Appendix M

ECOLOGICAL IMPACT ASSESSMENT (ECOFOCUS ENVIRONMENTAL CONSULTING)

EcoFocus
ENVIRONMENTAL CONSULTING

Central Precinct, Northern Sector

Ecological Impact Assessment

November 2019

Document History

Project Title: Central Precinct, Northern Sector Ecological Assessment		
Revision	**Date**	**Prepared by**
Draft 1	10/9/2019	Jacqui Coughlan
Draft 2	29/10/2019	Jacqui Coughlan
Final Draft	07/11/2019	Jacqui Coughlan
Final	12/11/2019	Jacqui Coughlan

Contents

Executive Summary

The Central Precinct, Northern Sector proposal site is part of the master-planned residential development, proposed by Wakefield Ashurst Developments. The original proposal had its inception in 1997 with the project then known as North Wallarah Peninsula. Following Local Environmental Studies and a site specific Local Environmental Plan (LEP), a Conservation and Land Use Management Plan, a masterplan (including eight site management plans) the proposal was approved as a development consent (DA2717/2003) in 2003. The masterplan proposal would deliver lots of various types to cater for original estimated on-site population of 5500 people. Conservation lands and open space have been incorporated into the masterplanned development, with numerous developments approved (over 350 lots in the Lake Sector) and completed. The largest of these, the Wallarah National Park conserves 174.7 ha of threatened species habitat on the southern boundary of the master-planned site. The masterplan site (including this precinct) is covered by a Clause 34A order that acknowledges the planning arrangements and confirms that biodiversity impacts have been satisfactorily addressed and that conservation measures to offset residual impacts (after the avoid and minimise impact measures) have been secured into the future. OEH advise that as a result, no further biodiversity offsets are required for development undertaken on land within the North Wallarah Masterplan Development.

The purpose of this Ecological Assessment is to describe the ecological characteristics of the study area, determine the ecological constraints of the proposal, assess the potential ecological impacts of the proposed development, assess the significance of the impact of the proposed activities on species, ecological communities and populations listed under the *Threatened Species Conservation Act 1995* (TSC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act), and to propose environmental management measures to minimise and mitigate any residual impacts not considered at the time of masterplan approval and the creation of the 174.7ha Wallarah National Park and other conservation areas as its adopted conservation strategy.

Substantial flora and fauna survey has been conducted on the site previously by other consultants over a period of approximately 22 years. Detailed flora and fauna surveys, including targeted threatened species searches, were undertaken between November 2016 and October 2018 by EcoFocus Environmental Consulting (EcoFocus).

Five threatened fauna species were recorded on the site – Little Bent Wing Bat, Large Bent-wing Bat, Greater Broad-nosed Bat, Grey-headed Flying Fox and Powerful Owl. Assessments of significance (7 part tests) under the TSC Act for threatened fauna species determined that the proposal is not likely to have a significant effect on any threatened species, population or ecological community. Detailed reasons are provided for this conclusion for each species.

Two threatened flora species were observed during the field surveys; *Tetratheca juncea* and *Callistemon linearifolius*. Threatened species evaluations determined that the area is unlikely to provide important habitat for any other of the flora species detected in background searches. The proposal will not pose a significant adverse effect on these species. Detailed reasons are provided for this conclusion for each species. In the case of *Callistemon linearifolius* detailed planning and design in response to survey results has allowed the retention of large numbers of individuals.

In assessing potential impacts of the development on threatened species, historical reports and data have been reviewed, in addition to the current targeted searches and research carried out by EcoFocus Environmental Consulting between 2016 and 2018 for this report.

Hollow-bearing tree resources were identified throughout the study area and identified for retention, noting that due to past site disturbance there are areas of the site that do not have these resources, or where they are in lower density. Approximately 62% of hollow bearing trees will be retained.

Of the 74.6 ha site, approximately 44.2 ha (59.3%) of vegetation will be cleared for the project, of which 2.4 ha will be revegetated back to natural and 2.6 ha will be revegetated back to managed vegetation. 17.2 ha (23%) of vegetation on site will be retained, including core riparian areas, buffer zones and additional land. Managed vegetation (select canopy retained, understorey cleared for asset protection) comprises 4.0 ha (5.36 %) of the site.

Existing infrastructure (roads and transmission lines) constitute 9.2 ha (12.3 %of the site). Over 73% of the site has been identified as previously disturbed by past activities.

The masterplanned project (for which the site subject to this report sits within) includes the protection of conservation lands comprising a 174.7 ha national park, a 19.8 ha coastal land dedication, a 7.78 ha Foreshore Reserve that protects a remnant of Forest Red Gum (*Eucalyptus tereticornis*) and Swamp Mahogany *(Eucalyptus robustus)* and a 100 m wide Habitat Corridor of some 21 ha to the west of the highway, that connects the national park in the south with the vegetated lands in the north.

The Wallarah National Park, the Habitat Corridor and the Foreshore Reserve were the key conservation initiatives identified to provide protection of the masterplan sites ecological values to permit certain development types, by protecting examples of each vegetation community, protecting adequate *Tetratheca juncea*, and retaining the most valuable habitats for fauna on site in those initiatives. Additionally, to support the adoption of the conservation strategy, development types were defined and an Ecological Site Management Plan (ESMP)(approved as part of the masterplan) identified a number of ecological strategies to exceed the ecological outcomes of the conservation strategy.

This report concludes that the proposed development will not have an adverse impact on any threatened species of flora or fauna, based on consideration of the extensive ecological survey informing the presence or absence of threatened species, the value of habitat on site for the threatened species, the retention of large numbers of hollow bearing trees, the protection of owl roosting habitat and conservation measures already undertaken for the project. Detailed analysis and justification for these conclusions are provided for each threatened species assessed according to the OEH threatened species assessment guidelines.

1. Introduction

1.1 Purpose of this report

This Ecological Impact Assessment report has been prepared to support a Development Application to Lake Macquarie City Council (LMCC), by assessing potential ecological impacts of the proposed development. The purpose of this report is to provide the results of detailed field surveys and desktop assessment carried out on the proposed development site and to assess and report on the potential impacts to the ecological environment.

The aims of this Ecological Assessment are to describe the ecological features and biodiversity value of the subject site and the direct and any indirect impacts of the proposed development particularly in relation to threatened species, populations and ecological communities listed under the NSW Threatened Species Conservation Act 1995 (TSC Act) and Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) in accordance with the Environmental Planning and Assessment Act 1979 (EP&A Act). The scope and aims of this report are to:

- Describe the ecological features of the subject site and any threatened flora or fauna therein;
- To assess the likely impacts of the proposed development on the natural environment and any threatened flora or fauna found or which is likely to occur on the subject site;
- To consider impacts to biodiversity within the local and/or regional context; and
- To address the requirements of the relevant legislation including the Environmental Planning & Assessment Act 1979 (EP&A Act), the Threatened Species Conservation Act 1995 (TSC Act) and the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Specifically, this Ecological Assessment:

- Identifies vegetation types and assesses likelihood of occurrence of threatened flora species on site
- Identifies fauna habitat particularly with respect to potential threatened species habitat
- Identifies any species, populations or communities listed as threatened under relevant legislation including the NSW *Threatened Species Conservation Act 1995* and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
- Provides the historical planning context that led to the proposed development of the site
- Provides a background to the numerous previous ecological studies conducted on the site
- Provides detailed methodology and survey effort including an assessment against the relevant Lake Macquarie City Council Guidelines and OEH guidelines.
- Provides assessments of significance (7 part tests) for threatened species listed under the NSW *Threatened Species Conservation Act 1995* in accordance with the Threatened Species Assessment Guideline (DECC 2007)
- makes recommendations for mitigation measures and environmental safeguards

This ecological assessment is prepared to accompany an application that proposes the bulk earthworks and clearing footprint, as well as revegetation and managed areas as described above, as part of the proposed subdivision of the land. The application also includes new roads and 262 residential lots, in stages, as well as a future village centre lot, public reserve lots, drainage reserve lot and residue future development lots, and other

associated works including bushfire management, stormwater drainage including basin and swales, provision of utilities, revegetation and landscaping.

1.2 Background to the project

A lengthy planning process involving substantial consultation with NPWS, LMCC, and Planning NSW across the masterplanned site has included:

- 1997-2001 - Preparation, Exhibition and Assessment of a detailed Local Environmental Study culminating in a *Conservation and Land Use Management Plan (CLUMP)* in 2000, and gazettal in 2001 of a site specific Local Environmental Plan, applying development, open space, environmental protection and national park land use zonings across the total project site;
- 2003 – Gazettal of Wallarah National Park, providing secure conservation tenure prior to any development activities;
- 2003 - Approval via issuing of a development consent (after exhibition and assessment) of the North Wallarah Peninsula Masterplan (DA2717/2003), including conditions and eight site management plans, including a Site Ecological Management Plan and approval for Pacific Highway interchange;
- 2004 – Determination by Commonwealth Department of Environment and Heritage that development within the Lake Sector is not a 'controlled action' under the EPBC Act;
- 2004-2005 – Preparation, exhibition, assessment and approval in Lake Sector of Village Drive (DA3306/2004), Stages 1-7 (DA3309/2004) and Stages 8-12 (DA 87/2005)
- 2007 – Determination by Department of Planning to waiver SEPP 71 masterplan requirements for North Wallarah Peninsula and Determination by Commonwealth Department of Environment and Heritage that development within the Northern Sector is not a 'controlled action' under the EPBC Act;
- 2008 – Preparation, exhibition, assessment and approval in Northern Sector for reconstruction and upgrade works on Old Pacific Highway/Scenic Drive (DA2450/2007);
- 2008-2009 – Preparation, exhibition, assessment and approval in Lake Sector of Stages 13a/b (DA 1969/2008);
- 2009 – Preparation, exhibition, assessment and approval in Coastal Sector of Access Drive (DA2449/2007) and Coastal Village Precinct Stages 1-4 (DA130/2008);
- 2010 – Preparation, exhibition, assessment and approval by Joint Regional Planning Panel in Lake Sector of Stage 14 (DA 1297/2009);
- 2010 – 2012 – Large Forest Owl Survey over Masterplan site;
- 2014 – conversion of planning controls by Council from North Wallarah LEP into standard template LGA wide Lake Macquarie Local Environmental Plan 2014, and creation and adoption of a Local Area Plan into the city wide Development Control Plan 2014, to give development control reference to the approved conservation strategy and masterplan (given the deletion of specific non-standard LEP clauses thought the standardised LEP conversion process).
- 2017-2019 – Preparation, exhibition, assessment and approval in Lake Sector of Stages 13C (DA2239/2017) and Swansea Valley 2 and concept footprint for Swansea Valley 3 (DA1531/2017).

- 2018 – Certification Order under Clause 34A that North Wallarah Peninsula Development is part of a relevant planning arrangement for which biodiversity impacts of the proposed development have been satisfactorily assessed and for which conservation measures have been secured.

The conservation outcomes of the planning process include:

- Wallarah National Park (WNP)– 174.7 ha containing the least disturbed and highest conservation value lands. Transferred from Lensworth Wallarah Peninsula to the NSW government in July 2001 and gazetted in 2003 following extensive consultation with NPWS (NPWS 2003) with its acceptance into the state conservation estate testament to its high conservation value. This provides secure, in perpetuity protection of the land and satisfies the principle of 'averted loss' and satisfies the principle of modern offsetting policy being part of the original site, supporting representatives of all vegetation communities, supporting threatened species habitat, containing large occurrences of the threatened plant *Tetratheca juncea*, a high density of hollow bearing trees and habitat for a full suite of threatened fauna species.

- Foreshore Reserve – 7 ha conserving the only Forest Red Gum (*Eucalyptus tereticornis*) vegetation community found within the Wallarah Peninsula.

- Habitat Corridor- A 100m wide corridor (21 ha) linking Wallarah National Park to Lake Macquarie and the Foreshore Reserve, being progressively dedicated to Lake Macquarie City Council

- Coastal Lands – 19.8ha of coastal lands dedicated to the Minister for Planning;

Additionally, the masterplan provided for protection of core riparian zones of "rivers" (as defined by DLWC) that occur throughout the Wallarah Peninsula and established ecological considerations to be considered at development application stage to enhance the adopted conservation outcome by providing refugia and habitat linkages.

Throughout the planning process described above, numerous ecological surveys and assessments have been conducted. Methodologies and results of those surveys are discussed in more detail for each relevant species in the body of this report and in the 7 part tests (Appendix F).

The intent of the adopted conservation strategy and land dedications to offset future proposals that followed is clear (noting the conservation strategy predated staged development applications, biobanking and voluntary planning agreement provisions that exist today).

The site is covered by an order made under S34A of the Biodiversity Conservation (Savings and Transitional) Regulation 2017 that states that:

a) The North Wallarah Masterplan Development is part of a relevant planning arrangement for which the biodiversity impacts of the proposed development have been satisfactorily assessed before 25 August 2017, and

b) that conservation measures to offset the residual impact of the proposed development on biodiversity values, after the measures required to be taken to avoid or minimise those impacts, have been secured into the future.

1.3 Existing Environment

The site known as the Central Precinct, Northern Sector (NS) is located east of and adjacent to the Pacific Highway approximately 2.3 km south of the township of Swansea in the Lake Macquarie Local Government Area (LGA) on the NSW Central Coast. It is bordered to the north by the suburb of Caves Beach, to the west by the Pacific Highway. Plains Gully Creek forms the eastern boundary while Scenic Drive partially forms the southern boundary. The eastern portion of WNP is located to the south and the western portion of WNP lies to the immediate south west across the Pacific Highway.

The site surrounds Mawsons lookout reserve in the south-east and will provide access to the approved Coastal Sector (Pinny Beach) further south-east. Other undeveloped residential zoned land of the Northern Sector sits to the north, as well as the existing Caves Beach urban edge.

The site consists of 74.6 ha, of which 54.4 ha (or 73%) has been identified as previously disturbed by past activities including large sections of highly disturbed former landfill, clay extraction pits, open cut mine, quarry and disturbed areas. Other cleared and disturbed areas of the site include the old Pacific Highway which forms the northwest boundary of the site and passes through the centre of the site and two transmission line corridors passing north-south through the west and centre of the site. A network of tracks and fire trails cris-cross the site. Previously cleared areas have revegetated with regrowth Casuarina scrub and mixed regrowth woodland and lack hollow bearing trees. Plan A, Appendix G shows historical disturbance across the site.

The site supports two main vegetation types; Smooth Barked Apple Open Forest and Spotted Gum Open Forest,

The undisturbed areas include an eastern watercourse and lower slopes on the interface to the existing urban edge of Caves Beach to the north (i.e. to existing lots off Forest Oak Place and Callistemon Close), and a narrow area that extends from part of the upper edge of a western watercourse in a south-easterly direction towards the old Pacific Highway alignment.

The whole of the site is zoned R1 General Residential, and the site is part of the North Wallarah Peninsula site and subject to an approved Masterplan (DA 2717/2003).

Because of the nature of previous disturbances on the site, major bulk earthworks are required to achieve the approved zoning and masterplan outcomes. These include remediating the former landfill, removing high walls and the open cut mining areas and edges, fixing slope stability issues and other disturbance areas, and providing a new finished surface over those and adjoining areas where necessary. These works require 44.2 ha (or 59.2%) of the site to be cleared, with 5 ha of that footprint identified to be revegetated (some to natural including the remediated southern edge of the western watercourse, and some to managed). The balance footprint is 39.2 ha to be cleared for new roads, lots and infrastructure (including electricity and sewer) and residential landscaping. Works also occur within parts of the existing road reserves.

The proposal retains 17.2 ha of existing vegetation within the site, in addition to the main conservation measures secured by earlier planning arrangements. This retention occurs in three main areas being:

- Lower vegetated slopes facing Caves Beach in the north-eastern part of the site that includes threatened species habitat features and connecting to the vegetated eastern watercourse and to existing Scenic Drive;
- Vegetated slopes of Mawsons Lookout (excluding the western cliff edge); and
- Vegetated western watercourse and an area of land above the existing dam that includes a pocket of habitat trees and threatened species.

In addition, some 4 ha of land is identified to be retained but managed (with tree canopy and habitat features selectively retained) mainly in areas also facing Caves Beach and in larger lots at the entry to the precinct.

The combined eastern and western sections of WNP comprise 174.7 ha of conservation lands dedicated to NSW National Parks and Wildlife Service in 2001 as part of conservation measures incorporated into the overall design. The site is currently vegetated but is part of a larger proposed, Master Plan approved, residential development on the Wallarah Peninsula. A series of development applications primarily in the Lake and Coastal Sectors have been approved by Lake Macquarie Council for residential development purposes.

The threatened ground cover species *Tetratheca juncea* (Black eyed Susan) has a small, scattered occurrence over the site. A population of 149 *Callistemon linearifolius* (Nettled Bottlebrush) plants occurs within the western watercourse and in land above the existing dam.

A Powerful Owl non-breeding roost site has been identified in the north-east of the site in the lower slope and on the boundary of the Caves Beach settlement.

Several ephemeral drainage lines dissect the site. A small dam (from previous mining activity) is situated in the south west of the site at the top of the western watercourse.

The ***study locality*** is defined as the area within a 5 kilometre (km) radius of the proposal site. Note that this is different to the definition of *locality* provided within the Threatened Species Assessment Guidelines (DECC 2007), which refers to either the local occurrence of a vegetation community or the local population of a species.

1.4 Description of Project

The application proposes bulk earthworks and clearing, as well as revegetation and managed areas as described above, as part of the proposed subdivision of the land. The application also includes new roads and 262 residential lots, in stages, as well as a future village centre lot, public reserve lots, drainage reserve lot, residue future development lots, and other associated works including bushfire management, stormwater drainage including basin and swales, provision of utilities, revegetation and landscaping.

Proposal stages are shown in Plan B Appendix H and described below:

- Stage 1c includes larger sized residential lots with building envelopes and contain areas of canopy retention (including habitat trees) around those envelopes, in the area not subjected to as much historical land disturbance;
- Stage 4 includes a community subdivision proposal to create fifteen (15) larger sized residential lots with building envelopes, with remediation of slope stability risks around and below those envelopes with a series of retaining walls stepping down the slope to a restricted access community road (not for lot access). The remediated slopes and areas to the south and above the community road are in both private and community ownership and will contain areas of canopy re-establishment on the remediated mid slopes, as well as managed areas (with select canopy retention). The community lot also includes the retained lands including the eastern watercourse and the lower slopes facing Caves Beach not previously subject to historical land disturbance. The retained areas include habitat trees, threatened species habitat and related buffers and are to the north and below the community road;
- Stage 5 includes a single large lot with single building envelope and retained, managed and revegetated lands around Mawsons lookout;
- Stage 6A includes a stormwater management facility generally in the location of the existing dam and a lineal area of land where an integrated design solution has been provided to include drainage swales designed around retention of trees and other ecological features including threatened flora species, surrounded by perimeter roads;
- Stage 6B includes the western watercourse that includes threatened flora species. A large section from its bank to the south needs to be remediated due to past disturbance and limitations for adjoining infrastructure, and then revegetated;

- The area to the south of Stage 6A and 6B forms part of the bulk earthworks and clearing, with separate application to follow for road and lot layout within that southern area.

Areas to be cleared and retained are shown in

Table **1-1** and displayed on a Plan C in Appendix H.

Table 1-1 Summary of Vegetation clearing and retention

	Total Site	Area Cleared, Roads or Existing Infrastructure	Vegetation Retained	Select Canopy Retained (managed)	Vegetation Removed
Area (ha)	74.6	9.2	17.2	4.0	44.2*
% of Site	100	12.3	23.0	5.4	59.3

**includes 2.4 ha to be revegetated plus 2.6 ha to be managed/selectively revegetated.*

In order to provide ongoing protection of surrounding environments the following measures are integrated into the development:

- Cats will be entirely prohibited from the development
- Dogs will be restricted from lots adjacent the retained vegetation protecting owl roosting habitat
- Signage will be installed to inform residents of sensitive ecological areas, particularly the owl habitat.
- Revegetation of the area would be undertaken using species characteristic of the previous vegetation community where possible and lists of such species should be provided to prospective residents for planting in lots, as per requirements of the Bushland Management Manual (Manidis Roberts 2007).

1.5 Conservation Protected lands on the Wallarah Peninsula and Locality

Approximately 3700 ha of conservation zoned lands are protected within 10 km of the site as shown in Plan D Appendix H. The conserved lands include Nature Reserves, State Conservation Areas and National Parks. The approximate breakdown of conserved land within 0-6+km of the site is as follows:

0-2km band	158 ha
2-4km band	436 ha
4-6km band	499 ha
6-10km band	2607 ha
Total	3700 ha

Table 1-2 lists conservation reserves in the region along with their dominant habitat type and threatened species known to occur.

Table 1-2 Conservation reserves in the vicinity of the Wallarah Peninsula.

Conservation Reserve	Distance and direction from site	Area (ha)	Habitat types and species	Source
Wallarah National Park	Adjacent to site (south & east)	180	**EEC:** Themeda grassland, lowland rainforest **Threatened flora:** Black-eyed Susan *Tetratheca juncea*, Coastal Headland Pea *Pultenaea maritima* **Threatened fauna:** Powerful Owl *Ninox strenua*, Squirrel Glider *Petaurus norfolcensis*, Little Bentwing Bat *Miniopterus australis. (quotes habitat only).* *Masked Owl and Powerful owl known from surveys for this project.* *Callistemon linearifolius recorded (Conacher Travers 2007b)*	OEH 2014a NGH (2012)
Pulbah Island Nature Reserve	5 km west	66.1	Glossy Black Cockatoo, Regent Honeyeater, Swift Parrot, Masked Owl, Little Lorikeet, spotted Harrier.	ALA 2016
Lake Macquarie SCA Six separate areas of the western and south-eastern shores of Lake Macquarie	~ 5 km S 3 km W	650	**Habitat:** Paperbark forest, eucalypt forest, swamp, thicket, heath, dry rainforest, saltmarsh, open scrub and woodland. Also, Swamp Oak Floodplain Forest EEC. **Threatened flora:** *Acacia bynoeana, Angophora inopina*, *Tetratheca juncea,* Magenta Lilly Pilly *Syzygium paniculatum, Genoplesium insignis*. **Threatened fauna:** Pied Oystercatcher *Haematopus longirostris*, Wallum Froglet *Crinia tinnula*, Eastern Bentwing Bat *Miniopterus oriane*, Little Bentwing Bat *Miniopterus australis,* Squirrel Glider *Petaurus norfolcensis*.	NPWS 2005
Munmorah State Conservation Area (SCA)	~8km S	1515	**Habitat:** Woodland, open forest, wetland, littoral rainforest, coastal tea tree shrubland and coastal heath. **Threatened flora:** *Tetratheca juncea* and Magenta Lilly Pilly *Syzygium paniculatum*. **Threatened fauna:** Squirrel Glider *Petaurus norfolcensis*, Grey-headed Flying Fox *Pteropus poliocephalus* (summer feeding sites), New Holland *Mouse Pseudomys novaehollandiae*, White-bellied Sea-eagle *Haliaeetus leucogaster* (nesting), Osprey *Pandion haliaetus*, Sooty Oystercatcher *Haematopus fuliginosus*, Wallum Froglet *Crinia tinnula*	NPWS 2009
Catherine Hill Bay development project area	~5 km S		**Habitat:** Banksia scrub, heath-scrub, woodland, grassy forest, paperbark swamp forest **Threatened Flora:** *Cryptostylis hunteriana, Tetratheca juncea* **Threatened fauna:** Wallum Froglet (in SEPP 14 wetland in Munmorah SCA adjoining project area), White-bellied Sea-eagle (in offset area), Masked Owl, Little Bentwing Bat, Eastern Bentwing Bat,	RPS 2014
Awaba State Forest (community and local government groups pushing for Awaba State Conservation Area)	~10 km W	2190	**Habitat:** woodland, forest **EEC:** Swamp Sclerophyll Forest, River Flat Eucalypt Forest **Threatened Flora:** *Acacia bynoeana, Grevillea parviflora* subsp *.parviflora, Tetratheca juncea* **Threatened fauna:** Squirrel Glider, Masked Owl, Powerful Owl, Sooty Owl, Grey-headed Flying-fox, Barking Owl, Swift Parrot, Regent Honeyeater, Wallum Froglet, Green-thighed Frog *Litoria brevipalmata*, Little Bentwing Bat	LMSNA 2016
Tingira Heights Nature Reserve	~10 km N	18	**Habitat:** dry eucalypt forest **Threatened flora**: *Tetratheca juncea*	NPWS 2009

Conservation Reserve	Distance and direction from site	Area (ha)	Habitat types and species	Source
			Threatened fauna recorded: Grey-headed Flying-fox	
Colongra Swamp Nature Reserve	~12 km S	112	**Habitat:** open forest, coastal wetlands, *Melaleuca* forest **EEC:** Swamp Scleropyhll Forest, Swamp Oak Floodplain Forest, River-flat Eucalypt Forest, Freshwater Wetlands **Threatened fauna**: Swift Parrot *Lathamus discolour*, Varied Sittella, Wallum Froglet, Little Lorikeet *Glossopsitta pusilla*.	OEH 2014 c
Awabakal Nature Reserve	~14 km NE	228	**Habitat:** freshwater lagoon, coastal heath, intertidal rock platforms, cliff-top sand dunes, eucalypt forest, grassland **EEC:** Sydney Freshwater Wetlands, Swamp Scleropyhll Forest, Themeda Grasslands **Threatened flora:** *Tetratheca juncea,* Camfield's Stringybark *Eucalyptus camfieldii* **Threatened fauna:** Powerful Owl, Masked Owl, Squirrel Glider, Eastern Bentwing Bat	OEH 2014 d
Sugarloaf SCA	~15 km NW	3926	**EEC:** Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion; Lowland Rainforest in North Coast Bioregion, Swamp Oak Floodplain Forest. **Threatened flora:** black-eyed Susan (Tetratheca juncea), small-flower grevillea (Grevillea parviflora ssp. Parviflora), leafless tongue-orchid (*Cryptostylis hunteriana*), and the heath wrinklewort (*Rutidosis heterogama*). **Threatened fauna:** regent honeyeater (*Anthochaera phrygia*) and threatened glossy black cockatoo (*Calyptorhynchus lathami*), little lorikeet (*Glossopsitta pusilla*), brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*), black-chinned honeyeater (eastern subspecies) (*Melithreptus gularis gularis*), powerful owl (Ninox strenua), masked owl *(Tyto novaehollandiae*), sooty owl (*Tyto tenebricosa*), spotted-tailed quoll (Dasyurus maculatus), yellow-bellied glider (*Petaurus australis*), koala (Phascolarctos cinereus), grey-headed flying-fox (*Pteropus poliocephalus*), eastern freetail-bat(*Mormopterus norfolkensis),* golden-tipped bat (*Kerivoula papuensis*), large-eared pied bat (*Chalinolobus dwyeri*),eastern false pipistrelle (Falsistrellus tasmaniensis), little bentwing-bat(*Miniopterus australis*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), greater broad-nosed bat (Scoteanax rueppellii), little eagle (*Hieraaetus morphnoides*) and Stephens' banded snake (*Hoplocephalus stephensii). (not clear if habitat present or actually known to occur)* second source: **Threatened flora**: black-eyed Susan (*Tetratheca juncea*), small-flower grevillea (Grevillea parviflora ssp. Parviflora), **Threatened fauna:** Spotted-tailed Quoll, Common Planigale *Planigale maculate*, Koala, Yellow-bellied Glider, Grey-headed Flying-fox, Eastern Freetail Bat, Little Bentwing Bat, Eastern Bentwing Bat, Large-eared Pied Bat, Eastern False Pipistrelle, Large-footed Myotis, Greater Broad-nosed Bat, Powerful Owl, Sooty Owl, Glossy Black Cockatoo, Scarlet Robin *Petroica boodang*, Varied Sittella *Daphoenositta chrysoptera*, Regent Honeyeater, Masked Owl.	OEH 2014b Xstrata Coal (2014)

Conservation Reserve	Distance and direction from site	Area (ha)	Habitat types and species	Source
Jilliby SCA and Watagans National Park	~20 km W	12, 159 7798	**Habitat:** dry grass forest, tall moist eucalypt forest, warm temperate rainforest, paperbark palm forest **EEC:** Hunter Lowland Redgum Forest, Lowland Rainforest **Threatened flora:** *Tetratheca glandulosa, Bosistoa transversa* **Threatened fauna**: Giant Barred Frog *Mixophyes iterates*, Giant Burrowing Frog *Heleiopous australiacus*, Stuttering Frog *Mixophyes balbus*, Stephens Banded Snake *Hoplocephalus stephensi*, Barking Owl *Ninox connivens*, Bush Stone-curlew *Burhinus grallarius*, Glossy Black Cockatoo, Masked Owl, Powerful Owl, Sooty Owl *Tyto tenebricosa*, Brush-tailed Rock Wallaby *Petrogale penicillata*, Yellow-bellied Glider, Koala, Large-eared Pied Bat, Spotted-tailed Quoll, Yellow-bellied Sheathtail Bat	NPWS 2010
Glenrock SCA	19 km N	534	**Threatened flora:** *Tetratheca juncea, Syzygium paniculatum, Diuris praecox, Cynanchum elegans, Rutidosis heterogama* **Threatened fauna:** powerful owl *Ninox strenua* vulnerable masked owl *Tyto novaehollandiae* vulnerable turquoise parrot *Neophema pulchella*, regent honeyeater *Xanthomyza Phrygia.* swift parrot *Lathamus discolor*, common bent wing bat *Miniopterus schreibersii* vulnerable little bent wing bat *Miniopterus australis* vulnerable grey-headed flying fox *Pteropus poliocephalus,* squirrel glider *Petaurus norfolcensis.*	v

1.6 Relevant Legislation

1.6.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Cwlth)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as matters of national environmental significance. Matters of national environmental significance relevant to biodiversity are:

- Wetlands of international importance.
- Nationally threatened species and ecological communities.
- Migratory species.
- Commonwealth marine areas.

Significance of impacts is determined in accordance with the *Significance impact guidelines 1.1 – matters of national environmental significance* (Department of Environment and Climate Change 2007).

Where a proposal is likely to have a significant impact on a matter of national environmental significance, the proposal is referred to the Commonwealth Environment Minister via the Department of the Environment (DoE). The Minister then determines whether the proposal is a 'controlled action'. If a proposal is declared a controlled action, an assessment of the action is carried out and the Minister makes a decision to approve, approve with conditions, or not approve the proposed action.

One Commonwealth listed threatened species (*Tetratheca juncea*) will be impacted as a result of this project. The Grey-headed Flying-fox was also recorded drinking from the dam in the west of the site. EPBC Referral decision

2007/3412 deemed the northern sector proposal (of which the Central Precinct sits within) to be not a controlled action (decision date May 2007). Therefore, preparation of a referral is not required.

1.6.2 NSW Environmental Planning and Assessment Act 1979 (EP&A Act)

The objectives of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) are:

a) to encourage:
   i. the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,
   ii. the promotion and co-ordination of the orderly and economic use and development of land,
   iii. the protection, provision and co-ordination of communication and utility services,
   iv. the provision of land for public purposes,
   v. the provision and co-ordination of community services and facilities, and
   vi. the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and
   vii. ecologically sustainable development, and
   viii. the provision and maintenance of affordable housing, and
b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and
c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.

Part 4 applies to projects that require development consent from a consent authority (usually a local council). A statement of environmental effects or environmental impact statement (for designated development) is prepared to assess environmental impacts.

Clauses 5A and 5C of the EP&A Act require that the significance of the impact of the proposal on terrestrial and aquatic threatened species, populations and endangered ecological communities is assessed. Threatened species assessment guidelines (OEH 2017) have been developed to assist in making this assessment.

1.6.3 NSW Threatened Species Conservation Act 1995 (TSC Act)

The *Threatened Species Conservation Act 1995* (TSC Act) aims to conserve biological diversity, promote ecologically sustainable development, prevent extinctions and promote recovery of threatened entities, protect critical habitat, assess the impacts of actions on, and encourage the conservation of threatened entities.

If works are likely to impact on a listed (threatened) species or ecological community, Section 94 of the TSC Act contains seven factors that can be used to determine whether the effect on the entity will be significant or not. Where a significant effect is likely to occur a Species Impact Statement (SIS) must be prepared for projects assessed under Part 4 and Part 5 of the EP&A Act. The content of a SIS is outlined in Sections 110 – 112 of the TSC Act and includes requesting Director-General's requirements. Clause 50 requires public authorities to have regard to critical habitat when exercising their functions on land to which a critical habitat declaration applies.

1.6.4 Noxious Weeds Act 1993 (NW Act)

The *Noxious Weeds Act 1993* (NW Act) aims to prevent the establishment, reduce the risk of spread and minimise the extent of noxious weeds. The NW Act guides the management of declared noxious weeds within Local

Government Areas (LGAs). The NW Act distinguishes between five classes of noxious weeds, which are separated based on their distributions and the level of threat that each species poses to the environment, human health, or primary production (Table 1-3). Noxious weeds that are classified as Class 1, 2 or 5 are also considered 'notifiable weeds', which simply means that the Local Control Authority (e.g. Council) must be informed about the presence of the weed on land within 24 hours of becoming aware or suspecting that the weed is on the land. Individual land holders and managers are required under the NW Act to control noxious weeds declared for their area according to their classification. Declared noxious weeds in NSW are plants that have been proclaimed under the NW Act. The legislation requires that these species be controlled or eradicated.

In addition to the NW Act, an effort to gain control of weeds in Australia led to the development of a National Weeds Strategy. The strategy was first developed in 1997 and further refined in 2007 by the Commonwealth of Australia and issued under the authority of the National Resource Management Ministerial Council. Detailed management procedures have been outlined under the strategy and published for the control of 21 of the 32 recognised Weeds of National Significance (WoNS). WoNS are recognised as having potential to cause a significant impact upon natural values including: threats to human health and safety; threats to pastoral and agricultural industries; threats to water quality and supply; threats to indigenous flora; and threats to biodiversity and cultural values.

Table 1-3: Noxious weed classes and their characteristics as listed under the Noxious Weeds Act 1993.

Noxious Weed Class	Class Characteristics
Class 1 **State Prohibited Weeds**	Plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.
Class 2 **Regionally Prohibited Weeds**	Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.
Class 3 **Regionally Controlled Weeds**	Plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.
Class 4 **Locally Controlled Weeds**	Plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.
Class 5 **Restricted Plants**	Plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.

1.6.5 NSW National Parks and Wildlife Act 1974 (NP&W Act)

This act aims to conserve nature, habitat, ecosystems, ecosystem processes and biological diversity at the community, species and genetic levels. Under this Act all native fauna is protected, threatened or otherwise. Schedule 13 of the act lists protected plants which shall not be harmed or picked on any land either on or off National Park estate.

With regard to threatened species a person must not:

(a) harm any animal that is of, or is part of, a threatened species, an endangered population or an endangered ecological community, or

(b) use any substance, animal, firearm, explosive, net, trap, hunting device or instrument or means whatever for the purpose of harming any such animal.

In relation to this project, the Act is relevant to:

- The protection of Wallarah National Park, which has been transferred to the NSW Government and will be managed under the Act;
- The protection of threatened or endangered ecological communities or species in conjunction with the Threatened Species Conservation Act, 1995.

1.6.6 SEPP 44 – Koala Habitat Protection

SEPP 44 encourages the conservation and management of natural vegetation areas that provide habitat for Koalas to ensure that permanent free living populations will be maintained over their present range.

SEPP 44 aims to identify areas of *potential* and *core* Koala Habitat. These are described as follows:

- *Core Koala Habitat* is defined as an area of land with a resident population of Koalas, evidenced by attributes such as breeding females, and recent and historical records of a population.
- *Potential Koala Habitat* is defined as areas of native vegetation where the trees listed in Schedule 2 of SEPP 44 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

The Lake Macquarie LGA is identified under Schedule 1 of SEPP 44. This Policy seeks to encourage the proper conservation and management of areas that provide habitat for Koalas.

Clause 9 of the SEPP states that:

(1) Before a council may grant consent to a development application for consent to carry out development on land to which this Part applies that it is satisfied is a core koala habitat, there must be a plan of management prepared in accordance with Part 3 that applies to the land.

(2) The council's determination of the development application must not be inconsistent with the plan of management.

Koalas have not been recorded on the site in the current survey, nor historically. The site is not potential or core Koala habitat. No further assessment of koalas is made within this report.

2. Methodology – Desktop

2.1 Literature Review

A large amount of ecological survey and assessment has been conducted in the study area and greater Wallarah Peninsula over the past 20 years. It is important to document and describe the outcomes of previous relevant surveys as they provide context to the work that has been done most recently on the subject site. However, a multitude of documents including ecological assessment reports, summary audit report, and documents associated with the master planning process, management plans and survey guidelines have been produced over the 20+ years of the project. Each of these documents refers to or summarises information from the previous studies. In some cases, this has resulted in misreporting and misinformation being perpetuated throughout years of reporting regarding the findings of each of the studies. This report summarises relevant historical ecological information and prior survey effort for each species in the Sections 4 and 5 (Results) so that the results of the current study and previous studies can be considered in conjunction.

The literature review for this study has consulted the original source documents and provided detailed, referenced summaries of those studies, as they relate to the current DA. The source documents have been consulted to ensure that the correct factual information is referred to and interpreted correctly. Information sourced from these key documents is in three main categories:

- Survey effort for each fauna group so it can be related to reported absence or non-recording of a particular threatened species, if this is the case.
- Survey locations – where the studies have been conducted so the correct relationship can be drawn between the results of a particular study, and the current subject site and DA.
- Survey results – so a cumulative picture can be built as to the threatened species that have been recorded, when, and where in relation to the current subject site and DA.

2.2 Background

Substantial flora and fauna survey has been conducted in the past for the North Wallarah Peninsula, including the northern sector. The following background information was reviewed prior to undertaking surveys and further reviewed and summarised during the preparation of the impact assessment report.

Previous flora and fauna surveys and summary reports:

- Ecological Site Survey Report Coastal & Northern Sectors (Conacher Travers Environmental Consultants 2007a);
- Environmental Audit Report Wallarah Peninsula Lakes, Coastal and Northern Sectors. (Conacher Travers 2007b).
- Flora and Fauna assessment report. Coastal Village Precinct. (Conacher Travers Environmental Consultants 2007c).
- Conservation and Land Use Management Plan (CLUMP) (Woodward Clyde 2000);
- North Wallarah Peninsula Masterplan. Ecological Site Management Plan (Manidis Roberts 2003);
- Environmental Audit Report Wallarah Peninsula Lakes, Coastal & Northern Sectors (Conacher Travers 2007);

- Lensworth North Wallarah Peninsula Masterplan: Concept development Planning- a reference for the masterplan;
- Lensworth (2003) North Wallarah Peninsula Masterplan Executive Summary;
- NSW National Parks and Wildlife Service (2002). Wallarah National Park Draft Statement of Interim Management Intent;
- NSW National Parks and Wildlife Service (2003) Wallarah National Park Interim Management Guidelines.

LMCC Guidelines:

- LMCC - Flora and Fauna Survey Guidelines Version 4.2 (2012) (LMCC FFSG).
- LMCC - Interim Lake Macquarie *Grevillea parviflora* subsp. *parviflora* Planning and Management Guidelines – June 2013
- LMCC - Interim Lake Macquarie Large Forest Owl Planning and Management Guidelines 2014
- LMCC - Lake Macquarie Squirrel Glider Planning and Management Guidelines 2015
- LMCC - Lake Macquarie *T. juncea* Planning and Management Guidelines 2014
- EcoLogical - Native Orchids in the Lake Macquarie LGA, with a special emphasis on Rare or Threatened Species. Report Prepared for Lake Macquarie city Council 2015.

The following background information has been reviewed during the preparation of this impact assessment report:

OEH Guidelines

- OEH NSW Guide to Surveying Threatened Plants (2016)
- DEC (2004). Threatened Species Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft).

Other published papers and unpublished reports relevant to the site and target species:

- SWC Wetland and Ecological Management Consultancy (1994). Pinny Beach Residential development Stage 2 Flora and fauna Assessment
- SWC Wetland and Ecological Management Consultancy (1996). Eleebana Local Squirrel Glider Study. Report to Lake Macquarie City Council.
- Payne (1999). Vegetation Mapping and Conservation Area Analysis North Wallarah Peninsula Project Site. Report Prepared for Lake Macquarie City Council.
- ERM Resource Planning (1995). Fauna Impact Statement for Lakeside Sector including Stages 2B & 3D Pinny Beach. Report prepared for James Mullan Developments Pty Ltd.
- NPWS (2009). Tingira Heights Nature Reserve Plan of Management.

- Nghenvironmental (2012). Threatened Owl nest sites and habitat. Stockland Land Holdings North Wallarah Peninsula. Report prepared for Stockland Developments.

Results of previous detailed flora and fauna surveys conducted on the Northern Sector are summarised in the Ecological Site Survey Report – Coastal and Northern Sectors, Wallarah Peninsula (Conacher Travers 2007c) and the Environmental Audit Report (Conacher Travers 2007). Table 2-1 lists previous survey effort and results from those reports, as they relate to the northern sector which this site sits within. This is in addition to extensive ecological survey program across the masterplan site between 2001 and 2006.

Table 2-1 previous survey effort on the Northern Sector

Year	Target group	Survey effort/type	Results
2005 & 2006	Terrestrial & arboreal mammals	290 Elliot tree traps, 294 ground Elliot traps, 66 small cage traps, 24 large cage traps.	No threatened mammals recorded.
2005	Mammals	Hair tubes. Not clear from report how many nights of trapping in northern sector	No hairs of threatened mammals identified.
2005	Nocturnal fauna	Spotlighting	No threatened fauna recorded.
2005& 2006	Microchiropteran bats	Anabat, harp trap	Threatened species Eastern Bentwing Bat, Little Bent wing bat, Greater Broad-nosed Bat, Yellow-bellied Sheathtailed bat.
2005	Birds	Point Bird survey x 1	No threatened birds recorded
2005 & 2006	Owls	Owl call playback x 2	Sooty owl response to call play back (likely form pair to west across the highway – refer ngh environmental 2012 for location).
2005	Flora/ Vegetation	10 x 100m veg transects 9 20x20 quadrats.	*Tetratheca juncea, Callistemon linearifolius* recorded. No *Diuris praecox* recorded in NS. Majority of southern section northern sector mapped as Type 2 Smooth-barked Apple Open Forest with patches of type (2a) Smooth-barked Apple Open Forest (She-oak Scrub), (2b) Smooth-barked Apple Open Forest (Mixed Regrowth Woodland) and (2c) Smooth-barked Apple Open Forest (Mixed Low Open Forest/Woodland)

Year	Target group	Survey effort/type	Results
	Vegetation	2 transects	Part of current study area labelled as coastal sector and mapped as Spotted Gum open forest (1) with small areas of riparian forest (6).
	Habitat trees		Mapped but not in relation to threatened species habitat.

2.3 Database Searches

Database searches undertaken for the purposes of this assessment included threatened species databases and noxious weed databases as listed in Table 2-2. The likelihood of identified threatened species to occur within the study area and their potential to be impacted by the Proposal is assessed throughout this report and considers the findings of the current study along with the results of historical studies.

Table 2-2 Databases searched

Database	Aspect searched	Date of search	Scope of search
BioNet Atlas Search	Threatened flora and fauna and populations	August 2019	10 km radius of proposal site
EPBC Act Protected Matters Search Tool	Threatened flora and fauna, endangered populations and ecological communities and migratory species	August 2019	5km radius of centre of proposal site
Department of Primary Industries (DPI) Noxious Weed database 'Weed Wise'	Noxious weeds declared in the relevant LGA.	August 2019	Lake Macquarie Local Control Area (LCA).

3. Methodology - Field

Field survey for the project were carried out over a two year period commencing in December 2016. General surveys were carried out in December 2016 and January 2017. Additional flora surveys were carried out as required to meet the seasonal survey requirements of certain species. Details of survey timing and effort are provided in the following sections.

3.1 Flora Survey Methodology

A significant amount of vegetation survey has already been conducted on the subject site by Conacher Travers Environmental Consultants (2007). Conacher Travers mapped vegetation on the site and undertook targeted threatened flora surveys as part of an extensive ecological survey program across the Wallarah Peninsula between 2001 and 2006 (refer Figure 6 Conacher Travers 2007a). Therefore, the flora survey undertaken by EcoFocus in 2016 and 2017 focused on confirming the results of this previous work and conducting additional targeted searches for threatened species.

For this study, flora surveys were carried out over a three day period between the 5th and 7th of December 2016 with a focus on targeted searches for threatened flora *Tetratheca juncea*, *Callistemon linearifolius* (both previously recorded in the northern sector), *Cryptostylis hunteriana* and confirmation of previously mapped vegetation types,

their boundaries and condition. Another three-day period of survey was conducted in February 2018 focussing on *Callistemon linearifolius* and additional vegetation plots. Surveys for *Diuris praecox* were carried out in August 2017. Additional surveys were carried out in May 2018 to confirm the classification of riparian vegetation in the east of the site and to confirm that it was not an Endangered Ecological Community (EEC).

Surveys were conducted by four highly qualified and experienced botanists. A full floristic list was compiled and GPS locations of all threatened species recorded. All survey locations and results were recorded on GPS as either tracks or waypoints depending on the type of survey.

Vegetation floristics and structure were assessed using 20x20m quadrats in which all species in all strata (ground, understorey, midstorey and canopy) were identified. A total of 30 vegetation quadrats were sampled with additional descriptions at incidental point locations.

Flora survey effort and detail on survey methodology is summarised in Table 3-1. Flora survey effort is shown in Figure 2.

Table 3-1 Flora survey effort

Survey type	Target group	Survey timing & effort
Vegetation surveys	All flora	30 20*20m quadrats (December 2016 and February 2018)
	Riparian vegetation	May 2018 Creekline 200m transect and 1 x 20x20m plot.
Threatened Flora Species	*Tetratheca juncea*	Targeted surveys by 2 botanists in December 2016. Additional searches during 2017 (fauna survey) and August 2017 (Diuris survey). Resurvey in October 2018.
Threatened Flora Species	*Cryptostylis hunteriana*	Targeted survey by 2 botanists in December 2016 and January 2017 within peak flowering season in suitable habitat.
Threatened Flora Species	*Diuris praecox*	Targeted survey by 2 botanists in August 2017 within peak flowering season as confirmed by flowering of reference population.
Threatened Flora Species	*Callistemon linearifolius*	Targeted survey by 2 botanists in December 2016 and February 2018
Threatened Flora Species	*Syzigium paniculatum*	Targeted survey by 2 botanists in suitable habitat in February and May 2018.

3.1.1 Tetratheca juncea

Priority targeted survey has been undertaken for *Tetratheca juncea* across most areas of Wallarah Peninsula during 2003, 2004 and 2006 (refer Figure 4.1 Conacher Travers 2007). The methodology employed by Conacher Travers was "targeted surveys for the threatened species *Tetratheca juncea* were undertaken by employing a systematic approach using parallel transects spaced 20-40 m within all areas containing potential habitat. Each *Tetratheca juncea* clump was defined as a single point where all stems entered the ground. A separation distance of 30cm was used to differentiate between each clump (as set out within the guidelines by Payne *et al.,* (2002). Where clumps were continuous, a set radius was determined and all plant clumps were counted within the set

radius. Targeted surveys were undertaken by experienced botanists in the appropriate flowering season" (Conacher Travers 2007 pp 9).

EcoFocus undertook targeted searches for *T. juncea* across the site in December 2016. The entire site was traversed by random meander and the species was recorded when it occurred in flora survey quadrats. Additional locations were recorded if located during fauna surveys in January 2017 and during *Diuris praecox* searches in August 2017. Thus, a combination of ground truthing, resurvey, quadrats, and random meander were used to ensure site coverage, confirm previous survey results and provide updated survey results. The location of all clumps was recorded with GPS. The methodology for counting clumps outlined in the Lake Macquarie *Tetratheca juncea* Planning and Management Guidelines (LMCC 2014) was followed. This mirrors Payne *et al* (2002) as quoted in Travers (2007) and is described as follows:

"it is proposed that a distance of 30 centimetres be adopted to delineate between adjacent clumps. Any distance greater than 30cm would mean that the clumps would be considered to be separate plant clumps. Clumps which appear to be separate plant clumps (ie stems converging to a single rootstock) but which are within a distance of 30cm of other adjacent clumps should be counted as a single plant clump".

The accepted method of assessment for *T. juncea* is to conduct one survey during the peak flowering period (mid-September to mid-October). The survey was conducted according to the *Environment Protection and Biodiversity Conservation Act 1999* referral guidelines for the vulnerable Black-eyed Susan, *Tetratheca juncea,* as required by the LMCC *T. juncea* planning and management guidelines.

T. juncea flowers from July to December so all above surveys were undertaken during the flowering season and according to relevant guidelines. However, flowering specimens were still being recorded during our surveys in January 2017. Survey effort is shown in Figure 2.

3.1.2 Diuris praecox

Diuris praecox (Rough Doubletail, an orchid) flowers from July to early September and typically grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey (OEH Threatened Species Profile).

Targeted surveys involving random meanders in potential habitat for *D. praecox* were undertaken across the Coastal and Northern Sectors by Conacher Travers (2007) in August 2001, August 2002, August 2003 and August 2005.

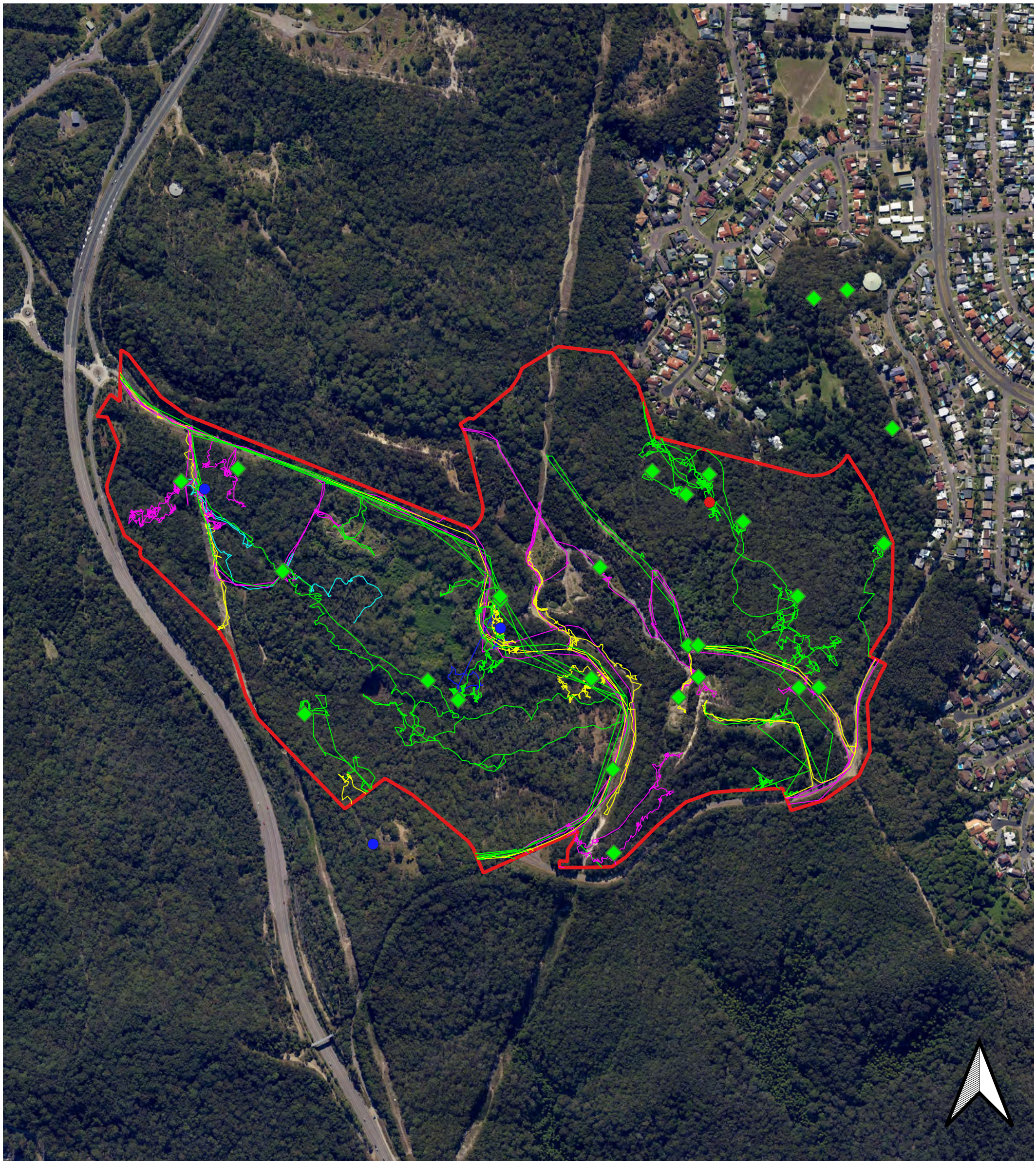
Surveys for *D. praecox* were undertaken by EcoFocus in August 2017. Detailed surveys were conducted over a three-day period by and experienced botanist and ecologist in areas of suitable habitat across the Central Precinct. Survey effort detail is shown in Figure 2. A reference site where the species had previously been recorded was checked for flowering individuals prior to commencing survey on the subject site to give an indication of likely detectability of the species on site. Flowering specimens were located at the reference site confirming that the survey timing was appropriate, and the species would be detectible if present. All other terrestrial orchids detected during surveys were recorded.

3.1.3 Cryptostylis hunteriana

Conacher Travers (2007a; Figure 4.2) undertook detailed surveys for *Cryptostylis hunteriana* within potential habitat (Smooth-barked Apple Open Forest) during 2006. Parallel transects of 10-20 m were performed in and random meanders were undertaken in the remaining vegetation communities.

Targeted searches were carried out for *Cryptostylis hunteriana* by EcoFocus in early December 2016 and January 2017. The searches were conducted by two very experienced botanists and entailed covering all suitable habitat across the site on foot. The random meander technique was considered more appropriate than transects as more ground can be covered.

Figure 2 Flora Survey Effort



Legend

Site Boundary

Flora Survey Locations

- Diuris praecox search
- Vegetation Plot
- Vegetation Survey Location

Flora Survey Tracks

- Callistemon linearifolius search
- Cryptostylis search
- Diuris praecox search
- Tetratheca juncea search
- Vegetation Survey Locations

0 250 500 m

EcoFocus ENVIRONMENTAL CONSULTING

All other Cryptostylis species detected during the surveys were recorded.

Survey effort is shown in Figure 2.

3.1.4 Callistemon linearifolius

Surveys were undertaken for *C. linearifolius* in December 2016 and again in February 2017. Suitable habitat was searched along the creekline in the west to the site to the south of the landfill. Locations of all individuals were recorded with GPS.

3.2 Fauna Survey Methodology

Substantial fauna survey has been undertaken on the NWP including the subject site over the past 23 years, and in particular over the past 10 years. Details of this survey effort are provided below and the relevant results are provided in Section 5 in relation to each fauna species.

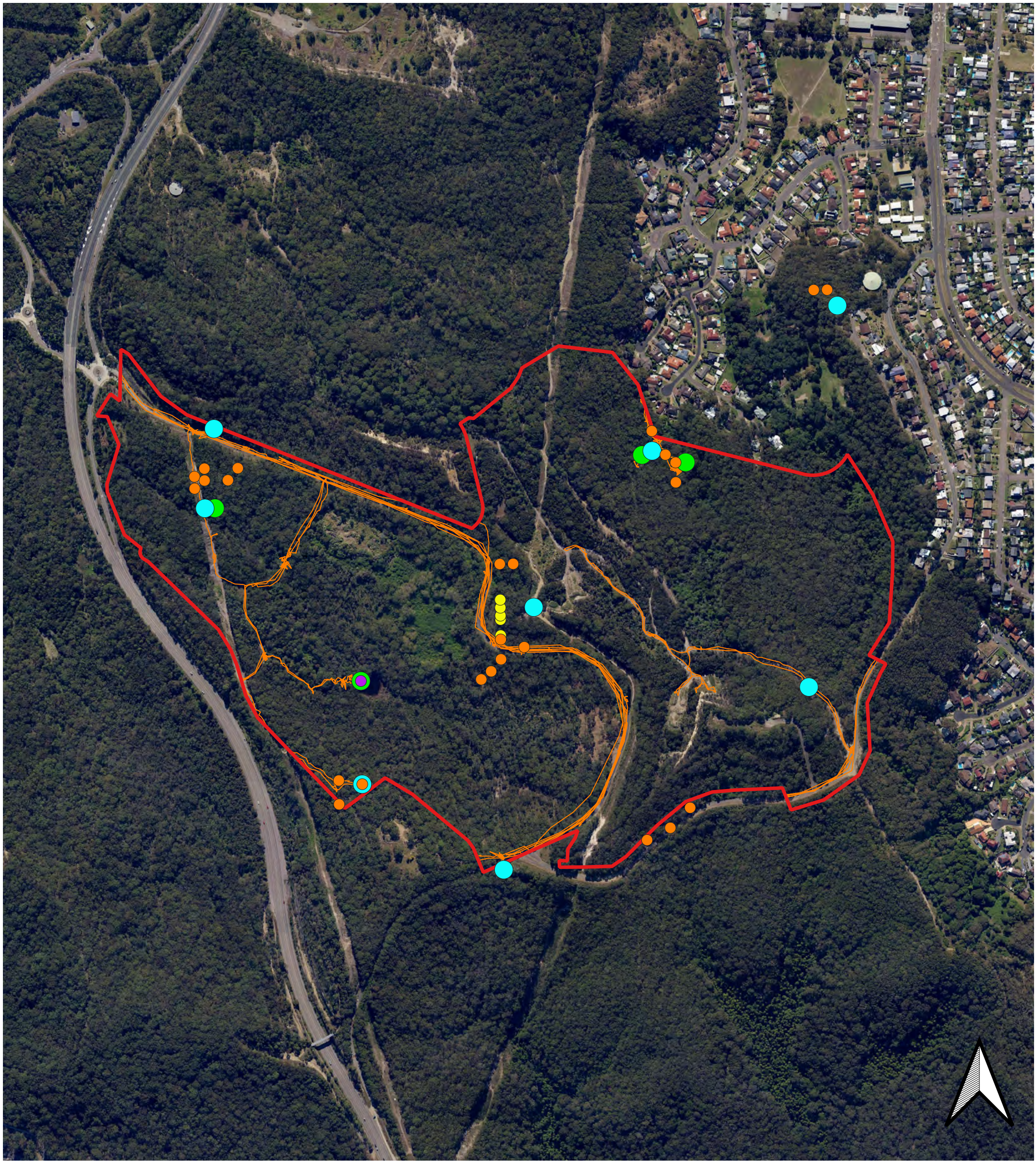
The aim of the terrestrial fauna assessment was to conduct both general fauna surveys and targeted threatened fauna surveys in order to assess the presence/absence or potential presence/likely absence of particular species on the subject site.

Fauna surveys were conducted over a nine-day period in January 2017, with some additional Anabat survey in February 2018. All surveys were conducted by two highly skilled and experienced ecologists.

Surveys were designed to meet the requirements of the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft (DEC 2004), LMCC Flora and Fauna Survey Guidelines (2012) and additional species/taxon specific LMCC guidelines for threatened species (listed in introduction and referenced throughout text). All surveys conducted met these guidelines (unless otherwise explained). In some cases, more survey effort was expended than the guideline required. In addition to addressing published guidelines, Dr Coughlan consulted with various species experts for informed and up to date input on the suitability of various species-specific survey methods. Fauna survey methodology and effort is summarised in Table 3-2 and compliance with these guidelines in Table 3-3. Experts consulted are listed following the reference section of this report. All survey locations and results were recorded on GPS as either tracks or waypoints depending on the type of survey. Fauna survey effort is shown on Figure 1. Details of fauna survey techniques and survey effort are provided in Table 3-1 below but in summary comprised of:

- Arboreal trapping for Squirrel Gliders
- Tree mounted hollow traps for Eastern Pygmy Possum
- Spotlighting and stag watching for arboreal mammals, microbats and owls
- Diurnal bird census
- Anabat detection for micro bats
- Call playback and listening for Wallum Froglet
- Litter searches/spotlighting for reptiles and amphibians

Figure 1 Fauna Survey Effort



Legend

- Site Boundary

Fauna Survey Locations

- Squirrel Glider Trap
- Frog Call Playback
- Eastern Pygmy Possum Trap
- Bird Survey Location
- Anabat Location
- Spotlight Tracks

0 250 500 m

EcoFocus
ENVIRONMENTAL CONSULTING

3.2.1 Fauna Survey Effort

Table 3-2 Fauna Survey Effort (EcoFocus 2017)

Survey type	Target group	Species	Survey methodology	Survey effort
Northern Sector January 2017 onwards				
Spotlighting	Nocturnal mammals, birds (owls), reptiles & frogs	Squirrel Glider Wallum Froglet Stephen's banded Snake Grey-headed Flying Fox Microbats	Walking transects Led Lenser head torches Nikon and Leica 10x42 binoculars	Approx. 21 hrs across 7 nights walking and driving transects x2 observers
Anabat	Microchiropteran bats	Any threatened microbat	SDII detectors directed into openings or potential flyways and over water bodies. Calls analysed by bat expert Glenn Hoye	14 Anabat nights/ 4 locations Jan 2017 Additional 4 Anabat nights Feb 2018
Anabat	Microchiropteran bats	Additional survey over offsite water bodies	SDII detectors directed over dam and adjacent typha swamp. Calls analysed by bat expert Glenn Hoye	5 Anabat nights Feb 2018
Diurnal bird survey	Diurnal birds	Any threatened species	20 min 2ha searches All birds observed & heard recorded all opportunistic observations recorded over 8 days	8 formal bird surveys Continual opportunistic observations by two experienced observers
Arboreal Trapping	Arboreal Mammals	Squirrel Glider	Custom designed cage traps mounted on trees at approx. 4m high. Baited with peanut butter oats and honey, trunks sprayed with honey water. Rebaited and resprayed regularly.	175trap nights
Hollow traps	Mammals	Eastern Pygmy Possum	Custom made log hollows attached to trees in suitable habitat	5 traps for10 months
Hollow bearing tree mapping across the site.				

Table 3-3 EcoFocus 2017 survey methodology - Compliance with recommended survey methodology.

Target species	Methodology	Summary effort	OEH requirement	Met	LMCC requirement	met
Squirrel Glider	Spotlighting walking and driving transects transects	21 hours walking over 7 nights	2 x 1 hour and 1km up to 200 hectares of	**Yes +**	Spotlighting in conjunction with trapping	Yes

Target species	Methodology	Summary effort	OEH requirement	Met	LMCC requirement	met
	Led lenser lights High quality binoculars		stratification unit, walking at approximately 1km per hour on 2 separate nights			
Squirrel Glider	Stag watching dusk to one hour after dusk. Observers watching several hollow bearing trees with lights off.	8 person nights (4 nights*2 people), prior to spotlighting	Observing potential roost hollows for 30 minutes prior to sunset and 60 minutes following sunset	Yes	Stag watching in conjunction with trapping	Yes
Squirrel Glider	Custom designed cage traps mounted on trees at approx. 4m high. Baited with peanut butter oats and honey, trunks sprayed with honey water. Rebaited and resprayed regularly.	175 trap nights over 7 nights over 74 ha	24 trap nights over 3-4 consecutive nights (per 50ha stratification unit). Another project – 4 nights, min night temperatures above 10 degrees.	**Yes +**	Site field surveys are to determine presence and/or absence of both squirrel gliders and sugar gliders with a 95% level of certainty. Trap surveys for a minimum of 5 consecutive nights are normally required to confirm presence, or 7 nights to infer the site may not be currently used by gliders. (Table 8 p 45).	Yes
Eastern Pygmy Possum	Custom made log hollows attached to trees.	5 traps 10 months	This technique is relatively new so not specified in the 2004 DECC draft guidelines.	n/a	Nest-boxes **may be** installed and monitored at a site, allowing for the detection of more cryptic species, such as the eastern pygmy possum. Nest-boxes need to be in place for months.	Yes
Wallum Froglet	Call playback at dam	1 night	A combination of listening for frog calls, spotlighting, searching within habitat	Yes No calls heard to be recorded	No suitable habitat available on site to survey in a targeted way for this species.	Yes

Target species	Methodology	Summary effort	OEH requirement	Met	LMCC requirement	met
			and call recording should be used.			
Stephen's Banded Snake	Spotlighting walking transects Hollow bearing tree surveys Inspection of rocky areas	21 hours walking over 7 nights including along tracks and inspecting tree trunks and hollows	Nocturnal spotlighting of tree trunks, sample during warmer months	YES	Spotlighting between october and march (LMCC FFSG)	YES
Microbats	Anabat detectors directed into openings or potential flyways. Set to run from dusk til dawn.	14 Anabat nights/ 4 locations Jan 2017 Additional 4 Anabat nights Feb 2018	2 sound activated recording devices utilised for the entire night starting at dusk for 2 nights (4 Anabat nights) October to March	**YES +**	2 separate nights continuous recording from dusk per site (minimum 4 hrs). October to May.	**YES +**
Microbats	Spotlighting walking transects	21 hours over 4 nights including along tracks and inspecting tree trunks and hollows	2 x 1 hour spotlighting on two separate nights All year	**Yes +**	*Not specified*	n/a
Regent Honeyeater	20 min 2ha searches Call identification and sightings recorded all opportunistic observations recorded	8 formal bird surveys during January Continual opportunistic observations by two experienced observers	Not stipulated but discusses 1 ha per 20 min area search (note search area dimensions are erroneously stated as 10 ha).	YES - 2ha 20min searches as per Birdlife Australia and EPBC Guidelines and accepted industry standard	1 ha sample plot per site for 20 mins (inconsistent with industry standard of 2h/20 min survey).	YES
Swift Parrot	20 min 2ha searches Call identification and sightings recorded all opportunistic observations recorded	8 formal bird surveys during January Continual opportunistic observations by two experienced observers	Not stipulated but discusses 1 ha per 20 min area search (note search area dimensions are erroneously	YES 2ha 20min searches as per Birdlife Australia and EPBC Guidelines and	1 ha sample plot per site for 20 mins (inconsistent with industry standard of 2h/20 min survey).	YES (BA & EPBC)

Target species	Methodology	Summary effort	OEH requirement	Met	LMCC requirement	met
			stated as 10 ha).	accepted industry standard *		
Glossy Black Cockatoo	20 min 2ha searches Call identification and sightings recorded all opportunistic observations recorded Searches and continual vigilance for GBC feed sign (chewed cones)	8 formal bird surveys during November Continual opportunistic observations by two experienced observers	Not stipulated but discusses 1 ha per 20 min area search (note search area dimensions are erroneously stated as 10 ha).	2ha 20min searches as per Birdlife Australia and EPBC Guidelines and accepted industry standard	1 ha sample plot per site for 20 mins (inconsistent with industry standard of 2h/20 min survey).	YES (BA & EPBC)
Varied Sittella	20 min 2ha searches Call identification and sightings recorded all opportunistic observations recorded	8 formal bird surveys during November Continual opportunistic observations by two experienced observers	Not stipulated but discusses 1 ha per 20 min area search (note search area dimensions are erroneously stated as 10 ha).	2ha 20min searches as per Birdlife Australia and EPBC Guidelines and accepted industry standard	1 ha sample plot per site for 20 mins (inconsistent with industry standard of 2h/20 min survey).	YES (BA & EPBC)
Grey-headed Flying Fox	Spotlighting, continual observations (visual and listening)	As for spotlighting	Spotlight searches combined with listening for audible calls and movements in trees, roost surveys	YES No roosts to search.	Not specified – other than criteria for 'all mammals' 2 x 30 min searches on 2 separate nights at walking rate of 1 km/hr per site	**YES +**
Powerful Owl & Masked Owl	Spotlighting, hollow bearing tree surveys (this study). Roost searches.	Extensive surveys to identify owl roosting and nesting habitat and pair locations carried out over 2 year period. Locations of owl pairs and territories known.	Effort exceeds guidelines and has been carried out by an owl expert	**YES +**	Effort exceeds guidelines and has been carried out by an owl expert	**YES +**

Note: Yes+ means effort exceeded guideline requirement.

3.3 Fauna Habitat

The habitat assessment will assist with predicting the likely occurrence of threatened animals in the study area and will guide the location and techniques for targeted surveys for threatened animals" DECC (2004).

In order to assess the habitat types available on the site and their quality and suitability as threatened species foraging or breeding habitat (e.g. presence of hollows, intact native vegetation, and presence of native ground

and shrub layers). A general description of the fauna habitat available on the site was compiled and the following attributes recorded:

- general structure and condition of vegetation (i.e. presence of intact ground, shrub and tree layers and prevalence of weeds).
- presence of hollow bearing trees (see below).
- presence of foraging resources for threatened species such as winter flowering eucalypt species, casuarinas, banksias, acacias, mistletoe.
- microhabitat complexity (fallen logs, leaf litter, rock outcrops, caves).
- other habitat features such as permanent or intermittent creeks, soaks, dams or other water sources.

In additional to the habitat assessment undertaken for this study, targeted surveys have previously been undertaken specifically to identify nesting and roosting habitat for large forest owls, including detailed hollow bearing tree inventory. Those surveys were undertaken by owl expert John Young with assistant from Dr. Coughlan and are reported in nghenvironmental (2012). Outcomes of the study directly relevant to the subject site are summarised in the relevant sections of this report. The purpose of the surveys was to provide detailed and comprehensive information of the location of resident owls and to confirm nest sites as required by condition 51(d) of Development Consent DA /1297/2009 for Stage 14 of the project. This information was also intended to inform future planning of all Stockland (now WAD) land holdings.

3.4 Hollow Bearing trees

Hollow-bearing tree surveys were undertaken across the site. HBT were mapped, flagged, given a unique label, and the following data recorded: tree species, canopy spread, number and type of hollows. Details of each tree were recorded including height, species, DBH (diameter at breast height in cm), canopy spread and number and size of hollows. Hollows were inspected with binoculars and recorded as possible hollows if visibility was restricted due to the angle of the hollow. Hollow-bearing trees were placed into two categories 'high' or 'moderate/low' value habitat trees based on the characteristics of the hollows they contained as follows:

High - if they contained large hollows, or numerous, diverse sized hollows, or hollows particularly suited to a given threatened species.

Low – Moderate - if they contained small to medium sized hollows, in low numbers, or were unlikely to persist in the environment as arboreal hollows (in late stage of decay, or damaged to the extent they would take on water).

From the ground, it is sometimes difficult to determine if what looks like a hollow is actually a hollow. In many cases the termination of branches is recorded as a hollow when it is in fact blind. For this reason, the number of hollows recorded is more likely to be an over estimation than an under estimation. This is based on the authors' observations and data collection over more than 10 years during the clearing process when trees are felled and hollows inspected.

The location of each hollow bearing tree was recorded with GPS and given a unique label. These were then mapped and provided to the proponent to assist in detailed layout planning.

4. Results - Flora

4.1 Database Searches

Database searches revealed records of 14 TSC Act threatened flora species within a 10 km radius of the subject site or predicted to occur within the Central Precinct region. The EPBC Act protected matters search tool revealed four plant species which may or are likely to occur within the search area. EPBC listings are not based on records but provide a general guide only based on predictive modelling of species occurrence. In some instances, the EPBC protected matters search tool may predict the occurrence of 'species or species habitat' within a search area whilst the atlas of living Australia shows no records of the species.

The results of the database searches were analysed to assess the likelihood that any of these species could occur on the site or be impacted by the proposal. The assessment was based on the results of flora survey including vegetation type assessment, targeted threatened species searches, results of other relevant studies in the area, understanding of the species habitat requirements and consultation with experts. Where a species was considered likely to occur, was known to occur or considered likely to be impacted, a seven-part test pursuant to Section 5A of the EP&A Act was prepared.

Results of database searches are provided in Appendix B. From the assessment in this report two threatened flora species (*Tetratheca juncea* and *Callistemon linearifolius*) have the potential to be impacted by the proposal. Further discussion is provided in section 4.

4.2 Literature Review

Conacher Travers Environmental Consultants have previously conducted a number of ecological surveys throughout the Wallarah Peninsula from 2001-2006 (Conacher Travers 2007 a & b). Those surveys included the following vegetation survey effort on the subject site:

- 10 x 100m vegetation transects in 2006 (2 in Spotted Gum Open Forest, 8 in Smooth Barked Apple Open Forest)
- 9 vegetation quadrats (20m x 20m) 2006 (2 in Spotted Gum Open Forest, 7 in Smooth Barked Apple Open Forest)

Those flora surveys identified three ecological communities within the subject site being Smooth-barked Apple Open Forest, Spotted Gum Open Forest (Hunter Valley Moist Forest) and Mixed Riparian Forest.

Two threatened flora species were identified during surveys; *Tetratheca juncea* and *Callistemon linearifolius*.

4.3 Vegetation Types

There are three major vegetation types present on site. The dry rainforest community (Travers mixed riparian), the Spotted Gum Open Forest, and the Smooth-barked Apple Open Forest. The latter community can be split into two sub-types, which reflect previous disturbance areas. Vegetation mapping is shown in Figure 3 and described further below. Appendix A lists species recorded in flora surveys.

Vegetation types and boundaries on the subject site conformed largely with those of Conacher Travers (2007a). That is, the majority of the site supports Smooth-barked Apple Open Forest with subunits dominated by Casuarina regrowth. Spotted Gum Open Forest (a sub-unit of Hunter Valley Moist Forest) occurs in the far eastern portion

Figure 3 Vegetation

of the site, south of the existing Caves Beach settlement. Within the area dominated by Spotted Gum Open Forest, riparian vegetation of the eastern watercourse (Plains Gully) and two minor drainage lines supports Lake Macquarie Dry Rainforest which Conacher Travers (2007 a) called 'Mixed Riparian Forest'.

4.3.1 Smooth-barked Apple Open Forest

This community occurs across the majority of the site covering an area of approximately 45 ha, with some 10.4 ha dominated by Casuarina regrowth and small patches of mixed regrowth woodland.

The dominant tree species in this community include Smooth-barked Apple (*Angophora costata*), Red Bloodwood (*Corymbia gummifera*), Grey Gum (*Eucalyptus punctata*), Brown Stringybark (*Eucalyptus capitellata*), Broad-leaved White Mahogany (*Eucalyptus umbra*) and Sydney Peppermint (*Eucalyptus piperita*) with Broad-leaved Scribbly Gum (*Eucalyptus haemastoma*) occurring less frequently (also conforms with Conacher Travers 2007).

Generalist shrub species that occur throughout these habitats include Tall Groundberry (*Acrotriche divaricata*) and Common Hop Bush (*Dodonaea triquetra*). Generally low frequencies of the noxious woody weeds Bitou Bush (*Chrysanthemoides monilifera* ssp *rotundata*) and Lantana *(Lantana camara)* also occur throughout the subject area. Common ground stratum plants and twiner species include Bordered Panic (*Entolasia marginata*) and Forest Grass Tree (*Xanthorrhoea media*).

The threatened plant *Tetratheca juncea* occurs in this vegetation type.

4.3.2 Spotted Gum Open Forest (Hunter Valley Moist Forest)

This community occurs in the far north-eastern part of the precinct covering an area of approximately 11.6 ha. The classification and naming of vegetation communities has changed since the original Conacher Travers mapping and again after 2010.

Conacher Travers (2007) termed the Spotted Gum forests that occur on better soils as Spotted Gum Open Forest. Later Bell and Driscoll (2010) described the same forests as Hunter Valley Moist Forest. More recently Bell (2016) described various sub-sets of the Hunter Valley Moist Forest community (Unit 12), including sub-set Unit 12c as Hunter Valley Moist Spotted Gum - Ironbark Forest, which is the community of Hunter Valley Moist Forest that occurs on the subject site. Bell (2016) provides the following description of Hunter Valley Moist Forest.

General Description:

Hunter Valley Moist Forest is a broadly defined unit requiring further clarification and assessment, and it may overlap considerably with other MU12 subunits so far defined. As defined here, this is an original REMS2000 unit that has been subdivided regionally (see MU12 subunits). This community is effectively an ecotonal unit between moister forests in sheltered locations, and drier ridgetop types. In most cases a canopy of *Corymbia maculata* with *Eucalyptus acmenioides* is present, although other species such as *Eucalyptus siderophloia* and *Eucalyptus punctata* may also occur. Important understorey species include *Polyscias sambuccifolia, Pteridium esculentum, Pittosporum undulatum, Notelaea longifolia, Poa affinis, Oplismenus imbecillus and Pseuderanthemum variabile.*

Characteristic features of the community are:

- canopy of Spotted Gum and White Mahogany, with Ironbarks and Grey Gum
- mid-storey of Elderberry Panax, Sweet Pittosporum, Bracken and Native Olive
- well developed ground layer of grasses, herbs and forbs

4.3.3 Lake Macquarie Dry Rainforest (Mixed Riparian Forest)

This vegetation type covers an area of approximately 1.9 ha within the site, along the two gullies and the eastern water course shown on Figure 3. Conacher Travers (2007a, pp40) provides the following explanation of their mapping of 'Mixed Riparian Forest':

Payne (1999) mapped this vegetation community as Spotted Gum/Ironbark Forest. Due to significant floristic differences within the riparian zones, Conacher Travers considered that Mixed Riparian forest should be mapped as a separate vegetation community.

For this report, a detailed analysis was carried out of the mixed riparian vegetation in the east of the Central Precinct, specifically to assess whether the community aligned with the threatened ecological community Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions. The results are discussed below.

Determination against Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions

Lowland Rainforest is a subtropical rainforest that occurs on high-nutrient geological substrates, notably basalts and fine-grained sedimentary rocks, on coastal plains and plateaux, footslopes and foothills (NSW Scientific Committee 2011). Due to its affinity with fertile soils of flats and valleys, Lowland Rainforest has undergone a large reduction in extent from historical clearing for coastal farming and development.

The dry rainforest at Callistemon Close occurs in a sheltered gully derived from conglomerate rock (i.e. large-grained sedimentary rock). The gully incises a steep north-facing hillside. The nature and position of the gully essentially precluded it from historical clearing for farming. This is evidenced by an historical aerial image clearly showing the valley system below the gully cleared and farmed.

The dry rainforest corresponds to Bell (2016) Lake Macquarie Dry Rainforest. Bell's report does not consider it part of the any rainforest threatened ecological community (TEC). The vegetation also corresponds to Floyd (1990) Suballiance 30 *Backhousia – Acmena.* This suballiance is included in the determination if it is 'transitional' or 'interspersed' among any seven suballiances listed in Paragraph 4 of the determination. These seven suballiances are considered the 'core' of Lowland Rainforest that principally make up the EEC. One of these core suballiances, Suballiance 6 *Archontophoenix – Livistona* has been recorded and mapped as Cabbage Palm Forest in valleys of Wallarah National Park by Conacher Travers (2007). It is likely that the valley system associated with Callistemon Close below the gully could have once been vegetated with Cabbage Palm Forest. However, this was cleared for farming many years ago. Google earth imagery clearly shows the lower slope and valley below the gully developed with housing. Therefore, the dry rainforest is not transitional or interspersed with a core suballiance that principally make up the EEC.

The intent to include 'transitional dry rainforest' is to avoid fragmentation of core patches of subtropical rainforest that are interspersed with dry rainforest. Dry rainforest often mosaics with subtropical rainforest when moisture and nutrient status decrease.

The Central Precinct patch contains 26 out of 108 characteristic species listed in Paragraph 2 of the determination which suggests the vegetation is at the wetter end of the dry rainforest moisture gradient. However, species composition needs to be considered equally with habitat and other environmental information.

<u>Conclusion</u>

The Lake Macquarie Dry Rainforest recorded above Callistemon Close does not conform to Lowland Rainforest due to its habitat, position in the landscape, geology and is not transitional with any core rainforest suballiance.

4.4 Threatened populations and ecological communities

No threatened vegetation communities occur on the site. There were no threatened populations located within the subject site either from the site surveys or from the background searches.

4.5 Threatened Flora Species

All flora species recorded during surveys are listed in Appendix A. Species targeted during survey are discussed in more detail below. Two threatened plant species *Tetratheca juncea* and *Callistemon linearifolius* were recorded on the site.

4.5.1 Tetratheca juncea

Literature Review and Previous Survey

Black-eyed Susan is endemic to New South Wales and was historically distributed from Botany Bay in Sydney north to Bulahdelah. Black-eyed Susan is now presumed extinct in the Sydney area. The current distribution is divided into two metapopulations: the central coast metapopulation (from Wyong to Beresfield) and the northern metapopulation (from Karuah to Bulahdelah). It is currently found in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock, with the Wyong and Lake Macquarie local government areas the stronghold for the species (DEE 2016).

Black-eyed Susan is found in sandy, occasionally moist heath and in dry sclerophyll vegetation communities endemic to coastal New South Wales. The species occurs on low-nutrient soils in open forest with a dense understorey in areas with an annual rainfall greater than 1000 mm. The species occurs on Quaternary sands, Triassic sandstones, Triassic shales, Permian coal measures and Carboniferous volcanics.

Populations throughout the species range occur predominately in three vegetation communities:

- coastal plains smooth-barked apple woodland
- coastal plains scribbly gum woodland
- coastal foothills spotted gum-ironbark forest.

T. juncea is counted in 'clumps' as it is difficult to distinguish individual plants due to the rhizomatous growth form. Separate clumps are defined as 30cm or more distant from each other. Results of previous surveys for *T. juncea* on the subject site and broader Wallarah Peninsula are summarised below.

Conacher Travers (2007a) conducted targeted searches for the species across most areas of the Wallarah Peninsula and reported that "24,062 clumps of *Tetratheca juncea* were recorded in targeted surveys to date across the Wallarah Peninsula. In addition, it is estimated that 1,073 clumps are present in potential habitat within Radar Hill Precinct which is to be surveyed in the future. It is therefore estimated that there is a total of 25,135 clumps of *Tetratheca juncea* within the Wallarah Peninsula. Of these, 9,988 are protected within the project conservation reserves Wallarah National Park and the Habitat Corridor. Conacher Travers (2007b Table 7) reported 6380 *T. juncea* clumps during targeted surveys 'Northern Sector' and noted that the majority of the *T. juncea* clumps in the Northern Sector and Coastal Sectors were located within the Smooth-barked Apple Open Forest.

Figure 4 of Conacher Travers (2007b) (provided in Appendix C) shows the distribution of *T. juncea* recorded during surveys of the Northern Sector and also shows the species to be widely and densely distributed throughout the habitat corridor and the WNP – the conservation areas identified during the design of the project and set aside at its commencement.

Plants conserved in the WNP and habitat corridor represented approximately 40% of the plants across the Wallarah Peninsula, a key reason for the conservation of the area as part of the project. Payne (1999) undertook vegetation mapping and conservation area analysis of the north Wallarah Peninsula project site as part of the LES prepared for LMCC. He concluded that the conservation reserves dedicated as part of the project would conserve "very significant sub-populations of *Tetratheca juncea*" and that "no additional conservation areas within the site

Figure 5 Flora Survey Results

Legend

Site Boundary

Flora Survey Results

- Callistemon linearifolius
- Tetratheca juncea

0 250 500 m

EcoFocus
ENVIRONMENTAL CONSULTING

would be therefore necessary". The conclusion of his report for the LES stated there will be no need to conserve additional sites of Tetratheca in the south eastern quadrant of the Lake Macquarie LGA or to prepare species impact statements for individual development sites.

In summary, the CLUMP (Woodward Clyde 2000, p.2-2) prepared for LMCC and endorsed by NPWS states:

The proposed Conservation Reserve will incorporate sub-populations of the threatened species Tetratheca juncea. The main subpopulations under consideration in relation to this proposal are located near the intersection of the Pacific Highway and Cams Wharf Road.

These sub-populations comprise a relatively high number of plant clumps (Payne, 1999) and will be included in the proposed Conservation Reserve. With the establishment of the proposed Conservation Reserve on the North Wallarah Peninsula Project site, Tetratheca juncea will be considered to be adequately conserved in the southeast quadrant of the Lake Macquarie Local Government Area.

Since that time, additional reservations have occurred to the south and provided expanded and significant protection for this species.

Furthermore, the NPWS (2000) considers that *T. juncea* is adequately conserved in the south eastern portion of its range with approximately 1300 plant clumps known from Awabakal Nature Reserve, Glenrock State Recreation Area, Lake Macquarie Recreation Area, and Munmorah State Recreation Area (Payne 2000). The adequacy of protection in the south east of its range has been significantly enhanced by the dedication of the Wallarah National Park as an offset for the project. This conservation action was a direct result of the project and added 10 000 clumps to the number protected in conservation reserves. Of note, since that time, significantly more conservation land has been dedicated and reserved including *T. juncea* habitat.

The species has been assigned to the 'Keep-watch species' management stream under the OEH *Saving our Species* program. Justification for allocation to this management stream is for species that require no immediate investment because they are either naturally rare, have few known threats, or are more abundant than previously assumed when they were listed as threatened.

However, the LMCC *T. juncea* guideline (LMCC 2014) contradicts these assessments and states that further reserves are required (Table 7, pp. 35).

Current Survey

Surveys by EcoFocus during the 2016/2017 flowering season recorded 52 clumps of *T. juncea* across the site. The plants were recorded in three main locations;

Area 1 - in the north west corner of the of the site (8)

Area 2 – in the centre of the site – east & west of the old highway (6/15)

Area 3 – (Lot 8) in the south eastern corner of the site (23)

These locations align with areas where Conacher Travers (2007a) also located the species, as shown in their Figure 4 Conacher Travers (2007b). It is noted that despite surveys, the species was not recorded in locations along the ridge and upper slopes of vegetation facing Caves Beach where it was previously recorded by Travers.

Surveys in 2016 by EcoFocus recorded the species in similar areas as those recorded by Conacher Travers (2007a), other than as referenced above, but in far lower numbers.

A recount of Area 1 in the north west corner in October 2018 recorded 160 clumps where previously 8 had been recorded. In the same area in 2006 Conacher Travers (2007a) had recorded a range of 202 to 580 clumps (this range is based on counts from Figure 4 in Conacher Travers (2007 b) which presents the number of clumps in broad ranges (i.e. 31 and above, 5-30 and 0-5) resulting in an upper and lower range for total number of clumps..

Clearly flowering in *T. juncea* is variable across its range from year to year and probably in response to prevailing environmental conditions (the 2018 re-survey was undertaken after a week of rain). Therefore, the data on which this impact assessment is based (shown in Table 4-1 below) uses a precautionary approach and is based on the

higher 2018 count recorded by EcoFocus in the north-west corner of the site (160) plants and adjusts the other counts accordingly (by a factor of 20). This is presented in Table 4-1, including comparison with previous targeted searches.

Table 4-1 Number of *Tetratheca juncea* clumps recorded across the site by EcoFocus (2016/2018) and Conacher Travers(2007a).

Location of records	EcoFocus 2016	EcoFocus 2018	Conacher Travers 2006
Area 1 (NW corner of site either side of transmission line corridor)	8	160	202-580
Area 2 (west of bend in old highway)	6	120*	129-225
Area 2 (east of bend in old highway)	15	300*	241-385
Area 3 (Lot 8)	23	460*	472-960
*Hunter Water road reserve***	*9*	*180**	*Incl. above*
Site total	52	1040*	1044-3110

**extrapolated by x20 as the 2018 count in Area 1 is 20 times higher than the 2016 count in Area 1.*

*** not impacted, not included in totals*

Using this conservative approach, the proposed project will result in the removal of approximately 580 clumps of *T. juncea*, acknowledging the retention of those extrapolated within Lot 8. Additionally, some clumps are retained, as intended by the masterplan, in and around retained vegetation in lots and other retained areas, however these aren't 'assumed' as retained. Table 4-2 lists the number of *T. juncea* clumps recorded across various stages of the Lake Sector development, the subject site, WNP and the Wallarah Peninsula. Table 4-3 shows the cumulative numbers of *T. juncea* removed as part of the NWP project as a percentage of the known local population (10000+ clumps), Wallarah Peninsula population (25135+ clumps) clumps) and Central Coast meta population (55000+ clumps).

As noted above, approximately 10,000 clumps have been recorded in the WNP and the habitat corridor which are connected with the subject site. LMCC guidelines state that 'a local population of *T. juncea* comprises the plants (plant clumps) on a site, plus the plants (plant clumps) on adjoining connected native vegetation'. Thus, the plants (plant clumps) on site are part of a local conserved population of more than 10,000 individuals. The approximate 580 clumps proposed for removal from the subject site constitute approximately 2.3% of the original local Wallarah Peninsula population (refer Table 4-3).

To date, the NWP development which has received individual stage development consents, has resulted in the likely removal of approximately 3046 clumps or, 12% of the Wallarah Peninsula population. The addition of this Central Precinct proposal brings this cumulative total to 14.4%. Plants conserved in the WNP and habitat corridor represent approximately 40% of the plants across the Wallarah Peninsula, a key reason for the conservation of the area as part of the project.

The size of the Central Coast metapopulation (from Wyong to Beresfield) is not known accurately but based on the data reported in DEE (2016) from results of surveys in the Wyong and Lake Macquarie LGAs, there is a minimum of 55000 clumps. The real population size is likely to be much larger given that the whole area has not been surveyed. The 580 clumps proposed for removal from the subject site constitute approximately 1.1% of the Central Coast metapopulation (refer Table 4-2).

The LMCC *T. juncea* Planning and Management Guideline (2014) lists three threshold criteria for significant impact on the species as listed below:

> 1. removes 25% or more of the total number of plants or plant clumps on a site or total connected population (where the number of plants and/or clumps on a site or in the population is more than 500, and/or covers an area of more than 5 ha), and/or

2. affects a population which is isolated or at the edge of the species geographic distribution, or where plants exhibit unique and distinct characteristics, or

3. affects plants with other biological or ecological characteristics (e.g. connectivity or local variation) which require special consideration.

It is clear from the discussion above and the data in Table 4-2 and Table 4-3 that the proposed removal of approximately 580 clumps of *T. juncea* does not meet any of the LMCC criteria for significant impact. Even if all 1040 clumps were to be removed (which is not proposed) this would comprise:

- 10% of the conserved remaining directly connected population (10000+ clumps)
- 4% of the local Wallarah Peninsula population (25000+ clumps)
- 2% of the Central Coast population (55000+ clumps)

This species is likely to be secure in NSW for the long term without targeted management, assuming adequate ongoing management of habitat within the public reserve system (OEH 2016). The species will be protected within retained vegetation on the site including the habitat corridor and the 174.4 ha Wallarah National Park conservation outcome for the masterplanned project.

Table 4-2 *Tetratheca juncea* plant numbers on the subject site and study area.

Area/Sector	Number of Clumps Recorded	% of Total Project Site Recorded	Reference
Central Coast metapopulation	55000		(minimum estimate based on data in DEE 2016).
Wallarah Peninsula Project Site consisting of:	25135	100%	Conacher Travers (2007b & 2007c) audit report & coastal sector report table 5
• *Conserved Wallarah National Park and Habitat Corridor*	*9988*	*40%*	Audit report table 7
• *Lake Sector*	*6542*	*26%*	Conacher Travers (2004), Conacher Travers (2005b), Conacher Travers (2007d), Travers Bushfire and Ecology (2009).
• *Northern Sector (northern and southern portions)*	*6380* *Of which Central Precinct consists of:* *1040* *Or* *1044*	*25%* *(4.1%)*	Conacher Travers (2007b) EcoFocus surveys and methodology for this report Estimates based on mapping from Conacher Travers 2007(b)
• *Coastal Sector*	*2225*	*9%*	Conacher Travers (2007b; 2007c)

Table 4-3 Proposed and cumulative Impact of loss of *Tetratheca juncea* from the local and regional population.

Area/Sector	Number of clumps reported as impacted	% of Wallarah Peninsula Population *(25135)*	% of Central Coast Population *(minimum 55000)*	Reference
Lake Sector Stage 1-7	697	2.8	1.26	Conacher Travers (2004)
Lake Sector Stage 8-12	1852	7.4	3.36	Conacher Travers (2005b)
Lake Sector Stage 13a/b/c	0	-	-	Conacher Travers (2007d).
Lake Sector Stage 14	0	-	-	Travers Bushfire and Ecology 2009.
Coastal Sector	232	0.9	0.4	Conacher Travers (2007b) Audit report/2007c coastal report table 5
Lake Sector Swansea Valley 2/3	265	1.05	0.48	EcoFocus (2017)
Sub Total impacted	***3046***	***12.1***	***5.5***	
Northern Sector	580	2.3%	1.05	Eco Focus (2019)
Cumulative Impact Total	**3626**	**14.4%**	**6.6%**	

A 7 part test for the species is provided in Appendix F. A Species Impact Statement is not required.

4.5.2 Cryptostylis hunteriana

Literature Review and Previous Survey

This species is a rare leafless saprophytic, terrestrial orchid, which is reliant on the symbiotic relationship with a mycorrhizal fungus found in decaying plant matter (Bell 2001). Pollination is dependent solely on the ichneumonid wasp (*Lissopimpla excelsa*) (Bell 2001). It occurs on the coast from southeast Victoria to northern New South Wales and grows on swampy heaths on sandy soils, and in habitats ranging from scrubby swamp fringes to steep bare hillsides in tall eucalypt forest (Bell 2001, Harden 1993, Jones 1993, Bishop 2000). It will often appear with *C. erecta* and *C. subulata* in small localised colonies and flowers from November to February (Bell 2001, Jones 1993).

In NSW, the Leafless Tongue-orchid occurs between Batemans Bay and Nowra with additional records in Nelson Bay, Wyee, Washpool National Park, Nowendoc State Forest, Ku-Ring-Gai Chase National Park, Ben Boyd National Park (DECC 2005a), the Catherine Hill Bay area, Dolphin Point (Cowman Stoddart 2007; HSO 2007a, 2007b) and Bulahdelah (Brown 2007).

Conacher Travers (2007) conducted detailed surveys and habitat surveys for *C. hunteriana* in 2005 and 2006 which included the subject site. Searches by Conacher Travers (2007) did not find the species in the Northern Sector.

Current Survey

Surveys by EcoFocus during the 2016/2017 flowering season did not record the species on the subject site but did record *C. subulata* and *C.erecta*. The *Cryptostylis* species were identified from the basal leaves, rather than from the flowers (as they don't typically flower this time of year). *Cryptostylis hunteriana* (the leafless tongue orchid) does not have basal leaves.

Given that surveys were conducted during the flowering season (in different years) for the species, and that similar species were located, the results strongly suggest the species does not occur on the site.

An assessment of significance has not been prepared for the *C. hunteriana* and a Species Impact Statement is not required.

4.5.3 Diuris praecox

Literature Review and Previous Survey

Previous surveys by Conacher Travers (2004 and 2007) detected *D. praecox* in the following three locations:

- Lake sector (26 specimens in Smooth-barked Apple open forest)
- In the far south of the eastern portion of WNP (3 specimens in coastal heath)
- Coastal sector (1 specimen in closed heath)

Searches by Conacher Travers (2007) did not find the species in the Northern Sector (including the subject site).

Locations where *D. praecox* has been previously recorded in the LGA are listed below (EcoLogical 2015).

- Glenrock SCA, along Camp Rd S. Rosenthal *pers. comm.*
- Along Fernleigh Bike Track Dash (2003)
- Mirabooka, Hillcrest Rd D. Herd pers. comm.
- c. 1 km NE of Cams Wharf Conacher Travers (2007)
- c. 700 m NW of Quarries Head Conacher Travers (2007)
- c. 500 m NW of The Caves Conacher Travers (2007)
- W of Caves Beach (2 subpopulations) Atlas records
- E and SE of Nords Wharf (several subpopulations) Atlas records
- *Diuris praecox* W of Pacific HWY, east of Crangan Bay Atlas record

Current Survey

Surveys conducted in August 2017 by EcoFocus did not detect the species on the subject site, despite thorough searching. *D. praecox* was flowering at a reference site checked before commencing surveys, confirming that the timing of the survey was appropriate, and the species was detectible. Sixteen species of terrestrial orchid were identified during searches for *D. praecox*. This demonstrates the searcher efficiency of the ecologists conducting the surveys and strongly suggests that had *D. praecox* been present it would have been detected.

The species is protected in the nearby WNP to the immediate south of the subject site and Smooth-barked Apple Open Forest is also conserved in the eastern section of WNP to the immediate west of the subject site.

The species is known to be conserved in Munmorah State Recreation Area and due to its protection in the WNP, the NWP development is not expected to have a significant impact on the species (ESMP - Mandis Roberts (2003).

The species has not been found to occur on site following thorough searches. It is unlikely to be impacted by the proposed development. A 7 part test and species impact statement are not required.

4.5.4 Callistemon linearfolius

Literature Review and Previous Survey

Conacher Travers (2007) undertook random meanders of all potential habitat in the Northern Sector in September 2005, January 2006 and October 2006 recording 119 specimens within the Smooth-barked Apple Open Forest vegetation community in the drainage corridor to the south of the landfill adjoining the old Pacific Highway (which is part of the Central Precinct the subject of this report).

According to Conacher Travers (2007) the species has also been observed in previous surveys within the western and eastern portions of Wallarah National Park. Figure 6 of Conacher Travers (2007) shows 10 specimens in southern tip of western WNP.

Current Survey

Searches by EcoFocus in 2017 confirmed the presence of a population of *Callistemon linearifolius* along a westerly flowing drainage line within the Smooth-barked Apple Open Forest in the south west of the site (south of the landfill and south/east of the old Pacific Highway). A more detailed targeted search was carried out by EcoFocus in February 2018 by two experienced botanists. All suitable habitat across the site was covered on foot. A total of 149 live plants and 11 dead plants were located along the same drainage line.

The plants occur primarily in Stage 6A and 6B (refer to Plan E, Appendix H). Within Stage 6B, remediation of an old clay pan/gravel mine will require excavation of uncontrolled fill which encroaches into the southern edge of the watercourse. Within Stage 6A, following remediation, a stormwater management basin with associated drainage will be constructed in the location of the existing dam and upstream. The basin will comprise an inner wetland basin that will be revegetated with native aquatic plants. An outer media filter basin will be revegetated with native ground cover. A 2.5m retaining wall will separate the southern boundary of the stormwater facility and retained plants upstream.

A 13 m wide rock lined swale will extend upstream approximately 225 m from the southern end/outlet of the detention basin. The placement of the swale has avoided loss of any Callistemon plants arising from its construction. Retaining walls of various heights surround the lineal strip of land that forms Stages 6A and 6B, generally providing an edge to the adjoining perimeter roads.

For the retained species above the water management facility, low flows will be diverted from the rock lined swale at key locations, in order to provide low flow waters to groups of Callistemon plants. For the retained individuals below (downstream) the water management facility, those located within the immediate watercourse and its edges will benefit from continuing flows as per current. For the group of Callistemon plants that sit outside (but still within the riparian area), which have flow from the side slopes captured upstream by the road and swale, a pit and small low flow pipe will be included from the road side swale above, in order to provide low flow waters to that group of plants.

Together Stage 6A (the drainage reserve with swale, retained Callistemon and other vegetation and water management facility) and Stage 6B (the riparian corridor) make up an area of 5.96 ha. Within this area there is a combined 0.9 ha of area to be cleared, remediated and revegetated.

The design and placement of the perimeter roads, the remediation of the former gravel mine area and the stormwater management and drainage features have been specifically amended to avoid an impact on the species, as well as hollow bearing trees, to the greatest extent possible. This has resulted in the retention of 133 individuals (89.3% of the onsite population) and the removal of only 16 plants (10.7%).

Ideally, and subject to DPIE approval, seed will be collected from the plants in the year prior to construction and retained for replanting in the riparian corridor and drainage reserve.

A 7 part test for the species is provided in Appendix F. A Species Impact Statement is not required.

4.5.5 Syzygium paniculatum

No *Syzygium paniculatum* individuals were detected during surveys. There are however several records nearby at Nords Wharf, Swansea Heads and Belmont indicating a local presence. The closest and most relevant record at Nords Wharf recorded rainforest of *Glochidion ferdinandi, Cryptocarya microneura, Pittosporum undulatum* and *Alphitonia excelsa* on alluvial floodplain, at approximately 10m elevation. This is considered ideal habitat according to OEH (2012). The drainage lines traversed during the survey occur above 30m elevation and do not conform to the species' preferred littoral or subtropical rainforest of sandy soils. Therefore, the riparian habitats of the Northern Sector are considered marginal habitat at best. The species will not be impacted by the proposed development. A 7 part test and species impact statement are not required.

4.6 Weeds

Twenty-six weed species were recorded in vegetation quadrats. These are listed and denoted with an asterisk in Appendix A.

Of these Bitou Bush (*Chrysanthemoides monilifera* ssp *rotundata*) and Lantana (*Lantana camara*) are ranked C4 and need to be controlled on site according to the measures specified in the Bushland Management Manual (Manidis Roberts 2007) or most recent Council and Department of Primary Industry Guidelines.

Areas with the highest coverage and diversity of weeds corresponded to areas that have undergone significant historical disturbance, areas such as the landfill and former open cut mine, as well as road and transmission line corridor edges.

Weed spread following disturbance is a potential problem. Where weeds invade relatively weed free habitats such as the WNP, riparian areas and the habitat corridor, the habitat quality for flora and fauna is reduced. These areas are important conservation reserves that have been set aside to allow persistence of threatened species. It is therefore critical that weeds be controlled regularly and thoroughly according to the Bushland Management Plan. Further recommendations are provided in Section 7.

5. Results – Fauna

5.1 General Fauna

A total of 63 native fauna species were recorded during the survey as listed below:

- 45 birds
- 16 mammals (12 bats, 2 possums, 1 glider, 1 Wallaby)
- 1 reptile (Common Scaly Footed Legless Lizard *Pygopus lepidopodus*)
- 1 amphibian (Eastern Dwarf Tree Frog *Litoria fallax*)

All fauna species recorded on the site across all survey sessions and opportunistically are listed in Appendix D.

Five threatened species were recorded as listed below:

- Powerful Owl (not seen/sign only)
- Little Bent-wing Bat (cave roosting) *Miniopterus australis*
- Large Bent-wing Bat (cave roosting) *Miniopterus oceanensis*
- Greater Broad-nosed Bat (tree roosting) *Scoteanax rueppellii* recorded drinking over dam in west of site.
- Grey headed flying fox *Pteropus poliocephalus* recorded drinking over dam in west of site.

These are all listed as Vulnerable on the TSC Act. The Grey-headed Flying Fox is additionally listed as Vulnerable on the EPBC Act.

A roost site for a Powerful Owl was identified under a low palm in the small gully in the far north east of the site adjacent the Caves Beach settlement. Further investigation found evidence of a non-breeding roost site within the larger gully to the immediate east of the small gully. The amount of whitewash present suggested the roost was not a breeding roost and may be used by a dispersing juvenile. A more detailed discussion on owl habitat is provided in Section 5.4.8. Habitat for large forest owls has been identified and mapped as part of a larger study across the NWP project (nghenvironmental 2012). None of the important HBT being used as owl nest trees occur on the site.

The majority of fauna observations were from bird surveys, spotlighting and Anabat detection. Common Brushtail Possum was the only species captured in the tree mounted cage traps. Nothing was found in the hollow log traps left on site for eight months.

Sugar Gliders were observed during all spotlighting sessions and heard vocalising. One was seen gliding and one emerging from a hollow. Both observers had a clear view of the tail, face and a lateral view of the animals allowing a positive identification that ruled out the large Squirrel Glider.

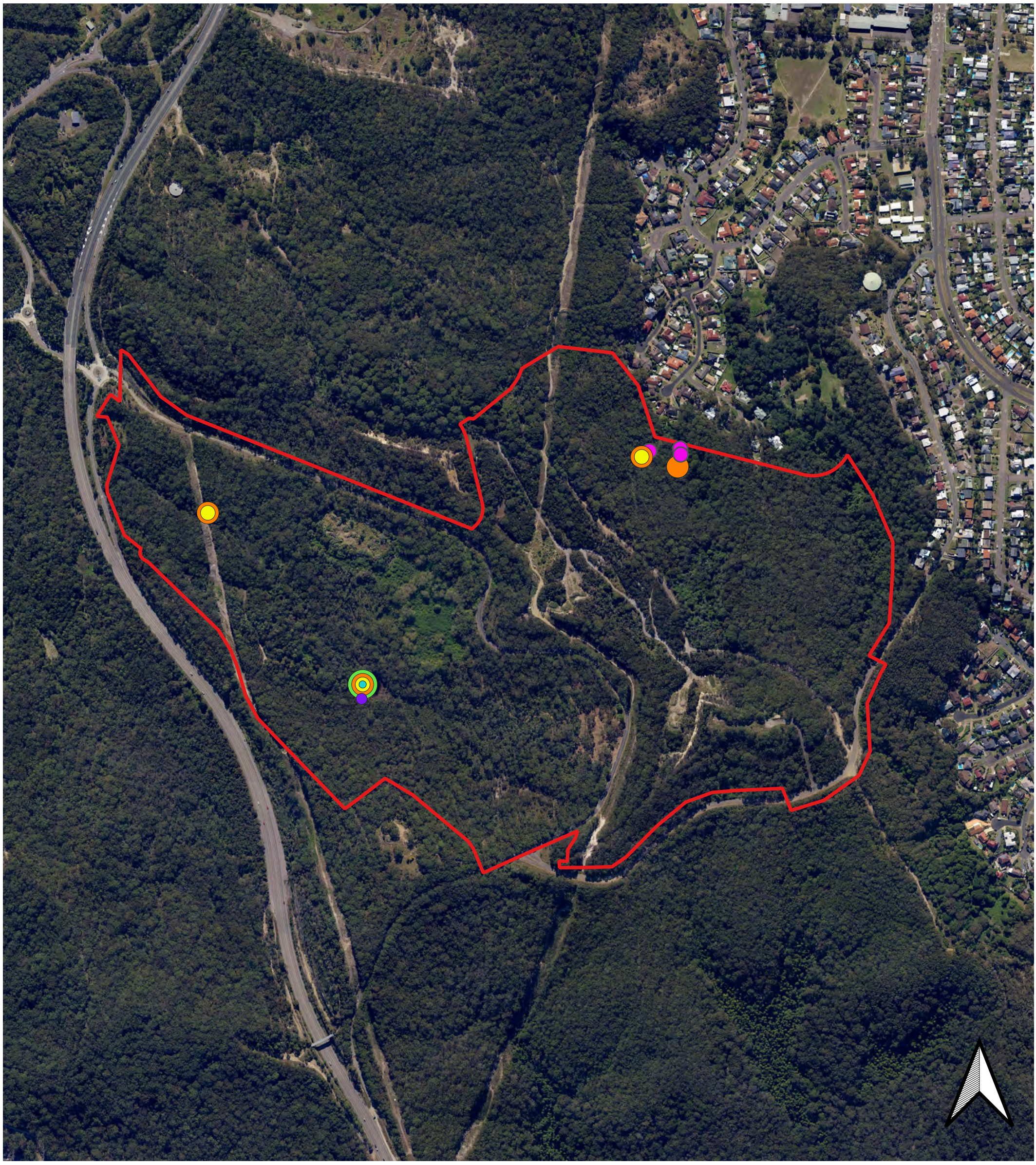
Bandicoot diggings were common across the site. Common Brushtail Possums and Common Ringtail Possums were observed during spotlighting and Common Brushtails were trapped on several occasions. Two introduced species were recorded (both during spotlighting) – Black Rat and Red Fox.

Despite the presence of numerous hollow bearing trees, very few arboreal mammals were detected during the surveys and it appears that, unlike many other forested areas in NSW, hollows, particularly small and medium hollows, are not a limiting factor on the site.

5.2 Fauna Habitat

The lack of mid storey diversity is likely a result of past disturbance by grazing, mining and logging and subsequent weed invasion, coupled with the low productivity of the soils across the subject site. Predation by foxes is likely

Figure 4 Threatened Fauna Results



to have led to the absence of high numbers and diversity of fauna species. Proximity to the settlement of Caves Beach also means that predation by cats would be a factor.

The site has good ground layer microhabitat diversity in the form of leaf litter and dead wood, including fallen trees. However, in previously disturbed areas and areas dominated by Casuarina regrowth this is not the case.

Several small gullies occur across the site and one larger gully, a mapped watercourse (Plains Gully) forms the eastern boundary of the site with another mapped watercourse located south of the Old Pacific Highway. There is limited habitat for amphibians on the site, the main location being the small dam formed form the previous clay extraction activities in the south west of the site. The only frog species recorded there was the common *Litoria fallax*. The site does not support suitable habitat for the Wallum Froglet.

Banksia and Acacia resources that might provide foraging habitat for small mammals were very limited on site. *Allocasuarina torulosa* (forest oak) and *A. littoralis* (black she oak) -the preferred feed species of Glossy Black Cockatoos - were both recorded in vegetation quadrats. The trees were fruiting at the time of survey but no GBC were seen or heard on site, and no evidence of chewed cones was discovered. Surveyors are experienced with listening for the soft chewing sounds and the muted calls they make while foraging and have had substantial field experience detecting the species, so it is unlikely it went unnoticed.

No large nests were observed that would belong to White-bellied Sea-eagle, Osprey, Little Eagle or Square-tailed Kite.

One hundred and forty-nine hollow bearing trees were mapped across the site and provide habitat for hollow dependent fauna such as bats, possums, gliders and owls. These are discussed in more detail below.

5.3 Hollow-bearing Trees

One thousand six hundred and sixty (1,660) habitat trees have been surveyed, assessed and mapped to date by others throughout the Coastal and Northern Sectors. Habitat trees have not been surveyed within Wallarah National Park, the northern part of the Northern Sector or the Radar Hill Precinct within the Coastal Sector (Conacher Travers 2007a).

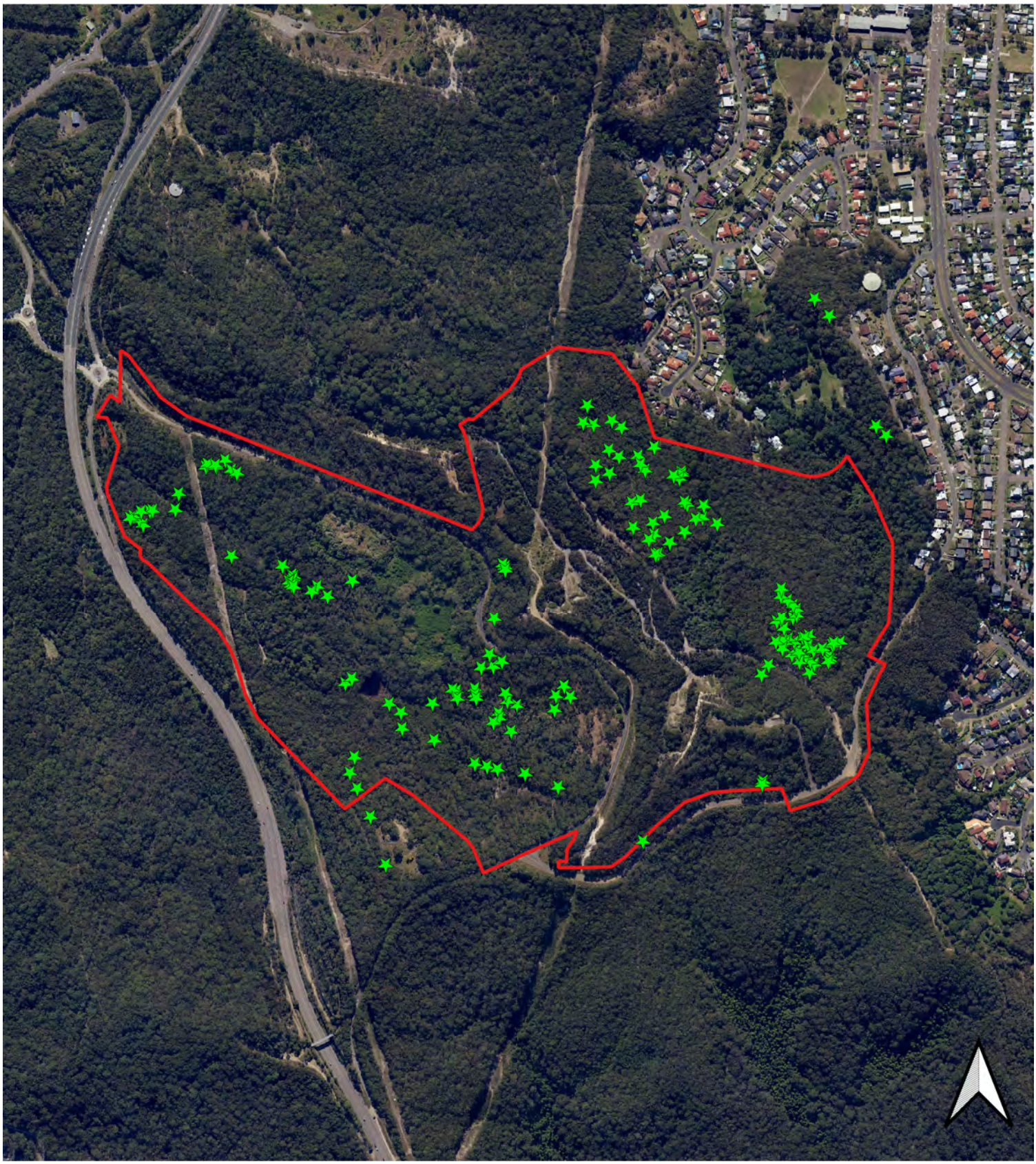
One hundred and forty-eight hollow bearing trees were recorded across the site, comprising 79 of high value and 69 of low-moderate value. Hollow bearing trees are absent from areas that have been previously disturbed; primarily the middle of the site.

Figure 6 shows the location of hollow bearing trees mapped across the site. Of the 148 HBT mapped, 57 (38%) will be removed and 91 (61% will be retained). Of the 79 high value trees, 50 (62%) will be retained. A register of all hollow bearing trees is provided in Appendix G. Locations of HBT are shown on Plan F, Appendix H.

Table 5-1 Number of individuals of each tree species to be removed

Tree Species	Number to be removed
Angophora costata	17
Corymbia maculata	12
Stag	15
Eucalyptus haemastoma	3
Eucalyptus umbra	10
Total	**57**

Figure 6 Hollow-bearing trees



5.4 Threatened Fauna Species

BioNet Atlas searches revealed records of 25 TSC Act threatened fauna species within 10 km of the site or predicted to occur within the subregion (Appendix E). This excludes fish. The EPBC Act protected matters search tool revealed nine migratory bird species for which habitat or breeding may occur within the search area. EPBC listings are not based on records but provide a general guide only based on predictive modelling of species occurrence. In some instances, the EPBC protected matters search tool may predict the occurrence of 'species or species habitat' within a search area whilst the Atlas of Living Australia databases show no records of the species.

The results of the database searches were analysed to assess the likelihood that any of these species would occur on the site or be impacted by the proposal. The assessment was based on results of field work (including historical studies) and research on species habitat preferences. Where a species was considered likely to occur, was known to occur or considered likely to be impacted, a seven-part test pursuant to Section 5A of the EP&A Act was prepared.

Part 5A of the EP&A Act requires the consideration of seven factors (the 7 part test) in assessing whether or not an action, development or activity is likely to significantly affect threatened species, populations or ecological communities, or their habitats, to the extent that a viable local population of that species would be placed at risk of extinction. The assessment takes into account the habitat preferences and life cycle of the species as well as the importance of the habitat to be removed to that species. The Threatened Species Assessment Guidelines (DECC 2007) provide guidance on the meaning and interpretation of the seven heads of consideration in the AOS. Importantly, the guidelines state that "All factors must be considered and an overall conclusion must be drawn from all factors in combination". The assessment of significance is the first step in considering potential impacts. When a significant effect is likely, a species impact statement may be required.

Potential impacts have been assessed in detail for 15 threatened fauna species. Species were chosen for reporting on one or more of the following criteria:

1. Existence of database records within a 5 km radius
2. Existence of historical records from previous studies on the NWP
3. Presence of suitable potential habitat elements on the site

The assessment was based on the results of the field work, results of other relevant studies in the area and research on species habitat preferences. Where a species was considered likely to occur (and considered likely to be impacted) or was known to occur, a seven-part test pursuant to Section 5A of the EP&A Act was prepared.

Of the 38 threatened fauna species listed on database search results for a 5-10 km radius of the site, five were recorded on site by current survey (Powerful Owl, Grey-headed Flying-fox, Little Bent-wing Bat, Large Bent-wing Bat and Greater Broad-nosed Bat). Assessments of Significance (7 Part tests) have been conducted for these species and are provided in Appendix F.

Figure 4 shows the location of threatened species recorded on the site during surveys for this report.

Under the TSA Guidelines "A species does not have to be considered as part of the assessment of significance if adequate surveys or studies have been carried out that clearly show that the species:

- does not occur in the study area, or
- will not use on-site habitats on occasion, or
- will not be influenced by off-site impacts of the proposal.

Historical and current survey effort and results are compiled to demonstrate the adequacy of surveys or studies, in relation to the TSA Guidelines.

Detailed information is provided below to support this conclusion for each species. This includes results of previous surveys on and around the site spanning a period of more than 10 years, results of targeted surveys conducted between late 2016 and 2018, review of known records within a 5-10km radius, extensive literature review including relevant reports dating back 22 years and consultation with species experts.

5.4.1 Microchiropteran Bats

Previous survey and records

The number of database records for threatened bat species within a 5 and 10 km radius of the site is shown in Table 5-2.

Table 5-2 Database records for Microchiropteran bat species

Species	Database records within 5km of the subject site	Database records within 10 km of the subject site
Eastern Free-tail Bat (t)	3	10
Greater Broad-nosed Bat (t)	1	7
Yellow-bellied Sheathtail-bat (t)	0	0
Little Bent-wing Bat (c)	14	24
Eastern (Large) Bent-wing Bat (c)	8	15

t= tree roosting species
c= cave roosting species

Previous bat surveys by Conacher Travers in 2001 and 2005 (2007a) recorded five species of threatened bats on or adjacent the site:

- Eastern (Large) Bent-wing Bat
- Little Bent-wing (just north of site boundary)
- Greater Broad-nosed bat
- Yellow bellied Sheathtail Bat
- Large-eared Pied Bat (dubious record – see below)

This is the only record of a Large-eared Pied Bat for the Lake Macquarie area. The record is from the Swansea open cut in the middle of the site during Anabat surveys in 2001. The record is dubious since Hoye (1995) states that no records of the species exist for the Lake Macquarie area but it is known from south of Gosford and Watagan State Forest. Hoye (1995) did not record the species in surveys at 15 sites in the Lake Sector, nor in the surveys of 19 sites on the Wallarah Peninsula including the Northern Sector (TUNRA and FBN 1995). There are no records on the BioNet database of the species within 10 km of the site. Local bat expert Glenn Hoye (*pers comm.)* suggests the species occurs in ranges to west of Lake Macquarie and may penetrate to western edge of lake but he is not aware of any records from the eastern side of the lake. Given there is only a single record of the Large-eared Pied Bat from all of these surveys, suggests that either it was a misidentification or that there is not an established population in the area. This species will not be impacted and has not been considered further.

Current Study

Anabat detectors were used to survey microbat fauna over seven nights across the site in January 2017. Anabat data files were analysed by Glenn Hoye of Fly by Night Bat surveys. These surveys recorded twelve species of bats including three threatened species.

A total of 1920 passes were recorded. Highest levels of bat activity (measured by number of passes) were recorded at the dam in the west of the site (1432 passes by 11 species). Bat activity at the dam represented 74% of the total activity from all four Anabat locations. One of the threatened species was only recorded at the dam. It is likely this very high level of activity represents multiple passes by individuals drinking at the dam. Calls were recorded on all sampling nights.

Threatened species were detected at all four Anabat locations. The following threatened species were recorded:

- **Little Bentwing bat** - recorded at all four sites.
- **Eastern (Large) Bentwing bat -** recorded at three sites
- **Greater Broad-nosed bat** - only recorded at the dam.

An additional four Anabat nights were conducted in February 2018 at a dam located immediately north of the site on WAD owned land (Refer Plan G, Appendix H) with the purpose of assessing habitat suitability for the bat species recorded on site. A typha swamp connected to the offsite water body was also surveyed. Surveys were conducted concurrently at the onsite dam so activity levels could be compared. Table 5-3 lists the species recorded in each of those surveys.

Table 5-3 Bat species recorded at onsite and offsite dams

Species	Recorded Jan 2017 onsite dam	Recorded Feb 2018 onsite dam	Recorded Feb 2018 offsite dam	Recorded by Conacher Travers
Greater Broad-nosed Bat (t)	Y	y	y	y
Little Bent-wing Bat (c)	Y	y	y	y
Eastern (Large) Bent-wing Bat (c)	Y	y	y	y
Yellow-bellied Sheathtail-bat (t)	N	N	N	Y (2001).single record

Microbats – tree (hollow) roosting (TSC-V)

One tree-roosting microbat species, the Greater Broad-nosed Bat (*Scoteanax rueppellii*) has been detected in the study area between 1995 and 2016 and again in 2017;

Conacher Travers (2007a) also notes a record of the Yellow-bellied Sheath-tailed bat (*Saccolaimus flaviventris*), from 2001, however this species was not recorded on or adjacent the site over 16 Anabat nights during summer 2017 and 2018. There are no records of this species on the Atlas of Living Australia database within 10km of the site. It forages high in most habitats for flying insects. The Yellow-bellied Sheathtail-bat roosts in tree hollows or buildings, and even in burrows when trees are scarce.

The Greater Broad-nosed Bat mainly occurs in gullies and river systems and is most common in tall wet forests. It forages along creek and river corridors, as well as open woodland habitat. Females of this species congregate in maternal tree hollows. There is one record of this species within 10 km of the subject site on the BioNet Atlas. The species was not recorded across the majority of the site but was recorded at the dam, suggesting it is not relying on the habitats on site for foraging and roosting, but is utilising the onsite water source. The species was also recorded at the existing dam located to the north outside the Central Precinct but within the Northern Sector and on land owned by

WAD, confirming that another water source for the species occurs at that location. Bat expert Glenn Hoye (*pers. comm*.) confirms that Greater Broad-nosed bats are usually more common in riparian sites and around water bodies than other parts of the landscape.

Bats roost in a wide range of tree types and sizes including in dead trees, dead limbs of live trees, hollows in the trunks of live trees or under bark (DEC 2004). Hollow microclimate may influence the selection of tree roosts and aspect, topographic position, orientation and opening dimension may be important factors. Roost sites may be identified by the accumulation of bat guano and evidence of foraging (e.g. moth wings) at or near potential sites such as derelict mines, caves or tunnel entrances, under bridges or at the base of trees with hollow/s (DEC 2004).

The number of calls detected by Anabat does not suggest large numbers of bats except at the dam where the large number of passes is likely due to multiple individuals drinking and/or foraging.

Microbats – cave roosting (TSC-V)

Two species of cave-roosting microbats have been detected in the region between 1995 and 2016 and again in 2017; the Eastern (Large) Bentwing-bat (*Miniopterus schreibersii oceanensis*) and the Little Bentwing-bat (*Miniopterus australis*).

The Eastern Bentwing-bat roosts in maternal caves during spring and summer but also uses derelict mines, storm-water tunnels, buildings and other man-made structures in winter months. This species forages for flying insects above forested and woodland canopies. There are no known maternity colonies in the Hunter-Central Rivers CMA. There are nine records for this species within 10 km of the site on the BioNet Atlas database.

The Little Bentwing-bat is generally found in well-timbered areas. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. Only five nursery sites /maternity colonies are known in Australia. It is possible that there are sea caves or man-made structures such as stormwater drains nearby which are being utilised as roosting sites. There are 24 records of this species on the BioNet Atlas Database within 10 km of the proposal site.

There are no caves, derelict mines, or other man-made structures within the subject site that are likely to provide breeding and/or roosting habitat for these microbat species. It is likely that these species utilise the site as foraging habitat, and roosting habitat outside the breeding season. As such, the proposal is unlikely to have an adverse effect on the life cycle of these species such that a viable local population would be placed at risk of extinction.

Microbats Assessment

Potential impacts of the development are loss of foraging habitat and potential roost sites in mature hollow bearing trees (for tree roosting species only) and removal of a water source. There is the potential for injury or direct mortality as a result of the felling of hollow bearing trees.

The proposal will remove 44.2 ha of vegetation containing foraging, drinking and potential roosting (tree roosting species only) habitat for microbats. Approximately 61% of the hollow bearing trees on site will be retained. At total of 17.2 ha of vegetation will be retained and will therefore continue to provide foraging and potential tree roosting habitat for microbats.

The existing dam within the precinct will be replaced with a stormwater management facility. The proposal includes some minor works to the edges of an existing dam located to the north outside the Central Precinct but within the Northern Sector and on land owned by WAD, generally being removal of rubbish and planting of small bare areas for a distance of 20m around the existing dam. Plant species will reflect those already occurring surrounding the dam.

A 7 part test for threatened microbats recorded on the site is provided in Appendix F. In summary, the Assessment of Significance has concluded that the proposed works are not likely to significantly affect microbats which are known to occur or are predicted to occur at the proposal site because:

1. Approximately 61% of HBT on the site will be retained across the site retaining habitat for tree roosting bats. Suitable breeding habitat for cave roosting bats is non-existent on the site.
2. As part of the project, an existing water resource and perimeter of native vegetation outside the precinct but within the Northern Sector will be protected as part of the future development of land to the north, Removal of rubbish and planting of bare areas will be undertaken for a buffer of approximately 20m around the waterbody. Plant species will reflect those already occurring surrounding the waterbody.
3. The existing dam in the west of the site will not be removed during the breeding season of the bats (October to February) when lactating and pregnant females require more water.
4. The 174.7 ha WNP containing suitable foraging and roosting woodland habitat for these species is located to the immediate south of the subject site.
5. Individuals can move at least several kilometres to water sources to drink (the waterbody is 800 m north of the site).
6. Mitigation measures (a two-stage clearing process) have been put in place to prevent loss of individuals during clearing, and this process has been proven successful for microbats on previously cleared areas of the Lake Sector.
7. Habitat at the site is likely to comprise mostly foraging habitat, and only occasional roosting habitat for some species,
8. Cats will be banned from the development to reduce predation pressure

A Species Impact Statement is not required.

Additional Mitigation Measures proposed for Microchiropteran Bats

Whilst a substantial amount of foraging habitat will be retained for this species both on the subject site and throughout the NWP project, the following recommendations are made to ensure conditions are maximised for the species to persist on site and habitat quality is maximised.

Acknowledging these potential impacts, the following additional mitigation measures to those listed above and included as part of the proposal will be put in place:

1. Minimise use of pesticides to allow the persistence of healthy insect populations on which bats forage
2. Manage/control light spill from the development towards any areas of retained vegetation and the WNP

5.4.2 Squirrel Glider

Key habitat requirements for Squirrel Gliders are hollows for nesting and flower and sap producing eucalypts, acacia and banksias. In a paper focussing on the habitat requirements of the Squirrel Glider on the New South Wales Central Coast, including Lake Macquarie, Smith and Murray (2003) described the vegetation types favoured by Squirrel Gliders as the following:

Type 1: dry sclerophyll forests and woodlands dominated by winter-flowering eucalypts such as spotted gum *(C. maculata),* various boxes and ironbarks *(E. crebra, E. macrocarpa, E. paniculata, E. leucoxylon, E. sideroxylon, E. siderophloia),* swamp mahogany *(E. robusta)* or red gum *(E. tereticornis, E.blakeyi).*

Type 2: dry sclerophyll forests without winter flowering eucalypts but with an understorey of gum-producing acacias, particularly pinnate leaved species (*A. dealbata, A. irrorata, A. mearnsii, A. parramattensis*).

Type 3: dry sclerophyll forests and woodlands with an understorey of banksias, particularly winter flowering species (*B. integrifolia, B. aemula*) and usually in association with spring- and summer-flowering eucalypts (*E. haemostoma, E. racemosa, A. costata*) or sap-feed trees (*A. woodsiana, C. gummifera, C. intermidia*).

The majority of canopy trees on the subject site are spring-summer flowering species [Brown Stringybark (*E. capitellata*), Sydney Peppermint (*E. piperita*), Turpentine (*Syncarpia glomulifera*), Red Bloodwood (*Corymbia gummifera*) and Broad-leaved White Mahogany (*E. umbra*)], with the exception of two winter flowering species [Ironbark (*E. siderophloia*) and Spotted Gum (*Corymbia maculata*)].

Historically, in SWC (1994) and ERM (1995), there have been claims of Squirrel Glider observations (2 only) in the Lake Sector of Murrays Beach and at Caves Beach. Taken in isolation these observations have been used to assert that there is a viable population of Squirrel Gliders on the Wallarah Peninsula. However, it is clear that all claimed observations of Squirrel Gliders are by a single individual, all during spotlighting, not verified by a second individual, a single Squirrel Glider observation among multiple observations, captures and calls of the very similar Sugar Glider. The asserted Squirrel Glider observations reported have never had their veracity confirmed, and they do not appear on the OEH BioNet database.

Fauna surveys, including tree trapping to target gliders, have occurred intermittently over a period of 23 years on the site and surrounding lands. More than 4000 arboreal trap nights have failed to produce any evidence that there is a viable population of Squirrel Gliders on any of the WAD owned land. This survey effort, along with the results for Sugar Gliders and Squirrel Gliders is shown below in Table 5-4.

Extensive and intensive spotlighting, trapping and hair tube sampling carried out by *Conacher Travers* (October 2001 to April 2004) and others, have not returned a single record of Squirrel Gliders for the subject site, study area or Wallarah Peninsula. This result has been confirmed by EcoFocus arboreal trapping over 7 nights in October 2016. The only reasonable conclusion from analysis of all fauna observations is that a Squirrel Glider population does not occur on the site, and the two (2) reported Squirrel Glider observations from 23 years ago were probably of Sugar Gliders.

The following table summarises survey effort and results for Sugar Gliders and Squirrel Gliders from six studies on the Wallarah Peninsula, including the current study.

Table 5-4 Previous Survey effort for Sugar Gliders and Squirrel Gliders

Study	Year	Location	Survey technique	Survey effort	Result Sugar Glider	Result Squirrel Glider
Shortland Wetlands Centre (SWC)	1994	"Pinneys Beach Stage 2" (= Stage 10-12 Lake Sector)	Arboreal trapping	60 trap nights (but not stated how many were arboreal)	NIL	NIL
Shortland Wetlands Centre (SWC)	1994	"Pinneys Beach Stage 2" (= Stage 10-12 Lake Sector)	Spotlighting	Not stated but maximum 2 nights	seen during spotlighting but numbers not stated	1 seen during spotlighting in stages 10 - 12 (since approved for development)

Study	Year	Location	Survey technique	Survey effort	Result Sugar Glider	Result Squirrel Glider
ERM Resource Planning	1995	Entire Lake Sector including Wallarah National Park (WNP)	Arboreal trapping	160 trap nights	2	NIL
ERM Resource Planning	1995	Entire Lake Sector including Wallarah National Park (WNP)	Spotlighting	8 hours (1 hour per site)	2	5 seen during spotlighting at sites 6 & 7 in WNP
TUNRA & FBN	1995	19 sites: 3 in northern sector, 1 in coastal sector, 15 in WNP	Arboreal trapping	228 trap nights (4 trapsx19 sites x 3 nights) (*methodology unclear but states a minimum of 2 nights, typically 3).*	Yes (at 4 sites)	NIL
	1995	19 sites: 3 in Northern Sector, 1 in coastal sector, 15 in WNP	Spotlighting		Yes (at 4 sites)	NIL
Conacher Travers (Environmental Audit Report)	2001-2006	Lake Sector, Northern Sector and WNP	Arboreal trapping	2485 arboreal trap nights (Elliot A & B)	Trapped at 6 sites	NIL
		Lake Sector, Northern Sector and WNP	Hair tubes	1030 arboreal hair tubes	Not stated	NIL
		Lake Sector, Northern	Spotlighting	Not stated	Calls heard	NIL

Study	Year	Location	Survey technique	Survey effort	Result Sugar Glider	Result Squirrel Glider
		Sector and WNP				
Nghenvironmental	2011	Swansea Valley Lake Sector	Spotlighting	2 hours	NIL	NIL
EcoFocus Environmental Consulting	2016	Swansea Valley Lake Sector	Spotlighting	12 hours	10 individuals seen across 3 sites & calls heard	NIL
EcoFocus Environmental Consulting	2016	Swansea Valley Lake Sector	Stag watch	4 nights	1 individual seen	NIL
EcoFocus Environmental Consulting	2016	Swansea Valley Lake Sector	Arboreal trapping	168 trap nights	NIL	NIL
EcoFocus Environmental Consulting	2017	Northern Sector (subject site)	Arboreal trapping	175 trap nights	NIL	NIL
EcoFocus Environmental Consulting	2017	Northern Sector (subject site)	Spotlighting	42 person hours	4 individuals	NIL
ALA database	38 records over 21 years within a 10 km radius of the site. 6 records over 21 years within a 5 km radius of the site (none shown on any WAD land (1 in developed Caves Beach, 2 in Lake Macquarie State Recreation Area, 1 in the centre of township of Gwandalan, 1 in WNP east and one in the ocean east of Caves Beach (database record translation error?). The ERM and SWC records mentioned above do not appear in the ALA database either because the observer did not register them or because their veracity was not confirmed (level of certainty not high enough?).					

More than 4000 trap nights over six studies have been undertaken over the past 22 years. The result of those surveys with respect to Squirrel Gliders has been one unverified spotlight record in the Lake Sector (subsequently approved for development) and five spotlight records at two sites in the southern Wallarah National Park. Because Squirrel Gliders are well known to be extremely difficult to differentiate from the common Sugar Glider, and these records have never been followed up with trapping or identification of an animal in the hand, it is difficult to accept them as accurate. When combined with the age of the records (22 years), the fact they are all from one observer, and no confirmed or verified Squirrel Glider observations or trap records have been made in the intervening 22 years, and that Sugar Gliders have routinely been observed and trapped, it is difficult to conclude

that a population of Squirrel Gliders inhabits the area. LMCC Squirrel Glider Planning and Management Guidelines (2015) note that *"there is a possibility that some records prior to about 2000 may have confused Squirrel Gliders with Sugar Gliders because the two species can be difficult to differentiate (especially if spotlighting)" (p. 15).*

They also state that *"spotlight data should be eliminated for determining absence as it is not reliable for identification"*. It logically follows that spotlight data is not sufficient alone to claim the presence of Squirrel Gliders, particularly when there is a single sighting by a single individual. With the elimination of the apparent spotlight record from 1993 there are no records of Squirrel Gliders on the Wallarah Peninsula. Furthermore, the LMCC Squirrel Glider Guideline (p. 57) shows the Wallarah Peninsula is not in high probability zone of modelled distribution.

A recommendation of the workshop with experts (Appendix 4 of the LMCC Squirrel Glider Guideline) during the formulation of the Guideline was that – "further survey work should be undertaken to determine absence of the species, especially west of the M1 Pacific Motorway."

In January 2017 Dr Jacqui Coughlan conducted 175 trap nights using a trap and technique designed by Squirrel Glider expert Rodney Van der Ree and previously used successfully for Squirrel Gliders by Dr Coughlan (over 2000 trap nights). Stag watching and spotlighting was also conducted. No Squirrel Gliders were observed, heard or captured over 7 nights of trapping, stag watching and spotlighting. The morphologically similar but much smaller Sugar Glider was observed during spotlighting and its calls heard. Identification of Sugar Gliders was confirmed by Jacqui Coughlan and Brenton von Takach Dukai on the basis of very small size, tail morphology, vocalisations, observations gliding, sitting and emerging from hollows. Similarly, no Squirrel Gliders were trapped over 168 trap nights conducted in the Lake Sector (Swansea Valley 2and 3) in 2016.

By comparison, during a five year trapping program of a known Squirrel Glider population by Dr Coughlan using identical traps and methodology as used here, the average capture rate was 6-8 Squirrel Glider individuals over 6 nights of trapping. So, using this method, as advocated by Dr Van der Ree, if Squirrel Gliders were present, they could reasonably be expected to have been trapped.

LMCC Guideline

Habitat quality (especially the presence of winter flowering species and banksias) is low on the site with only scattered occurrences of banksias and very few Acacias.

The LMCC Guideline states that '*where field surveys have been undertaken in accordance with these guidelines, a significant impact is expected to occur where squirrel gliders are present (or assumed to be present) if:*

- *An area of squirrel glider habitat of more than 4 ha will be cleared, and/or*
- *More than 1 ha of habitat will be cleared and the habitat patch size will be reduced to less than 4 ha, and/or*
- *There is a greater than 5% loss of a habitat patches with an area of more than 10 ha, and/or*
- *There will be a reduction in effectiveness of a key strategic corridor linkage connecting habitat patches, and/or*
- *Habitat connectivity to a habitat patch will be lost, or narrowed to a width that is not suitable for maintaining in the long term.'*

Under Section 4 of the TSC Act "habitat" means an area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community and includes any biotic or abiotic component. Squirrel Gliders do not occur on the subject site and so the site cannot be deemed to be habitat for a species that is absent from it. In terms of individual habitat elements required by Squirrel Gliders some are present (hollow bearing trees), while some are not (an understory of banksia and Acacia).

Surveys have been undertaken according to the LMCC guidelines. Squirrel Gliders do not occur on the site and are there is no basis for presuming they occur on the site. The proposed project does not meet any of the LMCC Guidelines significant impact triggers for loss of habitat.

Squirrel Gliders will not be impacted by the proposed development and a 7 part test is not required.

5.4.3 Eastern Pygmy Possum

There is one record of the Eastern Pygmy Possum within a 10km radius of the site which is 6.3 km south of the site (ALA 2016). No Eastern Pygmy Possums were captured in the tree mounted hollow traps left on site for 10 months. This is not a surprising result as the site does not support the Banksia heath preferred by the species.

The species will not be impacted by the project and has not been considered further. A 7 part test is not required.

5.4.4 Little Lorikeet

Little Lorikeets nest in hollow-bearing trees with openings as small as 3cm anywhere from 2-15 m from the ground in smooth-barked Eucalypts in proximity to feeding areas. This species is somewhat nomadic being influenced by season and food availability. Higher productivity in riparian areas can attract this species through a higher abundance of food availability and they generally forage in the canopy of Eucalypts, Angophoras and Melaleucas. However, this species does not solely rely on those areas of high food abundance as isolated trees can help sustain a population. Roost locations are in treetops not necessarily in proximity of feeding areas.

The site provides potential foraging habitat for the species in the form of flowering native eucalypts including winter flowering eucalypts Spotted Gum and Ironbark. Little Lorikeets have been recorded in the Lake Sector, but were not recorded during 8 days of bird survey on the subject site, including constant recording of bird observations by two highly experienced bird observers outside of formal bird survey times during full days on site and an additional 10 days on site for flora surveys in which experienced bird observers recorded opportunistic observations.

Approximately 17 ha of vegetation will be retained within the site boundaries. An additional 4 ha comprises existing and newly managed vegetation in which select canopy trees will be retained and continue to provide hollows and foraging resources (flowering eucalypts). The species is highly mobile in its foraging habits and known to forage on edges, and small remnants and even isolated trees. Wallarah National Park to the immediate south of the site supports 174.7 ha of habitat suitable for the Little Lorikeet.

Sixty-two percent of hollow bearing trees on site will be retained including many trees with small hollows which provide suitable breeding habitat for Little Lorikeets.

Thus, substantial habitat suitable for the Little Lorikeet for foraging, roosting and nesting is being retained. It is therefore unlikely that the action proposed would have an adverse effect on the life cycle of the species such that a viable local population would be placed at risk of extinction.

While the proposed action will involve the removal of potential foraging resources for the Little Lorikeet, the species was not recorded during surveys and:

- Little Lorikeets are a highly mobile, fast flying species that travels long distances from their roost sites to foraging sites daily.
- The retention of 62% of hollow bearing trees and 17 ha of vegetation on the site means substantial potential foraging and nesting resources for the Little Lorikeet are being protected. This includes winter flowering eucalypt species.
- The WNP protects 174 ha of foraging and breeding habitat for the species

The proposal is unlikely to significantly impact the Little Lorikeet to the extent that a local viable population would be put at risk of extinction.

A 7 part test is provided in Appendix F. A Species Impact Statement is not required.

5.4.5 Glossy Black Cockatoo

The Glossy Black Cockatoo is widespread in eastern Australia from Eungella, Queensland south to east Gippsland, Victoria, and inland from southern central Queensland through the central west of New South Wales to north-eastern Victoria. There is also an isolated population on Kangaroo Island, South Australia (Birds Australia 2016).

The species is dependent on large upright spout hollows for breeding (Cameron 2007) with hollows preferred 15-30m above ground (The Glossy Black Conservancy). GBC feed exclusively on the seeds of *Allocasuarina* species. In eastern NSW Black She-oak *(A. littoralis)* is preferred (Chapman 2000). They tend to return regularly to traditional feeding, roosting, nesting and drinking areas each year.

The BioNet Atlas shows 19 records of GBC within a 10 km radius of the subject site.

Conacher Travers (2004) conducted searches within stands of *Allocasuarina* spp. to determine foraging resources available for and utilised by the GBC and recorded observations, calls and feeding signs. Surveys were conducted in 2003 and recorded the GBC as follows:

- 1 record on the western boundary of WNP (a bird drinking)
- 7 records of chewed cones within the central and northern portion of the habitat corridor (Lake Sector)
- 7 records in Stages 1-7 Lake Sector (DA approved 2005 and built from 2006) (chewed cones, flyover and feeding)

These observations were made within the Smooth-barked Apple Forest in the study area. They noted that "*foraging habitat for the Glossy Black-Cockatoo is common in the study area. Moreover, Allocasuarina species are a very common component of the flora of the Wallarah Peninsula and in particular the Habitat Corridor and Wallarah NP. Both Allocasuarina torulosa and Allocasuarina littoralis are significant understorey and canopy components in the study area in Smooth-barked Apple Forest and Spotted Gum/Ironbark Forest.*"

EcoFocus did not record the species over 13 days on site during December 2016 and January 2017, despite constant vigilance by two observers skilled in the identification of the soft calls of the species both while feeding and in flight. While the preferred food trees *A. torulosa* and *A. littoralis* occur as a scattered midstorey element within the spotted gum forest, no feed signs or GBC were recorded and there is no evidence of past or current use of the site by the species.

Given the lack of foraging evidence the site is obviously not a preferred feeding site, possibly because of the dominance of *A. torulosa* over *A. littoralis.* While GBC are capable of flying long distances to feed, when breeding they prefer to forage close to the nest site. The site is possibly too distant from the nearest nest site to provide a viable breeding season foraging area.

The proposed works are not likely to significantly affect the Glossy Black Cockatoo because:

1. No nesting resources for the species were identified on site and none will be removed.
2. There is no evidence of past or current foraging activity on the site. *A. torulosa* is the dominant feed species on site while the preferred feed tree *A. littoralis* is uncommon.
3. 17 ha vegetation is being retained on the site which includes Allocasuarina feed species for the GBC.
4. The entire habitat corridor and WNP also support Allocasuarina foraging habitat for the species.

5. Being a highly mobile species that travels 10 km to forage, the loss of a small amount of foraging resource will not put the species at risk in the locality.
6. Evidence from Conacher Travers and EcoFocus indicates GBC are utilising foraging resources in the habitat corridor (Lake Sector), on road edges and within the WNP. Thus, it is clear the GBC is utilising resources within the conservation areas of the site.

A 7 part test is not required and a Species Impact Statement is not required.

5.4.6 Large Forest Owls

Previous Surveys

Surveys were carried out over two years during the owl breeding season of April to June 2010 and April to July 2011 to ascertain the location of large forest owls that may occur on or adjacent to Stockland land (now WAD land) on the Wallarah Peninsula. The purpose of the surveys was to provide detailed and comprehensive information of the location of resident owls and to confirm nest sites as required by condition 51(d) of Development Consent DA /1297/2009 for Stage 14 of the project. This information was also intended to inform future planning of all Stockland (now WAD) land holdings. Surveys were directed and conducted by owl expert John Young. Survey results and management recommendations were detailed in the report 'Threatened Owl Nests Sites and Habitat '(nghenvironmental 2012). Key findings are summarised here.

Breeding pairs of Masked Owls were located on Stockland land (Stage 14 Lake Sector and Northern Sector northern section) as well as in the Wallarah National Park, to the immediate south of Stockland landholdings. A nest and roost site for a breeding pair of Powerful Owls was located on private land to the south of Stockland land adjacent and to the east of Rafferty's Resort. A roost and nest site for a second pair of Powerful Owls was located to the north of Stockland land and breeding confirmed in 2011. No Powerful Owls were found resident on Stockland (now WAD) land. A Sooty Owl was located in the vicinity of the Pacific Highway south of Swansea. Its nest site location was confirmed in 2011 outside Stockland landholdings to the north.

In addition to locating owl pairs, extensive hollow bearing tree surveys were undertaken to identify potential Masked Owl nest and roost trees and potential Powerful Owl nest trees. Fourteen alternative suitable nest trees for Masked Owl were identified, marked for retention and mapped in nghenvironmental (2012). All trees identified as potential Masked Owl nest or roost trees have been retained within stages of the NWP development approved by LMCC.

It should be noted that although previous surveys undertaken between 2001 and 2006 by Conacher Travers indicated the presence of threatened owl species either on or adjacent to Stockland land on the Wallarah Peninsula, it was not clear whether those observations were of owls that were resident on Stockland land and if so to what extent they utilised resources on Stockland land for breeding. Furthermore, it appeared that some of the previous observations may represent calls elicited in response to owl call playback, which can give an inaccurate indication of territory in use by a given pair, since owls will move out of their home range to respond to a call. For this reason, it was considered important to carry out targeted surveys during the breeding season and to repeat the surveys as the breeding season progressed to gain an accurate picture of the location of all owls and their nesting and roosting resources, and the extent to which they occur on and use resources on Stockland land. **Results of owl surveys prior to 2008, particularly maps showing point location results for owl call playback should not be relied upon.**

5.4.7 Masked Owl

The three pairs of Masked Owls identified so far are thought to be the only pairs breeding in the vicinity of the masterplan site (the pair in Stage 14 Lake Sector, one pair in Wallarah National Park (eastern side of highway), and one in the northern portion of the Northern Sector).

No Masked Owls were recorded on the subject site during the EcoFocus 2017 surveys, nor any previous survey. No evidence of their presence in the form of whitewash, pellets or feathers was recorded. Detailed survey and mapping of known pairs of Masked Owls by owl expert John Young identified the occurrence of a pair in the northern portion of the Northern Sector 1km to the north of the site as reported in nghenvironmental (2012). Another pair was located in the WNP to the south of the site.

The proposed works are not likely to significantly affect Masked Owls as a result of this project because:

1. The species does not occur on the site.
2. No breeding or roosting habitat for the owls will be removed.
3. Extensive owl and hollow bearing tree surveys over the past 10 years have identified multiple suitable e nesting resources and identified the location of all pairs on the Wallarah Peninsula – none of which occur on the site.
4. It is possible the Masked Owls would utilise habitat on the site as part of their broader foraging home range. Home range has been estimated as 400-1000 ha according to habitat productivity; measured as 1100 ha for one adult female of a resident pair in the non-breeding season, in bushland fragmented by suburban and semi-rural developments (Kavanagh and Murray 1996).
5. Within a 2 km radius of the site there is significantly more than 500 ha of potential Masked Owl foraging habitat.

A 7 part test is provided in Appendix F. A Species Impact Statement is not required.

5.4.8 Powerful Owl

A Powerful Owl roost site was identified in the east of the site adjacent the existing Caves Beach settlement during EcoFocus surveys in January 2017. Whitewash, a pellet and a small feather were found in a small area of mapped mixed riparian forest vegetation while an adult feather was found to its east near a large Spotted Gum with a large hollow. The whitewash, pellet and feather found in January 2017 were probably of a young owl dispersing from its natal territory, possibly a young from one of the known pair with nest trees to the west and south-west across the Pacific Highway as identified by John Young during peninsula wide owl surveys (nghenvironmental 2012).

A subsequent inspection by John Young in May 2018 identified two recently used roost trees within the mapped mixed riparian forest vegetation of the creek line to the immediate east of the 2017 sites. Based on the amount of whitewash under the trees he concluded that the roost sites had only be used temporarily and were not a regular roost site. He considered that the habitat was clearly suitable for Powerful Owls, had been used by them in 2017 and 2018, and would probably continue to be used in the future.

During the breeding season Powerful Owls will roost in dense vegetation close to the nest tree, while outside of the breeding season the owls will utilise several different roost sites more distant from the nest site. The roost sites identified on site are non-breeding roost sites. This habitat sits within an area identified to retain vegetation and exclude bushfire management (approximately 10.8 ha), which is also extended either side of the centre line of the drainage line extending from the Caves Beach boundary to the extent of the creekline vegetation that is suitable for owl roosting. The two riparian roost trees and the small drainage line roosting habitat are protected within the 10.8 ha.

No breeding site/nest tree was identified but several hollow bearing trees with hollows of suitable size for Powerful Owls were identified and these will be retained and protected. The 10.8 ha of retained vegetation contains numerous hollow bearing trees with large hollows suitable for PO, plus small and medium hollows suitable for prey species.

LMCC Guidelines

The Interim Lake Macquarie Large Forest Owl Planning and Management Guidelines (2014) (The Owl Guidelines) intend to provide supplementary information to the LMCC Flora and Fauna Guidelines and are to be considered in strategic planning, conservation planning and development proposals.

The Owl Guideline (p39) recommends that APZs, slashing, grazing and roads / trails be excluded from nest and roost tree buffers, riparian buffers, corridors and/or conservation priority areas. It was also recommended that effort be made to locate service easements outside of these areas and that public authorities be notified where nest and breeding roost sites occur on land that they manage. Nest and roost tree buffer areas should be excluded and protected from hazard reduction burns. Hazard reduction burns in areas outside of nest tree buffers would also preferably be conducted outside of the large forest owl primary breeding period of March to October.

After outlining the existing forestry prescriptions, the Guideline makes the following conclusion regarding recommended buffers (page 37):

In the absence of more information on the tolerance levels of large forest owl nest and roost trees to urban development impacts, particularly for new estates that result in substantial clearing and loss of habitat, it was considered the interim guideline should require a:

- *Minimum 100m vegetation buffer to all nest trees;*
- *Minimum 50m vegetation buffer to all breeding roost trees;*
- *Minimum 100m wide vegetation connectivity corridor between all nest trees and breeding roost trees; and*
- *Vegetation connectivity between nest / roost trees and riparian corridors.*

The Guideline considers that to avoid significant impact, as defined under Section 5A of the EP&A Act, to nest and breeding roost trees that the above buffer widths and vegetation would need to be retained. It was also noted in the Guideline that these buffers and vegetation should be retained as an important resource within the LGA regardless of whether large forest owls temporarily vacate the site for a number of years.

For the purposes of assessing development applications under Section 5A of the EP&A Act, the Guideline states a significant impact on large forest owls includes an impact which:

- *Encroaches within 100m of confirmed nest trees;*
- *Encroaches within 50m of confirmed breeding roost trees;*
- *Severs vegetation connectivity between a confirmed nest and/or breeding roost tree and adjoining large forest owl habitat; and*
- *Affects connectivity corridors such that prey species are significantly impacted.*

For the purposes of assessing **cumulative impact** of development applications under Section 5A of the EP&A Act, the guidelines state a significant impact on large forest owls includes an impact which proposes to remove >1ha of large forest owl habitat on land zoned Environmental Protection, Rural, Recreation and/ or Special Purpose; or >5ha of large forest owl habitat on land zoned Residential/ Industrial and/ or Business, within 2km of a confirmed nest site where:

- *Home range extent habitat within this area has already been reduced to less than 500ha; and*
- *A strategic area wide assessment and a strategic area based plan has yet to be undertaken / prepared. Note: Where loss of large forest owl habitat cannot be avoided on site a strategic area wide assessment may be undertaken and an area based plan prepared which includes suitable provisions of biodiversity offsets to compensate for the loss of foraging habitat.*

The Guideline also states that "Conservation priority habitat currently protected in conservation reserves is not adequate either to protect viable local populations of large forest owls or to conserve large forest owls across their local geographic range. Additional conservation reserves in public ownership or with legal security are required. The Guidelines identify that areas to be prioritised for conservation reserve investigations include:

Confirmed nest and breeding roost trees:

- *All confirmed nest and breeding roost trees are to be retained with minimum 100m and 50m vegetation buffers respectively; and*
- *Corridors of native vegetation, are to be retained between confirmed nest trees, breeding roost trees and riparian corridors. Corridors should be assessed on a site-by-site basis and would preferably be of 100m width.*

Home range extent habitat:

- A minimum of 500ha of suitable foraging habitat within a radius of 2km of detected confirmed nest sites is to be prioritised for conservation (see Map 7).

- Retained habitat (native vegetation) should be in no more than 3 to 4 large patches as fragmentation can affect quality of foraging habitat (i.e. the number of prey)."

Riparian habitat:

Riparian habitat provides core prey habitat. Riparian habitat also provides preferred roosting and nesting habitat for the majority of large forest owl species. The Guidelines identify Minimum 25m, 50m, 75m, 100m, 150m and 200m vegetation buffers on both sides of all 1st, 2nd, 3rd, 4th, 5th and 6th order streams within the LGA should be prioritised for conservation across the Lake Macquarie LGA and particularly within 2kms of confirmed nest and breeding roosts (see Map 7).

Specific requirements of the LMCC Owl Guidelines as described above are addressed in Table 5-5 in relation to the proposed development. Plan C Appenix H shows the location of the Powerful Owl roost sites and proposed retained vegetation.

Table 5-5 Assessment against LMCC Large Forest Owl Planning and Management Guidelines

CATEGORY	LMCC CRITERIA	RESPONSE
nest and roost trees	*Minimum 100m vegetation buffer to all nest trees*	No nest tree identified on site
	Minimum 50m vegetation buffer to all breeding roost trees	Site is a non - breeding season (summer) roost site within mixed riparian forest, and therefore a 50m vegetation buffer not required.
	Minimum 100m wide vegetation connectivity corridor between all nest trees and breeding roost trees	No nest or breeding roost trees within the site.
	Vegetation connectivity between nest / roost trees and riparian corridors.	A nest tree has not been identified within the site. Vegetation connectivity is provided within the site contiguous around the non-breeding roost sites and the Mixed Riparian Forest, and that habitat is not severed by the proposed surrounding clearing.
a significant impact on large forest owls includes an impact which:	*Affects connectivity corridors such that prey species are significantly impacted.*	Habitat will be retained on site that supports populations of ringtail and brushtail possums, birds and sugar gliders – all known prey species of the Powerful Owl. The adjacent 174.7 ha national park and other conserved areas within foraging ranges can be reasonably expected to support populations of these prey species and remain accessible to the mobile Powerful Owl.
	Encroaches within 50m of confirmed breeding roost trees	There is no confirmed breeding roost habitat on the site. Thus, the proposed development does not encroach within 50m of a breeding roost tree.
	Encroaches within 100m of confirmed nest trees	There is no confirmed nest tree (hollow) on site and the proposed development does not encroach within 100m of a confirmed nest tree.
	Severs vegetation connectivity between a confirmed nest and/or breeding roost tree and adjoining large forest owl habitat	There is no confirmed nest or breeding roost tree on the site and the proposal does not sever connectivity between the known nest trees on the NWP and available owl habitat.
For the purposes of assessing cumulative impact of development applications under	a significant impact on large forest owls includes an impact which proposes to remove >5ha of large forest owl habitat on land zoned Residential/	More than 500 ha of Powerful Owl habitat remains within a 2km radius of each of the confirmed Powerful Owl nest sites.

Section 5A of the EP&A Act	Industrial and/ or Business, within 2km of a confirmed nest site where: ***Nb:*** **Section 5A of the EP&A Act does not require nor provide for the assessment of cumulative impact so this criterion is misleading in assessing impact under the relevant legislation.**	
Confirmed nest and breeding roost trees	*All confirmed nest and breeding roost trees are to be retained with minimum 100m and 50m vegetation buffers respectively*	Only non-breeding (summer) roost habitat has been identified on site.
Riparian buffers	*1st order streams require a 25m buffer.*	20m buffers (either side of centreline) are provided on all mapped watercourses as per the approved masterplan. The area of retained vegetated around the identified temporary roost habitat and associated gully, which includes mapped mixed riparian forest, contains 'buffers' of 25m either side.

The LMCC Owl Guideline, while advocating the protection of riparian areas, does not make specific recommendations for riparian Powerful Owl roosting habitat that is utilised in the non-breeding season. Soderquist and Gibbons (2007) noted that for Powerful Owls, selection of roosting sites was flexible and did not constrain spatial use of home-range, with 96% of roosts in very small to medium-sized trees, which are widely distributed. This is an important distinction because Powerful Owls do not roost in the hollow of a specific tree (as Masked Owls do). Their roosting habitat is spread throughout the dense (often low) vegetation of the entire riparian strip, so the application of a specific buffer to a specific tree is not relevant (plans show distances around the identified roost resource to aid assessment).

Thus, the proposed development, which protects non-breeding roosting habitat for the Power Owl is consistent with the LMCC Owl Guideline recommendations, and consistent with the recommendation of Australian owl expert John Young (nghenvironmental 2012) and who was consulted on the preparation of the Owl Guideline.

The following site-wide strategies for provision and maintenance of refugia will be implemented (ESMP Table 4.1 pp. 66) (Manidis Roberts 2003). These measures will ensure that disturbance to the owls roosting habitat is avoided and minimised:

- Lighting will be directed away from owl habitat (specifically Lots 401 to 415 must not have bright lighting facing toward the owl buffer) and street lighting must be placed so as to avoid light throw into the bushland in the vicinity of the owl habitat).
- Cats will be prohibited from the entire development
- No dogs to be allowed on Lots 402, 405 and 415 adjacent the owl buffer.
- One dog only permitted on lots 401,403,404,406-414 within restricted development envelope type 1 which essentially keeps the dogs in and around the house and not in the lower rear yards.
- Dogs to be on leashes in public areas.
- Informative signage will be placed in prominent locations on the development boundary with the owl habitat and retained vegetation to notify residents of the sensitive environment/threatened species habitat and the need to minimise noise and disturbance.
- The proposed perimeter road is community title, will be gated and does not cater for individual lot access. It is located to provide emergency bushfire access only. The design of the road (edged with

retaining walls and batters and well separated from public roads and building envelopes means that additional fencing to the edge of the retained vegetation to prevent access is not warranted.

The 7 part test (AOS) for Powerful Owl has concluded that the project is unlikely to have an adverse effect on any aspect of the ecology and behaviour of the Powerful Owl that would place it at risk of extinction because:

- The non-breeding season roost habitat including the length of riparian habitat will be protected within the 10.8 ha of retained vegetation contained within a community association lot;
- HBT with hollows of suitable size for large forest owls and their prey species (such as ring tail possums, brush tail possums and sugar gliders) have been identified and mapped and will be retained within the vegetated lands;
- No dogs will be allowed on Lots adjacent the buffer
- The 174 ha Wallarah National Park to the south of the precinct protects owl foraging habitat, as does other conservation zoned lands within the foraging home ranges.
- No nesting habitat for the Powerful Owl will be impacted by the development, directly or indirectly.
- No breeding season roost habitat for the Powerful Owl will be impacted by the development, directly or indirectly.
- The species is known to utilise a foraging home-range of 1382 to 4774 ha with range length of 5.7–8.9 km (Soderquist and Gibbons 2007).

A Species Impact Statement is not required.

5.4.10 Grey Headed Flying Fox

The Grey-headed Flying-fox is listed as vulnerable under the TSC and EPBC Acts. Grey-headed Flying Foxes (GHFF) were recorded flying over and drinking from the dam in the west of the site during spotlighting in January 2017.

None were recorded by NGH (2013) or Conacher Travers (2007b) in any of the studies undertaken for the NWP project since 2003. Hoye (1995) did not record the species during a detailed studied of bats in the Lake Sector in 1995. The subject site would provide potential foraging habitat when eucalypts are in flower. There are no camps (roosts) in the vicinity of the site.

The dam where the GHFF were recorded sits over historical clay pan and uncontrolled fill which requires remediation as part of the project. A dam situated immediately north of the site boundary on land subject to future development, will be protected to continue to provide water resources.

Grey-headed Flying-foxes roost in Blackbutt Reserve to the north and Glenrock State Conservation Area to the north east of the reserve. These roosts disperse each evening to forage for nectar and pollen, including within the nature reserve and surrounds during periods of the year when Eucalyptus and Angophora trees are in flower. Many individuals were observed in and around the nature reserve in the 2006 surveys when Red Bloodwood (*Corymbia gummifera*) was flowering in abundance (Forest Fauna Surveys, 2006).

While clearing of vegetation from the site will remove potential foraging habitat for the species it will not result in fragmentation of foraging areas for the species nor impact on any camps and therefore not threaten the survival of the species.

A 7 part test for the species is provided in Appendix F and concludes that the species will not be significantly impacted by the Proposal. A Species Impact Statement is not required.

6. Potential Impacts

6.1 Overview

The effects of a proposal on the environment are likely to be unique due to its nature, construction, operation and location (DECC 2004). The proposed residential development at the Northern Sector will have both direct and indirect impacts on the environment. However, the nature, construction and operation of the development are unique and should be considered when assessing and describing potential impacts.

It is important to recognise the nature of both direct and indirect impacts and their likely magnitude during the construction and operational phases of any proposal. Examples of indirect and direct impacts that are common impacts to threatened biodiversity include (DECC 2004):

- clearing, fragmentation, alteration and destruction of native vegetation and animal habitats;
- pollution of watercourses and wetlands;
- sediment, nutrient and pollutant run-off into adjacent vegetation and animal habitats;
- noise and vibration disturbances to bat roosting sites;
- an increase in introduced plants and animals; and

- road fatalities.

The proposed development at NWP of which CPNS is a part, is unique in the depth and breadth of ecological data that has been collected over the past 10 years, with some relevant survey dating back 22 years. The detailed mapping and categorisation of hollow bearing trees is a key feature of the baseline survey that has been conducted. This means that the assessment of potential impact and associated 7 part tests are based on a large amount of survey over multiple years and seasons and is therefore are very reliable and the conclusion supported by large amounts of data.

6.2 Vegetation Removal

The 'Vegetation Management Plan' for the site is provided as Plan C in Appendix H and shows the areas of vegetation to be removed, retained and managed (for bushfire protection). Approximately 73% (54.4 ha) of the site is defined as disturbed from previous activities (e.g. quarrying, land fill, clay extraction, open cut mining). This results in large areas the site needing to be remediated despite vegetation having re-established over time.

Excluding the existing infrastructure corridors (Road Reserves and Overhead Electrical lines), approximately 44 ha of vegetation will be removed while 17 ha of vegetation will be retained within the site boundaries. An additional 4 ha comprises managed areas in which canopy trees will be retained and continue to provide fauna habitat including hollows and flowering/foraging resources for a range of species.

Table 5-6 lists the clearing statistics for the proposed development including vegetation to be removed, retained or managed. **Table 5-7** Shows vegetation removal by vegetation type.

Table 5-6 Vegetation areas to be removed and retained.

	Total Site	Existing Infrastructure Corridors (Road Reserves and overhead electrical)	Vegetation Retained (incl. managed)	Vegetation Removed
Area (ha)	74.6	9.2	21.2	44.1*
% of Site	100	12.3	28.4	59.1

**includes 2.4 ha to be revegetated to natural; 2.6 ha to be managed/revegetated.*

Table 5-7 Breakdown of Vegetation types to be removed.

(n.b. For impact assessment purposes it is assumed that all infrastructure corridor vegetation is removed).

Vegetation Type	Existing Vegetation (ha)	Vegetation Removed (ha)	Vegetation to Remain
Smooth-barked Apple Open Forest	45.5	35.6	9.90
Mixed Riparian/Lake Macquarie Dry Rainforest	1.9	0.00	1.90
Spotted Gum Open Forest	11.6	2.30	9.30

Exotic/Highly disturbed (excl. infrastructure corridors)	6.4	6.4	0
Infrastructure corridors	9.2 (1)	See note (1)	

(1) Total area of existing road reserves and overhead electrical Lines. Majority are cleared/disturbed or exotic vegetation.

The majority of the vegetation to be cleared is Smooth Barked Apple Open Forest (35.6 ha) which occurs in the western and central portion of the site. The majority of the Spotted Gum Open Forest in the east of the site will be retained within the east of the site (2.30 ha to be removed). The entire eastern portion of the WNP supports Spotted Gum Open Forest while the western portion of the WNP supports the vegetation type that occurs across the majority of the site.

6.3 Alternative Water Resource

In order to mitigate against the loss of the dam in the west of the site (created from former clay extraction activities and requiring remediation and conversion to a stormwater management facility) another existing water body has been identified that will be protected from future development. This other waterbody is located approximately 800 m north of the dam to be removed and outside the Central Precinct, but in lands owned by the applicant. A similar suite of bat species was recorded at this dam (compared to those surveyed using the dam to be removed) when surveyed in February 2018, so it provides suitable drinking water supply for Microchiropteran bats.

The dam is located within an area of Smooth-barked Apple Open Forest. The perimeter of the dam is vegetated with a dense coverage of dense edge of Gahnia, ferns and regrowth casuarina. A small Typha swamp is situated above the dam and is connected to it. This provides an additional element of habitat diversity and foraging habitat associated with the dam.

Removal of rubbish and planting of bare areas will be undertaken for a distance of approximately 20m around the dam outside the Central Precinct. Plant species will reflect those already occurring surrounding the dam. The dam is shown in the images below.

6.4 Ecological Site Management Plan, CLUMP and Ecological Validation

6.4.1 Conservation Outcomes

A significant conservation outcome for Wallarah Peninsula has been achieved through the adoption of the conservation strategy contained in the CLUMP which recommended the establishment of Wallarah National Park and creation of the Forest Red Gum Reserve on the foreshore of Lake Macquarie. It also recommended that a habitat corridor be retained between Wallarah National Park and the Forest Red Gum Reserve and the bushland to the north of the site to facilitate fauna movements between these areas. All of these recommendations have been achieved.

Since the inception of the project, the intention has been to dedicate conservation lands from within the rezoned lands. This has been achieved following a lengthy process involving LMCC, NPWS, the proponent and Department of Planning.

The conservation lands set aside as part of the design of the project are:

- Habitat corridor (23 ha)
- Foreshore reserve (8 ha)
- Wallarah National Park (174 ha)

The conservation lands were chosen to encompass the best quality habitat within the potentially developable lands, to provide representative examples of the vegetation types on the rest of the rezoned land and to ensure connectivity to allow fauna movement.

This has resulted in the protection of land that meets the 'like for like' criteria in current day biodiversity offsetting principles (OEH) in that the conservation lands are in close proximity to the developed lands and contain the same vegetation types and fauna habitats as the land to be developed. Furthermore, the majority of the conservation lands (the 174 ha WNP) are managed in perpetuity by NSW NPWS.

The Ecological Site Management Plan (ESMP) (Manidis Roberts 2003) prepared for the NWP Masterplan provides a detailed analysis of the vegetation types and species known to be present in WNP and known to provide a direct offset to loss of similar vegetation types, species and potential habitat for those species (even where that species has not been recorded on the site).

6.4.2 Ecological Validation

In addition to the overall conservation strategy described above, the masterplan identifies the following ecological strategies of particular relevance to the site (and required ecological assessment at the time of each development application):

- 20m ecological fire management buffer zone (serving a bushfire protection function and providing a habitat transition area) between development areas and the Wallarah National Park and the habitat corridor (This is not applicable to the current proposal as no works associated with this current proposal occur within 100m of the boundary of the National Park, with the site separated by existing Scenic Drive road reservations and other applicant owned lands which provide buffer and separation to the National Park)

- Protection of habitat linkages and protection and maintenance of refugia; - with an overall goal to provide an inter-connected system of natural vegetation to larger habitat, Wallarah National Park and the habitat corridor, using riparian areas and retention within road and lot design of natural vegetation (in accordance with specified development types) including large mature trees with hollows;

- Development within Smooth-barked Apple Forest (Northern Sector); and

- Development within Spotted Gum/Ironbark Forest (Northern Sector).

The ecological conservation and management strategies outlined in this ESMP (Manidis Roberts 2003) for the areas of the site identified for development (now zoned R1) complement and enhance the conservation outcome achieved by the CLUMP.

An ecological validation process is required for the proposed development to confirm that its design conforms to the ecological outcomes and prescriptions outlined in the Masterplan. The Masterplan ESMP identified 12 ecological considerations which form the criteria against which the development was validated. Ecological considerations relevant to the Central Precinct are:

Two site-wide ecological considerations:

1. Provision and Maintenance of Refugia; and
2. Provision of Habitat linkages.

Two ecological considerations are:

3. Development within Smooth-barked Apple Forest (Northern Sector); and
4. Development within Spotted Gum/Ironbark Forest (Northern Sector).

These criteria are addressed below for the proposed development.

Provision and Maintenance of Refugia & Provision of Habitat linkages.

The role of refugia within the development areas is to complement the conservation areas of the site and to provide sufficient habitat and access to food resources to sustain isolated and transient species as they move across the site.

In the Central Precinct, Northern Sector the provision of refugia and habitat linkages are achieved through retention of 62% of all hollow bearing trees mapped on the site and retention of areas of vegetation for habitat resource and linkage.

The retained hollow bearing trees include a variety of trees species and hollow sizes suitable for a range of fauna species including threatened species, and their prey species. These are retained in a variety of settings:

- individual trees in managed areas and backs of lots (primarily Stage 1C),
- clusters of trees such as those within the western riparian sector and the drainage reserve above; and
- the retained and managed area on the north-eastern edge of the site that is contiguous with the riparian vegetation of Plains Gully.

Retained vegetation along the western creek supports the threatened plants *Callistemon linearifolius* and *Tetratheca juncea*.

As well as providing important habitat for hollow dependent fauna, the retained trees will provide foraging habitat in the form of both winter and summer flowering species.

These site wide ecological considerations complement the larger scale conservation outcomes for the project namely the WNP, Foreshore Reserve and Habitat Corridor. A total of 21 ha of vegetation will be retained in the Central Precinct (including 4ha of managed vegetation where the canopy und some understorey will be retained). This comprises primarily Spotted Gum Ironbark Forest in the south-eastern lower slopes connecting to Plains Gully, with 9.9 ha of Smooth Barked Apple Open Forest. The retained vegetation also extends around the slopes of Mawsons Lookout (other than on the cliff edge) and to Scenic Drive edges, which then maintains existing linkages to other vegetated areas and the National Park. A linear riparian area is also retained (including some revegetation) along the western riparian area. Both vegetation types to be retained support hollow bearing trees and other habitat. In addition, managed vegetation (with select canopy retention) in some parts of the precinct will continue to provide some foraging, roosting and nesting habitat for a range of species including birds, bats and arboreal mammals.

It is considered that the proposal is consistent with the complementary ecological considerations for connectivity and function of the Wallarah Peninsula landscape, and in line with the strategies identified within the CLUMP 2000, ESMP 2003 and approved Masterplan.

Development within Smooth-barked Apple Forest

Unlike the Lake Sector, which identified ecological functioning of this vegetation type, the Northern Sector consideration relates to development within it rather than its own ecological functioning. The ESMP identifies that much of the Northern Sector is not significantly constrained by ecological considerations (even with substantial regrowth of vegetation and pockets of natural vegetation on slopes and ridges). The majority of the sector is identified by the masterplan approval as suitable for Development Type (DT) 4 (which covers the majority of the Central Precinct and the majority of the Smooth-barked Apple Forest vegetation extent within the precinct)

and provides for urban village settlement with landscaping using indigenous species to enhance retained vegetation in road reserves and along drainage lines).

Otherwise, the ESMP identifies the sector's contribution to complement the larger scale conservation outcome for the project in maintaining connections to the more ecologically significant areas identified for DT 2 (which covers a less disturbed pocket of land at the entrance to the precinct and to the north-eastern slopes identified for larger clustered lots with envelopes and select canopy removal) and with Wallarah National Park to the south.

The ESMP identifies that the development approach in this sector is to target badly degraded areas for higher density development, whilst retaining lower development densities in the areas of greater ecological significance. The ESMP states that "The mixture of development types adopted for this part of the site corresponds to the varied nature of the site as represented by the Development Land Use Plan in which healthy stands of vegetation are interspersed with badly degraded areas. The previously disturbed areas include the former Swansea Open Cut Coal Mine, which requires extensive remediation involving clearing of regrowth, reshaping of overburden spoil heaps, compaction of soil, and revegetation. On the ridge top and mid-slope areas of the sector, lower density development types that correspond predominantly to eco-residential/Development Type 2 has been adopted by the CLUMP to maximise the amount of retained natural vegetation".

Within this forest type, priority has been given to retaining stands of mature trees with hollows and in conjunction with other threatened species characteristics as outlined above relating to refugia and habitat, taking into account the reality of past disturbance, remediation and bushfire management requirements. This includes areas where bushfire management is precluded from retained patches, to provide for ongoing emergent and mature trees and understorey – being the western riparian area (which will include a landscape program for revegetation in areas previously disturbed and requiring remediation), the drainage reserve to its east and the slopes of Mawsons Lookout.

As envisaged by the ESMP, the DT2 lots to the south of the precinct entry also retain canopy with understorey subject to management for bushfire purposes, and these lots will be subject to covenants.

More detailed geotechnical investigations have identified further disturbance and high risk slope instability areas extend further into the ridge top and upper slope areas of the north-eastern edge of Central Precinct than evident from the canopy that remains. These works are on the edge of DT4 and DT2 mapping and extend into DT2 areas. This requires the need to remediate and clear natural vegetation on parts of the ridge and upper slopes where the forest type has been mapped. Re-establishment objectives of the remediated areas relate to managing scenic quality/visual absorption and bushfire management, rather than ecological. Given this, and existing and remediated topography, the proposal aims to retain a larger area of native vegetation in the lower slopes (i.e. without clustering of larger lots down the slopes through to Caves Beach), outside the Smooth-Barked Apple Forest.

The larger conservation strategy protects areas of Smooth-barked Apple Forest within the Wallarah National Park, including the majority of the western side of the National Park, and the opposite edge of the eastern side of the National Park (totalling 38ha), as well as parts of the western Habitat Corridor, and is well represented in the conservation system.

Development within Spotted Gum/Ironbark Forest.

A large area of Spotted Gum/Ironbark Forest (approx. 137 ha) has been protected in the WNP eastern section as part of the conservation measures for the project. Therefore, Spotted Gum Ironbark Forest is particularly well represented in the conservation system. The majority of the Spotted Gum Ironbark Forest on the site will be

retained within the north-eastern portion of the site as part of the proposal. The ESMP approach to ecological management is to retain natural vegetation in the DT2 areas and ensure vegetation connections are maintained through to DT3 areas (not within the Central Precinct but to the south of Mawsons Lookout and either side of the coastal village drive) and Wallarah National Park to the south. Vegetation connections are maintained and within this forest type, priority has been given to retaining stands of mature trees with density of hollows and in conjunction with other threatened species characteristics as outlined above relating to refugia and habitat, taking into account the reality of past disturbance, remediation and bushfire management requirements, with an area over 10ha in the mid and lower slopes (providing separation to the Caves Beach urban edge) and through to Plains Gully and beyond.

6.5 Cumulative Impacts

Section 94 of the TSC Act 1995 does not require the consideration of cumulative impact when making a determination as to whether a proposal is likely to significantly affect threatened species, populations or ecological communities, or their habitats.

As outlined earlier, the Central Precinct is located in the context of significant conservation zoned lands that are in public ownership within the wider Wallarah Peninsula context, with Munmorah SCA and Lake Macquarie SCA now consisting of some 1342 ha of reserved land within the LGA boundary, with a further contiguous 2125 ha sitting with the SCA within the Central Coast LGA, supplement also by conservation zoned lands that are in private ownership.

The cumulative nature of the project was inherent and obvious from the outset and the NWP project has always been presented in its entirety with Masterplan approval for the whole project. Whilst recognising that the project would be assessed, approved and developed in stages, the dedication of significant conservation lands, and the strategic selection of areas to be developed versus areas to be conserved was part of a process designed to remove uncertainty about the level of ecological impact into the future. So the cumulative impact of the project has been recognised and considered and reflected in conservation outcomes including consideration for ecological functioning such as connectivity, vegetation diversity and refugia - since its inception.

It should be noted that the land forming the Wallarah National Park was dedicated to NPWS in 2003 for conservation purposes by the previous landowner Lensworth as a direct conservation outcome for the North Wallarah Peninsula development. The purpose of that land dedication was to protect habitat for threatened species known or predicted to occur in the area, and in recognition of the development that was to proceed north of the now National Park. The boundaries of the dedicated lands were decided following detailed habitat and vegetation analysis for threatened species and abundance of hollow bearing trees.

The conservation initiatives embedded in the project from its inception have successfully protected important habitat for a range of threatened species. The Clause 34A order has acknowledged the unique project history and its planning arrangements and certified that the overall North Wallarah Peninsula masterplan development (of which the Central Precinct forms a part), has satisfactorily addressed biodiversity impacts and that conservation measures have been secured into the future, with advice from the Office of Environment and Heritage (OEH) that no further biodiversity offsets are required for development undertaken on land within the project.

7. Recommendations

7.1 Safeguards and Environmental Management

The following measures in **Table 5-8** re proposed for proposed subdivision, in addition to the details incorporated into the proposal itself.

Table 5-8 Management Measures and Safeguards

Potential Impact	Management Measure/Safeguard	Responsibility	Timing
Clearing and prevention of over-clearing	• Prior to the commencement of work, a physical vegetation clearing boundary at the approved clearing limit is to be clearly demarcated and implemented. The delineation of such a boundary may include the use of temporary fencing, flagging tape, para-webbing or similar. • Trees to be retained will be marked clearly according to the tree retention plan prior to commencement of works. • Trees would be removed/trimmed/lopped in such a way as not to cause damage to surrounding vegetation. This would ensure groundcover disturbance would be kept to a minimum. • Where possible, trees to be removed would be mulched onsite and re-used to stabilise disturbed areas. • Where trees are to be retained, an adequate protection zone (TPZ) would be provided around each tree for the duration of construction. The radius of this zone is calculated by multiplying the diameter of the tree at breast height (1.4 m) by 12, and is a minimum of 2 m and a maximum of 12 m. • If work cannot avoid encroaching into the TPZ, it would not impinge on the structural root zones (SRZ) of trees to be retained. This zone is calculated using the formula: SRZ = (diameter above root buttress x 50).	Contractor	Pre-construction Construction
Loss of hollow-bearing trees	An ecologist would be present during felling of HBT to ensure that any potential impacts on fauna are minimised. A two-stage clearing process should be followed, leaving HBT to stand at least 24 hours following	Contractor	Clearing

Potential Impact	Management Measure/Safeguard	Responsibility	Timing
	clearing of surrounding vegetation and this procedure must be communicated clearly to tree clearing contractors.		
Disturbance to fallen timber, dead wood and bush rock	Any fallen timber, dead wood and bush rock (if present) encountered onsite would be left in situ or relocated to a suitable place nearby. Rock would be removed with suitable machinery so as not to damage the underlying rock or result in excessive soil disturbance.	Contractor	Construction
Disturbance to waterways	Ephemeral waterways are present at the proposal site. Indirect impacts to drainage lines should be avoided by installing upslope erosion and sedimentation controls.	Contractor	Construction
Erosion	Erosion controls would be put in place on the upslope of works to prevent soil and debris travelling downslope.	Contractor	Pre-construction and construction
Light spill impacts on bats, owls and other nocturnal fauna that interferes with foraging behaviours	Light spill from the development towards any areas of retained vegetation and the WNP must be managed and minimised on outer edges.	Design Phase	
Damage to native vegetation outside of impact zone	• Stockpile and compound sites would be located using the following criteria: • At least 40 metres away from the nearest waterway. • In areas of low ecological conservation significance (i.e. previously disturbed land). • On relatively level ground. • Outside the 1 in 10 year Average Recurrence Interval (ARI) floodplain. • Stockpiling materials and equipment and parking vehicles would be avoided within the dripline (extent of foliage cover) of any tree.	Contractor	Construction
Introduction and spread of noxious weeds and pathogens	• Bushland Management Plan • Declared noxious weeds would be managed according to the requirements stipulated by the *Noxious Weeds Act 1993*, and any relevant Council Guidelines. • targeted control of noxious and environmental weeds would take place prior to clearing and ongoing after clearing • Construction machinery (bulldozers, excavators, trucks, loaders and graders) would be cleaned using a high-pressure	Contractor	Construction

Potential Impact	Management Measure/Safeguard	Responsibility	Timing
	washer (or other suitable device) prior to entering and exiting work sites. • Imported fill would be used for onsite earthworks. • All pesticides would be used in accordance with the requirements on the label. Any person undertaking pesticide (including herbicide) application would be trained to do so and have the proper certificate of completion/competency or statement of attainment issued by a registered training organisation. • Appropriate notifications of use of herbicides should also be made to local residents and other relevant stakeholders/affected parties.		

Additionally, the following recommendations are made regarding landscaping and the use of native plants, buffers, corridors and refugia.

- Revegetation of areas should be undertaken using species characteristic of the previous vegetation community and lists of such species should be provided to prospective residents, as per requirements of the Bushland Management Manual (2007).
- The LMCC DCP should be adhered to. Recommended species lists for planting are provided in Appendix G (Central Precinct plant species list) of the DCP.
- All residents must be provided with clear planting guidelines that are in accordance with the Bushland Management Plan, including lists of allowable plant species and guidance as to where to obtain them.
- Signage and protection of the Powerful Owl habitat is important. This area protects Powerful Owl roosting habitat outside of the breeding season and should be protected from disturbance such as walking tracks, pedestrian traffic, vehicular traffic and walking of dogs. Dog ownership will be prohibited on certain lots adjacent the protected owl habitat, as described in more detail below.

The following specific controls on dog ownership have been implemented for the Central Precinct Northern Sector based on the specific proposal and surrounding habitats:

1. DT 2 area located south of estate entry (Stage 1C).
    - No Dogs on Lot 133 – as this lot directly adjoins the Riparian Corridor
    - Max 2 Dogs permitted on Lots 134-148, as discussed whilst these lots are in the DT 2 area and vegetation outside of the envelopes will be kept, these lots do not adjoin the national park or habitat corridor and are located between the Old Pacific Highway and proposed roads 17 and 14
2. Community Title Stage 4
    - No dogs on lots 402 and 405 & 415 (402 directly adjoins lot 400 – Future Community Property) 405 whilst it is still above the proposed community road, the development envelope (and therefore future dwelling) sit closest to lot 400. 415 is the eastern most lot with closest proximity to the Lot 400 riparian.

- All remaining 12 lots 401,403,404,406-414 one dog is permitted within restricted development envelope type 1 which essentially keeps the dogs in and around the house and not in the rear yards (closest to the community roads)

3. No Dogs on Lots 352,353,354,355 due to proximity to lot 400 riparian corridor

The pet ownership policy should be accompanied by an appropriate education program, informing residents of the impacts of domestic cats and dogs on native fauna. The relevant education materials should be incorporated into a home-owner's manual that addresses the full range of ecological management issues at the site. The pet ownership guidelines could be implemented through the use of covenants on title (Stage 1C) and/or management statements under a community title scheme (Stage 4).

The efficacy of refugia is likely to be greatly reduced as a result of the negative impacts on native fauna, particularly terrestrial mammal species, of uncontrolled cats and dogs. Accordingly, pet ownership guidelines are proposed that:

- prohibit cats in all development types;
- dogs to be on leashes in public areas.

8. Summary

Extensive ecological surveys both historical and recent, carried out in accordance with all relevant state and local government guidelines, and research into the distribution and habitat requirements of target threatened species, has categorically concluded that the proposal will not significantly affect threatened species, populations or ecological communities, or their habitats to the extent that a local population of a species would go extinct.

In relation to the conservation outcomes of the project – namely protection of 220 ha of high ecological value land – the Conservation and Land use Management Plan prepared for LMCC concluded that:

> *The proposed Conservation Reserve System, incorporating the wildlife habitat corridors, includes representative examples of all the key vegetation communities, habitat features and archaeologically sensitive landscape units contained on the site. The proposed System will be consistent with State and Federal Biodiversity Policies. NPWS has been directly involved in determining the details of the Conservation Reserve System and has endorsed the conservation outcome in their submission to LMCC. In referring to the Conservation Strategy the NPWS stated that, "The advantages of this approach are that a positive conservation outcome has been achieved and the developer will have greater certainty of not triggering a significant effect on threatened species, populations or ecological communities at the DA stage".*

A large amount of data derived from surveys and assessments that span a period of 23 years has been reviewed, analysed and collated within this report and attached 7 part tests. Additional substantial field work has been conducted targeting listed threatened species.

The site has undergone substantial historical disturbance, clearing and destruction of habitat from mining, clay extraction, landfill and powerline and road easements. Almost all of the Spotted Gum/Ironbark Forest (12 ha) on site will be retained and the removal of the Smooth-barked Apple Open Forest, much of which is regrowth will not substantially impact local populations of any threatened species.

Of the 15 threatened fauna species assessed within this report, only five, the Little Bentwing Bat, Large Bentwing Bat, Greater Broad-nosed Bat, Grey-headed Flying-fox and the Powerful Owl have been recorded on the site.

The project will result in the removal of 44.1 ha of potential foraging habitat for the three species of microchiropteran bats. However, 21 ha of suitable foraging habitat will be retained on the subject site (17 ha intact, 4 ha managed, with canopy retained). Thus, a significant effect on the populations of these bat species is unlikely. Despite this, additional mitigation measures and monitoring are proposed.

The Powerful Owl has been the subject of additional survey and expert reporting resulting in protective measures being put in place for the non-breeding season roost sites situated in the eastern portion of the site. Additional mitigation measures such as signage, banning of cats and dog management will further protect the roost habitat.

The assessment of potential impacts on threatened flora and fauna in this report is robust and based on a detailed analysis of all available data. There is no likelihood that any local population of threatened species will be placed at risk of extinction as a result of the proposal.

An SIS is required to be prepared when a species is likely to be significantly affected by a proposed activity and "further consideration is required and is more appropriately carried out when preparing a species impact statement." (DECC 2007).

Furthermore, a species impact statement is unlikely to provide additional data that would change the assessment of potential impact on the subject species. Such a large amount of survey has been conducted on and around the site over the past 14 years and spanning back as far as 23 years that the ecological characteristics of the site and its biodiversity value have been thoroughly documented. This report reviews all of that information and adds another up to date, site specific, ecological survey and assessment. Therefore, the conclusion that no threatened species will be affected to the extent that a population of the species would be placed at risk of extinction is considered to be robust and based on rigorous analysis and unlikely to change with an SIS.

8.1 Conclusion

The potential for both direct and indirect impacts have been taken into account during the assessment and response to 7 part tests and are summarised for each species in Section 5. The clearing of 2 ha of Spotted Gum Ironbark Forest and 36 ha of Smooth-barked Apple Woodland will result in the loss of some potential foraging habitat for bird and bat species, and loss of hollow bearing den trees for some arboreal mammals. However, the design of the project, the habitat tree retention rate (62% of habitat trees), the protection of 220 ha of high ecological value conservation lands, as well as the mitigation measures put in place (see section 7) mean that the magnitude of these impacts is substantially reduced. Viable populations of native flora and fauna will continue to persist on the site and be connected to larger tracts of forest that are protected in perpetuity. Large amounts of survey and data analysis have informed the 7 part tests for this assessment which have concluded that no threatened flora or fauna species will be significantly adversely affected by the proposed development. In summary, the reasons for this are:

1) In the case of some species, the species has not been recorded on the site in this or any previous survey undertaken on the site over a 20+ year period.
2) Approximately 61% of HBT on the site will be retained.
3) No threatened species breeding habitat is being removed.
4) An area of high-quality, connected vegetation is to be retained on the subject site, which contains hollow bearing trees and stags that provide roosting habitat for birds and bats.
5) Large areas of foraging habitat exist across the Wallarah Peninsula.

Therefore, a Species Impact Statement is not required.

As expressed within this report and the Executive Summary, the masterplan site (which includes this Central Precinct) is covered by a Clause 34A order that acknowledges the planning arrangements and confirms that biodiversity impacts have been satisfactorily addressed and that conservation measures to offset residual impacts (after the avoid and minimise impact measures) have been secured into the future. OEH advise that as a result, no further biodiversity offsets are required for development undertaken on land within the North Wallarah Masterplan Development.

9. References

Atlas of Living Australia website at http://www.ala.org.au/page name. Accessed November 2016 and July 2017.

http://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10183

Bell, S.A.J. (2016) Volume 2: Vegetation Community Profiles, Lake Macquarie Local Government Area. Working Draft v2. Unpublished Report to Lake Macquarie City Council. March 2016. Eastcoast Flora Survey.

Bell, Stephen A.J. (2001). Notes on population size and habitat of the vulnerable *Cryptostylis hunteriana* (Orchidaceae) from the Central Coast of New South Wales. *Cunninghamia*. *7(2): 195–204.*

Birdlife Australia (2016): http://www.birdlife.org.au/projects/woodland-birds-for-biodiversity/regent-honeyeater-wl

Birdlife Australia (2016). Glossy Black Cockatoo species profile. http://www.birdlife.org.au/bird-profile/glossy-black-cockatoo.

Birdlife Australia (2017). A Regent Victory. Vol 5. No. 2 p. 66.

BOM (2017) *Norah Head, New South Wales, October 2016 Daily Weather Observations*, accessed online at http://www.bom.gov.au/climate/dwo/201611/html/IDCJDW2099.2016 11.shtml in February 2017

https://www.calendar-12.com/moon_calendar/2016/october

Cameron, M (2007). Cockatoos. CSIRO Publishing. Australia.

Christidis, L. and Boles, W.E (2008). Systematics and Taxonomy of Australian Birds. CSIRO Publishing. Australia.

Conacher Travers Environmental Consultants (2004). Ecological Assessment. Flora and Fauna. Stages 1-7 Lake Sector and Village Drive Access Road. Wallarah Peninsula. Volume 2. Report Prepared for Lensworth Wallarah Peninsula Pty Ltd.

Conacher Travers Environmental Consultants (2005a). Environmental and Ecological Validation Report Stages 8-12 Lake Sector North Wallarah Peninsula Volume 1. Prepared for Lensworth Wallarah Peninsula Pty Ltd.

Conacher Travers Environmental Consultants (2005b). Flora and Fauna Assessment Stages 8-12 Lake Sector North Wallarah Peninsula Volume 2. Prepared for Lensworth Wallarah Peninsula Pty Ltd.

Conacher Travers Environmental Consultants (2007a). Ecological Site Survey Report Coastal and Northern Sectors, Wallarah Peninsula. Report prepared for Stockland.

Conacher Travers Environmental Consultants (2007b). Environmental Audit Report Wallarah Peninsula Lakes, Coastal and Northern Sectors. Report prepared for Stockland.

Conacher Travers Environmental Consultants (2007c). Flora and Fauna assessment report. Coastal Village Precinct. Coastal Sector Wallarah Peninsula. Report prepared for Stockland.

Conacher Travers Environmental Consultants (2007d). Integrated ecological assessment report. Stages 13A and 13B. Report prepared for Stockland.

Commonwealth Department of Environment Interactive Flying-fox web Viewer.http://www.environment.gov.au/biodiversity/threatened/species/flying-fox-monitoring

DEC (2004). Threatened Species Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft).

DECC (2007). Threatened species assessment guidelines. The assessment of significance.

DEWHA (2010). Survey guidelines for Australia's threatened birds. Guidelines for detecting birds listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999.*

Driscoll, C. (2003). Pollination ecology of *Tetratheca juncea* (Tremandraceae): finding the pollinators. *Cunninghamia* 8(1): 133–140

Ecobiological Survey & Assessment (no date). Flora, fauna and threatened species assessment. Lot 414 DP 866775, Tingira Drive, Croudace Bay. Report prepared for Lake Macquarie City Council.

EcoLogical (2015). Native Orchids in the Lake Macquarie LGA, with a special emphasis on Rare or Threatened Species. Report Prepared for Lake Macquarie city Council.

EcoFocus Environmental Consulting (2017). Swansea Valley 2 and 3 Ecological Impact Assessment. Report prepared for Wakefield Ashurst developments.

ERM Resource Planning (1995). Fauna Impact Statement for Lakeside Sector including Stages 2B & 3D Pinny Beach. Report prepared for James Mullan Developments Pty Ltd.

Hoye, G (1995). Report on a survey of the bat fauna of the lakeside sector of the proposed Pinny Beach development Near Cams Wharf, New South Wales. Appendix C to ERM Resource Planning (1995). Fauna Impact Statement for Lakeside Sector including Stages 2B & 3D Pinny Beach. Report prepared for James Mullan Developments Pty Ltd.

Kavanagh, RP and Murray M (1996). Home Range, Habitat and Behaviour of the Masked Owl *Tyto novaehollandiae* near Newcastle, New South Wales. *Emu:* 96: 250-257.

Lake Macquarie City Council (2014). Lake Macquarie *Tetratheca juncea* Planning and Management Guidelines.

Lake Macquarie City Council (2012). Flora and Fauna Survey Guidelines. V4.2.

Lake Macquarie City Council (2013). Interim Lake Macquarie *Grevillea parviflora* subsp*. parviflora* Planning and Management Guidelines.

Lake Macquarie City Council (2014). Interim Lake Macquarie Large Forest Owl Planning and Management Guidelines.

Lake Macquarie City Council (2015). Lake Macquarie Squirrel Glider Planning and Management Guidelines.

Lake Macquarie City Council (2014). Lake Macquarie *Tetratheca juncea* Planning and Management Guidelines.

Lensworth (2003a). North Wallarah Peninsula Masterplan: Concept development Planning- a reference for the masterplan.

Lensworth (2003b). North Wallarah Peninsula Masterplan Executive Summary.

Lindenmayer, D (2002). Gliders of Australia. A Natural History. UNSW Press.

LMSNA (2016) *Awaba State Conservation Area (proposed)*, Lake Macquarie Sustainable Neighbourhood Alliance, Lake Macquarie City Council. Accessed online at http://www.sustainableneighbourhoods.org.au/uploads/6/7/0/6/6706950/booklet2.pdf in February 2017.

Manidis Roberts (2003). North Wallarah Peninsula Masterplan. Ecological Site Management Plan.

Manidis Roberts (2007) Bushland Management Manal Wallarah Peninsula.

Meyer, E., Hero, J-M., Shoo, L. and Lewis, B. (2006). National recovery plan for the wallum sedgefrog and other wallum-dependent frog species. Report to Department of the Environment and Water Resources, Canberra. Queensland Parks and Wildlife Service, Brisbane.

nghenvironmental (2010). Masked Owl Management Plan. Stage 14 North Wallarah Peninsula. Report prepared for Stockland.

nghenvironmental (2010). Masked Owl Discussion Paper and 7 Part Test. Stage 14 North Wallarah Peninsula Report prepared for Stockland.

nghenvironmental (2011). Draft Ecological Assessment Stage 13C Murrays Beach. Report prepared for Stockland developments. (Based on November 2010 surveys).

nghenvironmental (2012). Threatened Owl nest sites and habitat. Stockland Land Holdings North Wallarah Peninsula. Report prepared for Stockland Developments.

nghenvironmental (2013). Draft Ecological Assessment Swansea Valley 2 and 3. Report prepared for Stockland developments. (Based on August 2011 to January 2012 surveys). Unfinalised draft.

NPWS (2010) *Watagans National Park and Jilliby State Conservation Area: Plan of Management*, NSW National Parks and Wildlife Service, Department of Environment and Climate Change, NSW. Accessed online at http://www.environment.nsw.gov.au/resources/planmanagement/final/20101032WatagansJillibyFinal.pdf in February 2017

NPWS (2009) *Munmorah State Conservation Area and Bird Island Nature Reserve: Plan of Management*, NSW National Parks and Wildlife Service, Department of Environment and Climate Change, NSW. Accessed online at http://www.environment.nsw.gov.au/resources/planmanagement/final/MunmorahSACandBirdIslandNR.pdf in February 2017

NSW National Parks and Wildlife Service (2010) Department of Environment, Climate Change and Water Glenrock State Conservation Area Plan of Management Accessed online at: https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Parks-reserves-and-protected-areas/Parks-plans-of-management/glenrock-state-conservation-area-plan-of-management-100835.pdf

NPWS (2005) *Lake Macquarie State Conservation Area, Pulbah Island Nature Reserve and Moon Island Nature Reserve: Plan of Management*, NSW National Parks and Wildlife Service, Department of Environment and Climate Change, NSW. Accessed online at http://www.environment.nsw.gov.au/resources/parks/PoMLakeMacquarieSCAPulbahIslandNRMoonIslandNR.pdf in February 2017.

NSW National Parks and Wildlife Service (2002). Wallarah National Park. Draft Statement of Interim Management Intent.

NSW National Parks and Wildlife Service (2003). Wallarah National Park Interim Management Guidelines.

NSW National Parks and Wildlife Service (2009). Tingira Heights Nature Reserve Plan of Management.

NSW Scientific Committee (2008). Squirrel Glider *Petaurus norfolcensis*. Review of Current Information in NSW. August 2008.

OEH (2004). Threatened Biodiversity Survey and Assessment Guidelines

OEH (2014a) *Statement of Management Intent: Wallarah National Park*, Office of Environment and Heritage, New South Wales Government. Accessed online at http://www.environment.nsw.gov.au/resources/parkmanagement/SMI/20140243SMIWallarahNP.pdf in February 2017

OEH (2014b) *Statement of Management Intent: Sugarloaf State Conservation Area*, Office of Environment and Heritage, New South Wales Government. Accessed online at http://www.environment.nsw.gov.au/resources/parkmanagement/SMI/20140224SMISugarloafSCA.pdf in February 2017

OEH (2014c) *Statement of Management Intent: Colongra Swamp Nature Reserve*, Office of Environment and Heritage, New South Wales Government. Accessed online at http://www.environment.nsw.gov.au/resources/parkmanagement/SMI/20140138SMIColongraSwampNR.pdf in February 2017

OEH (2014d) *Statement of Management Intent: Awabakal Nature Reserve*, Office of Environment and Heritage, New South Wales Government. Accessed online at http://www.environment.nsw.gov.au/resources/parkmanagement/SMI/20140108SMIAwabakalNR.pdf in February 2017

OEH (2016). NSW Guide to Surveying Threatened Plants.

Okada, S. (2006) The Distribution and Abundance of *Callistemon linearifolius* and *Corybas dowlingii* at Stoney Ridge Reserve, Soldiers Point NSW. Report to Port Stephens Council.

Payne, R. (1999). Vegetation Mapping and Conservation Area Analysis. North Wallarah Peninsula Project Site. Report prepared for Lake Macquarie City Council.

Payne, R. (2000) Lake Macquarie *Tetratheca juncea* Conservation Management Plan.

Roderick, M., Ingwersen, D.A. and Tzaros, C.L. (2013). Swift Parrots and Regent Honeyeaters in the Lower Hunter Region of New South Wales: an assessment of status, identification of high priority habitats and recommendations for conservation. Report for Sustainable Regional Development Program. Department of Sustainability, Environment, Water, Population and Communities. BirdLife Australia, Melbourne.

Roderick, M. and Ingwersen, D.A. (2014). Swift Parrots and Regent Honeyeaters in the Lake Macquarie City Council area of New South Wales: an assessment of status, identification of high priority habitats and recommendations for conservation. Report for Lake Macquarie City Council. BirdLife Australia, Melbourne.

SGS Australia Pty Ltd (2016). Analytical Report to Stockland

Smith A. P. and Murray, M. (2003). Habitat requirements of the squirrel glider (*Petaurus norfolcensis*) and associated possums and gliders on the New South Wales central coast. *Wildlife Research* 30: 291-301.

Soderquist, T. and Gibbons, D. (2007). Home-range of the Powerful Owl (*Ninox strenua*) in dry sclerophyll forest. Emu, 107: 177–184.

SWC Wetland and Ecological Management Consultancy (1994). Pinny Beach Residential Development Stage 2. Flora and Fauna Assessment. Report to James Mullan Development Pty Ltd.

SWC Wetland and Ecological Management Consultancy (1996). Eleebana Local Squirrel Glider Study. Report to Lake Macquarie City Council.

The Glossy Black Conservancy. http://www.glossyblack.org.au/glossy_fact_sheet.html

Tunra and Fly By Night Bat surveys (1995). Pinny Beach Fauna study (including Wallarah Peninsula South). Report to Lake Macquarie City Council.

Woodward Clyde (2000). Conservation and Land Use Management Plan (CLUMP).

US Naval Observatory (2017) *Phases of the Moon*, accessed online at http://aa.usno.navy.mil/cgi-bin/aa_phases.pl?year=2016&month=11&day=1&nump=50&format=p in February 2017

Xstrata Coal (2014) *Sustainable Development Plan: Biodiversity Management Plan West Wallsend Colliery*, accessed online at http://www.westwallsendmine.com.au/EN/Publications/Subsidence%20Management%20Plans/LW4243%20Biodiversity%20Management%20Plan.pdf in February 2017

RPS (2014) *Subdivision and Urban Development at Catherine Hill Bay: flora and fauna management plan*, prepared by RPS Australia East Pty Ltd for Coastal Hamlets Pty Ltd. Accessed online at http://rosegroup.com.au/wp-content/uploads/2014/02/Flora-and-Fauna-Management-Plan-Final-CHB-EPBC-17-01-14.pdf in February 2017.

9.1 Experts consulted

The following fauna and flora experts were consulted throughout the preparation of this report:

Graeme Bradburn – orchids

John Young – Owls

Graham Errington RBG Seedbank – *Callistemon linearifolius*

Ross Goldingay – Squirrel Gliders – foraging and habitat

Glenn Hoye – Bats

Rod Van der Ree – Squirrel Gliders – trapping

Matthew Cameron – Glossy Black Cockatoo – diet and nesting

9.2 Personnel

The following personnel undertook surveys for this assessment:

Dr Jacqui Coughlan – Fauna and Flora

Brenton von Takach Dukai – Fauna and Flora

Dr. James Schlunke -Flora

Ryan Sims – Flora

Peter Stricker -Flora

Appendix A. Flora species recorded at subject site

Family	Scientific Name	Common Name
TREES		
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak
Apocynaceae	*Alstonia constricta*	Quinine Bush
Myrtaceae	*Angophora costata*	Sydney Red Gum
Myrtaceae	*Backhousia myrtifolia*	Grey Myrtle
Malvaceae	*Brachychiton populneus*	Kurrajong
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush
Myrtaceae	*Corymbia gummifera*	Red Bloodwood
Myrtaceae	*Corymbia maculata*	Spotted Gum
Lauraceae	*Cryptocarya glaucesens*	Jackwood
Lauraceae	*Cryptocarya microneura*	Murrogan
Lauraceae	*Cryptocarya subulata*	
Sapindaceae	*Diploglottis australis*	Native Tamarind
Elaeocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash
Celastraceae	*Elaeodendron australe*	Red fruited Olive Plum
Myrtaceae	*Eucalyptus capitellata*	Brown Stringybark
Myrtaceae	*Eucalyptus acmenoides*	White Mahogany
Myrtaceae	*Eucalyptus haemastoma*	Broad-leaved Scribbly Gum
Myrtaceae	*Eucalyptus paniculata*	Grey Ironbark
Myrtaceae	*Eucalyptus resinifera*	Red Mahogany
Myrtaceae	*Eucalyptus umbra*	Broad-leaved White Mahogany
Phyllanthaceae	*Glochidian ferdinandi*	Cheese Tree
Arecaceae	*Livistona australis*	Cabbage Palm
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree
Primulaceae	*Myrsine variabilis*	Muttonwood
Myrtaceae	*Syncarpia glomulifera*	Turpentine
Ericaceae	*Trochocarpa laurina*	Tree Heath
SHRUBS		
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally
Fabaceae (Mimosoideae)	*Acacia irrorata*	Green Wattle
Fabaceae (Mimosoideae)	*Acacia longifolia*	
Fabaceae (Mimosoideae)	*Acacia maidenii*	Maiden's Wattle
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses
Ericaceae	*Acrotriche divaricata*	
Asteraceae	**Ageratina adenophora*	Crofton Weed
Proteaceae	*Banksia spinulosa*	Hairpin Banksia
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush

Pittosporaceae	*Bursaria spinosa*	Native Blackthorn
Myrtaceae	*Callistemon linearifolius*	Netted Bottlebrush
Myrtaceae	*Callistemon linearis*	Narrow-leaved bottlebrush
Asteraceae	**Chrysanthemoides monilifera* ssp *rotundata*	Bitou Bush
Lamiaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum
Rubiaceae	*Cyclophyllum longipetalum*	Coast Canthium
Fabaceae	*Davesia ulicifolia*	Gorse Bitter Pea
Celastraceae	*Denhamia silvestris*	Narrow-leaved Orangebark
Fabaceae	*Dilllwynia retorta*	Eggs and Bacon
Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush
Ericaceae	*Epacris pulchella*	Wallum Heath
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart
Moraceae	*Ficus coronata*	Creek Sandpaper Fig
Sapindaceae	*Guioa semiglauca*	Guioa
Proteaceae	*Grevillea sericea*	Pink Spider Flower
Proteaceae	*Hakea dactyloides*	Finger Hakea
Dilleniaceae	*Hibbertia obtusifolia*	Hoary Guinea Flower
Myrtaceae	*Kunzea Bush*	Tick Bush
Verbenaceae	**Lantana camara*	Lantana
Proteaceae	*Lambertia formosa*	Mountain Devil
Myrtaceae	*Leptospermum polygalifolium*	Tantoon
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree
Ericaceae	*Leucopogon ericoides*	Pink Beard-heath
Ericaceae	*Leucopogon juniperinus*	Prickly Beard-heath
Ericaceae	*Leucopogon lanceolatus*	Lance -leaved Beard-heath
Myrtaceas	*Melaleuca linariifolia*	Snow in Summer
Myrtaceae	*Melaleuca sieberi*	
Picrodendraceae	*Micrantheum ericoides*	
Myrsinaceae	*Myrsine variabilis*	
Oleaceae	*Notelaea longifolia intermedia*	Large Mock-olive
Ochnaceae	**Ochna serrulata*	Mickey Mouse Plant
Asteraceae	*Olearia nernstii*	
Proteaceae	*Persoonia lanceolata*	Lance Leaf Geebung
Proteaceae	*Persoonia levis*	Broad-leaved Geebung
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung
Proteaceae	*Persoonia laurina*	Laurel Geebung
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge
Pittosporaceae	*Pittosporum multiflorum*	Orange Thorn
Pittosporaceae	*Pittosporum spinescens*	
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax
Rhamnaceae	*Pomaderris lanigera*	Woolly Pomaderris
Rhamnaceae	*Pomaderris elyptica*	
Fabaceae (Faboideae)	*Pultenaea daphnoides*	Large-leaf Bush-pea
Fabaceae (Caesalpinioideae)	**Senna pendula var. glabrata*	
Elaeocarpaceae	***Tetratheca juncea***	Black-eyed Susan
Thymelaeaceae	**Wikstroemia indica*	Bootlace Bush

Monimiaceae	*Wilkea huegliana*	Veiny Wilkea
VINES/CLIMBERS		
Asparagaceae	**Asparagus spp.*	
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry
Lauraceae	*Cassytha glabella*	Slender Devils Twine
Vitaceae	*Cayratia clematidea*	Native Grape
Vitaceae	*Cissus antarctica*	Kangaroo Vine
Vitaceae	*Cissus hypoglauca*	Giant Water Vine
Ranunculaceae	*Clematis aristata*	Old Man's Beard
Dioscoreaceae	*Dioscorea transversa*	Native Yam
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily
Luzuriagaceae	*Hibbertia aspera*	Trailing Guinea Flower
Dilleniaceae	*Hibbertia dentata*	Twining Guinea Flower
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower
Convolvulaceae	**Ipomoea purpurea*	Morning Glory
Caprifoliaceae	**Lonicera japonica*	Japanese Honeysuckle
Apocynaceae	*Marsdenia rostrata*	Milk Vine
Rubiaceae	*Morinda jasminoides*	Sweet Morinda
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine
Apocynaceae	*Parsonsia straminea*	Common Silkpod
Menispermaceae	*Sarcopetalum harveyanum*	Pearl Vine
Smilacaceae	*Smilax australis*	Lawyer Vine
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla
FERNS		
Adiantaceae	*Adiantum hispidulum*	Rough Maidenhair
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern
Pteridaceae	*Cheilanthes sieberi*	Rock Fern
Cyatheaceae	*Cyathea australis*	Rough Treefern
Blechnaceae	*Doodia aspera (=Blechnum neohollandicum)*	Prickly Rasp Fern
Lindsaeaceae	*Lindsaea linearis*	Screw Fern
Lindsaeaceae	*Lindsaea microphylla*	Lacy wedge fern
Adiantaceae	*Pellaea falcata*	Sickle Fern
Adiantaceae	*Pellaea paradoxa*	
Dennstaedtiaceae	*Pteridium esculentum*	Bracken
FORBS		
Acanthaceae	*Brunoniella pumilio*	Dwarf Blue Trumpet
Anthericaceae	*Caesia parviflora*	Pale Grass-lily
Commelinaceae	*Commelina cyanea*	Native Wandering Jew
Orchidaceae	*Cryptostylis erecta*	Tartan Tongue Orchid
Orchidaceae	*Cryptostylis subulata*	
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender Tick-trefoil
Fabaceae (Faboideae)	*Desmodium rhytidophyllum*	
Convolvulaceae	*Dichondra repens*	Kidney Weed
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine
Fabaceae (Faboideae)	*Glycine microphylla*	Small-leaf Glycine

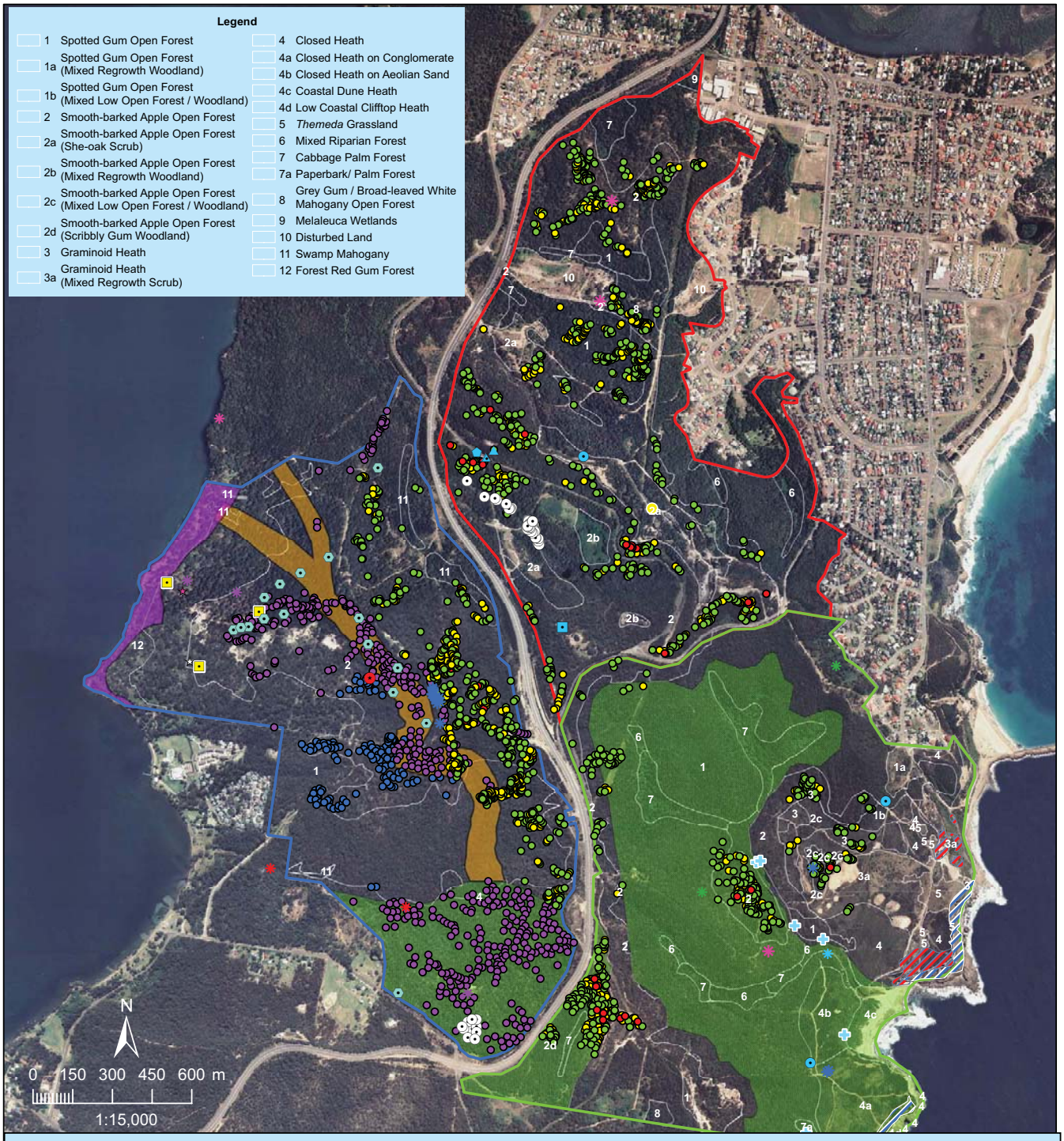
Dilleniaceae	*Hibbertia empetrifolia subsp. empetrifolia*	
Rubiaceae	*Opercula diphylla*	
Iridaceae	*Patersonia glabrata*	Leafy Purple-Flag
Iridaceae	*Patersonia sericea*	Silky Purple-Flag
Lamiaceae	*Plectranthus parviflorus*	
Lobeliaceae	*Pratia purpurascens*	Whiteroot
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower
Solanaceae	*Solanum prinophyllum*	Forest Nightshade
GRASSES		
Poaceae	*Aristida vagans*	Threeawn Speargrass
Poaceae	*Austrostipa pubescens*	Speargrass
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass
Poaceae	*Entolasia marginata*	Bordered Panic
Poaceae	*Entolasia stricta*	Wiry Panic
Poaceae	*Imperata cylindrica*	Blady Grass
Poaceae	*Microlaena stipoides*	Weeping Grass
Poaceae	*Oplismenus imbecillis*	
Poaceae	*Panicum simile*	Two-colour Panic
Poaceae	**Paspalum urvillea*	Vasey Grass
Poaceae	*Poa affinis*	
Poaceae	*Poa sieberiana*	
Poaceae	*Rytidosperma pallidum*	Redanther Wallaby Grass; Silvertop Wallaby Grass
Poaceae	*Rytidosperma fulva*	Wallaby Grass
Poaceae	*Themeda triandra*	Kangaroo Grass
GRAMINOIDS		
Cyperaceae	*Baumea juncea*	Twig Rush
Cyperaceae	*Carex appressa*	Tall Sedge
Cyperaceae	*Cyperus spp.*	
Cyperaceae	*Cyperus spp. 2*	
Phormiaceae	*Dianella caerulea var. producta*	Blue Flax-lily
Phormiaceae	*Dianella revoluta*	Blueberry Lily
Anthericaceae	*Dichopogon fimbriatus*	Nodding Chocolate Lily
Cyperaceae	*Gahnia spp.*	Saw-sedge
Cyperaceae	*Gahnia spp. 2*	Saw-sedge
Cyperaceae	*Gahnia clarkei*	Saw-sedge
Araceae	*Gymnostachys anceps*	Settler's Twine
Juncaceae	*Juncus continuus*	
Cyperaceae	*Lepidosperma laterale*	Variable Swordsedge
Cyperaceae	*Lepidosperma filiforme*	Common rapier-sedge
Restionaceae	*Lepyrodia scariosa*	
Lomandraceae	*Lomandra confertifolia subsp. rubiginosa*	Matrush
Lomandraceae	*Lomandra glauca*	Pale Mat-rush
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush
Lomandraceae	*Lomandra obliqua*	
Cyperaceae	*Schoenus melanostachys*	
Phormiaceae	*Thelionema caspitosum*	Tufted Blue Lily

ADDITIONAL SPECIES		
Asparagaceae	**Asparagus aethiopicus*	Asparagus Fern
Zamiaceae	*Macrozamia communis*	Burrawang
Xanthorrhoeaceae	*Xanthorrhoea macronema*	
Xanthorrhoeaceae	*Xanthorrhoea latifolia*	Forest Grass Tree

Appendix B. Threatened flora species previously recorded within a 10km radius of the site.

Common Name	Scientific Name	Conservation Status	
		TSC Act	EPBC Act
Callistemon linearifolius	Netted Bottle Brush	Vulnerable	
Angophora inopina	Charmhaven Apple	Vulnerable	Vulnerable
Eucalyptus camfieldii	Camfield's Stringybark	Vulnerable	Vulnerable
Eucalyptus oblonga	*Eucalyptus oblonga* population at Bateau Bay, Forresters Beach and Tumbi Umbi in the Wyong local government area	Endangered population	
Eucalyptus parramattensis subsp. *parramattensis*	*Eucalyptus parramattensis* C. Hall. subsp. *parramattensis* in Wyong and Lake Macquarie local government areas	Endangered population	
Acacia bynoeana	Bynoe's Wattle	Endangered	Vulnerable
Caladenia tessellata	Thick Lip Spider Orchid	Endangered	Vulnerable
Corybas dowlingii	Red Helmet Orchid	Endangered	
Cryptostylis hunteriana	Leafless Tongue Orchid	Vulnerable	Vulnerable
Diuris praecox	Rough Doubletail	Vulnerable	Vulnerable
Diuris bracteata		Endangered	EXTINCT
Genoplesium insigne	Variable Midge Orchid	Critically Endangered	Critically Endangered
Pultenaea maritima	Coast Headland Pea	Vulnerable	
Niemeyera white	Rusty Plum	Vulnerable	
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	Vulnerable	Vulnerable
Rutidosis heterogama	Heath Wrinklewort	Vulnerable	Vulnerable
Syzygium paniculatum	Magenta Lilly Pilly	Endangered	Vulnerable
Tetratheca juncea	Black-eyed Susan	Vulnerable	Vulnerable

Appendix C. *Tetratheca juncea* historical records of Conacher Travers.



Legend

Threatened Fauna

- Coastal Sector Boundary
- Lake Sector Boundary
- Northern Sector Boundary
- National Park Boundary
- Foreshore Reserve Boundary
- Habitat Corridor
- Large-eared Pied Bat (Dec. 2001
- Glossy Black-Cockatoo (2003) (Drinking/ Feeding/ Flyover)
- Eastern Freetail-bat (2001)
- Greater Broadnosed Bat (Oct. 2005)
- Yellow-bellied Sheath-tailed Bat (Oct. 2005)
- Eastern Bentwing-bat (Dec. 2005)
- Little Bentwing-bat (Sept/Oct 2005)
- Masked Owl (calling individual sighted - 2001)
- Masked Owl (individual sighted - 2003)
- Sooty Owl (2005)
- Powerful Owl (calling individual heard - 2001)
- Powerful Owl (calling individual sighted and heard - 2003)
- Powerful Owl (2004 - Observations)
- Powerful Owl (2005)
- Powerful Owl (2006)

Threatened Flora

- *Syzygium paniculatum* (2005 2006)
- *Callistemon linearifolius* population
- *Cryptostylis hunteriana*
- *Diuris praecox*
- *Pultenaea maritima* (Nov. 2004)
- *Pultenaea maritima x vilosa* (Nov 2004)
- 0 - 5 *Tetratheca juncea* Clumps (2006)
- 6 - 30 *Tetratheca juncea* Clumps (2006)
- 31 and above *Tetratheca juncea* Clumps (2006)
- Undifferentiated *Tetratheca juncea* Clumps (Sept 2003)
- Undifferentiated *Tetratheca juncea* Clumps (Sept 2004)

CONACHER TRAVERS

Bushfire & Environmental Consultants
Building 40, The Avenue, Mt. Penang Parklands,
Central Coast Highway, Kariong NSW 2250
Ph (02) 4340 0677 Fax (02) 4340 2367
e-mail: ecology@conachertravers.com.au

Figure 4 -
Threatened Species
Wallarah Peninsula

Ver.F4
07/08/07
Ref.No.6218

Source: Stockland Wallarah Peninsula

Appendix D. Fauna species recorded in Central Precinct, Northern Sector

Common Name	Scientific Name	Observation Type	Conservation Status	
			TSC Act	EPBC Act
BIRDS				
Falconidae				
Brown Falcon	*Accipiter fasciatus*	O		
Columbidae - Pigeons and Doves				
Wonga Pigeon	*Leucosarcia pictata*			
Bar-shouldered Dove	*Geopelia humeralis*	H		
Brown Cuckoo Dove	*Macropygia amboinensis*	O		
White-headed Pigeon	*Columba leucomela*	O		
Cuculidae – Cuckoos				
Fantail Cuckoo	*Cacomantis flabelliformis*	H		
Strigidae – Owls				
Powerful Owl	*Ninox strenua*	S	Vulnerable	
Podargidae – Frogmouths				
Tawny Frogmouth	*Podargus strigoides*	O		
Alcedinidae – Kingfishers				
Laughing Kookaburra	*Dacelo novaeguineae*	O/ H		
Sacred Kingfisher	*Todiramphus sanctus*	H		
Coraciidae – Rollers				
Dollarbird	*Eurystomus orientalis*	O/H		Marine
Eastern Koel	*Eudnamys orientalis*	H		
Cacatuidae – Cockatoos				
Sulphur Crested Cockatoo	*Cacatua galerita*	O		
Psittacidae – Parrots				
Rainbow Lorikeet	*Trichoglossus haematodus*	H		
Maluridae – Fairywrens				
Variegated Fairywren	*Malurus lamberti*	O		
Meliphagidae- Honeyeaters				
Red Wattlebird	*Anthochaera carunculata*	H		
Scarlet Honeyeater	*Myzomela sanguinolenta*	O		
Lewin's Honeyeater	*Meliphaga lewinii*	O		

Common Name	Scientific Name	Observation Type	Conservation Status	
			TSC Act	EPBC Act
Yellow Faced Honeyeater	*Lichenostomus chrysops*	O		
Noisy Friarbird	*Philemon corniculatus*	H		
Bell Miner	*Manorina melanophrys*	H		
Eastern Spinebill	*Acanthorhynchus tenuirostris*	O		
Pardalotidae – Pardalotes				
Spotted Pardalote	*Pardalotus punctatus*	O		
Acanthizidae – Thornbills and Allies				
Brown Gerygone	*Gerygone mouki*	O/H		
Striated Thornbill	*Acanthiza lineata*	O		
Brown Thornbill	*Acanthiza pusilla*	H		
White Browed Scrubwren	*Sericornis frontalis*	O		
Psophodidae – Whipbirds and Wedgebills				
Eastern Whipbird	*Psophodes olivaceus*	H		
Cracticidae – Bellmagpies and Allies				
Grey Butcherbird	*Cracticus torquatus*	H		
Pied Currawong	*Strepera graculina*	O		
Campephagidae – Cuckooshrikes				
Black-faced Cuckooshrike	*Coracina novaehollandiae*	O/H		Marine
Cicadabird	*Edolisoma tenuirostre*	H		Marine
Ptilonorhynchidae – Bowerbirds		H		
Satin Bowerbird	*Ptilonorhynchus violaceus*	H		
Estrildidae- Finches				
Red-browed Finch	*Neochmia temporalis*	O		
Rhipiduridae – Fantails				
Grey Fantail	*Rhipidura albiscapa*	H/O		
Rufous Fantail	*Rhipidura rufifrons*	H		
Leaden Flycatcher	*Myiagra rubecula*	O		
Corvidae – Crows, Jays and Magpies				
Australian Raven	*Corvus coronoides*	H/O		
Australian Magpie	*Cracticus tibicen*	O		
Petroicidae – Australasian Robins				

Common Name	Scientific Name	Observation Type	Conservation Status	
			TSC Act	EPBC Act
Eastern Yellow Robin	*Eopsaltria australis*	O		
Zosteropidae – White-eyes and Allies				
Silvereye	*Zosterops lateralis*	O		Marine
Dicaeidae – Flowerpeckers				
Mistletoebird	*Dicaeum hirundinaceum*	O		
Climacteridae – Treecreepers				
White-throated Treecreeper	*Cormobates leucophaea*	H		
Apodidae – Swifts and Swiftlets				
White throated Needletail	*Hirundapus caudacutus*	O/F		
Aegothelidae -				
Australian Owlet-nightjar	*Aegotheles cristatus*	H		
MAMMALS				
Bats				
White-striped Freetail Bat	*Austronomus australis*	A		
Eastern Freetail Bat	*Mormopterus ridei*	A		
Eastern Horseshoe Bat	*Rhinolophus megaphyllus*	A		
Gould's Wattled Bat	*Chalinolobus gouldii*	A		
Chocolate Wattled Bat	*Chalinolobus morio*	A		
Little Bent-wing Bat	*Miniopterus australis*	A	Vulnerable	
Large Bent-wing Bat	*Miniopterus oceanensis*	A	Vulnerable	
Greater broad-nosed Bat	*Scoteanax ruepelli*	A	Vulnerable	
Eastern Broad-nosed Bat	*Scotorepens orion*	A		
Little Forest Bat	*Vespadelus vulturnus*	A		
Unidentified long-eared bat	Nyctophilus sp.	A		
Grey-headed Flying Fox	*Pteropus poliocephalus*	O	Vulnerable	Vulnerable
Arboreal				
Brushtail Possum	*Trichosurus vulpecula*	O		
Ringtail Possum	*Pseudocheirus peregrinus*	O		
Sugar Glider	*Petaurus breviceps*	O		
Terrestrial				
Red Fox*	*Vulpes vulpes*	O		
Swamp Wallaby	*Wallabia bicolor*	O		

Common Name	Scientific Name	Observation Type	Conservation Status	
			TSC Act	EPBC Act
Black Rat*	*Rattus rattus*	O		
REPTILES				
Common Scaly Foot Legless Lizard	*Pygopus lepidopodus*	O		
AMPHIBIANS				
Eastern Dwarf Tree frog	*Litoria fallax*	H		

O= Observed
H = Heard.
S= Sign only, not seen or heard
F= Flyover
*introduced species

Appendix E. Threatened fauna species previously recorded within a 10km radius of the site.

Common Name	Scientific Name	Conservation Status	
		TSC Act	EPBC Act
BIRDS			
Barking Owl	*Ninox connivens*	Vulnerable	
Black Bittern	*Ixobrychus flavicollis*	Vulnerable	
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	Vulnerable	
Bush Stone-curlew	*Burhinus grallarius*	Vulnerable	
Eastern Bristlebird	*Dasyornis brachypterus*	Endangered	Endangered
Gang-gang Cockatoo	*Callocephalon fimbriatum*	Vulnerable	
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	Vulnerable	
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	Vulnerable	
Little Eagle	*Hieraaetus morphnoides*	Vulnerable	
Little Lorikeet	*Parvipsitta pusilla*	Vulnerable	
Masked Owl	*Tyto novaehollandiae*	Vulnerable	
Painted Honeyeater	*Grantiella picta*	Vulnerable	
Powerful Owl	*Ninox strenua*	Vulnerable	
Regent Honeyeater	*Anthochaera Phrygia*	Critically Endangered	Critically Endangered
Rose-crowned Fruit-Dove	*Ptilinopus regina*	Vulnerable	
Scarlet Robin	*Petroica boodang*	Vulnerable	
Spotted Harrier	*Circus assimilis*	Vulnerable	
Square-tailed Kite	*Lophoictinia isura*	Vulnerable	
Superb Fruit-dove	*Ptilinopus superbus*	Vulnerable	
Swift Parrot	*Lathamus discolor*	Endangered	Critically Endangered
Varied Sittella	*Daphoenositta chrysoptera*	Vulnerable	
White-fronted Chat	*Epthianura albifrons*	Vulnerable	
MAMMALS			

Bats			
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	Vulnerable	
Eastern Cave Bat	*Vespadelus troughtoni*	Vulnerable	
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	Vulnerable	
Eastern Freetail-bat	*Mormopterus norfolkensis*	Vulnerable	
Greater Broad-nosed Bat	*Scoteanax rueppellii*	Vulnerable	
Large-footed bat	*Myotis macropus*	Vulnerable	
Little Bentwing-bat	*Miniopterus australis*	Vulnerable	
Arboreal			
Eastern Pygmy-possum	*Cercartetus nanus*	Vulnerable	
Grey-headed Flying-fox	*Pteropus poliocephalus*	Vulnerable	
Koala	*Phascolarctos cinereus*	Vulnerable	
Squirrel Glider	*Petaurus norfolcensis*	Vulnerable	
Terrestrial			
Rufous Bettong	*Aepyprymnus rufescens*	Vulnerable	
Spotted-tailed Quoll	*Dasyurus maculatus*	Vulnerable	
AMPHIBIANS			
Green and Golden Bell Frog	*Litoria aurea*	Endangered	
Red-crowned Toadlet	*Pseudophryne australis*	Vulnerable	Vulnerable
Tusked Frog	*Adelotus brevis*	Endangered population in the Nandewar and New England Tableland Bioregions	Vulnerable
Wallum Froglet	*Crinia tinnula*	Vulnerable	

Appendix F. Assessments of Significance

INTRODUCTION

Section 5A of the *Environmental Planning and Assessment Act 1979* (EPA Act) states that in the administration of s78A, there are seven factors that must be taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats. Those factors are listed in part 2 of s5A and are known as a 7 part test. If a 7 part test concludes that a significant effect is likely on any of the above then the proponent is required to prepare a Species Impact Statement (SIS). Threatened species and habitat have the same meaning as in the *Threatened Species Conservation Act 1995* (TSC Act).

Under Section 4 of the TSC Act **"habitat"** means an area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community and includes any biotic or abiotic component.

The 7 part test aims to improve the standard of consideration afforded to threatened species, populations and ecological communities, and their habitats throughout the planning and assessment process and to ensure this consideration is transparent. Listed under the *Threatened Species Conservation Amendment Act 2002* (TSCA Act), the revised factors affect s5A EP&A Act, s94 *Threatened Species Conservation Act 1995* (TSC Act) and s220ZZ *Fisheries Management Act 1994* (FM Act).

The seven factors to be considered when determining whether an action, development or activity is likely to significantly affect a threatened species, population or ecological community, or their habitats, are addressed below for threatened species that have previously been recorded on or in the vicinity of the subject site or not recorded but required by LMCC to have the 7 part test applied. The subject site is the Wakefield Ashurst Developments (WAD) owned land proposed for development and known as the Central Precinct, Northern Sector, North Wallarah Peninsula. The study area is the same as the subject site in this case. Where reference is made to data from previous reports the relevant 'study area' is defined and referenced. In preparing this assessment the Threatened Species Assessment Guidelines (DECC 2007) (the TSA Guidelines) have been taken into account, as required under s 5A (1)(b) of the EPA Act.

Under the TSA Guidelines "A species does not have to be considered as part of the assessment of significance if adequate surveys or studies have been carried out that clearly show that the species:

- does not occur in the study area, or
- will not use on-site habitats on occasion, or
- will not be influenced by off-site impacts of the proposal.

Historical and current survey effort and results are compiled to demonstrate the adequacy of surveys or studies, in relation to the TSA Guidelines.

MICROBATS

Background

Anabat survey for this study recorded three threatened microbat species – all listed as Vulnerable under the TSC Act:

- Little Bent-wing Bat (cave roosting) *Miniopterus australis*
- Large Bent-wing Bat (cave roosting) *Miniopterus oceanensis*
- Greater Broad-nosed Bat (tree roosting) *Scoteanax rueppellii*

Greater Broad-nosed bats are tree roosting while the bent wing bats are cave roosting.

The Greater Broad-nosed Bat mainly occurs in gullies and river systems and is most common in tall wet forests. It forages along creek and river corridors, as well as open woodland habitat. Females of this species congregate in maternal tree hollows. There are seven records of this species within 10 km of the subject site according to the Atlas of Living Australia database. The species was not recorded across the majority of the site but was recorded at the waterbody, suggesting it is not relying on the habitats on site for foraging and roosting, but is utilising the onsite water source. The species was also recorded at the proposed compensatory waterbody confirming that suitable habitat for the species occurs at that location.

The highest amount of bat activity was recorded at the small water body in the south west of the site. This is an artificial water body created from a previous clay extraction pit. The pit contains uncontrolled fill which requires remediation as part of the project. The area will be re-modelled to form a detention basin for run off and water quality and will continue to provide a water resource for bats, although a smaller one. In addition, a dam situated immediately north of the site boundary on WAD owned land will be protected from future development to provide a continuing water resources.

All three species are protected in the WNP.

Microbats – tree roosting (TSC-V)

Two tree-roosting microbat species have been detected in the study area between 1995 and 2016; the Yellow-bellied Sheath-tailed bat (*Saccolaimus flaviventris*) and the Greater Broad-nosed Bat (*Scoteanax rueppellii*).

The Yellow-bellied Sheathtail-bat roosts in tree hollows or buildings, and even in burrows when trees are scarce. It forages high in most habitats for flying insects. Females congregate in maternity colonies in tree hollows.

There are no records of this species on the BioNet Atlas or the Atlas of Living Australia within 10km of the site. Conacher Travers (2007a; Figure 7) report a single record from the study site in 2001. TUNRA & FBN (1995) recorded it in the eastern section of WNP.

The Greater Broad-nosed Bat prefers moist gullies in mature coastal forest or rainforest and is most common in tall wet forests (taller than 20m). It generally roosts in eucalypt hollows but has also been found under loose bark on trees or in buildings. It hunts above or just below the tree canopy and preferring larger slower prey such as moths and beetles and hibernates in winter.

The species is known to forage along rows of trees lining creeks and the edges of patches of woodland in otherwise cleared paddocks (Churchill 1998). Females of this species congregate in maternal tree hollows.

There are seven records of this species within 10 km of the subject site according to the Atlas of Living Australia database.

The species was recorded at the dam in the west of the site in this study and in 2005 by Conacher Travers (2007a) near the northern boundary of the Precinct near the interchange. In 1995 it was recorded tentatively from a call at one site in ridgeline forest in the north of the Lake Sector (Swansea Valley 1) (ERM 1995). TUNRA & FBN (1995) recorded it at two sites in the eastern portion of WNP.

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

The proposal will remove roosting habitat including potential maternity roost habitat. Areas containing mature trees with hollows are likely to provide critical diurnal roost sites and maternity roost sites for these species (Hoye 1995). A dam which provides a drinking water resource which is important for pregnant and lactating bats will be removed.

However, significant impacts will be avoided because:

- Approximately 61 % of hollow-bearing trees on the site will be retained and all of the retained vegetation on site contains HBT suitable as roosting habitat for bats
- Hollow bearing tree removal will not be conducted when roost sites could potentially be occupied for winter hibernation or summer maternity roosts.
- An existing dam providing a drinking water resource is being protected as part of the project to ensure continuation of drinking water resource in the locality of the small dam in the west of the site that is being removed.
- The existing dam will not be drained during the breeding season of the bats (October to February) when lactating and pregnant females require more water.
- Conservation lands set aside as part of the project amount to 250 ha of forested habitat that will remain in perpetuity and continue to support local bat populations including containing hollow bearing trees.
- An ecologist will be present during tree felling to ensure any bats can be captured and relocated.

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

None of these threatened tree-roosting microbat species comprise endangered populations according to Part 2 of Schedule 1 of the TSC Act.

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

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

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

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

The proposal will remove 44ha of foraging, drinking and roosting habitat for these species. Approximately 61% of the hollow bearing trees on site will be retained. This habitat provides roosting and foraging habitat for tree-roosting microbats. At total of 21 ha of vegetation will be retained, including 4.1 ha where understorey vegetation is selectively thinned but trees are retained and will therefore continue to provide foraging and roosting habitat for microbats.

However, 250 ha of conservation lands containing valuable habitat have been set aside as part of the ongoing project and these bat species have been recorded in those conservation lands, including the Wallarah National Park. These reserved and undeveloped areas will continue to provide quality roosting and foraging habitat, including hollow-bearing trees, for microbats.

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

Riparian corridors across the site will be retained and vegetated connections to the eastern portion of Wallarah National Park will remain. Canopy connectivity will be maintained and there will be no barrier effect for these highly mobile bats.

Vegetated riparian corridor and ridgetop vegetation in the north east of the site will be retained, conserved and not developed.

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

The habitat to be removed provides potential foraging and diurnal and maternal roosting habitat (hollows) for tree-roosting microbat species. Loose bark can also be used by these species and is available throughout the proposal site and surrounding areas, although the dominant species on site are smooth barked. The loss of 44 ha of habitat due to the proposal is unlikely to affect the long-term survival of these microbats due to the abundance of similar habitat that is contiguous within the locality. In particular, these areas include Wallarah National Park, Foreshore Reserve, Habitat Corridor, Munmorah State Conservation Area, Lake Macquarie State Conservation Area, Glenrock State Conservation Area and more recently conserved lands added to these areas.

The species are mobile in their foraging habits and known to forage on edges, and small remnants and even isolated trees. Canopy trees and understory that will support insect populations will remain in 17 ha of retained vegetation.

For highly mobile species such as these bats, areas in which the canopy is retained will continue to provide foraging resources. All creeks will be protected with riparian buffers and no tall wet gully forest will be cleared as part of the project so foraging habitat for the Greater-Broad-nosed Bat is not threatened.

Given the extent of protected habitat both within the region (Wallarah National Park, Munmorah State Conservation Area, Lake Macquarie State Conservation Area), a very large amount of intact and conserved land supporting similar vegetation to that on site is available for foraging and roosting. So the life cycles of these wide-ranging and mobile species are unlikely to be affected such that a viable local population would be placed at risk of extinction.

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

No critical habitat according to Part 3 of the TSC Act would be adversely affected by the proposed works.

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

There are no recovery plans for the Yellow-bellied Sheath-tailed Bat or Greater Broad-nosed Bat. The Action Plan for Australian Bats provides recovery outlines for the Greater Broad-nosed Bat. Recommended actions relevant to the proposal include:

Greater Broad-nosed Bat

- Ensure protection of populations throughout the range of the species. For such a strategy to be successful, minimum viable population sizes and the area required for such populations need to be calculated.
- Carry out ecological research to determine:
    - habitat requirements;
    - roost and maternity site selection, particularly winter and maternity roosts in the northern, central and southern sections of its distribution;
    - the sensitivity of roosts to disturbance (for example during construction monitoring);
    - key foraging areas and to ascertain the effectiveness of current forestry management practices in protecting these areas.
    - population dynamics; and
    - threatening processes.

The proposal is unlikely to interfere with the actions of this action plan.

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

Key threatening processes (KTP) relevant to microbats include the following:

- Clearing of native vegetation
- Removal of hollow-bearing trees
- Removal of dead wood and dead trees

The clearing of native vegetation is considered a major contributor to the loss of biodiversity. In the determination, the NSW Scientific Committee found that 'clearing of any area of native vegetation, including areas less than two hectares in extent, may have significant impacts on biological diversity'.

The proposal does involve vegetation clearing, however clearing is done in a selective and staged manner retaining hollow bearing trees identified for their habitat value. Much of the site has been previously cleared and degraded and now supports regrowth vegetation that is too young to have developed hollows. However, of the 149 hollow bearing trees recorded on the site 62% will be retained. In addition, within the 17 ha of vegetation surrounding the development that will be retained intact, hollow bearing trees within certain development envelopes and managed areas will also be retained. Thus, the impact of the KTP in terms of loss of foraging and roosting habitat has been minimised as much as possible. Additionally, the transfer of 174.7 ha of land to National Parks in the WNP offset area has prevented the loss of a further 174.7 ha of vegetation that now has long term security.

Dead trees (stags) and dead wood that occur within the proposal site would be removed or temporarily disturbed (during relocation and subsequent settling) as part of the proposed works. This has the potential

to impact microbats through the removal of roosting and breeding habitat. The presence of scattered dead trees and wood in surrounding bushland means that the removal of dead wood within the proposal site is unlikely to have a significant impact on any threatened species.

Conclusion

The proposal unlikely to have a significant effect on these species of microbats because:

1) 61% of HBT on site will be retained.
2) Moist forest with rainforest elements occurs in the riparian forest in the east of the site (Plains Gully), and in the WNP
3) Another water resource has been identified and will be protected from further development. To ensure a continuing drinking water supply
4) Riparian areas will be retained and protected
5) Cats will be prohibited
6) Light spill into forested areas will be controlled
7) The 174.7 ha WNP containing suitable foraging and roosting woodland habitat for these species is adjacent to the subject site and large conservation areas further south
8) Mitigation measures (a 2-stage clearing process) have been put in place to prevent loss of individuals, and this process has been proven successful for microbats on previously cleared areas of the lake sector.

Therefore, a Species Impact Statement is not required

Microbats – cave roosting (TSC-V)

Two species of cave-roosting microbats have been detected in the study area between 1995 and 2016; the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) and the Little Bentwing-bat (*Miniopterus australis*).

The Eastern (Large) Bentwing-bat roosts in maternal caves during spring and summer but also uses derelict mines, storm-water tunnels, buildings and other man-made structures in winter months. This species forages for flying insects above forested and woodland canopies. Females congregate in large maternity colonies at specific sites of high temperature and humidity and will travel large distances between roost sites (Hoye 1995). There are no known maternity colonies in the Hunter-Central Rivers CMA. There are 15 records for this species within 10 km of the site according to the Atlas of Living Australia database. The species was recorded during the current study with confidence at two sites and from a possible call at the dam in in the west of the site. Conacher Travers (2007a, Figure 7) recorded the species in December 2005 close to the southern boundary of the Precinct.

The Little Bentwing-bat is generally found in well-timbered areas, including rainforest, wet and dry sclerophyll forests, *Melaleuca* swamps and coastal forests (Churchill 1998). Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. Only five nursery sites /maternity colonies are known in Australia. It is possible that there are sea caves or man-made structures such as stormwater drains in the locality which are being utilised as roosting sites. According to bat expert Glenn Hoye (*pers. comm.)* there is only one record of the species roosting in trees and it is not known how prevalent this practice is.

There are 24 records of this species within 10 km of the proposal site according to the Atlas of Living Australia database. The Little Bentwing Bat was recorded on site by EcoFocus in surveys for this report. Conacher Travers (2007a, Figure 7) recorded the species in 2005 in the northern part of the northern sector, immediately north of the site and in the WNP (Conacher Travers 2007b).

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

There are no caves, derelict mines, or other man-made structures within the subject site that are likely to provide breeding and/or roosting habitat for these microbat species so the species is unlikely to be roosting on site. It is likely that these species utilise the site as foraging habitat, and roosting habitat outside the breeding season. As such, the proposal is unlikely to have an adverse effect on the life cycle of these species such that a viable local population would be placed at risk of extinction.

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

Not applicable

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

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

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

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

Approximately 44ha of vegetation will be removed while 17 ha will be retained. An additional 4 ha comprises managed vegetation in which canopy trees, including HBT will be retained. Approximately 61% of HBT on the site will be retained.

No caves, derelict mines or other man-made structures occur within the subject site. The woodland habitat may provide foraging habitat, and roosting habitat outside of the breeding season, for these species of microbats. The Wallarah National Park is part of 250 ha of conservation lands that have been set aside as part of the ongoing project. So large areas of continuous forested habitat will remain to provide foraging habitat.

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

Micro bats are highly mobile and travel large distances to forage so populations within the Wallarah National Park will be able to utilise the vegetation that remains on site in riparian corridors and buffer zones in Area B. A compensatory wetland habitat is provided to the immediate north of the site to ensure drinking resources remain accessible.

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

The habitat to be removed from the proposal site provides potential foraging and occasional roosting habitat for cave-roosting microbat species.

Approximately 44 ha of vegetation will be removed while 17 ha will be retained and 4 ha will comprise managed vegetation in which the canopy trees, including HBT will be retained. Approximately 61% of HBT on the site will be retained.

The loss of 44ha of habitat due to the proposal is unlikely to affect the long-term survival of these microbats due to the abundance of similar habitat that is occurs within the locality including Wallarah National Park, Munmorah State Conservation Area, and Lake Macquarie State Conservation Area.

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

No critical habitat according to Part 3 of the TSC Act would be adversely affected by the proposed works.

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

There are no recovery plans for the Eastern Bentwing-bat or Little Bentwing-bat. A Species Action Statement has been developed for EBB. Actions pertain to protection of important cave sites. No cave sites will be impacted by the proposed development.

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

Key threatening processes (KTP) relevant to microbats include the following:

- Clearing of native vegetation
- Removal of hollow-bearing trees
- Removal of dead wood and dead trees

The clearing of native vegetation is considered a major contributor to the loss of biodiversity. In the determination, the NSW Scientific Committee found that 'clearing of any area of native vegetation, including areas less than two hectares in extent, may have significant impacts on biological diversity'.

The proposal does involve vegetation clearing, however clearing is done in a selective and staged manner retaining hollow bearing trees identified for their habitat value. 61% of all HBT on site will be retained. Thus, the impact of the KTP in terms of loss of foraging and roosting habitat has been minimised as much as possible, and to a much greater extent than most residential developments. Additionally, the transfer of 174.7 ha of developable land to NSW National Parks in the WNP offset area has prevented the loss of a further 174.7 ha of vegetation that now has long term security.

Dead trees (stags) and dead wood that occur within the proposal site would be removed or temporarily disturbed (during relocation and subsequent settling) as part of the proposed works. This has the potential to impact microbats through the removal of roosting and breeding habitat. The presence of scattered dead trees and wood in surrounding bushland means that the removal of dead wood within the proposal site is unlikely to have a significant impact on any threatened species.

Conclusion

The Assessment of Significance has concluded that the proposed works are not likely to significantly affect cave-dwelling microbats such that a local population would be placed at risk of extinction because:

1. habitat at the site is likely to comprise mostly foraging habitat, and only occasional roosting habitat for some species
2. suitable breeding habitat does not occur on the site (caves, mine shafts, etc.),
3. the populations are unlikely to be limited to proposed clearing areas
4. the area of vegetation to be removed is small (44 ha) relative to the more than 250 ha of conserved habitat available for foraging bats in the vicinity of the project site.
5. mitigation measures that are proven to work will be put in place to prevent loss of individuals.
6. Both species of Bentwing bat recorded on site are confirmed as occurring in the Wallarah National Park which provides 174.7ha of protected habitat as a conservation outcome of the project.

A Species Impact Statement is not required.

References

Conacher Travers (2007a). Ecological site survey report - coastal and northern sectors, Wallarah Peninsula. Report prepared for Stockland,

Conacher Travers (2007b). Environmental Audit Report Wallarah Peninsula Lakes, Coastal and Northern Sectors. Report prepared for Stockland.

ERM Resource Planning (1995). Fauna Impact Statement for Lakeside Sector including Stages 2B & 3D Pinny Beach. Report prepared for James Mullan Developments Pty Ltd.

Hoye, G (1995). Report on a survey of the bat fauna of the lakeside sector of the proposed Pinny Beach development Near Cams Wharf, New South Wales. Appendix C to ERM Resource Planning (1995). Fauna Impact Statement for Lakeside Sector including Stages 2B & 3D Pinny Beach. Report prepared for James Mullan Developments Pty Ltd.

SWC Wetland and Ecological Management Consultancy (1994). Pinny Beach Residential Development Stage 2. Flora and Fauna Assessment. Report to James Mullan Development Pty Ltd.

Tunra and Fly By Night Bat surveys (1995). Pinny Beach Fauna study (including Wallarah Peninsula South). Report to Lake Macquarie City Council.

POWERFUL OWL

Background

A Powerful Owl roost site was identified in the north east of the site adjacent the existing Caves Beach settlement during EcoFocus surveys in January 2017. Whitewash, a pellet and a small feather were found in a small drainage line while an adult feather was found to its east near a large Spotted Gum with a large hollow. The whitewash, pellet and feather found in January 2017 were probably of a young owl dispersing from its natal territory, possibly a young from one of the two breeding pairs known from the Wallarah Peninsula (nghenvironmental 2012).

A subsequent inspection by John Young in May 2018 identified two recently used roost trees within the riparian vegetation of the creek line to the immediate east of the small drainage line and the Spotted Gum. Based on the amount of whitewash under the trees he concluded that the roost sites had only be used temporarily and were not a regular roost site. He considered that the habitat was clearly suitable for Powerful Owls, had been used by them in 2017 and 2018, and would probably continue to be used in the future.

During the breeding season Powerful Owls will roost in dense vegetation close to the nest tree, while outside of the breeding season the owls will utilise several different roost sites more distant from the nest site.

The following protections have been put in place for the Powerful Owl roosting habitat:

- The entire Lot 400 (future Lot 1) to be protected in community association title
- A minimum separation distance of 60 m from the closest recorded roost site to the nearest vegetation clearing
- A separation of 112 m from the eastern most recorded roost sites to the nearest vegetation clearing.
- Retention of numerous hollow bearing trees within the owl buffer that will provide habitat for both the owls and their prey.
- Lighting will be directed away from owl habitat (specifically Lots 401 to 415 must not have bright lighting facing toward the owl buffer) and street lighting must be placed so as to avoid light throw into the bushland in the vicinity of the owl habitat).
- Cats will be prohibited from the entire development
- No dogs to be allowed on Lots 402, 405 and 415 adjacent the owl buffer.
- One dog only permitted on lots 401,403,404,406-414 within restricted development envelope type 1 which essentially keeps the dogs in and around the house and not in the lower rear yards.
- Dogs to be on leashes in public areas.
- Informative signage will be placed in prominent locations on the development boundary with the owl habitat and retained vegetation to notify residents of the sensitive environment/threatened species habitat and the need to minimise noise and disturbance.
- The proposed perimeter road is community title, will be gated and does not cater for individual lot access. It is located to provide emergency bushfire access only. The design of the road (edged with retaining walls and batters and well separated from public roads and building envelopes means that additional fencing to the edge of the retained vegetation to prevent access is not warranted.

In addition, placement of Road no. 26 and associated retaining walls mean that there is an effective 'hard boundary' between the owl habitat and the development. The height of the retaining walls will be a deterrent to human access and this will assist in reducing disturbance to this area.

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

No breeding site/nest tree was identified but several hollow bearing trees with hollows of suitable size for Powerful Owls were identified and these will be retained and protected. Roost sites that have been most likely used by dispersing juveniles will be entirely protected within a 10.8 ha area of retained Spotted Gum Open Forest and riparian vegetation.

Thus, no adverse effect on the life cycle of the Powerful Owl is likely to result from the proposed action.

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

Not applicable.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

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

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

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

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

The proposal involves the removal of 44 ha of vegetation including potential foraging and roosting habitat for Powerful Owls. No breeding or roosting habitat for the owls will be removed. No evidence of breeding activity or permanent presence of owls was found.

The roosting habitat in the gullies will be retained and protected within the 10.8 ha of retained vegetation in the east of the site. The retained vegetation supports numerous hollow bearing trees that will support Powerful Owl prey species such as brush tailed possums, common ringtail possums, sugar gliders and birds. In addition, 61% of all hollow bearing trees identified across the site will be retained.

Important roosting habitat will be protected within the riparian vegetation of Plains Gully. This minimises "the extent to which habitat is likely to be removed or modified as a result of the action proposed".

The Wallarah National Park provides 174 ha of foraging habitat within 800 m south of the site.

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

No critical habitat is listed on the critical habitat register for the Powerful Owl.

(f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

The DECC (2006) Recovery Plan for Large Forest Owls identifies eight overall objectives each with a number of priority actions within it.

Objective 1*: Assess the distribution and amount of high quality habitat for each owl species across public and private lands to get an estimate of the number and proportion of occupied territories of each species that are, and are not, protected.*

Objective 2*: To monitor trends in population parameters (numbers, distribution, territory fidelity and breeding success) across the range of the three species and across different land tenures and disturbance histories.*

Objective 3: *To assess the implementation and effectiveness of forest management prescriptions designed to mitigate the impact of timber-harvesting operations on the three owl species and, (if necessary), to use this information to refine the prescriptions so that forestry activities on state forests are not resulting in adverse changes in species abundance and breeding success.*

Objective 4: *Ensure the impacts on large forest owls and their habitats are adequately assessed during planning and environmental assessment processes.*

Objective 5: *Minimise further loss and fragmentation of habitat by protection and more informed management of significant owl habitat (including protection of individual nest sites).*

Objective 6: *To improve the recovery and management of the three large forest owls based on an improved understanding of key areas of their biology and ecology.*

Objective 7: *To raise awareness of the conservation requirements of the three large forest owls amongst the broader community, to involve the community in owl conservation efforts and in so doing increase the information base about owl habitats and biology.*

Objective 8: *To coordinate the implementation of the recovery plan and continually seek to integrate actions in this plan with actions in other recovery plans or conservation initiatives.*

Strategic planning for the development of the Northern Sector has involved peninsula wide surveys to identify the location of breeding pairs of owls and key roosting and nesting habitat and set project, site based and specific recommendations to inform management. Such areas that occur on WAD owned land have been protected. The project has also resulted in major new additions to the conservation reserve system with the dedication of the 174.7 ha WNP, and the onsite conservation reserve system comprising of high quality linked vegetation, as well as significant conservation lands further south across the wider peninsula.

So the project is consistent with and contributing to the objectives as relevant to this project and land tenure, particularly Objectives 1 and 4.

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

Key threatening processes (KTP) relevant to Powerful Owls include the following:

- Clearing of native vegetation
- Removal of hollow-bearing trees

The clearing of native vegetation is considered a major contributor to the loss of biodiversity. In the determination, the NSW Scientific Committee found that 'clearing of any area of native vegetation, including areas less than two hectares in extent, may have significant impacts on biological diversity'.

The proposal does involve vegetation clearing, however clearing is done in a staged manner retaining 61% of hollow bearing trees identified across the site. In addition to the 17 ha of retained vegetation across the site, canopy trees will be retained within 4 ha of managed vegetation. Hollow bearing trees will be retained within some development envelopes, managed areas, retained vegetation and riparian areas. Thus, the impact of the KTP in terms of loss of foraging and roosting habitat has been minimised as much as possible, and to a much greater extent than most residential developments. Additionally, the transfer of 174.7 ha of developable land to National Parks in the WNP has prevented the loss of a further 174.7 ha of vegetation that now has long term security.

Conclusion

The project is unlikely to have an adverse effect on any aspect of the ecology and behaviour of the Powerful Owl that would place it at risk of extinction because:

- Non-breeding season roosting habitat will remain in the form of three gullies and their riparian vegetation zones and will be protected within 10.8 ha of intact Spotted Gum Open Forest.
- The 10.8 ha of vegetated lands to be protected also support habitat for owl prey species such as possums and gliders.
- The entire Lot 400 will be transferred to community association land
- No dogs will be allowed in certain Lots adjacent the retained lands, as identified in the report.
- Owl foraging habitat is provided in the 174 ha Wallarah National Park the to the immediate south of the site
- The retained vegetation areas on the site and the Wallarah National Park contributes to the security of foraging resources for the species in the long term.

A Species Impact Statement is not required.

References

Department of Environment and Conservation (NSW) (2006). NSW Recovery Plan for the Large Forest Owls: Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*) DEC, Sydney.

nghenvironmental (2012). Threatened Owl Nest Sites and Habitat - Stockland land holdings. North Wallarah Peninsula. Report prepared for Stockland Developments.

Soderquist and Gibbons (2007). Home-range of the Powerful Owl (*Ninox strenua*) in dry sclerophyll forest. *Emu*, 2007, **107**, 177–184.

MASKED OWL

Background

Comprehensive surveys of threatened owl nests sites and habitat were undertaken across the Wallarah Peninsula by owl expert John Young over two years during the owl breeding season of April to June 2010 and April to July 2011. Survey results and management recommendations were detailed in the report 'Threatened Owl Nests Sites and Habitat' (nghenvironmental 2012). The purpose of the surveys was to provide detailed and comprehensive information of the location of resident owls and to confirm nest sites as required by condition 51(d) of Development Consent DA /1297/2009 (Stage 14). This information was also to be used to inform future planning of all NWP land holdings and was provided in a report to LMCC. Those surveys identified three breeding pairs of Masked Owls as follows (nghenvironmental 2012):

Pair	Location	Distance and Direction from Central Precinct, Northern Sector
Masked Owl Pair 1	Lake Sector, Stage 14	1.5 km
Masked Owl Pair 2	Wallarah National Park (east of Pacific Hwy)	700 m
Masked Owl Pair 3	Northern Precinct, Northern Sector	1.3 km

In relation to the Pair 2 (Wallarah National Park), the report stated that 'The centre of this pair's territory is well south of southern section of the Northern Sector of Stockland land and deep within the Wallarah National Park. Given the location of the nest and roost habitat within the National Park, and the substantial vegetated lands to the south, John Young considers that the pair is highly unlikely to be affected by any development in the southern Northern Sector, should it occur".

It should be noted that the land forming the Wallarah National Park was dedicated to NPWS in 2003 for conservation purposes by the previous landowner Lensworth as a direct conservation outcome for the North Wallarah Peninsula development. The purpose of that land dedication was to protect habitat for threatened species known or predicted to occur in the area (which included the Masked Owl), and in recognition of the development that was to proceed north of the now National Park. The boundaries of the dedicated lands were decided following detailed habitat and vegetation analysis for threatened species and abundance of hollow bearing trees. Mr Young has expressed expert opinion, following search efforts in 2009, endorsing that the National Park is extremely well sited from a habitat perspective for Masked Owls.

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

Masked Owls breed annually between March and September peaking in May to July. The distinctive courtship behaviour can begin as early as February. The birds nest in large hollows of old eucalypts. The nest hollow is typically greater than 40 cm wide and greater than 100 cm deep. There is no relationship with distance to streams (DECC 2006). Roosting hollows can also be used as nest sites and are usually located in dense forested gullies. Caves and cliffs are also used as roost sites. A pair is faithful to a nesting hollow but may also use alternative breeding hollows in the territory in different years (DECC 2006 quoting data from various sources; John Young *pers. comm*.).

No Masked Owl breeding habitat is being removed from the Central Precinct and the proposed development will not impact on breeding habitat of the three known pairs of Masked Owl on the Wallarah Peninsula. It is thus highly improbable that the proposed development will have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

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

Not applicable

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

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

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

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

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

Approximately 44 ha of vegetation will be cleared and approximately 21 ha of vegetation will be retained.

No breeding or roosting habitat for Masked Owls will be removed. It is possible the Masked Owls would utilise habitat on the site as part of their broader foraging home range. Home range has been estimated as 400-1000 ha according to habitat productivity; measured as 1100 ha for one adult female of a resident pair in the non-breeding season, in bushland fragmented by suburban and semi-rural developments (Kavanagh and Murray 1996).

The Masked Owl is a specialist predator of terrestrial mammals, particularly native rodents. Small Dasyurids are also important prey in forests; introduced rodents and rabbits are important in disturbed areas. The diet is supplemented by bandicoots, arboreal mammals (Sugar Glider, Common Ringtail Possum), and some birds. It forages by hunting from perches at or near ground level on the forest edge, in woodland or in open country.

Within a 2km radius of the site there is significantly more than 500 ha of potential Masked Owl foraging habitat. On the proposal site itself, an area of 10.8 ha of vegetation is being retained in the east of the site and supports habitat for Masked Owl prey species. In addition, 61% of all hollow bearing trees on the site will be retained, providing important prey species habitat.

No Masked Owl breeding sites have been located on the site and no one of the alternate hollow bearing tree resources identified by John Young (nghenvironmental 2012) are located on the site.

No breeding or roosting habitat for the Masked Owl will be fragmented or isolated as a result of the proposal.

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

No critical habitat has been declared for this species.

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

The DECC (2006) Recovery Plan for Large Forest Owls identifies eight overall objectives, each with a number of priority actions within it. Table below outlines recovery actions to which Stockland intend to contribute through this project and which we recommend be drafted into development consent conditions.

Table 4 Recovery Actions for Large Forest Owls

Recovery Plan Objective	Recovery Plan Objective details	Wakefield Ashurst Developments Response
Objective 1	Model and map owl habitat and validate with surveys.	Completed by the previous landowner Stockland and information continues to be used to inform the development and design process.
Objective 2	Monitor Owl population parameters (numbers, distribution, territory fidelity and breeding success).	The Community Association is continuing to monitor the post development breeding success and territory fidelity of the Stage 14 breeding pair of Masked Owls.
Objective 3	Audit Forestry Prescriptions.	LMCC Large Forest Owl Guidelines have been addressed.
Objective 4	Ensure the impacts on large forest owls and their habitats are adequately assessed during planning and environmental assessment processes.	Peninsula wide surveys have been conducted for large forest owls to ensure the location of breeding pairs and their key resources are known and impacts to them can be avoided. This information has been used to inform planning. There are no Masked Owls or their key breeding and roosting resources on the subject site.
Objective 4.2	Monitor and report on the effectiveness of concurrence and licence conditions that have previously been applied to reduce the impacts of developments on the three large forest owl species or their habitats. This involves post-development monitoring.	The Community Association is continuing the post development monitoring commenced by Stockland in accordance with the consent conditions for the Stage 14 project. Monitoring reports are provided annually to LMCC.
Objective 5.	Minimise further loss and fragmentation of habitat by protection and more informed management of significant owl habitat (including protection of individual nest sites).	A significant contribution to protection of Masked Owl habitat was made with the dedication of the 174,7 ha Wallarah National Park which supports a known pair and numerous high quality nesting and roosting resources. The nest site on Stage 14 is protected within a 50 m radius buffer zone. Buffer areas have been identified in the vicinity of the MO pair in the Northern Sector that will be

Recovery Plan Objective	Recovery Plan Objective details	Wakefield Ashurst Developments Response
		implemented should the Northern Sector be developed in the future.
Objective 5.3	Encourage private landholders to undertake management options to conserve and/or actively manage large forest owl habitat (and particularly nest sites) through incentive Property Vegetation Plans, Voluntary Conservation Agreements or other management initiatives.	This has been actioned since the original conceptual planning stages by provision of extensive forest conservation areas and connective corridors throughout the Lake Sector and most notably the conservation by the developer of the Wallarah National Park (174 ha).
Objective 6	Undertake research on key areas of biology and ecology including trialling nest boxes for owls and their prey.	The Community Association is continuing the post-development monitoring including monitoring of nest box use at Stage 14.
Objective 6.1	Seek an ARC Linkage grant or other joint funding opportunity to initiate research into identified key areas of the biology and ecology of the large forest Owls.	n/a
Objective 7	Increase Community Awareness and involvement in owl conservation.	WAD to consider future possibilities for raising community awareness.

Thus, the development is consistent with and actively addresses the objectives and actions of the relevant recovery plan and will contribute significantly to achieving those objectives as they relate to Masked Owls.

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

A key threatening process is defined in the *TSC Act* (1995) as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities.

Key threatening processes relevant to the proposal include:

- clearing of native vegetation
- loss of hollow-bearing trees

The removal of native vegetation on the subject site is not likely to significantly affect the Masked Owl due to the extent of vegetation to be retained, large areas of natural vegetation within the local area; all of which has been validated in the biodiversity strategy (CLUMP 2000 and ESMP 2003). More than 500ha of potential foraging habitat occurs within a 2km radius of the site.

The main threat to this species is likely to be the clearing of forest for agriculture and intensive logging (Garnett 2000) which remove old trees containing suitable nesting hollows. In addition, the vigorous regrowth following logging is thought to limit foraging habitat availability.

The majority (61%) of hollow bearing trees identified on the site will be retained. None of these have been identified as Masked Owl roost or nest trees either historically, or during surveys for the Central Precinct impact assessment.

Extensive survey and detailed planning have ensured that known alternative nest and roost trees for Masked Owls are protected. No HBT suitable for Masked Owls will be removed as a result of the project and in fact approximately 90 HBT will be retained. This tree retention ensures prey populations will persist in the vicinity of the known Masked Owl pairs.

Therefore, the development will not exacerbate any of threatening processes to the extent that they will impact on any of the three Masked Owls pairs identified as occurring on the Wallarah Peninsula.

Conclusion

Based on the information presented in this document and the assessment against the Section 5A heads of consideration, it is considered unlikely that the proposed development in the Central Precinct, Northern Sector will have a significant effect on the local Masked Owl population. Further, this report concludes that it is highly unlikely that the proposed development will have an adverse effect on the life cycle of the species such that the local population of the Masked Owls is placed at risk of extinction.

This is in view of the following key facts:

- No breeding or roosting habitat for Masked Owls is being removed
- Foraging habitat is being retained on site including hollow bearing trees that support prey species for Masked Owls.
- The project will entail the loss of 44 ha of potential foraging habitat (although much is disturbed regrowth that may not support large mammal populations) for a species that forages over thousands of hectares.
- In a landscape context, more than adequate habitat resources are protected for a Masked Owl pair in the North Wallarah Peninsula area, with some 400 ha of forested habitat protected by various conservation zonings or riparian protection.

References

Department of Environment and Conservation (NSW) (2006). NSW Recovery Plan for the Large Forest Owls: Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*) DEC, Sydney.

nghenvironmental (2010). Masked Owl Discussion Paper and 7 Part Test. Stage 14 North Wallarah Peninsula. Report prepared for Stockland.

nghenvironmental (2012). Threatened Owl Nest Sites and Habitat - Stockland land holdings. North Wallarah Peninsula. Report prepared for Stockland Developments.

Kavanagh, RP and Murray M (1996). Home Range, Habitat and Behaviour of the Masked Owl *Tyto novaehollandiae* near Newcastle, New South Wales. *Emu:* 96: 250-257.

LITTLE LORIKEET

Background

The range of the Little Lorikeet extends along the east coast of Australia from Cape York in the north to South Australia and is found as far west as Dubbo and Albury. This species is somewhat nomadic being influenced by season and food availability. Higher productivity in riparian areas can attract this species through a higher abundance of food availability and they generally forage in the canopy of Eucalypts, Angophoras and Melaleucas. However, this species does not solely rely on those areas of high food abundance as isolated trees can help sustain a population.

Little Lorikeets nest in hollow-bearing trees with openings as small as 3cm anywhere from 2-15 m from the ground in smooth-barked Eucalypts in proximity to feeding areas. Roost locations are in treetops not necessarily in proximity of feeding areas. Preferred sites for nesting may be a limiting factor. Nesting occurs from May to September. This species is gregarious, travelling and feeding in flocks, often with other Lorikeets. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes.

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

Little Lorikeets were not recorded during bird surveys in the Central Precinct but have been recorded elsewhere on the Peninsula (approved Stage 14 and 13C). However, the species is highly mobile in its foraging habits and known to forage on edges, and small remnants and even isolated trees. Thus the site provides, and will retain, foraging habitat in the form of flowering eucalypts.

The proposal will remove 44 ha of vegetation and retain 17 ha. The majority of retained vegetation is Spotted Gum Ironbark Forest that will continue to provide foraging resources for the species. An additional 4 ha will comprise managed vegetation in which canopy trees will be retained and continue to provide hollows and flowering resources. Wallarah National Park to the immediate south and south west of the site supports 174 ha of habitat suitable for the Little Lorikeet, as do other conservation reserved lands further south. 61% of hollow bearing trees on the site will be retained.

Thus, substantial habitat suitable for the Little Lorikeet for foraging, roosting and nesting is being retained. It is therefore unlikely that the action proposed would have an adverse effect on the life cycle of the species such that a viable local population would be placed at risk of extinction.

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

Not applicable.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

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

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

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

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

The proposal involves the removal of an area of 44 ha of vegetation and the retention of 21 ha of vegetation (including 61% of hollow bearing trees on the site). This includes flowering eucalypts that would provide an occasional foraging resource for Little Lorikeets.

Retention of habitat and habitat linkages have been incorporated into the design of the development. This minimises "the extent to which habitat is likely to be removed or modified as a result of the action proposed". The species is highly mobile so the proposal will not fragment the existing available foraging habitat on the Peninsula. Habitat trees bearing hollows have been preferentially retained as part of the development (see response to **a)**).

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

No areas of critical habitat have been declared for the Little Lorikeet at the time of writing this report.

(f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

There is no recovery plan for the Little Lorikeet at the time of writing this report.

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

Key threatening processes relevant to the proposal in relation to the Little Lorikeet are:

- Clearing of native vegetation
- Loss of hollow-bearing trees
- Removal of dead wood and dead trees.

The clearing of native vegetation is considered a major contributor to the loss of biodiversity. In the determination, the NSW Scientific Committee found that 'clearing of any area of native vegetation, including areas less than two hectares in extent, may have significant impacts on biological diversity'. Clearing can lead to direct habitat loss, habitat fragmentation and associated genetic impacts, habitat degradation and off-site impacts such as downstream sedimentation. This proposal will clear 44 ha of Vegetation that provides potential forging habitat for Little Lorikeets. However the majority of the vegetation to be removed is Smooth barked Apple Open Forest, while the majority of the retained vegetation is Spotted Gum Ironbark Forest supporting a diversity of flowering Eucalypts as well as hollows suitable for breeding (61 % of which will be retained).

The Wallarah National Park (immediately south and south west of the subject site), dedicated as an offset for this project, comprises 174.7 ha of vegetation supporting hollow bearing trees and stags. The Habitat Corridor and foreshore Reserve in the Lake Sector conserved important winter flowering eucalypt resources of the species. So the amount of hollow bearing and flowering vegetation that is being retained far outweighs the amount being cleared.

While the development of the site involves the clearing of native vegetation and removal of dead wood and trees, the retention of native vegetation in the 10.8 ha protected for the Powerful Owl roost habitat as well as at the rear of lots, in managed areas and riparian areas greatly minimises the extent to which these KTPs could operate and ensures these resources remain available as foraging, roosting and nesting habitat for fauna. Furthermore, the dedication of the 174 ha WNP, which has been excised from the developable landholdings, ensures that these key threatening processes will cease to operate.

Given the small amount of vegetation clearing that will take place relative to the large areas of conserved forest in the vicinity of the site, and the planned retention of 21 ha of vegetation on the site, the proposed action, while constituting these key threatening process, will not be substantial given the retention of habitat on the subject site and the presence of surrounding habitat and resources for the Little Lorikeet.

Conclusion

While the proposed action will involve the removal of some vegetation that may provide foraging resources from time to time for the Little Lorikeet, the impact of this vegetation removal is unlikely to significantly impact a population of Little Lorikeets because:

- The species was not recorded on site – either foraging or breeding
- Little Lorikeets are a highly mobile, fast flying species that travels long distances from their roost sites to foraging sites daily
- The retention of 21 ha of vegetation (including Spotted Gum Ironbark Forest and riparian forest) and 61% of all HBT on the site means large amounts of potential foraging habitat for the species is being retained.
- Apart from the subject site, the NWP development will retain important areas of foraging habitat for the highly mobile species, namely:
    - The Wallarah National Park to the immediate south and south west of the site
    - The Habitat Corridor and Foreshore reserve in the Lake Sector
    - The Foreshore Reserve within the Lake Sector which protects Forest Red Gum – an important winter flowering foraging resource for the Little Lorikeet.

So, the loss of a relatively small amount of potential foraging resource is unlikely to significantly impact the Little Lorikeet to the extent that a local viable population would be put at risk of extinction.

A Species Impact Statement is not required.

GREY-HEADED FLYING FOX

Background

Grey-headed Flying Foxes were recorded flying over and drinking from the dam during spotlighting in January 2017.

None were recorded by NGH (2013) or Conacher Travers (2007b) in any of the studies undertaken for the NWP project since 2003. Hoye (1995) did not record the species during a detailed studied of bats in the Lake Sector in 1995. The subject site would provide potential foraging habitat when eucalypts are in flower. There are no camps (roosts) in the vicinity of the site.

The dam sits over historical clay pan and uncontrolled fill which requires remediation as part of the project. A dam situated immediately north of the site boundary on land subject to future development, will be protected to provide ongoing water resources.

Grey-headed Flying-foxes roost in Blackbutt Reserve to the north and Glenrock State Conservation Area to the north east of the reserve. These roosts disperse each evening to forage for nectar and pollen, including within the nature reserve and surrounds during periods of the year when Eucalyptus and Angophora trees are in flower. Many individuals were observed in and around the nature reserve in the 2006 surveys when Red Bloodwood (*Corymbia gummifera*) was flowering in abundance (Forest Fauna Surveys, 2006).

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

Grey-headed Flying-foxes (GHFF) breed, raise their young and daytime roost in large permanent aggregations known as camps. The nearest known GHFF camp to the proposal site is on Mudd Creek at Blackalls Park (OEH 2018) 13 km north-west of the site. The proposal will not have any direct or indirect impact on any camps and the carrying out of the life cycle of the species.

Individuals can commute daily to foraging areas within 15 km of a roost site and are capable of night flights up to 50 km to forage. Thus, the site is within foraging distance of the Blackalls Park camp. GHFF are extraordinarily mobile, with individuals changing camps regularly and capable of moving hundreds of kilometres over periods of days, while, and the distribution of the population appears to respond rapidly to changes in resource distribution with entire camps and regions being colonised or vacated in short periods (CSIRO 2011).

The GHFF are clearly utilising water resources on the site which will be removed as part of the development. However, given they have not been regularly recorded over various years of survey on the site suggests that this is not a critical resource for the local population and may be used periodically. As part of the project, a compensatory water source is being protected adjacent the site to ensure water resources remain.

The proposal involves removing approximately 44 ha of vegetation which provides potential foraging habitat for the GHFF. However, lack of records from previous surveys including Hoye (1995) suggests the species is not necessarily using the site as foraging habitat.

Given the extraordinary mobility of the GHFF and their non-permanent presence on site and the distance of the site from known camps, the loss of the foraging and drinking resources available on site are not likely to have and an adverse effect on the life cycle of this species such that a local population would be placed at risk of extinction.

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

Not applicable

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

(iii) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(iv) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

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

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

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

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

The proposal involves removing approximately 44 ha of vegetation which provides potential foraging habitat for the GHFF as well as a small dam in the south west of the site.

Relative to the availability of large areas of foraging habitat in the WNP and other conservation areas set aside in the Lake Sector as part of the project the habitat on site to be removed could not be considered important to the survival of a GHFF population, particularly given the large areas of disturbed land on the site. In particular, these areas include Wallarah National Park, Foreshore Reserve, Habitat Corridor, Munmorah State Conservation Area, and Lake Macquarie State Conservation Area, and more recently conserved lands added to these areas.

Loss of the small drinking water dam will be compensated for by the protection of a dam to the immediate north of the site to ensure a drinking resource remains in the Precinct.

The site adjoins the settlement of Caves Beach and lies immediately to the north of the WNP. Thus, the development will not fragment other existing habitats. The foraging habitat for the Grey-headed Flying-fox to be removed due to the proposal includes native nectar producing trees and shrubs. There is an abundance of this habitat in the local area outside the proposal site, therefore, the loss of habitat due to the proposal will not affect the survival of this species in the locality. The proposal will contribute to the

loss of a very small amount of potential foraging habitat, however, this loss in foraging habitat could not conceivably lead to a decline in the local population.

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

No critical habitat according to Part 3 of the TSC Act would be adversely affected by the proposed works.

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

A draft national Recovery Plan for the Grey-headed Flying-fox has been prepared.

The overall objectives of recovery are:

- to reduce the impact of threatening processes on Grey-headed Flying-foxes and arrest decline throughout the species' range
- to conserve the functional roles of Grey-headed Flying-foxes in seed dispersal and pollination
- to improve the standard of information available to guide recovery of the Grey-headed Flying-fox, in order to increase community knowledge of the species and reduce the impact of negative public attitudes on the species.

The proposed works are not in conflict with recovery objectives and will not interfere with the recovery of the species.

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

A key threatening process (KTP) is a process listed under the Threatened Species Conservation Act 1995 (TSC Act), which threatens, or may have the capability of threatening, the survival or evolutionary development of a species, population or ecological community.

Clearing of native vegetation is a KTP relevant to the project and the GHFF. While clearing of vegetation from the site will remove potential foraging habitat for the species it will not result in fragmentation of foraging areas for the species nor impact on any camps and therefore not threaten the survival of the species. Further, large areas of habitat for the GHFF have been conserved as an outcome of the project.

Conclusion

A Species Impact Statement is not required for the GHFF.

References

Commonwealth Department of Environment Interactive Flying-fox web Viewer.http://www.environment.gov.au/biodiversity/threatened/species/flying-fox-monitoring

CSIRO (2011) (David A. Westcott, Adam McKeown, Helen T. Murphy and Cameron S. Fletcher). A monitoring method for the grey-headed flying-fox, *Pteropus poliocephalus*.

CALLISTEMON LINEARIFOLIUS NETTED BOTTLEBRUSH

Background

Callistemon linearifolius is a shrub listed as vulnerable under the *Threatened Species Conservation Act 1995*. This shrub grows to 3-4 m tall, with linear (long and narrow) to linear-lanceolate (lance shaped) leaves 8-10 cm long, and 5-7 mm wide with and sharp tip, thickened margins, and distinct lateral veins. Flowers are clustered into the typical "bottlebrushes" of *Callistemon* species. The brushes are red and usually 9-10 cm long and approximately 50 mm in diameter. The stems upon which the filaments occur are covered in a soft downy hair at flowering. The seed capsules are approximately 7 mm in diameter. *C. linearifolius* grows in dry sclerophyll forest on the coast and adjacent ranges and flowers in spring - summer (OEH 2017).

The plants are bird pollinated. The seed is held within the capsules on the plant for years and released after heat from a bushfire (Graham Errington RBG Seedbank Curator *pers. comm.*).

The species has been recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. It was recorded in 2000 at Coalcliff in the northern Illawarra. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically recorded in the Sydney area. Three of the remaining populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve and Spectacle Island Nature Reserve. The species has also been recorded from Yengo National Park.

According to Okada (2006) the species is known to occur in the following areas in NSW:

- Pittwater sub-region of the Hawkesbury/Nepean Catchment Management Region (CMR),
- Hunter, Karuah Manning, Wyong and Yengo sub-regions of the Hunter/Central Rivers CMR,
- Illawarra sub-regions of the Southern Rivers CMA (restricted to north of Wollongong),
- Cumberland, Pittwater, Sydney Cataract sub-regions of the Sydney Metro CMR (DEC 2005).

A population of thousands of individuals is known from Stoney Ridge Reserve near Port Stephens (*pers. comm.* Jordan Skinner, bushland management officer, Port Stephens Council).

In Port Stephens LGA, *C. linearifolius* is also known to occur in the Karuah area, around Scobbies Hill. It is also known to occur in the adjacent parcel of the Diemars Quarry (Marchment 2006: *per comm*).

According to Travers (2007) the species is known from Munmorah SRA where it occurs in woodland, in a south facing valley, immediately above the coal seam which marks the line of demarcation between the Permian and Triassic geological periods. Although that habitat is relatively common in Munmorah SRA, there is only one known stand of this species.

Conacher Travers (2007b) shows a population of 10 individuals of the species in the eastern portion of the Wallarah National Park (Figure 4).

The plant numbers in any one population are largely unknown but there are a number of locations with low population numbers. The species is threatened by continuing loss of habitat due primarily to urban development. There is also a high risk of local extinction due to low population numbers.

This species has been assigned to the data-deficient species management stream under the OEH Saving our Species (SoS) program. This is because its taxonomy needs to be reviewed and little is known about its ecology.

Conacher Travers (2007) undertook random meanders of all potential habitat in the Northern Sector in September 2005, January 2006 and October 2006 recording 119 specimens within the Smooth-barked Apple Open Forest vegetation community in the drainage corridor to the south of the landfill adjoining the old Pacific Highway.

According to Conacher Travers (2007) the species has also been observed in previous surveys within the western and eastern portions of Wallarah National Park. Figure 6 of Conacher Travers (2007) shows 10 specimens in southern tip of western WNP.

Searches by EcoFocus in 2017 confirmed the presence of a population of *Callistemon linearifolius* along a westerly flowing drainage line within the Smooth-barked Apple Open Forest in the south west of the site (south of the landfill and south/east of the old Pacific Highway). A more detailed targeted search was carried out by EcoFocus in February 2018 by two experienced botanists. All suitable habitat across the site was covered on foot. A total of 149 live plants and 11 dead plants were located along the same drainage line.

The plants occur in Stage 6A and 6B where remediation of an old clay pan/gravel mine will require excavation of uncontrolled fill which encroaches into the riparian zone of the project area. Following remediation, a stormwater management facility with associated drainage will be constructed in the location of the existing water body. This will comprise an inner wetland basin that will be revegetated with native aquatic plants. An outer media filter basin will be revegetated with native ground cover. A 2.5m retaining wall will separate the southern boundary of the stormwater facility and the retained plants. swale will extend upstream approximately 225 m from the southern end/outlet of the detention basin. The placement of the swale has avoided loss of any Callistemon plants.

The design and placement of these features has been specifically amended to avoid an impact on the species, as well as hollow bearing trees, to the greatest extent possible. This has resulted in the retention of 133 individuals (89.3% of the onsite population) and the removal of only 16 plants (10.7%).

7 part test

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

Each Callistemon flower produces a small woody fruit containing hundreds of tiny seeds. These fruits form in clusters along the stem and are usually held on the plant for many years. The seeds are usually not released from the fruits for several years, but in some species the fruits open after about a year. Fire also

stimulates the opening of the fruits in some bottlebrushes. Death of the plant can also cause the seeds to be released through slits in the tops of the capsules.

The majority (89%) of the population on site will be retained. Ideally, and subject to DPIE approval, seed will be collected from the plants in the year prior to construction and retained for replanting in the riparian corridor and bushland park.

In the area of uncontrolled fill and development footprint where the plants have established, 16 plants will be removed as a result of the development. The development will not interrupt the life cycle of the plant as it is bird pollinated and the retained vegetation across the site as well as in the nearby national park will continue to support bird populations.

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

Not applicable

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

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

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

Together Stage 6A (the drainage reserve with swale, retained Callistemon and other vegetation and water management facility) and Stage 6B (the riparian corridor) make up an area of 5.96 ha. Within this, a combined total area of 0.9 ha will be cleared, remediated and revegetated.

The remaining individuals (89%) will be protected within a drainage and bushland reserve. Prior to any clearing and construction all individuals will be clearly marked, and protective fencing and signage installed.

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

The linear connectivity along the creek line will be maintained. The species is pollinated by birds, and the project will retain patches of bushland that will continue to support native bird populations.

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

The location of the mapped 149 individuals is the only occurrence of the species on the site. So clearing across the rest of the site will not impact on the species. The majority of the population (89%) will remain intact and not be impacted.

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

Critical habitat has not been declared for *C. linearifolius* as it is not listed as endangered under the TSC Act.

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

The OEH threatened species profile for the species lists the following activities to assist this species:

- Search for the species in suitable habitat in areas that are proposed for development or management actions, protect any such site found.
- Protect known habitat from clearing or disturbance.
- Determine response of species to fire and develop and promote a recommended fire regime.

A targeted strategy for managing this species has been developed under the Saving Our Species program (OEH 2016). One of the management actions for the species under the Saving Our Species Program is to "Collect seed for NSW Seedbank" and "develop a collection program in collaboration with BGT - single provenance".

Pending approval of relevant licences and permits, the proponent intends to collect seed from the known population, propagate them and plant the propagated individuals on site following restoration of the riparian soil profile.

There is no adopted or made recovery plan for this species. This species has been assigned to the 'data deficient species' management stream under the Saving our Species program.

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

Clearing of native vegetation is a listed key threatening process in the *NSW Threatened Species Conservation Act 1995* that will occur as part of the proposed project. Remediation of the uncontrolled fill in the riparian zone of one creek line will result in the direct loss of 16 individuals of *C. linearifolius* from an onsite population of 149 individuals. The removal of these individuals will not put the remainder of the population under threat. As an additional measure seed collection and propagation will be undertaken and plants will be reinstated in the area from which they were removed. The remaining plants will not be impacted and will remain in a bushland reserve.

Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants is a listed key threatening process.

The structure and composition of the 21 ha of retained vegetation will be maintained through implementation of the bushland management plan for the project (Manidis Roberts 2007) and the LMCC DCP which controls the type of plants that can planted in residential areas of the project. These guidelines will ensure that weeds and non-native species do not spread to natural areas of bushland, including the riparian zones. Re-establishment of the riparian zones following remediation will include planting of species indicative of the pre-existing community, in addition to the propagated *C. linearifolius* (if possible).

Therefore, the proposed action does not constitute and will not result in a key threatening process for *C. linearifolius.*

Conclusion

A Species Impact Statement is not required.

References

NSW Scientific Committee (1999) *Callistemon linearifolius* (a shrub) - Vulnerable species determination - final. https://www.environment.nsw.gov.au/determinations/CallistemonLinearifoliusVulSpListing.htm

Office of Environment and Heritage (2016). More plants and animals to be saved from extinction. Saving our Species 2016–21.

Office of Environment and Heritage (2017). Netted Bottlebrush profile https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10129

Office of Environment and Heritage (2019). Translocation operational policy. https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/translocation-operational-policy-190162.pdf

Conacher Travers (2007a). Ecological Site Survey Report Coastal and Northern Sectors, Wallarah Peninsula. Report prepared for Stockland.

Conacher Travers (2007b). Environmental Audit Report Wallarah Peninsula Lakes, Coastal and Northern Sectors. Report prepared for Stockland.

Harden GJ (1993). Flora of NSW. Vol 4. UNSW Press.

Okada, S. (2006) The Distribution and Abundance of *Callistemon linearifolius* and *Corybas dowlingii* at Stoney Ridge Reserve, Soldiers Point NSW. Report to Port Stephens Council.

TETRATHECA JUNCEA BLACK EYED SUSAN

Background

Black-eyed Susan is endemic to New South Wales and was historically distributed from Botany Bay in Sydney north to Bulahdelah. Black-eyed Susan is now presumed extinct in the Sydney area. The current distribution is divided into two metapopulations: the central coast metapopulation (from Wyong to Beresfield) and the northern metapopulation (from Karuah to Bulahdelah). It is currently found in the local government Areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock, with the Wyong and Lake Macquarie local government areas the stronghold for the species.

Black-eyed Susan is found in sandy, occasionally moist, heath and in dry sclerophyll vegetation communities endemic to coastal New South Wales. The species occurs on low-nutrient soils in open forest with a dense understorey in areas with an annual rainfall greater than 1000 mm. The species occurs on Quaternary sands, Triassic sandstones, Triassic shales, Permian coal measures and Carboniferous volcanics.

Populations throughout the species range occur predominately in three vegetation communities. These include:

- coastal plains smooth-barked apple woodland
- coastal plains scribbly gum woodland
- coastal foothills spotted gum-ironbark forest.

T. juncea is counted in 'clumps' as it is difficult to distinguish individual plants due to the rhizomatous growth form. Separate clumps are defined as 30 cm or more distant from each other. Results of previous surveys for *T. juncea* on the subject site and broader Wallarah Peninsula are summarised below:

Payne (1999) undertook vegetation mapping and conservation area analysis of the north Wallarah Peninsula project site as part of the LES prepared for LMCC. He concluded that the conservation reserves dedicated as part of the project would conserve "very significant sub-populations of *Tetratheca juncea*" and that "no additional conservation areas within the site would be therefore necessary". The conclusion of his report for the LES stated there will be no need to conserve additional sites of Tetratheca in the south-eastern quadrant of the Lake Macquarie LGA or to prepare species impact statements for individual development sites.

Conacher Travers (2007b) conducted targeted searches for the species across most areas of Wallarah Peninsula and reported that "24,062 clumps of *Tetratheca juncea* were recorded in targeted surveys to date across the Wallarah Peninsula. In addition, it is estimated that 1,073 clumps are present in potential habitat within Radar Hill Precinct which is to be surveyed in the future. It is therefore estimated that there is a total of 25,135 clumps of *Tetratheca juncea* within the Wallarah Peninsula. Of these 9,988 are reserved within Wallarah National Park and the Habitat Corridor conservation zone.

A total of 10,825 *Tetratheca juncea* clumps were recorded within the Coastal and Northern Sectors during targeted surveys, mainly within the Smooth-barked Apple Open Forest**.**

EcoFocus 2016 and 2017 recorded approximately 160 clumps (refer to calculations in body of report) of the species across the subject site. Individuals were recorded in the same three main areas across the site as Conacher Travers (2007a) but in much lower numbers.

The species is known to occur in the dedicated project conservation areas (Habitat Corridor and Wallarah National Park).

7 part test

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

T. juncea is pollinated by insects. Therefore, connectivity and fragmentation are important issues both for seed dispersal and pollination.

Approximately 10000 plants are conserved in the Wallarah National Park set aside as a conservation outcome of the project. The project will not impact on life cycle processes such as pollination and seed dispersal for this portion of the Wallarah Peninsula population. Plants conserved in the WNP represent approximately 41% of the plants across the Wallarah Peninsula, a key reason for the conservation of the area as part of the project.

The proposed project will result in the removal of approximately 580 clumps of *T. juncea*, acknowledging the retention of those extrapolated within Lot 8. Additionally, some clumps are retained, as intended by the masterplan, in and around retained vegetation in lots and other retained areas, however these aren't 'assumed' as retained.

The approximate 580 clumps proposed for removal from the subject site constitute approximately 2.3% of the original local Wallarah Peninsula population.

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

Not applicable

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

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

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

The area to be impacted supports approximately 1040 clumps of *T. juncea.* This represents approximately 4% of the estimated number of plants on the Wallarah Peninsula and 1.9 % of the central coast population of the species. The WNP offset supports approximately 10,000 clumps of the species. Thus, the extent of habitat for the species to be removed from the subject site is small in a local and regional context.

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

Connectivity is particularly important for maintaining gene flow given *T. juncea* is pollinator limited and has limited dispersal ability. Effective pollination is important to maintain population viability in the long term.

The size and connection of habitat affects the ability of individual plants to disperse seed and genetic material, and also determines what constitutes a population and future viability. Fragmentation and connectivity are primarily long term issues relating to population viability and the likelihood of species extinction.

.

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

The NPWS considers that *T. juncea* is adequately conserved in the south eastern portion of its range with approximately 1300 plant clumps known from Awabakal Nature Reserve, Glenrock State Recreation Area, Lake Macquarie Recreation Area, and Munmorah State Recreation Area (Payne 2000 in NPWS 2000). The adequacy of protection in the south east of its range has been significantly enhanced by the dedication of the Wallarah National Park which added 10 000 clumps to the number protected in conservation reserves.

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

Critical habitat has not been declared for *T. juncea* as it is not listed as endangered under the TSC Act.

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

There is no adopted or made recovery plan for this species. The Commonwealth considers that a recovery plan is not required.

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

"High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition" is listed in the *NSW Threatened Species Conservation Act 1995* as a key threatening process that may affect *T. juncea*. A detailed bushfire management plan is being put in place for the project.

The structure and composition of the 17 ha of retained vegetation and the WNP will be maintained through implementation of the bushland management plan (Manidis Roberts 2007) for the project and the LMCC DCP which controls the type of plants that can planted in residential areas of the project. These guidelines will ensure that weeds and non-native species do not spread to natural areas of bushland supporting *T. juncea,* particularly the WNP to the south of the project area.

Conclusion

This species is likely to be secure in NSW for the long term without targeted management, assuming adequate ongoing management of habitat within the public reserve system (OEH 2016). The dedicated conservation reserves set aside for the project, including the 174 ha Wallarah National Park will protect local populations of the species in the long term.

This species has been assigned to the 'Keep-watch species' management stream under the OEH *Saving our Species* program. Justification for allocation to this management stream is for species that require no immediate investment because they are either naturally rare, have few known threats, or are more abundant than previously assumed when they were listed as threatened.

A Species Impact Statement is not required.

References

Conacher Travers (2007a). Ecological Site Survey Report Coastal and Northern Sectors, Wallarah Peninsula. Report prepared for Stockland.

Conacher Travers (2007b). Environmental Audit Report Wallarah Peninsula Lakes, Coastal and Northern Sectors. Report prepared for Stockland.

Department of Environment and Energy (2016). Species Profile and Threats Database. Accessed November 2016.

Driscoll, C. (2003). Pollination ecology of *Tetratheca juncea* (Tremandraceae): finding the pollinators. *Cunninghamia* 8(1): 133–140

Lake Macquarie City Council (2014). Lake Macquarie *Tetratheca juncea* Planning and Management Guidelines.

Manidis Roberts (2007). Bushland Management Manual Wallarah Peninsula. Report prepared for Stockland Wallarah Peninsula Pty Ltd.

OEH (2016) http://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10799

National Parks and Wildlife Service (2000). Environmental Impact Assessment Guidelines: *Tetratheca juncea*.

Payne, R. (1999). Vegetation Mapping and Conservation Area Analysis. North Wallarah Peninsula Project Site. Report prepared for Lake Macquarie City Council.

Payne, R. (2000) Lake Macquarie *Tetratheca juncea* Conservation Management Plan Final Report. Unpublished report prepared for NSW NPWS, Lake Macquarie City Council and BHP P/L.

Appendix G. Hollow-bearing tree register

Tree No.	Tree Species	Class	Proposed Status
H515	Stag	High	remove
H529	Stag	High	remove
HBTNS	*Corymbia gummifera*	Low/Mod	remove
HBTNS1	*Angophora costata*	Low/Mod	remove
HT0902	Stag	Low/Mod	remove
HT1374	Stag	Low/Mod	remove
HT1375	Stag	Low/Mod	remove
HT1383	-	Low/Mod	retain
HT1397	Stag	Low/Mod	retain
M180	*Eucalyptus haemastoma*	Low/Mod	remove
N01	*Angophora costata*	High	remove
N02	*Angophora costata*	High	retain
N03	Stag	low	retain
N04	*Angophora costata*	med	retain
N05	Stag	low	retain
N06	Stag	High	retain
N07	*Angophora costata*	Low	retain
N08	Stag	Low	retain
N09	*Angophora costata*	Low/Mod	retain
N10	*Angophora costata*	Low/Mod	retain
N100	Stag	Low/Mod	retain
N101	*Corymbia maculata*	Low/Mod	retain
N102	*Corymbia maculata*	Low/Mod	retain
N103	*Eucalyptus umbra*	Low/Mod	retain
N104	*Eucalyptus umbra*	Low/Mod	retain
N105	*Corymbia maculata*	High	retain
N106	*Corymbia gummifera*	Low/Mod	retain
N107	*Corymbia gummifera*	High	retain
N108	Stag	High	retain
N109	*Corymbia gummifera*	Low/Mod	retain
N11	*Angophora costata*	High	retain
N110	*Eucalyptus umbra*	High	retain
N111	*Corymbia maculata*	High	retain
N112	*Eucalyptus umbra*	Low/Mod	retain
N113	*Corymbia maculata*	High	retain
N114	Stag	High	retain
N115	*Corymbia maculata*	High	retain
N116	*Eucalyptus ?acmenioides*	High	retain
N117	*Corymbia maculata*	High	retain
N118	*Corymbia maculata*	High	retain
N119	*Corymbia maculata*	High	retain
N120	*Corymbia maculata*	High	retain
N121	*Eucalyptus ?acmenioides*	High	retain
N122	*Corymbia maculata*	High	retain
N123	*Angophora costata*	High	remove

N124	*Angophora costata*	High	remove
N125	*Angophora costata*	High	remove
N126	*Angophora costata*	High	remove
N127	*Angophora costata*	High	remove
N128	*Angophora costata*	High	remove
N129	*Angophora costata*	High	remove
N130	*Eucalyptus umbra*	High	remove
N131	*Eucalyptus umbra*	High	remove
N132	Stag	High	remove
N133	*Corymbia gummifera*	Low/Mod	remove
N134	*Corymbia gummifera*	High	remove
N135	Eucalyptus umbra	Low/Mod	remove
N136	Stag	High	remove
N137	*Eucalyptus umbra*	High	remove
N138	Stag	High	remove
N139	*Eucalyptus umbra*	Low/Mod	remove
N141	*Corymbia maculata*	Low/Mod	retain
N142	*Eucalyptus umbra*	High	retain
N143	*Eucalyptus umbra*	High	retain
N144	*Corymbia maculata*	Low/Mod	remove
N145	*Eucalyptus umbra*	High	retain
N146	*Corymbia maculata*	High	retain
N147	*Eucalyptus paniculata*	Low/Mod	retain
N149	*Angophora costata*	Low/Mod	remove
N150	*Eucalyptus umbra*	Low/Mod	retain
N151	*Corymbia maculata*	Low/Mod	retain
N152	*Eucalyptus umbra*	Low/Mod	remove
N153	*Corymbia maculata*	High	retain
N16	*Eucalyptus haemastoma*	High	retain
N160	*Corymbia gummifera*	Low/Mod	remove
N17	*Eucalyptus haemastoma*	Low/Mod	retain
N18	*Angophora costata*	Low/Mod	retain
N19	*Angophora costata*	High	retain
N20	*Angophora costata*	high	retain
N21	*Angophora costata*	High	retain
N22	*Angophora costata*	High	retain
N23	Stag	Low/Mod	retain
N24	Stag	Low/Mod	retain
N25	Stag	Low/Mod	retain
N26	*Eucalyptus haemastoma*	Low/Mod	retain
N27		LOW	retain
N28	*Corymbia gummifera*	Low/Mod	retain
N29	Stag	Low/Mod	retain
N30	Stag	Low/Mod	retain
N31	*Angophora costata*	Low/Mod	retain
N32	Grey Gum	Low/Mod	retain
N34		Low/Mod	retain
N35	Stag	Low/Mod	retain
N36	*Angophora costata*	Low/Mod	remove

N37	*Corymbia gummifera*	Low/Mod	remove
N38	Stringy Bark	Low/Mod	retain
N39	Peppermint	Low/Mod	retain
N40	*Corymbia maculata*	High	retain
N42	*Angophora costata*	High	retain
N43	*Eucalyptus haemastoma*	Low/Mod	remove
N45	*Corymbia maculata*	High	retain
N46	Ironbark	High	retain
N47	Stringy Bark	Low/Mod	retain
N48	Ironbark	High	retain
N49	*Corymbia maculata*	High	retain
N50	*Eucalyptus haemastoma*	High	retain
N52	*Angophora costata*	Low/Mod	retain
N53	*Angophora costata*	High	remove
N54	Stag	med	retain
N55	Corymbia gummifera	High	remove
N5a	fallen		retain
N60	*Corymbia gummifera*	Low/Mod	remove
N61	Stag	High	remove
N62	*Eucalyptus haemastoma*	High	retain
N63	*Corymbia gummifera*	Low/Mod	retain
N64	*Angophora costata*	High	retain
N65	*Eucalyptus umbra*	Low/Mod	retain
N66	*Corymbia maculata*	Low/Mod	retain
N67	*Eucalyptus umbra*	Low/Mod	remove
N68	*Eucalyptus umbra*	High	remove
N70	*Corymbia maculata*	High	retain
N71	Stag	High	retain
N72	*Corymbia maculata*	High	remove
N73	*Eucalyptus umbra*	High	retain
N75	*Corymbia maculata*	High	retain
N76	*Corymbia gummifera*	Low/Mod	retain
N77	*Corymbia gummifera*	High	retain
N78	*Angophora costata*	High	remove
N79	Stag	High	remove
N80	Stag	Low/Mod	remove
N81	unsure, rough bark	High	retain
N82	Stag	Low/Mod	remove
N83	*Angophora costata*	High	remove
N84	*Angophora costata*	High	retain
N85	*Angophora costata*	Low/Mod	remove
N86	*Angophora costata*	High	remove
N87	*Angophora costata*	High	remove
N88	Stag	Low/Mod	remove
N89	Stag	Low/Mod	remove
N90	Stag	Low/Mod	remove
N91	*Eucalyptus haemastoma*	High	remove
N92	*Eucalyptus umbra*	High	remove
N93	*Corymbia maculata*	Low/Mod	remove

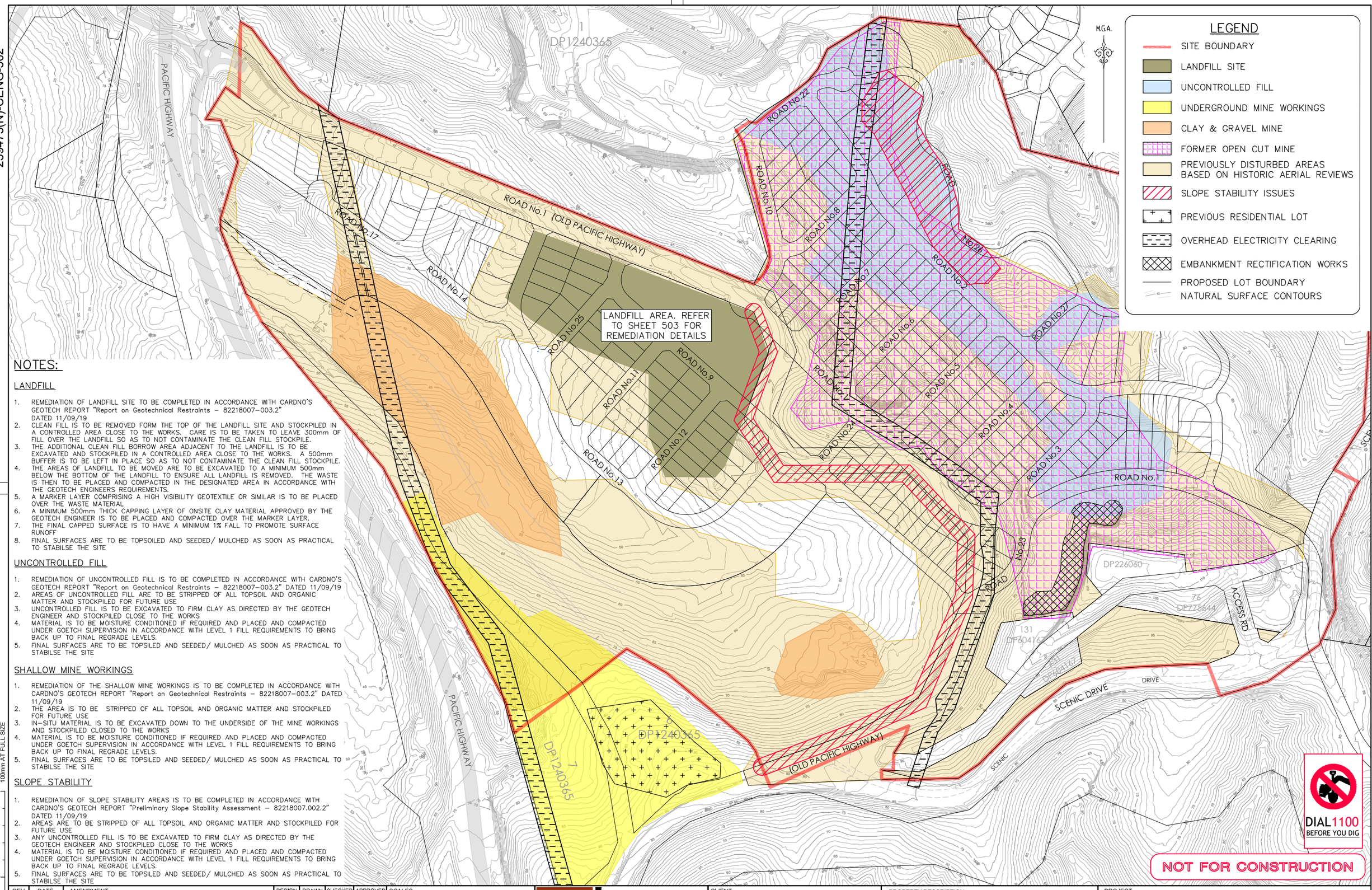
N94	*Eucalyptus umbra*	Low/Mod	remove
N95	*Corymbia maculata*	Low/Mod	remove
N97	*Corymbia maculata*	High	remove
N98	*Corymbia maculata*	High	retain
NSHBT	*Corymbia maculata*	High	retain

Appendix H. Site Plans

Plan A Disturbance History

D09530896

239475(N)-CENG-502



NOTES:

LANDFILL

1. REMEDIATION OF LANDFILL SITE TO BE COMPLETED IN ACCORDANCE WITH CARDNO'S GEOTECH REPORT "Report on Geotechnical Restraints – 82218007–003.2" DATED 11/09/19
2. CLEAN FILL IS TO BE REMOVED FORM THE TOP OF THE LANDFILL SITE AND STOCKPILED IN A CONTROLLED AREA CLOSE TO THE WORKS. CARE IS TO BE TAKEN TO LEAVE 300mm OF FILL OVER THE LANDFILL SO AS TO NOT CONTAMINATE THE CLEAN FILL STOCKPILE.
3. THE ADDITIONAL CLEAN FILL BORROW AREA ADJACENT TO THE LANDFILL IS TO BE EXCAVATED AND STOCKPILED IN A CONTROLLED AREA CLOSE TO THE WORKS. A 500mm BUFFER IS TO BE LEFT IN PLACE SO AS TO NOT CONTAMINATE THE CLEAN FILL STOCKPILE.
4. THE AREAS OF LANDFILL TO BE MOVED ARE TO BE EXCAVATED TO A MINIMUM 500mm BELOW THE BOTTOM OF THE LANDFILL TO ENSURE ALL LANDFILL IS REMOVED. THE WASTE IS THEN TO BE PLACED AND COMPACTED IN THE DESIGNATED AREA IN ACCORDANCE WITH THE GEOTECH ENGINEERS REQUIREMENTS.
5. A MARKER LAYER COMPRISING A HIGH VISIBILITY GEOTEXTILE OR SIMILAR IS TO BE PLACED OVER THE WASTE MATERIAL
6. A MINIMUM 500mm THICK CAPPING LAYER OF ONSITE CLAY MATERIAL APPROVED BY THE GEOTECH ENGINEER IS TO BE PLACED AND COMPACTED OVER THE MARKER LAYER.
7. THE FINAL CAPPED SURFACE IS TO HAVE A MINIMUM 1% FALL TO PROMOTE SURFACE RUNOFF
8. FINAL SURFACES ARE TO BE TOPSOILED AND SEEDED/ MULCHED AS SOON AS PRACTICAL TO STABILSE THE SITE

UNCONTROLLED FILL

1. REMEDIATION OF UNCONTROLLED FILL IS TO BE COMPLETED IN ACCORDANCE WITH CARDNO'S GEOTECH REPORT "Report on Geotechnical Restraints – 82218007–003.2" DATED 11/09/19
2. AREAS OF UNCONTROLLED FILL ARE TO BE STRIPPED OF ALL TOPSOIL AND ORGANIC MATTER AND STOCKPILED FOR FUTURE USE
3. UNCONTROLLED FILL IS TO BE EXCAVATED TO FIRM CLAY AS DIRECTED BY THE GEOTECH ENGINEER AND STOCKPILED CLOSE TO THE WORKS
4. MATERIAL IS TO BE MOISTURE CONDITIONED IF REQUIRED AND PLACED AND COMPACTED UNDER GOETCH SUPERVISION IN ACCORDANCE WITH LEVEL 1 FILL REQUIREMENTS TO BRING BACK UP TO FINAL REGRADE LEVELS.
5. FINAL SURFACES ARE TO BE TOPSILED AND SEEDED/ MULCHED AS SOON AS PRACTICAL TO STABILSE THE SITE

SHALLOW MINE WORKINGS

1. REMEDIATION OF THE SHALLOW MINE WORKINGS IS TO BE COMPLETED IN ACCORDANCE WITH CARDNO'S GEOTECH REPORT "Report on Geotechnical Restraints – 82218007–003.2" DATED 11/09/19
2. THE AREA IS TO BE STRIPPED OF ALL TOPSOIL AND ORGANIC MATTER AND STOCKPILED FOR FUTURE USE
3. IN–SITU MATERIAL IS TO BE EXCAVATED DOWN TO THE UNDERSIDE OF THE MINE WORKINGS AND STOCKPILED CLOSED TO THE WORKS
4. MATERIAL IS TO BE MOISTURE CONDITIONED IF REQUIRED AND PLACED AND COMPACTED UNDER GOETCH SUPERVISION IN ACCORDANCE WITH LEVEL 1 FILL REQUIREMENTS TO BRING BACK UP TO FINAL REGRADE LEVELS.
5. FINAL SURFACES ARE TO BE TOPSILED AND SEEDED/ MULCHED AS SOON AS PRACTICAL TO STABILSE THE SITE

SLOPE STABILITY

1. REMEDIATION OF SLOPE STABILITY AREAS IS TO BE COMPLETED IN ACCORDANCE WITH CARDNO'S GEOTECH REPORT "Preliminary Slope Stability Assessment – 82218007.002.2" DATED 11/09/19
2. AREAS ARE TO BE STRIPPED OF ALL TOPSOIL AND ORGANIC MATTER AND STOCKPILED FOR FUTURE USE
3. ANY UNCONTROLLED FILL IS TO BE EXCAVATED TO FIRM CLAY AS DIRECTED BY THE GEOTECH ENGINEER AND STOCKPILED CLOSE TO THE WORKS
4. MATERIAL IS TO BE MOISTURE CONDITIONED IF REQUIRED AND PLACED AND COMPACTED UNDER GOETCH SUPERVISION IN ACCORDANCE WITH LEVEL 1 FILL REQUIREMENTS TO BRING BACK UP TO FINAL REGRADE LEVELS.
5. FINAL SURFACES ARE TO BE TOPSILED AND SEEDED/ MULCHED AS SOON AS PRACTICAL TO STABILSE THE SITE

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.07.19	ISSUED FOR APPROVAL	JD	JD	ND	LB
B	16.08.19	ISSUED FOR INFORMATION	JD	JD	ND	LB
C	05.09.19	ISSUED FOR APPROVAL	JD	JD	ND	LB
D	01.10.19	ISSUED FOR APPROVAL	JD	JD	ND	LB
E	15.10.19	ISSUED FOR DA	JD	JD	ND	LB

SCALES: A1 1:2000 / A3 1:4000 (0, 50, 100m)

DESIGN FILE S:\239475\239475(Northern)\Design\12D\MAWSONS.project

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

adw johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: WAKEFIELD ASHURST

PROPERTY DESCRIPTION: LOTS 2,3,4,5,7 & 8 D.P.1240365, LOT 3 D.P.1090495 NORTHERN SECTOR, WALLARAH PENINSULA

SURVEYED: ADWJ | DATUM: A.H.D.

PROJECT: CENTRAL PRECINCT

PLAN TITLE: SITE REMEDIATION PLAN

PROJECT No. 239475(N) – DISCIPLINE CENG – NUMBER 502 | REV. E

100mm AT FULL SIZE

Plotted By: Jeremy Dick Plot Date: 29/10/19 11:16:13AM Cad File: S:\239475\239475(NORTHERN)\DRAWINGS\ENGINEERING\CIVIL\CENG\239475(N)–CENG–502.DWG

Plan B. Proposal Staging

SUBDIVISION OF LOTS 2, 3, 5 & 8 DP 1240365, PART LOT 4 DP 1240365, LOT 3 DP 1090496, AND OLD PACIFIC HIGHWAY

WALLARAH PENINSULA INTERCHANGE

SCENIC DRIVE

FUTURE DEVELOPMENT (PINNY BEACH)

LEGEND

- PROPOSED SITE BOUNDARY
- PROPOSED LOT BOUNDARY
- PROPOSED STAGE BOUNDARY
- EXISTING DCDB
- 5 PROPOSED STAGE NUMBER
- PROPOSED BUILDING ENVELOPE
- (E) EASEMENT FOR ELECTRICITY PURPOSES (15 WIDE)
- (F) EASEMENT FOR ELECTRICITY PURPOSES (VARIABLE WIDTH)
- PROPOSED DT2 LOT
- PROPOSED LOT
- PROPOSED COMMERCIAL LOT
- PROPOSED COMMUNITY LOT
- PROPOSED COUCNIL OWNERSHIP

ver.	date	comment	drawn	pm
E	01.10.19	MINOR LOT LAYOUT AMENDMENTS	JD	ND

level information: **DATUM:** N/A **CONTOUR INTERVAL:** N/A

scale (A1 original size): A1 1:2500 — 0 50 100 125m — A3 1:5000

notes

drawing title: STAGING PLAN

location: CENTRAL PRECINCT

council: LMCC

dwg ref: 239475(N)-SUB-000

client:

adw johnson
central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
sydney office ph: (02) 8046 7411
www.adwjohnson.com.au

working beyond expectations

Plan C. Vegetation Management Plan

D09530896

239475(N)-CENG-004

LEGEND

- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- EXTENT OF DISTURBED AREA FROM PREVIOUS LAND USES (54.4ha)
- 0–20m RIPARIAN CORRIDOR
- 20–40m RIPARIAN CORRIDOR
- VEGETATION TO BE CLEARED: (44.2ha)
- MANAGED AREA: (4.0ha)
- VEGETATION TO REMAIN (17.2ha)
- OLD PACIFIC HIGHWAY / SCENIC DRIVE / CLEARED OVERHEAD ELECTRICAL (9.2ha)
- AREA TO BE RE-VEGETATED – Natural (2.4ha)
- AREA TO BE RE-VEGETATED – Managed (2.6ha)
- AREA UNDER SEPARATE OWNERSHIP (3.0ha) (excluded from Site Area)
- PROPOSED BUILDING ENVELOPE
- CALLISTEMON LINEARIFOLIUS
- TETRATHECCA JUNCEA (KEEP & REMOVE)
- HABITAT TREE TO REMAIN
- HABITAT TREE TO BE REMOVED
- ROOST HABITAT 1 (BLUE) & 2 (RED)

DIAL1100 BEFORE YOU DIG

100mm AT FULL SIZE

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A		NOT ISSUED				
B	16.08.19	ISSUED FOR INFORMATION	JD	JD	ND	LB
C	05.09.19	ISSUED FOR APPROVAL	JD	JD	ND	LB

SCALES: A1 1:2000 / A3 1:4000 (0, 50, 100m)

DESIGN FILE S:\239475\239475(Northern)\Design\12D\MAWSONS.project

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

adw Johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: WAKEFIELD ASHURST

PROPERTY DESCRIPTION: LOTS 2,3,4,5,7 & 8 D.P.1240365, LOT 3 D.P.1090495 NORTHERN SECTOR, WALLARAH PENINSULA

SURVEYED: ADWJ

DATUM: A.H.D.

PROJECT: CENTRAL PRECINCT

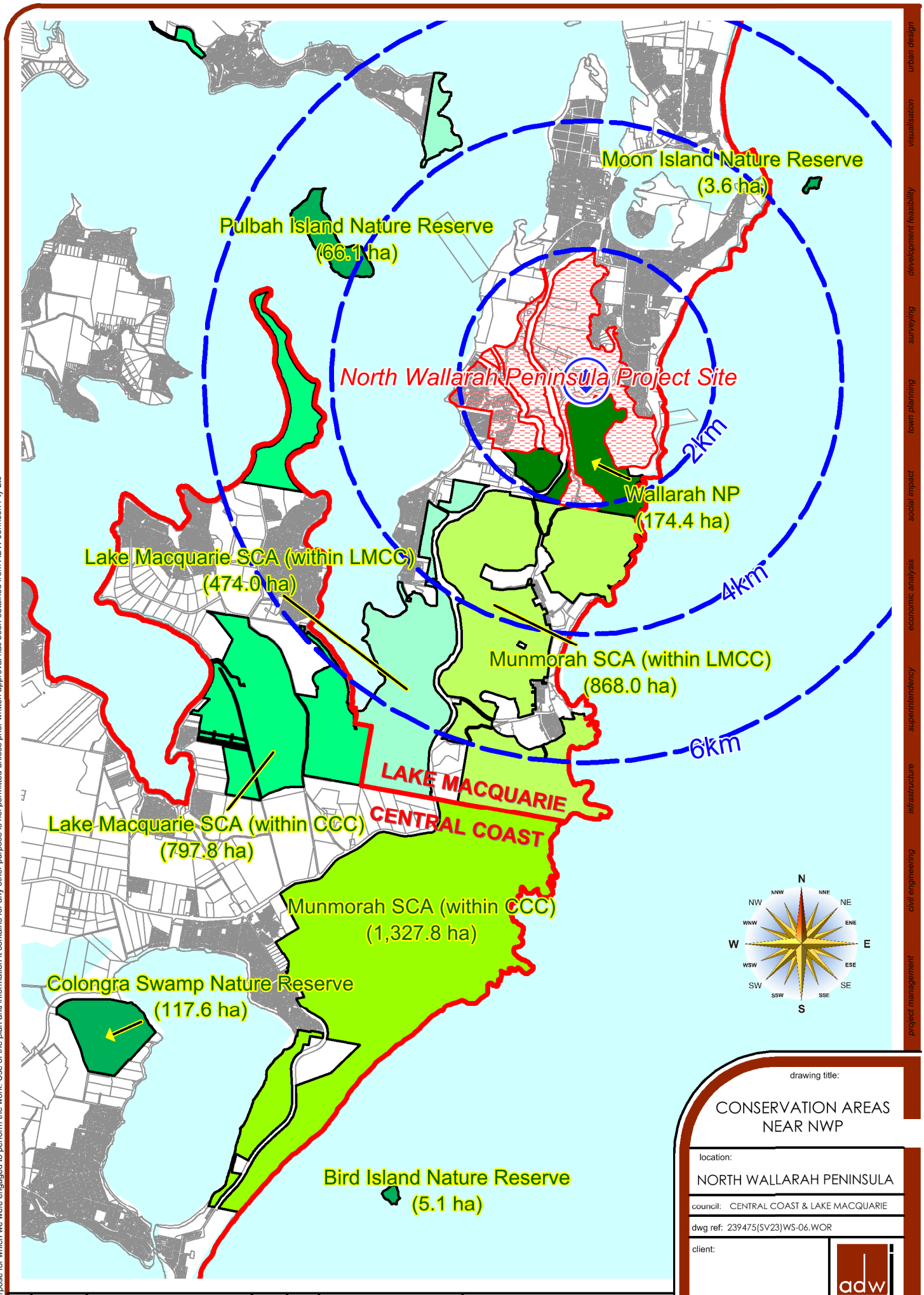
PLAN TITLE: VEGETATION MANAGEMENT PLAN

PROJECT No.	DISCIPLINE	NUMBER	REV.
239475(N)	CENG	004	C

Plotted By: Jeremy Dick Plot Date: 11/09/19 4:11:50PM Cad File: S:\239475\239475(NORTHERN)\DRAWINGS\ENGINEERING\CIVIL\CENG\239475(N)-CENG-004.DWG

Plan D. Conservation Lands

D09530896



ver.	date	comment	drawn	pm		
A	31/10/2019	FIRST ISSUE	MS	SH		

working beyond expectations

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

drawing title:

CONSERVATION AREAS NEAR NWP

location:

NORTH WALLARAH PENINSULA

council: CENTRAL COAST & LAKE MACQUARIE

dwg ref: 239475(SV23)WS-06.WOR

client:

adw johnson
central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
www.adwjohnson.com.au

Plan E. Callistemon linearifolius retention

D09530896

PROVIDE LOW FLOW PIPE THROUGH RETAINING WALL TO PROVIDE REGULAR WATERING OF EXISTING CALLISTEMON

602 (41,373m²)

LEGEND

- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- CLEARING WORKS
- HABITAT TREE TO REMAIN
- HABITAT TREE TO BE REMOVED
- CALLISTEMON LINEARIFOLIUS (133)
- CALLISTEMON LINEARIFOLIUS TO BE REMOVED (16)
- RETAINING WALL
- 2m WIDE PATHWAY/CROSSING
- 0-20m RIPARIAN
- 20-40m RIPARIAN
- VEGETATION TO BE CLEARED
- MANAGED AREA
- VEGETATION TO REMAIN
- CLEARED OVERHEAD ELECTRICAL
- AREA TO BE RE-VEGETATED - Managed

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
K	07.11.19	CL REPLACED	JD	ND	DATUM: AHD CONTOUR INTERVAL: N/A	0 12.5 25.0m SCALE: 1:500 (FULL)	

drawing title:
STAGE 6
CALLISTEMON PLAN
SHEET 1

location: CENTRAL PRECINCT

council: LMCC

dwg ref: 239475(N)-ESK-118

client:

adw johnson
central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
sydney office ph: (02) 8046 7411
www.adwjohnson.com.au

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

working beyond expectations

239475(N)-ESK-118 119[K]

LEGEND

- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- CLEARING WORKS
- HABITAT TREE TO REMAIN
- HABITAT TREE TO BE REMOVED
- CALLISTEMON LINEARIFOLIUS (133)
- CALLISTEMON LINEARIFOLIUS TO BE REMOVED (16)
- RETAINING WALL
- 2m WIDE PATHWAY/CROSSING
- 0-20m RIPARIAN
- 20-40m RIPARIAN
- VEGETATION TO BE CLEARED
- MANAGED AREA
- VEGETATION TO REMAIN
- CLEARED OVERHEAD ELECTRICAL
- AREA TO BE RE-VEGETATED - Managed

PROVIDE LOW FLOW PIPE THROUGH RETAINING WALL TO PROVIDE REGULAR WATERING OF EXISTING CALLISTEMON

ROCK LINED SWALE DRAIN

PROVIDE LOW FLOW DIVERSION FROM SWALE TO PROVIDE REGULAR WATERING OF EXISTING CALLISTEMON

PROVIDE LOW FLOW DIVERSION FROM SWALE TO PROVIDE REGULAR WATERING OF EXISTING CALLISTEMON

602 (41,373m²)

601 (23,233m²)

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
K	7.11.19	CL REPLACED	JD	ND	DATUM: AHD CONTOUR INTERVAL: N/A	0 12.5 25.0m SCALE: 1:500 (FULL)	

drawing title:
STAGE 6
CALLISTEMON PLAN
SHEET 2

location: CENTRAL PRECINCT

council: LMCC

dwg ref: 239475(N)-ESK-119

client:

adw johnson
central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
sydney office ph: (02) 8046 7411
www.adwjohnson.com.au

working beyond expectations

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

Plotted By: Jeremy Dick Plot Date: 07/11/19 1:52:26PM Cad File: S:\239475\239475(NORTHERN)\DRAWINGS\GENERAL\239475(N)-ESK-118 119[K].DWG

This plan includes coloured information. If you have a black and white copy you do not have all of the information. This note is coloured RED.

Plan F. Hollow-bearing Tree Locations

239475(N)-ESK-099[F]

LEGEND

- SITE BOUNDARY
- HABITAT TREE TO REMAIN (42 OFF)
- HABITAT TREE TO BE REMOVED (27 OFF)
- HIGH CLASS HABITAT TREE TO REMAIN (49 OFF)
- HIGH CLASS HABITAT TREE TO BE REMOVED (30 OFF)

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
F	19.09.19	HABITAT TREES AMENDED	JD	ND	DATUM: N/A CONTOUR INTERVAL: N/A	0 50 100 125m SCALE: 1:2500 (FULL)	

drawing title:

CONFIRMED HABITAT TREE LOCATIONS

location: CENTRAL PRECINCT

council: LMCC

dwg ref: 239475(N)-ESK--099

client:

adw johnson

central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
sydney office ph: (02) 8046 7411

www.adwjohnson.com.au

working beyond expectations

Plan G. Location of northern waterbody

SWANSEA

6
D.P.791995

1
DP.811739

7
D.P.791995

AVAILABLE WATER SOURCE
IN THIS LOCATION TO BE
RETAINED WITH 20m EDGE

1 1121576

5
DP.1090495

2
DP.1121576

OLD PACIFIC HIGHWAY

PACIFIC HIGHWAY

EXISTING
FIRETRAIL

NORTHERN PRECINCT
SUBJECT TO FUTURE
PRECINCT PLANS

2
DP.1121576

LOT 1
DP.1240365

WALLARAH
PENINSULA
INTERCHANGE

JETTY POINT DRIVE

3
DP.1090496

LOT 2
DP.1240365

LOT 4
DP.1240365

CAVES BEACH

PARK AVENUE

SCENIC DRIVE

LOT 3
DP.1240365

PT.2
DP.1093709

LOT 5
DP.1240365

MAWSONS
LOOKOUT

ACCESS RD

LOT 8
DP.1240365

LOT 8
DP.1240365

SCENIC DRIVE

LOT 7
DP.1240365

LOT 6
DP.1240365

PACIFIC HIGHWAY

FUTURE
DEVELOPMENT
(PINNY
BEACH)

LOT 7
DP.1240365

WALLARAH
NATIONAL PARK

FOOTBRIDGE

LEGEND

- NORTHERN SECTOR BOUNDARY
- EXISTING LOT BOUNDARY
- WALLARAH PENINSULA TRACK
- EXISTING EASEMENT FOR ELECTRICITY TRANSMISSION LINES VARIABLE WIDTH (D.P.807342)
- HUNTER WATER OWNERSHIP
- COUNCIL OWNERSHIP
- NATIONAL PARK
- CENTRAL PRECINCT
- NORTHERN PRECINCT
- EXISTING GATES (ROAD CLOSED)

NORTHERN SECTOR - OVERVIEW

OVERALL SITE PLAN

0 150 300 375m
SCALE: 1:7500 (FULL)

SHEET 1 OF 9

REV D - 20.09.19

D09530896

Plotted By: Jeremy Dick Plot Date: 20/09/19 10:03:58AM Cad File: S:\239475\239475\NORTHERN\DRAWINGS\PLANNING\239475(N)-PSK-201-209[D].DWG