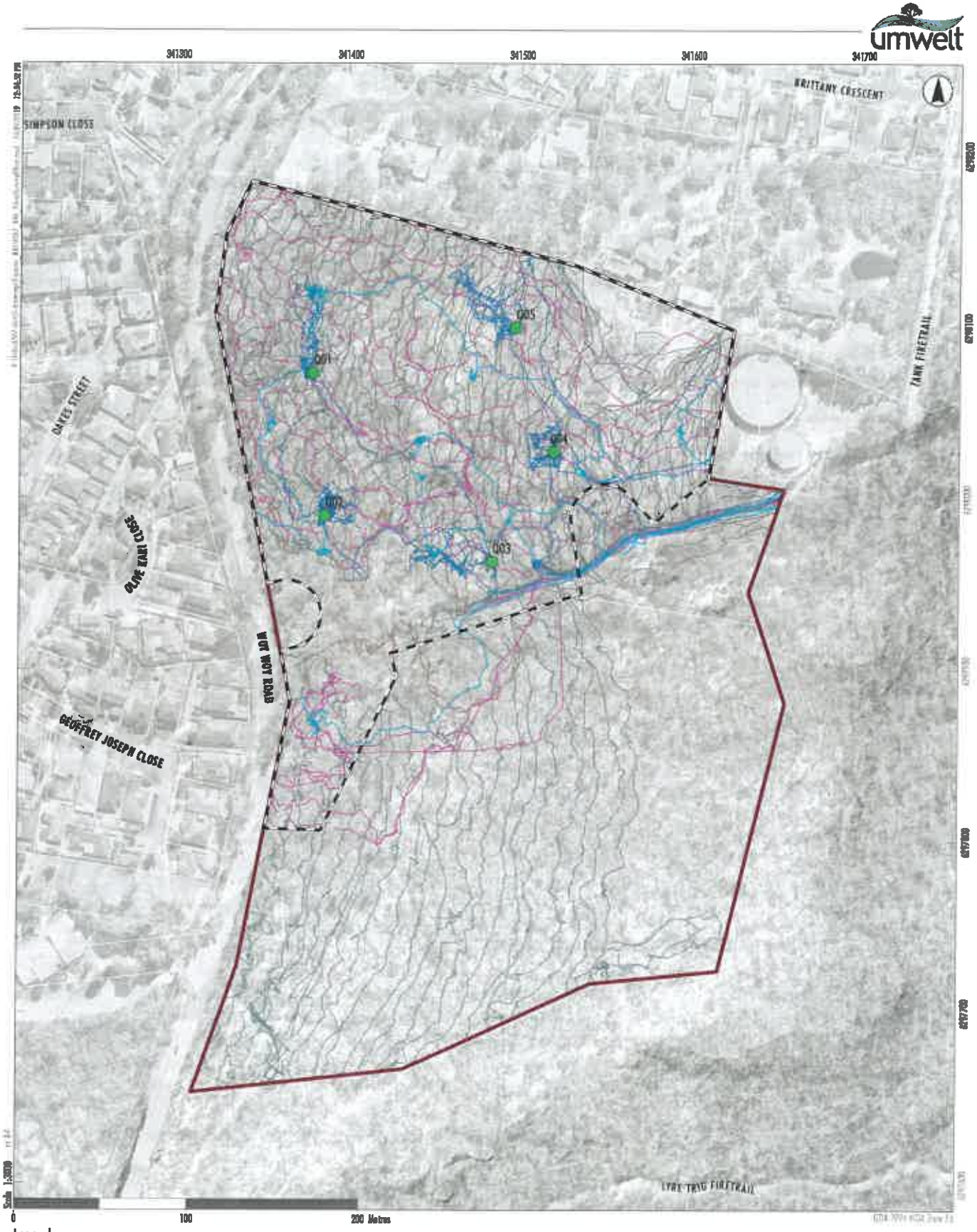


FIGURE 2.2

Flora Survey Effort

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

2.2.7 Threatened Ecological Community Delineation Techniques

Where applicable, vegetation communities identified in the Development Footprint were compared to TECs listed under the Commonwealth EPBC Act and NSW BC Act and an assessment of similarity with the NSW Scientific Committee Final Determinations and the Commonwealth Threatened Species Scientific Committee Listing and Conservation Advice. The following approach was used:

- full-floristic plot assessments and meandering surveys to determine floristic composition and structure of each ecological community
- comparison with published species lists, including lists of 'important species' as identified on the listing advice provided by the NSW Scientific Committee and/or Commonwealth Threatened Species Scientific Committee
- comparison with habitat descriptions and distributions for listed TECs
- assessment using guidelines and recovery plans published by the Commonwealth Department of Environment and Energy (DoEE) and the NSW OEH
- comparison with other assessments of TECs in the region.

2.2.8 Plant Community Type (PCT) Allocation

Each of the vegetation communities described within the Development Footprint were aligned with an equivalent PCT as detailed in the VIS Classification Database (OEH 2019c). For each vegetation community described in the Development Footprint, the dominant and characteristic species were entered into the online plant community identification tab and an initial list of PCTs was generated. The profiles for each of the possible PCTs were then interrogated and the most appropriate match assigned based on floristic, structure, soil, landform and distribution details.

Further detail regarding this allocation for individual PCT is outlined in **Section 3.2.1.**

2.3 Threatened Species

2.3.1 Literature and Database Review

A review of previous documents and reports relevant to the Project was undertaken. This included ecological reports, previous ecological surveys undertaken in the vicinity of the Development Footprint and also relevant ecological database searches. The information obtained was used to inform survey design where required, and was also used to assist in the assessment of potentially occurring ecosystem-credit and species-credit species. Relevant documents and resources included:

- OEH BioNet Atlas of NSW Wildlife database and mapping tool (OEH 2019a), accessed March 2019
- OEH Threatened Biodiversity Data Collection (OEH 2019b) for known/predicted threatened species in the Pittwater IBRA subregion, accessed March 2019
- PlantNET (Botanic Gardens Trust 2019) database search for threatened plants within a 10 kilometre radius of the Development Footprint, accessed March 2019
- DoEE Protected Matters Search Tool (DoEE 2019) for known/predicted EPBC Act-listed species, accessed March 2019.

A preliminary assessment using the TBDC was undertaken which provided a list of species-credit species that might require survey and the suitable survey periods for each species. The results of these database searches, literature review and TBDC review were used to design the appropriate survey requirements for species-credit species.

2.3.2 Ecosystem-credit Species

Ecosystem-credit species are those threatened species that can be predicted by vegetation surrogates and landscape features. Ecosystem-credit species are not required to be specifically targeted during field surveys, however an assessment of the suitability of habitat in the Development Footprint is undertaken to determine the species' presence or otherwise in the vegetation zones identified.

Appendix A outlines the ecosystem credit species predicted by the BAM calculator or identified in the literature review.

2.3.3 Species-credit Species

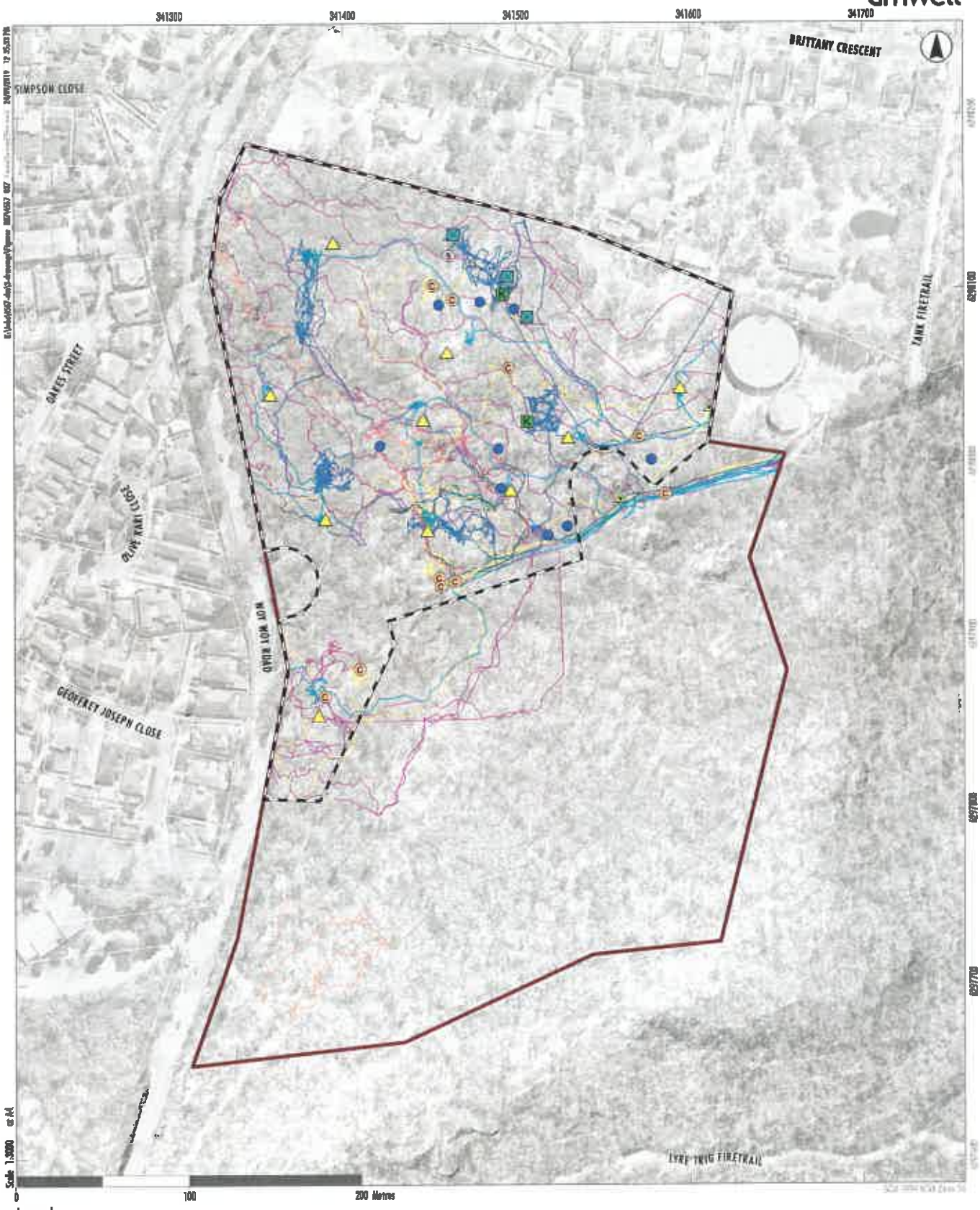
Targeted and opportunistic surveys and walking transects for species-credit species were undertaken across the Development Footprint (refer to **Figure 2.3**). **Table 2.2** below outlines the dates, methods and species targeted during the surveys.

Table 2.2 Species credit species survey methodology and timing

Survey Date	Method	Species Targeted
27 and 28 August 2018	Spotlighting and call playback	barking owl (*Ninox connivens*) masked owl (*Tyto novaehollandiae*) powerful owl (*Ninox strenua*) sooty owl (*Tyto tenebricosa*)
	Threatened species transects Opportunistic observations and habitat assessments	rough doubletail (*Diuris praecox*) *Diuris bracteata*
	Habitat assessments (evidence of breeding)	white- bellied sea- eagle (*Haliaeetus leucogaster*) little eagle (*Hieraaetus morphnoides*) square- tailed kite (*Lophoictinia isura*) eastern osprey (*Pandion cristatus*)
29 August 2018	Diurnal habitat searches and assessments	broad-headed snake (*Hoplocephalus bungaroides*)
18 and 31 October 2018	Targeted threatened species transects and habitat mapping	thick lip spider orchid (*Caladenia tessellata*)netted bottlebrush (*Callistemon linearifolius*) spreading guinea flower (*Hibbertia procumbens*) Somersby mintbush (*Prostanthera junonis*)

Survey Date	Method	Species Targeted
		eastern underground orchid (*Rhizanthella slateri*) black eyed Susan (*Tetratheca juncea*) *Tetratheca glandulosa*
24 January 2019	Targeted threatened species transects	Giant dragonfly
23 and 24 January 2019	Threatened species transects	Bynoes wattle (*Acacia bynoeana*) downy wattle (*Acacia pubescens*) *Ancistrachne maidenii* thick- leaf star- hair (*Astrotricha crassifolia*) *Baloskion longipes* leafless tongue orchid (*Cryptostylis hunteriana*) white- flowered wax plant (*Cynanchum elegans*) *Darwinia glaucophylla*
		Camfield's stringybark (*Eucalyptus camfieldii*) slaty red gum (*Eucalyptus glaucina*) *Epacris purpurascens* subsp. *purpurascens* Bauers midge orchid (*Genoplesium bauera*) small- flowered grevillea (*Grevillea parviflora* subsp. *parviflora*) *Grevillea shiressii* spreading guinea flower (*Hibbertia procumbens*) *Hibbertia puberula* subsp. *puberula* Deanes paperbark (*Melaleuca deanei*) Groves paperbark (*Melaleuca groveana*) *Micromyrtus blakelyi* hairy geebung (*Persoonia hirsuta*) heath wrinklewort (*Rutidosis heterogama*)

Survey Date	Method	Species Targeted
25 – 28 March 2019	Nocturnal searches Call- playback Gang- gang cockatoo and glossy black-cockatoo survey (breeding habitat assessment) Koala SAT tests	pale- headed snake (*Hoplocephalus bitorquatus*) bush stone- curlew (*Burhinus grallarius*) grey- headed flying- fox (*Pteropus poliocephalus*) koala (*Phascolarctos cinereus*) red- crowned toadlet (*pseudophryne australis*) giant burrowing frog (*Heleioporus australiacus*) green-thighed frog (*Litoria brevipalmata*) stuttering frog (*Mixophyes balbus*)
25 March – 6 May 2019	Remote camera	eastern pygmy possum (*Cercartetus nanus*) parma wallaby (*Macropus parma*) squirrel glider (*Petaurus norfolcensis*) greater glider (*Petauroides volans*) brush- tailed phascogale (*Phascogale tapoatafa*)
April 1 and 2 2019	BAM floristic and vegetation integrity plot surveys	NA
6 – 8 May 2019	Nocturnal searches Hollow bearing tree analysis Call- playback Stag watching Gang- gang cockatoo and glossy black-cockatoo survey (breeding habitat assessment)	gang- gang cockatoo (*Callocephalon fimbriatum*) glossy black- cockatoo (Calyptorhynchus lathami) powerful owl (*Ninox strenua*) barking owl (*Ninox connivens*) masked owl (*Tyto novaehollandiae*) sooty owl (*Tyto tenebricosa*)



Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- Lot Boundaries

Survey Effort

- Call Playback Locations
- Remote Camera Locations
- Bird Survey Location
- Spotlighting Survey Location
- Stag Watch Location
- Koala SAT
- Hollow Bearing Trees

- March 2019 Fauna Survey Trackog
- March 2019 Bird Survey Trackog
- March 2019 Spotlighting Survey Trackog
- April 2019 Fauna Survey Trackog
- Summer 2019 Giant Dragonfly Survey Trackog
- Summer 2019 Fauna Survey Trackog
- August 2018 Broad-headed Snake Survey Trackog

FIGURE 2.3

Fauna Survey Effort

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

Species-credit surveys considered the following survey guidelines:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* – Working Draft (DEC 2004)
- *NSW Guide to Surveying Threatened Plants* (OEH 2016)
- *Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians* (DECC 2009)
- Draft Survey Guidelines for Australia's Threatened Orchids (DoE 2013)
- *Flora and Fauna Survey Guidelines* (CCC 2019)

Appendix B outlines the species-credit species predicted by the BAM calculator or identified in the literature review and the targeted survey effort undertaken in accordance with BAM survey requirements.

Appendix B also notes where species-credit species were not considered to require further survey in accordance with Section 6.4 (Step 3) of the BAM (OEH 2017a).

2.3.4 Weather Conditions and Limitations

Table 2.3 below outlines the weather conditions for the surveys. Data is derived from the Central Coast weather station in Gosford (061425) from the Bureau of Meteorology (2019).

Table 2.3 Weather Conditions for Surveys

Date	Daily Data			Monthly Data		
	Min-Max Temp.	Rainfall (mm)	Relative Humidity (%)	Min-Max Temp (mean)	Rainfall (total) (mm)	Relative Humidity (mean) (%)
27 August 2018	9.9-14.0	1.8	87	6.4-19.0	17.6	15.5
28 August 2018	9.1-14.6	0	51			
29 August 2018	2.4-15.8	0	51			
18 October 2018	17.6-25.1	0	88	13.6-21.7	258.0	95
31 October 2018	16.1-26.0	0	70			
23 January 2019	20.6-31.6	0	75	20.7-30.3	57	96
24 January 2019	21.6-25.9	0	85			
25 March 2019	20.0-25.5	4.4	81	17.7-26.6	256.4	65
26 March 2019	16.0-25.9	3	48.5			
27 March 2019	13.9-23.9	0	64			
28 March 2019	14.6-26.8	0	72			
1 April 2019	17.3-29.4	0	71	15.8-25.7	40.2	65

Date	Daily Data			Monthly Data		
	Min-Max Temp.	Rainfall (mm)	Relative Humidity (%)	Min-Max Temp (mean)	Rainfall (total) (mm)	Relative Humidity (mean) (%)
2 April 2019	16.8-32.4	0	63			
6 May 2019	13.8-20.4	0	54			
7 May 2019	6.6-23.5	0	48	10.3-22.0	17.6	62
8 May 2019	8.9-21.4	0	43			

3 Results

3.1 Landscape Value

The buffer area contains a range of landscape features typical of the landscapes around the Central Coast region. These landscape features are shown on Figure 2.1 and outlined in relation to the Development Footprint in Table 3.1 below.

Table 3.1 Landscape Features in the Development Footprint

Landscape Features	
IBRA Bioregion	Sydney Basin
IBRA Subregion	Pittwater
Mitchell Landscape	Gosford – Cooranbong Coastal Slopes
Rivers, Streams, Estuaries	No Strahler streams in the Development Footprint
Wetlands (within, adjacent to and downstream)	*Coastal Upland Swamp in the Sydney Basin Bioregion* EEC occurs within the Development Footprint
Native Vegetation Cover	634.5 hectares in the 1500m buffer area (73%)
Areas of Geological Significance or Soil Hazard Features	None identified
Areas of Outstanding Biodiversity Value	None identified
Cleared Areas	0.29 hectares within the Development Footprint
Connectivity Features	The Development Footprint is part of extensive native vegetation extending to the east and south, which provides connectivity and enables transfer of genetic material for both flora and fauna in the locality. Not identified within a Priority Investment Area (OEH 2017c). Not identified as an important flyway for migratory species.

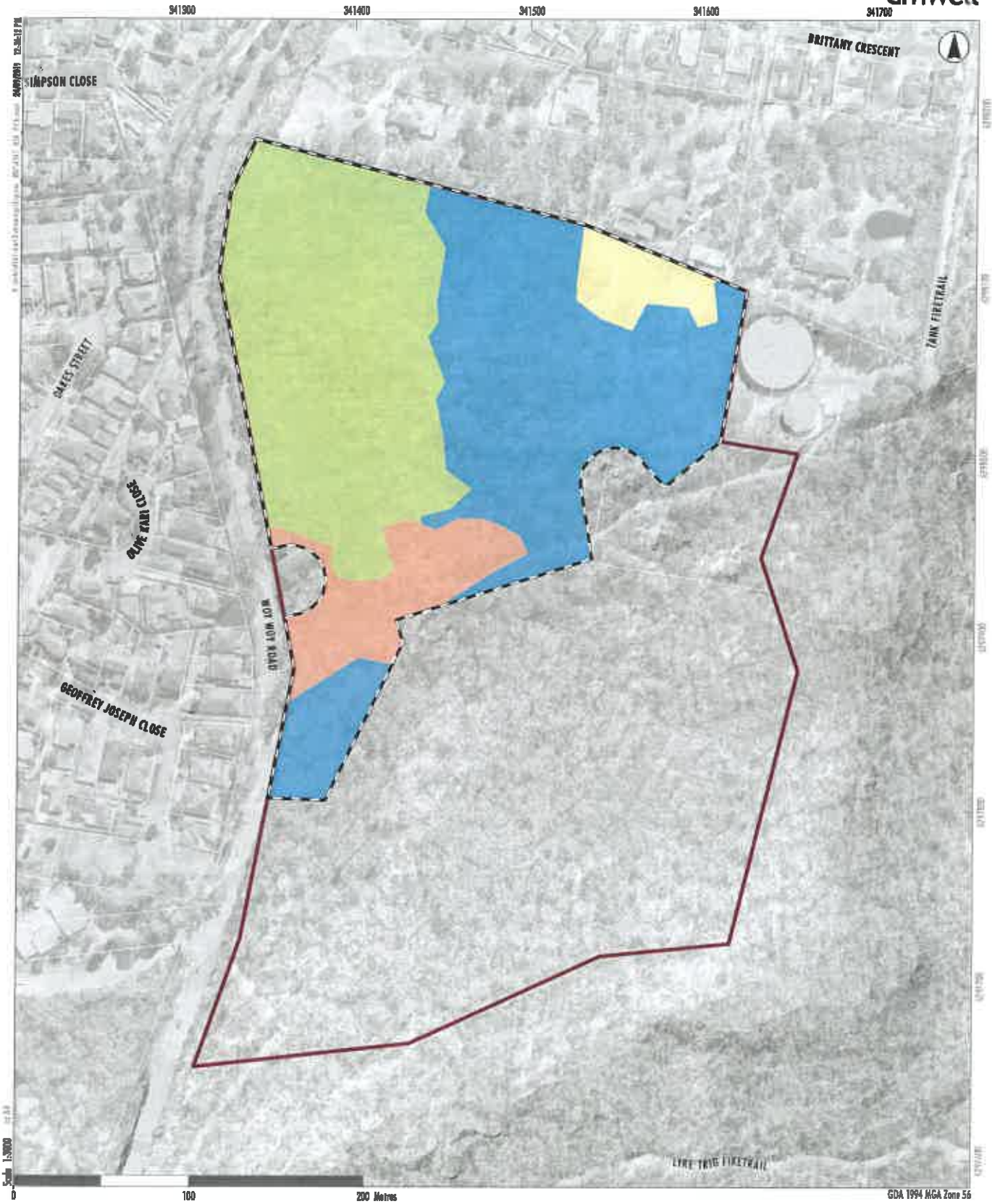
3.2 Native Vegetation within the Development Footprint

3.2.1 Plant Community Types and Vegetation Zones

Surveys of the Development Footprint identified three Plant Community Types (PCTs) across one condition class being (refer to **Figure 3.1**):

- PCT1641 Dwarf Apple – Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast (*Good Condition*)
- PCT1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast (*Good Condition*)
- PCT1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast (*Good Condition*)

A description of the vegetation zones is outlined below, and a flora species list is included in **Appendix C.**



Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- Lot Boundaries

Plant Community Type (Umwelt 2019)

- 1641 - Dwarf Apple Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast (Good Condition)
- 1642 - Scribbly Gum; Red Bloodwood; Old Man Banksia heathy woodland of southern Central Coast (Good Condition)
- 1699 - Heath-leaved Banksia; Coral Fern wet heath on sandstone ranges of the lower Central Coast (Good Condition)
- Cleared/Disturbed

FIGURE 3.1

Plant Community Types in the Development Footprint

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

Zone 1 – PCT 1641 Dwarf Apple – Scribbly Gum heathy low woodland on sandstones ranges of the Central Coast (Good Condition)

PCT Name	PCT 1641 Dwarf Apple – Scribbly Gum heathy low woodland on sandstones ranges of the Central Coast
Condition	Good
Formation	Heathlands
Class	Sydney Coastal Heaths
Percent cleared	44.00
Area in Development Footprint (ha)	2.51
Patch Size Class (ha)	>101
Location	Occurs in the western portion of the Development Footprint (refer to **Figure 3.1**).
Canopy Description	Sparse canopy dominated by dwarf apple (*Angophora hispida*) with the occasional scribbly gum (*Eucalyptus haematoma*) occurring due to the proximity to PCT 1642.
Mid-storey Description	A very dense mid- storey dominated by fern- leaved banksia (*Banksia oblongifolia*) and heath-leaved banksia (*Banksia ericifolia*), flaky- barked tea- tree (*Leptospermum trinervium*), black she-oak (*Allocasuarina littoralis*), fringed baeckea (*Baeckea diosmifolia*), tick bush (*Kunzea ambigua*), conesticks (*Isopogon anemonifolius*), mountain devils (*Lambertia formosa*) drumsticks (*Petrophile pulchella*) and tantoon (*Leptospermum polygalifolium*).
Ground Cover Description	This vegetation zone is characterised by a fairly dense ground layer of sedges, grasses and herbs. Dominant species include *Cyathochaeta diandra*, oat speargrass (*Anisopogon avenaceus*), silky purple flag (*Patersonia sericea*), *Lepyrodia scariosa* and wiry panic (*Entolasia stricta*). Less dominant grasses are also present including bordered panic (*Entolasia marginata*).
PCT Allocation	Vegetation Zone 1 was aligned with PCT1641 as it supports a number of the species identified for the PCT as listed on the VIS Classification Database (OEH 2019c). It is dominated by dwarf apple (*Angophora hispida*) and scribbly gum (*Eucalyptus haemastoma*) which are the only two diagnostic species listed as occurring in the canopy. Further, the mid-stratum contains 75% of the species listed in the VIS Classification Database (OEH 2019c), with the ground stratum containing 5 of 7 (71%) of the listed diagnostic species. Furthermore, the vegetation description for this community is very close to what is occurring on site, being an *Angophora* dominated woodland occurring on dissected sandstone hills of the Central Coast. PCT1641 was therefore determined to be the best overall fit in terms of diagnostic species and the community's location in the landscape.
BC Act Status	This vegetation zone is not consistent with any TEC listed under the BC Act.
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.

Zone 2 – PCT 1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast (Good Condition)

PCT Name	Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast
Condition	Good
Formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Class	Sydney Coastal Dry Sclerophyll Forests
Percent cleared	30.00
Area in Development Footprint (ha)	2.67
Patch Size Class (ha)	> 101
Location	Occurs at the top of the ridge in the eastern portion of the development footprint (refer to **Figure 3.1**).
Canopy Description	Mid-dense canopy dominated by scribbly gum (*Eucalyptus haemastoma*), red bloodwood (*Corymbia gummifera*) and silvertop ash (*Eucalyptus sieberi*). Scattered occurrences of Sydney red gum (*Angophora costata*), grey gum (*Eucalyptus punctata*) and blue- leaved stringybark (*Eucalyptus agglomerata*).
Mid-storey Description	A fairly dense mid-storey is present and contains an array of species including tantoon (*Leptospermum polygalifolium*), conesticks (*Petrophile pulchella*), sweet wattle (*Acacia suaveolens*), heath- leaved banksia (*Banksia ericifolia*), broad- leaved geebung (*Persoonia levis*), narrow- leaved geebung (*Persoonia linearis*), old man banksia (*Banksia serrata*), prickly- leaved tea- tree (*Acacia ulicifolia*), prickly beard- heath (*Leucopogon juniperinus*) and native currant (*Leptomeria acida*).
Ground Cover Description	This vegetation zone is characterised by a diverse and fairly dense ground layer of ferns, sedges and sub-shrubs. Dominant species include *Platysace linearifolia*, lesser flannel flower (*Actinotus minor*), *Cyathochaeta diandra*, *Xanthorrhoea media*, oat speargrass (*Anisopogon avenaceus*), pale mat- rush (*Lomandra glauca*), wiry panic (*Entolasia stricta*), *Lepyrodia scariosa* and screw fern (*Lindsaea linearis*).
PCT Allocation	Vegetation Zone 2 was aligned with PCT1642 as it supports a high number of the diagnostic species identified for the PCT as listed on the VIS Classification Database (OEH 2019c). The canopy contains three of the four listed characteristic species, being *E. haemastoma*, *C. gummifera* and *A. costata*, as well as containing all seven diagnostic mid- storey species listed. The ground stratum also contains 100% of the species listed in the VIS Classification Database (OEH 2019c). PCT1642 was therefore determined to be the best overall fit in terms of diagnostic species and the community's location in the landscape.

PCT Name	Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast
Condition	Good
BC Act Status	This vegetation zone is not consistent with any TEC listed under the BC Act. PCT 1642 can be aligned with *Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion* CEEC listed under the BC Act. However, the vegetation on site is not considered to be consistent with this CEEC, due to a lack of floristic similarity, with the majority of the *Eucalyptus* species (*Eucalyptus piperita, Eucalyptus racemosa, Eucalyptus acmenoides, Eucalyptus pilularis, Eucalyptus resinifera* and *Syncarpia glomulifera*) being absent from the site (NSW Scientific Committee 2011). The only canopy species listed for the CEEC that are present on site are *Angophora costata* (in very low numbers) and *Corymbia gummifera* (NSW Scientific Committee 2011).
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.

Zone 3 – PCT 1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast (Good Condition)

PCT Name	Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast
Condition	Good
Formation	Freshwater Wetlands
Class	Coastal Heath Swamps
Percent cleared	0.00
Area in Development Footprint (ha)	0.63
Patch Size Class (ha)	>101
Location	A small portion occurs on the poorly draining lower areas towards the southern boundary (refer to Figure 3.1).
Canopy Description	Trees are largely absent, with occasional scattered red bloodwood (*Corymbia gummifera*) and blue- leaved stringybark (*Eucalyptus agglomerata*).
Mid-storey Description	A relatively open midstorey containing scattered occurrences of heath- leaved banksia (*Banksia ericifolia*) is present, with occasional tantoon (*Leptospermum polygalifolium*), sweet pittosporum (*Pittosporum undulatum*), prickly moses (*Acacia ulicifolia*) and red- stemmed wattle (*Acacia myrtifolia*).
Ground Cover Description	This vegetation zone is characterised by a dense layer of pouched coral fern (*Gleichenia dicarpa*), with other sedges and grasses such as wiry panic (*Entolasia stricta*), *Cyathochaeta diandra* and red- fruited saw- sedge (*Gahnia sieberiana*).

PCT Name	Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast
Condition	Good
PCT Allocation	Vegetation Zone 3 was aligned with PCT1699 as it supports a number of the species and stratum specifics identified for the PCT as listed on the VIS Classification Database (OEH 2019c). It is dominated by heath- leaved banksia (*Banksia ericifolia*) and tantoon (*leptospermum polygalifolium*) which are two of the eight positive diagnostic species occurring in the mid stratum. Further, the ground layers contain two of the four (50%) species listed on the VIS Classification Database (OEH 2019c). Additionally the ground stratum contains the diagnostic species pouched coral fern (*Gleichenia dicarpa*) at almost 100% coverage, which is diagnostic for this PCT. PCT1699 was therefore determined to be the best overall fit in terms of diagnostic species and the community's location in the landscape, given that this PCT is described as a Banksia dominated wet heath occurring on dissected Hawkesbury sandstone from Peats Ridge to Mooney Creek, which accurately describes the vegetation on Development Footprint.
BC Act Status	This vegetation zone is consistent with *Coastal Upland Swamp in the Sydney Basin Bioregion* EEC listed under the BC Act. The vegetation within the Development Footprint has been found to be consistent with the EEC due to the floristic similarity found on site and the position in the landscape on poorly draining/waterlogged soils. In particular, a dominance of species such as *Banksia ericifolia, Baumea* sp. and *Gahnia sieberiana,* and an almost complete coverage of *Gleichenia dicarpa* in the ground layer, closely aligns to the description of this EEC (NSW Scientific Committee 2012). The absence of any tree species in the canopy, aside from those overhanging from adjacent communities, is also a conforming feature of this EEC and matches that which was found within the Development Footprint. The vegetation in the Development Footprint occurs on waterlogged sandy substrates, which conforms to the soil type described in the NSW Final Determination (NSW Scientific Committee 2012) for this community. Finally, many species found within the Coastal Upland Swamp EEC are absent from the surrounding vegetation communities (NSW Scientific Committee 2012), which is particularly true for the vegetation within the Development Footprint which is starkly different from the surrounding vegetation, largely due to the dominance of the *Gleichenia dicarpa* which forms large colonies around swamps.
EPBC Act Status	This vegetation zone is also consistent with the *Coastal Upland Swamps in the Sydney Basin Bioregion* EEC under the EPBC Act. As per the assessment above according to the BC Act status, this vegetation zone within the Development Footprint is consistent with the EEC under the EPBC Act due to the floristic similarity found on site and the position in the landscape on poorly draining/waterlogged soils (DoE 2014). Characteristic species included in the EPBC conservation advice for this community have been extracted from the NSW final determination, therefore the NSW and Commonwealth listings share the same list of characteristic species.

3.2.2 Exotic Vegetation

The Development Footprint contains very few exotic species, and no areas have been mapped as exotic vegetation. One weed species present in the Development Footprint is classed as a High Threat Weed species under the BAM, whisky grass (*Andropogon virginicus*), and is identified in the flora species list in **Appendix C**.

There is an area cleared of vegetation in the north- east portion of the Development Footprint. This area is largely devoid of any native vegetation, and also contains various objects, such as an old container truck, and the area is apparently being used as storage by the surrounding landowner.

3.2.3 Threatened Ecological Communities

One threatened ecological community was recorded within the Development Footprint, *Coastal Upland Swamp in the Sydney Basin Bioregion* EEC listed under the BC Act and the EPBC Act.

3.2.4 Vegetation Integrity Score

Table 3.2 below details the vegetation integrity scores for each of the vegetation zones in the Development Footprint. The vegetation integrity data for each of the vegetation zones is provided in Appendix D.

Table 3.2 Vegetation Zone Vegetation Integrity Scores

Veg Zone	PCT Name	Composition	Structure	Function	Current Vegetation Integrity Score
1	1641 Dwarf Apple – Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast *Good Condition*	92.9	84.4	66.6	80.5
2	1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast *Good Condition*	83.6	60.8	65.7	69.4
3	1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast *Good Condition*	72.4	8.4	-	24.6

3.3 Threatened Species within the Development Footprint

3.3.1 Ecosystem-credit Species

A list of the ecosystem-credit species predicted to occur by the BAM Calculator and/or the literature review and whether they are considered likely to occur in the vegetation zones within the Development Footprint is provided in Appendix A. Threatened species records are shown on Figure 3.2.

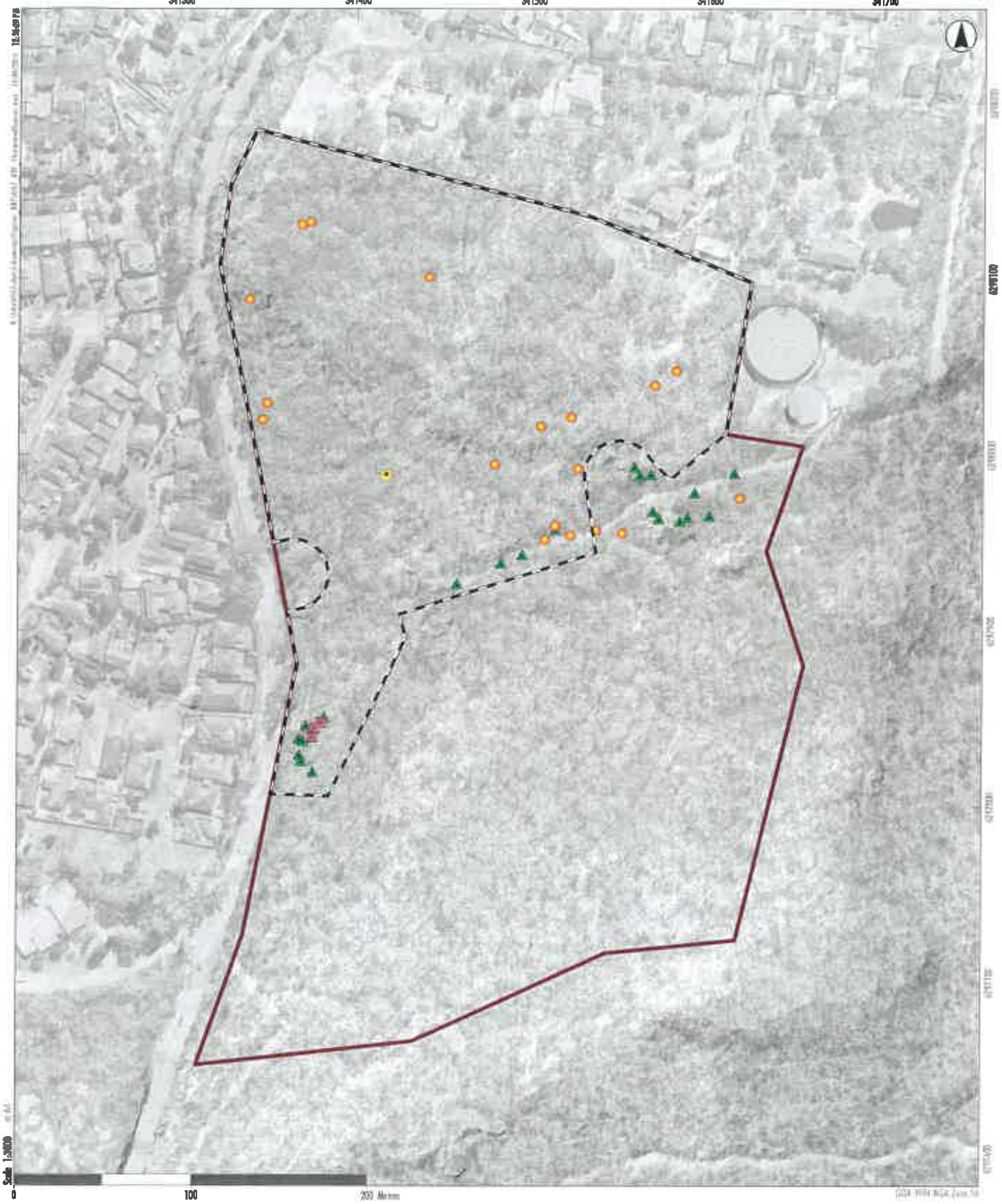


FIGURE 3.2

Threatened Species

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

3.3.2 Species-credit Species

A list of the species-credit species predicted to occur by the BAM Calculator and/or the literature review and a discussion on their inclusion or exclusion from the BAM Calculator assessment is provided in Appendix B. Species-credit species recorded or assumed present are shown in Table 3.3 and further information on the surveys undertaken for these species is provided in Appendix B.

Table 3.3 Species-credit Species within the Development Footprint

Species	BC Act	EPBC Act	Species Presence	Justification
Netted Bottlebrush *Callistemon linearifolius*	V	-	**Yes (surveyed)**	Three individuals detected within Development Footprint.
eastern pygmy possum *Cercartetus nanus*	V		**Yes (assumed)**	There is a high number (29) of records within 10 km of the Development Footprint, including nine records within the suburb of Kariong itself. One record occurs immediately south of the Development Footprint, while two records occur immediately north of the Development Footprint. While remote cameras were deployed within the Development Footprint, this species is known to be difficult to detect and cannot be discounted. The species polygon has been aligned with PCTs 1641 and 1642 according to the TBDC (OEH 2019b).
large-eared pied-bat *Chalinolobus dwyeri*	V	V	**Yes (assumed)**	This species is considered to occur where there are potential roosts located within 2 km of associated PCTs. Potential roosts are caves, scarps, cliffs, rock overhangs and disused mines (OEH 2019b; 2018b), and these features are highly likely to occur within 2 km of the Development Footprint. As it is not possible to survey within 2 km of the Development Footprint for any possible roosts, and as PCT 1642 is associated with this species according to the TBDC (OEH 2019b), the species has been assumed to occur on site according to the requirements of the survey guidelines for *'Species- credit' Threatened Bats and Their Habitats* (OEH 2018b). The species polygon has been aligned with PCT 1642. There is one record of this species in the locality.
Darwinia glaucophylla	V	-	**Yes (surveyed)**	Approximately 11 patches recorded within Development Footprint associated with exposed sandstone.

Species	BC Act	EPBC Act	Species Presence	Justification
spreading guinea flower *Hibbertia procumbens*	E	-	**Yes (surveyed)**	**Approximately 73 individuals detected within Development Footprint across PCT 1641 and 1642.**
Hibbertia puberula subsp. *puberula*	E	-	**Yes (surveyed)**	**Two plants recorded at a single location within Development Footprint in 1641.**
southern myotis *Myotis macropus*	V	-	**Yes (assumed)**	**This species is considered to occur where there are waterbodies (> 3m) within 200 m of hollow-bearing trees in associated PCTs. There is a large dam located within 200 m of the Development Footprint, and PCTs 1641 and 1642 are associated with this species according to the TBDC (OEH 2019b) and the survey guidelines for *'Species- credit' Threatened Bats and Their Habitats* (OEH 2018b.**

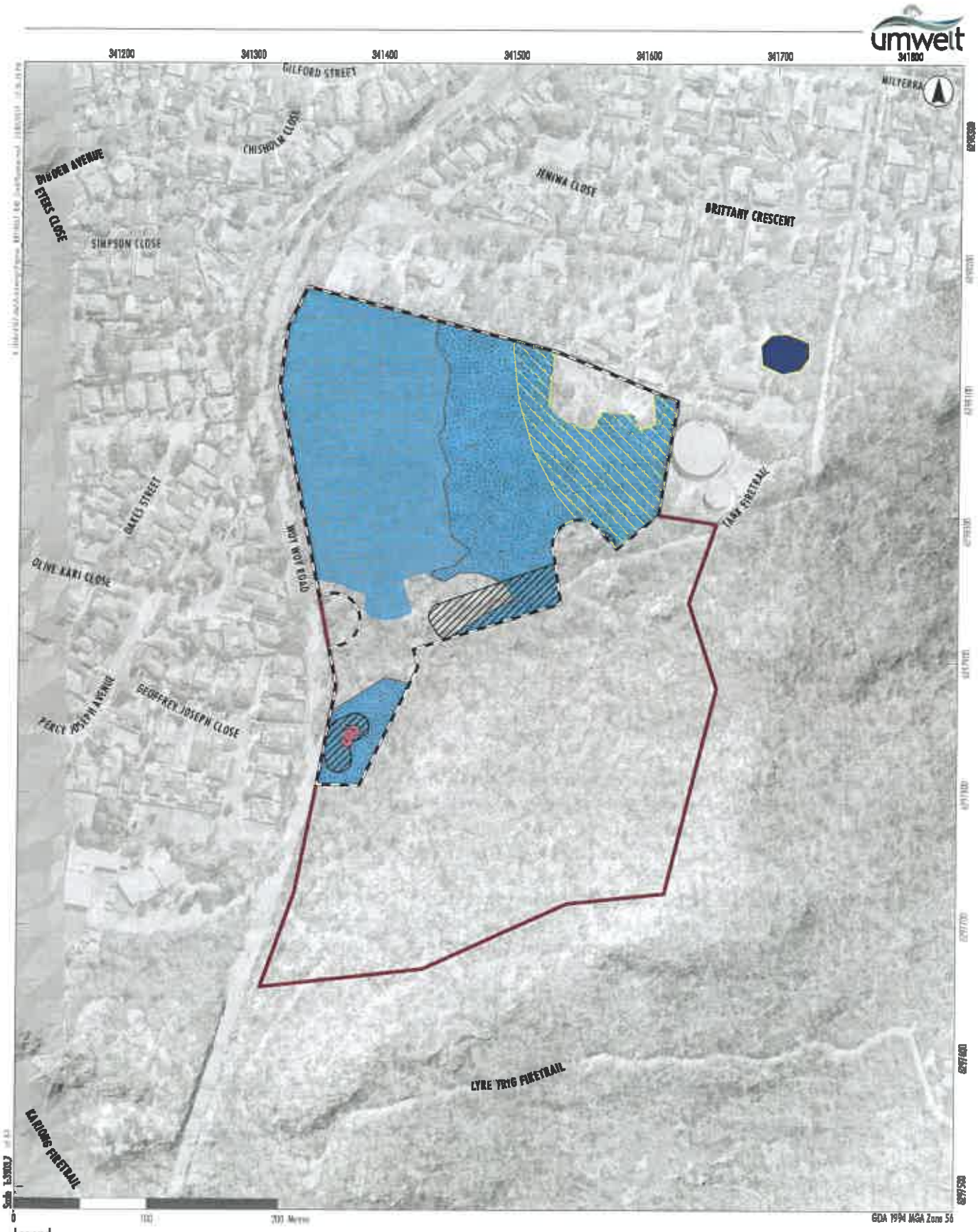
3.3.3 Species Habitat Polygons and Biodiversity Risk Weighting

Species habitat polygons have been prepared for the species outlined in Table 3.4 below. Polygons are shown on Figure 3.3.

Table 3.4 Species-credit Species

Species	Biodiversity Risk Weighting	Species Habitat Polygon Area (ha)	Species Habitat Polygon Description
Netted Bottlebrush *Callistemon linearifolius*	2	**NA – assessed by number of individuals**	**Three individuals situated in the south west of the development footprint) (refer Figure 3.1).**
eastern pygmy possum *Cercartetus nanus*	2	**5.2**	**All areas of Vegetation Zone 1 and 2 (1641_Good and 1642_Good) (refer Figure 3.1).**
large- eared pied- bat *Chalinolobus dwyeri*	3	**2.7**	**All areas of PCT 1642 (assumed to be within 2 km of roosting habitat) (refer Figure 3.1).**
Spreading Guinea Flower *Hibbertia procumbens*	2	**5.2**	**All areas of Vegetation Zone 1 and 2 (1641_Good and 1642_Good) (refer Figure 3.1).**
Hibbertia puberula subsp. puberula	2	**2.5**	**All areas of Vegetation 2 (1641_Good) (refer Figure 3.1).**

Species	Biodiversity Risk Weighting	Species Habitat Polygon Area (ha)	Species Habitat Polygon Description
Darwinia glaucophylla	1.50	**0.4**	**Disturbed areas situated adjacent to the track and exposed sandstone areas in the south of the development footprint, and adjacent to Woy Woy Road in the south west of the Development Footprint (0.3 ha in PCT 1642 and 0.1 ha in PCT 1699) (refer Figure 3.1).**
southern myotis *Myotis macropus*	2	**0.9**	**Any portion of PCT 1641 and 1642 that are situated within a 200 m buffer from nearby dams (refer Figure 3.1).**



Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- Callistemon linearifolius
- Southern Myotis Foraging Habitat
- Southern Myotis Foraging Habitat Buffer
- Large-eared Pied Bat Habitat
- Darwinia glaucophylla Habitat
- Hibbertia puberula subsp. puberula Habitat
- Eastern Pygmy Possum & Hibbertia procumbens Habitat

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

FIGURE 3.3

Species Credit Species Polygons

4 Avoidance and Minimisation of Impacts

Darkinjung have sought to avoid and minimise the potential impacts on the ecological values of the Project primarily through site selection and through consideration of project design and scheduling of works. **Figure 4.1** below documents the final Development Footprint in relation to the biodiversity constraints that were considered by Darkinjung during the planning process.

Biodiversity surveys were initially conducted at the Karlong site to identify biodiversity constraints and determine the most appropriate locations for future development. An Ecological Investigation Report was prepared to identify the ecological characteristics of the site and provide preliminary ecological and bushfire hazard planning considerations to assist in the development of land use concept plans for the site (Conacher Consulting 2016).

The Ecological Investigation Report identified broad vegetation communities, including EECs, threatened flora species and threatened fauna species within the proposed development area and adjacent habitats within the Darkinjung Land holding to the south.

Following completion of field surveys further analysis of the most appropriate development footprint was undertaken with avoidance and minimisation of direct impacts on key biodiversity features a key consideration. The following sections detail the key decisions that relate to the avoidance and minimisation of impacts on biodiversity and the determination of the development footprint assessed by this biodiversity assessment and **Figure 4.1** shows the biodiversity values that were avoided as part of project design.

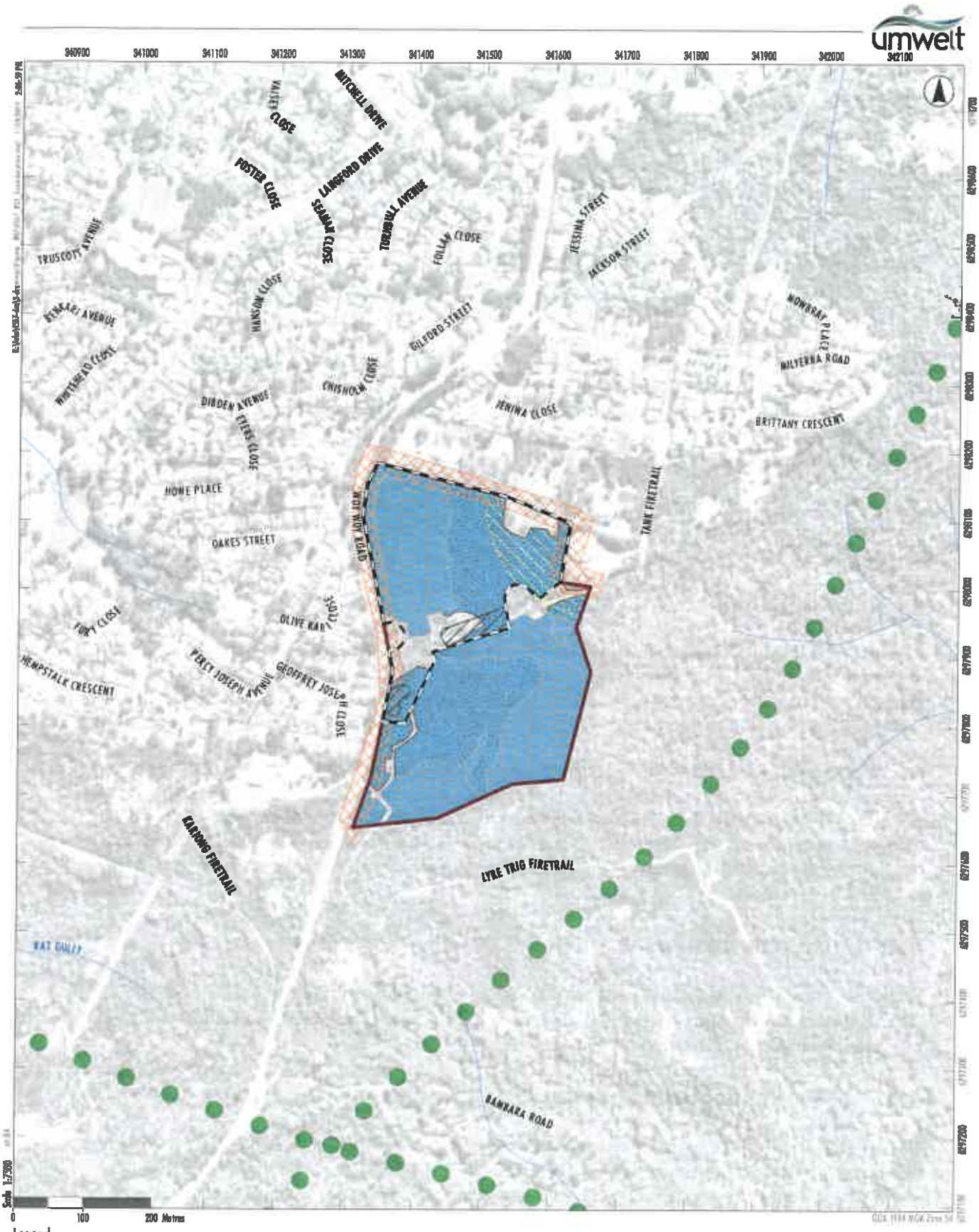
4.1 Site Selection and Avoidance of Native Vegetation and Habitat

Whilst an alternative development footprint has not been provided, the placement of the current Development Footprint boundary has been developed to avoid and minimise direct, indirect and prescribed biodiversity impacts. Prescribed impacts set out in the BAM (OEH 2017a) have been completely avoided by the project. Further detail on the assessment of prescribed impacts is outlined in **Section 5.2.**

Following the completion of the Ecological Investigation Report (Conacher Consulting 2016) a range of threatened flora and fauna species were identified within the proposed Development Footprint and on Darkinjung land holdings adjoining the site to the south. Key threatened species avoided include:

- *Darwinia glaucophylla* - listed as Vulnerable under the BC Act
- *Hibbertia procumbens* - listed as Endangered under the BC Act
- Red-crowned toadlet (*Pseudophryne australis*) - listed as Vulnerable under the BC Act
- Giant burrowing frog (*Heleioporus australiacus*) – listed as Vulnerable under the BC Act and EPBC Act
- Eastern freetail-bat (*Mormopterus norfolkensis*) - listed as Vulnerable under the BC Act
- Coastal Upland Swamp in the Sydney Basin Bioregion – Listed as an Endangered Ecological community under the BC Act and EPBC Act.

While not all of the threatened species and ecological communities could be avoided by the proposed development, concentration of the proposed development impacts in the north of the site ensures that approximately 54 per cent of the site is avoided.



umwelt

Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- Watercourses
- Vegetation Corridor Consideration
- *Darwinia glaucophylla* Habitat Considerations
- Edge Effects Zone Considerations
- *Hibbertia puberula subsp. puberula* Habitat Considerations
- *Large-eared Pied Bat* Habitat Considerations
- *Southern Myotis* Foraging Habitat Considerations
- *Eastern Pygmy Possum and Hibbertia procumbens* Habitat Considerations

FIGURE 4.1

Biodiversity Constraints considered to inform Impact Avoidance and Mitigation Measures

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

4.1.1 Size

The Development Footprint is approximately 6.1 ha in area and represents approximately 46 per cent of the total area of Lot 512 and 513 DP 727686. Darkinjung, during their planning process, have actively avoided direct biodiversity impacts to approximately 7.1 ha of vegetated land in Lot 512 and 513 DP 727686 which contains habitat for a range of listed flora and fauna species including, but not limited to, those occurring in the Development Footprint (see above).

4.1.2 Location

The Development Footprint has been located immediately adjacent to Woy Woy Road, in areas more likely to be already subject to edge effects and indirect impacts from existing surrounding development. Edge effects noted during surveys include weed incursions, access tracks and rubbish dumping (refer to **Figure 4.1**). The intact bushland to the south of the development footprint will remain relatively intact, with little incursion into these areas.

The concentration of development impacts in the north of the site effective infills the existing Kariong urban area, reducing edge effects elsewhere in the local area where inappropriate development could adversely impact biodiversity values.

4.1.3 Connectivity

As mentioned above, the Development Footprint has been positioned in the north of the land holding in an area more already subject to edge effects and indirect impacts from existing surrounding development. In addition to this, the Development Footprint has been reduced in the south, to stop short of the existing residential development to the west of Woy Woy Road to retain all connectivity values that currently exists.

Impacts on connectivity were identified in the Ecological Investigation Report (Conacher Consulting 2016) and was a key consideration in the design of the proposed development. The proposed development has been designed to avoid impacts on connectivity in the local area and region. As shown on **Figure 4.1**, existing connectivity values will be retained and the functionality of corridors as identified in the Central Coast Regional Plan 2036 Biodiversity Corridors will be preserved through the appropriate siting of the proposed development.

4.2 Project Design

Whilst detailed design plans aren't available, Darkinjung will consider the biodiversity values of the land when preparing the development plans at the DA stage of the project to further avoid impacts of the proposed development on biodiversity values.

4.3 Timing and Methods for Clearing Works

Darkinjung has committed to the design and implementation of a comprehensive biodiversity impact minimisation strategy to minimise and mitigate the unavoidable impacts of the Project. The following specific control measures are considered to be integral to the minimisation of impacts on the biodiversity features of the Development Footprint and surrounds. Control measures include:

- demarcation of approved clearance boundaries
- weed management
- fencing and access control

- bushfire management, and
- pre-clearance and tree felling procedures.

4.3.1 Tree Felling Procedure

The supervision of all tree and vegetation removal works is to be completed by a suitably qualified and experienced ecologist. If an unanticipated ecological issue is encountered, further advice is to be sought on the most appropriate measures to ensure minimal impact on fauna species, particularly threatened species. Prior to the commencement of felling activities, a local veterinarian and/or qualified wildlife carer will be identified and their contact details kept on hand, in the case their assistance is needed for injured wildlife. All personnel who are involved in the capture/handling/housing and/or transport of native fauna species (injured or uninjured) must be appropriately licensed under the requirements of the NSW Animal Ethics Committee. All clearing works will be completed at an appropriate time to minimise the risk of impacts on threatened species.

The following sections document the steps required to be completed as part of the tree felling process.

No more than two weeks prior to tree felling habitat trees, the following activities will be undertaken:

- Remove non-habitat trees/vegetation less than 3 m in height, as close to the habitat tree felling date as possible (less than one week) in order to create disturbance to discourage fauna usage of the habitat trees.
- In the event that threatened fauna are identified, provide a minimum 48 hour window for any threatened fauna species to vacate hollows or nests.

On the day of felling of habitat trees, the following activities will be undertaken:

- Complete a visual inspection of the area to be cleared for fauna species and nests that may have become active since pre-clearing surveys.
- Shake the habitat tree (with heavy machinery) for at least 30 seconds or as appropriate prior to felling to encourage fauna to abandon the tree.
- Ensure that habitat trees are lowered away from adjoining retained habitats.
- Lower the habitat tree as gently as possible with heavy machinery, noting in some situations (i.e. steep slopes) manual felling by chainsaw may be appropriate.
- Inspect all hollows and canopy of felled trees for remaining or injured fauna.
- Capture any displaced or injured fauna. Unharmed fauna are to be released into nearby secure habitats on the same day. Injured fauna are to be triaged immediately, humanely euthanized if required, or taken to a veterinarian or local volunteer wildlife carer group for further attention if required.
- Felled trees are to be rolled where appropriate so that the number of hollows blocked against the ground is minimised.
- In the event that threatened fauna are identified, provide a minimum 48 hour window for any threatened fauna species to vacate hollows or nests.

4.4 Summary of Measures

Table 4.1 below outlines the avoidance and minimisation measures proposed for the Project including the timing, action, outcome and responsibility of these measures.

Table 4.1 Avoidance and Minimisation Measures

Measure	Timing	Responsibility	Proposed Techniques	Outcome
Preliminary ecological site inspection	Pre-project design	N/A	N/A	• Preliminary assessment of areas of avoidance to inform project design.
Location and design of facilities in existing disturbed areas.	Project design	N/A	N/A	• Focus impacts on areas of low biodiversity value.
Pre-clearance Surveys and Tree Felling Procedure	Prior to clearance and during clearance activities	Site Manager	• Pre-clearance surveys and felling procedures as described above	• Minimisation of impacts to resident fauna species within the Development Footprint
Demarcation of approved clearance boundaries	Prior to clearance and during clearance activities	Site Manager	• Establish construction fencing or marking tape around areas not proposed for clearance.	• Minimisation of unnecessary impacts to surrounding vegetation and habitats.
Weed management	Construction and operation	Site Manager	• Chemical and physical removal of invasive weed species in accordance with the *Noxious and Environmental Weeds Handbook* (DPI 2014).	• Minimisation of environmental and noxious weeds in the Development Footprint. • Minimisation of weed spread from and into the wider locality.

5 Assessment of Impacts

5.1 Impacts on Native Vegetation and Habitat

5.1.1 Direct Impacts

The development of the Project will result in direct impacts on biodiversity values. Direct impacts include the loss of vegetation and fauna habitats as a result of clearance works and subsequent impacts from residential housing. The Development Footprint contains a range of habitat features (such as hollow-bearing trees, fallen logs and threatened flora species habitat) and species-credit species have been identified to occur within the Development Footprint.

Table 5.1 below outlines the direct impacts on native vegetation, which totals approximately 5.8 hectares. This assumes that the entire Development Footprint will be cleared as a result of the rezoning and subsequent development of the site. Avoidance and mitigation measures associated with minimising the impacts of these direct impacts are discussed in Section 4.0 above.

Table 5.1 Direct Impacts of the Proposed Modification on Biodiversity Features

Species	Area within the Development Footprint (ha)
Plant Community Type	
PCT1641 Dwarf Apple – Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast	2.5
PCT1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast	2.7
PCT1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast	0.6
Species-credit Species Habitats	
Callistemon linearifolius	3 individuals
eastern pygmy possum – *Cercartetus nanus*	5.2
large- eared pied- bat – *Chalinolobus dwyeri*	2.7
Hibbertia procumbens - Spreading Guinea Flower	5.2
Hibbertia puberula	2.5
Darwinia glaucophylla	4
southern myotis – *Myotis macropus*	0.9

5.1.2 Indirect Impacts

The Project is not expected to result in any additional indirect impacts on the biodiversity values of surrounding lands. No substantial indirect impacts are expected to occur in relation to connectivity, corridors, habitat fragmentation or light emissions beyond minimal encroachment from the Development Footprint. However, some minor indirect impacts associated with water runoff, noise, dust and weeds may occur during the during the subsequent development of the Development Footprint. These are discussed below.

No indirect impact zones have been identified for this Project.

5.1.2.1 Noise Impacts

Noise impacts have the potential to adversely impact native species. Potential impacts include:

- noise disturbing the roosting and foraging behaviour of fauna species
- noise reducing the occupancy of areas of suitable habitat.

In regard to potential impacts on biodiversity, noise disturbance is likely to be highest during construction of the project. Upon completion, noise levels are likely to be similar to those already experienced in the area from the nearby Woy Woy Road and residences. Noise from proposed residences is not expected to be of any level of significance in relation to threatened species, populations and communities.

5.1.2.2 Dust Impacts

Dust emissions have the potential to adversely impact native species during ground disturbance works and construction. Potential impacts include dust covering vegetation, which thereby potentially reduces vegetation health and growth. This subsequently impacts upon native fauna species. The design of the Project will include measures to minimise the potential for adverse dust impacts. Dust impacts will also only be present during the construction phase of the project and will therefore be a temporary disturbance to the vegetation and habitats adjacent to the Development Footprint.

5.1.2.3 Weed Impacts

Weed species could be inadvertently brought into the Development Footprint with imported materials, on equipment, or could invade naturally through removal of native vegetation and establishment of gardens. The presence of weed species within the Development Footprint has the potential to decrease the value of extant vegetation to native species. Mitigation measures outlined in **Section 4.0** will be implemented to minimise the potential for weed encroachment into areas surrounding the Development Footprint.

There is unlikely to be any substantial change to impacts from weeds. Any additional impacts resulting from weeds are not expected to be of any level of significance in relation to threatened species, populations and communities.

5.2 Prescribed Impacts

No impacts are expected to occur to threatened species' or communities' habitat associated with karst, caves, cliffs and other geological features of significance or human-made structures as these do not occur within the Development Footprint. However, small rocky areas and crevices do occur within the Development Footprint, which can be considered a prescribed impact. These areas are relatively small, considering the larger area of surrounding habitat.

No areas of non- native vegetation exist within the Development Footprint. There is a cleared area in the northern portion of the Development Footprint, however this area is largely devoid of any vegetation and is considered extremely unlikely to provide any habitat for threatened species. Threatened microbats may forage above this area for insects, however there is no roosting or breeding habitat available within this cleared area.

Important connectivity and movement habitat is unlikely to be substantially impacted by the project given that it is located immediately adjacent to existing residential areas and will negligibly reduce the extent of the existing extensive vegetated corridor to the east and south. The project proposes to impact a relatively minor proportion of this area of native vegetation and will not result in severing any major fauna movement habitat which would result in the loss of connectivity in the wider landscape, or movement important for threatened species to maintain their life cycle. The Development Footprint is located within the corridor identified in the Central Coast Regional Plan 2036 (NSW Government 2016) as connecting the central National parks and State Forests. The project proposes to impact a relatively minor proportion of this area of native vegetation (approximately 300 m wide). The corridor itself will remain the same size overall, and minor impacts to connectivity will occur (refer to **Figure 2.1**). The remainder of Lot 512 DP 727686 is planned to be conserved through a Stewardship Agreement, which will provide in perpetuity conservation of a considerable section of the identified corridor in the Central Coast Regional Plan 2036 (NSW Government 2016).

Only those threatened fauna species that are not particularly mobile are likely to be impacted by the proposal. Similarly, threatened flora species and threatened ecological communities rely on connectivity for the exchange of genetic material. Therefore, impacts to connectivity limit the diversity within any given gene pool. However, considering the small area of connectivity to be removed, and given that the retained vegetation will remain almost entirely surrounded by native vegetation, impacts to genetic exchange are not anticipated such that these threatened species or communities would cease to exist in the locality.

No impacts on water quality or hydrological processes that sustain threatened species and threatened ecological communities are likely to occur. No creeks or mapped drainage lines occur within the Development Footprint. Wet soak areas were detected, especially in the vicinity of the *Coastal Upland Swamp in the Sydney Basin Bioregion* EEC, though these are only moist after rainfall.

No direct impacts to the hydrological processes of any offsite unmapped drainage lines are anticipated to occur as part of the proposed activity. Should any indirect impacts occur, these are expected to be short-term in duration and persist only during the construction phase of the project. These should also be minimal provided appropriate erosion and sediment controls are in place.

Access to the Development Footprint will occur via Woy Woy Road. As the Development Footprint occurs immediately adjacent to this busy roadway, it is unlikely that any threatened species or animals that are part of a TEC would be adversely impacted by the increase in vehicle movement in or near to the Development Footprint. As the proposed activity would result in an increase in residences in the area, an increase in local vehicle movement is anticipated. However, the anticipated increase is not at such a scale that the increase in vehicle strikes would be significant to the decline of any threatened species.

The impacts of wind turbines are not applicable to this project.

5.2.1 Uncertain Prescribed Impacts

Uncertain impacts are those that are unable to be reliably predicted during the assessment process or are infrequent in nature. These usually refer to impacts associated with caves, cliffs, mine subsidence and wind turbine strikes and increased vehicle strikes. Indirect impacts associated with the interruption of ecosystem processes are also complex and difficult to quantify.

The Project is unlikely to result in any uncertain prescribed impacts.

5.3 Serious and Irreversible Impacts

Under the BC Act, a determination of whether an impact is serious and irreversible must be made in accordance with the principles prescribed in the BC Regulation. The principles have been designed to capture those impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in New South Wales. These are impacts that:

- will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or
- will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or
- impact on the habitat of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or
- impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

None of the PCTs or species-credit species that generate biodiversity credits for the Project are nominated as candidate SAII entities in the *Guidance to Assist a Decision-Maker to Determine a Serious and Irreversible Impact* (OEH 2017b) or recent updates in the TBDC (OEH 2019b). Furthermore, of the predicted species outlined in **Appendix B**, the candidate SAII entities are listed for breeding habitat components only (e.g. cave and cliff line habitat for cave-roosting microbat species), contain distributional restrictions (i.e. SAII for south of the Sydney Basin Bioregion only) or the species do not occur in the Development Footprint (i.e. flora species). While it has been assumed that the large- eared pied- bat (*Chalinolobus dwyeri*) would be present within the Development Footprint, no evidence of breeding habitat has been detected and the presence of this species is based on foraging habitat only being present. This is also true for little bentwing- bat (*Miniopterus australis*) and eastern bentwing- bat (*Miniopterus schreibersii oceanensis*) which are captured under ecosystem- credit species where no breeding habitat is present.

No species or ecological communities listed as SAII entities are likely to occur within the Development Footprint and no further assessment of SAII is required.

6 Biodiversity Credit Impact Summary

6.1 Impacts Not Requiring Assessment

Under the BAM impacts to areas of land without native vegetation do not require further assessment. The Development Footprint contains approximately 0.29 ha of cleared land that will be removed as a result of the project. **Figure 3.1** shows the cleared/disturbed areas within the Development Footprint not requiring assessment in accordance with Section 10.4 of the BAM.

6.2 Impacts Not Requiring Offset

Impacts on native vegetation not requiring offsets under the BAM include native vegetation that has a vegetation integrity score of less than 20 (where it is not associated with ecosystem-credit species habitat or a TEC), less than 17 (where it is associated with ecosystem-credit habitat or a TEC) or less than 15 (where it is representative of a EEC or CEEC).

As all native vegetation recorded within the Development Footprint has a higher vegetation integrity score than the required threshold, there are no areas of native vegetation impact not requiring offset.

6.3 Impacts Requiring Offset

Three PCTs and seven species-credit species are considered to require offsetting in accordance with the BAM (OEH 2017a). **Table 6.1** summarises this outcome.

Table 6.1 Impacts Requiring Offset

Veg Zone	PCT/Species-credit	Vegetation Integrity Score			Area (ha)	Credits Required
		Current	Future	Change		
1	PCT1641 Dwarf Apple – Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast *Good Condition*	80.5	0	-80.5	2.5	75
2	PCT1642 Scribbly Gum – Red Bloodwood – Old Man Banksia heathy woodland of southern Central Coast *Good Condition*	69.4	0	-69.4	2.7	70
3	PCT1699 Heath- leaved Banksia – Coral Fern wet heath on sandstone ranges of the lower Central Coast *Good Condition*	24.6	0	-24.6	0.6	7
-	Netted Bottlebrush *Callistemon linearifolius*	-	-	-	3 individuals	6
-	eastern pygmy possum *Cercartetus nanus*	-	-	-	5.2	195
-	*Darwinia glaucophylla*	-	-	-	4	9
-	large- eared pied- bat *Chalinolobus dwyeri*	-	-	-	2.7	141
-	spreading guinea flower - *Hibbertia procumbens*	-	-	-	5.2	195
-	*Hibbertia puberula*	-	-	-	2.5	101
-	southern myotis *Myotis macropus*	-	-	-	0.9	31

7 Biodiversity Credit Report

A full Biodiversity Credit Report is included in Appendix E.

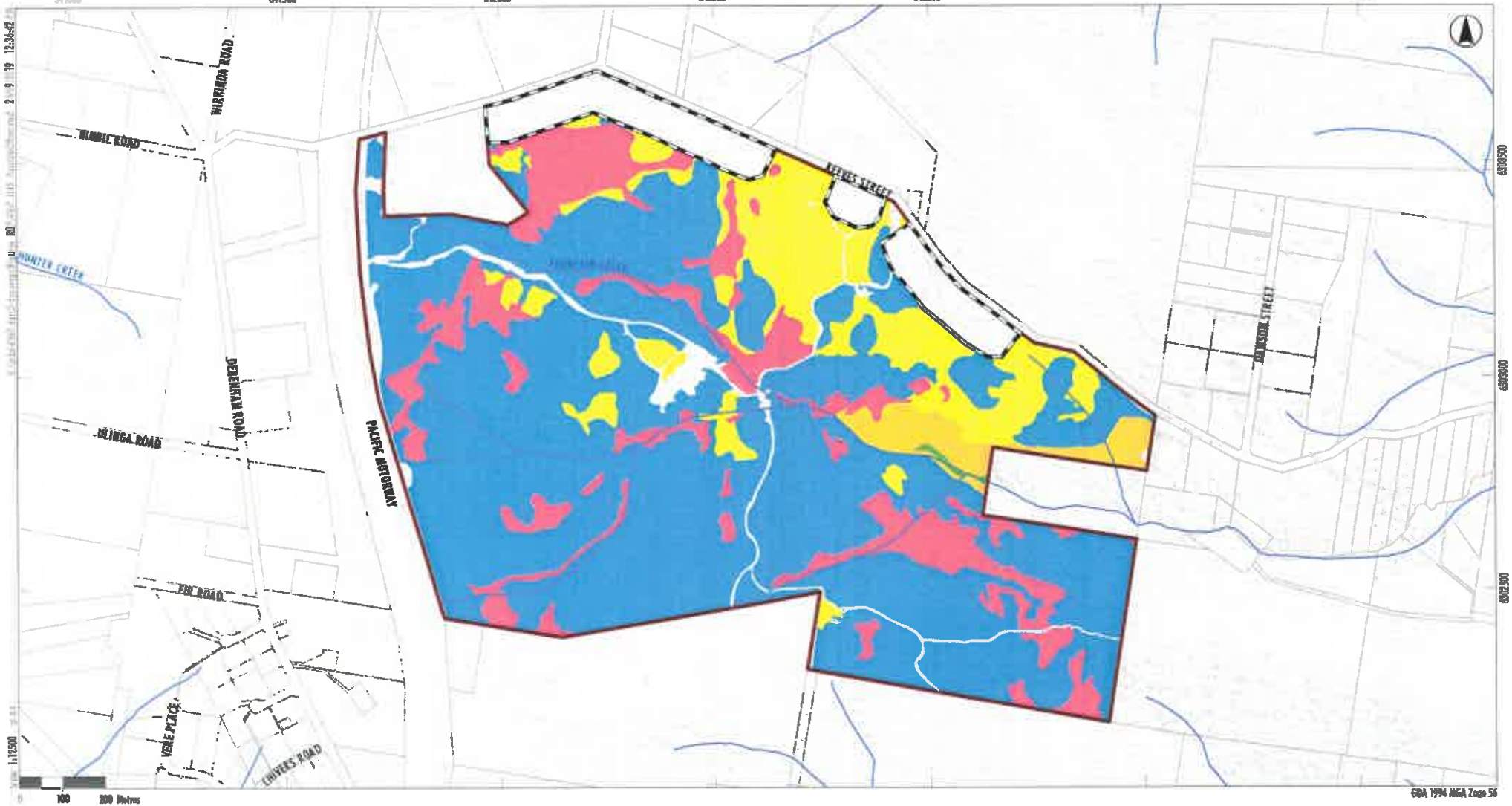
8 Biodiversity Offset Strategy

The Darkinjung- owned lands located at Woy Woy Road Kariong is approximately twice the size of the proposed Development Footprint (refer to **Figure 2.1**). This area is located immediately south of the Development Footprint and comprises approximately 7 ha in total. Considering that the site occurs immediately adjacent to the Development Footprint, and based on a high-level habitat suitability assessment in conjunction with previous ecological studies (Conacher Consulting 2016), the site will likely generate a portion of the required credits to offset the impacts of the project if it was to be established as a Biodiversity Stewardship site. In addition to this, the remainder of Lot 481 DP 1184693 Reeves Street, Somersby located approximately 4 km north of the Development Footprint comprises over 178 ha of similar vegetation communities (Conacher 2015) which is likely to generate the majority of the required credits to offset the impacts of the project (refer to **Figure 8.1**).

Darkinjung is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of biodiversity values as a result of the project under the *BC Act 2016* and *Biodiversity Conservation Regulation 2017*. Firstly, Darkinjung has, where possible, altered the project to avoid and minimise biodiversity impacts in the project planning stage, and a range of impact mitigation strategies to mitigate the impact on ecological values (refer to **Section 4.0**) prior to the consideration of offsetting requirements.

Fulfilling offset requirements under the *BC Act 2016* can be undertaken using one or a combination of the following offset strategies:

- In-perpetuity conservation through the establishment of a Stewardship site achieved and the retirement of credits.
- Securing required credits through the open credit market and/or
- Payments to the Biodiversity Conservation Fund.



Legend

- Development Footprint
- Lot 48 DP118467
- Lot Boundaries
- Watercourses

Vegetation Communities (Cumberbatch 2015)

- Coastal Upland Swamp (EEC under BC Act and EPBC Act)
- Exposed Hawkesbury Woodland
- Hawkesbury Plateau Banksia Scrub
- Sandstone Ranges Warm Temperate Rainforest
- Sheltered Dry Hawkesbury Woodland

Image Source: Nearmap (March 2019) Data source: NSW LPI (2019); Cumberbatch (2015)

FIGURE 8.1

Potential Somersby Offset Site

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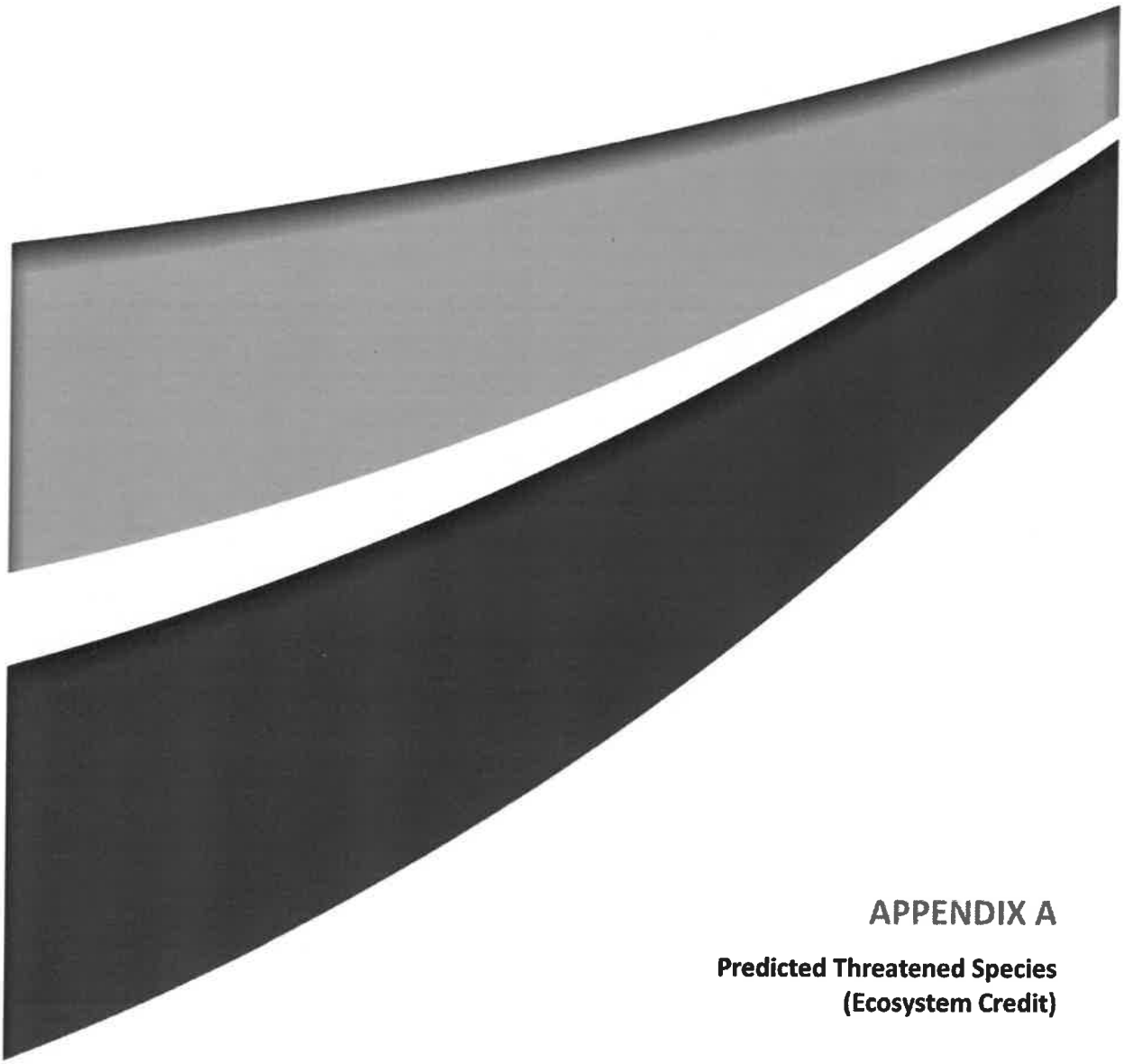


APPENDIX A

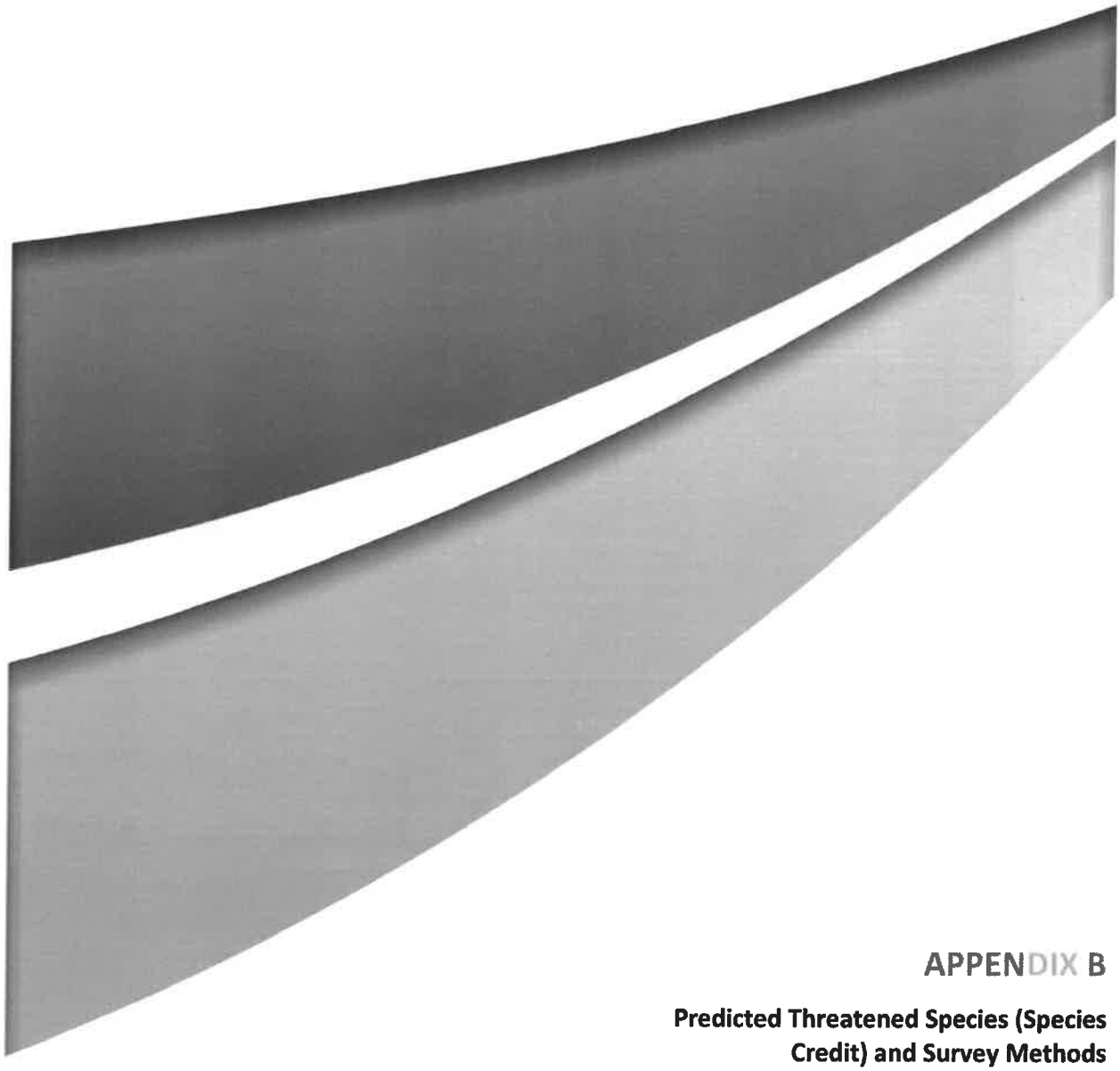
Predicted Threatened Species (Ecosystem Credit)

Predicted Threatened Species (Ecosystem Credit)

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint
regent honeyeater (foraging) *Anthochaera phrygia*	CE	CE	Very High	-
dusky woodswallow *Artamus cyanopterus*	V	-	Moderate	-
australasian bittern *Botaurus poicilopterus*	E	E	High	-
gang-gang cockatoo (foraging) *Callocephalon fimbriatum*	V	-	Moderate	-
glossy black-cockatoo (foraging) *Calyptorhynchus lathami*	V	-	High	Presence of *Allocasuarina* and *casuarina* species.
brown treecreeper (eastern subspecies) *Climacteris picumnus victoriae*	V	-	High	-
varied sittella *Daphoenositta chrysoptera*	V	-	Moderate	-
spotted-tailed quoll *Dasyurus maculatus*	V	E	High	-
white- fronted chat *Epthianura albifrons*	V	-	Moderate	-
eastern false pipistrelle *Falsistrellus tasmaniensis*	V	-	High	-
little lorikeet *Glossopsitta pusilla*	V	-	High	-
painted honeyeater *Grantiella picta*	V	V	Moderate	Mistletoes present at a density of greater than five mistletoes per hectare.
white-bellied sea-eagle (foraging) *Haliaeetus leucogaster*	V	-	High	Within 1km of a river, lake, large dam or creek, wetlands and coastlines.
little eagle (foraging) *Hieraaetus morphnoides*	V	-	Moderate	-
broad-headed snake *Hoplocephalus bungaroides*	E	V	High	-
black bittern *Ixobrychus flavicollis*	V	-	Moderate	
golden-tipped bat *Kerivoula papuensis*	V	-	High	-

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint
swift parrot (foraging) *Lathamus discolor*	E	CE	Moderate	-
square-tailed kite (foraging) *Lophoictinia isura*	V	-	Moderate	-
black-chinned honeyeater (eastern subspecies) *Melithreptus gularis*	V	-	Moderate	-
little bentwing-bat (foraging) *Miniopterus australis*	V	-	High	-
eastern bentwing-bat (foraging) *Miniopterus schreibersii oceanensis*	V	-	High	-
eastern freetail-bat (foraging) *Mormopterus norfolkensis*	V	-	High	-
turquoise parrot *Neophema pulchella*	V	-	High	-
barking owl (foraging) *Ninox connivens*	V	-	High	-
powerful owl (foraging) *Ninox strenua*	V	-	High	-
eastern osprey (foraging) *Pandion cristatus*	V	-	Moderate	-
yellow-bellied glider *Petaurus australis*	V	-	High	Hollow-bearing trees with hollows greater than 25cm diameter.
scarlet robin *Petroica boodang*	V	-	Moderate	-
koala (foraging) *Phascolarctos cinereus*	V	V	High	-
long-nosed potoroo *Potorous tridactylus*	V	V	High	Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e. to capture populations inhabiting wet sclerophyll and rainforest).
eastern chestnut mouse *Pseudomys gracilicaudatus*	V	-	High	-
new Holland mouse *Pseudomys novaehollandiae*	-	V	Moderate	-
grey-headed flying-fox (foraging) *Pteropus poliocephalus*	V	V	High	-

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint
Australian painted snipe *Rostraula australis*	E	E	High	-
greater broad- nosed bat *Saccolaimus flaviventris*	V	-	Moderate	-
greater broad-nosed bat Scoteanax rueppellii	V	-	High	-
masked owl (foraging) *Tyto novaehollandiae*	V	-	High	-
sooty owl (foraging) *Tyto tenebricosa*	V	-	Moderate	-
Rosenberg's goanna *Varanus rosenbergi*	V	-	High	-



APPENDIX B

Predicted Threatened Species (Species Credit) and Survey Methods

Predicted Threatened Species (Species Credit) and Survey Methods

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
Flora Species						
Bynoe's wattle *Acacia bynoeana*	E	V	Sept-Mar	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in October 2018 and January 2019 in suitable habitat over 6 days. Opportunistic observations were completed throughout all Umwelt survey periods.
downy wattle *Acacia pubescens*	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018, and January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Ancistrachne maidenii	V	-	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018, and January 2019 in suitable habitat over 6 days.
Asterolasia elegans	E	E	All year	-	Yes	**Species not present.** No habitat present for this species within the Development Footprint. No records of this species within 10 km of the Development Footprint.
thick-leaf star-hair *Astrotricha crassifolia*	V	V	All year	-	Yes	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat over 2 days. Opportunistic observations were completed throughout all Umwelt survey periods.
dense cord- rush *Baloskion longipes*	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat over 2 days. Opportunistic observations were completed throughout all Umwelt survey periods.
thick lip spider orchid *Caladenia tessellata*	E	V	Sept-Nov^	-	Yes	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in October 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
netted bottle brush *Callistemon linearifolius*	V	-	Sept-Mar	-	No	**Species detected.** Three individuals located in the south- west of the development footprint in PCT 1642. Species habitat polygon mapped on **Figure 3.3.**
leafless tongue orchid *Cryptostylis hunteriana*	V	V	Nov-Feb	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
white-flowered wax plant *Cynanchum elegans*	E	E	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Darwinia glaucophylla	V	-	All year	-	No	**Species detected.** Approximately 11 individuals detected within the development footprint in PCTs 1642 and 1699 in the south-west of the area, and adjacent to the track. Species habitat polygon mapped on **Figure 3.3.**
Diuris bracteata	E	Ex.	Aug-Sept	-	Yes	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
camfield's stringybark *Eucalyptus camfieldii*	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018 and January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Slaty Red Gum *Eucalyptus glaucina*	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
Epacris purpurascens subsp. *purpurascens*	V	-	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018 and January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Yellow Gnat- orchid *Genoplesium baueri*	E	E	Feb-Mar	-	Yes	**Species not detected.** This species was targeted as part of BAM plot/transect surveys conducted in March 2019. This species is typically found in moss gardens over sandstone and is unlikely to be present in the site.
small-flower grevillea *Grevillea parviflora* subsp. *parviflora*	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018 and January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Grevillea shiressii	V	V	All year	-	Yes	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018 and January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Wingless Raspwort *Haloragis exalata* subsp. *exalata*	V	V	All year	Waterbodies	No	**Species not present.** No habitat present for this species within the Development Footprint. No records of the species within 10 km of the Development Footprint.
spreading guinea flower *Hibbertia procumbens*	E	-	Dec-Mar	-	No	**Species detected.** Approximately 73 individuals detected within the development footprint across much of the area in PCTs 1641 and 1642. Species habitat polygon mapped in **Figure 3.3.**
Hibbertia puberula subsp. *puberula*	E	-	Sept - Feb	-	No	**Species detected.** One individual detected within the development footprint in PCT 1641. Species habitat polygon mapped in **Figure 3.3.**
biconvex paperbark *Melaleuca biconvexa*	V	V	All year	-	No	**Species not present.** No habitat for this species within the development footprint.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
Deane's Paperbark *Melaleuca deanei*	V	V	Dec-Feb	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Grove's paperbark *Melaleuca groveana*	V	-	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Micromyrtus blakelyi	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Hairy geebung *Persoonia hirsuta*	E	E	Dec-May	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Pimelea curviflora subsp. *curviflora*	V	V	All year	-	No	**Species not present.** No habitat present for this species within the Development Footprint. No records of the species within 10 km of the Development Footprint.
tranquility mintbush *Prostanthera askania*	E	E	Sept-Dec	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in October 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Somersby mintbush *Prostanthera junonis*	E	E	Sept-Nov	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in October 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
scrub turpentine *Rhodamnia rubescens*	CE	-	All year	-	Yes	**Species not present.** No habitat present for this species within the Development Footprint. No records of the species within 10 km of the Development Footprint.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
native guava *Rhodomyrtus psidioides*	CE	-	All year	-	Yes	**Species not present.** No habitat present for this species within the Development Footprint. No records of the species within 10 km of the Development Footprint.
eastern underground orchid *Rhizanthella slateri*	V	E	Sept-Nov	-	Yes	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in October 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
heath wrinklewort *Rutidosis heterogama*	V	V	All year	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August 2018, October 2018 and January 2019 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
magenta lilly pilly *Syzygium paniculatum*	E	V	All year	-	No	**Species not present.** No habitat present for this species within the Development Footprint. No records of the species within 10 km of the Development Footprint.
black-eyed Susan *Tetratheca juncea*	V	V	Jul-Dec	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August and October 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
Tetratheca glandulosa	V	-	Jul-Nov	-	No	**Species not detected.** Threatened flora searches and walking transects targeting this species were undertaken in August and October 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods.
austral toadflax *Thesium australe*	V	V	Nov-Feb	-	No	**Species not present.** No habitat present for this species within the Development Footprint. No records of the species within 10 km of the Development Footprint.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
Fauna Species						
regent honeyeater (breeding) *Anthochaera phrygia*	CE	CE	Sep-Dec	-	Yes	**Breeding habitat not present.** Consultation with OEH staff (John Seidel, Senior Team Leader Ecosystem Assessment – Conservation and Regional Delivery) was undertaken as part of the winter surveys to determine the need for targeted species credit surveys for the regent honeyeater in areas of preferred habitat. OEH advised that the potential development areas will not trigger the important habitat map for the regent honeyeater and the species can therefore be assessed as part of ecosystem credit requirements. As such there is no need to undertake targeted surveys for this species.
bush stone-curlew *Burhinus grallarius*	E	-	All year	Fallen/standing dead timber including logs.	No	**Species not detected.** Habitat on site is marginal for this species. Nocturnal spotlighting searches were undertaken in March and May 2019 over six nights in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches. Call- playback was also undertaken for this species over three consecutive nights during March 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes. Opportunistic observations were completed throughout all Umwelt survey periods and this species was not flushed during flora transects.
gang-gang cockatoo (breeding) *Callocephalon fimbriatum*	V	-	Oct-Jan	Eucalypt tree species with hollows greater than 9cm diameter.	No	**No suitable breeding habitat present.** This species breeds in very tall, old- growth forests in mountain regions (OEH 2019b). Habitat assessments and targeted searches were conducted in March and May 2019 over 2 days to identify potential breeding habitat available for the species across the Development Footprint. Suitable tree species containing hollows greater than 9 cm were recorded and inspected for occupants. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
glossy black-cockatoo (breeding) ***Calyptorhynchus lathami***	V	-	Mar-Aug	Living or dead trees with hollows greater than 15cm diameter, and greater than 5m above ground.	No	**Species not detected.** Breeding habitat on site is marginal for this species. Habitat assessments were conducted in March and May 2019 over 2 days targeting suitable breeding hollows (greater than 15 cm diameter). No suitable hollows were detected. Unsuitable hollows (i.e. larger than 15 cm but less than 3 m from the ground) were stagwatched for signs of diurnal activity. None detected. Opportunistic observations were completed throughout all Umwelt survey periods.
eastern pygmy possum ***Cercartetus nanus***	V	-	Oct-Mar	-	No	**Assumed Present.** However, this species is highly cryptic and a high number (25) of records exist within 10 km of the Development Footprint. 14 of these records have been submitted since 1 January 2009, with three of these being extremely close to the Development Footprint. Bushnell Trophy Cam HD cameras were installed at 10 locations within the Development Footprint from 25 March 2019 to 6 May 2019 (43 nights). At each site, a remote camera was mounted on a tree trunk and positioned towards a bait station containing peanut butter, honey and oats. Cameras were set to take three photos in quick succession when movement was detected. Nocturnal spotlighting searches were also undertaken in March and May 2019 over six nights in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
large-eared pied bat *Chalinolobus dwyeri*	V	V	Sept-Mar	Land within 2km of rocky areas containing cliffs, caves, overhangs, escarpments, outcrops, or crevices. Land within 2km of old mines or tunnels.	Yes	**Breeding and roosting habitat not present, however species assumed present.** Habitat assessments for suitable breeding habitat for this species (caves, scarps, rocky areas, overhangs, crevices, cliffs, escarpments or old mines) was conducted opportunistically during all survey periods in 2018 and 2019. While there are some rocky areas, these areas do not contain crevices or caves that would be utilised by this species. All of these areas were checked for the presence of bats and none were detected. This species is considered to occur where there are potential roosts located within 2 km of associated PCTs. As it is not possible to survey within 2 km of the Development Footprint for any possible roosts, and as PCT 1642 is associated with this species, the species has been assumed to occur on site. The species polygon has been aligned with PCT 1642.
white-bellied sea-eagle (breeding) *Haliaeetus leucogaster*	V	-	Jul-Dec	Living or dead mature trees within suitable vegetation within 1km of rivers, lakes, large dams or creeks, wetlands and coastlines.	No	**No suitable breeding habitat present.** This species requires very tall, dead or alive, trees suitable for a very large stick nest. Habitat assessments and targeted searches were conducted in August and October 2018 to identify potential breeding habitat available for the species across the Development Footprint. Suitable tree species were inspected for large stick nests and/or evidence of breeding pairs. Opportunistic observations for very large stick nests were completed throughout all Umwelt survey periods, none of which were detected.
giant burrowing frog *Heleioporus australiacus*	V	V	Sept-May	-	No	**Species not detected.** Targeted searches and spotlighting conducted in March and May 2019 over six nights in areas of suitable habitat. Call- playback was also undertaken for this species over three consecutive nights during March 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
little eagle (breeding) *Hieraaetus morphnoides*	V	-	Aug-Oct	Nest trees; live (occasionally dead) large old trees within vegetation.	No	**No suitable breeding habitat present.** This species requires very tall, dead or alive, trees suitable for a very large stick nest. Habitat assessments and targeted searches were conducted in August and October 2018 to identify potential breeding habitat available for the species across the Development Footprint. Suitable tree species were inspected for large stick nests and/or evidence of breeding pairs. Opportunistic observations for very large stick nests were completed throughout all Umwelt survey periods. None were detected.
pale-headed snake *Hoplocephalus bitorquatus*	V	-	Nov-Mar	Within 500m of moderate to good vegetation.	No	**Species not detected.** Targeted searches and walking transects were undertaken during March 2019 in suitable habitat over three nights. Opportunistic observations were completed throughout all Umwelt survey periods. No records of this species within 10 km of the site.
broad-headed snake (breeding) *Hoplocephalus bungaroides*	E	V	Aug-Sept	Including escarpments, outcrops and pagodas within the Sydney Sandstone geologies	Yes	**Species not detected.** Targeted searches and walking transects were undertaken during August 2018 in suitable habitat. Opportunistic observations were completed throughout all Umwelt survey periods. Limited rocky habitat is available within the Development Footprint.
swift parrot (breeding) *Lathamus discolor*	E	CE	May-Aug	-	Yes	**Breeding/Important habitat not present.** Consultation with OEH staff (John Seidel, Senior Team Leader Ecosystem Assessment – Conservation and Regional Delivery) was undertaken as part of the winter surveys to determine the need for targeted species credit surveys for the swift parrot in areas of preferred habitat. OEH advised that the potential development areas will not trigger the important habitat map for the swift parrot and the species can therefore be assessed as part of ecosystem credit requirements. As such there is no need to undertake targeted surveys for this species.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
green and golden bell frog *Litoria aurea*	E	V	Nov-Mar	Semi-permanent/ephemeral wet areas, within 1km of swamps or waterbodies.	No	**Species not present.** No habitat for this species within the development footprint.
green-thighed frog *Litoria brevipalmata*	V	-	Oct-Mar	-	No	**Species not detected.** Targeted searches and spotlighting conducted in March over three consecutive nights in areas of suitable habitat. Call- playback was also undertaken for this species over three consecutive nights during March 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes.
littlejohn's tree frog *Litoria littlejohni*	V	V	Jul-Nov	-	No	**Species not present.** No habitat for this species within the development footprint.
square-tailed kite (breeding) *Lophoictinia isura*	V	-	Sept-Jan	Nest trees.	No	**No suitable breeding habitat present.** This species requires very tall, dead or alive, trees suitable for a very large stick nest. Habitat assessments and targeted searches were conducted in August and October 2018 to identify potential breeding habitat available for the species across the Development Footprint. Suitable tree species were inspected for large stick nests and/or evidence of breeding pairs. Opportunistic observations for very large stick nests were completed throughout all Umwelt survey periods. None were detected.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
parma wallaby ***Macropus parma***	V	-	**All year**	-	No	**Species not detected.** Bushnell Trophy Cam HD cameras were installed at 10 locations within the Development Footprint from 25 March 2019 to 6 May 2019 (43 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and oats. Cameras were set to take three photos in quick succession when movement was detected. Nocturnal spotlighting searches were also undertaken in March and May 2019 over six nights in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches.
little bentwing-bat (breeding) ***Miniopterus australis***	V	-	**Dec-Feb**	Caves, tunnels, mine, culverts or other structures known or suspected to be used for breeding.	Yes	**Breeding habitat not present.** Habitat assessments for suitable breeding habitat for this species (caves, scarps, rocky areas, overhangs, crevices, cliffs, escarpments or old mines) was conducted opportunistically during all survey periods in 2018 and 2019. While there are some rocky areas, these areas do not contain crevices or caves that would be utilised by this species. All of these areas were checked for the presence of bats and none were detected.
eastern bentwing-bat (breeding) ***Miniopterus schreibersii oceanensis***	V	-	**Nov-Feb**	Caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding.	Yes	**Breeding habitat not present.** Habitat assessments for suitable breeding habitat for this species (caves, scarps, rocky areas, overhangs, crevices, cliffs, escarpments or old mines) was conducted opportunistically during all survey periods in 2018 and 2019. While there are some rocky areas, these areas do not contain crevices or caves that would be utilised by this species. All of these areas were checked for the presence of bats and none were detected.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
stuttering frog *Mixophyes balbus*	E	V	Sept-Mar	-	Yes	**Species not detected.** Targeted searches and spotlighting conducted in March over three consecutive nights in areas of suitable habitat. Call- playback was also undertaken for this species over three consecutive nights during March 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes.
giant barred frog *Mixophyes iteratus*	E	E	Oct-Mar	Land within 50m of semi-permanent and permanent drainages	No	**Species not present.** No habitat for this species is present within the development footprint.
southern myotis *Myotis macropus*	V	-	Nov-Mar	Hollow-bearing trees, bridges, caves or artificial structures, within 200m of riparian zone. Within 500m of foraging habitat.	No	**Species assumed present.** This species is considered to occur where there are waterbodies (> 3m) within 200 m of hollow-bearing trees in associated PCTs. There is one dam located within 200 m from the Development Footprint, and PCTs 1641 and 1642 are associated with this species. Species polygon mapped in **Figure 3.3.**

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
barking owl (breeding) ***Ninox connivens***	V	-	May-Dec	Living or dead trees with hollows greater than 20cm diameter and greater than 4m above the ground.	No	**Species not detected.** Habitat assessments were conducted in March and May 2019 over 2 days to identify potential habitat available for the species across the Development Footprint. Suitable living trees and stags were recorded and inspected for any evidence of occupation (e.g. scats, whitewash, noise). Two suitable nesting trees (containing a hollow larger than 20 cm) were stagwatched at dusk during May 2019. Nothing was observed entering or exiting the hollow. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over six nights in March and May 2019. Call- playback was also undertaken for this species over three consecutive nights during May 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
powerful owl (breeding) *Ninox strenua*	V	-	May-Aug	Living or dead trees with hollow greater than 20cm diameter.	No	**Species not detected.** Habitat assessments were conducted in March and May 2019 over 2 days to identify potential habitat available for the species across the Development Footprint. Suitable living trees and stags were recorded and inspected for any evidence of occupation (e.g. scats, whitewash, noise). Several suitable nesting trees (containing a hollow larger than 20 cm) were stagwatched at dusk during May 2019. Nothing was observed entering or exiting the hollow. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over six nights in March and May 2019. Call- playback was also undertaken for this species over three consecutive nights during May 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes Opportunistic observations were completed throughout all Umwelt survey periods.
eastern osprey (breeding) *Pandion cristatus*	V	-	Apr-Nov	Living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting.	No	**No suitable breeding habitat present.** This species requires very tall, usually dead but occasionally alive, trees suitable for a very large stick nest. Habitat assessments and targeted searches were conducted in August 2018, October 2018 and March 2019 to identify potential breeding habitat available for the species across the Development Footprint. Suitable tree species were inspected for large stick nests and/or evidence of breeding pairs. Opportunistic observations for very large stick nests were completed throughout all Umwelt survey periods. None were detected.

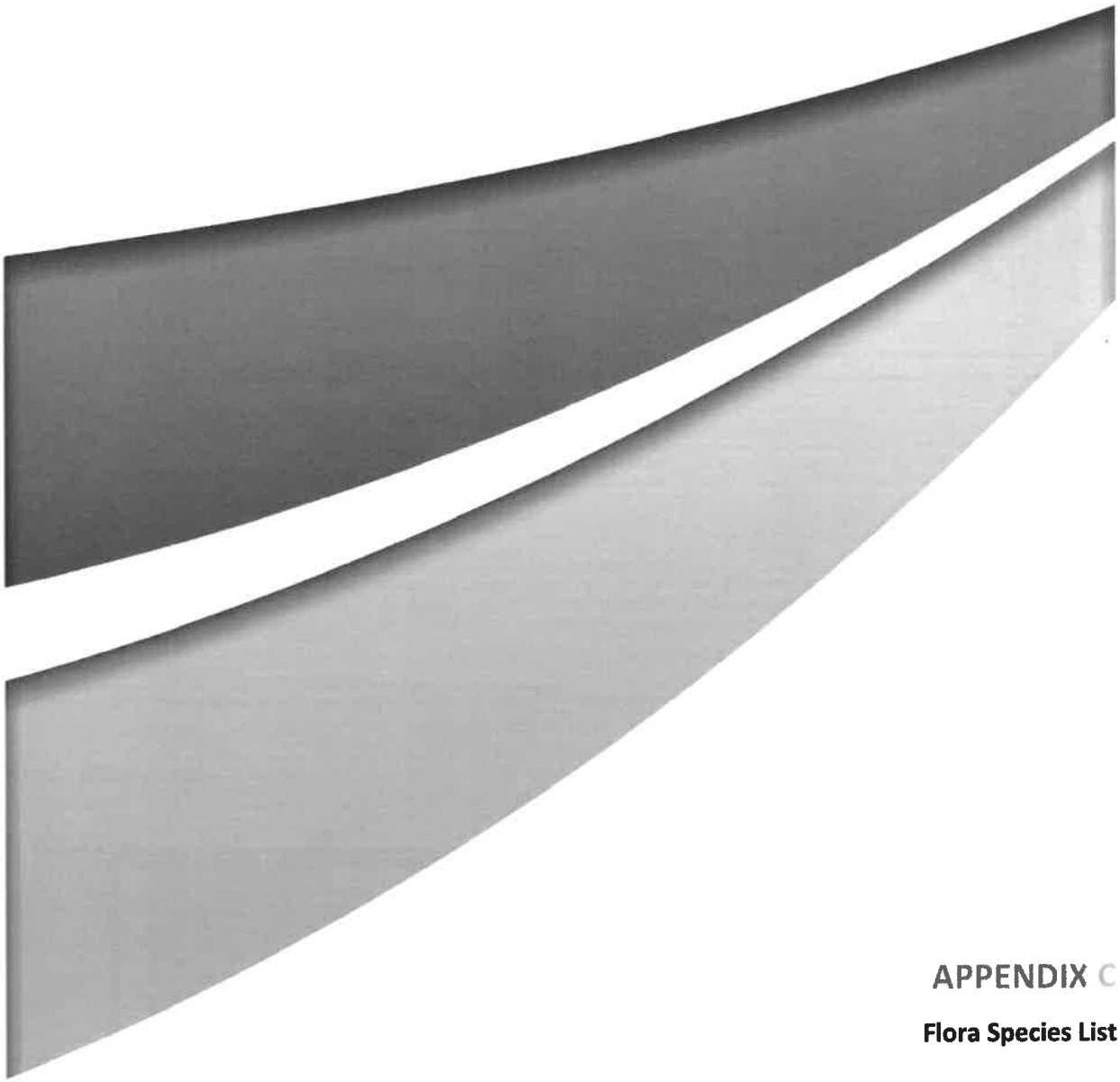
Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
giant dragonfly *Petalura gigantea*	E	-	Dec-Jan	Within 500 m of swamps	Yes	**Species not detected.** Habitat assessments and targeted searches conducted in January 2019 within and adjacent to suitable swamp habitats. Opportunistic observations were completed throughout all Umwelt survey periods.
squirrel glider *Petaurus norfolcensis*	V	-	All year	-	No	**Species not detected.** Bushnell Trophy Cam HD cameras were installed at 10 locations within the Development Footprint from 25 March 2019 to 6 May 2019 (43 nights). At each site, a remote camera was mounted on a tree trunk and positioned towards a bait station containing peanut butter, honey and oats. Cameras were set to take three photos in quick succession when movement was detected. Nocturnal spotlighting searches were undertaken in March and May 2019 over six nights in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches. Call- playback was also undertaken for this species over three consecutive nights during March 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes. Opportunistic observations were completed throughout all Umwelt survey periods.
brush-tailed rock-wallaby *Petrogale penicillata*	E	V	All year	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines.	Yes	**Species not present.** Habitat on site is unsuitable for this species. This species is found on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges. The Development Footprint does not contain suitable habitat for the species and therefore does not require further assessment.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
koala (breeding) *Phascolarctos cinereus*	V	V	All year	-	No	**Species not detected.** Bushnell Trophy Cam HD cameras were installed at 10 locations within the Development Footprint from 25 March 2019 to 6 May 2019 (43 nights). At each site, a remote camera was mounted on a tree trunk and positioned towards a bait station containing peanut butter, honey and oats. Cameras were set to take three photos in quick succession when movement was detected. Three Spot Assessment Techniques (SAT) searches were undertaken in the woodland vegetation across the development footprint during March 2019. This involves searching underneath suitable trees (at least 30 trees) for Koala scats. Nocturnal spotlighting searches were undertaken in March and May 2019 over six nights in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches. Call- playback was also undertaken for this species over three consecutive nights during March 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes. Opportunistic observations were completed throughout all Umwelt survey periods.
greater glider *Petauroides volans*	-	V	All year	Hollow- bearing trees	No	**Species not detected.** Habitat on site is marginal for this species. Bushnell Trophy Cam HD cameras were installed at 10 locations within the development footprint from 25 March 2019 to 6 May 2019 (43 nights). At each site, a remote camera was mounted on a tree trunk and positioned towards a bait station containing peanut butter, honey and oats. Cameras were set to take three photos in quick succession when movement was detected. Nocturnal spotlighting searches were undertaken in March and May 2019 over six nights in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
red-crowned toadlet *Pseudophryne australis*	V	-	All year	-	No	**Species not detected.** Targeted searches and spotlighting conducted in March and May 2019 over six nights in areas of suitable habitat. Call- playback was undertaken for this species over three consecutive nights during March 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes.
grey-headed flying-fox (breeding) *Pteropus poliocephalus*	V	V	Oct-Dec	Breeding camps.	No	**No camps detected.** Individual foraging flying- foxes detected. However, the entire Development Footprint was traversed during targeted searches for threatened flora and fauna species in August and October 2018, and January, March and May 2019. Opportunistic observations were completed throughout all Umwelt survey periods and no flying- fox camps were detected.
masked owl (breeding) *Tyto novaehollandiae*	V	-	May-Aug	Living or dead trees with hollows greater than 20cm diameter.	No	**Species not detected.** Habitat assessments were conducted in March and May 2019 over 2 days to identify potential habitat available for the species across the Development Footprint. Suitable living trees and stags were recorded and inspected for any evidence of occupation (e.g. scats, whitewash, noise). Several suitable nesting trees (containing a hollow larger than 20 cm) were stagwatched at dusk during May 2019. Nothing was observed entering or exiting the hollow. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over six nights in March and May 2019. Call- playback was also undertaken for this species over three consecutive nights during May 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
sooty owl (breeding) *Tyto tenebricosa*	V	-	Apr-Aug	Caves/hollow-bearing trees	Yes	**Species not detected.** Habitat assessments were conducted in March and May 2019 over 2 days to identify potential habitat available for the species across the Development Footprint. Suitable living trees and stags were recorded and inspected for any evidence of occupation (e.g. scats, whitewash, noise). Several suitable nesting trees (containing a hollow larger than 20 cm) were stagwatched at dusk during May 2019. Nothing was observed entering or exiting the hollow. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over six nights in March and May 2019. Call- playback was also undertaken for this species over three consecutive nights during May 2019. This involved playing the call of the species for five minutes, followed by a listening period of five minutes. Opportunistic observations were completed throughout all Umwelt survey periods.
eastern cave bat *Vespadelus troughtoni*	V	-	Nov-Jan	Caves or within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds.	Yes	**Breeding habitat not present.** Habitat assessments for suitable breeding habitat for this species (caves, scarps, rocky areas, overhangs, crevices, cliffs, escarpments or old mines) was conducted opportunistically during all survey periods in 2018 and 2019. None detected. Species is also not associated with any of the PCTs found on site (OEH, 2019b).

^ Survey period derived from resources other than TBDC.



APPENDIX C

Flora Species List

Flora Species List

The following list was developed from the floristic plot surveys of the Development Footprint. It includes all species of vascular plants observed during these surveys. It is acknowledged that the list is not comprehensive, as not all species are readily detected at any one time of the year. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many of these species cannot be identified, or even detected.

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

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

sp.	specimens that are identified to genus level only.

The following abbreviations or symbols are used in the list:

AA	denotes abundance rating according to BAM
PC	cover measure according to BAM
asterisk (*)	denotes species non-native species
double asterisk (**)	denotes High Threat Weed species under the BAM
subsp.	subspecies and
var.	variety.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust 2018), the on-line plant name database maintained by the National Herbarium of New South Wales.

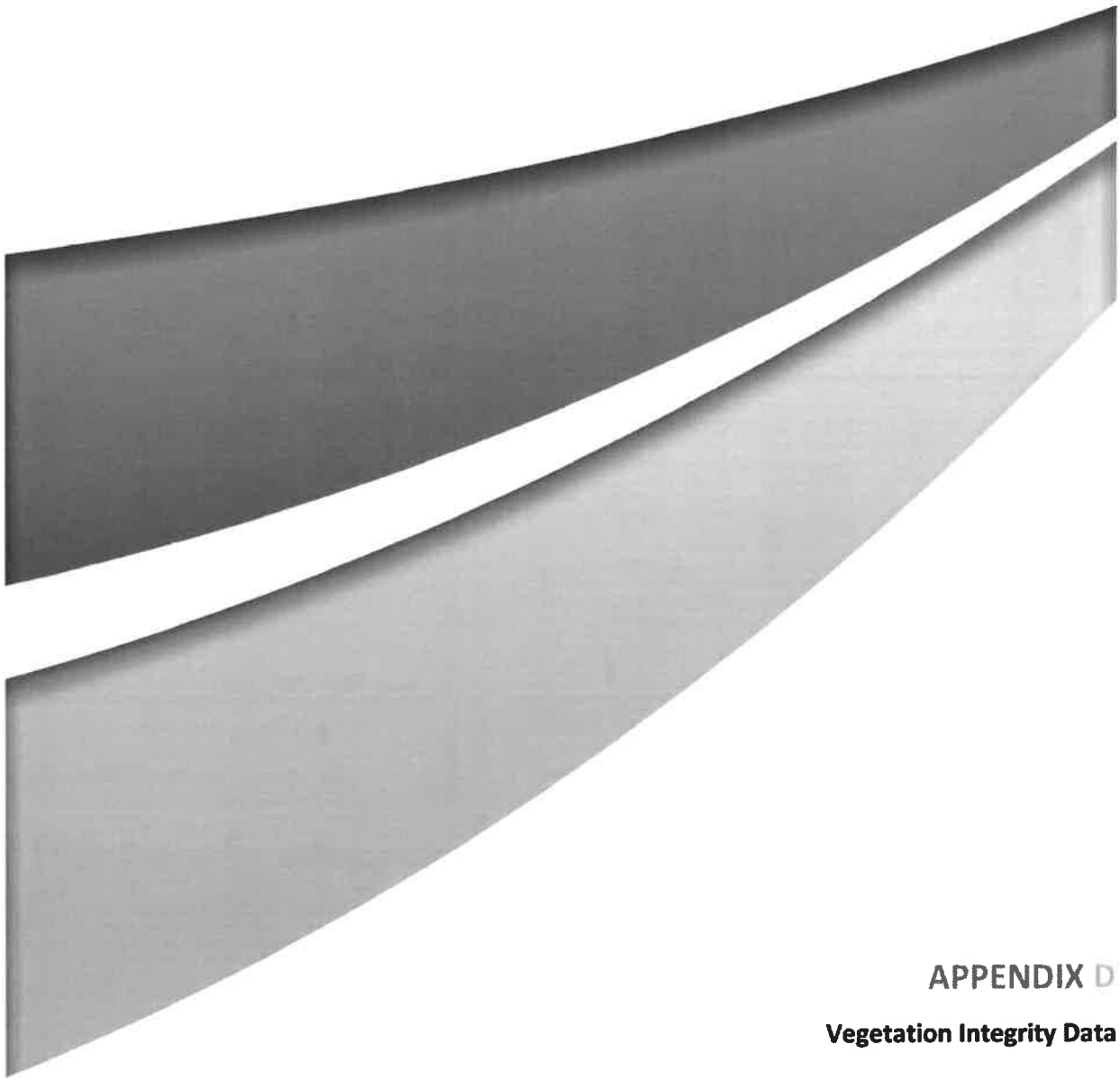
Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

			Q01		Q02		Q03		Q04		Q05	
Family	Scientific Name	Common Name	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Apiaceae	*Actinotus minor*	Lesser Flannel Flower	20	0.1	100	0.1			1000	1	3	0.1
Apiaceae	*Platysace linearifolia*		50	0.2	100	0.5			25	0.1	100	1
Apocynaceae	*Parsonsia straminea*	Common Silkpod			50	0.1	1	0.1	20	0.1		
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak	10	2	5	0.5	1	0.1				
Cyperaceae	*Baumea* sp.						500	0.3				
Cyperaceae	*Caustis flexuosa*	Curly Wig									10	0.1
Cyperaceae	*Cyathochaeta diandra*		200	5	1000	1	1000	5	1000	10	500	5
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge					2	0.2				
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge							1000	0.5	20	0.1
Cyperaceae	*Lepidosperma urophorum*								1000	1		
Cyperaceae	*Schoenus apogon*	Fluke Bogrush									20	0.1
Dilleniaceae	*Hibbertia acicularis*										2	0.1
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower			20	0.1			20	0.5	2	0.1
Dilleniaceae	*Hibbertia linearis*										3	0.1
Dilleniaceae	*Hibbertia obtusifolia*	Hoary Guinea Flower	20	0.1	100	0.5			200	2	5	0.1
Ericaceae (Epacridoideae)	*Epacris pulchella*	Wallum Heath	10	0.1	75	0.5	5	0.1	50	0.5		
Ericaceae (Epacridoideae)	*Epacris* sp.				40	0.1						
Ericaceae (Epacridoideae)	*Leucopogon juniperinus*	Prickly Beard-heath	5	0.1							5	0.1
Ericaceae (Epacridoideae)	*Woollsia pungens*				1	0.1						
Euphorbiaceae	*Ricinocarpos pinifolius*	Wedding Bush					2	0.1				
Fabaceae (Faboideae)	*Bossiaea ensata*	Sword Bossiaea	20	0.2	5	0.1			5	0.1		
Fabaceae (Faboideae)	*Bossiaea heterophylla*	Variable Bossiaea	10	0.1					15	0.1	5	0.1
Fabaceae (Faboideae)	*Bossiaea obcordata*	Spiny Bossiaea									10	0.1
Fabaceae (Faboideae)	*Gompholobium latifolium*	Golden Glory Pea									3	0.1
Fabaceae (Faboideae)	*Hovea linearis*										1	0.1
Fabaceae (Faboideae)	*Mirbelia rubiifolia*	Heathy Mirbelia	1	0.1	10	0.1						
Fabaceae (Faboideae)	*Pultenaea paleacea*	Chaffy Bush-pea							10	0.2	2	0.1
Fabaceae (Faboideae)	*Pultenaea rosmarinifolia*		10	0.1	25	0.1						

			Q01		Q02		Q03		Q04		Q05	
Family	Scientific Name	Common Name	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Fabaceae (Mimosoideae)	*Acacia linifolia*	Narrow-leaved Wattle					2	0.1			1	0.1
Fabaceae (Mimosoideae)	*Acacia longifolia*										1	0.1
Fabaceae (Mimosoideae)	*Acacia myrtifolia*	Red-stemmed Wattle					2	0.1				
Fabaceae (Mimosoideae)	*Acacia oxycedrus*	Spike Wattle	10	0.1	5	0.5						
Fabaceae (Mimosoideae)	*Acacia suaveolens*	Sweet Wattle	10	0.1	10	0.5	3	0.1	12	1	2	0.1
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses					1	0.1	1	0.1	5	0.1
Gleicheniaceae	*Gleichenia dicarpa*	Pouched Coral Fern					3000	98	100	2		
Goodeniaceae	*Dampiera stricta*		10	0.1	10	0.1					2	0.1
Goodeniaceae	*Goodenia* sp.				25	0.1			25	0.1		
Iridaceae	*Patersonia sericea*	Silky Purple-Flag	50	5	500	0.5			500	1	10	0.1
Lauraceae	*Cassytha glabella*								75	0.1	1	0.1
Lindsaeaceae	*Lindsaea linearis*	Screw Fern	20	0.1					100	0.1	10	0.1
Lomandraceae	*Lomandra filiformis*				100	0.1						
Lomandraceae	*Lomandra glauca*	Pale Mat-rush									200	1
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush			100	0.1						
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush	3	0.1								
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush			50	0.1			200	0.1		
Lomandraceae	*Lomandra obliqua*		10	0.1	200	0.2					20	0.1
Myrtaceae	*Angophora costata*	Sydney Red Gum							0	0.5		
Myrtaceae	*Angophora hispida*	Dwarf Apple	50	2	10	2						
Myrtaceae	*Baeckea diosmifolia*	Fringed Baeckea	1	0.1	75	0.2						
Myrtaceae	*Callistemon citrinus*	Crimson Bottlebrush							2	0.5		
Myrtaceae	*Corymbia gummifera*	Red Bloodwood			1	0.5	2	0.2	0	5	7	10
Myrtaceae	*Darwinia fascicularis* subsp. *fascicularis*				40	0.2						
Myrtaceae	*Eucalyptus agglomerata*	Blue-leaved Stringybark					1	5	0	5	2	5
Myrtaceae	*Eucalyptus haemastoma*	Broad-leaved Scribbly Gum	1	2	5	10			0	5	4	35
Myrtaceae	*Eucalyptus punctata*	Grey Gum									2	10
Myrtaceae	*Kunzea* sp.				10	0.5						

			Q01		Q02		Q03		Q04		Q05	
Family	Scientific Name	Common Name	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Myrtaceae	*Leptospermum arachnoides*		1	0.1								
Myrtaceae	*Leptospermum continentale*	Prickly Teatree					1	0.1				
Myrtaceae	*Leptospermum polygalifolium*						10	5	25	5		
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree	30	10	15	20					5	2
Myrtaceae	*Leptospermum divaricatum*								15	7		
Orchidaceae	*Cryptostylis erecta*	Tartan Tongue Orchid							25	0.1	5	0.1
Orchidaceae	*Cryptostylis* sp.						5	0.1				
Orchidaceae	*Cryptostylis subulata*	Large Tongue Orchid			20	0.1						
Phormiaceae	*Dianella revoluta*	Blueberry Lily	10	0.1	10	0.1					2	0.1
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge			50	0.1					3	0.1
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	5	0.1								
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum					2	0.1				
Poaceae	*Anisopogon avenaceus*	Oat Speargrass	200	5	1000	0.5			1000	10	500	5
Poaceae	*Entolasia marginata*	Bordered Panic									500	0.2
Poaceae	*Entolasia stricta*	Wiry Panic	500	10	1000	1	100	1	1000	2	###	2
Proteaceae	*Banksia ericifolia*	Heath-leaved Banksia	100	45	100	15	35	15	12	10	14	10
Proteaceae	*Banksia oblongifolia*	Fern-leaved Banksia	10	3	10	0.5	3	0.1	12	0.5	4	1
Proteaceae	*Grevillea buxifolia*	Grey Spider Flower									1	0.1
Proteaceae	*Hakea gibbosa*		20	3	20	5	1	0.1	1	0.5		
Proteaceae	*Hakea teretifolia*	Needlebush	20	0.5	30	15			5	1		
Proteaceae	*Isopogon anemonifolius*	Broad-leaf Drumsticks			75	0.5					20	0.5
Proteaceae	*Isopogon* sp.								30	0.5		
Proteaceae	*Lambertia formosa*	Mountain Devil	1	0.1	10	0.5			25	1	2	0.1
Proteaceae	*Persoonia levis*	Broad-leaved Geebung			2	0.5			1	0.2	2	0.1
Proteaceae	*Petrophile pulchella*	Conesticks	5	0.1							5	0.1
Ranunculaceae	*Ranunculus* sp.		20	0.1	1	0.1			10	0.1		
Restionaceae	*Lepyrodia scariosa*		1000	15	1000	15			1000	10	20	0.1
Rutaceae	*Boronia ledifolia*	Sydney Boronia	10	0.1	50	0.5			10	0.1		

			Q01		Q02		Q03		Q04		Q05	
Family	Scientific Name	Common Name	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Santalaceae	*Leptomeria acida*	Sour Currant Bush									2	0.2
Schizaeaceae	*Schizaea bifida*	Forked Comb Fern									3	0.1
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla					1	0.1				
Xanthorrhoeaceae	*Xanthorrhoea media*						50	0.2			3	0.1
Xanthorrhoeaceae	*Xanthorrhoea minor* subsp. *minor*		10	0.2								
Xanthorrhoeaceae	*Xanthorrhoea* sp.				15	0.5			10	1		
		TOTAL		**37**		**45**		**25**		**41**		**48**



APPENDIX D

Vegetation Integrity Data

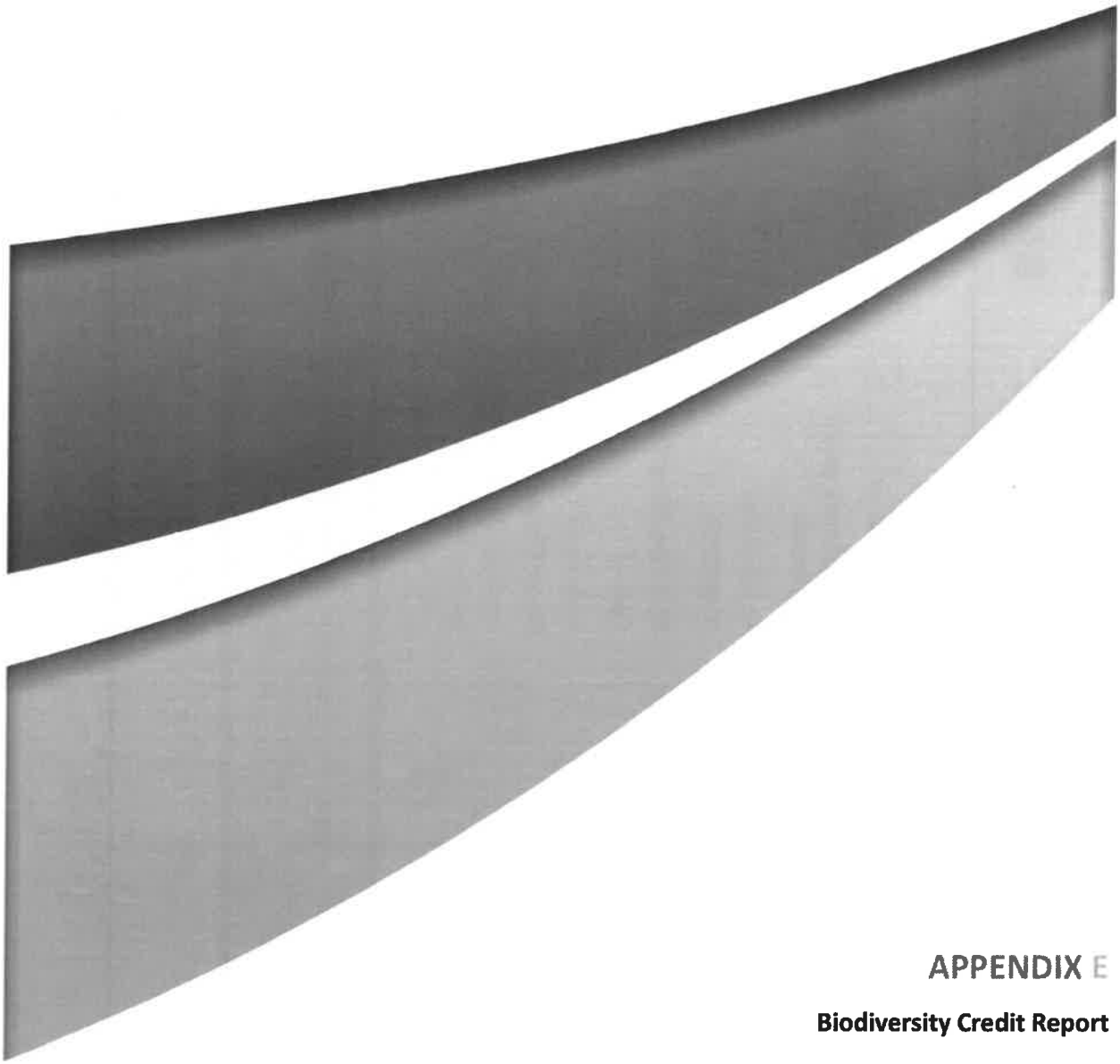
Vegetation Integrity Data

The following vegetation integrity data was collected from surveys of the Development Footprint. It includes the composition, structure and function attributes that are recorded in each BAM plot. This data is assessed against benchmark data for PCTs and entered into the BAM Calculator to assess the condition of each PCT in the Development Footprint.

The following abbreviations are used in the table below:

Tr	Tree (growth form)
Sh	Shrub (growth form)
Gr	Grass (growth form)
Fb	Forb (growth form)
Fn	Fern (growth form)
Ot	Other (growth form)

	COMPOSITION						STRUCTURE						FUNCTION										
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds
													>5	5-10	10-20	20-30	30-50	50-80					
Q01	3	20	8	4	1	1	6	63.2	35.5	5.3	0.1	0.1	1	1	1	1	1	1	0	0	53	10	0.2
Q02	4	25	10	5	0	1	13	61.7	18.6	0.9	0	0.1	1	1	1	1	1	1	1	0	41	11	0
Q03	3	13	5	1	1	1	5.3	21.1	6.7	0.1	98	0.1	1	1	1	1	1	1	1	0	19.0	200	0
Q04	4	21	8	4	2	2	15.5	31	34.6	2.2	2.1	0.2	1	1	1	1	0	1	0	0	57.0	38	0
Q05	4	24	12	5	2	1	60	16.5	13.9	0.5	0.2	0.1	1	1	1	1	1	1	1	1	68.0	38	0



APPENDIX E

Biodiversity Credit Report

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00015326/BAAS18117/19/00015327	Kariong Development Assessment	30/08/2019
Assessor Name	Report Created	BAM Data version *
Philippa Fagan	20/09/2019	13
Assessor Number	BAM Case Status	Date Finalised
BAAS18117	Open	To be finalised
Assessment Revision	Assessment Type	
0	Biocertification	

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

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

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Dwarf Apple - Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast								
1	1641_good	80.5	2.5	0.25	High Sensitivity to Potential Gain	1.50		75
							Subtotal	**75**

Heath-leaved Banksia - Coral Fern wet heath on sandstone ranges of the lower Central Coast							
3	1699_good	24.6	0.6	0.25	High Sensitivity to Potential Gain	2.00	7
						Subtotal	**7**
Scribbly Gum - Red Bloodwood - Old Man Banksia heathy woodland of southern Central Coast							
2	1642_good	69.4	2.7	0.25	High Sensitivity to Potential Gain	1.50	70
						Subtotal	**70**
						Total	**152**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAII	Species credits
Callistemon linearifolius / Netted Bottle Brush (Flora)						
1642_good	N/A	3	0.25	2	False	6
					Subtotal	**6**
Cercartetus nanus / Eastern Pygmy-possum (Fauna)						
1641_good		80.5	2.5	0.25	2 False	101
1642_good		69.4	2.7	0.25	2 False	94
					Subtotal	**195**
Chalinolobus dwyeri / Large-eared Pied Bat (Fauna)						
1642_good		69.4	2.7	0.25	3 True	141
					Subtotal	**141**

Darwinia glaucophylla / Darwinia glaucophylla (Flora)						
1642_good	69.4	0.3	0.25	1.5	False	8
1699_good	24.6	0.1	0.25	1.5	False	1
					Subtotal	**9**
Hibbertia procumbens / Spreading Guinea Flower (Flora)						
1641_good	80.5	2.5	0.25	2	False	101
1642_good	69.4	2.7	0.25	2	False	94
					Subtotal	**195**
Hibbertia puberula / Hibbertia puberula (Flora)						
1641_good	80.5	2.5	0.25	2	False	101
					Subtotal	**101**
Myotis macropus / Southern Myotis (Fauna)						
1642_good	69.4	0.9	0.25	2	False	31
					Subtotal	**31**

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Attachment 3

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Environmental & Social Consultants

Local Aboriginal Land Council
DARKINJUNG

PRELIMINARY BUSHFIRE RISK ASSESSMENT REPORT

Woy Woy Road, Kariong

FINAL

September 2019

Local Aboriginal Land Council
DARKINJUNG

PRELIMINARY BUSHFIRE RISK ASSESSMENT REPORT

Woy Woy Road, Kariong

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Darkinjung Local Aboriginal Land Council

Project Director:	Barbara Crossley
Project Manager:	Les Seddon
Technical Director:	Cormac Farrell
Technical Manager:	Clare Naylor
Report No.	4567/R04/V1
Date:	September 2019

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ISO 9001

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
Final V1	Cormac Farrell	24/09/19	Barbara Crossley	30/09/2019

Table of Contents

Figures

Tables

1.0 Introduction

1.1 Project Background

Darkinjung Local Aboriginal Land Council (DLALC) is currently preparing four separate planning proposals for the re-zoning of DLALC owned land for a mix of residential, rural residential and industrial land uses.

The planning proposals are outlined in the Interim Darkinjung Development Delivery Plan (February 2019). The planning proposals are at various stages and DLALC are currently in consultation with Department of the Environment (DPE) regarding the planning proposals. Darkinjung requires a preliminary bushfire risk assessment at the following sites as they are mapped as bushfire prone land under the Central Coast Council Local Environmental Plan 2013 (LEP):

- Lot 481 DP1184693 Reeves Street, Somersby
- Lots 512 and 513 DP727686 Woy Woy Road, Kariong.

Umwelt has been engaged by DLALC to undertake a preliminary bushfire risk assessment for the proposed rezoning request review at Lot 481 DP1184693 Reeves Road, Somersby and Lots 512 and 513 DP727686 Woy Woy Road, Kariong. This is an initial assessment of bushfire hazard providing an analysis of risk mitigations and infrastructure requirements under the NSW Planning system, with particular reference to *Planning for Bushfire Protection* published by the NSW Rural Fire Service (RFS). This includes guidance on areas within the flame zone of bushfires where residential development is not permitted, effectively acting as a site constraint to development of housing.

This preliminary bushfire risk assessment report is applicable to Woy Woy, Kariong (the site) only as shown in **Figure 1.1**.

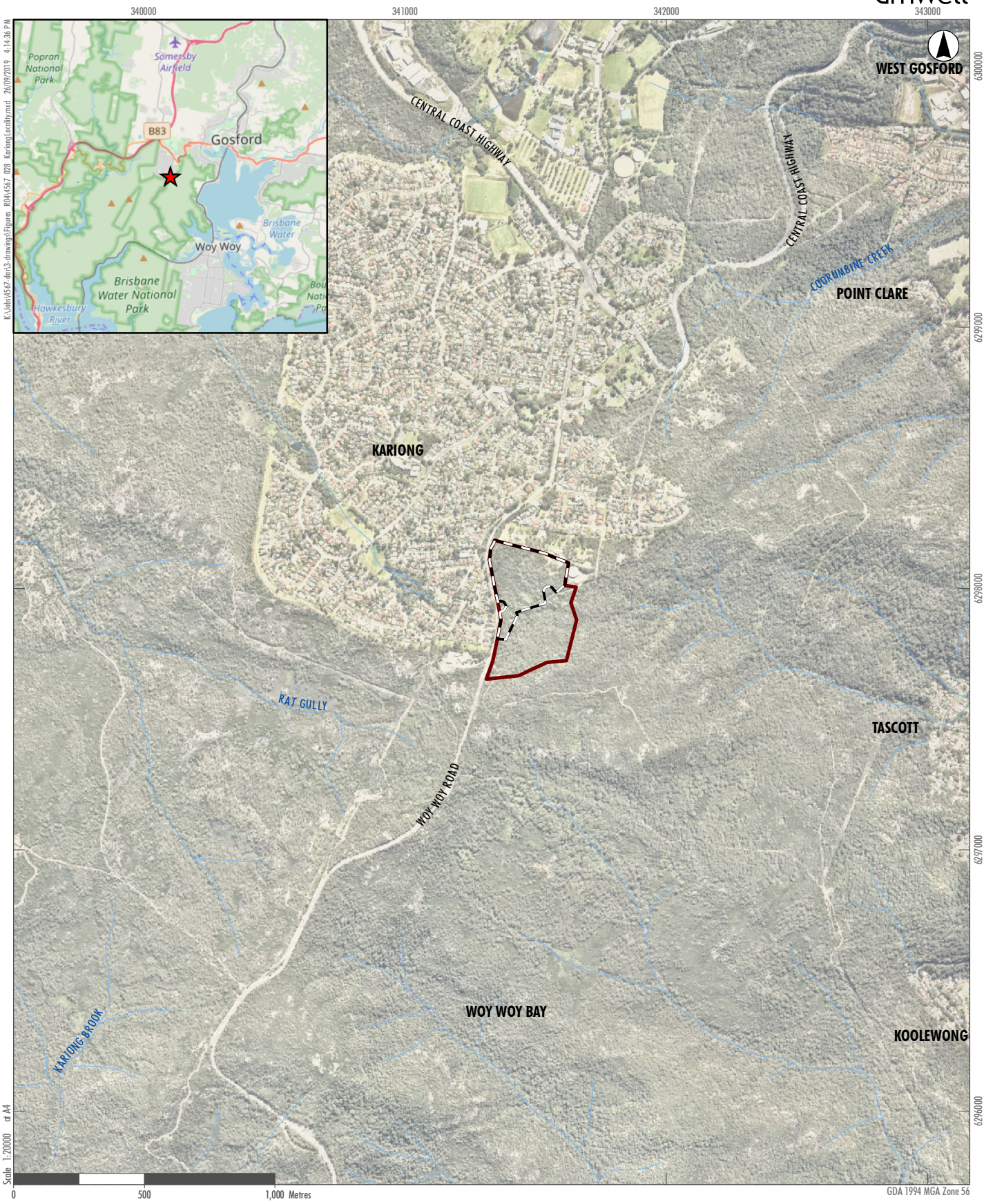
1.2 Site Identification

The proposed site is located in a rural residential setting and is separated from the adjacent bushland to the south by the Tank fire trail. The site is bounded by Woy Roy Road to the west, residential properties to the north and a water reservoir to the east.

The site is accessed via a locked access gate at the start of the Tank fire trail. The fire trail slopes to the north towards Brittany Crescent (to the east of the water reservoirs) and slopes to the south-west (adjacent west of the water reservoirs). The vegetation to the south of the proposed development is also gently sloping to the south but some steep drop offs do exist in localised areas. **Table 1.1** below provides a summary of the land details of the site.

Table 1.1 Site Details

Aspect	Site Details
Lot and Deposited Plan	Lots 512 and 513 DP727686
Address	Woy Woy Road, Somersby
Local Government Area	Central Coast Council
Current Zoning	E2 – Environmental Conservation
Bushfire Prone Land	Vegetation Category 1



Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- Watercourses

FIGURE 1.1

Locality Plan

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

1.3 Proposed Development

The rezoning request review at Lots 512 and 513 DP727686 Woy Woy Road, Kariong is for potential rezoning of the land for urban expansion purposes (approximately 6.5 hectares) as seen in **Figure 1.2**.

It is noted that lot yield and final layouts are subject to modification during preparation of the final planning proposal. A study area, as per **Figure 1.3** has been adopted that represents the potential cleared development footprint that future dwellings may be located within.

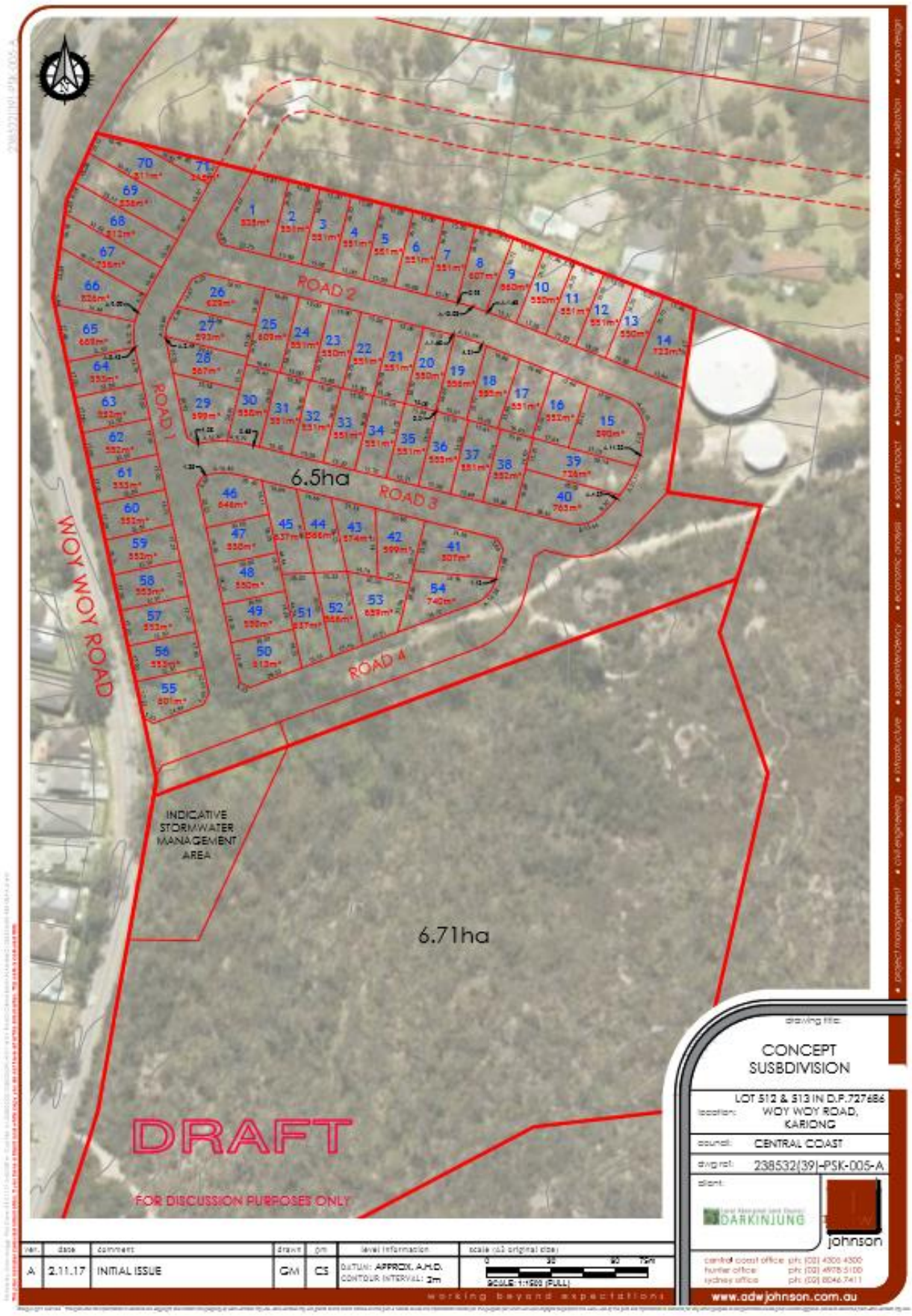
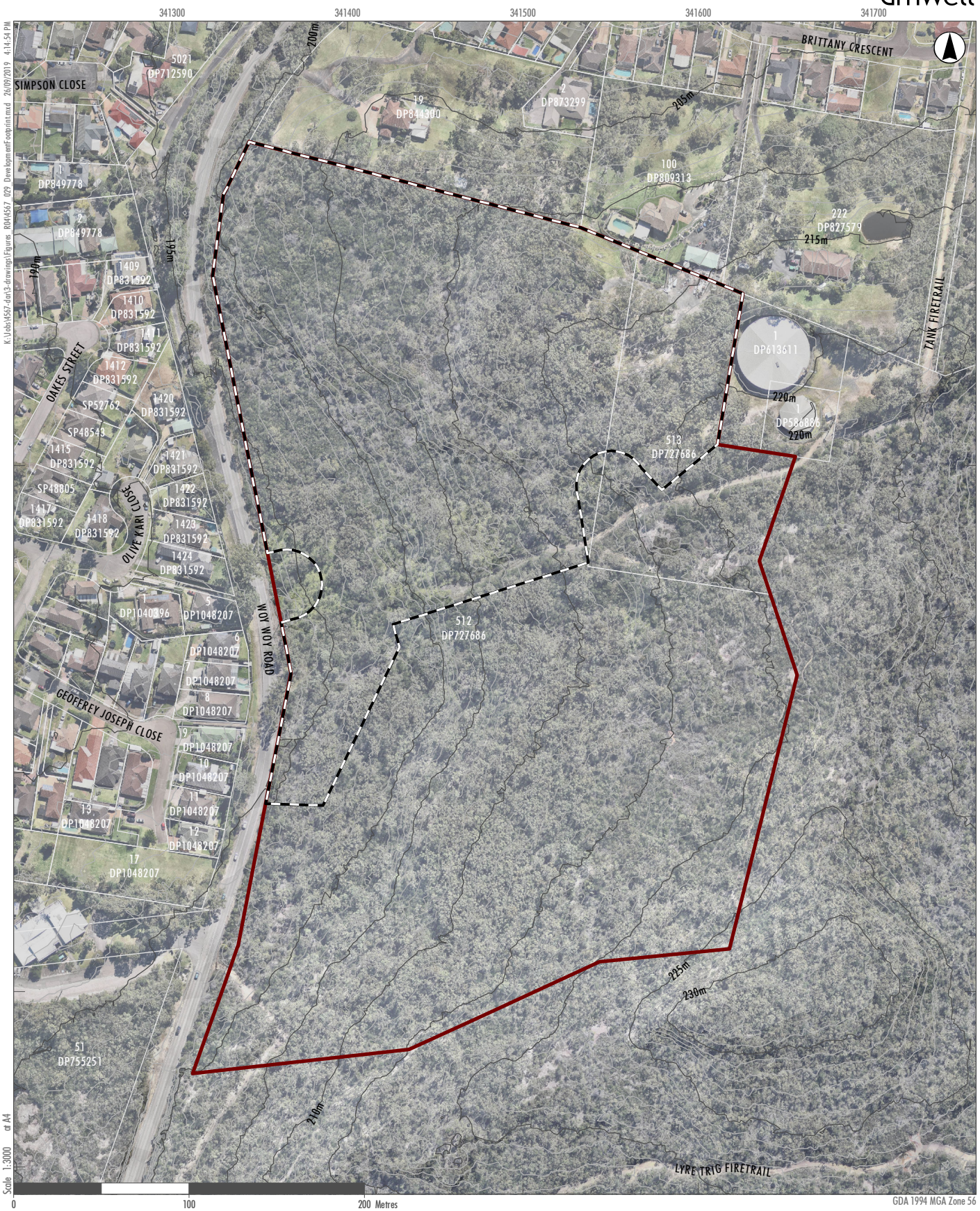


Figure 1.2 Indicative proposed Development at Woy Woy Road, Kariong



Legend

- Development Footprint
- Lots 512 & 513 DP 727686

Contours (1m)

- Minor Contours
- Major Contours
- Lot Boundaries

FIGURE 1.3

Development Footprint

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

1.4 Purpose of this Report

This preliminary bushfire assessment aims to establish if it is feasible to develop the site in consideration of bushfire hazards and identify relevant bushfire performance criteria and management measures to be considered during the planning proposal process.

This assessment does not seek to remove the threat of bushfire risk but provide DLALC with information to be considered during the next stages of the planning process to manage the threat of this risk.

In particular, the report will consider:

- The modelling of bushfire hazard across the proposed development areas in accordance with *AS3959 Australian Standard for Building in Bushfire Prone Areas*
- The provision of a summary of bushfire protection performance criteria and acceptable solutions under the *Planning for Bushfire Protection 2006* (amended 2018)
- The identification of opportunities for cultural burning activities in surrounding bushland in accordance with the *NPWS Cultural Fire Management Policy.*

1.5 Limitations

The findings of this report are based upon visual observations of the sites, discussions with site personnel and our interpretation of documentation provided by DLALC.

Opinions presented herein apply to the site as it existed at the time of the site inspection, from information provided by site personnel and based on design information provided by DLALC. Any changes to or omissions in this information of which Umwelt is not aware and has not had the opportunity to evaluate therefore cannot be considered in this report.

Umwelt has taken due care to consider all reasonably available information provided during the undertaking of this assessment and have taken this information to represent a fair and reasonable characterisation of the environmental status of the site, but recognise that any site assessment program is necessarily limited in scope and true site conditions may differ from those inferred from the available data.

This report has been prepared against the Site Assessment Methodology within Planning for Bushfire Protection to provide a standardised estimate of hazard. A low or managed risk of bushfire does not provide complete protection against bushfire, particularly under extreme weather conditions.

2.0 Methodology

This section describes the selection and mapping undertaken to establish the bushfire hazard at the site. An understanding of the bushfire hazard is necessary to determine the application of bushfire protection measures such as asset protection zones (APZ) and building construction standards.

This assessment consisted of both a desktop and site assessment. A desktop assessment was undertaken for the site including a review of:

- Vegetation mapping
- Aerial photographs
- Contour mapping
- Bushfire Prone Land Mapping.

A site assessment was conducted on 13 May 2019 by Clare Naylor (Senior Environmental Scientist, Umwelt) and Kelvin Johnson (Work Health Safety and Environmental Officer, DLALC). The site assessments included a vegetation and slope assessment in accordance with the requirements of *Planning for Bushfire Protection* Section A1.3 and fuel load assessments at representative locations of the surrounding bushland in accordance with the Overall Fuel Hazard Guide (Leonard et. al, 2014).

2.1 Selection of Fuel Load Sample Points

The location of sampling points for fuel load assessments were identified prior to the site inspection using satellite imagery of the study area to provide an initial placement. Fuel load plot locations were identified to represent the typical fuel load of the surrounding bushland. Fuel load plot locations were selected away from areas where edge effects may be operating such as roads and in different vegetation types to accurately represent the current conditions of the surrounding bushland.

The placement of fuel load plot locations was confirmed on site by Clare Naylor and Kelvin Johnson and were relocated where necessary after an initial site walk through.

2.2 Vegetation Sampling

Visual estimates of bushfire fuel levels were undertaken at seven locations at the site representative of the typical fuel loads. This method provides a combined estimate of bushfire fuel hazard by assessing discrete levels of the vegetation including:

Bark Fuels – specifically targeting trees with ribbon or stringy bark that is likely to generate long-lived embers that can be carried ahead of the main fire front to create new fires, a behaviour known as spotting.

Elevated fuels - including the upright plant material and upper leaves of shrubs, grasses that contribute towards flame height and the rate of spread of the fire.

Near surface fuel - that includes living and dead plant material close to the ground surface with a mixture of vertical and horizontal arrangement, which contributes towards flame height and the rate of spread of the fire.

Surface fuel – including leaves, twigs, bark and other fine fuels in direct contact with the ground. This fuel layer has a strong influence on the rate of spread of the fire.

These assessments provide both an overall fuel hazard rating, which can be used to assess the likelihood of fire suppression succeeding, as well as the estimated rate of spread of the fire (Hines et al 2010 p.7), which may be useful for subsequent bushfire planning.

The fuel hazard rating at each discrete layer was also cross-referenced against estimates of available bushfire fuel to estimate the total fuel load in tonnes per hectare at each vegetation sampling point (Gould et al 2007 Tables F1-F4 p.8-17).

2.3 Mapping of Bushfire Attack Categories

In accordance with the Site Assessment Methodology within *Planning for Bushfire Protection* Appendix 1 the following site details were assessed as a desktop review. This method involves a 6-step process as follows:

1. Determine the relevant Fire Danger Index (FDI) from the *Planning for Bushfire Protection* Section A1.5

2. Determine the classified vegetation type(s) present on site based on *Planning for Bushfire Protection* Section A1.2

3. Determine the distance of the site from the classified vegetation type(s)

4. Determine the effective slope(s) of the ground underneath the classified vegetation type(s)

5. Use these values to determine the Bushfire Attack Level (BAL) from the appropriate table *Planning for Bushfire Protection* Tables A1.11.1 – A1.11.19

6. Determine the appropriate management requirements.

Methodology for this site assessment for bushfire attack and recommended mitigation measures (setback distances and construction standards) are based on Appendix 1 of PBP 2018. Minimum required APZ and other recommended setback measures for bushfire protection are derived from distances outlined by PBP 2018 for a residential subdivision development within an FDI 100 Fire Area.

The relevant Fire Danger Index (FDI) for New South Wales is FDI 100 (AS3959 Table 2.1 p.14, *Planning for Bushfire Protection* Section A1.5). This FDI was matched with vegetation configurations within Tables A1.11.1 – A1.11.19 for each effective slope to create zones of bushfire hazard that correspond to a given Bushfire Attack Level (BAL). The recorded fuel levels were checked against the maximum fuel assumptions for the vegetation fuel to confirm that model parameters were not being exceeded (AS3959 Table B2 p.97, Planning for Bushfire Protection Table A1.11.23).

BALs provide a means of measuring the severity of a building's potential exposure to ember attack, radiant heat and direct flame contact, using increments of radiant heat expressed in kilowatts per metre squared (kW/m2), which is the basis for establishing the requirements for construction to improve protection of building elements from attack by bush fire (RFS 2019).

The following BAL zones were modelled across the site, and a summary of what each BAL zone represents in terms of design requirements and housing approvals is summarised below.

BAL-FZ – representing direct exposure to flames from fire front in addition to an intense heat flux and extensive ember attack. This is listed as an extreme risk zone under AS3959, as noted below additional assessment and approval processes are required for any dwellings likely to exist in this zone.

BAL-40 – representing increasing levels of ember attack and burning debris ignited by wind born embers together with increasing heat flux with the increased likelihood of direct contact with flames. This is rated as a very high risk within AS3959, and RFS require that Performance Based Solutions are required for any housing construction within BAL-40 and BAL-FZ categories (Planning for Bushfire Protection 2017, p.118). This is a significantly higher level of design and approval and includes the development of a detailed report that complies with a verification method listed in Planning for Bushfire Protection Section A2.4

BAL-29 — representing the edge of the area where direct flame contact is likely to occur. Inside this zone direct flame contact on structures is expected, and the hazard is considered high. This zone represents the limit of where Deemed to Satisfy solutions under AS3959 are permitted within Planning for Bushfire Protection (PBP 2018 Section 7.5).

BAL-19 – representing the zone where embers have the potential to form piles against a structure, particularly at corners and other collection points where dry grasses, leaves and litter collects. Deemed to Satisfy and Complying Development approvals are allowed for this zone, and the additional costs of construction are generally more manageable, being restricted to materials close to ground level and glazing treatments.

BAL-12.5 — representing the zone where up to 12.5kW/m^2 of heat energy will be generated, which is primarily through ember attack. This represents a low overall risk unless embers contact an exposed fuel source that can establish a secondary fire. There are relatively few design changes from a standard house required at this level of risk and Deemed to Satisfy/Complying Development approval pathways are available.

The significantly higher hazard, combined with the increased assessment and approval requirements, make locating houses in BAL-40 and BAL-FZ zones less feasible, and our subsequent analysis has been on the basis that all dwellings will be located in areas that are expected to experience BAL-29 or below.

Distances for BAL zones will be established based on the Method 1 Calculations within AS3959 and overlaid onto aerial photographs of the site to provide an estimate of bushfire hazard across the landscape. The results of the BAL mapping are presented in **Section 3.0** below.

3.0 Results

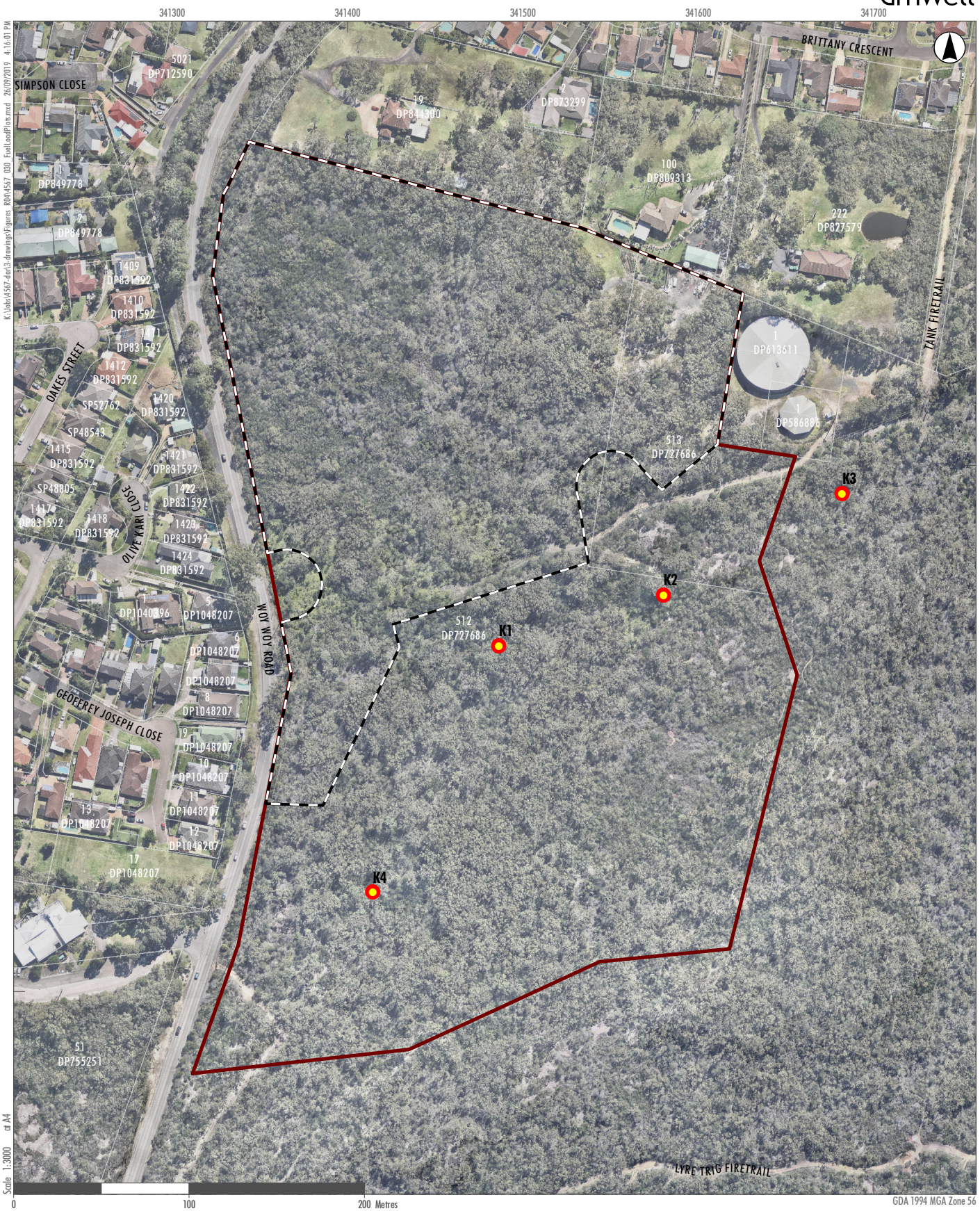
3.1 Bushfire Fuel Load Assessment

The assessment of bushfire fuels was undertaken by Umwelt and DLALC on 13 May 2019 covering four points through the vegetation on the southern boundary of the site. Weather conditions during the survey were clear and sunny, and an inspection of areas surrounding each point confirmed that they were broadly representative of the vegetation in the area.

The results of the bushfire fuel assessment are summarised in **Table 3.1** below and the locations of the plots are shown in **Figure 3.1**. The fuel levels for the surrounding vegetation is within the reference values for these vegetation types, however some areas are approaching the upper limit of desirable fuel loads. Options to manage fuel through Cultural Burning are discussed in **Section 5.0** below.

Table 3.1 Bushfire Fuel Investigation Results

Sample Point	AS3959 Vegetation Classification	Bark Fuel Hazard	Elevated Fuel Hazard	Near Surface Fuel Hazard	Surface Fuel hazard	Overall Fuel Classification	Estimated Fuel Level (t/ha)
1	Forest	High	High	Very High	Extreme	Very High	33
2	Forest	High	Extreme	Extreme	Moderate	Extreme	28
3	Forest	Extreme	Very High	Very High	Very High	Extreme	38
4	Forest	Very High	Very High	Very High	High	Very High	30



Legend

- Bushfire Fuel Load Plots
- Development Footprint
- Lots 512 & 513 DP 727686

FIGURE 3.1

Fuel Load Plot Locations

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

3.2 AS3959 Vegetation Classification

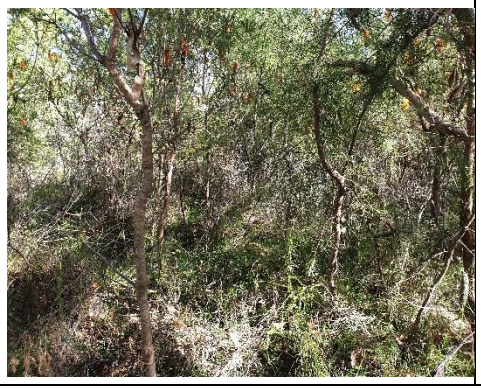
The vegetation fuel classification at and adjacent to the site was identified as low open forest, in accordance with AS3959 Table 2.3 and Figure 2.4. In addition to the site surveys, reference to the Great Hunter Native Vegetation Mapping has been undertaken to confirm vegetation types. Vegetation mapping has been provided in **Figure 3.2**. This inspection does not constitute an ecological assessment and was done for the purposes of classifying potential bushfire fuels.

The area of vegetation sampled was generally homogenous with some variation relating to the mixing of heath community with a low woodland/forest community as seen by lower canopy heights (see sample points 3, 4, 5 in **Table 3.2**). The vegetation showed some evidence of previous fire in the form of fire scarring, however it is likely that this area has not experienced a fire in over 20 years, based on the estimated age of regrowth on the site. While from an ecological perspective these areas are mapped as woodland, the closed canopy and dense shrub growth means that in a bushfire they have the characteristics of a forest during bushfire events, as the layers of fuel allow for the establishment of intense canopy fires.

Table 3.2 below provides a description of the vegetation and bushfire fuel present at each sample plot.

Table 3.2 Vegetation and Fuel Load Characteristics

Vegetation Sample	Bushfire Fuel Description
1 – Forest 	Forest vegetation with a very high fuel hazard dominated by elevated and near-surface fuels. Bark fuels were present, and a prominent surface fuel layer was also present dominated by Eucalyptus leaves. Dominant species present were Banksias (*Banksia* sp.), Red Bloodwood (*Corymbia gummifera*), Ironbark (*Eucalyptus* sp.) and Scribbly Gums (*Eucalyptus haemastoma*). The sample site was relatively flat. Evidence of fire scarring was identified at the site.
2 – Forest 	Forest vegetation (with heath vegetation characteristics such as a smaller canopy height and abundance of shrubs) with an extreme fuel hazard dominated by elevated fuels. Only a moderate surface fuel layer was present, dominated by Eucalyptus leaves. Dominant species included Banksia (*Banksia* sp.), Geebung (*Persoonia* sp.) and Paperbark (*Melaleuca* sp). The sample site was relatively flat and some rocky outcrops were present. Evidence of scorching was identified at the site.

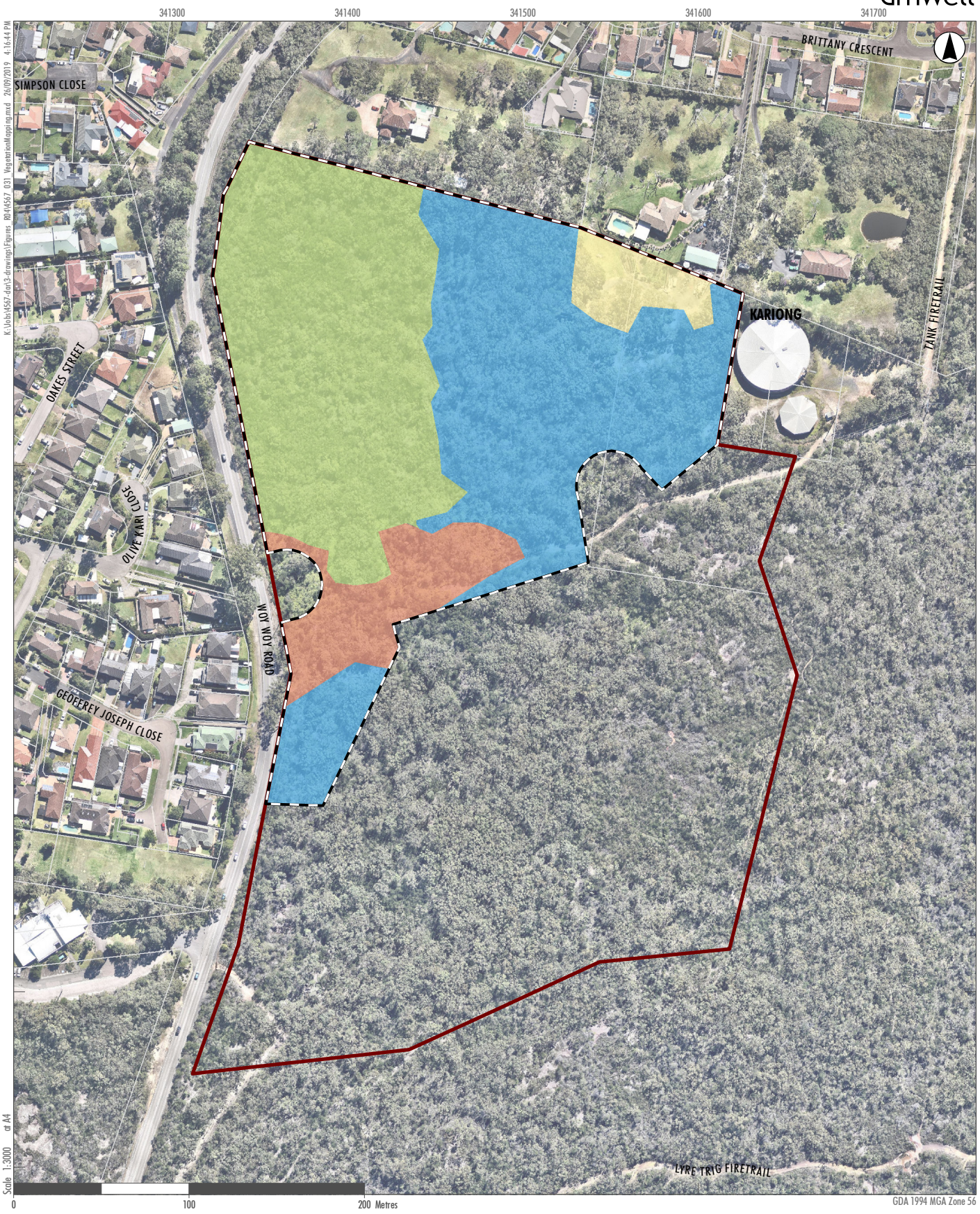
Vegetation Sample	Bushfire Fuel Description
3 – Forest 	Forest vegetation (with heath vegetation characteristics such as a smaller canopy height and abundance of shrubs) with an extreme fuel hazard dominated by elevated and near surface fuels. This would allow laddering of a fire into the crown of this vegetation community. Bark fuels were present, and a prominent surface fuel layer was also present dominated by Eucalyptus leaves. Dominant species recorded included Scribbly Gum, Banksia (Banksia sp.), and Paperbark (*Melaleuca* sp). There was a high level of dead material in the near surface layer which would facilitate the spread of a surface fire.
4 – Forest 	Forest vegetation with a very high fuel hazard dominated by elevated and near-surface fuels. Bark fuels were present, and a prominent surface fuel layer was also present dominated by Eucalyptus leaves. Dominant species present were Banksias (Banksia sp.), Paperbark and Tea Tree (*Melaleuca* sp). Rocky outcrops were present at the site.

3.3 Overall Fuel Hazard

The results for Overall Fuel classification provide a basis for estimating how likely initial attack on any bushfire is to be successful however, it does not increase the likely extent of BAL zones, as these are based on a 'worst case' scenario with fuel loads of 35 tonnes per hectare. One of the vegetation plots did exceed this value, with an estimated fuel load of 38 tonnes per hectare (AS3959 Table B2 p.97), but the overall fuel load across all sites did not exceed the reference values for these forest types. The fuel load assessments undertaken resulted in an Overall Fuel Hazard Rating of 'Very High' and 'Extreme' as seen in **Table 3.1**. In general, the near surface layer was abundant, and elevated fuel layers consisted of shrubs which would allow laddering of a fire into the crown of this vegetation community.

Vegetation located to the south of the site is extensive and DLALC will be responsible for managing the development in a way that does not compromise the safety of residents. As identified in **Section 1.2** there is an existing firetrail that would separate the proposed development from the bushland to the south. Nonetheless, an adequate APZ will be required and DLALC will be responsible for the maintenance of the APZ.

The required APZ/set back distance is based on vegetation type, slope and the nature of the development and the method for determining minimum distances is presented in Appendix 1 of Planning for Bushfire Protection. This report has focused on determining whether it is feasible to develop the proposed area, and more detailed delineation of APZ clearance should be undertaken as part of the detailed design of subdivisions and residences.



Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- Watercourses

Plant Community Type (Umwelt 2019)

- 1641 - Dwarf Apple Scribbly Gum heathy low woodland on sandstone ranges of the Central Coast (Good Condition)
- 1642 - Scribbly Gum; Red Bloodwood; Old Man Banksia heathy woodland of southern Central Coast (Good Condition)
- 1699 - Heath-leaved Banksia; Coral Fern wet heath on sandstone ranges of the lower Central Coast (Good Condition)
- Cleared/Disturbed

FIGURE 3.2

Vegetation Mapping

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

3.4 Mapping of Bushfire Attack levels

Table 3.3 provides the Method 1 details for the proposed development in each direction and required APZs. **Figure 3.3** shows the slope of the proposed development and surrounding area. **Figure 3.4** shows the Bushfire Attack Levels surrounding the proposed development.

It should be noted that the mapping of BAL levels assumes total clearance of the blocks, which is unlikely to happen. The focus of this assessment has been to determine how much of the blocks would be inside of the BAL-FZ and BAL-40 zones that could make housing development unviable.

The mapping shows that there are significant areas of the blocks that are viable for residential housing, and that the creation of APZ's will be an effective measure to manage bushfire risk.

The minimum APZ distances in **Table 3.3** below are taken from Tables A1.11.4 and A1.11.5 within PBP 2018 and are intended to provide an estimate of how much set-back from unmodified vegetation is required to place all new residential developments are placed outside the flame zone (representing BAL40 and above). It does not imply that approval would be granted for dwellings that did not meet other aspects of Planning for Bushfire Protection.

Table 3.3 Bushfire Attack Assessment

Direction	FDI	Vegetation type	Slope (degrees)	Minimum distances for APZs (metres)
North	100	Woodland (grassy)	Downslope 5-10°	20
East	100	Woodland (grassy)	Downslope 0-5°	16
South	100	Forest	Downslope 10-15°	46
West	100	Low threat vegetation	Downslope 10-15°	Nil

This assessment has assumed no BAL risk to the west of the proposed development, given that all vegetation in this area will be cleared for the proposed development and that this area is located adjacent to existing cleared areas (Woy Woy Road). It is anticipated that vegetation may be remained in a nature strip formation adjacent to Woy Woy Road however this is classed as low threat vegetation in accordance with AS3959 as it is in a narrow strip (less than 20 m wide) with breaks in the fuel at road junctions, and cannot sustain a bushfire.

Areas to the north and east of the proposed development represent areas of managed lands for rural residential land and water infrastructure. During field assessments it was noted that in some areas there is both grassy understorey fuels and areas of continual tree cover. The management of these rural residential blocks may reduce the overall fire hazard, particularly if understorey fuels are managed. However, this assessment has adopted a conservative approach and has considered these areas to form woodland vegetation rather than managed lands given that there are still patches of vegetation present in these areas that represent a potential bushfire risk.

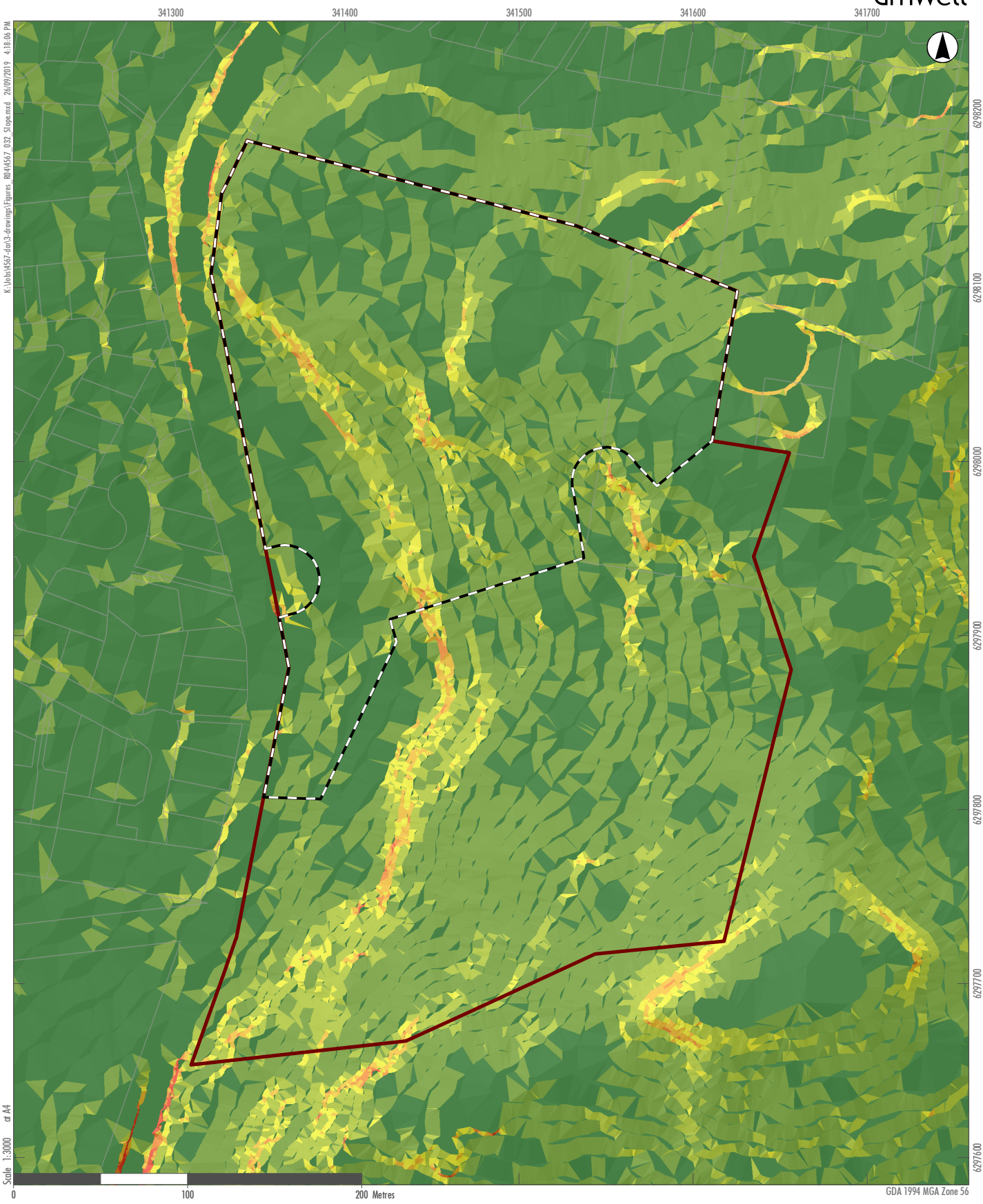


FIGURE 3.3

Slope

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

Legend

- Development Footprint
- Lots 512 & 513 DP 727686
- Lot Boundaries

Bushfire Attack Levels (BAL)

- BAL12.5
- BAL19
- BAL29
- BAL40
- BALFZ

FIGURE 3.4

Bushfire Attack Levels

Image Source: Nearmap (2019); Open Street Map (2019) Data source: NSW LPI (2019)

4.0 Performance and Design Criteria

Performance criteria and acceptable solutions for APZs for residential and rural subdivisions are provided in **Table 4.1** below and are referenced from PBP 2018. In addition to the consideration of performance criteria outlined in PBP 2018, the design of the proposed development on individual lots would need to consider the construction requirements for the applicable BAL contained in AS3959, and noting that NSW RFS require performance based solutions for BAL-40 and BAL-FZ constructions. The development of performance based solutions is likely to be prohibitive, and it is recommended that appropriate APZ's based on RFS standards are developed as an alternative to a building design approach (NSW RFS 2017). Additional hazard reduction measures would be to adopt the cultural burning prescriptions outlined in Section 5 below to reduce fuel loads and promote a more open grassy woodland structure in areas close to residences and in the main fuel body to the south and east of the development.

The creation of APZ's does not need to result in the total removal of all trees and shrubs. The current APZ Standard requires vegetation thinning that is consistent with an open parkland structure to the retained vegetation, and is intended to reduce the risk of crown fires adjacent to residences (RFS 2017 p.6-8). Wherever possible the emphasis should be on the removal of exotic species and weeds, followed by trees with Stringybark or Ribbon barks that can generate embers. There are two areas where vegetation should be retained to reduce the risk to heritage sites, and these can be left as they form a small island isolated from other fuels, and are less than 20% of the total area. Vegetation management closest to houses will have the highest positive effect on housing survival (Gibbons et al 2012).

Table 4.1 Performance Criteria for Residential and Rural Subdivisions

Aspect	Performance Criteria	Acceptable Solutions
Access (general)	Firefighting vehicles are provided with safe, all-weather access to structures and hazard vegetation.	• property access roads are two-wheel drive, all-weather roads; and • perimeter roads are provided for residential subdivisions of three or more allotments; and • subdivisions of three or more allotments have more than one access in and out of the development; and • traffic management devices are constructed to not prohibit access by emergency services vehicles; and • maximum grades for sealed roads do not exceed 15^{o} and an average grade of not more than 10^{o} or other gradient specified by road design standards, whichever is the lesser gradient; and • all roads are through roads. Dead end roads are not recommended, but if unavoidable, dead ends are not more than 200 m in length, incorporate a minimum 12 m radius turning circle, and are clearly sign posted as a dead end; and • where kerb and guttering is provided on perimeter roads, roll top kerbing should be used to the hazard side of the road; and • where access/egress can only be achieved through forest, woodland or heath vegetation, secondary access shall be provided to an alternate point on the existing public road system

Aspect	Performance Criteria	Acceptable Solutions
	The capacity of access roads is adequate for firefighting vehicles.	The capacity of perimeter and non-perimeter road surfaces and any bridges/causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges/causeways are to clearly indicate load rating.
	There is appropriate access to water supply.	• hydrants are located outside of parking reserves and road carriageways to ensure accessibility to reticulated water for fire suppression; • hydrants are provided in accordance with AS2419.1:2005; • there is suitable access for a Category 1 fire appliance to within 4 m of the static water supply where no reticulated supply is available
Perimeter Roads	Access roads are designed to allow safe access and egress for medium rigid firefighting vehicles while residents are evacuating as well as providing a safe operational environment for emergency service personnel during firefighting and emergency management on the interface.	• perimeter roads are two-way sealed roads; • 8m carriageway width kerb to kerb; • parking is provided outside of the carriageway width; • hydrants are located clear of parking areas; • there are through roads, and these are linked to the internal road system at an interval of no greater than 500 m; • curves of roads have a minimum inner radius of 6m; • the maximum grade road is 15° and average grade is 10°; • the road crossfall does not exceed 3°; • a minimum vertical clearance of 4 m to any overhanging obstructions, including tree branches, is provided.
Non-Perimeter Roads	Access roads are designed to allow safe access and egress for medium rigid firefighting vehicles while residents are evacuating.	• minimum 5.5 m width kerb to kerb; and • parking is provided outside of the carriageway width; • hydrants are located clear of parking areas; and • roads are through roads, and these are linked to the internal road system at an interval of no greater than 500 m; • curves of roads have a minimum inner radius of 6 m; • the road crossfall does not exceed 3°; and • a minimum vertical clearance of 4 m to any overhanging obstructions, including tree branches, is provided.

Aspect	Performance Criteria	Acceptable Solutions
Property Access	Firefighting vehicles can access the dwelling and exit safely.	No specific access requirements apply in a urban area where a 70 m unobstructed path can be demonstrated between the most distant external part of the proposed dwelling and the nearest part of the public access road (where the road speed limit is not greater than 70 kph) that supports the operational use of emergency firefighting vehicles (i.e. a hydrant or water supply). In circumstances where this cannot occur, the following requirements apply: • minimum carriageway width of 4 m; • in forest, woodland and heath situations, rural property access roads have passing bays every 200 m that are 2 m long by 2 m wide, making a minimum trafficable width of 6 m at the passing bay; • a minimum vertical clearance of 4 m to any overhanging obstructions, including tree branches; • provide a suitable turning area in accordance with Appendix 3; • curves have a minimum inner radius of 6 m and are minimal in number to allow for rapid access and egress; • the minimum distance between inner and outer curves is 6 m; • the crossfall is not more than 10°; and maximum grades for sealed roads do not exceed 15° and not more than 10° for unsealed roads; • and a development comprising more than three dwellings has formalised access by dedication of a road and not by right of way. Note: Some short constrictions in the access may be accepted where they are not less than the minimum (3.5 m), extend for no more than 30 m and where the obstruction cannot be reasonably avoided or removed. The gradients applicable to public roads also apply to community style development property access roads in addition to the above.
Water Supply	Water supplies are located at regular intervals The water supply is accessible and reliable for firefighting operations	• fire hydrant spacing, design and sizing comply with the Australian Standard AS2419.1:2005; • hydrants are not located within any road carriageway; • reticulated water supply to urban subdivisions uses a ring main system for areas with perimeter roads.
	Flows and pressure are appropriate.	• fire hydrant flows and pressures comply with AS2419.1:2005.
	The integrity of the water supply is maintained.	• all above-ground water service pipes are metal, including and up to any taps.

Aspect	Performance Criteria	Acceptable Solutions

Electrical Services	Location of electricity services limits the possibility of ignition of surrounding bush land or the fabric of buildings.	• where practicable, electrical transmission lines are underground;
		• where overhead, electrical transmission lines are proposed as follows:
		  ○ lines are installed with short pole spacing (30 m), unless crossing gullies, gorges or riparian areas;
		  ○ no part of a tree is closer to a power line than the distance set out in accordance with the specifications in ISSC3 Guideline for Managing Vegetation Near Power Lines.

Gas Services	Location and design of gas services will not lead to ignition of surrounding bushland or the fabric of buildings.	• reticulated or bottled gas is installed and maintained in accordance with AS/NZS 1596:2014 and the requirements of relevant authorities, and metal piping is used; • all fixed gas cylinders are kept clear of all flammable materials to a distance of 10 m and shielded on the hazard side; • connections to and from gas cylinders are metal; polymer-sheathed flexible gas supply lines are not used; • above-ground gas service pipes are metal, including and up to any outlets.
Asset Protection Zones	Provide a fuel reduced area between the unmodified vegetation and residences to reduce the overall bushfire intensity of fires and prevent crown fire development	• Thinning of trees to create an open park-like structure with separation of tree canopies and the removal of most shrubs in the understorey; • Thinning of trees to provide a minimum separation of 2-5 m between tree crowns. Lower branches to be trimmed to lift the crown to 3-5 m above ground level; • Mowing, grazing or cultural burning of grasses to less than 10 cm average height, maintained for the duration of the fire season; • Removal of most shrubs in the understorey, these should be confined to well-separated clumps making up no more than 20% of the total area; • Clumps of retained shrubs can be left around cultural heritage sites for amenity and to minimise risk of disturbance; • Weeds to be removed entirely, and regular inspections to treat any weeds that establish in the APZ.

5.0 Cultural Fire Management

Cultural burning is an approach to prescribed fire that emphasises the maintenance of indigenous knowledge and their connection to the land. In addition to the preservation of traditional knowledge, these practices have been tailored to the Australian environment by the longest continual culture on earth, increasing the likelihood of enhancing biodiversity.

One alternative to broad-scale fuel reduction burns that are more suitable for smaller areas and ecological objectives is Cultural Fire Management. Cultural fire management is any burn with a cultural objective, and where Aboriginal community leaders have been involved in the planning of the activity. In addition to providing Aboriginal communities with a way to connect with country and pass on traditional knowledge, these approaches can enhance biodiversity and reduce bushfire fuel loads.

Cultural burning prescriptions commonly emphasise undertaking fuel reduction under lower risk fire weather conditions, allowing hazard reduction closer to assets than standard fuel reduction burns where more extensive control lines are required. Research following major fire events found that managing vegetative fuel within 40 metres of houses is the more important than broad scale fuel reductions (Gibbons et al 2012). It is recommended that the zone from property boundaries out to 40 m should be the focus of cultural burning activities in the first instance, and if possible, should aim to create an open grassy woodland structure that will reduce the likelihood of more intense crown fires.

Planning of controlled burns as a treatment should specifically consider:

- Capacity to include traditional owners, communities and RFS and other agencies in the planning and management of the fuel reduction.
- Recommended fire interval for ecosystems within the block, incorporating and documenting before and after condition.
- Flowering and seed set time of any weeds present
- Potential to enhance biodiversity outcomes on the block, and record and verify this.
- Emphasise reducing fuel within 40 m of block boundaries.

The Office of Environment and Heritage (OEH) National Parks and Wildlife Service (NPWS) have released a Cultural Fire Management Policy that provides guidelines for incorporating this into land management. This provides the overall objectives and requirements for implementing cultural fire management but is an overarching policy document.

DLALC in developing a Bushfire Management Plan for the proposed development should consider the NPWS Cultural Fire Management Policy and the extensive knowledge and experience of their employees in managing fire.

6.0 Conclusion

This report is a preliminary investigation to determine if the risk of bushfire can be managed within the proposed development areas in a way that is consistent with NSW Planning guides, particularly Planning for Bushfire Protection. The assessment is based on the following broad assumptions:

- Development lots will be for free-standing residential buildings.
- The recommended APZs will be created and maintained, and properties will be generally managed in compliance with RFS guidelines.
- Fuel loads in the surrounding area are within the estimated average fuel loading for each vegetation formation.

Provided that the proposed development, APZ areas, access and water supply facilities within the subject development site are constructed/designed/maintained in accordance with the recommendations as described by this report, it is a considered opinion that the subject development can satisfy the aims, objectives and performance requirements PBP 2018.

Bushfire safety compliance and mitigation (as recommended and/or purported by this report) for the subject development site comprises a package of 'measures in combination' primarily including asset protection zoning, construction standards, property roadway access and adequate water supply for firefighting purposes.

It is also recommended that DLALC consider implementing cultural burning practices in the areas immediately adjacent to the proposed development. This will both reduce the overall fuel load and maintain environmental values while also maintaining cultural knowledge around fire.

The above measures have been derived from provisions and recommendations as outlined within PBP 2018, professional judgment, considered opinion, and advice from Indigenous employees of DLALC in relation to cultural burning practices.

7.0 References:

AS3959:2009 Australian Standard – Construction of Buildings in Bushfire Prone Areas (2011) Standards Australia, Sydney NSW.

Fire Trail Standards (2017) NSW Rural Fire Service, Sydney http://www.rfs.nsw.gov.au/__data/assets/pdf_file/0009/69552/Fire-Trail-Standards.pdf

Gibbons P, van Bommel L, Gill AM, Cary GJ, Driscoll DA, Bradstock RA, et al. (2012) *Land Management Practices Associated with House Loss in Wildfires*. PLoS ONE 7(1): e29212. https://doi.org/10.1371/journal.pone.0029212

Guidelines for Community (Low Risk) Cultural Burning on NPWS Managed Lands (2017) NSW National Parks and Wildlife Service, Sydney Rural Fire Service (2019) www.rfs.nsw.gov.au/plan-and-prepare/building-in-a-bush-fire-area/what-you-need-to-know

Planning for Bushfire Protection – A guide for councils, planners, fire authorities and developers (2018) NSW Rural Fire Service, Sydney NSW

Standards for Asset Protection Zones (2017) NSW Rural Fire Service, Sydney http://www.rfs.nsw.gov.au/__data/assets/pdf_file/0010/13321/Standards-for-Asset-Protection-Zones.pdf

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Attachment 4

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VALUING OUR PAST - CREATING OUR FUTURE

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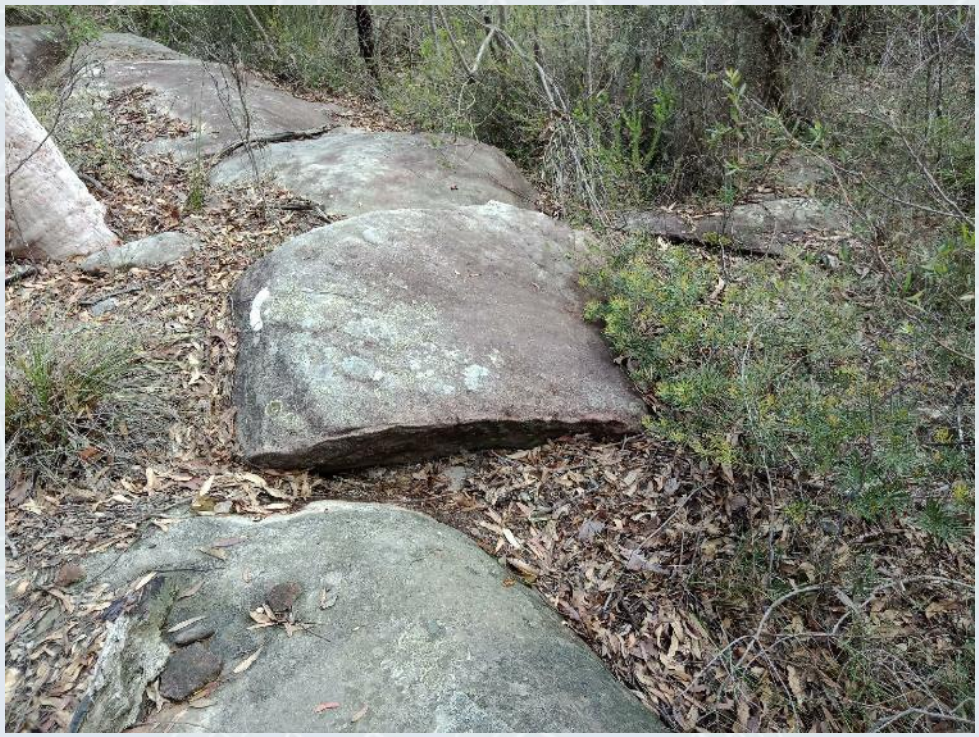

WOY WOY ROAD, KARIONG ABORIGINAL CULTURAL HERITAGE ASSESSMENT REPORT

DRAFT 28 / 04 / 2020

DARKINJUNG LOCAL ABORIGINAL LAND COUNCIL
168 Pacific Highway WATTANOBI NSW 2259
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Executive Summary

Heritage Now has been engaged by Darkinjung Local Aboriginal Land Council (the Proponent) to conduct an Aboriginal Cultural Heritage Assessment at Lot 512 and 513, DP727686, Woy Woy Road, Kariong for a proposed residential development. Only the northern portion of the Project Area is currently planned for residential development.

Aboriginal consultation has been undertaken in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (BCD-DPIE) and 11 Registered Aboriginal Parties (RAPs) have been consulted.

The archaeological survey was undertaken on 17 March 2020 by Heritage Now Principal Consultant Tessa Boer-Mah along with RAP representatives: Amanda Shields of Darkinjung Local Aboriginal Land Council and Tracey Howie of Awabakal Traditional Aboriginal Owners Corporation. The survey focussed on the northern portion of the Project Area which is to be impacted.

AHIMS#45-3-3044 was ground-truthed and identified to be approximately 70 metres north west of its recorded location in the AHIMS database (and this update will be sent to AHIMS). The location of AHIMS#45-3-3052 was inspected, but the site was not observed. Two Aboriginal sites within 20 metres of the impact area, as yet unregistered on the AHIMS database (WWR4 and WWR8) were ground-truthed, but not identified at their recorded locations. In the case of WWR4, dense vegetation may have obscured the site. For WWR8 the recorded location of this site when ground-truthed was within a drainage channel, with no outcropping sandstone, thus the recorded location is likely incorrect and it is located in the eastern part of the Project Area (which also aligns with the stated site description). WWR3, WWR5 and WWR7 also unregistered Pross sites were also not observed during the survey. A previously unrecorded site, HN-WW-E01, was identified and contained two mundoe engravings near a waterhole.

In addition, archaeologically sensitive sandstone sheets were identified which were too obscured to positively identify if they contained Aboriginal engravings or grinding grooves, these were identified throughout the impact area.

AHIMS#45-3-3044 and HN-WW-E01 were identified to be of high local significance and moderate regional significance. The significance of remaining Aboriginal sites could not be assessed, as they were not located during the survey. A significance assessment of the archaeologically sensitive sandstone sheets could not be made, as they were obscured by soil and vegetation.

There are no Aboriginal sites within the impact area of the Project, however, archaeologically sensitive sandstone sheets have been identified. Aboriginal sites (AHIMS#45-3-3052, WWR4 and WWR8) within 20 metres of the impact area and thus fencing during construction is required to ensure there are no inadvertent impacts to these sites. AHIMS#45-3044, HN-WW-E01, WWR3, WWR5 and WWR7 are to be marked on construction maps as no-go areas along with AHIMS#45-3-3052, WWR4 and WWR8. Archaeologically sensitive sandstone sheets are to be inspected after vegetation removal.

All on-site personnel are to be made aware of their obligations under the National Parks and Wildlife Act 1974, this includes protection of Aboriginal sites and the reporting of any new Aboriginal, or suspected Aboriginal, heritage sites. This may be done through an onsite induction or other suitable format.

The works are to be undertaken in accordance with the below recommendations.

Recommendation 1

High visibility barrier fencing is to be erected along the buffer for Aboriginal sites AHIMS#45-3-3052, WWR4 and WWR8. The high visibility barrier fence is to be erected prior to construction and remain in place until the cessation of construction.

Recommendation 2

The archaeologically sensitive sandstone sheets are to be inspected by a RAP representative after vegetation removal, but before ground disturbance works and levelling to verify if they contain Aboriginal engravings or grinding grooves. If Aboriginal engravings, grooves or other site type is identified during this process, then mitigation and management measures are to be identified and implemented in consultation with the RAPs and a heritage consultant.

Recommendation 3

The eight Aboriginal sites are to be clearly marked on all relevant construction drawings, along with buffers and fencing, as relevant.

Recommendation 4

If Aboriginal engravings, grooves or other site type is identified during this process, then mitigation and management measures are to be identified and implemented in consultation with the RAPs and the heritage consultant.

Recommendation 5

All on-site personnel are to be made aware of their obligations under the National Parks and Wildlife Act 1974, this includes protection of Aboriginal sites and the reporting of any new Aboriginal, or suspected Aboriginal, heritage sites. This may be done through an onsite Aboriginal Cultural Heritage induction or other suitable format.

Acronyms, Terms and Definitions

Acronym	Definition
ACHA	Aboriginal Cultural Heritage Assessment
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information System
AHIP	Aboriginal Heritage Impact Permit
BCD	Biodiversity and Cultural Division
DECCW	Department of Environment Climate Change and Water
DLALC	Darkinjung Local Aboriginal Land Council
DP	Deposited Plan
DPIE	Department of Planning, Industry and Environment
EP&A	Environmental and Planning Assessment
LEP	Local Environmental Plan
LGA	Local Government Area
NSW	New South Wales
NPW	National Parks and Wildlife
OEH	Office of Environment and Heritage
PAD	Potential Archaeological Deposit
SEPP	State Environmental Planning Policy
RAPs	Registered Aboriginal Parties

Contents

Tables

Figures

Plates

1 Introduction

Heritage Now has been engaged by Darkinjung Local Aboriginal Land Council (DLALC) (the Proponent) to conduct an Aboriginal Cultural Heritage Assessment (ACHA) at Lot 512 and 513, DP727686, Woy Woy Road, Kariong for a proposed residential development.

The assessment is to inform the planning under the Aboriginal Lands State Environmental Planning Policy (SEPP).

The aim of this ACHA report is to identify Aboriginal cultural heritage values through consultation with Registered Aboriginal Parties (RAPs). The ACHA report enables those values to be respected throughout the process through the identification of appropriate mitigation measures to avoid and/or minimise harm to Aboriginal cultural heritage and values.

1.1 Project Area

The Project Area is approximately 5 km southwest of Gosford. The project extent is 6.1 hectares and is approximately 400m north-south and 360m east-west. The northern portion of the Project Area is proposed for residential development (Figure 1).

1.2 Project Proposal

The proponent plans to develop the northern part of the Project Area for residential purposes. The residential development will involve clearing of vegetation as well as cut and fill to prepare the Project Area. It will require the installation of below and above ground services including water and sewer, telecommunications and electricity. It will also require the formation of roads and access ways to the residential lots as well as the building of individual residences.

1.3 Project Methodology

This ACHA report has been prepared in accordance with, but not limited to, the National Parks and Wildlife Act 1974, the National Parks and Wildlife Regulations 2009, the Environmental Planning and Assessment Act 1979, Gosford Local Environmental Plan 2014. and the State Environmental Planning Policies. The following guidelines and codes of practice have been used in preparing this ACHA report:

- Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH 2011).
- Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (OEH, formerly DECCW 2010)
- Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH, formerly DECCW 2010).

In accordance with the guidelines this report has outlined the:

- The Project Area and proposed activity (project proposal) (Section 1.2 and 6.1)
- the Aboriginal consultation process (Section 3 and Appendix 1),
- provided relevant background information (Section 4.1 and 4.2),
- undertaken an assessment of cultural heritage values (Section 5),

- undertaken an impact assessment, including consideration of avoidance and/or mitigating harm (Section 6), and
- provided recommendations (Section 7).

1.4 Authorship

This report was written by Crystal Phillips, Heritage Consultant at Heritage Now and Tessa Boer-Mah, Principal Heritage Consultant at Heritage Now.

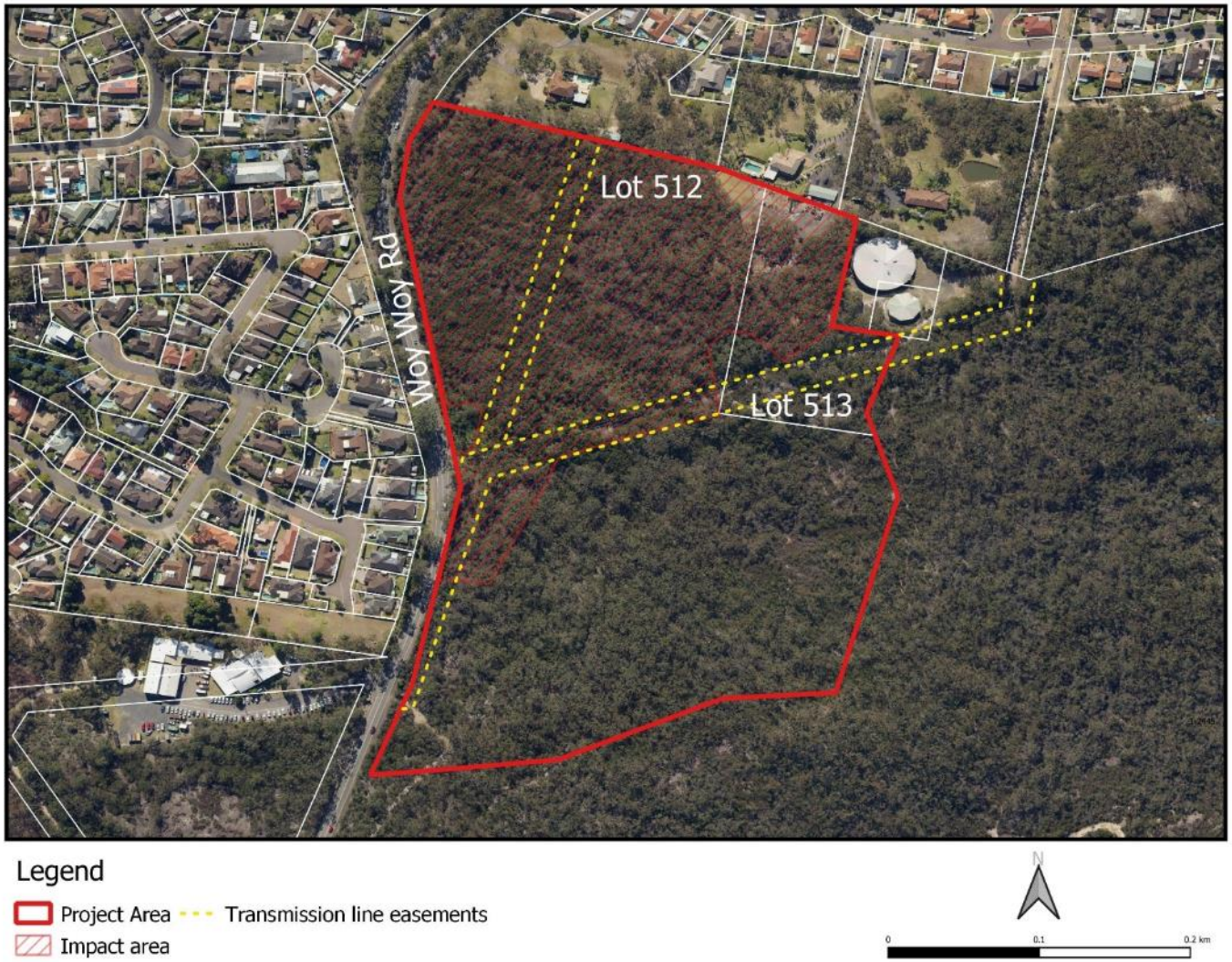


Figure 1: Project Area

2 Legislative Context

This section provides an outline of the Acts, Regulations and guidelines under which this assessment has been undertaken. It is for information purposes only and should not be taken as legal advice.

2.1 National Parks and Wildlife Act 1974

This Act contains the provisions for protecting Aboriginal objects in NSW. Aboriginal objects are protected regardless of whether they are in their original context (location) or not and it is an offence to harm an Aboriginal object regardless of whether you know it is an Aboriginal object or not. Protection under Section 86 of the Act is as follows:

- s86(1) A person must not harm or desecrate an object that the person knows is an Aboriginal object.
- s86(2) A person must not harm an Aboriginal object.
- s86(3) A person must not harm or desecrate an Aboriginal place.

Penalties for harming Aboriginal objects or Places range from $80,000-$800,000 for individuals and $330,000-$1,650,000 for corporations and may also include imprisonment. Under Section 87 there are certain defences from prosecution, these include that harm was authorised under an Aboriginal Heritage Impact Permit (AHIP) and actions were in accordance with the AHIP, that due diligence was exercised in relation to Aboriginal object/s and/or the activity was classified as low impact.

Under Section 89A Aboriginal object/s must be reported to the Office of Environment and Heritage (OEH) within a reasonable timeframe, unless it has previously been recorded and submitted to the Aboriginal Heritage Information Management System (AHIMS). Penalties for failure to report an Aboriginal object range from $16,500 for individuals and $33,000 for corporations.

2.2 National Parks and Wildlife Regulations 2009

This Regulation includes provides a framework for exercising due diligence and provides codes of practice in respect to Aboriginal objects (Section 80A) as well as defences for carrying out certain low impact activities (Section 80B). The Regulation also outlines requirements for Aboriginal consultation (Section 80C), particularly in relation to an Aboriginal Heritage Impact Permit. Under the Regulation the following codes of practice and guidelines are recognised, amongst others:

- *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (OEH, formerly DECCW 2010a),
- *NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects* (Minerals Council),
- *Aboriginal Cultural Heritage Consultation Requirements for Proponents*. (OEH, formerly DECCW 2010b),
- *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011), and
- *Code of Practice for Archaeological Investigation of Aboriginal objects in NSW* (OEH, formerly DECCW 2010c).

2.3 Aboriginal Land Rights Act 1983

This Act provides land rights to Aboriginal people through the Local Aboriginal Land Councils. It outlines a process for claiming unused Crown Land in NSW and for creating land use. It also allows for agreements to permit traditional hunting, fishing and gathering.

2.4 Environmental Planning and Assessment Act 1979

The Environmental Planning and Assessment (EP&A) Act provides triggers for undertaking environmental and heritage assessments as part of the wider land use planning framework. This Act has three main parts of direct relevance to Aboriginal cultural heritage. Namely, Part 3 which governs the preparation of planning instruments, Part 4 which relates to development assessment proves for local government (consent) authorities and Part 5 which relates to activity approvals by governing (determining) authorities. Planning decisions within Local Government Areas (LGAs) are guided by Local Environmental Plans (LEPs). Each LGA is required to develop and maintain an LEP that includes Aboriginal and historical heritage items which are protected under the EP&A Act and the NPW Act.

2.5 State Environmental Planning Policy (Aboriginal Land) 2019 (SEPP)

This SEPP provides for the making of development delivery plans (DPPs) for land owned by a LALC that must be considered when determining a DA for that land. The SEPP also allows for specified development carried out on land owned by a LALC to be declared regionally significant development. Presently the SEPP only pertains to certain land owned by the Darkingjung LALC (DLALC).

The Minister for Planning reviews and approves all DPPs. In accordance with the SEPP a DPP must include the following (under clause 9(1)):

- the general objectives of the LALC for the land;
- the nature of the development proposed for the land;
- the basis on which the development is proposed, having regard to economic, social and environmental factors;
- strategies, actions and a program for achieving the objectives; and
- other matters the Minister thinks appropriate.

A DDP may also set out (under clause 9(2)):

- the bulk, scale and size of development proposed for the land to which the plan applies;
- measures to support Aboriginal cultural heritage and biodiversity conservation relating to the land; and
- proposals for the provision of public utility infrastructure and roads.

This report provides an assessment of and measures to support the Aboriginal cultural heritage values of the Project Area.

2.6 Gosford Local Environmental Plan (LEP) 2014

The Gosford LEP 2014 requires development consent to demolish, disturb, excavate or develop land on which an Aboriginal object is located or that is within an Aboriginal place of significance. Council must consider the effect of a proposal on an Aboriginal Place and any Aboriginal object located within an area of works. Council must inform the local Aboriginal community about the application where impacts to Aboriginal cultural heritage may occur. Protected heritage under the LEP is listed in Schedule 5.

There are no Aboriginal sites listed in Schedule 5 of the Gosford LEP.

3 Aboriginal Consultation

This section documents the Aboriginal Consultation that has been undertaken for the project in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (BCD-DPIE, formerly DECCW 2010b) and will be referred to as the 'Aboriginal Consultation Requirements'. The four stages of Aboriginal consultation were undertaken and additional documentation is available in Appendix 1.

3.1 Stage 1

In accordance with Stage 1 of the Aboriginal Consultation Requirements requests for information on knowledge holders were send to the Central Coast and Hunter OEH office, the Darkinjung Local Aboriginal Land Council, the Registrar of Aboriginal Owners, Native Title Services, the Central Coast Council and the Greater Sydney office of Local Land Services. The National Native Title Tribunal only accepts searches of crown land. There is no crown land in the Project Area.

Based on information collected from government agencies, invitations for expressions of interest to become a Registered Aboriginal Party for the Project were sent to the knowledge holders.

A public notice was placed in the Coast Community News local newspaper.

As a result of the expressions of interest invitations and the public notice 11 Aboriginal representatives nominated to become Registered Aboriginal Parties for the Project (Table 1).

Table 1 Registered Aboriginal Parties

Organisation/Individual	Representative Name/s
A1 Indigenous Services	Carolyn Hickey
Awabakal & Guringai Pty Ltd	Tracey Howie and Kerrie Brauer
Awabakal Traditional Owners Aboriginal Corporation	Kerrie Brauer
Didge Ngunawal Clan	Paul Boyd and Lilly Carroll
Guringai Tribal Link	Tracey Howie
Kawul Pty Ltd trading as Wonn1 Sites	Arthur and Lynne Fletcher
Walkaloa	Tracey Howie
Widescope Indigenous Group	Steven Hickey
Individual	Sharon Hodgetts
Individual	Trudy Smith
Confidential registration	Confidential

3.2 Stages 2 and 3

In accordance with Stages 2 and 3 details of the project and the assessment methodology was sent out to the RAPs and opportunities for feedback were provided (Table 2). Opportunities for feedback were also provided during the fieldwork. Field work was completed on Tuesday 17 March 2020. Awabakal Traditional Owners Aboriginal Corporation and Didge Ngunawal Clan were engaged for fieldwork, however, no representatives from Didge Ngunawal Clan attended the survey.

Table 2 Responses to Assessment Methodology by Registered Aboriginal Parties

Organisation/Individual	Representative Name/s	Response summary (full response in Appendix 1)
A1 Indigenous Services	Carolyn Hickey	Agrees with methodology
Guringai Tribal Link	Tracey Howie	Agrees with methodology
Walkaloa	Tracey Howie	Agrees with methodology
Widescope Indigenous Group	Steven Hickey	Agrees with methodology

3.3 Stage 4

The draft report will be sent to the Registered Aboriginal Parties and 28 days provided for comment.

3.4 Summary

As a result of the Aboriginal consultation process 11 Registered Aboriginal Parties were identified. Feedback from the Aboriginal consultation, thus far, has been incorporated into the assessment of significance and the development of heritage management and mitigation strategies for the Project.

4 Archaeological Assessment

The archaeological assessment outlines the environmental and heritage context for the Project Area. It also reports on the archaeological survey.

4.1 Environmental Context

This section provides the environmental context for the assessment of past Aboriginal occupation in the Project Area.

4.1.1 Geology and Soils

The Project Area lies within the Hawkesbury sandstone geological zone that formed in the Middle Triassic Period (Geological Services of NSW, 2015). This zone is categorised by medium to very coarse-grained sandstone, minor laminated mudstone and siltstone lenses. Large sandstone outcrops were often used for rock art and engravings. Larger outcrops often provided rocks shelters, which could be used as campsites with natural protection from the weather. Sandstone with a nearby water source was also used for sharpening and grinding stone tools, leaving axe-grinding groove sites. Mudstone and siltstone can be used to create stone tools.

The soil in Kariong is comprised of an A1 Horizon of black coarse loamy sand from 0-0.3m. The A2 Horizon is a light grey coarse sand from 0.3-0.7m. The B Horizon is a dark brown loamy sandstone. The sandiness of the soils can be attributed to degrading sandstone formations that dominate the geology of the area.

4.1.2 Topography and Hydrology

The Project Area is on sloping land, which rises from 100-200m in the west to the 400-500m in the east. There are no streams within the Project Area, however, a water hole has been noted as being within the project area. The closest streams are first order streams approximately 200m to the east and west of the project area.

4.1.3 Flora and Fauna

This section is intended to give a general overview of the flora and fauna that may have been used by Aboriginal people in the past. The information has been supplied for understanding the past Aboriginal use of the landscape and is not intended for ecological assessment purposes.

The vegetation throughout the entire Project Area is classed as Sydney Coastal Heaths based on Keith (2006). This class is dominated by emergent mallees up to 4 m tall and shrubs up 1.5 m tall with a semi-continuous graminoid groundcover. Trees present would normally include mallee forms of red bloodwood, heart-leaved stringy-bark, yellow-top ash and Port Jackson mallee, while shrubs include scrub she-oak, dwarf apple, heath banksia, old man banksia, cone-seeds, egg and bacon pea, coral heath, dagger hakea, broad-leaved drumsticks, pink tea-tree, flaky-barked teatree, small-leaved white beard, lance-leaved geebung and grass-trees.

These coastal heaths provide the habitat for wallabies, kangaroos, potoroos, possums, bats, and quolls. These fauna were an important source of food to the Darkinjung people and their hides were also a resource to make clothing. Possum skin and hair was one of the more frequently chosen sources of clothing (Australian Walkabout Wildlife Park, 2018).

4.1.4 Land Use

The Project Area is largely undeveloped bushland, although it has two existing electricity easements and access tracks.

4.1.5 Synthesis

The Project Area occurs within the Hawkesbury River Sandstone Geological Zone which would have provided an excellent source material for art engravings and axe grinding grooves. There is also a wealth of floral and faunal resources that occur in the area. However, the slope of the land and distance form a reliable water source suggest that it is unlikely location for camp site occupation, sites containing art and engravings are more likely.

4.2 Heritage Context

A review of the archaeological, ethno-historical and post-contact history of an area provides contextual information for Aboriginal sites within the local and regional landscape. Previous archaeological research undertaken in the region as well as a review of environmental factors can inform predictive models for the locations of Aboriginal sites. Predictive models can be further refined by the consideration of the post-contact land use of the area which may identify potential sources of post-depositional disturbances that may have occurred.

4.2.1 Ethno-historical Context

Aboriginal people have occupied Australia for at least 50,000 years. The traditional owners of the land within the area of study are the Darkinjung people. Historical records indicate that the traditional lands of the Darkinjung are bounded by the Hawkesbury River floodplain to the south, the Hunter River floodplain to the north, the Pacific Ocean to the east and Watagan mountains to the west (Ford, 1939; Darkinjung Local Aboriginal Land Council, n.d). The land surrounding Brisbane Water and its tributaries are of cultural significance to the Darkinjung and Guringai people (Central Coast Council, 2018). The traditional lands of the Darkinjung are bordered by the Awabakal to the north east, the Wonnarua to the north, the Daruk to the south west and Guringai to the south. (Tindale, 1974). There were likely zones that were utilised by both the Darkinjung and neighbouring groups (DLALC, n.d). The Darkinjung were speakers of the Darkinjung (Darkinyung) language. Much of what we know today about this language comes from field reports by Robert H Matthews and W.J. Enright. These texts have been used to research and revitalise the language.

The Darkinjung have social systems or relationship rules that are the same or very similar to many other groups throughout NSW including the Wiradjuri, Kamilaroi, Wanggaybuwan, Wayilwan and Ngiyambaa. Matthews documented Darkinjung relationship rules. They consist of two moieties (blood) divide into four sections (skin/meat). They are known as Ippai, Ippatha Bya, Matha Kumbo, Butha Kubbi, Kubbitha. One person could have many totems.

Some of the documented totems for Bya and Kubbi include, the Scrub Opossum (Possum), Native bee, Emu, Bandicoot, Eaglehawk, stingaree and Wallaroo.

Some of the documented totems for Ippai and Kumbo include, Grey Kangaroo, Diamond Snake, Wombat, Black Snake, Wallaby.

It is important to remember that much of this history has been recorded by European colonists and consider how their biases may have influenced these records.

4.2.2 Aboriginal Occupation of the Central Coast – Archaeological Background

Aboriginal occupation in the area has been dated to 11,000 years before present which precedes the rise of sea levels around 6000 years before present (Attenbrow, 2006, p. 8). This date comes from a rockshelter site in Mangrove Creek, 20 km North West of Gosford. Due to the limitations in dating techniques, this figure may be even older.

There are a variety of site types found in Darkinjung country, including grinding grooves, art sites, artefacts, water holes, modified trees, and Dreaming sites.

Grinding grooves were important to stone tool maintenance and food preparation. Grinding grooves are commonly found in sandstone sheets associated with creeks and water holes. Water was needed to be able to sharpen stone tools on the sandstone.

Art sites often take the form of rock engravings in Darkinjung country. These engravings were usually made on flat sandstone sheets and represented hundreds of spiritual figures including ancestral beings (sky heroes) and a wide range of animals and objects and normal-sized human beings. There is very little historical accounts of their use, as it appears they were mainly used for ceremonial activities and thus under Aboriginal custom their use was not openly discussed. The oldest of these art sites in Darkinjung country has been dated to 4000 years old (Taçon, et al., 2007).

Shields were often made from the buttress of the giant nettle tree (Dendrocnide excelsa) or fig tree (ficus spp). Usually about 1 m long and 0.5 m wide, with a handle on the inner side and soft paperbark padding. Bark was also removed to make vessels for food. Hardwood Eucalypt species were important for hunting sticks, throwing sticks, digging sticks, boomerangs and clubs. Although these types of artefacts are unlikely to survive due the nature of the organic material, the modifications made to trees for their creation can survive as they often left a distinctive scar on the tree.

4.2.3 Aboriginal Heritage Information Management System (AHIMS)

The AHIMS database was searched on 20 December 2019 from Latitude -33.4553 to -33.436 and Longitude 151.2827 to 151.306. The search identified 92 sites and 2 Aboriginal Places. The AHIMS sites were plotted according to the latitude and longitude co-ordinates in the extensive search.

Majority of the sites in the AHIMS search are associated with sandstone formations such as rock engravings, art, rock shelters and grinding grooves. There are 62 (67.39%) art sites. This includes rock engravings and other art sites where it hasn't specified whether they are painted or engraved. There are 11 (11.96 %) grinding grooves sites and 9 (9.78%) sites include both grinding grooves and art. In total sites associated with sandstone account for 88.52% of all sites.

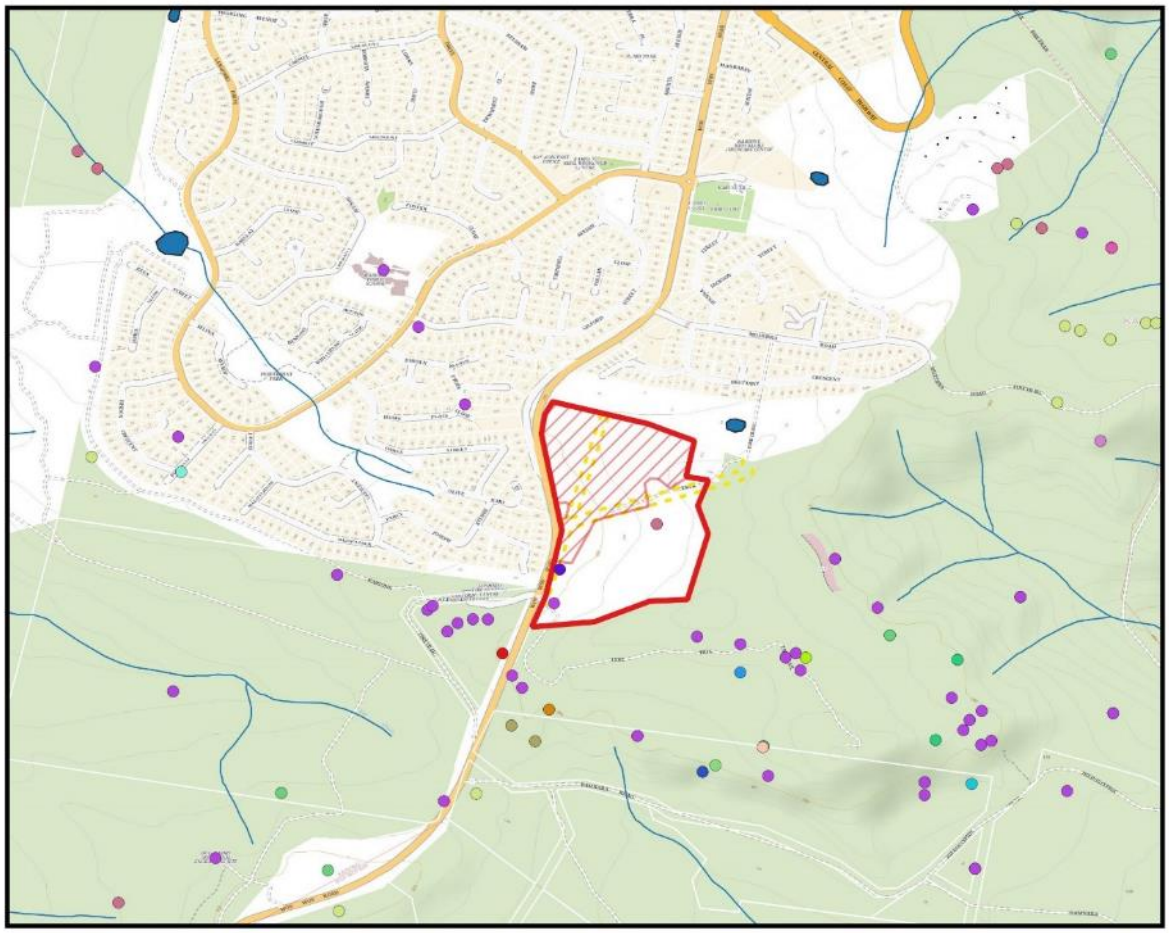
Grinding groove sites tend to be in close proximity to the streams, where art sites occur near by water sources as well as at higher elevations, towards the ridgelines.

Table 3 AHIMS Site Types

Site types	Number	Percent
Rock Engraving	50	54.35%
Art (Pigment or Engraved)	10	10.87%
Axe Grinding Groove	7	7.61%
Axe Grinding Groove, Rock Engraving	6	6.52%
Stone Arrangement	3	3.26%
Axe Grinding Groove, Rock Engraving, Shelter with Art	3	3.26%
Artefact Scatter	2	2.17%
Isolated Find	1	1.09%
Grinding Groove / Water Hole	1	1.09%
Art (Pigment or Engraved) / Water Hole	1	1.09%
PAD	1	1.09%
Water Hole/Well	1	1.09%
Rock Engraving, Stone Arrangement	1	1.09%
Grinding Groove / PAD	1	1.09%
Water Hole	1	1.09%
Axe Grinding Groove, Water Hole/Well	1	1.09%
Aboriginal Ceremony and Dreaming	1	1.09%
Grinding Groove	1	1.09%
Grand Total	**92**	**100.00%**

Two Aboriginal places were identified in the AHIMS search, but are not in the Project Area, a summary of these places are provided as they emphasise the importance of the locality for Aboriginal people. The area immediately south of the Project Area is recognised as an Aboriginal Place and is listed as Kariong Sacred Land. The area of approximately 66 ha is noted for its numerous rock engravings as well as its role as a traditional meeting place and centre for learning and ceremony. It continues to be used as a place of education as elders run a 'bush schoolroom' on site to teach the younger generations about Aboriginal history, traditional stories, how to interpret the engravings and rock paintings, and about traditional practices such as collecting and using bush foods and natural medicines that abound the area (Office of Environment and Heritage, 2015).

Bulgandry Art Site is located south west of the Project Area and is listed as an Aboriginal place. It is also listed as an AHIMS site #45-3-0450. The site includes many impressive rock engravings and is a traditional ceremonial place of the Darkinjung people (Office of Environment and Heritage, 2015).



Legend

- Project Area
- Impact area
- Transmission line easements

Kariong AHIMS Search

- Aboriginal Ceremony and Dreaming
- Art (Pigment or Engraved)
- Art (Pigment or Engraved) / Water Hole
- Artefact Scatter
- Axe Grinding Groove
- Axe Grinding Groove,Rock Engraving
- Axe Grinding Groove,Rock Engraving,Shelter with Art
- Axe Grinding Groove,Water Hole/Well
- Grinding Groove
- Grinding Groove / PAD
- Grinding Groove / Water Hole
- Isolated Find
- PAD
- Rock Engraving
- Rock Engraving,Stone Arrangement
- Stone Arrangement
- Water Hole
- Water Hole/Well
- hydroline
- hydroarea

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Figure 2 AHIMS Search Results

4.2.4 Sites within the Project Area

There are three AHIMS sites are located within the Project Area. AHIMS# 45-3-3052 is a water hole/well, AHIMS #45-3-3043 is a rock engraving and AHIMS #45-3-3044 an axe grinding groove site.

A previous survey of the Project Area by David Pross for DLALC identified twelve sites. However, these sites are not registered in the AHIMS database and so did not come up in the AHIMS search. There are ten sites identified by Pross within the Project Area.

Including the AHIMS sites, there are 13 known sites within the Project Area. The details are provided in Table 4.

Table 4 Summary of sites within the Project Area

Site code	Site Type	Description
WW1	Rock Engraving: Mondo	A 9 centimetres engraved circle with stone pecking
WW2	Water Pools with channels	Near WW1 on large rock platform near boundary of Lot 512 and 513
WW3	Rock Engraving: Mondo	Mondo 25 x 29 centimetres on edge of rock platform towards the middle of transmission line
WW4	Stone Arrangement	A pile of sandstone rocks that are flattish on two sides and placed in a slightly semi circular pattern 3 x 1 metres an 0.75 metres high. Possible burial site
WW5	Rock Engraving: Mondo	An irregular circle engraved on the rounded face of the platform wall 20 x 13 centimetres.
WW6	Water Hole	A very deep vegetation filled depression with channels, diameter 7.25 metres and 60 centimetres deep
WW7	Fire Places and Oven	Several fire circles identified on platform and possible oven
WW8	Rock Engraving: Arc/Crescent	A crescent shape etched in a sandstone outcrop 60 centimetres long and with half radius of 20 centimetres. The groove contained 1 centimetre of water
WW9	Rock Engraving: Circle Arrangement	Two circles joined together facing east-west 75 centimetres in diameter and 1.5 in total length. To the north of these is a ring of seven small circles, each 11 centimetres in diameter. The total diameter of the ring of circles is 2 m. The purpose of the arrangement is unclear
WW10	Basin carved into a platform	A basin containing water measuring 4 x 1.5 metres with 1.5 metres depth. Evidence of pecking, suggesting it was dug out of the sandstone
45-3-3043	Rock engraving	A series of pits scattered across the surface of a sandstone platform.
45-3-3044	Grinding groove	A channel 2.65 metres long and 3 centimetres wide, surrounds a pot hole
45-3-3052	Water hole/well - Mundoe pits	Contains mundoe pits

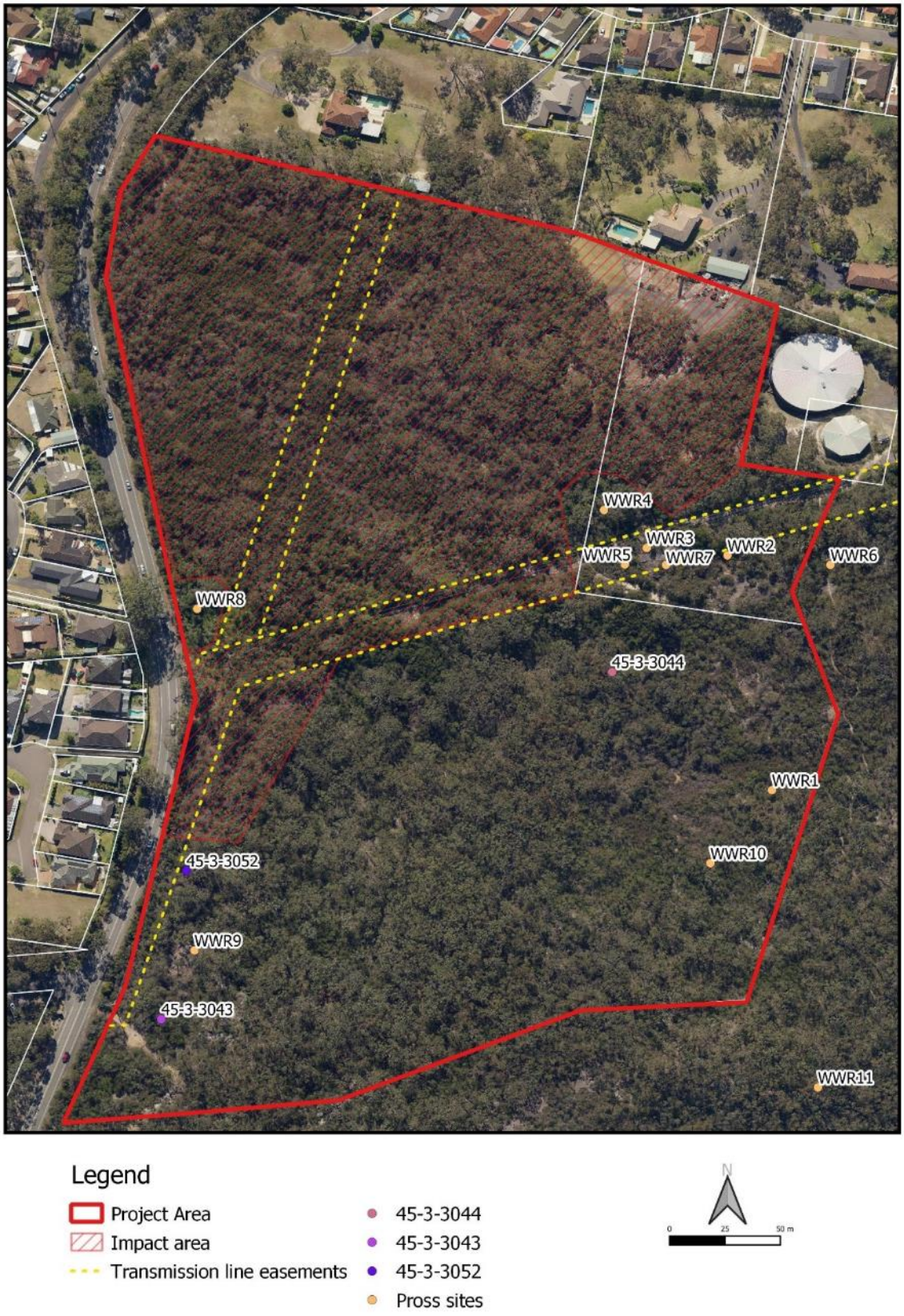

Figure 3: Aboriginal sites within the Project Area

4.2.5 Heritage Report Summaries

Heritage reports relevant to the Project Area have been summarised in this section to provide an understanding of the previous assessments that have been undertaken and the implications for Aboriginal site patterning.

Pross 2007 Preliminary Archaeological Heritage Assessment: Lot 512 and Lot 513 in DP 7552517 Woy Woy Road Kariong

Pross undertook an archaeological survey through the Project Area for DLALC in 2007. The survey identified 11 sites. All sites were associated with sandstone and including six rock engravings, two stone arrangements, a water hole, a carving for an oven and carvings for use as a water basin (Pross, 2007, pp. 13-14). Pross recommended for further investigation of the area including night recordings (Pross, 2007, p. 15). No works were planned at time of the survey however, it was recommended that if there were any future works that a cultural heritage officer be present (Pross, 2007, p. 15).

Roberts and Pross 2008 Archaeological Assessment Bambara Road Kariong

An archaeological assessment was completed for lots 229, 4712, 251, 2501, 2502, and 478 Bambara Road, 350 m south of the Project Area. The survey identified 12 site complexes which included rock engravings, rock shelters, grinding grooves and stone arrangements. Two previously recorded AHIMS sites were identified AHIMS #45-3-028 and #45-3-0496. Four others were noted in the database as being within the project area but were not located during survey. It is possible they could have been covered by soil or incorrectly recorded in AHIMS. It was recommended that no developments occur above the 170 m contour line in the northern area of lot 2501 as there are significant and culturally sensitive sites in the area (Roberts & Pross, 2008, p. 87).

Biosis 2008 Archaeological Survey – Kangoo Road to Langford Drive, Kariong

Biosis surveyed a 150m long area with a 50 m buffer zone for a proposed road alignment between Kangoo Road Langford Drive,1.5 km north west of the Project Area. They did not identify any Aboriginal sites, but they did note exposed sandstone in the creek with a natural pothole which potentially was a source of drinking water in drier seasons (Biosis, 2008, p. 30). Sandstone was of a high enough quality that it could have been utilised for Aboriginal engraving or grinding purposes, although no evidence of this was identified by the survey. The tributary that the sandstone and potholes were identified with is the southern portion of the stream that runs through the current Project Area. It is possible that similar quality sandstone exists in the current Project area but has been covered by silt as noted by JMCHM (1997, p. 12).

Drew 1994 Archaeological Assessment Woy Woy Road, Kariong

An archaeological survey was conducted on Woy Woy Road in Kariong, immediately west of the Project Area. The survey identified 5 sites. This included a previous recording of an engraving of a fish (AHIMS #45-3-1293). Another previously recorded rock engraving site found was also of a fish (AHIMS #45-3-0705) however it appeared to have been weathered significantly since its last documentation. Another site included rock engravings of two emus (AHIMs #45-3-0470). Previous recordings of the site identified further figures, though they appear to have been weathered of covered by lichen. Drew describes the site as being on the west side of Woy Woy Road, but Dallas (1981) records it as being on the eastern side. A previous recording of a kangaroo was also identified (AHIMS #45-3-2413). One never previously documented site was identified, referred to as a

'mythological site' (Drew, 1994, p. 8). Consultation with Aboriginal community identified an area of Aboriginal tradition and ceremony. The site is situated at the south eastern side of the track junction, 250 m down the east-west fire trail from Woy Woy Road. The rock platform curves around the east to the second fire trail. The whole area is approximately 40 m East-West and 50 m North-South. It was recommended for all of these sites to be protected.

Dallas 1981 Archaeological Survey and Rockshelter Excavation - Kariong

Dallas (1981) surveyed a three square kilometre area in Kariong, including the western portion of the Project Area along Woy Woy Road. Thirteen Aboriginal sites were identified mainly comprising engravings (8), three rockshelters (3), an axe-grinding groove site (1) and an isolated find (1). One historic site comprising the collapsed chimney of a house was also identified. Four chert artefacts were excavated from a 50 centimetres x 50 centimetres trench in Whale Shelter 1 (AHIMS#45-3-1290) (Dallas, 1981, pp. 11-13) and was identified as a location warranting further research. If the listed location in AHIMS is correct it appears that this shelter was destroyed in the subdivision of suburb of Kariong.

4.2.6 Predictive Model

The most common Aboriginal archaeological sites are predicted to be those associated with sandstone outcrops, especially rock engravings and grinding grooves.

Rock engravings are the most common site associated with sandstone, accounting for over 75% of all Aboriginal archaeological sites in the area. Majority of sites occur at elevations above 150 m AHD where the land transitions from steep hills to ridge lines. One site occurs as low as 90 m, however this site is also associated with a grinding groove site, which frequently occur near lower lying creek lines.

Grinding grooves result from the sharpening of ground stone axes/hatchets. To sharpen a stone axe/hatchet the hafted stone piece is ground into the sandstone using water as a lubricant. Often grinding grooves are within or directly adjacent watercourses, as these supplied water for grinding. Majority of the grinding grooves in the area can be found at first order streams or in close proximity to wells and waterholes. However, there are a several outliers to this pattern with many over 50 m away from a water source, and some up to 250 m. This may be due to waterholes being present in the sandstone sheets which may have provided a source of water for grinding. AHIMS #45-3-3044 is a grinding groove within the Project Area. Based on the AHIMS site card this site is located alongside an ephemeral drainage line, unmarked on topographic maps, this may be the case for other sites that appear far from creek lines. AHIMS #45-3-3395 is the furthest grinding groove to a water source. This site however is both a grinding groove and a potential archaeological deposit and is a rare site.

Water holes are also documented in the area, including within the Project Area. All of these occur at high elevations above 190 m AHD.

Surface stone artefact sites (isolated finds and artefact scatters) are rare in the area. There is a concentration of them around Bambara road, however this is likely a reflection of detailed survey being completed in the area, as well as the low detection of these sites where ground surface visibility is low.

Based on the environmental and heritage information available it is predicted that Aboriginal sites associated with sandstone would be most likely within the Project Area, this could be in the form of rock engravings or grinding grooves or rockshelters or stone arrangements depending on the nature of the outcropping sandstone. Grinding grooves are most likely to occur along the ephemeral drainage line running west to east in the centre of the Project Area, where engraving sites are more likely to occur on the ridge line in the north section of the Project Area. There is moderate potential for surface artefact sites (artefact scatters/isolated finds) throughout the Project Area.

4.3 Archaeological Survey

The archaeological survey was undertaken on 17 March 2020 by Heritage Now Principal Consultant Tessa Boer-Mah along with Amanda Shields of Darkinjung Local Aboriginal Land Council and Tracey Howie of Awabakal Traditional Aboriginal Owners Corporation. The survey focussed on the northern portion of the Project Area which is to be impacted.

4.3.1 Survey Unit

The survey unit comprised an upper slope landform, it was higher in the east than in the west. The area was primarily vegetated bushland. Exposures occurred along access tracks associated with the electricity easements and near the residential development areas in the north (Plate 1 and Plate 2). Overall, ground surface exposure was 10% and ground surface visibility was 15%.

The surveyed area contained sandstone outcropping throughout (Plate 3 and Plate 4). Not all of the sandstone was suitable for engravings (Plate 5). Vegetation included candle-stick banksia (Plate 6), grass trees, stringy bark and gum trees (Plate 7). One previously recorded AHIMS site was ground-truthed; AHIMS #45-3-3044. One previously unrecorded site was identified HN-WW-E01.

Survey Unit Summary

The Project Area was surveyed in using one survey unit as it was all an upper slope landform (Figure 4, Table 5).

Table 5 Survey Coverage

Survey Unit	Landform	Survey Unit Area	Visibility %	Exposure %	Effective Coverage Area (m^2)	Sample Fraction (%)	Number of Sites Identified
1	Upper Slope	83704	15%	10%	1255.56	2%	2

4.3.2 Aboriginal Sites Identified/Ground-truthed

Aboriginal sites within 40 metres of the impact area were inspected.

AHIMS #45-3-3044 was identified, however it is located approximately 70 metres north west of its recorded location in the AHIMS database. It contains a rock engraving, consisting of two channels that meet around a 30 centimetres diameter pit (Plate 8, Plate 9 and Plate 10). This pit in the sandstone is presently filled with vegetation. It is located outside the impact area.

Site WWR4 (not registered on AHIMS) was identified by Pross (2007) as a stone arrangement. This location was ground-truthed, but was highly vegetated (Plate 11) and the stone arrangement was not identified. It is possible that has been obscured by vegetation.

Site WWR8 (not registered on AHIMS) was identified by Pross (2007) as a rock engraving. The ground-truthing of this general area showed that it was part of an informal drainage line and was partially inundated, there was not outrcropping sandstone in this area. The description of this site as being near WWR7 which is located in the eastern portion of the Project Area and is likely located in the east. It is very unlikely that it located at it recorded location in the western part of the Project Area.

WWR2 (not registered on AHIMS) was identified by Pross (2007) as water pools with channels, this location was inspected, but the site was not observed.

WWR3 (not registered on AHIMS) was identified by Pross (2007) as an mondo (elipse) engraving 25 x 29 centimetres. This site was not identified during the survey.

WWR5 (not registered on AHIMS) was identified by Pross (2007) as an irregular circular engraving on the rounded face of the platform wall. This feature was not identified during the survey.

WWR7 (not registered on AHIMS) was identified by Pross (2007) as comprising fire circles identified on platform and possible oven, these features were not identified during the survey.

The location of AHIMS#45-3-3052, a waterhole/well with engravings was also inspected but was not identified.

A previously unrecorded site, HN-WW-E01, was identified 20 metres west of 45-3-3044. It is located 15 metres south of the fire trail, approximately 350 metres along the fire trail from Brittany Crescent. It contains two mundoes, 1.2 metres apart alongside a waterhole (Plate 12-Plate 14).

The Pross (2007) report does not contain photographs of the sites and the co-ordinates are not consistently recorded in the same datum, some of the site descriptions do not match the reported coordinates; hence it is very difficult to discern the nature and location of the Pross sites. For the purposes of this assessment the coordinates reported by Pross are taken to be their location.

4.3.3 Archaeologically Sensitive Sandstone Sheets

Sandstone sheets were identified throughout the Project Area. The soil, vegetation and lichen covering the sheets was too thick to adequately determine if they contained engravings or grinding grooves and thus have been identified as being archaeologically sensitive. There is potential that vegetation clearance will uncover more sandstone sheets.

4.3.4 Aboriginal Consultation

Tracey Howie from Awabakal Traditional Owners Aboriginal Corporation and Amanda Shields from Darkinjung Local Aboriginal Land Council attended the archaeological survey. Both agreed that the site identified was AHIMS#45-3-3044 based on the previous recordings and that the other sandstone sheets should be inspected once vegetation was removed.

4.3.5 Summary

AHIMS#45-3-3044 was ground-truthed and identified to be approximately 70 metres north west of its recorded location in the AHIMS database. The location of AHIMS#45-3-3052 was inspected, but the site was not observed. Two Aboriginal sites within 20 metres of the impact area, as yet unregistered on the AHIMS database (WWR4 and WWR8) were ground-truthed, but not identified at their recorded locations. In the case of WWR4, dense vegetation may have obscured the site. For WWR8 the recorded location of this site when ground-truthed was within a drainage channel, with no outcropping sandstone, thus the recorded location is likely incorrect and it is located in the eastern part of the Project Area (which also aligns with the stated site description). WWR3, WWR5 and WWR7 also unregistered Pross sites were also not observed during the survey. A previously unrecorded site, HN-WW-E01, was identified and contained two mundoe engravings near a waterhole. In addition, archaeologically sensitive sandstone sheets were identified which were too obscured to positively identify if they contained Aboriginal engravings or grinding grooves.

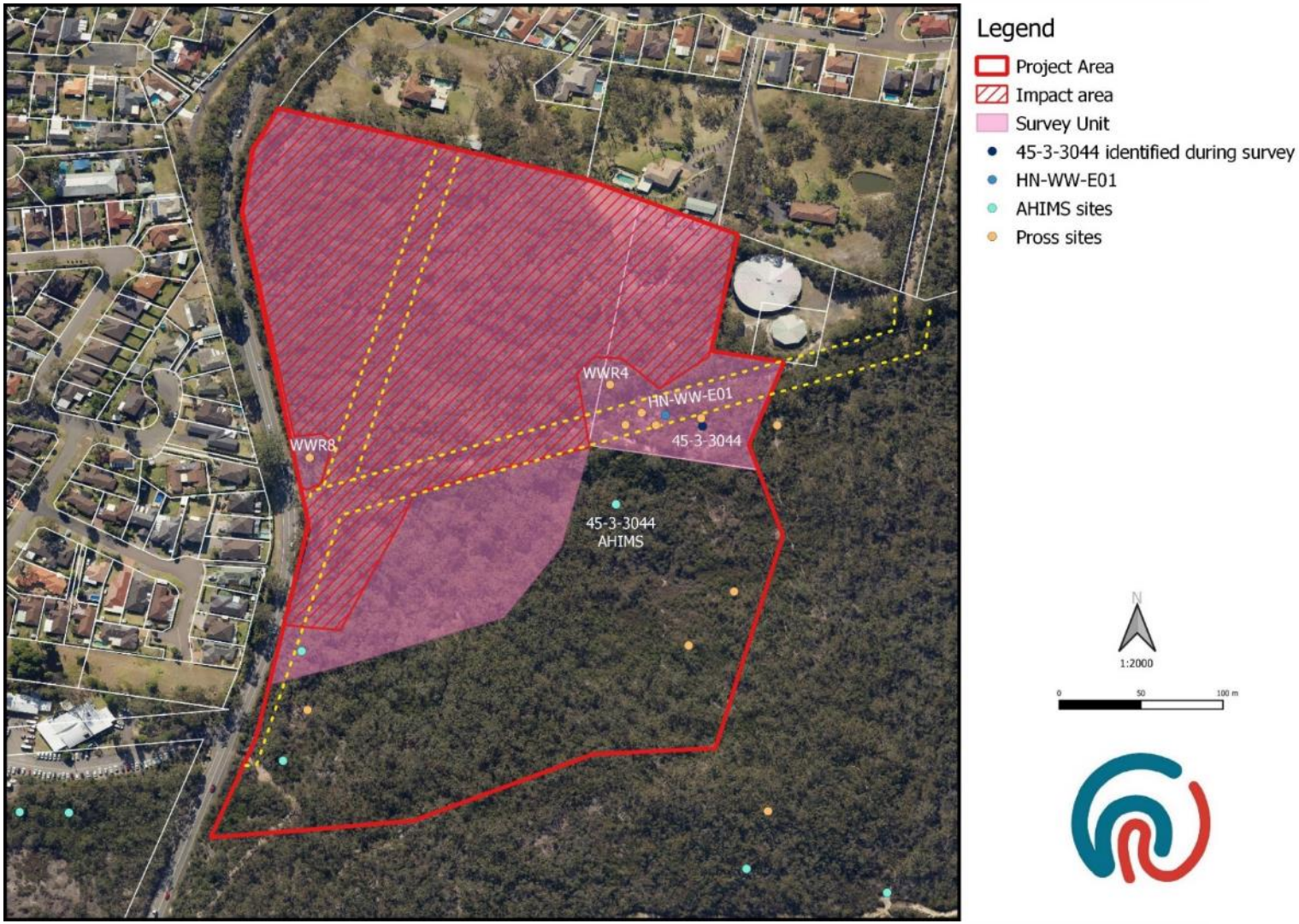

Figure 4: Kariong Survey Area

5 Significance Assessment and Aboriginal Cultural Values

Cultural heritage refers to the tangible and intangible values that we choose to pass on to future generations. In order to identify the values worth passing on, a significance assessment needs to be undertaken. The significance assessment needs to: identify the range of values present across the Project Area and assess their importance.

5.1 Methodology

Identifying the Aboriginal cultural values is part of the significance assessment process and is guided by the Burra Charter and the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW.*

There are four recognised classes of values under the Burra Charter (Australia ICOMOS, 2013):

- Social,
- Historical,
- Aesthetic, and
- Scientific

Within this significance assessment, Aboriginal cultural values are captured within social, historical and aesthetic values. The archaeological values are contained within scientific values.

Social value refers to the spiritual, traditional, historical or contemporary associations that Aboriginal people have for place. Historical value refers to the associations of a place with a historically important person, event, phase or activity in the Aboriginal community. Aesthetic value refers to the sensory, scenic, architectural and creative aspects of the place.

Archaeological values refer to the importance of the landscape, area, place or object because of its rarity, representativeness and the extent to which it may inform our understanding of Aboriginal culture.

5.1.1 Aboriginal Cultural Values

Aboriginal cultural values are identified through the Aboriginal consultation process. Formal opportunities for the Aboriginal community to contribute to identifying cultural values are provided in the ACHA methodology review period, during fieldwork and during the draft report review period. In addition, RAPs are invited to provide feedback at any time through the consultation process, by phone or in writing (email or letter).

5.1.2 Archaeological (Scientific) Values

Archaeological (scientific) values relate to whether the Project Area can contribute to our understanding of Aboriginal culture. Under the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW*, archaeological values are to be considered within the below sub-categories:

- Representativeness,
- Rarity,

- Research potential, and
- Educational potential.

5.2 Aboriginal Cultural Values of the Project Area

Feedback during fieldwork from Amanda Shields and Tracey Howie was that the sites were of high importance to Aboriginal people.

5.3 Archaeological Values of the Project Area

This section assesses the archaeological values of the Project Area according to the criteria in the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW*.

5.3.1 AHIMS#45-3-3044 and HN-WW-E01

AHIMS#45-3-3044 and HN-WW-E01 are representative of sandstone engraving sites associated with the Aboriginal occupation of the local area. The site type is not rare, with majority of sites identified in the area being engravings on sandstone formations. The sites have local research value as it is part of a cultural complex in this area and they were likely used for Aboriginal ceremony. These sites have high local educational value as tangible evidence of Aboriginal art and ceremony, although there are more extensive sites with higher interpretation value on a regional scale. Overall, both sites are of high local and moderate regional significance.

5.3.2 AHIMS#45-3-3052, WWR3, WWR4, WWR5, WWR7 and WWR8

These sites were not identified during the survey and thus an assessment of significance cannot be made.

5.3.3 Archaeologically Sensitive Sandstone Sheets

There are numerous sandstone sheets partially covered in soil and/or vegetation throughout the impact area which have potential for Aboriginal grinding grooves and/or engravings and thus have been identified as being archaeologically sensitive. An assessment of significance cannot be made at this time, as they were obscured by soil and vegetation.

5.4 Summary

AHIMS#45-3-3044 and HN-WW-E01 were identified to be of high local significance and moderate regional significance. The significance of remaining Aboriginal sites could not be assessed, as they were not located during the survey. A significance assessment of the archaeologically sensitive sandstone sheets could not be made, as they were obscured by soil and vegetation.

6 Impact Assessment and Mitigation

This section assesses the potential impact of the proposed works in relation to Aboriginal heritage values in the Project Area and provides options for mitigating loss of Aboriginal cultural values.

6.1 Proposed works

The proponent plans to develop the northern part of the Project Area for residential purposes. The residential development will involve clearing of vegetation as well as cut and fill to prepare the Project Area. It will require the installation of below and above ground services including water and sewer, telecommunications and electricity. It will also require the formation of roads and access ways to the residential lots as well as the building of individual residences.

6.2 Impact Assessment

This section addresses the potential impacts to Aboriginal cultural values as result of the proposed works.

6.2.1 Aboriginal sites (AHIMS#45-3-3044, HN-WW-E01, WWR3, WWR4, WWR5, WWR7 and WWR8)

The AHIMS site identified during survey (AHIMS#45-3-3044) showed that it was not the location registered in AHIMS. This site is outside the impact zone and is 10 metres south of the marked electricity easement and 16 metres south of the existing vehicle track associated with the electricity poles.

HN-WW-E01, WWR3, WWR5 and WWR7 are within the marked electricity easement, but are 8-20 metres south of the electricity easement access track and are on raised sandstone sheets.

A 20 metre buffer zone has been placed around WWR4 and WWR8. Vegetation clearance, ground disturbing works and construction is required to occur outside this zone.

AHIMS#45-3-3052 is 17 metres south of the project area based on its AHIMS recorded location, the site was not observed during the survey.

The sites (AHIMS#45-3-3044, AHIMS#45-3-3052, HN-WW-E01, WWR3, WWR4, WWR5, WWR7 and WWR8) are outside the direct impact zone for the proposed development, however given their proximity to the impact zone boundary there is potential for inadvertent impacts to occur.

6.2.2 Archaeologically Sensitive Sandstone Sheets

Archaeologically sensitive sandstone sheets were identified throughout the Project Area. There is also potential that more sandstone will be identified as land is cleared for the proposed residential development. These sandstone sheets have potential to be impacted by earthworks, particularly in parts of the Project Area where cut is required.

6.3 Mitigation

The below strategies have been developed to mitigate harm and/or loss of Aboriginal cultural values as a result of the proposed works.

6.3.1 Aboriginal sites AHIMS#45-3-3044, HN-WW-E01, WWR3, WWR5 and WWR7

These sites are outside the impact zone for the development. They are located on sandstone sheets which are very visible. The potential for inadvertent impacts can be reduced by clearly demarcating their locations on construction plans and communicating that the sandstone sheets to the south of the electricity access track are not to be accessed.

6.3.2 Aboriginal Sites AHIMS#45-3-3-52, WWR4 and WWR8

A buffer zone of 17-20 metres has been allowed for around these sites. To ensure they are not accessed or inadvertently impacted during construction. High visibility barrier fencing will need to be installed prior to works commencing and remain in place until works are complete.

6.3.3 Archaeologically Sensitive Sandstone Sheets

Partially obscured sandstone sheets occur throughout the Project Area, once vegetation is removed, any sandstone sheeting is to be inspected and if necessary, soil removed by machine or hand under the supervision of a heritage consultant and a representative of the RAPs. The sandstone sheets are then to be inspected to identify if they contain Aboriginal engravings or grinding grooves. If Aboriginal engravings, grooves or other site type is identified during this process, then mitigation and management measures are to be identified and implemented in consultation with the RAPs.

6.3.4 General mitigation strategies

The four Aboriginal sites are to be clearly marked on all relevant construction drawings, along with buffers and fencing, as relevant.

All on-site personnel are to be made aware of their obligations under the National Parks and Wildlife Act 1974, this includes protection of Aboriginal sites and the reporting of any new Aboriginal, or suspected Aboriginal, heritage sites. This may be done through an onsite induction or other suitable format.

6.4 Sustainable Development

Under the NSW *Protection of the Environmental Administration Act 1991* Ecologically sustainable development principles (ESD) are to be considered in the assessment of environmental impacts; and this includes impacts to heritage. The consideration of ESD principles is required under the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in New South Wales 2010.* In particular, the precautionary principle and the principle of inter-generational equity are to be considered where there are proposed impacts to the environment (which includes heritage).

6.4.1 Precautionary Principal

The precautionary principle states that if there are threats of serious or irreversible damage to the environment, then a lack of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

The proposed works will not impact the identified sites and therefore the works do not pose a threat of serious or irreversible damage to the environment. The mitigation measures have also addressed the potential for inadvertent impacts and provide excellent conservation outcomes for the Aboriginal sites.

6.4.2 Inter-generational Equity

The principle of inter-generational equity states that the present generation should ensure the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

The mitigation measures proposed will ensure that the Aboriginal sites are either conserved in-situ and avoided and thus satisfies the principle of inter-generational equity.

6.5 Summary

There are no Aboriginal sites within the impact area of the Project, however, archaeologically sensitive sandstone sheets have been identified. Aboriginal sites (AHIMS#45-3-3052, WWR4 and WWR8) within 20 metres of the impact area and thus fencing during construction is required to ensure there are no inadvertent impacts to these sites. AHIMS#45-3044, HN-WW-E01, WWR3, WWR5 and WWR7 are to be marked on construction maps as no-go areas along with AHIMS#45-3-3052, WWR4 and WWR8. Archaeologically sensitive sandstone sheets are to be inspected after vegetation removal.

All on-site personnel are to be made aware of their obligations under the National Parks and Wildlife Act 1974, this includes protection of Aboriginal sites and the reporting of any new Aboriginal, or suspected Aboriginal, heritage sites. This may be done through an onsite induction or other suitable format.

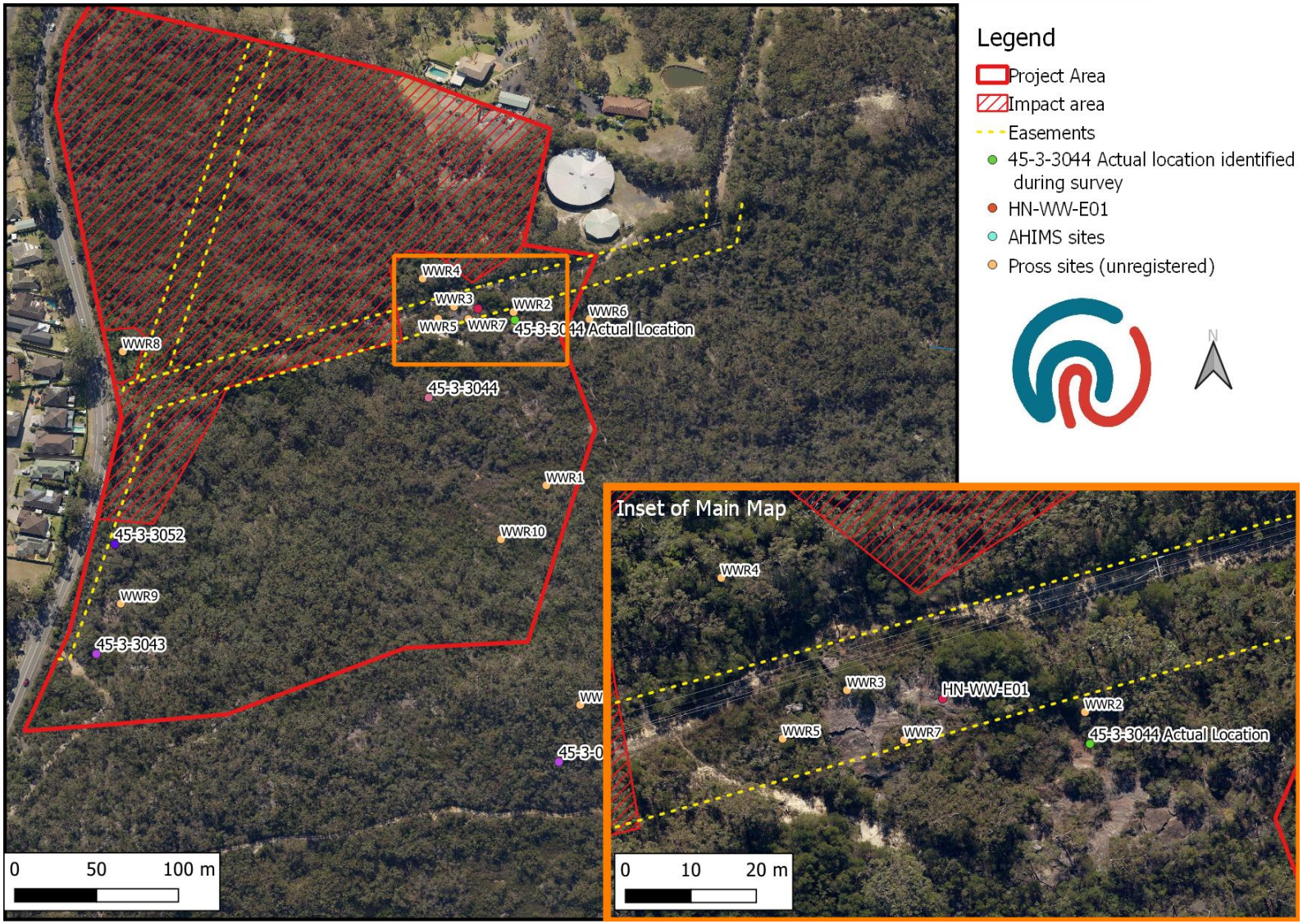

Figure 5: Impact Area with Aboriginal sites

7 Conclusions and Recommendations

The archaeological survey was undertaken on 17 March 2020 by Heritage Now Principal Consultant Tessa Boer-Mah along with RAP representatives: Amanda Shields of Darkinjung Local Aboriginal Land Council and Tracey Howie of Awabakal Traditional Aboriginal Owners Corporation. The survey focussed on the northern portion of the Project Area which is to be impacted.

AHIMS#45-3-3044 was ground-truthed and identified to be approximately 70 metres north west of its recorded location in the AHIMS database. The location of AHIMS#45-3-3052 was inspected, but the site was not observed. Two Aboriginal sites within 20 metres of the impact area, as yet unregistered on the AHIMS database (WWR4 and WWR8) were ground-truthed, but not identified at their recorded locations. In the case of WWR4, dense vegetation may have obscured the site. For WWR8 the recorded location of this site when ground-truthed was within a drainage channel, with no outcropping sandstone, thus the recorded location is likely incorrect and it is located in the eastern part of the Project Area (which also aligns with the stated site description). WWR3, WWR5 and WWR7 also unregistered Pross sites were also not observed during the survey. A previously unrecorded site, HN-WW-E01, was identified and contained two mundoe engravings near a waterhole.

In addition, archaeologically sensitive sandstone sheets were identified which were too obscured to positively identify if they contained Aboriginal engravings or grinding grooves, these were identified throughout the impact area.

AHIMS#45-3-3044 and HN-WW-E01 were identified to be of high local significance and moderate regional significance. The significance of remaining Aboriginal sites could not be assessed, as they were not located during the survey. A significance assessment of the archaeologically sensitive sandstone sheets could not be made, as they were obscured by soil and vegetation.

There are no Aboriginal sites within the impact area of the Project, however, archaeologically sensitive sandstone sheets have been identified. Aboriginal sites (AHIMS#45-3-3052, WWR4 and WWR8) within 20 metres of the impact area and thus fencing during construction is required to ensure there are no inadvertent impacts to these sites. AHIMS#45-3044, HN-WW-E01, WWR3, WWR5 and WWR7 are to be marked on construction maps as no-go areas along with AHIMS#45-3-3052, WWR4 and WWR8. Archaeologically sensitive sandstone sheets are to be inspected after vegetation removal.

All on-site personnel are to be made aware of their obligations under the National Parks and Wildlife Act 1974, this includes protection of Aboriginal sites and the reporting of any new Aboriginal, or suspected Aboriginal, heritage sites. This may be done through an onsite induction or other suitable format.

The works are to be undertaken in accordance with the below recommendations.

Recommendation 1

High visibility barrier fencing is to be erected along the buffer for Aboriginal sites AHIMS#45-3-3052, WWR4 and WWR8. The high visibility barrier fence is to be erected prior to construction and remain in place until the cessation of construction.

Recommendation 2

The archaeologically sensitive sandstone sheets are to be inspected by a RAP representative after vegetation removal, but before ground disturbance works and levelling to verify if they contain Aboriginal engravings or grinding grooves. If Aboriginal engravings, grooves or other site type is identified during this process, then mitigation and management measures are to be identified and implemented in consultation with the RAPs and a heritage consultant.

Recommendation 3

The eight Aboriginal sites are to be clearly marked on all relevant construction drawings, along with buffers and fencing, as relevant.

Recommendation 4

If Aboriginal engravings, grooves or other site type is identified during this process, then mitigation and management measures are to be identified and implemented in consultation with the RAPs and the heritage consultant.

Recommendation 5

All on-site personnel are to be made aware of their obligations under the National Parks and Wildlife Act 1974, this includes protection of Aboriginal sites and the reporting of any new Aboriginal, or suspected Aboriginal, heritage sites. This may be done through an onsite Aboriginal Cultural Heritage induction or other suitable format.

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Plates

Plate 1:Northern portion of survey unit

Plate 2: Example of exposure in northern portion of survey unit

Plate 3: Sandstone near northern Project Area boundary

Plate 4: Sandstone sheet south of fire trail

Plate 5: Low quality, coarse grained sandstone – not suitable for engraving

Plate 6: Thick vegetation covering sandstone, including banksia trees

Plate 7: Banksia, stringy bark and gum trees in Project Area

Plate 8: AHIMS 45-3-3044 with string facing south west

Plate 9: AHIMS 45-3-3044 facing north east

Plate 10: Close up of engraving at AHIMS #45-3-3044

Plate 11: Location of WWR4

Plate 12: HN-WW-E01 with string and marked by arrows, facing south

Plate 13: HN-WW-E01 without string, facing south

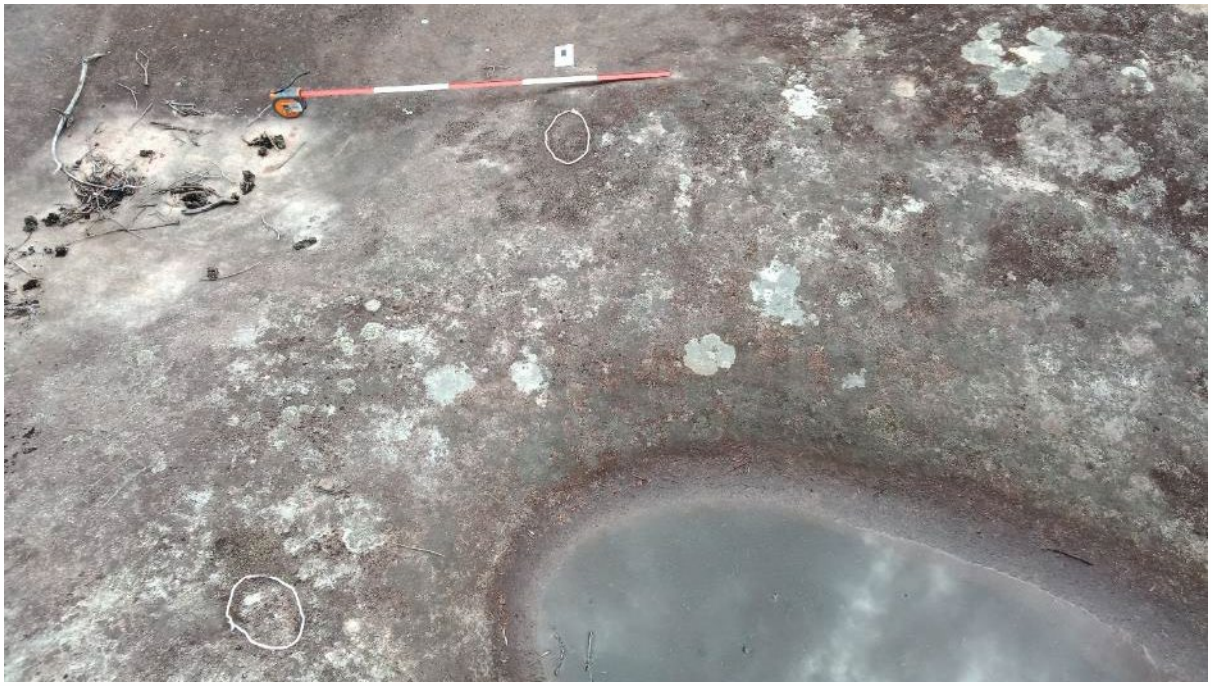

Plate 14: HN-WW-E01 with string, facing north

Appendix 1 Aboriginal Consultation

Appendix 2 AHIMS

SECAsolution
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19 May 2020

P1790 BRP Residential rezoning Kariong traffic advice

Barr Property & Planning
92 Young Street
Carrington NSW

Attn: Andrew Donald

Dear Andrew,

Traffic advice – proposed residential rezoning application, land off Woy Woy Road, Kariong

Further to your recent email, we have reviewed the information provided for the land off Woy Woy Road in Kariong as well as read through the previous traffic advice provided by Urbis for the project. We have also completed a site visit to review the existing road environment as part of the access review for the project. We would provide the following advice.

We note that Urbis had previously advised that the access should be reviewed in accordance with advice to be provided by Transport for NSW (formerly RMS). However, a review of the classified road network shows that Woy Woy Road is in fact an unclassified regional road and as such TfNSW do NOT need to review or provide any concurrence for the access under the Road Act. This should be emphasised to Council to ensure that this application is not sent to TfNSW. If Council do refer to TfNSW then TfNSW have no option but to review and provide advice which Council will then adopt. Schedule 3 of the Infrastructure SEPP 2007 also indicates that for a subdivision of land with less than 200 allotments or for the development of 300 residential dwellings, with access onto an unclassified road, there is no need for referral.

Existing situation

Woy Woy Road provides a single lane of travel in both directions in this location and operates under the posted speed limit of 60 km/h. The road pavement provides an overall width in the order of 7.5 metres, with no sealed shoulders or footpaths. There is no kerb and gutter provided and there are a number of access points along its length and further to the north there are residential lots with driveways with direct access to Woy Woy Road.

Traffic flows on Woy Woy Road are reasonably high during the commuter peaks as it provides an attractive route between Woy Woy and suburbs further south and the Central Coast Highway for connection to the M1 Pacific Motorway to the west of the locality. Woy Woy Road connects to the Central Coast Highway via a 3-way signal-controlled intersection that allows for all turn movements.

Photo 1 – View along Woy Woy Road showing typical cross section in the vicinity of the subject site (top of picture)

Proposed Development

The project seeks approval for a rezoning to allow for a residential subdivision allowing for up to potentially 50 residential lots. Access is proposed direct to Woy Woy Road only.

Based upon the Guide to Traffic Generating Developments, a residential development typically generates 0.71 trips per lot in the AM peak and 0.78 trips in the PM peak. For the potential lot yield of 50 this would give 36 trips in the AM peak and 39 in the PM peak. Daily traffic flows are typically 7.4 per lot per day providing 370 per day for the subject site (185 inbound and 185 outbound per day).

Access design

It is considered that the majority of the traffic movements associated with the project will be to / from the north, generating left turn movements into the site and right turn out. Commuter demands would primarily be towards the M1 Motorway or Gosford. Similarly, education and shopping are typically located to the north of the site and accessed via the Central Coast Highway. These traffic patterns will generate left turn movements into the site and corresponding right turn movements out. It is considered that the demands for left out and right turn in movements as such will be very low for the project.

Whilst no traffic data has been collected for this project, based on observations on site it is considered that a left turn deceleration lane will be required for the site access. Using the advice available within Austroads Guidelines the provision of an AUL (S) is considered appropriate for the traffic volumes associated with the project site. Given the low right turn demand for entering traffic, a BAR type intersection will be appropriate for the site, allowing for shoulder widening on the left hand side of the road to allow through traffic to pass a vehicle propped waiting to turn right into the site.

Site access location – Woy Woy Road

The potential location for the site has been reviewed on site, with regard to sight lines which are reliant upon the horizontal alignment of the road. Sight line requirements are important for road safety as well as to allow a driver to determine a suitable gap in the traffic stream when exiting the site.

The access location assessed by Urbis has been reviewed on site as well as the full frontage of the site to Woy Woy Road and it is considered that the location advised by Urbis (Attachment A) is appropriate, with sight lines at this point being consistent with the requirements of Austroads Guidelines. For the posted speed limit of 60 km/h the sight distance requirement is 114 metres minimum. The sight distance has been assessed on site and it is considered that this distance is available.

Photo 2 – View to right for a driver exiting the site onto Woy Woy Road.

Photo 3 – View to left for a driver exiting the site onto Woy Woy Road.

Crash Data

Road upgrades have been undertaken along Woy Woy Road in recent years to improve overall road safety.

A review of the crash data provided by TfNSW for the intersection of Woy Woy Road and Milyerra Road and 1 kilometre south indicates there have been four crashes in the five years October 2014- September 2019. Of these two had fatigue as a factor whilst one was at the intersection of Milyerra Road and the other was a vehicle running off the road during the day.

Allowing for the high traffic volumes in this area this indicates that the road layout within the vicinity of the site provides a safe road environment.

The provision of an additional access onto Woy Woy Road is unlikely to impact on the overall level of road safety in this location.

Alternative access to north

The access options to the north of the site have been assessed and whilst it can be seen that from a traffic perspective this would be a satisfactory approach, a review of Nearmap shows that access would be required across 3rd party land with associated restriction / cost. Connecting through to Milyerra Road would allow for access to Woy Woy Road via the seagull type intersection and it is considered that this access would have adequate capacity to cater for these additional traffic movements.

Based on the Central Coast Council Development Control Plan the following guidelines are provided for this access:

- Access Street – up to 40 dwellings, road reserve 15m allowing for 8m carriageway and 3.5m verges
- Collector Road – up to 200 dwellings, road reserve 18m allowing for 11m carriageway and 3.5m verges

Allowing for the subdivision to provide for up to 50 lots this road link may be required to be built as a collector road with a road reserve of 18 metres.

Conclusion

In conclusion, a review of the potential traffic generation and access requirements for the rezoning of the subject land indicate that access can be provided onto Woy Woy Road in a manner consistent with Austroads requirements. As such there are no impediments on access grounds to this rezoning.

Yours sincerely,

Sean Morgan
Director

Attachment A – Urbis Assessment October 2019

Figure 1 – Potential Site Access Locations

Base Map Source: NearMap