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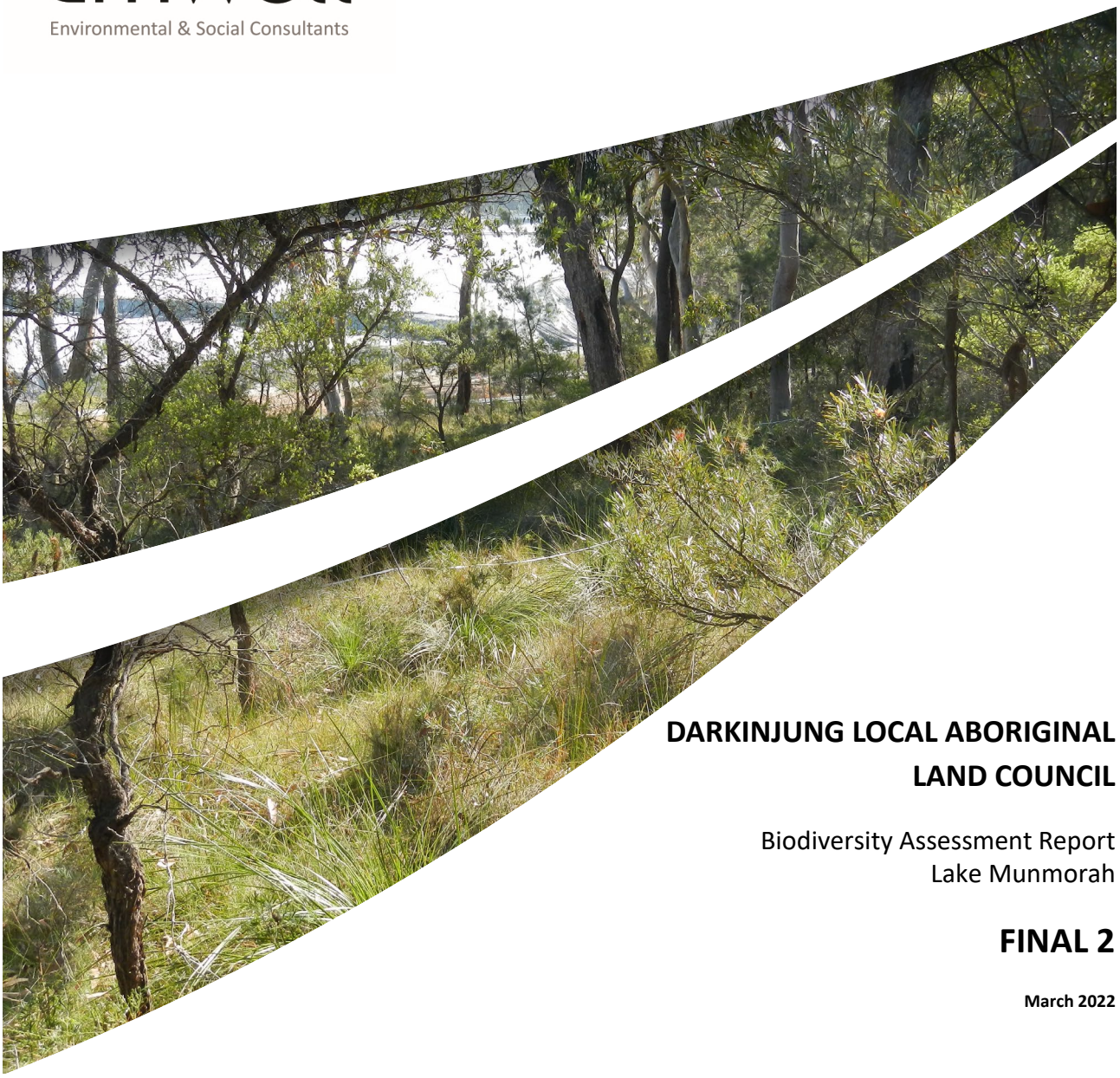

DARKINJUNG LOCAL ABORIGINAL LAND COUNCIL

Biodiversity Assessment Report
Lake Munmorah

FINAL 2

March 2022

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Biodiversity Assessment Report
Lake Munmorah

FINAL 2

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

Project Director:	Naomi Buchhorn
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Report No.	4567B/R01
Date:	March 2022

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
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Executive Summary

Darkinjung Local Aboriginal Land Council (Darkinjung LALC) has lodged a planning proposal for the rezoning and subdivision of a site located at part Lot 642 DP 1027231 and part Lot 100 DP 1044282, Lake Munmorah NSW, for the purposes of a residential housing development. Darkinjung LALC is seeking to have the proposed site rezoned from C3 Environmental Management and C2 Environmental Conservation to RE1 Public Recreation and residential zoned land (R1 General Residential and R3 Medium Density Residential) with the intent 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 at 405-415 Pacific Highway Lake Munmorah (Lot 642 DP 1027231) and 425 Pacific Highway, Crangan Bay (Lot 100 DP 1044282) in the Central Coast Local Government Area. The Development Footprint covers an area of approximately 34.7 hectares (ha) and is surrounded by a mosaic of intact native vegetation along Karignan Creek and national park estate to the north and south, and residential development of Lake Munmorah to the west and south and Chain Valley Bay to the north. The Pacific Highway separates the site from Munmorah State Conservation Area to the south and Chain Valley Bay Road dissects the two lots. Karignan Creek discharges into the waters of Lake Macquarie in Chain Valley Bay about one kilometre to the north west.

This Biodiversity Assessment Report (BAR) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) on behalf of Darkinjung to assess the potential biodiversity impacts of the proposed rezoning and subsequent development in accordance with the Biodiversity Assessment Method (BAM) and identify potential biodiversity credits required to offset the impacts.

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

- 23.0 ha of PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast (*Good Condition*).
- 1.9 ha of PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast (*Disturbed Condition*).
- 7.3 ha of PCT 1638 Smooth- barked Apple – Red Bloodwood – Brown Stringybark – Hairpin Banksia heathy open forest of coastal lowlands (*Good condition*).
- 1.4 ha of PCT 1724 Broad- leaved paperbark – Swamp Oak – Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North 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:

- 577 credits for PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast.
- 225 credits for PCT 1638 Smooth- barked Apple – Red Bloodwood – Brown Stringybark – Hairpin Banksia heathy open forest of coastal lowlands.
- 48 credits for PCT 1724 Broad- leaved paperbark – Swamp Oak – Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast.
- 36 credits for wallum froglet, 1407 credits for swift parrot and 857 credits for black-eyed Susan.

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:

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

Glossary

BAM	Biodiversity Assessment Methodology
BAR	Biodiversity Assessment Report
BC Act	NSW *Biodiversity Conservation Act 2016*
CEEC	Critically Endangered Ecological Community
Development Footprint	The total impact zone associated with the Project.
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DNG	Derived Native Grasslands
DPIE	Department of Planning, Industry and Environment
Ecosystem credit	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur in 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
PCT	Plant Community Type
PMST	Protected Matters Search Tool (EPBC Act)
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

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Appendices

1.0 Introduction

Darkinjung Local Aboriginal Land Council (Darkinjung LALC, Darkinjung) is seeking a residential rezoning and associated subdivision of part Lot 642 DP 1027231, 405-415 Pacific Highway, Lake Munmorah, and part Lot 100 DP 1044282, 425 Pacific Highway, Crangan Bay, New South Wales (NSW) (hereafter referred to as the 'Development Footprint').

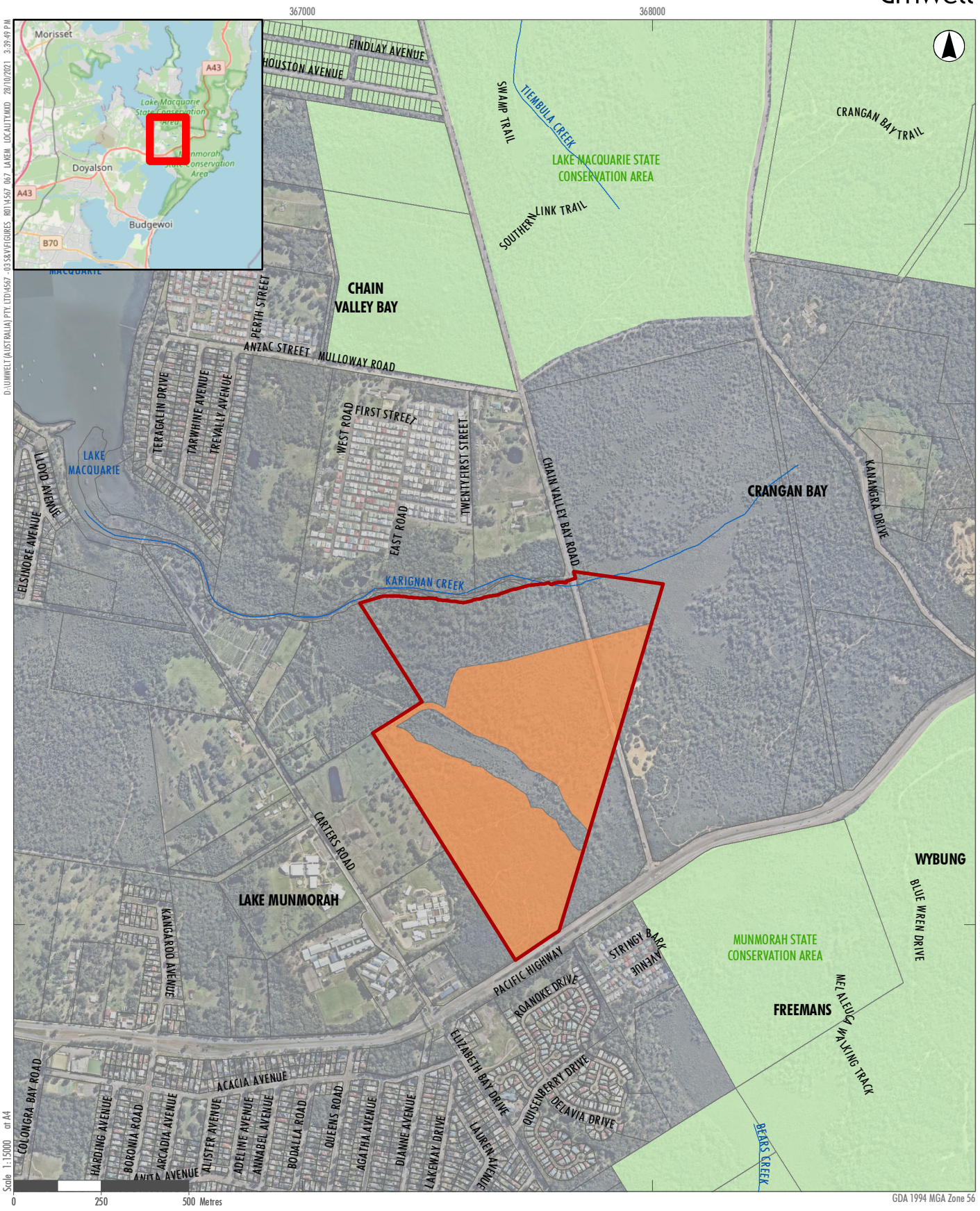
The Development Footprint is located either side of Chain Valley Bay Road, Lake Munmorah, (refer to **Figure 1.1**) near the intersection with the Pacific Highway in the Central Coast Local Government Area (LGA). The Development Footprint covers an area of approximately 34.7 hectares (ha) and is surrounded by a mosaic of intact native vegetation along Karignan Creek and in national park estate to the north and south, and residential development of Lake Munmorah to the west and south and Chain Valley Bay to the north. The multi laned Pacific Highway separates the Development Footprint from Munmorah State Conservation Area to the south and Chain Valley Bay Road dissects the two lots subject to rezoning. Karignan Creek discharges into the waters of Lake Macquarie in Chain Valley Bay about one kilometre to the north west.

Darkinjung LALC is seeking to have the proposed Development Footprint rezoned from C3 Environmental Management and C2 Environmental Conservation to RE1 Public Recreation and residential zoned land (R1 General Residential and R3 Medium Density Residential). The intent of the proposed rezoning is to provide for development of residential housing lots, and ancillary infrastructure such as internal roadways, sewerage, and stormwater management, while applying C2 zoning to areas of environmental significance.

GHD Pty Ltd (GHD) were previously engaged to conduct the ecological assessments for the Development Footprint and prepared a Biodiversity Certification Assessment Report in 2018 based on the original Development Footprint. The Development Footprint has since changed following re-zoning advice from the Department of Planning, Industry and Environment (DPIE) and advice from Umwelt (Australia) Pty Limited (Umwelt) in relation to maintaining a biodiversity corridor along Karignan Creek to the north of the residential area. The Development Footprint changed a third and final time in 2021 to accommodate a larger riparian corridor through the centre of the residential area along a tributary of Karignan Creek. This corridor avoids and minimises impacts to threatened ecological communities along the tributary. The development footprint, and previous footprints, are shown in **Figure 1.2**.

Umwelt were engaged by Darkinjung LALC to complete the remaining biodiversity surveys in 2019 and provide a Biodiversity Assessment Report (BAR) on the revised development footprint, building on the surveys undertaken for the GHD BAR prepared in April 2018.

This BAR has been prepared by 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* (BC Act). It provides the findings of the biodiversity assessment of the proposed rezoning and residential subdivision. It addresses the specific requirements of the BAM (DPIE 2020a) that may apply for either biodiversity certification and/or biodiversity development assessment report.



Legend

- Proposed Rezoning Extent
- Revised Development Footprint
- NPWS Estate
- Watercourses

FIGURE 1.1

Locality

Image Source: Nearmap (2020) Data source: NSW LPI (2019); DSFI (2017)

Legend

- Proposed Rezoning Extent
- Current Development Footprint
- Revised Development Footprint
- Original Development Footprint
- C2 Zone
- Watercourses

FIGURE 1.2

Development Footprint

Image Source: Nearmap (April 2020) Data source: DSFI (2017); NSW LPI (2019)

1.1 Development Footprint Information

The Development Footprint entirely comprises intact vegetation adjacent to existing disturbances such as residential land and major roadways, aside from approximately 1.1 ha of existing tracks and trails. The native vegetation is generally in moderate to good condition. Some areas, such as along tracks, contain small outbreaks of exotic plant species and disturbances such as rubbish and erosion. Landscape details of the Development Footprint are detailed in **Table 1.1**.

Table 1.1 Development Footprint Location in the Landscape

Development Footprint Location in the Landscape	
IBRA Bioregion	Sydney Basin
IBRA Subregion	Wyong
LGA	Central Coast
Development Footprint Size	34.7 ha
Assessment Type	Site-based
Lot and DP	Part Lot 642 DP 1027231 and Part Lot 100 DP 1044282

1.2 Local Ecological Context

The Development Footprint is located in the Central Coast local government area (refer to Figure 1.2). The locality is characterised by residential areas, with substantial intact vegetation extending to the south and north, some of which forms part of Munmorah State Conservation Area (SCA) and Lake Macquarie SCA, respectively. The multi lane Pacific Highway is located immediately to the south, contributing to vegetation fragmentation and providing a barrier to movement of 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 and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and south east corner bioregions EEC* listed under the BC Act; and *Posidonia australis seagrass meadows of the Manning-Hawkesbury ecoregion* listed under the EPBC Act.

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 *Tetratheca juncea,* Charmhaven apple (*Angophora inopina*), heath wrinklewort (*Rutidosis heterogama*), rough doubletail (*Diuris praecox*) and variable midge orchid (*Genoplesium insigne*). Records of threatened fauna species in the locality include wallum froglet (*Crinia tinnula*), eastern osprey (*Pandion cristatus*), powerful owl (*Ninox strenua*), masked owl (*Tyto novaehollandiae*), eastern pygmy possum (*Cercartetus nanus*) and grey- headed flying- fox (*Pteropus poliocephalus*).

1.3 Key Resources, Policies and Documents

The following key resources, policies and documents were used during the preparation of this BAR:

- Biodiversity Assessment Method 2020 (DPIE 2020a)
- Biodiversity Assessment Method Operational Manual (Stage 1) (DPIE 2017)
- Biodiversity Assessment Method Calculator (BAM-C)
- BioNet Atlas of NSW Wildlife database and mapping tool (DPIE 2021a), last accessed October 2021
- Threatened Biodiversity Data Collection (TBDC) (DPIE 2021b), last accessed October 2021
- Vegetation Information System (VIS) Classification Database (DPIE 2021c), last accessed October 2021
- Surveying Threatened Plants and Their Habitats (DPIE 2020b) and
- Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (DAWE 2021), last accessed October 2021.

1.4 Report Preparation

This BAR was prepared by Philippa Fagan (Senior Ecologist: Botanist) (BAM Accreditation Number BAAS18117) with review and technical direction from Naomi Buchhorn (Principal Ecologist). Field surveys were undertaken by Philippa Fagan and a number of other Umwelt ecologists under the guidance of the accredited assessor.

This BAR was finalised on 31 March 2022.

Philippa Fagan
Senior Ecologist: Botanist
BAM Accreditation No. BAAS18117

2.0 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 1500m buffer area, cleared areas, rivers, streams, wetlands, and connectivity features were identified within the Development Footprint where appropriate in accordance with Section 3.1 of the BAM (DPIE 2020a).

Determining 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 3.2 of the BAM (DPIE 2020a).

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. This included ecological reports and 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:

- Interim Ecological Inventory Report: Darkinjung Local Aboriginal Land Council North Wyong Land holdings 2010-2012 (EcoLogical Australia 2012)
- Darkinjung Local Aboriginal Land Council: Lake Munmorah Industrial Subdivision Biodiversity Certification Assessment Report (GHD 2018)
- OEH BioNet Atlas of NSW Wildlife database and mapping tool (DPIE 2020a), last accessed October 2021
- VIS Classification Database (DPIE 2021c), last accessed October 2021
- DAWE Protected Matters Search Tool for known/predicted EPBC Act-listed TECs, last accessed October 2021

The results of these database searches, literature review and TBDC review were used to review and design the appropriate survey requirements for remaining species-credit species.

2.2.2 Floristic and Vegetation Integrity Survey

Floristic and vegetation integrity surveys were undertaken by GHD in the original assessment provided in 2018. Umwelt also undertook further floristic plots and used these, in conjunction with the GHD plot data, to achieve the required number of floristic plots per plant community type (PCT). Umwelt's floristic data have been reproduced in **Appendix C** and all structure and function data have been reproduced in **Appendix D**.

During all targeted species surveys, Umwelt ground-truthed the vegetation mapping completed by GHD and took rapid assessments to verify the dominant species in each layer across the site. Umwelt altered the vegetation mapping after completion of all surveys.

A total of 12 BAM plots were conducted within (or immediately adjacent to) the Development Footprint during the surveys undertaken for this assessment by both GHD and Umwelt (refer to **Figure 2.2**). Umwelt has used the data from three plots conducted by GHD to enter into the BAM Calculator but did not use all of the plots conducted by GHD, so that the majority of the data was collected by Umwelt and could be justified by Umwelt as required. Floristic and vegetation integrity data was collected in accordance with minimum requirements under the BAM (DPIE 2020a).

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 by GHD	Completed by Umwelt
1	1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast - remnant	23.0	4	4	2
2	1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast - disturbed	1.9	1	0	1 (Adjacent to Development Footprint but representative)
3	1638 Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	7.3	3	0	3
4	1724 Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast	1.4	1	1	1
	Disturbed	1.1	-	-	-
	TOTAL	**34.7**	**9**	**12**	

Note that 1.1 ha of the development footprint is existing tracks and trails and are not considered

At each floristic and vegetation integrity plot, data were recorded according to Section 5.0 of the BAM (DPIE 2020a). 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.

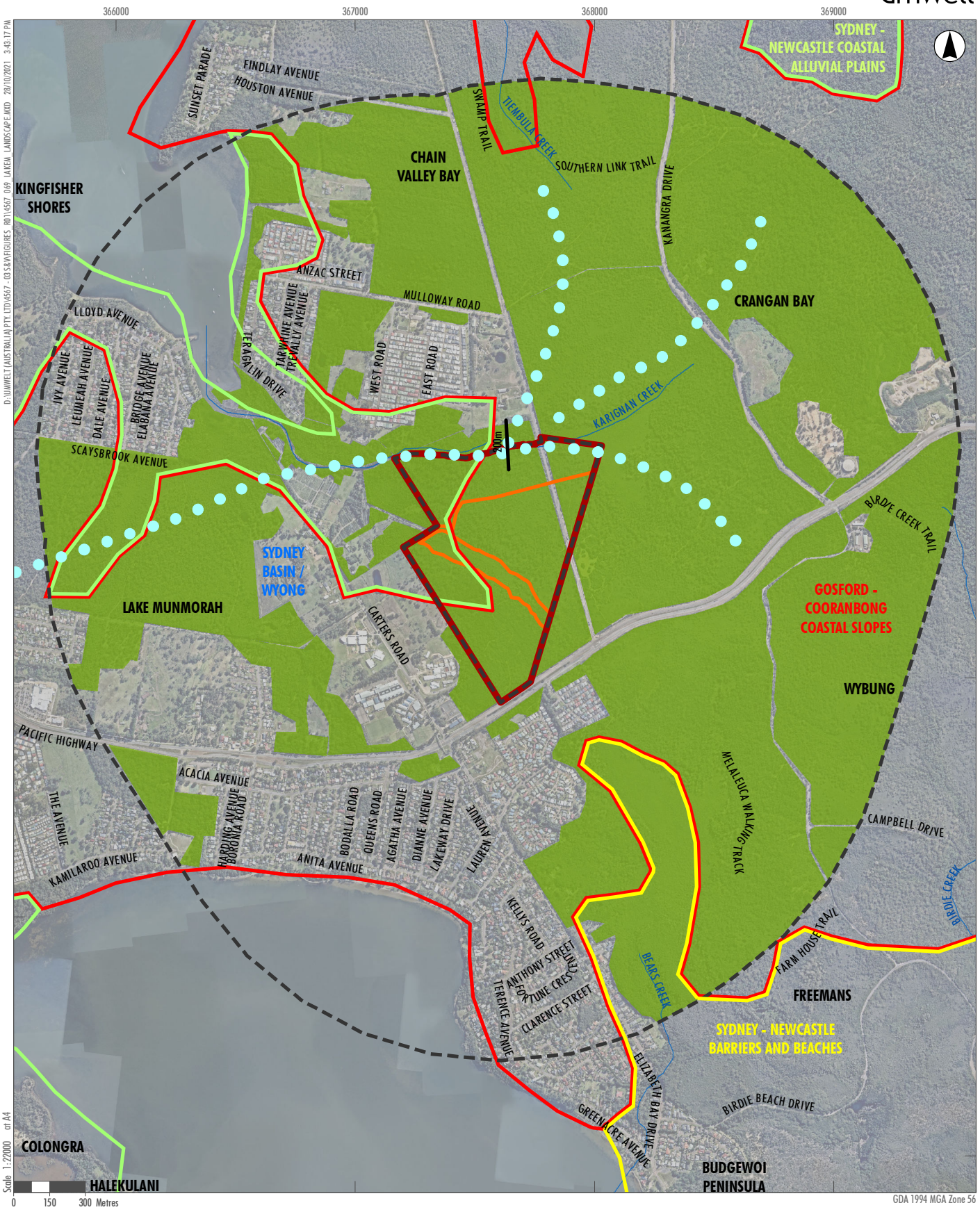
At each plot/transect, roughly 45 to 60 minutes was spent searching for all vascular flora species present within the 20 x 20 m plot. Searches of each 20 x 20 m plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, 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 (DPIE 2020a):

- 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 (DPIE 2020a) 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.



Legend

- Proposed Rezoning Extent
- Revised Development Footprint
- 1500m Buffer
- Native Vegetation
- East-West Corridor and Connectivity
- Watercourses

IBRA Region / Sub Region

- Sydney Basin / Wyong

Mitchell Landscape

- Gosford - Cooranbong Coastal Slopes
- Sydney - Newcastle Coastal Alluvial Plains
- Sydney - Newcastle Barriers and Beaches

FIGURE 2.1

Landscape Features

Image Source: Nearmap (April 2020) Data source: DSFI (2017); NSW LPI (2019)

2.2.3 Targeted and Meandering Transects

Targeted transects for threatened flora species were conducted by Umwelt during the months of August, October, November, December, 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 all survey periods.

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 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 2020).

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 (DPIE 202c) and plant communities as described by GHD (2018)
- analysis of plot data (GHD 2018)
- 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.

2.2.7 Threatened Ecological Community Delineation Techniques

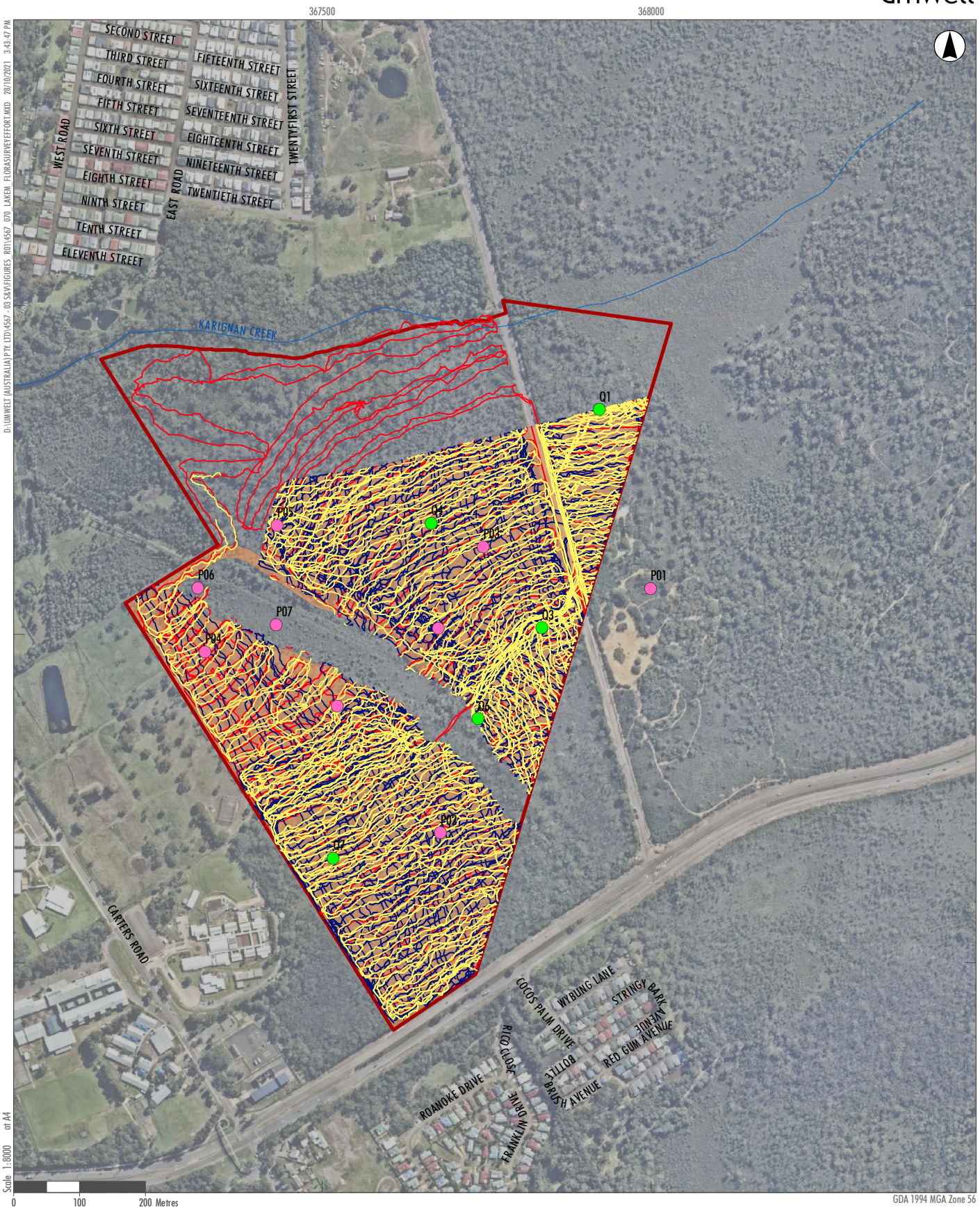
Where applicable, vegetation communities identified in the Development Footprint were compared to TECs listed under the Commonwealth EPBC Act and NSW BC Act and an assessment of similarity with the NSW Scientific Committee Final Determinations and the Commonwealth Threatened Species Scientific Committee 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 were aligned with an equivalent PCT as detailed in the VIS Classification Database (DPIE 2021). For each vegetation community, 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**.



Legend

- Proposed Rezoning Extent
- Revised Development Footprint
- Spring Flora Survey Tracks
- Summer Flora Survey Tracks
- Winter Flora Survey Tracks
- Watercourses
- Plot Location
- GHD Plot Location

FIGURE 2.2

Flora Survey Effort

Image Source: Nearmap (April 2020) Data source: DSFI (2017); NSW LPI (2019)

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 and 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:

- Interim Ecological Inventory Report: Darkinjung Local Aboriginal Land Council North Wyong Land holdings 2010-2012 (EcoLogical Australia 2012)
- Darkinjung Local Aboriginal Land Council: Lake Munmorah Industrial Subdivision Biodiversity Certification Assessment Report (GHD 2018)
- OEH BioNet Atlas of NSW Wildlife database and mapping tool (DPIE 2021a), last accessed October 2021
- VIS Classification Database (DPIE 2021b), last accessed October 2021
- DAWE Protected Matters Search Tool for known/predicted EPBC Act-listed TECs, last accessed October 2021

The results of these database searches, literature review and TBDC review were used to review and design the appropriate survey requirements for remaining 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** outlines the dates, methods and species targeted during the surveys. GHD's fauna survey effort is displayed in **Figure 2.4**.

Table 2.2 Species credit species survey methodology and timing

Survey Date	Method	Species Targeted
Original Development Footprint (GHD Survey Effort)		
24 to 26 November 2016 **23 and 25 November 2017**	BAM floristic and vegetation integrity plot surveys	-
22 and 23 August 2017	Targeted threatened species transects	rough doubletail (*Diuris praecox*) thick-leaf star hair (*Austrotricha crassifolia*) small- flower grevillea (*Grevillea parviflora* subsp. *parviflora*)

Survey Date	Method	Species Targeted
23 and 24 October 2017	Targeted threatened species transects	thick-leaf star hair (*Austrotricha crassifolia*) thick lip spider orchid (*Caladenia tessellata*) netted bottlebrush (*Callistemon linearifolius*) variable midge orchid (*Genoplesium insigne*) small- flower grevillea (*Grevillea parviflora* subsp. *parviflora*) tranquility mintbush (*Prostanthera askania*) heath wrinklewort (*Rutidosis heterogama*) *Tetratheca glandulosa* Black- eyed susan (*Tetratheca juncea*)
12 – 15 December 2017	Nocturnal searches Hollow bearing tree analysis Call- playback Remote Cameras Stag watching Anabat Detectors Arboreal trapping Harp trapping Diurnal reptile searches Diurnal bird surveys Active searches for signs and scats Diurnal habitat assessments	pale- headed snake (*Hoplocephalus bitorquatus*) bush stone- curlew (*Burhinus grallarius*) grey- headed flying- fox (*Pteropus poliocephalus*) koala (*Phascolarctos cinereus*) eastern pygmy possum (*Cercartetus nanus*) common planigale (*Planigale maculata*) squirrel glider (*Petaurus norfolcensis*) brush- tailed phascogale (*Phascogale tapoatafa*) gang- gang cockatoo (*Callocephalon fimbriatum*) glossy black- cockatoo (Calyptorhynchus lathami) large- eared pied- bat (*Chalinolobus dwyeri*) wallum froglet (*Crinia tinnula*) white- bellied sea- eagle (*Haliaeetus leucogaster*) square- tailed kite (*Lophoictinia isura*) giant burrowing frog (*Heleioporus australiacus*) green and golden bell frog (*Litoria aurea*) green-thighed frog (*Litoria brevipalmata*) southern myotis (*Myotis Macropus*) giant dragonfly (*Petalura gigantea*) long- nosed potoroo (*Potorous tridactylus*) Mahony's toadlet (*Uperoleia mahonyi*)
Original Development Footprint (Umwelt Survey Effort)		
24 March 2020	BAM Integrity Plots	-
27 August 2018 **29 August 2018** **30 August 2018**	Threatened species transects Opportunistic observations and habitat assessments	rough doubletail (*Diuris praecox*) thick-leaf star hair (*Austrotricha crassifolia*) bush stone- curlew (*Burhinus grallarius*) small- flower grevillea (*Grevillea parviflora* subsp. *parviflora*) gang- gang cockatoo (*Callocephalon fimbriatum*) glossy black- cockatoo (*Calyptorhynchus lathami*) eastern osprey (*Pandion cristatus)* koala (*Phascolarctos cinereus*)

Survey Date	Method	Species Targeted
24 September 2018 **25 September 2018**	Threatened species transects Opportunistic observations and habitat assessments	thick-leaf star hair (*Austrotricha crassifolia*) bush stone- curlew (*Burhinus grallarius*) thick lip spider orchid (*Caladenia tessellata*) netted bottlebrush (*Callistemon linearifolius*) variable midge orchid (*Genoplesium insigne*) small- flower grevillea (*Grevillea parviflora* subsp. *parviflora*) tranquility mintbush (*Prostanthera askania*) heath wrinklewort (*Rutidosis heterogama*) *Tetratheca glandulosa* Black- eyed susan (*Tetratheca juncea*) little eagle (*Hieraaetus morphnoides*) white- bellied sea- eagle (*Haliaeetus leucogaster*) square- tailed kite (*Lophoictinia isura*) koala (*Phascolarctos cinereus*)
12 February 2018 **13 February 2018** **14 February 2018** **11 November 2019** **2 December 2019** **3 December 2019**	Threatened species transects Opportunistic observations and habitat assessments	Bynoe's wattle (*Acacia bynoeana*) Charmhaven apple (*Angophora inopina*) thick- leaf star- hair (*Astrotricha crassifolia*) bush stone- curlew (*Burhinus grallarius*) *Corunastylis sp.* Charmhaven leafless tongue orchid (*Cryptostylis hunteriana*) Camfield's stringybark (*Eucalyptus camfieldii*) *Eucalyptus parramattensis* subsp. *decadens* small- flowered grevillea (*Grevillea parviflora* subsp. *parviflora*) Deanes paperbark (*Melaleuca deanei*) Biconvex paperbark (*Melaleuca biconvexa*) heath wrinklewort (*Rutidosis heterogama*) variable midge orchid (*Genoplesium insigne*) white- bellied sea- eagle (*Haliaeetus leucogaster*) square- tailed kite (*Lophoictinia isura*) tall knotweed (*Persicaria elatior*) giant dragonfly (*Petalura gigantea*) tranquility mintbush (*Prostanthera askania*) koala (*Phascolarctos cinereus*) *Tetratheca glandulosa* grey- headed flying- fox (*Pteropus poliocephalus*)
13 and 14 May 2019	Nocturnal searches Call- playback Gang- gang cockatoo and glossy black-cockatoo survey (breeding habitat assessment) Koala SAT tests	bush stone- curlew (*Burhinus grallarius*) powerful owl (*Ninox strenua*) barking owl (*Ninox connivens*) masked owl (*Tyto novaehollandiae*) sooty owl (*Tyto tenebricosa*) gang- gang cockatoo (*Callocephalon fimbriatum*) glossy black- cockatoo (*Calyptorhynchus lathami*)

Survey Date	Method	Species Targeted
Original Development Footprint and Revised Development Footprint (Umwelt Survey Effort)		
29 November 2019 **2 December 2019**	Threatened species transects Opportunistic observations and habitat assessments	Bynoe's wattle (*Acacia bynoeana*) Charmhaven apple (*Angophora inopina*) thick- leaf star- hair (*Astrotricha crassifolia*) bush stone- curlew (*Burhinus grallarius*) *Corunastylis sp.* Charmhaven leafless tongue orchid (*Cryptostylis hunteriana*) Camfield's stringybark (*Eucalyptus camfieldii*) *Eucalyptus parramattensis* subsp. *decadens* small- flowered grevillea (*Grevillea parviflora* subsp. *parviflora*) Deanes paperbark (*Melaleuca deanei*) Biconvex paperbark (*Melaleuca biconvexa*) heath wrinklewort (*Rutidosis heterogama*) variable midge orchid (*Genoplesium insigne*) white- bellied sea- eagle (*Haliaeetus leucogaster*) square- tailed kite (*Lophoictinia isura*) tranquility mintbush (*Prostanthera askania*) koala (*Phascolarctos cinereus*) *Tetratheca glandulosa* grey- headed flying- fox (*Pteropus poliocephalus*)
Remainder of Revised Development Footprint (Umwelt Survey Effort)		
26 and 27 August 2020	Targeted threatened species transects Nocturnal searches Call- playback Gang- gang cockatoo and glossy black-cockatoo survey (breeding habitat assessment)	*Diuris praecox* bush stone- curlew (*Burhinus grallarius*) powerful owl (*Ninox strenua*) barking owl (*Ninox connivens*) masked owl (T*yto novaehollandiae*) sooty owl (*Tyto tenebricosa*) gang- gang cockatoo (*Callocephalon fimbriatum*) glossy black- cockatoo (Calyptorhynchus lathami)
11 September 2020	Threatened species transects Opportunistic observations and habitat assessments	thick-leaf star hair (*Austrotricha crassifolia*) bush stone- curlew (*Burhinus grallarius*) thick lip spider orchid (*Caladenia tessellata*) netted bottlebrush (*Callistemon linearifolius*) variable midge orchid (*Genoplesium insigne*) small- flower grevillea (*Grevillea parviflora* subsp. *parviflora*) tranquility mintbush (*Prostanthera askania*) heath wrinklewort (*Rutidosis heterogama*) *Tetratheca glandulosa* Black- eyed susan (*Tetratheca juncea*) little eagle (*Hieraaetus morphnoides*) white- bellied sea- eagle (*Haliaeetus leucogaster*) square- tailed kite (*Lophoictinia isura*) koala (*Phascolarctos cinereus*)

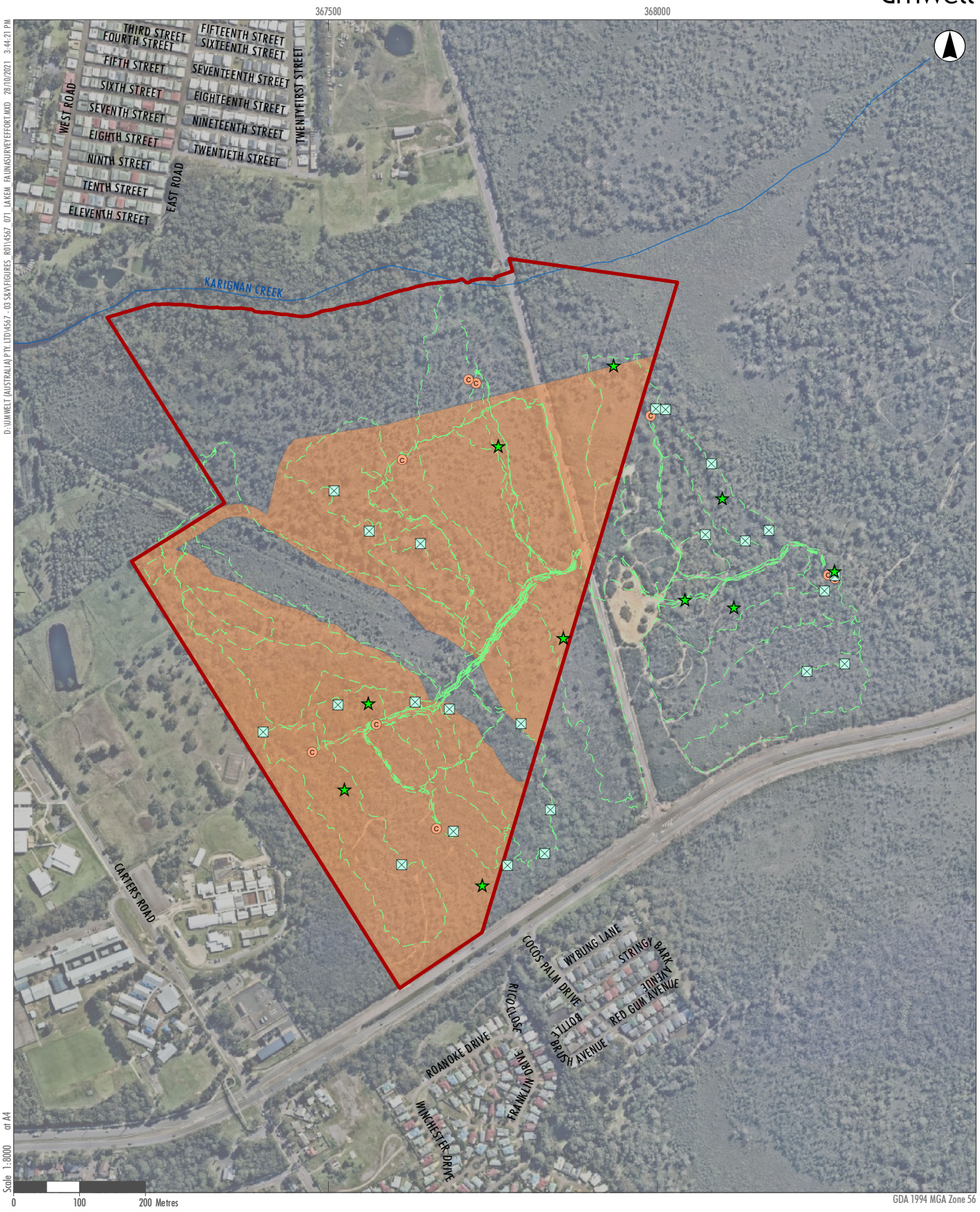
Survey Date	Method	Species Targeted
11 November 2020	Threatened species transects Opportunistic observations and habitat assessments	Bynoe's wattle (*Acacia bynoeana*) Charmhaven apple (*Angophora inopina*) thick- leaf star- hair (*Astrotricha crassifolia*) bush stone- curlew (*Burhinus grallarius*) *Corunastylis sp.* Charmhaven leafless tongue orchid (*Cryptostylis hunteriana*) Camfield's stringybark (*Eucalyptus camfieldii*) *Eucalyptus parramattensis* subsp. *decadens* small- flowered grevillea (*Grevillea parviflora* subsp. *parviflora*) Deanes paperbark (*Melaleuca deanei*) Biconvex paperbark (*Melaleuca biconvexa*) heath wrinklewort (*Rutidosis heterogama*) variable midge orchid (*Genoplesium insigne*) white- bellied sea- eagle (*Haliaeetus leucogaster*) square- tailed kite (*Lophoictinia isura*) tranquility mintbush (*Prostanthera askania*) koala (*Phascolarctos cinereus*) *Tetratheca glandulosa* grey- headed flying- fox (*Pteropus poliocephalus*)
19 January 2021	Remaining BAM Integrity plot	-

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)
- *Surveying Threatened Plants and Their Habitats* (DPIE 2020b)
- *Flora and Fauna Survey Guidelines* (CCC 2019a)

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 (DPIE 2020a).



Legend

- Proposed Rezoning Extent
- Revised Development Footprint
- Rapid Assessment
- Call Playback Locations
- Hollow-Bearing Trees
- Spotlight Survey Locations
- Watercourses

FIGURE 2.3

Umwelt Fauna Survey Effort

Image Source: Nearmap (April 2020) Data source: DSFI (2017); NSW LPI (2019)

Paper Size A4

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Biocertification area
- Cadastre
- Watercourse
- Arboreal trap line
- H Anabat
- J Call playback
- S Camera trap
- Harp trap
- U Stagwatching
- BAM plot surveys

DRAFT

Darkinjung Local Aboriginal Land Council
Lake Munmorah Residential Subdivision
Biodiversity Certification Assessment Report

Job Number 22-18587
Revision A
Date 08 Feb 2018

Survey locations

Figure 2-4

G:\22\18587\GIS\Maps\Deliverables\BCAR\2218587_BCAR009_FaunaSurveys_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com W www.ghd.com.au

Data source: LPI: DTDB / DCDB, 2012, Aerial Imagery, 2016. Created by: fmackay

2.3.4 Weather Conditions and Limitations

Table 2.3 outlines the weather conditions for fauna surveys. Data is derived from the Central Coast weather station in Norah Head (061366) from the Bureau of Meteorology (2021).

Table 2.3 Weather Conditions for Umwelt Surveys

Date	Daily Data			Monthly Data		
	Min-Max Temp.	Rainfall (mm)	Relative Humidity (%)	Min-Max Temp (mean)	Rainfall (total) (mm)	Relative Humidity (mean) (%)
12 December 2017	19.1-27.1	0	70	18.5-25.1	65.2	70
13 December 2017	19.2-27.9	0	68			
14 December 2017	19.4-26.5	0	68			
15 December 2017	19.5-23.9	0	72			
12 February 2018	21.7-28.8	0	76	20.0-26.1	118.0	76
13 February 2018	23.6-29.4	0	72			
14 February 2018	23.8-30.7	0	75			
27 August 2018	12.2-14.6	0.8	60	10.5-18.9	70.0	60
29 August 2018	6.5-15.5	0.2	62			
30 August 2018	6.6-17.5	0	58			
24 September 2018	12.6-15.4	1.2	62	12.8-21.1	62.2	62
25 September 2018	11.1-17.5	11.4	62			
13 May 2019	13.3-24.6	0	68	13.1-20.3	128.0	68
14 May 2019	14.2-24.3	0	69			
11 November 2019	14.8-25.7	0	67	11.7-36.2	27.0	63
29 November 2019	19.4-27.2	0	75			
2 December 2019	17.7-23.6	0	42	12.9-34.4	1.6	68
26 August 2020	7.6-18.3	0	55	5.9-24.2	56	60
27 August 2020	8.5-21.4	0	60			
11 September 2020	15.2-26.0	0	73	17.0-25.3	51.8	96
19 January 2021	21.1-24.9	0	78	19.3-26.2	88.4	77

3.0 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	Wyong
Mitchell Landscape	Gosford – Cooranbong Coastal Slopes, with a small portion of Sydney – Newcastle Coastal Alluvial Plains
Rivers, Streams, Estuaries	No Strahler streams in the Development Footprint
Wetlands (within, adjacent to and downstream)	*Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions* EEC occurs within and adjacent to the Development Footprint
Native Vegetation Cover	760.4 hectares in the 1500m buffer area (61%)
Areas of Geological Significance or Soil Hazard Features	None identified
Areas of Outstanding Biodiversity Value	None identified
Cleared Areas	Small tracks throughout the development footprint are present
Connectivity Features	The Development Footprint is located within the corridor identified in the Central Coast Regional Plan 2036 (NSW Government 2016) as connecting the coast to the foothills and providing an inter-regional landscape break. 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

Umwelt surveys of the Development Footprint identified three Plant Community Types (PCTs) across two condition classes being:

- PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast (*Good Condition*)
- PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast (*disturbed condition*)
- PCT 1638 Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands (*good condition*)
- PCT 1724 Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (*good condition*).

These PCTs are different to those chosen by GHD in 2018 and were adjusted by Umwelt through a combination of ground truthing, additional floristic plots and rapid vegetation assessments. These are shown on **Figure 3.1** and a description of the vegetation zones is outlined below. A flora species list is included in **Appendix C**.

Legend

- Proposed Rezoning Extent
- Revised Development Footprint
- Watercourses
- PCT1636 - Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast - Disturbed
- PCT1636 - Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast - Good
- PCT1638 - Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
- PCT1724 - Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast
- Cleared/Disturbed

FIGURE 3.1

Plant Community Types in the Development Footprint

Image Source: Nearmap (April 2020) Data source: DSFI (2017); NSW LPI (2019)

Zone 1 – PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast (good condition)

PCT Name Condition	PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast (*good condition*) Good	
Formation	Dry sclerophyll forests (shrubby sub-formation)	
Class	Sydney coastal dry sclerophyll forests	
Percent cleared	58.00	
Area in Development Footprint (ha)	23.0	
Patch Size Class (ha)	>101	
Location	Occurs across the majority of the Development Footprint (refer to **Figure 3.1**).	
Canopy Description	Moderately dense canopy dominated by scribbly gum (*Eucalyptus haemastoma*) and smooth-barked apple (*Angophora costata*), with red bloodwood (*Corymbia gummifera*) and forest oak (*Allocasuarina littoralis*).	
Mid-storey Description	A very dense mid- storey dominated by fern- leaved banksia (*Banksia oblongifolia*), finger hakea (*Hakea dactyloides*), flaky- barked tea- tree (*Leptospermum trinervium*), drumsticks (*Petrophile pulchella*), conesticks (*Isopogon anemonifolius*), mountain devils (*Lambertia formosa*), large-leaf hop bush (*Dodonaea triquetra*), sweet wattle (*Acacia suaveolens*) and rice flower (*Pimelea linifolia*).	
Ground Cover Description	This vegetation zone is characterised by a fairly dense ground layer of sedges, grasses and herbs. Dominant species include *Xanthorrhoea latifolia*, kangaroo grass (*Themeda triandra*), *Lepyrodia scariosa,* blue bottle- daisy (*Lagenophora stipitata*), wiry panic (*Entolasia stricta*), *Cyathochaeta diandra,* blue trumpet (*Brunoniella australis*) and yellow autumn- lily (*Tricoryne elatior*).	

PCT Name Condition	PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast (*good condition*) Good
PCT Allocation	Vegetation Zone 1 was aligned with PCT1636 as it supports a number of the species identified for the PCT as listed on the VIS Classification Database (DPIE 2021c). It is dominated by scribbly gum (*Eucalyptus haemastoma*) and red bloodwood (*Corymbia gummifera*) which are the only two diagnostic species listed as occurring in the canopy. The mid-stratum contains 100% of the species listed in the VIS Classification Database (OEH 2020c), with the ground stratum containing 5 of 7 (71%) of the listed diagnostic species. The vegetation description for this community is very close to what is occurring on site, being a scribbly gum dominated woodland occurring on coastal flats, low rises and hills of the Central Coast on sandstone soils. PCT1636 was 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 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast (disturbed condition)

PCT Name Condition	PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast (*disturbed condition*) Disturbed	
Formation	Dry sclerophyll forests (shrubby sub-formation)	
Class	Sydney coastal dry sclerophyll forests	
Percent cleared	58.00	
Area in Development Footprint (ha)	1.9	
Patch Size Class (ha)	>101	
Location	Occurs as a small patch in the east of the Development Footprint, with minor areas along the western boundary (refer to **Figure 3.1**).	
Canopy Description	Dense canopy dominated by regrowth black she-oak (*Allocasuarina littoralis*). This zone is categorised by an absence of mature trees, though there are occasional saplings of scribbly gum (*Eucalyptus haemastoma*) and smooth- barked apple (*Angophora costata*).	
Mid-storey Description	A very dense mid- storey dominated by regrowth of sydney golden wattle (*Acacia longifolia*), red- stemmed wattle (*Acacia myrtifolia*), fern- leaved banksia (*Banksia oblongifolia*), drumsticks (*Petrophile pulchella*), conesticks (*Isopogon anemonifolius*), large- leaf hop bush (*Dodonaea triquetra*), sweet wattle (*Acacia suaveolens*) and rice flower (*Pimelea linifolia*).	

PCT Name Condition	PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast (*disturbed condition*) Disturbed
Ground Cover Description	This vegetation zone is characterised by a moderately dense ground layer of sedges and grasses. Dominant species include *Xanthorrhoea latifolia, Leptocarpus tenax* and wiry panic (*Entolasia stricta*).
PCT Allocation	Vegetation Zone 2 was aligned with PCT1636 in a regrowth form because it is clear that PCT 1636 formerly occurred at this location, based on the surrounding non- disturbed vegetation, and has subsequently been disturbed and thinned.
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 3 – PCT 1638 Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands (good condition)

PCT Name Condition	PCT 1638 Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands (good condition) Good	
Formation	Dry sclerophyll forests (shrubby sub-formation)	
Class	Sydney coastal dry sclerophyll forests	
Percent cleared	50.00	
Area in Development Footprint (ha)	7.3	
Patch Size Class (ha)	>101	
Location	Occurs on either side of the swampy areas in the centre of the Development Footprint (refer to **Figure 3.1**).	
Canopy Description	Moderately dense canopy dominated by smooth- barked apple (*Angophora costata*) and red bloodwood (*Corymbia gummifera*).	
Mid-storey Description	A very dense mid- storey dominated by black she-oak (*Allocasuarina littoralis*), flaky- barked tea- tree (*Leptospermum trinervium*), mountain devils (*Lambertia formosa*), red- stemmed wattle (*Acacia myrtifolia*), drumsticks (*Petrophile pulchella*), conesticks (*Isopogon anemonifolius*), and rice flower (*Pimelea linifolia*).	
Ground Cover Description	This vegetation zone is characterised by a fairly dense ground layer of sedges, grasses and herbs. Dominant species include *Xanthorrhoea latifolia*, kangaroo grass (*Themeda triandra*), *Lepyrodia scariosa,* wiry panic (*Entolasia stricta*), *Cyathochaeta diandra,* fishbones (*Lomandra obliqua*), lesser flannel flower (*Actinotus minor*), *Ptilothrix deusta* and silky purple flag (*Patersonia sericea*).	

PCT Name Condition	PCT 1638 Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands (good condition) Good
PCT Allocation	Vegetation Zone 3 was aligned with PCT1638 as it supports a number of the species identified for the PCT as listed on the VIS Classification Database (DPIE 2021c). It is dominated by smooth- barked apple (*Angophora costata*) and red bloodwood (*Corymbia gummifera*) which are the only two diagnostic species listed as occurring in the canopy. The mid-stratum contains 100% of the species listed in the VIS Classification Database (OEH 2020c), with the ground stratum also containing 100% of the listed diagnostic species. Furthermore, the location described for this community is very localised, being within a small area of the central coast, including the Lake Munmorah LGA. The PCT is described as occurring on flats, rises and low hills and is appropriate for the development site.
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 4 – PCT 1724 Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (good condition)

PCT Name Condition	PCT 1724 Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (*good condition*) Good	
Formation	Forested wetlands	
Class	Coastal swamp forests	
Percent cleared	31.00	
Area in Development Footprint (ha)	1.4	
Patch Size Class (ha)	>101	
Location	Occurs as a small patch in the centre of the Development Footprint (refer to **Figure 3.1**).	
Canopy Description	Fairly open canopy dominated by broad- leaved paperbark (*Melaleuca quinquenervia*) with very occasional swamp mahogany (*Eucalyptus robusta*).	
Mid-storey Description	A very dense mid- storey dominated by *Melaleuca sieberi* and tall saw- sedge (*gahnia clarkei*). There is also occasional Sydney golden wattle (*Acacia longifolia* subsp. *longifolia*).	
Ground Cover Description	This vegetation zone is characterised by a very dense ground layer of sedges and ferns including swamp water fern (*Blechnum indicum*), jointed twig- rush (*Baumea articulata*), *Empodisma minus,* blue flax- lily (*Dianella caerulea*), raspwort (*Gonocarpus teucrioides*) and spiny- headed mat- rush (*Lomandra longifolia*).	

PCT Name Condition	PCT 1724 Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (*good condition*) Good
PCT Allocation	Vegetation Zone 4 was aligned with PCT1724 as it supports a number of the species identified for the PCT as listed on the VIS Classification Database (OEH 2020c). It is acknowledged that no PCT appeared to be a perfect fit, but PCT1724 was the best available. It contains two of the three diagnostic species listed as occurring in the canopy. The mid-stratum only contains one of the three species listed in the VIS Classification Database (DPIE 2021c), however the ground stratum contains 4 of 6 (67%) of the listed diagnostic species. Furthermore, the vegetation description for this community is very close to what is occurring on site, being a swamp open forest with area of standing water dominated by *Melaleucas* (OEH 2020c). PCT1724 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 forms part of *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community* listed under the BC Act.
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.

3.2.2 Exotic Vegetation

The revised Development Footprint contains very few exotic species, and no areas have been mapped as exotic vegetation. A number of weeds recorded in the Development Footprint are classed as High Threat Weed species under the BAM, including whisky grass (*Andropogon virginicus*), blackberry (*Rubus aggregatus*) and crofton weed (*Ageratina adenophora*) and are identified in the flora species list in Appendix B of the GHD BCAR (GHD 2018). None of these occur in high numbers.

3.3.3 Threatened Ecological Communities

PCT 1724 is consistent with *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community* listed under the BC Act.

3.2.4 Vegetation Integrity Score

Table 3.2 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	Contains Hollow-bearing Trees	Composition	Structure	Function	Current Vegetation Integrity Score
1	1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast – good	Yes	55.1	78.5	32.8	**52.1**
2	1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast - disturbed	No	72.2	87.4	39.4	**62.9**

Veg Zone	PCT Name	Contains Hollow-bearing Trees	Composition	Structure	Function	Current Vegetation Integrity Score
3	1638 Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	Yes	74.2	59.9	79	**70.5**
4	1724 Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast	No	85	99.9	37.5	**68.3**

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**.

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
wallum froglet *Crinia tinnula*	V	-	Detected by GHD 2018 and Umwelt in 2020	Recorded during targeted surveys in 2018 by GHD and by Umwelt in 2020. Species polygon aligned with PCT1724.
black- eyed Susan *Tetratheca juncea*	V	V	Detected by GHD 2018 and Umwelt 2019 and 2020	Species recorded by GHD in 2018 and Umwelt in 2019 and 2020 across much of the Development Footprint within PCT 1636 and 1638. While the species is associated with PCT 1724, it was not detected in this PCT during any survey event, and this PCT is considered far too dense and wet to support this species. GHD originally mapped the species habitat polygon for this species as aligning to only a small portion of the site (1.9 ha). However, the species is associated with PCT 1636 (DPIE 2021b) and was detected in this and PCT 1638 and is mapped according to suitable habitat. The species polygon has therefore been mapped across the entirety of PCT 1636 (good) and 1638 in the development footprint (30.3 ha).
swift parrot *Lathamus discolor*	E	CE	BOAMS important habitat area mapping	Important habitat areas mapped covering a total of 32.4 ha across the development footprint, encompassing the majority of all PCTs.

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
wallum froglet *Crinia tinnula*	1.5	1.4	Aligned with PCT 1724 (refer **Figure 3.3**).
black- eyed susan *Tetratheca juncea*	2	30.3	Aligned with PCT 1636 (good) and 1638 (refer to **Figure 3.3**).
swift parrot *Lathamus discolor*	3	32.4	Aligned with important habitat mapping. Encompasses the majority of the Development Footprint (refer to **Figure 3.3**).

Legend

- Proposed Rezoning Extent
- Revised Development Footprint
- Watercourses

Threatened Species Records

- Wallum Froglet
- *Tetratheca juncea*

FIGURE 3.2

Threatened Species in the Revised Development Footprint

Image Source: Nearmap (April 2020) Data source: DSFI (2017); NSW LPI (2019)

Legend

- Proposed Rezoning Extent
- Revised Development Footprint
- Swift Parrot Species Habitat
- *Tetratheca juncea* Species Habitat
- Wallum Froglet Species Habitat
- Watercourses

FIGURE 3.3

Species-credit Species Polygons

Image Source: Nearmap (April 2020) Data source: DSFI (2017); NSW LPI (2019)

4.0 Avoidance and Minimisation of Impacts

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

The initial BCAR (GHD 2018) identified PCTs, including EECs, threatened flora species and threatened fauna species habitats within the original development footprint, which may form part of a stewardship site, should Darkinjung choose this path moving forward.

Following completion of field surveys further analysis of the most appropriate footprint was undertaken with avoidance and minimisation of direct impacts on essential biodiversity features a key consideration. The following sections detail the important decisions that relate to the avoidance and minimisation of impacts on biodiversity and the determination of the final Development Footprint assessed by this biodiversity assessment. 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

The placement of the revised Development Footprint boundary has been developed to avoid and minimise direct, indirect, and prescribed biodiversity impacts. Prescribed impacts set out in the BAM (DPIE 2020a) have been almost completely avoided by the project, aside from minor impacts to connectivity. Further detail on the assessment of prescribed impacts is outlined in **Section 5.2**.

Following the completion of the original BCAR (GHD 2018) a range of threatened flora and fauna species were identified within the proposed Development Footprint, some of which are now excluded from direct impacts. Key threatened species avoided include:

- A reduction to impacts to black- eyed Susan (*Tetratheca juncea*) - listed as Vulnerable under the BC Act
- Breeding trees for the Masked owl (*Tyto novaehollandiae*) - listed as Vulnerable under the BC Act
- A reduction to impacts to habitat for the wallum froglet (*Crinia tinnula*) - listed as Vulnerable under the BC Act
- *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast and Sydney Basin Bioregions EEC*.

The original Development Footprint would have resulted in a larger area of habitat for both black- eyed Susan and wallum froglet being removed, as well as a much larger area of *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast and Sydney Basin Bioregions EEC*.

Additionally, GHD detected a masked owl (*Tyto novaehollandiae*) breeding tree in the bushland to the east of Chain Valley Bay Road, opposite the current Development Footprint. An adult and a juvenile masked owl emerged from the breeding hollow at dusk, which was also littered with bones, feathers and whitewash at the base of the tree. This tree has now been avoided.

Furthermore, a second breeding tree for masked owl was also detected by John Young (2019) to the north of the Development Footprint in the riparian corridor which is now zoned as C2 land and will be avoided with a substantial buffer. Both breeding trees are situated greater than 200 metres from the edge of the Development Footprint and will remain in intact bushland.

While not all the threatened species and ecological communities could be avoided by the proposed development, concentration of the proposed development impacts in the southwest of the site ensures that a large area of habitat of threatened entities is avoided. **Figure 4.1** shows these entities that have been avoided as part of the assessment process.

4.1.1 Size

The Development Footprint is approximately 34.7 ha in area and represents approximately 23.6 per cent of the total area of Lot 642 DP 1027231 and Part Lot 100 DP 1044282, which combined are a total of 147 ha. Darkinjung LALC, during their planning process, have therefore actively avoided direct biodiversity impacts to approximately 112.3 ha of vegetated land 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 the Pacific Highway and Chain Valley Bay 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 minor weed incursions, access tracks and rubbish dumping. The bushland to the north of the development footprint will remain relatively intact, with little incursion into these areas.

4.1.3 Connectivity

As mentioned above, the Development Footprint has been positioned in the southwest of the land holding in an area already subject to edge effects and indirect impacts from existing surrounding development and roads. In addition to this, the Development Footprint has been reduced in the north to retain connectivity values that currently exist.

Impacts on connectivity were identified in the original BCAR (GHD 2018) and was a key consideration in the re-design of the proposed development. The revised development footprint 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 largely 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.

Legend

- Proposed Rezoning Extent
- Current Development Footprint
- E2 Zone
- Revised Development Footprint
- Original Development Footprint
- Watercourses

Threatened Species Records

- *Tetratheca juncea*
- Masked Owl Breeding Tree

FIGURE 4.1

Biodiversity Constraints Considered to Inform Impact Avoidance

Image Source: Nearmap (April 2020) Data source: DSFI (2017); NSW LPI (2019)

4.2 Timing and Methods for Clearing Works

Darkinjung LALC 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 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.

4.2.1 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) 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.

4.3 Summary of Measures

Figure 4.1 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 and high- threat weed species in accordance with the *NSW Weed Control Handbook* (DPI 2018).	• Minimisation of environmental and noxious weeds in the Development Footprint. • Minimisation of weed spread from and into the wider locality.

5.0 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 due to 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 outlines the direct impacts on native vegetation, which totals approximately 33.6 ha. 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 effects of these direct impacts are discussed in **Section 4.0** above.

Table 5.1 Direct Impacts of the development on Biodiversity Features

Species	Area within the Development Footprint (ha)
Plant Community Type	
1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast - good	23.0
1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast - disturbed	1.9
1638 Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	7.3
1724 Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast	1.4
Species-credit Species Habitats	
black- eyed susan (*Tetratheca juncea*)	30.3
wallum froglet (*Crinia tinnula*)	1.4
Swift parrot (*Lathamus discolor*)	32.4

5.1.2 Indirect Impacts

The proposed development is not expected to result in any substantial indirect impacts on the biodiversity values of the adjacent land. No indirect impacts are expected to occur in relation to surrounding connectivity, corridors or habitat fragmentation, considering the already disturbed nature of the Development Footprint. However, some minor indirect impacts associated with noise, dust and weeds may occur during construction. These are discussed in **Table 5.2**. No indirect impact zones have been identified for this assessment.

Table 5.2 Indirect Impacts

Impact	Description
Water	Changes to the water flow or quality from the Development Footprint into the adjacent watercourse (occurring in the centre of the Development Footprint) are likely to occur as a result of increased runoff from hardstand areas. However, the major watercourse and swampy areas forming part of the C2 zoned area will not be directly impacted. Changes to hydrology are considered minor and the design should incorporate maintenance of pre-development flows from the development area (quantity and quality) into the hydrogeological system wherever possible. The buffer provided by the C2 zone will help to minimise runoff from the hardstand areas by providing a natural 'sponge' and slowing the excess in times of heavy rainfall. Additionally, water management within the design of the project should take these factors into account to ensure that hydrology is not altered significantly. Impacts to Karignan Creek to the north are likely to be of lesser consequence, given its distance from the Development Footprint and its proximity to the C2 zone.
Noise	Construction noise may disrupt the roosting and foraging behaviour of fauna species and reduce the occupancy of areas of suitable habitat. With regard to potential impacts on biodiversity, there will be no substantial change to noise impacts given that the development will be located immediately adjacent to the Pacific Highway, a very busy roadway. Any additional impacts resulting from noise emissions are not expected to be of any level of significance in relation to threatened species, populations and communities.
Weed management	Weed species could be inadvertently brought into the Development Footprint with imported materials or could invade naturally through removal of native vegetation. The presence of weed species within the Development Footprint have the potential to decrease the value of proximate extant vegetation. Mitigation measures outlined in **Section 4.2** will be implemented to minimise the potential for weed encroachment into areas surrounding the Development Footprint.
Pest animal species	Populations of feral fauna species such as foxes, rabbits and cats can increase and quickly populate new areas as a result of disturbance. Clearing, thinning of vegetation and the creation of tracks have the ability to assist the establishment and spread of feral fauna species. However, given the level of clearing proposed and the increase in human activity, it is unlikely that fauna species would populate the Development Footprint. Mitigation measures outlined in **Section 4.2** will minimise the potential for feral animal spread and impacts into surrounding areas around the Development Footprint.
Air quality impacts	Air quality impacts have the potential to adversely impact native species during ground disturbance works. Potential impacts include dust covering vegetation thereby potentially reducing vegetation health and growth. The design of the proposal will include inherent measures to minimise the potential for adverse dust impacts.

With regard to potential impacts on biodiversity, the majority of impacts will be pertaining to the removal of habitat and disruption to connectivity. There will be some impact and change to water flows (see above), though impacts to noise, weed species, pest animal, lighting or air quality related impacts are likely to be of little consequence. This is because the land will be devoid of vegetation and will therefore provide little to no habitat for flora and fauna and is adjacent to existing land uses that are fairly disruptive. There will be some edge effects related to encroachment of weeds, additional noise and lighting from residential backyards and street lighting, but these are anticipated to be minor.

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.

No areas of non- native vegetation exist within the Development Footprint. There are several cleared tracks through the Development Footprint, though these do not 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 these cleared areas.

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 major roads and will negligibly reduce the extent of the existing extensive vegetated corridor to the north and east. 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 Coast National Parks and State Forests. The project proposes to impact a relatively minor proportion of this area of native vegetation (approximately 875 m at its widest point), and by revising the Development Footprint to the current iteration, is now 100 metres wider. This occurred following detailed discussions with Central Coast Council and DPIE and a detailed letter regarding the functionality of the Corridor was prepared by Umwelt on behalf of Darkinjung LALC (Umwelt 2020) and is discussed below.

The Project's potential impacts on corridor widths and functionality in the locality was raised early in the design of the project footprint following re-zoning advice from DPIE in relation to the Project's original proposed layout. The advice received by Darkinjung LALC was to ensure that the corridor was not reduced to less than 200 metres, which was consistent with the width of the corridor to the west of the site, as identified in the draft Greater Lake Munmorah Structure Plan (CCC 2019b). Darkinjung LALC then amended the project layout again to ensure the project would not result in narrowing this east-west corridor to less than 200 metres. As discussed, the layout has been revised a third time, to result in an additional 100 m width.

The guidance of retaining a 200 metre east-west corridor along Karignan Creek is considered an appropriate balance between conservation outcomes and facilitating development in the locality given the existing mixed land use and the habitat requirements for the species considered likely to occur on site. The project will not sever the patch size class which is currently over 700 hectares in the 1500m buffer area in accordance with the BAM. This patch is much larger in the wider locality connecting habitats outside the 1500 metre buffer area.

The corridor itself will remain the same size overall, and minor impacts to connectivity will occur. Should the remainder of the Darkinjung LALC- owned lands at Lake Munmorah be conserved through a Stewardship Agreement, it would 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 development. The masked owl (*Tyto novaehollandiae*) is known to forage and breed in this corridor, but its habitat will remain largely unchanged, with the two known breeding trees being retained in a buffer. Similarly, threatened flora species and threatened ecological communities rely on connectivity for the exchange of genetic material, with black- eyed Susan (*Tetratheca juncea*) being known to occur. Therefore, impacts to connectivity limit the diversity within any given gene pool. However, considering the relatively small area of connectivity to be removed, and given that the vegetation is already somewhat disturbed, and the fact that large numbers of black- eyed Susan occur outside the Development Footprint, impacts to genetic exchange are not anticipated such that these threatened species or communities would cease to exist in the locality.

No creeks or mapped drainage lines occur within the Development Footprint. Wet soak areas were detected, especially in the vicinity of the *Swamp Sclerophyll Forest on Coastal Floodplains in the NSW North Coast and Sydney Basin Bioregion* EEC, though these are typically only moist after rainfall. Changes to the water flow or quality from the Development Footprint into the adjacent watercourse (occurring in the centre of the Development Footprint) are likely to occur as a result of increased runoff from hardstand areas. This area provides habitat for the threatened species wallum froglet (*Crinia tinnula*) in the way of a heathy swamp, though significant changes to its habitat are not anticipated to occur, such that the species would decline or evacuate the area. In fact, the majority of the habitat provided will remain in the C2 zoned area.

No direct impacts to the hydrological processes of Karignan Creek 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 in times of heavy rainfall. These should also be minimal, given the buffer provided by the C2- zoned area, and provided appropriate erosion and sediment controls are in place.

Access to the Development Footprint will occur via Chain Valley Bay Road. As the Development Footprint occurs immediately adjacent to this and the Pacific Highway, a very 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. The anticipated increase in vehicular movement is not at such a scale that the increase in vehicle strikes would be significant such that any population of a threatened species would become further reduced.

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.

One of the species- credit species with habitat mapped within the Development Footprint is listed as potentially serious and irreversible impacts (SAII), swift parrot (*Lathamus discolor*).

Further assessment of the swift parrot against the principles of SAII species is provided below.

5.3.1 Swift Parrot SAII Assessment (S9.1 BAM 2020)

As noted in **Section 3.3** and shown in **Figure 5.1**, the Development Footprint occurs in an area that is mapped by DPIE as 'important habitat' for the swift parrot. The swift parrot important habitat area mapping was developed according to the following methods:

- Swift parrot sighting records from 1990-2018 were extracted from BioNet and BirdLife Australia Atlas. Records were checked and cleaned. Records were filtered to include only sightings with five or more birds. A two kilometre radial buffer was applied.

- Important areas were defined by:

    - Areas with five or more records, where observations have occurred over two or more years and are within two kilometres of one another, or

    - Areas with a single record of 40 or more birds.

The NSW State Vegetation Type Map (including draft East Coast classification) was used to select Plant Community Types associated with the swift parrot within the buffers. Any areas of vegetation less than one hectare were excluded.

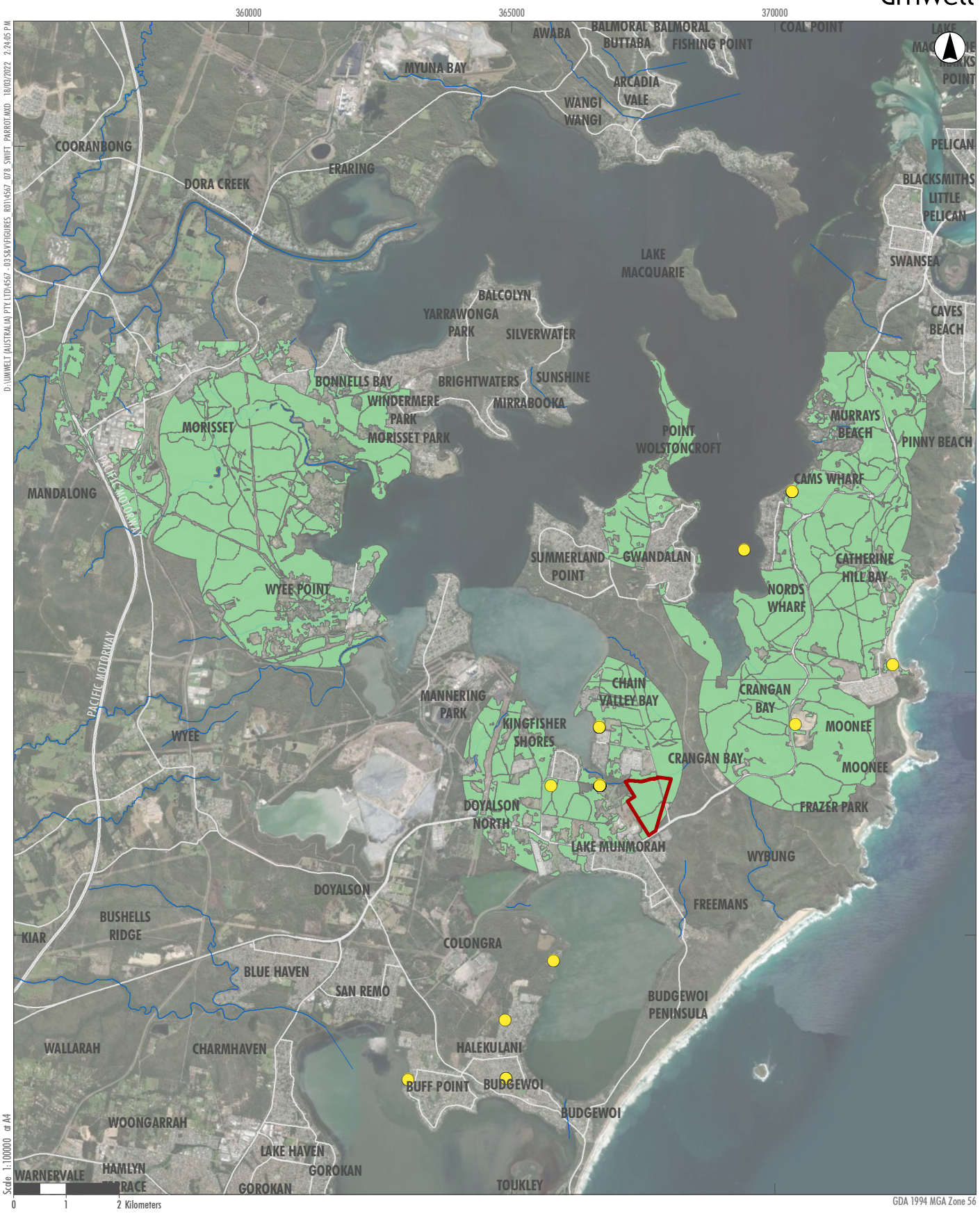
There is a total of 4903.8 ha of important habitat shown within ten kilometres of the Development Footprint as shown in **Figure 5.1**.

The swift parrot is listed as endangered under the BC Act and critically endangered under the EPBC Act. The species breeds in Tasmania and moves to mainland Australia for the non-breeding season (usually arriving between February and March) (Saunders and Tzaros 2011). Most of the population winters in Victoria and NSW where it disperses across broad landscapes foraging on nectar and lerps in eucalypts. They return to Tasmania in spring (September-October).

Until recently it was thought that in NSW, swift parrots forage mostly in the coastal and western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region (Saunders and Tzaros 2011). However, evidence is gathering that the forests on the coastal plains from southern to northern NSW are also important.

Upon reaching their core non-breeding range there is no known geographical pattern of movement. The movements of this species on the mainland are poorly understood, but it is considered to be nomadic and irruptive, moving in response to food supply. During the non-breeding season, the home-range varies tremendously between individuals and between years.

The swift parrot is likely to utilise coastal forest and river-flat vegetation associations. Key foraging tree species identified in the management plan for the Hunter-Central Rivers natural resource management region and coastal NSW include swamp mahogany (*Eucalyptus robusta*), blackbutt (*Eucalyptus pilularis*), forest red gum (*Eucalyptus tereticornis*) and spotted gum (*Corymbia maculata*) (Saunders and Tzaros 2011).



Legend

- Proposed Rezoning Extent
- Swift Parrot Important Areas
- Swift Parrot Records (Bionet 2022)
- Roads
- Drainage Line

FIGURE 5.1

Swift Parrot Important Habitat Mapping

Image Source: Nearmap (Feb 2022) Data source: DSFI (2017); NSW LPI (2019); Bionet (2022)

Priority sites for the swift parrot have been identified within the National Recovery Plan for the species (Saunders and Tzaros 2011). In NSW priority sites are to be identified in the Hunter Central Rivers natural resource management area, which includes the locality of Lake Munmorah, which are habitats used by large proportions of the population, repeatedly used (site fidelity) or occupied for prolonged periods (site persistence (Saunders and Tzaros 2011). Site fidelity is considered important for the long-term survival.

As discussed above, areas of important habitat for the swift parrot in NSW have been mapped by DPIE and mapping is provided in **Figure 5.1**. **Figure 5.1** also provides the NSW Bionet Atlas (2022) records that are likely to have been considered in development of the mapping. **Plate 5.1** shows records of the swift parrot from Bird Data (2022) in the vicinity of the Development Footprint from 1995 to present.

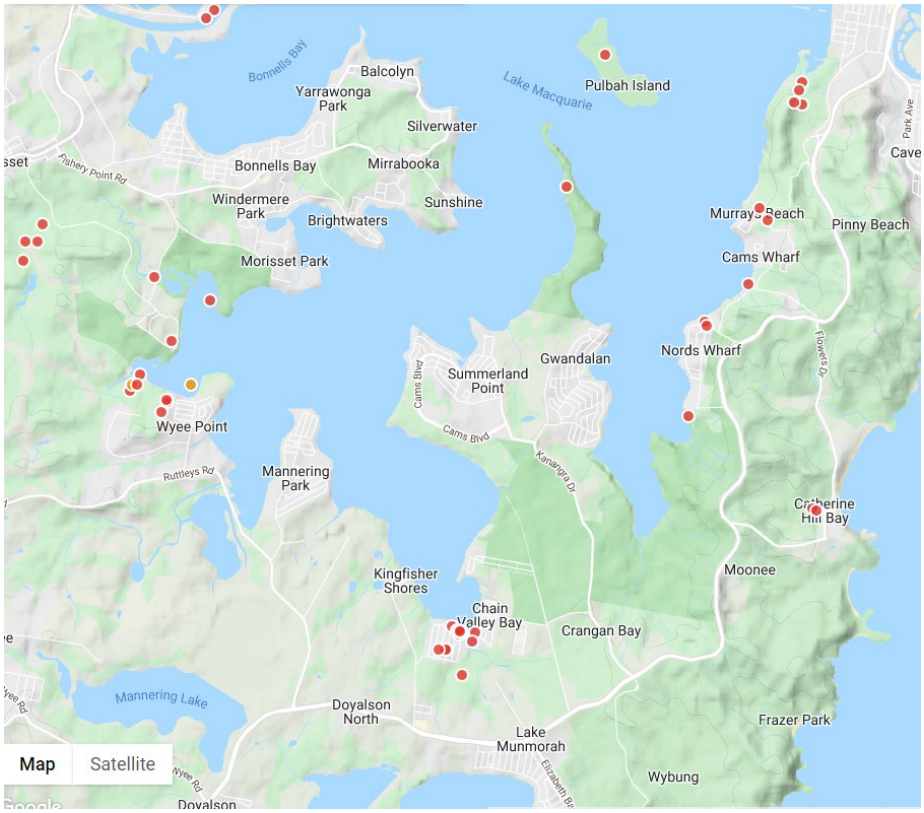


Plate 5.1 Bird Data sighting records of swift parrot in the vicinity of the Development Footprint

In relation to the Development Footprint, there have been no sightings of the swift parrot on site but there are regular sightings of this species nearby with all records from the immediate area occurring at Chain Valley Bay (refer to **Plate 5.1** and **Figure 5.1**). The majority of records are at Joshua Porter Reserve and Karignan Creek Reserve about 1.3 km and 0.9 km to the east of the Development Footprint, respectively. These reserves are on the shores of Chain Valley Bay where Karignan Creek flows into Lake Macquarie.

Both Joshua Porter Reserve and Karignan Creek Reserve are named as 'hotspots' by eBird Australia with records of swift parrots. Other nearby 'hotspots' do not have any records of the swift parrot. The swift parrot was first reported at Joshua Porter Reserve in April 2011, with the highest estimate of numbers at 150 birds in May 2019 to a low of only 2 individuals reported in April 2021 (ebird, hotspot L2535120). At nearby Karingnan Creek Reserve the swift parrot was first recorded in June 2011, last seen May 2021 and the highest estimate of numbers 30 in July 2011 (ebird hotspot L2534952). At these reserves swift parrots are generally recorded feeding within swamp mahogany (*Eucalyptus robusta*) (eBird Australia 15/03/2022).

While there have been no records of swift parrot on site, and preferred foraging resources for the swift parrot is only associated with swamp mahogany that occurs in very low numbers in PCT 1724, in accordance with the BAM, important habitat mapping is used to determine impacts.

An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct if:

- It 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
- It 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
- The 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
- The impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

In relation to the swift parrot, none of the principles above are considered likely to occur as a result of the proposed project. Notwithstanding this, an assessment in accordance with Section 9.1.2 of the BAM is provided in **Table 5.3** and **Table 5.4**.

Table 5.3 SAII Assessment – Current Population Status

Criteria	Assessment
Evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the:	
• **decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or**	Estimating the population size of this species in NSW is not possible due to its migratory nature and yearly fluctuations. The national population of this species was estimated to be 2000 in the mid 1990s (TSSC 2016). A recent score card for this species assessing change in the population since then has projected an annual percentage population decline between 4 - 5% (National Environmental Science Program Threatened Species Research Hub 2019). Other recent estimates are that the population size is between 750 and 300 individuals in Australia (Birdlife Australia 2021).
• **decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites.**	Estimating the population size of this species in NSW is not possible due to its migratory nature and annual fluctuations to dispersal. As note above the national population size is estimated at 2000 however it is unclear what the population is now but has been declining primarily due to threats in breeding habitat in Tasmania. However, loss of over-wintering foraging habitat is a threat to the population. Important over-wintering habitat has been mapped for swift parrot. About 4903 ha has been mapped within 10 km of the Development Footprint. It is unlikely that the removal of approximately 32.4 ha (or 0.7%) of potential foraging habitat would cause a further decline in the species or reduce its population size.

Criteria	Assessment
Evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by:	
• **an estimate of the species' current population size in NSW,**	Estimating the population size of this species in NSW is not possible due to its migratory nature and annual fluctuations to dispersal over-winter. Roderick and Stuart (2016) report that frequently about 100 birds visit the Hunter Region each winter, representing about 5% of the total estimated population (estimated to be 2000). Known records of the swift parrot in the immediate locality are at nearby Joshua Porter Reserve and Karignan Creek Reserve. The most birds recorded at any one time is reported at 150 in May 2019 at Joshua Porter Reserve. This represents about 7.5% of the national population.
• **an estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and**	Estimating the population size of this species in NSW is not possible due to its migratory nature and annual fluctuations to dispersal. It is estimated that 10 years ago, there were 2000 mature individuals breeding in Tasmania (Garnett et al 2011) and the population is now reportedly between 300 and 750 individuals (Birdlife Australia 2021). The species' population has declined over the previous decade as is recognised in the national conservation listing changing from endangered to critically endangered. Decline is likely to be attributed to a range of factors over a very wide geographic distribution.
• **where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations**	The species is described as one national population because the entire species migrates from breeding sites in Tasmania to the mainland each winter.
Evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by:	
• **extent of occurrence**	This species is highly mobile and migrates from Tasmania to the mainland each year (DPIE 2021b). The extent of occurrence is estimated (low confidence) to be 57,000km^2 and is not considered limited (TSSC 2016).
• **area of occupancy**	The species breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland (DPIE 2021b). The conservation advice for listing of the species nationally identified that the area of occupancy for the swift parrot for breeding habitat is estimated to be between 41km^2 in 2014 to 713km^2 in 2011, an average of 425km^2 per year (TSSC 2016). Including breeding and foraging habitat it is estimated to range from 18.5 to 355km^2 between 2009 - 2014 (TSSC 2016). While an area of 32.4 ha of swift parrot important habitat is proposed to be removed, this represents a very minor area of important habitat mapped within the greater area, being a total of 4903.8 ha (**Figure 5.1**). The area to be removed represents 0.7% of this mapped habitat. Swift parrot important habitat mapping extends even further outside this area in the locality to the north and south, with large areas mapped at Norah Head, Wyong and The Entrance to the south, and Belmont, Kilaben Bay and Fennell Bay to the north. Therefore, the total to be removed on the Central Coast region would be less than 0.7%.

• **number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and**	Not applicable to this species due to its high mobility. The PCTs that are mapped as important habitat for the swift parrot in the Development Footprint are very common in the region and extend outside the Development Footprint on DLALC- owned land (GHD 2018). There is approximately 4,761 ha of PCT 1636 in Lake Macquarie Local Government Area (LGA) alone (Bell 2016) and about 3,380 ha in the Central Coast region (Bell 2019). The removal of 23 ha, the largest PCT being removed, represents about 0.3% of that PCT in the Lake Macquarie and Central Coast area. Similarly, PCT 1638 is the second- largest vegetation type area to be removed with 7.3 ha in the Development Footprint. there is approximately 1697 ha of this PCT in Lake Macquarie LGA (Bell 2016) and about 380 ha in the Central Coast region (Bell 2019). The area to be removed represents 0.4% of the PCT in the Lake Macquarie and Central Coast area. More importantly for the swift parrot, there are large areas of vegetation communities in the Lake Macquarie area that contain swamp mahogany (*Eucalyptus robusta*) as the dominant species. Swamp mahogany is a typical winter- flowering species that does provide important habitat for the swift parrot during its winter migration to mainland Australia. The three largest vegetation communities within Lake Macquarie LGA that have swamp mahogany as the dominant species totals 2,257 ha (Bell 2016). The proposed rezoning and subsequent development have largely avoided clearing areas supporting swamp mahogany. About 1.4 ha of PCT 1724 is mapped in the Development Footprint however there are few swamp mahogany in this PCT. It is unlikely that the loss of 1.4ha of this PCT would cause this species to be rapidly affected such that it would become extinct particularly given that the PCT on site supports very few swamp mahogany. One of the dominant trees on site is red bloodwood (*Corymbia gummifera*). While the profile for swift parrot states that, in addition to the aforementioned trees, red bloodwood is a favoured feed tree in winter, this species is in fact not typically a winter- flowering tree. When the swift parrot arrives in southern NSW, in autumn the red bloodwood is still flowering and may provide an important foraging resource. However, by the time the birds reach the Central Coast region of NSW in May, June or July, this tree has typically finished its flowering for the season (Cooke 2007). On the Central Coast, the swift parrot is far more likely to be reliant on well- documented winter- flowering species being swamp mahogany and spotted gum (Roderick and Ingwersen 2014), neither of which are found in the Development Footprint. Further, records of swift parrot from 1995 to 2014 in the Central Coast region alone do not mention any recordings in red bloodwood, whereas swamp mahogany was repeatedly mentioned (Roderick and Ingwersen 2014). The foraging habitat in the Development Footprint are unlikely to be regularly relied upon by the swift parrot that may occur in the locality in response to winter flowering trees, given that the dominant trees in the Development Footprint (scribbly gum (E*ucalyptus haemastoma*), smooth-barked apple (*Angophora costata*), red bloodwood (*Corymbia gummifera*), brown stringybark (*Eucalyptus capitellata*) and *Angophora inopina*) are not typically flowering in winter when the swift parrot occurs in the region. While the broad- leaved paperbark (*Melaleuca quinquenervia*) that occurs on site in PCT 1724, flowers in winter it is not identified as a preferred foraging resource in the recovery plan and/or

Criteria	Assessment
	local reports. Therefore, it is unlikely that this area of habitat would be relied upon year after year by the swift parrot as a foraging resource. This species also does not breed in NSW, so the removal of any potential nest sites, is not applicable to this assessment. Furthermore, the Project is avoiding a much larger area of swamp sclerophyll forest EEC (in the C2 zoned area and downstream), which typically includes the winter- flowering feed tree swamp mahogany (*Eucalyptus robusta*), known to provide resources for the swift parrot, it is unlikely that the removal of 32.4 hectares of marginal foraging habitat would be significant to the survival of the swift parrot, or impede its recovery. Therefore, the quality of the habitat to be removed is not considered high.
• **whether the species' population is likely to undergo extreme fluctuations**	The population of this species is not likely to undergo extreme fluctuations, as it is not typically a 'boom and bust' species subject to major fluctuations in the availability of resources. Even if a 'boom' of winter- flowering trees occurred in NSW, this is unlikely to cause an extreme fluctuation of this species, because this would be occurring when the species is not breeding, and therefore will not affect the rate at which the species can produce young and increase the population.
Evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because:	
• **known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g., species is clonal) on, a biodiversity stewardship site**	This species does not have reproductive characteristics that severely limit its ability to increase in population size or occupy new habitat. While the species is reliant on old- growth forest in Tasmania for breeding, this is not applicable to this assessment.
• **the species is reliant on abiotic habitats which cannot be restored or replaced (e.g., karst systems) on a biodiversity stewardship site, or**	This species is not reliant on abiotic habitats.
• **life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g., frogs severely impacted by chytrid fungus).**	This species does not have life history traits whereby the ability to control key threatening processes is negligible.

Table 5.4 SAII Assessment – Impact Assessment

In relation to the impacts from the proposal on the species at risk of an SAII, the assessor must include data and information on:	
The impact on the species' population (Principles 1 and 2) presented by:	
i. an estimate of the number of individuals (mature and immature) present in the subpopulation on the subject land (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and	No individuals were present in the Development Footprint. This species was not detected during surveys and is being assessed for important mapped habitat only.
ii. an estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or	No individuals are present in the Development Footprint. This species was not detected during surveys and is being assessed for important mapped habitat only. Roderick and Stuart (2016) report that frequently about 100 birds visit the Hunter Region each winter, representing about five per cent of the total estimated population (estimated to be 2000). Known records of the swift parrot in the immediate locality are at nearby Joshua Porter Reserve and Karignan Creek Reserve. The most birds recorded at any one time is reported at 150 in May 2019 at Joshua Porter Reserve. This represents about five per cent of the national population.
iii. if the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal	No individuals were present in the Development Footprint. This species was not detected during surveys and is being assessed for important mapped habitat only. The area and quality of the habitat to be impacted will be used as a surrogate for the population of the species, as well as the mapped important habitat. 32.4 ha of important mapped habitat occurs in the Development Footprint. As stated above, the area to be removed represents 0.7% of the important habitat mapped in the local area, as 0.5% of PCT 1636 (the largest PCT to be removed) in the Central Coast LGA. This represents a minimal area of habitat to be removed. Furthermore, according to the National Recovery Plan for the Swift Parrot (Saunders and Tzaros, 2011), important foraging habitat in NSW includes woodland and forest with the following key tree species: • Mugga ironbark (*Eucalyptus sideroxylon*) • Grey box (*Eucalyptus microcarpa*) • White box (*Eucalyptus albens*) • Yellow box (*Eucalyptus melliodora*) • Swamp mahogany (*Eucalyptus robusta*) • Forest red gum (*Eucalyptus tereticornis*) • Blackbutt (*Eucalyptus pilularis*) • Spotted gum (*Corymbia maculata*). The Development Footprint occurs in an area where the swift parrot important habitat mapping does not align with important foraging habitat according to the National Recovery Plan. The surveyed habitat in the Development Footprint comprises the following PCTs and tree species: • 1636 Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast moderate condition

In relation to the impacts from the proposal on the species at risk of an SAII, the assessor must include data and information on:	
	• PCT 1638 Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands (good condition) • PCT 1724 Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (good condition). The trees that dominate the Development Footprint are not identified in the recovery plan as forming important winter foraging habitat for the swift parrot. The only important feed tree present in the vicinity of the Development Footprint is the swamp mahogany (*Eucalyptus robusta*), but this species occurs to the north of the Development Footprint and will not be impacted. This species occurs in very low numbers in PCT 1724. There are stands of swamp mahogany downstream along Karignan Creek. One of the dominant trees on site is red bloodwood (*Corymbia gummifera*). While the profile for swift parrot states that, in addition to the aforementioned trees, red bloodwood is a favoured feed tree in winter, this species is in fact not typically a winter- flowering tree. The swift parrot migrates from Tasmania into Victoria and then onto NSW. In southern NSW red bloodwood does provide an important feed tree for the swift parrot upon its entry into NSW when arrival of the swift parrot coincides with flowering of the red bloodwood. However, by the time the birds reach the Central Coast region of NSW in May, June or July, this tree has typically finished its flowering for the season (Cooke 2007). On the Central Coast/Lake Macquarie area, particularly along the coast, the swift parrot is far more likely to be reliant on well- documented winter-flowering species being swamp mahogany and spotted gum (Roderick and Ingwersen 2014), neither of which are found in the Development Footprint. Further, records of swift parrot from 1995 to 2014 in the Central Coast region alone do not mention any recordings in red bloodwood, whereas swamp mahogany was repeatedly mentioned (Roderick and Ingwersen 2014). Therefore, the quality of the habitat to be removed is not considered high.
Impact on geographic range (Principles 1 and 3) presented by:	
i. the area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total Area of Occupation (AOO), or Extent of Occupation (EOO) within NSW	Information regarding AOO or EOO is not available, due to the migratory nature of the species and its sporadic occurrence across NSW during migration. This species occupies breeding habitat in Tasmania, but also migrates into Victoria and NSW, therefore the proposed removal of 32.4 ha of habitat is negligible to this large area. However, as stated above, the area to be removed represents 0.7% of the important habitat mapped in the locality, and 0.3% of PCT 1636 (the largest PCT to be removed) in the Central Coast and Lake Macquarie LGA. This represents a minimal area of habitat to be removed.
ii. the impact on the subpopulation as either: • **all individuals will be impacted (subpopulation eliminated);** • **OR impact will affect some individuals and habitat;** • **OR impact will affect some habitat, but no individuals of the species will be directly impacted**	32.4 ha of important mapped habitat occurs in the Development Footprint, but no individuals of the species will be directly impacted.

In relation to the impacts from the proposal on the species at risk of an SAII, the assessor must include data and information on:	
iii. to determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g., seed dispersal) and pollination distance for the species	The swift parrot is assessed as one national population with no subpopulations. The removal of 32.4 ha of important habitat as mapped by DPE is unlikely to impact upon the viability of any individuals that may forage within the locality and Development Footprint. Genetic exchange is likely to remain unaffected due to the highly mobile nature of the species.
iv. to determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections of the BDAR or BCAR.	The removal of 32.4 ha or 0.7% of important mapped habitat in the locality is unlikely to change any potential threats for this highly mobile species. The proposal is not likely to change fire regimes, hydrology, pollutants, disease, pathogens and parasites. However, the removal of 33.6 ha for the Development Footprint has the potential to result in changes to species interactions, fragmentation, edge effects and likelihood of disturbance. Edge effects and fragmentation are not likely to significantly and directly disrupt the locally occurring population of swift parrots, because they are highly mobile and tend to forage wherever food is abundant including in isolated flowering trees, as opposed to requiring large contiguous tracts of native vegetation. However, the creation of fragmentation and edge effects does play a role in the interaction of bird species, particularly where aggression is shown by one species over another. By reducing the availability of habitat in the wider area, these threats can exacerbate such things as competition by locally- common, aggressive species, such as the noisy miner (*Manorina melanocephala*). This species tends to drive away other birds when they forage in open, cleared areas typically created by human disturbance. By removing 33.6 ha of native vegetation, the open areas created by this disturbance may increase the availability of habitat for noisy miners, thereby increasing the likelihood of this species to drive away less aggressive birds such as the swift parrot. Refer to **Section 4.2** for minimisation and avoidance measures.

5.4 Aquatic Impacts

Aquatic habitats within the Development Footprint consist of the margins of swampy areas, adjacent to the drainage line which occurs outside the Development Footprint in the C2 zoned area. The potential impacts on water quality are anticipated to be limited, given that only the margins occur within the footprint, and that these swampy areas are only inundated after rainfall.

Standard environmental management measures will be implemented and are expected to sufficiently manage any impacts. Water and erosion management controls will be employed to minimise erosion and discharge of sediment and other pollutants during construction.

6.0 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 does not contain any areas that are currently unvegetated with native vegetation. There is approximately 1.1 ha of tracks and trails within the Development Footprint that do not require assessment.

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 an 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. **Figure 6.1**. summarises the above.

6.3 Impacts Requiring Offset

Four PCTs and three species-credit species require offsetting in accordance with the BAM (DPIE 2020a). **Table 6.1** and **Figure 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	1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast - good	52.1	0	-52.1	23.0	**525**
2	1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast - disturbed	62.9	0	-62.9	1.9	**52**
3	1638 Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	70.5	0	-70.5	7.3	**225**
4	1724 Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast	68.3	0	-68.3	1.4	**48**
-	black-eyed Susan (*Tetratheca juncea*)	-	-	-	30.3	**857**
-	wallum froglet (*Crinia tinnula*)	-	-	-	1.4	**36**
-	swift parrot (*Lathamus discolor*)	-	-	-	32.4	**1407**

Legend

- Proposed Rezoning Extent
- Revised Development Footprint
- Areas requiring assessment
- Areas not requiring assessment
- Watercourses

FIGURE 6.1

Impact Summary

Image Source: Nearmap (April 2020) Data source: DSFI (2017); NSW LPI (2019)

7.0 Biodiversity Credit Report

A full Biodiversity Credit Report is included in **Appendix E**.

A summary of the key outcomes is provided in **Table 7.1**.

Table 7.1 Credits Required to Offset the Proposed Development

Veg Zone	PCT/Species-credit	Credits Required
1	1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast - good	**525**
2	1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast - disturbed	**52**
3	1638 Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	**225**
4	1724 Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast	**48**
-	black-eyed Susan (*Tetratheca juncea*)	**857**
-	wallum froglet (*Crinia tinnula*)	**36**
-	swift parrot (*Lathamus discolor*)	**1407**

8.0 Biodiversity Offset Strategy

Darkinjung LALC is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of biodiversity values, as a result of development, under the BC Act and *Biodiversity Conservation Regulation 2017*. Firstly, Darkinjung LALC has, where possible, altered the Project to avoid and minimise biodiversity impacts in the planning stage, and committed to a range of mitigation strategies to mitigate the impact to ecological values (refer to **Section 4.0** and GHD (2018)) 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:

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

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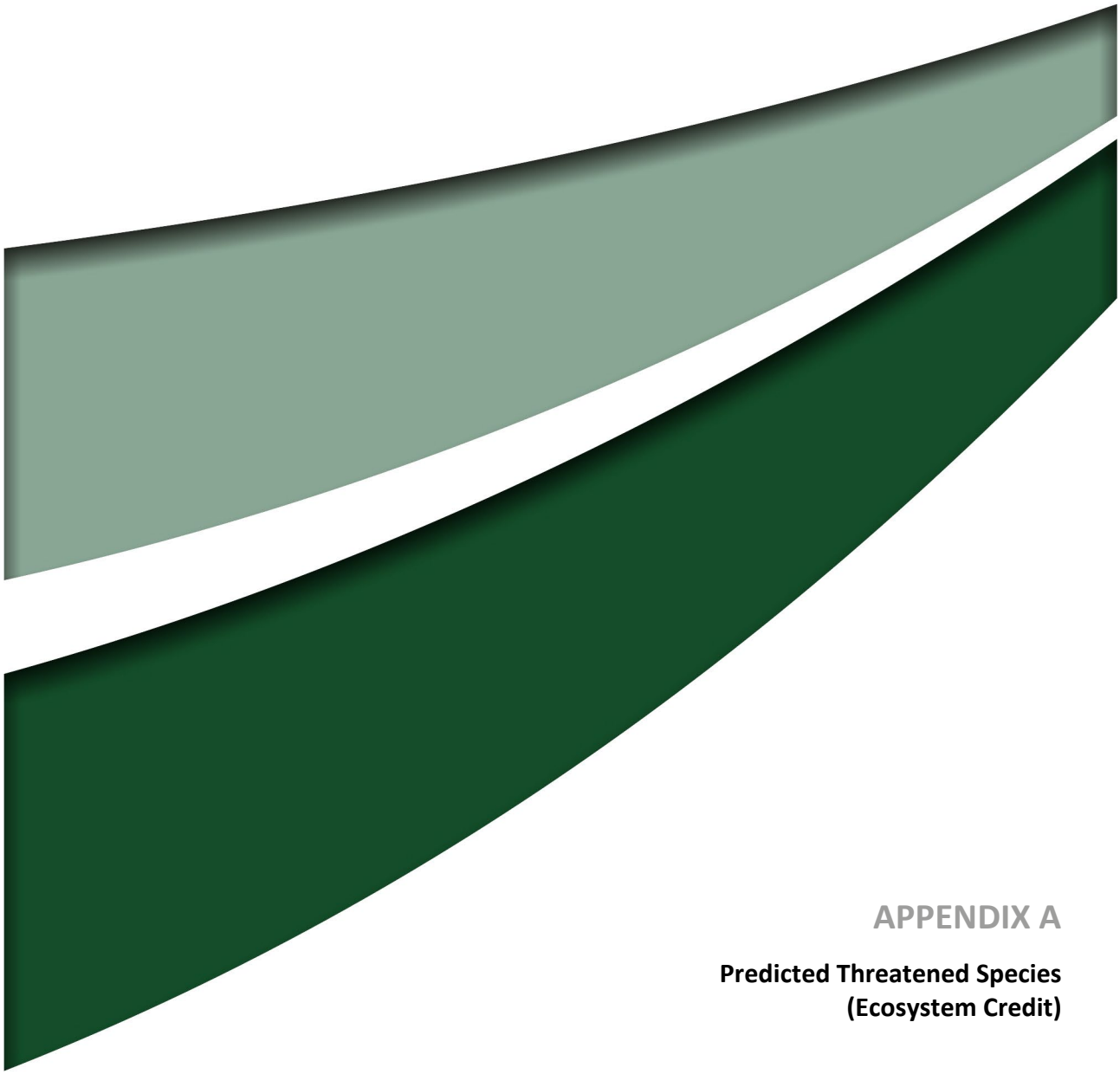


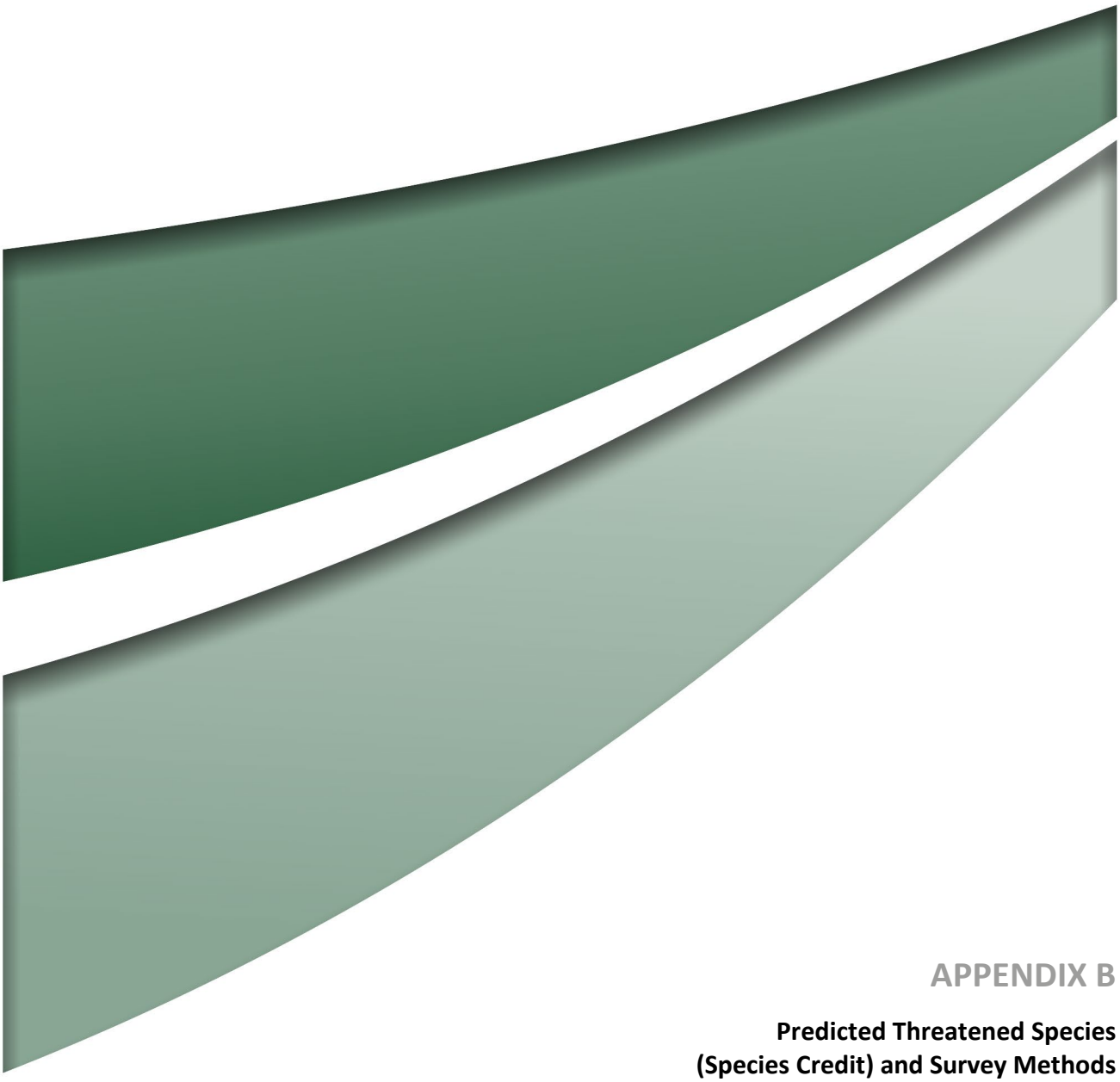
APPENDIX A

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	-
gang-gang cockatoo (foraging) *Callocephalon fimbriatum*	V	-	Moderate	-
speckled warbler *Chthonicola sagitatta*	V	-	High	-
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	-
black- necked stork *Ephippiorhynchus asiaticus*	E	-	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	-
black bittern *Ixobrychus flavicollis*	V	-	Moderate	
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	-
eastern coastal free-tailed bat *Micronomus norfolkensis*	V	-	High	-
little bentwing-bat (foraging) *Miniopterus australis*	V	-	High	-

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint
eastern bentwing-bat (foraging) *Miniopterus schreibersii oceanensis*	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	-
golden- tipped bat *Phoniscus papuensis*	V	-	High	-
grey- crowned babbler *Pomatostomus temporalis temporalis*	V	-	Moderate	-
eastern chestnut mouse *Pseudomys gracilicaudatus*	V	-	High	-
grey-headed flying-fox (foraging) *Pteropus poliocephalus*	V	V	High	-
greater broad- nosed bat *Saccolaimus flaviventris*	V	-	Moderate	-
greater broad-nosed bat Scoteanax rueppellii	V	-	High	-
masked owl (foraging) *Tyto novaehollandiae*	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	All year	-	No	**Species not detected.** Targeted threatened species transects across original and revised development footprint in August 2018 in suitable habitat (PCT 1636). Targeted threatened species transects across part of the revised development footprint in October 2018. Targeted threatened species transects during February, November and December 2019 across the original development footprint, and part of the revised development footprint. Targeted threatened species transects across the remainder of the revised development footprint in August, September and November 2020.
charmhaven apple ***Angophora inopina***	V	V	All year	-	No	**Species not detected.** Targeted threatened species transects across original and revised development footprint in August 2018 in suitable habitat (PCT 1636). Targeted threatened species transects across part of the revised development footprint in October 2018. Targeted threatened species transects during February, November and December 2019 across the original development footprint, and part of the revised development footprint. Targeted threatened species transects across the remainder of the revised development footprint in August, September and November 2020.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
thick-leaf star-hair ***Astrotricha crassifolia***	V	V	Jul-Dec	-	Yes	**Species not detected.** Targeted threatened species transects across original and revised development footprint in August 2018 in suitable habitat (PCT 1636). Targeted threatened species transects across part of the revised development footprint in October 2018. Targeted threatened species transects during February, November and December 2019 across the original development footprint, and part of the revised development footprint. Targeted threatened species transects across the remainder of the revised development footprint in August, September and November 2020.
thick lip spider orchid ***Caladenia tessellata***	E	V	Sept-Oct	-	Yes	**Species not detected.** Targeted threatened species transects across the original development footprint in October 2018. Targeted threatened species transects across the remainder of the revised development footprint in September 2020.
netted bottle brush ***Callistemon linearifolius***	V	-	Oct-Jan	-	No	**Species not detected.** Targeted threatened species transects across part of the revised development footprint in October 2018. Targeted threatened species transects during November and December 2019 across the original development footprint, and part of the revised development. Targeted threatened species transects across the remainder of the revised development footprint in November 2020.
Sand spurge ***Chamaesyce psammogeton***	E	-	All year	-	No	**Species not present.** No habitat for this species within the development footprint.
***Corunastylis* sp. charmhaven**	CE	CE	Nov-Apr	-	No	**Species not detected.** Targeted threatened species transects during February, November and December 2019 across the original development footprint, and part of the revised development. Targeted threatened species transects across the remainder of the revised development footprint in November 2020.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
leafless tongue orchid ***Cryptostylis hunteriana***	V	V	Nov-Jan	-	No	**Species not detected.** Targeted threatened species transects during November and December 2019 across the original development footprint, and part of the revised development footprint. Targeted threatened species transects across the remainder of the revised development footprint in November 2020.
rough doubletail ***Diuris praecox***	V	V	Aug	-	No	**Species not detected.** Targeted threatened species transects during August 2018 across original and revised development footprint in August 2018 in suitable habitat. Targeted threatened species transects across the remainder of the revised development footprint in August 2020.
camfield's stringybark ***Eucalyptus camfieldii***	V	V	All year	-	No	**Species not detected.** Targeted threatened species transects across original and revised development footprint in August 2018 in suitable habitat (PCT 1636). Targeted threatened species transects across part of the revised development footprint in October 2018. Targeted threatened species transects during February, November and December 2019 across the original development footprint, and part of the revised development footprint. Targeted threatened species transects across the remainder of the revised development footprint in August, September and November 2020.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
Eucalyptus parramattensis **subsp. *decadens***	V	V	All year	-	No	**Species not detected.** Targeted threatened species transects across original and revised development footprint in August 2018 in suitable habitat (PCT 1636). Targeted threatened species transects across part of the revised development footprint in October 2018. Targeted threatened species transects during February, November and December 2019 across the original development footprint, and part of the revised development footprint. Targeted threatened species transects across the remainder of the revised development footprint in August, September and November 2020.
Eucalyptus parramattensis **subsp. *parramattensis* endangered population**	EP	-	All year	Wyong and Lake Macquarie LGAs	No	**Species not detected.** Targeted threatened species transects across original and revised development footprint in August 2018 in suitable habitat (PCT 1636). Targeted threatened species transects across part of the revised development footprint in October 2018. Targeted threatened species transects during February, November and December 2019 across the original development footprint, and part of the revised development footprint. Targeted threatened species transects across the remainder of the revised development footprint in August, September and November 2020.
variable gnat- orchid ***Genoplesium insigne***	CE	CE	Sept-Nov	-	Yes	**Species not detected.** Targeted threatened species transects during November and December 2019 across the original development footprint, and part of the revised development. Targeted threatened species transects across the remainder of the revised development footprint in September and November 2020.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
small-flower grevillea *Grevillea parviflora* subsp. *parviflora*	V	V	Aug-Nov	-	No	**Species not detected.** Targeted threatened species transects across original and revised development footprint in August 2018 in suitable habitat (PCT 1636). Targeted threatened species transects across part of the revised development footprint in October 2018. Targeted threatened species transects during November 2019 across the original development footprint, and part of the revised development footprint. Targeted threatened species transects across the remainder of the revised development footprint in August, September and November 2020.
Maundia triglochinoides	V	-	Nov-Mar	Riparian areas, drainage lines, water ponding, man- made dams, drainage channels, semi-permanent or ephemeral wet areas, swamps, shallow swamps, shallow water bodies up to 1 m deep		**Species not detected.** Targeted threatened species transects during February, November and December 2019 across the original development footprint, and part of the revised development. Targeted threatened species transects across the remainder of the revised development footprint in November 2020.
biconvex paperbark *Melaleuca biconvexa*	V	V	All year	-	No	**Species not detected.** Targeted threatened species transects during February, November and December 2019 across the original development footprint, and part of the revised development. Targeted threatened species transects across the remainder of the revised development footprint in August, September and November 2020.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
Grove's paperbark *Melaleuca groveana*	V	-	All year	-	No	**Species not detected.** Targeted threatened species transects during February, November and December 2019 across the original development footprint, and part of the revised development. Targeted threatened species transects across the remainder of the revised development footprint in August, September and November 2020.
tall knotweed *Persicaria elatior*	V	V	Dec-May	Semi- permanent, ephemeral wet areas or within 50 m of swamps, waterbodies or wetlands	No	**Species not detected.** Targeted threatened species transects during February and December 2019 across the original development footprint, and part of the revised development. Targeted threatened species transects across the remainder of the revised development footprint in November 2020 (outside survey period but no *Persicaria spp* found).
tranquility mintbush *Prostanthera askania*	E	E	Sept-Nov	-	No	**Species not detected.** Targeted threatened species transects during November 2019 across the original development footprint, and part of the revised development. Surveys also conducted in revised development footprint in September and November 2020. Targeted threatened species transects across the remainder of the revised development footprint in September and November 2020.
native guava^ *Rhodomyrtus psidioides*	CE	-	All year	-	Yes	**Species not detected.** No habitat for this species within the development footprint.
heath wrinklewort *Rutidosis heterogama*	V	V	All year	-	No	**Species not detected.** Targeted threatened species transects across original and revised development footprint in August 2018 in suitable habitat (PCT 1636). Targeted threatened species transects across part of the revised development footprint in October 2018. Targeted threatened species transects during February, November and December 2019 across the original development footprint, and part of the revised development footprint. Targeted threatened species transects across the remainder of the revised development footprint in August, September and November 2020.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
magenta lilly pilly *Syzygium paniculatum*	E	V	Apr-Jun	-	No	**Species not detected.** No habitat for this species within the development footprint.
Tetratheca glandulosa	V	-	Aug-Nov	-	No	**Species not detected.** Targeted threatened species transects across original and revised development footprint in August 2018 in suitable habitat (PCT 1636). Targeted threatened species transects during November 2019 across the original development footprint, and part of the revised development footprint. Targeted threatened species transects across the remainder of the revised development footprint in August, September and November 2020.
black-eyed Susan *Tetratheca juncea*	V	V	Jul-Dec	-	No	**Species detected.** Species habitat aligned with PCT 1636 and PCT 1638.
Fauna Species						
regent honeyeater (breeding) *Anthochaera phrygia*	CE	CE	NA	-	Yes	**Important habitat not present.** Analysis of the DPIE critical habitat mapping shows that the development footprint does not compromise important habitat for this species.
bush stone-curlew *Burhinus grallarius*	E	-	All year	Fallen/standing dead timber including logs.	No	**Species not detected.** Species not seen or heard during any surveys in August or October 2018, or February, May, November and December 2019, or September, or November 2020, or August 2021. Nocturnal call- playback for this species conducted in December 2017 (GHD), and May 2019 and August 2020 (Umwelt).
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 hollow watching conducted in May 2019 and August 2020. 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	-	Apr-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 and hollow watching conducted in May 2019 and August 2020. Opportunistic observations were completed throughout all Umwelt survey periods.
eastern pygmy possum ***Cercartetus nanus***	V	-	Oct-Mar	-	No	**Species not detected.** Spotlighting, arboreal Elliot traps and camera traps in original development footprint by GHD in December 2017. Nocturnal spotlighting searches were undertaken in March and May 2019 over six nights, and two nights in August 2020, in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches.
large-eared pied bat ***Chalinolobus dwyeri***	V	V	Nov-Jan	Land within 2km of rocky areas containing cliffs, caves, overhangs, escarpments, outcrops, or crevices. Land within 2km of old mines or tunnels.	Yes	**No suitable habitat present.** No habitat present (lack of sandstone ridgelines, cliffs and escarpments within 2km). Microchiropteran bat surveys and Harp trapping in original development footprint by GHD in December 2017.
wallum froglet ***Crinia tinnula***	V	-	All year	-	No	**Species detected** (by GHD in 2018 and Umwelt in 2019 and 2020)**.** Aligned with PCT 1724.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
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. Searches for large stick nests conducted during targeted threatened species transects in August, November and December 2019 across the original development footprint, and part of the revised development. Searches across revised development footprint conducted in August, September and November 2020. 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.** Spotlighting and nocturnal amphibian surveys in December 2017 in original development footprint by GHD. Habitat for this species is not present.
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. Searches for large stick nests conducted during targeted threatened species transects in August, November, and December 2019 (some surveys outside breeding season but presence of inactive large stick nests would give an indication that the site is breeding habitat) across the original development footprint, and part of the revised development. Further surveys in the revised development footprint conducted in August and September 2020. 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.** Spotlighting in December 2017 by GHD in original development footprint. Opportunistic observations were completed throughout all Umwelt survey periods. No records of this species within 10 km of the site.
swift parrot (breeding) *Lathamus discolor*	E	CE	NA	-	Yes	**Breeding/Important habitat present.** Important area mapping in the BOAMS shows important habitat across almost the entirety of the development footprint, encompassing 32.4 ha.

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 detected.** No habitat for this species within the development footprint. Spotlighting and nocturnal amphibian surveys by GHD in December 2017 in original development footprint.
green-thighed frog *Litoria brevipalmata*	V	-	Oct-Mar	-	No	**Species not detected.** No habitat for this species within the development footprint. Spotlighting and nocturnal amphibian surveys by GHD in December 2017 in original 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. Searches for large stick nests conducted during targeted threatened species transects in August, November, and December 2019 (some surveys outside breeding season but presence of inactive large stick nests would give an indication that the site is breeding habitat) across the original development footprint, and part of the revised development. Further surveys conducted across revised development footprint in September and November 2020. Opportunistic observations for very large stick nests were completed throughout all Umwelt survey periods. None were detected.
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, 2019 and 2020.
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, 2019 and 2020.

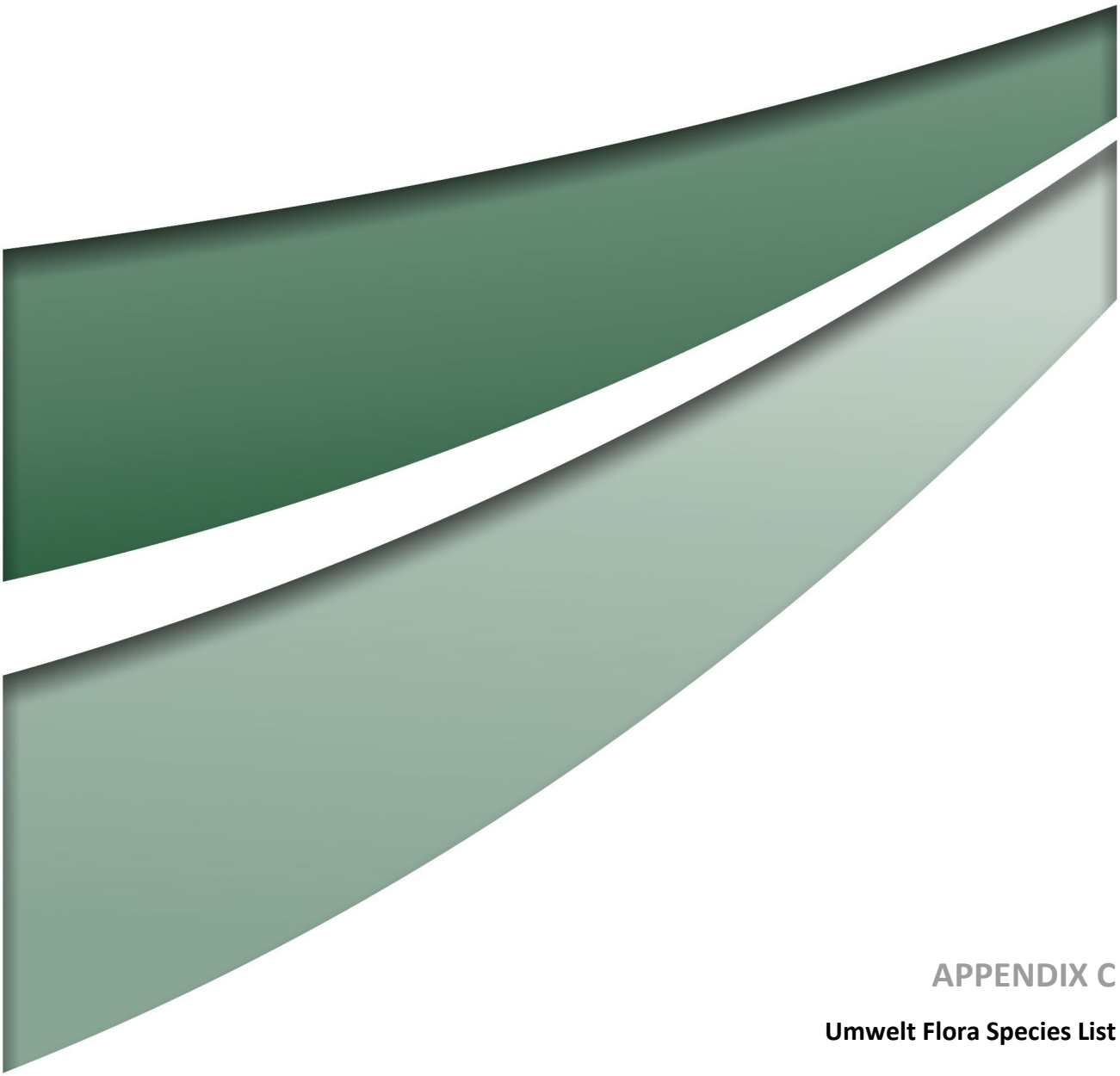
Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAII Entity	Survey Method
southern myotis ***Myotis macropus***	V	-	Oct-Mar	Hollow-bearing trees, bridges, caves or artificial structures, within 200m of riparian zone. Within 500m of foraging habitat.	No	**Species not detected.** Microchiropteran bat surveys and Harp trapping conducted by GHD in original development footprint in December 2017.
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.** Call playback, spotlighting and stagwatching conducted in original development footprint in May 2019. 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 and two consecutive nights in August 2020. 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.** Call playback, spotlighting and stagwatching conducted in original development footprint in May 2019. 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 and two consecutive nights in August 2020. 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. Searches for large stick nests conducted during targeted threatened species transects in August, November and December 2019 (some surveys outside breeding season but presence of inactive large stick nests would give an indication that the site is breeding habitat) across the original development footprint, and part of the revised development. Further surveys conducted in the revised development footprint in in August, September and November 2020. 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.** Targeted threatened species transects during February and December 2019 in suitable habitat across the original development footprint, and part of the revised development footprint. Habitat is marginal at best, with no swamps present. Visual searches and habitat assessments in original development footprint by GHD in December 2017 Opportunistic observations were completed throughout all Umwelt survey periods.
squirrel glider ***Petaurus norfolcensis***	V	-	All year	-	No	**Species not detected.** Spotlighting, arboreal elliot traps and camera traps in original development footprint by GHD in December 2017. Nocturnal spotlighting searches were undertaken in March and May 2019 over six nights, and two nights in August 2021, 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 nocturnal spotlighting.
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
brush- tailed phascogale ***Phascogale tapoatafa***	V	-	Dec- Jun	-	No	**Species not detected.** Spotlighting, arboreal elliot traps and camera traps in original development footprint by GHD in December 2017. Nocturnal spotlighting searches were undertaken in March and May 2019 over six nights, and two nights in August 2020, in suitable habitat areas between sunset and midnight using 30 watt hand-held spotlights and head torches.
koala (breeding) ***Phascolarctos cinereus***	V	V	All year	-	No	**Species not detected.** Spotlighting and camera traps in original development footprint by GHD in December 2017. 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, and two nights in August 2020, 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.
common planigale ***Planigale maculata***	V	-	All year	-	No	**Species not detected.** Habitat on site is marginal for this species and species typically does not occur south of Newcastle. Spotlighting and camera traps in original development footprint by GHD in December 2017. 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
long- nosed potoroo ***Potorous tridactylus***	V	V	All year	Dense shrub layer or alternatively high canopy cover exceeding 70%	No	**Species not detected.** Targeted searches and spotlighting conducted in March and May 2019 over six nights, and two nights in August 2020, in areas of suitable habitat. Spotlighting and camera traps in original development footprint by GHD in December 2017.
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, and November 2020, and August 2020. 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 detected. Breeding habitat avoided.** Call playback, searches for breeding hollows, stag watching and spotlighting in original development footprint in August 2018 by GHD (not in original BCAR). Call playback, spotlighting and stagwatching conducted in original development footprint in May 2019 by Umwelt. Call- playback was also undertaken for this species over three consecutive nights during May 2019 and two consecutive nights in August 2020. 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.
Mahony's toadlet ***Uperoleia mahonyi***	E	-	Dec-Mar	-	No	**Breeding habitat not present.** Spotlighting and nocturnal amphibian surveys in December 2017 in original development footprint by GHD. Species is also not associated with any of the PCTs found on site (OEH, 2019b).



APPENDIX C

Umwelt 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	percent 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.

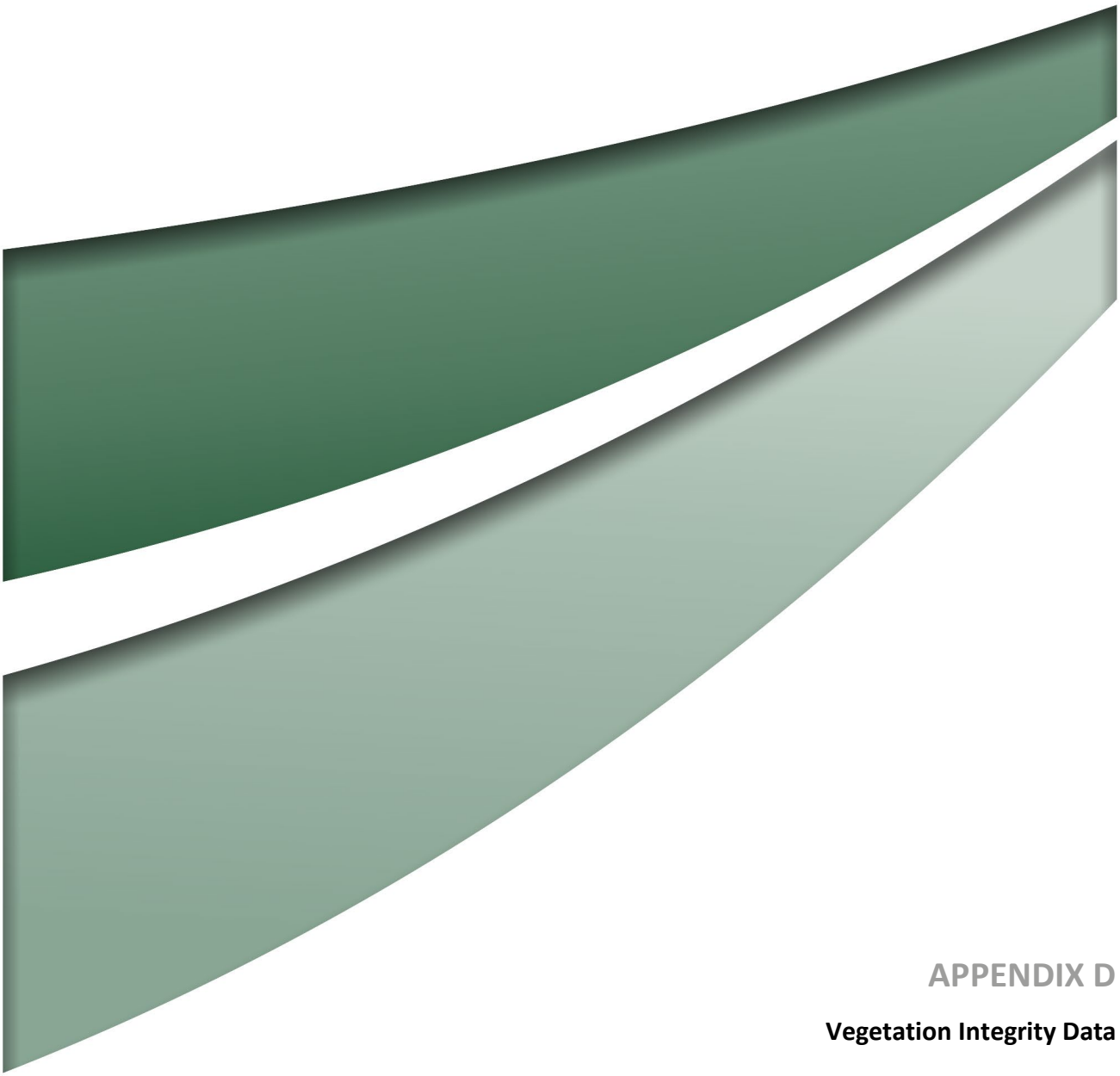
All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust 2018), the on-line plant name database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

Species Name	Growth Form	PCT 1636 Disturbed				PCT 1636 Good				PCT 1638		PCT 1724			
		P_01		P_02		P_03		P_04		P_05		P_08		P_06	
		PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA
Acacia decurrens	TG	0	0	0.1	1	0	0	0	0	0	0	0	0	0	0
Acacia longifolia	SG	0	0	0	0	0	0	0	0	0	0	0	0	5	15
Acacia longifolia subsp. longifolia	SG	0.5	1	0.1	1	0	0	0	0	0	0	1	20	0	0
Acacia myrtifolia	SG	2	20	0	0	0	0	0.5	5	15	500	0.2	10	0	0
Acacia stricta	SG	0	0	0	0	0	0	0	0	0	0			0	0
Acacia suaveolens	SG	0	0	0	0	0.2	50	0.2	3	8	80	1	10	0	0
Acacia ulicifolia	SG	0	0	0	0	0	0	0	3	0	0	0	0	0	0
Actinotus helianthi	FG	5	60	0	0	0	0	0	0	0	0	0	0	0	0
Actinotus minor	FG	0	0	5	500	0.1	300	0.2	20	0.1	100	0.1	20	0	0
Allocasuarina littoralis	TG	30	0	30	20	5	300	5	10	15	500	15	100	0.1	1
Anisopogon avenaceus	GG	0	0	0	0	0	0	0	0	0	0	3	1000	0	0
Angophora costata	TG	0	0	0	0	0	0	0	0	0	0	2	2	0	0
Baeckea diosmifolia	SG	0	0	0.1	5	0.1	1	0	0	0	0	0	0	0	0
Banksia oblongifolia	SG	10	0	10	80	0	0	5	10	0	0	0	0	0	0
Banksia robur	SG	0	0	0	0	0	0	0	0	0	0	0	0	0.1	3
Banksia serrata	TG	0	0	5	100	10	800	0	0	0.2	25	0	0	0	0
Banksia spinulosa	SG	0	0	0	0	0	0	0	0	0.1	1	0	0	0	0
Billardiera scandens	OG	0	0	0	0	0	0	0.1	1	0	0	0.1	4	0	0
Blechnum cartilagineum	EG	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boronia parviflora	FG	0	0	0	0	0	0	0	0	0	0	0	0	0.1	5
Boronia polygalifolium	SG	0	0	0	0	0	0	0	0	0	0	0.1	5	0	0
Brunoniella australis	FG	0	0	0.1	5	0	0	0.1	10	0	0	0.1	5	0	0
Brunoniella pumilio	FG	0	0	0	0	0	0	0.1	10	0	0	0	0	0	0
Burchardia umbellata	FG	0.1	1	0	0	0	0	0.1	1	0	0	0	0	0	0
Callistemon citrinus	SG	0	0	0	0	0	0	0	0	0	0	0	0	2	5
Callistemon linearis	SG	0	0	0	0	0	0	0.1	1	0	0	0	0	0	0
Callistemon viminalis	TG	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cassytha glabella	OG	0.2	10	0.2	1000	0	0	0.5	20	0.1	100	1	100	0	0
Cassytha glabella f. glabella	OG	0	0	0	0	0.2	100	0	0	0	0	0	0	0.1	20
Chorizandra cymbaria	GG	0	0	0	0	0	0	0	0	0	0	0	0	10	0
Comesperma ericinum	FG	0.1	10	0.1	50	0	0	0	0	0	0	0.1	10	0	0
Conospermum ericifolium	SG	0	0	0.5	300	0.2	100	0	0	0.1	5	0	0	0	0
Corymbia gummifera	TG	5	1	0	0	0.1	1	0	0	0	0	0	0	0	0
Cryptostylis erecta	FG	0	0	0	0	0	0	0	0	0.1	1	0	0	0	0
Cryptostylis subulata	FG	0	0	0	0	0	0	0.1	10	0	0	0.1	1	0	0
Cyathochaeta diandra	GG	20	0	10	1000	20	1000	5	100	0.1	5	0	0	0	0
Dampiera stricta	FG	0.1	2	0	0	0	0	0	0	0	0	0.1	10	0	0
Dillwynia retorta	SG	2	20	0	0	0	0	0	0	0	0	0	0	0	0
Diospyros australis	SG	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dodonaea triquetra	SG	1	10	0	0	0	0	0	0	0	0	0	0	0	0
Empodisma minus	GG	0	0	0	0	0	0	0	0	0	0	0	0	5	100
Entolasia stricta	GG	10	200	0.5	300	0.5	300	20	0	0	0	0	0	2	30
Epacris obtusifolia	SG	0	0	0	0	0	0	0	0	0	0	0	0	1	20
Epacris pulchella	SG	0	0	0.1	10	0	0	1	20	0.1	20	0.1	2	0	0

Species Name	Growth Form	PCT 1636 Disturbed				PCT 1636 Good				PCT 1638		PCT 1724			
		P_01		P_02		P_03		P_04		P_05		P_08		P_06	
		PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA
Eucalyptus capitellata	TG	0	0	0	0	0	0	0	0	0	0	5	2	0	0
Eucalyptus haemastoma	TG	0	0	25	8	0	0	0	0	30	6	10	6	0	0
Eucalyptus racemosa	TG	0	0	0	0	0	0	15	0	0	0	0	0	0	0
Euphrasia collina subsp. paludosa	FG	0.1	1	0	0	0	0	0	0	0	0	0	0	0	0
Gahnia clarkei	GG	0	0	0	0	0	0	0	0	0	0	10	1000	20	20
Gahnia sieberiana	GG	0	0	0	0	0	0	0	0	0	0	0	0	5	10
Genoplesium fimbriatum	FG	0	0	0.1	3	0	0	0	0	0	0	0	0	0	0
Glycine clandestina	OG	0	0	0	0	0	0	0.1	1	0.1	2	0	0	0	0
Gompholobium glabratum	SG	0.1	5	0	0	0	0	0	0	0	0	0	0	0	0
Gompholobium pinnatum	SG	0	0	0	0	0.1	1000	0.1	1	0	0	0.1	10	0	0
Gonocarpus micranthus	FG	0	0	0	0	0	0	0	0	0	0	0	0	0.1	10
Gonocarpus teucrioides	FG	0	0	0	0	0	0	0	0	0	0	0.1	20	0.1	20
Goodenia hederacea subsp. hederacea	FG	0	0	0	0	0	0	0	0	0	0	0.1	1	0	0
Goodenia heterophylla	FG	0	0	0	0	0	0	0	0	0	0	0	0	0.1	10
Grevillea sericea	SG	0.1	4	0	0	0.1	20	0.1	1	0	0	0	0	0	0
Grevillea speciosa	SG	0	0	0	0	0.1	1	0	0	0	0	0	0	0	0
Haemodorum planifolium	FG	0.1	1	0	0	0.1	2	0.2	10	0	0	0.1	5	0	0
Hakea bakeriana	SG	0	0	0.1	1	0	0	0.5	2	0	0	0	0	0	0
Hakea dactyloides	SG	0.5	1	1	3	0	0	0.1	1	0.2	15	0	0	0	0
Hakea salicifolia	SG	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hakea sericea	SG	0	0	0	0	0	0	0	0	0.1	1	0	0	0	0
Hakea teretifolia	SG	10	0	0	0	1	100	0	0	0	0	0	0	3	10
Hardenbergia violacea	OG	0	0	0	0	0	0	0.1	2	0.1	2	0	0	0	0
Hibbertia acicularis	SG	0	0	0	0	0.1	1	0	0	0	0	0	0	0	0
Hibbertia vestita	SG	1	20	0.1	1	0	0	0.1	2	0.1	100	0	0	0	0
Hybanthus monopetalus	FG	0	0	0	0	0	0	0	0	0	0	0.1	10	0	0
Hovea linearis	FG	0.1	10	0	0	0	0	0	0	0	0	0	0	0	0
Imperata cylindrica	GG	0	0	0	0	0	0	0	0	0.2	50	0	0	0.1	10
Isopogon anemonifolius	SG	1	20	0	0	0	0	0	0	0	0	0	0	0	0
Isopogon sp.	SG	0	0	0	0	3	300	0	0	0	0	0	0	0	0
Lambertia formosa	SG	3	20	5	100	0.2	500	1	5	10	200	2	10	0	0
Lepidosperma laterale	GG	5	100	40	1000	0	0	10	200	0.2	20	0	0	0.2	30
Leptocarpus tenax	GG	0	0	0	0	0	0	1	40	0	0	0	0	20	0
Leptospermum juniperinum	SG	0	0	0	0	0	0	0	0	0	0	0	0	20	0
Leptospermum laevigatum	SG	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptospermum petersonii	SG	0.1	1	0	0	0	0	0	0	0	0	0	0	0	0
Leptospermum polygalifolium subsp. cismontanum	SG	0	0	0.1	2	0	0	0	0	0	0	0	0	0	0
Leptospermum trinervium	SG	1	10	0	0	0.3	80	0.5	5	0.5	200	0	0	0	0
Lepyrodia scariosa	GG	0	0	0	0	0.1	5	0	0	0	0	0	0	0	0
Lindsaea linearis	EG	0	0	0	0	0.1	50	0	0	0	0	0.1	10	0.1	3
Lindsaea microphylla	EG	0	0	0	0	0	0	0.1	2	0	0	0	0	0	0
Livistona australis	OG	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lobelia purpurascens	FG	0	0	0	0	0	0	0	0	0	0	0.1	10	0	0
Lomandra longifolia	GG	0	0	0	0	0.1	50	0	0	0	0	0	0	0	0

Species Name	Growth Form	PCT 1636 Disturbed				PCT 1636 Good				PCT 1638		PCT 1724			
		P_01		P_02		P_03		P_04		P_05		P_08		P_06	
		PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA
Lomandra multiflora	GG	0	0	0	0	0.1	1	0	0	0	0	0	0	0	0
Lomandra obliqua	GG	0.5	20	0.1	50	0	0	2	40	0	0	0.1	20	0	0
Melaleuca linariifolia	SG	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca quinquenervia	TG	0	0	0	0	0	0	0	0	0	0	0	0	10	2
Melaleuca sieberi	SG	0	0	0	0	0	0	2	5	0	0	1	5	5	10
Melaleuca thymifolia	SG	0	0	0	0	0.1	1	0.2	2	0	0	0	0	0	0
Microlaena stipoides	GG	0	0	0	0	0	0	0	0	0.1	10	0	0	0	0
Micromyrtus ciliata	SG	0.2	10	0	0	0	0	0	0	0	0	0	0	0	0
Microtis parviflora	FG	0.1	1	0	0	0	0	0	0	0	0	0	0	0	0
Mirbelia rubiifolia	SG	0.1	5	0.1	10	0	0	2	20	0.1	10	0.1	15	0	0
Panicum simile	GG	0	0	0	0	0	0	0.1	5	0	0	0	0	0	0
Paspalidium distans	GG	0	0	0.1	1	0	0	0	0	0	0	0.1	20	3	40
Patersonia sericea	FG	0.1	10	0	0	0	0	0.1	1	0	0	0	0	0	0
Persoonia lanceolata	SG	0.1	2	0	0	0	0	0	0	0	0	0	0	0	0
Persoonia levis	SG	0.2	2	0.2	3	0	0	0.1	1	0	0	1	2	0	0
Petrophile pulchella	SG	1	10	0.2	20	0.2	200	0.1	2	0	0	0	0	0	0
Pimelea latifolia subsp. hirsuta	SG	5	40	0.2	10	0.2	100	0.1	1	0.1	10	0	0	0	0
Pimelea linifolia	SG	0.1	5	0	0	0	0	0.2	10	0	0	0	0	0	0
Pimelea linifolia subsp. linifolia	SG	0	0	1	500	0.1	100	0	0	0.1	50	0.1	10	0	0
Polyscias sambucifolia	SG	0	0	0	0	0	0	0	0	0.1	1	0	0	0	0
Pteridium esculentum	EG	0	0	0	0	0	0	0	0	0	0	0	0	0.1	5
Pultenaea paleacea	SG	0	0	0	0	0	0	0.5	10	0	0	0	0	2	30
Pultenaea tuberculata	SG	2	20	0	0	0.1	5	0	0	0	0	0	0	0	0
Rytidosperma pallidum	GG	0	0	3	800	0	0	5	80	0.1	50	0	0	0	0
Scaevola ramosissima	FG	0	0	0	0	0.1	1	0.2	5	0.1	10	0	0	0	0
Schoenus brevifolius	GG	0	0	0	0	0	0	0	0	0	0	0	0	3	40
Selaginella uliginosa	EG	0	0	0	0	0	0	0	0	0	0	0	0	0.1	20
Sida spinosa	EX	0	0	0.1	1	0	0	0	0	0	0	0	0	0	0
Stackhousia monogyna	FG	0	0	0.1	50	0	0	0	0	0	0	0	0	0	0
Stackhousia viminea	FG	0.2	30	0	0	0	0	0	0	0	0	0	0	0	0
Styphelia triflora	SG	0.1	3	0	0	0	0	0	0	0	0	0	0	0	0
Themeda triandra	GG	0	0	2	500	0.2	100	5	100	5	500	25	1000	0	0
Thysanotus tuberosus	FG	0.1	5	0	0	0	0	0	0	0	0	0	0	0.1	1
Thysanotus tuberosus subsp. tuberosus	FG	0	0	0	0	0.1	5	0	0	0	0	0	0	0	0
Tricoryne elatior	FG	0	0	0.1	1	0	0	0	0	0	0	0.1	5	0	0
Trifolium campestre	EX	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Villarsia exaltata	FG	0	0	0	0	0	0	0	0	0	0	0	0	0.2	30
Xanthorrhoea fulva	OG	0	0	0	0	0	0	0	0	0	0	0	0	10	0
Xanthorrhoea latifolia subsp. latifolia	OG	5	40	50	1000	50	1000	10	0	20	500	0	0	0	0
Xanthosia tridentata	FG	0	0	0	0	0	0	0	0	0.1	50	0	0	0	0
		42		**35**		**32**		**44**		**31**		**35**		**31**	



APPENDIX D

Vegetation Integrity Data

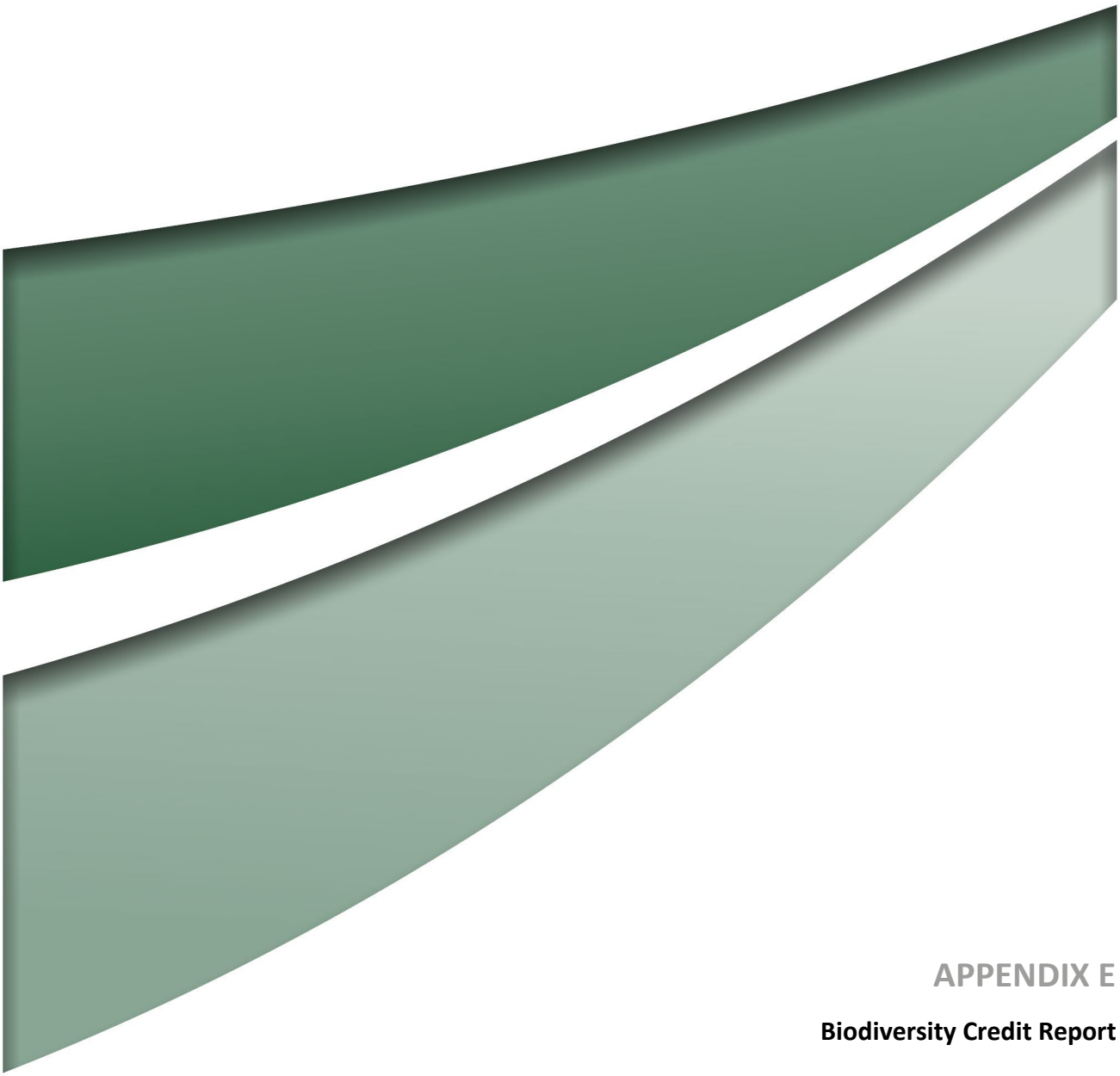
Vegetation Integrity Data

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)

Surveyor	PCT	Plot ID	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					
Umwelt	1636	Q01	2	23	4	11	0	2	35	41.1	35.5	6.1	0	5.2	1	1	1	0	0	0	0	0	48	9	0
	1636	Q02	4	15	7	6	0	2	60.1	18.8	55.7	5.5	0	50.2	1	1	1	1	0	1	1	1	14	8	0
	1636	Q03	3	16	6	4	1	2	15.1	6.1	21	0.4	0.1	50.2	0	1	1	1	1	0	0	0	30	5	0
	1638	Q04	180	3	20	8	8	1	5	35	14.4	48.1	1.1	0.1	1	1	1	1	1	0	2	4	26	39	0
	1638	Q05	108	4	14	6	4	0	4	60.2	34.6	5.7	0.4	0	1	1	1	1	1	0	2	3	22	79	0
	1724	Q06	45	3	12	6	7	2	3	25.1	29.1	60	0.7	1.1	1	1	1	0	0	0	0	0	10	15	0
	1638	Q08	4	11	5	12	1	2	32	4.9	38.2	1.2	0.1	1.1	1	1	1	1	1	1	1	3	19	83	0
GHD	1636	Q03	3	11	7	7	1	2	21.0	50.0	87.0	13.0	1.0	17.0	1	1	1	1	1	1	0	4	21.0	2.0	0
	1724	Q06	2	7	14	9	1	1	25.0	27.0	163.0	15.0	2.0	5.0	1	1	1	1	1	0	1	3	14	12	2
	1636	Q07	2	5	5	5	0	2	45.0	28.0	9.0	0	22.0	0	1	1	1	1	1	0	1	2	11.0	3.0	0



APPENDIX E

Biodiversity Credit Report

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00020006/BAAS18117/20/00020007	Lake Munmorah BCAR	10/06/2021
Assessor Name	Report Created	BAM Data version *
	26/10/2021	45
Assessor Number	BAM Case Status	Date Finalised
	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	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast											
3	1724_Good	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	68.3	68.3	1.4	Endangered Ecological Community	Not Listed	High Sensitivity to Potential Gain	2.00		48
										Subtotal	**48**
Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast											
1	1636_Disturbed	Not a TEC	62.9	62.9	1.9			High Sensitivity to Potential Gain	1.75		52
4	1636_Good	Not a TEC	52.1	52.1	23			High Sensitivity to Potential Gain	1.75		525
										Subtotal	**577**
Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast											
2	1638_Good	Not a TEC	70.5	70.5	7.3			High Sensitivity to Potential Gain	1.75		225
										Subtotal	**225**
										Total	**850**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits

Crinia tinnula / Wallum Froglet (Fauna)								
1724_Good	68.3	68.3	1.4	Vulnerable	Not Listed	1.5	False	36
							Subtotal	**36**
Lathamus discolor / Swift Parrot (Fauna)								
1636_Disturbed	62.9	62.9	1.8	Endangered	Critically Endangered	3	True	85
1636_Good	52.1	52.1	22.1	Endangered	Critically Endangered	3	True	864
1638_Good	70.5	70.5	7.3	Endangered	Critically Endangered	3	True	386
1724_Good	68.3	68.3	1.4	Endangered	Critically Endangered	3	True	72
							Subtotal	**1407**
Tetratheca juncea / Black-eyed Susan (Flora)								
1636_Good	52.1	52.1	23	Vulnerable	Vulnerable	2	False	600
1638_Good	70.5	70.5	7.3	Vulnerable	Vulnerable	2	False	257
							Subtotal	**857**

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