CULBURRA GOLF COURSE

SIS Addendum Report

For:

allen price & scarratts

December 2017

Final

PO Box 2474
Carlingford Court 2118

Report No. 16087RP1

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Version	Date Issued	Amended by	Details
001	29/11/2017	MF, KW	Draft Report
002	13/12/2017	MF, TM	Final

Approved by: Dr David Robertson

Position: Director

Signed: David Robertson

Date: *14 December, 2017*

DECLARATION

I Matt Philpott of Allen Price & Scarratts Pty Ltd (75 Plunkett Street Nowra), being the applicant for the proposed Culburra Golf Course on Long Bow Point (Development Application DA 11/1728 lodged with Shoalhaven City Council), have read and understood the Species Impact Statement Addendum Report. I understand the implications of the recommendations made in the statement and accept that they may be placed as conditions of consent or concurrence for the proposal.

Signed:

Date:

Table of Contents

Table of Contents *(Cont'd)*

Table of Contents *(Cont'd)*

Table of Contents *(Cont'd)*

List of Appendices

List of Tables

List of Figures

List of Figures

Glossary of Terms

BVT	BioMetric Vegetation Type
Council	Shoalhaven City Council
DGR	Director General Requirements
DA	Development Application
ELA	Eco Logical Australia
EMP	Environmental Management Plan
GCPoM	Golf Course Plan of Management
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectares
LGA	Local Government Area
Locality	The area of contiguous, or near-contiguous ecosystems and habitats within a 5km radius of the subject site
Long Bow Point	Property located in Culburra on Lake Wollumboola, including parts of Lots 5 and 6, DP1065111
NorBE	Neutral or Beneficial Effect
NSW	New South Wales
MNES	Matters of National Environmental Significance
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
Proposed Development	Proposed development of an 18 hole golf course and associated structures
Revised SIS	Species Impact Statement prepared by Gunninah 2015
SIS	Species Impact Statement
study area	The area including the subject site and any areas affected by the proposal, either directly or indirectly (**Figure 1.1**)
subject site	The area subject to the proposed action, as shown in **Figure 1.1**

TEC	Threatened ecological community
TSC Act	NSW *Threatened Species Conservation Act 1995*
VMP	Vegetation Management Plan

Executive Summary

S1.1 Introduction

Cumberland Ecology was commissioned by Allen Price & Scarratts to prepare an addendum ecological report to provide supplementary information for the Species Impact Statement (SIS) prepared by Gunninah (2015) for the Culburra Golf Course Project (the 'proposed development'). As such, this addendum report needs to be read in conjunction with the Gunninah SIS.

The proposed development involves the construction and operation of an 18-hole golf course on Long Bow Point. This addendum report will accompany the Gunninah SIS and form part of the Development Application (DA) documentation being submitted to Shoalhaven City Council.

S1.2 Background

The proposed development is for an 18-hole golf course and associated works on Long Bow Point, which is located on the periphery of Lake Wollumboola near the township of Culburra Beach, on the south coast of NSW. The study area is 226.6 ha, which comprises 196.1 ha of naturally vegetated land, with existing disturbance in its central portion, as well as a 100m buffer along the foreshores of Lake Wollumboola of 30.5 ha.

The study area has been redefined for this addendum report as all areas that are likely to be affected by the proposal, either directly or indirectly. This encompasses the land within Lots 5 and 6 DP DP1065111 south of Culburra Road, as well as a 100 metre buffer zone along the shores of Lake Wollumboola. The subject site is the area where clearing of vegetation is required in order to accommodate the proposed development and associated works, which comprises 35.7 hectares.

Several previous reports have been prepared for the study area since 2011, including a Flora and Fauna Assessment report, a Species Impact Statement (SIS), a Revised SIS and a Biobanking Assessment. Additionally, the Council and OEH have reviewed the Revised SIS and provided comments on outstanding information. The responses raised a number of concerns in relation to biodiversity and the SIS concurrence with the Director Generals Requirements (DGRs).

S1.3 Initial Assessment

Additional research was conducted to supplement the Revised SIS and ensure all subject species, populations and communities potentially occurring within the study area were identified.

OEH mapping of Threatened Ecological Communities (TECs) of the Shoalhaven, Eurobodalla and Bega Valley LGA (OEH, 2013), as well as mapping of the Long Bow Point

Property prepared by ELA (2016a), were consulted to assist in determining TECs to be included within the list of subject communities.

Database analyses and review of the current literature for records of threatened species occurring within the locality were examined to determine the likelihood of threatened species to occur in the study area. Database analysis was undertaken using the OEH Atlas of NSW Wildlife Database (OEH, 2017a), the BioBanking Credit Calculator and the Commonwealth Protected Matters Search Tool (DoEE, 2017). Additionally the DGR's and the Revised SIS were analysed to determine additional species that are potentially occurring within the locality.

S1.4 Additional Surveys

An array of flora and fauna surveys has been carried out within the study area and surrounding lands between 1993 and 2015, which provide a comprehensive database of the native flora and fauna present. Some threatened flora and fauna species, however, still lack the survey effort required to meet the DGRs as identified in the SIS review by Council. As such, targeted searches for threatened flora and fauna were carried out by Cumberland Ecology in 2017 to provide supplementary information on threatened species within the study area.

Additional field surveys have been conducted including target surveys for orchids and threatened fauna species. Furthermore, updated vegetation mapping of the study area by ELA in 2016 has been used for this report.

To satisfy outstanding requirements of the DGRs a targeted threatened orchid survey was conducted within the subject site by Cumberland Ecology on 21 and 22 September 2017. The areas directly impacted by the proposed development were the primary focus of the survey.

Systematic parallel transects were used to survey the subject site for targeted threatened orchids. These transects were carried out according to the OEHs' *NSW Guide to Surveying Threatened Plants* (OEH, 2016), as well as the *Draft survey guidelines for Australia's threatened orchids* (DoE, 2013), which involved two observers systematically traversing the subject site in parallel transects five to ten meters apart.

Additional fauna surveys were carried out by Cumberland Ecology to target species identified in the initial assessment that required further assessment. A combination of infra-red (IR) cameras, pitfall traps, Elliot traps and nest boxes have been used to survey for potential threatened species.

S1.4.1 Survey Results

i. Vegetation Communities

The BioBanking Assessment undertaken by ELA identified nine Biometric Vegetation Types (BVT's) that were present within the study area. Due to the fact that BVTs have since been phased out, Plant Community Type (PCT) codes were also determined. Nine BVTs were identified by ELA within the study area. The nine vegetation communities have been divided

into fifteen vegetation zones in order to further stratify the vegetation by condition. These can be seen in the table below.

Table S.1 Vegetation zones and communities within the study area

Zone	BVT	PCT	BVT Description	Area (ha)
1	SR592	1079	Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion	58.62
2	SR648	1231	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion	13.84
3	SR669	1326	Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	7.43
4	SR650	1234	Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	5.05
5	SR649	1232	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	4.02
6	SR649	1232	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	15.35
7	SR651	1236	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	14.04
8	SR512	659	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion	3.66
9	SR592	1079	Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion	0.00
13	SR516	694	Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion	43.21
14	SR648	1231	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion	5.21
21	SR614	1126	Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	4.22
24	SR651	1236	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	0.74
29	SR648	1231	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion	12.72
32	N/A	N/A	Cleared (SR592)	0.11
0	N/A	N/A	Cleared	7.87
0	N/A	N/A	Cleared (Water)	30.47
TOTAL				**226.55**

**Note: Zone 9 contains 0.000689 ha. Areas within the table have been rounded up.*

These BVTs conform to four TECs, which all have the potential to be either directly or indirectly impacted by the proposed development. These include:

- Bangalay Sand Forest of the Sydney Basin and South East Corner Bioregions (Bangalay Sand Forest) (TSC Act: EEC; EPBC Act: Not listed);
- Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Coastal Saltmarsh) (TSC Act: EEC; EPBC Act: Vulnerable Ecological Community (VEC));
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Oak Floodplain Forest) (TSC Act: EEC, EPBC Act: Not listed); and
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest) (TSC Act: EEC, EPBC Act: Not listed).

ii. Flora

No threatened orchids were recorded during the targeted surveys. Three orchids that were previously recorded within the study area were recorded during the surveys. These included the Large Tongue Orchid (*Cryptostylis subulata)*, Bonnet Orchid *(Cryptostylis erecta)* and Pink Fairy Orchid *(Caladenia carnea)*. Additionally one common orchid, the White Caladenia *(Caladenia catenata)*, was recorded that was not previously recorded within the study area. This species was only detected in one location along the western boundary of the study area.

iii. Fauna

No threatened fauna species listed under the TSC Act and/or EPBC Act were recorded during surveys within the study area. All of the fauna species recorded during the additional surveys undertaken for the purpose of this assessment have previously been recorded within the study area.

S1.5 Impact Assessment

S1.5.1 Direct Impacts

i. Vegetation Communities

The land within the study area is approximately 196.1 ha and the subject site is 35.7 ha in area (i.e. 18%). The table below provides a summary of the areas of each vegetation community to be cleared or modified within the subject site. It also shows the proportions of each community to be retained within the study area. Note that the vegetation to be retained includes the conservation area and vegetation strips retained between the fairways.

The subject site, which is proposed to be cleared, comprises four native vegetation communities and areas of cleared land. Small areas of two TECs are proposed for removal

within the subject site, which include Swamp Sclerophyll Forest and Swamp Oak Floodplain Forest.

Table S.2 Area in hectares of vegetation zones and communities to be removed and retained (does not include cleared areas or water)

Zone	BVT Description	Study Area (ha)	Subject Site		Retained Area	
			Area (ha)	Cleared (%)	Area (ha)	Retained (%)
1	Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion (BVT SR592 / PCT 1079)	58.62	11.33	19%	47.29	81%
2	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion (BVT SR648 / PCT 1231)	13.84	2.06	15%	11.78	85%
3	Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin and South East Corner (BVT SR669 / PCT 1326)	7.43	0.57	8%	6.86	92%
4	Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR650 / PCT 1234)	5.05	0.00	0%	5.05	100%
5	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR649 / PCT 1232)	4.02	0.00	0%	4.02	100%
6	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR649 / PCT 1232)	15.35	2.06	13%	13.28	87%
7	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR651 / PCT 1236)	14.04	0.00	0%	14.04	100%
8	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR512 / PCT 659)	3.66	0.00	0%	3.66	100%
9	Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion (BVT SR592 / PCT	0.00	0.00	0%	0.00	100%

Table S.2 Area in hectares of vegetation zones and communities to be removed and retained (does not include cleared areas or water)

Zone	BVT Description	Study Area (ha)	Subject Site		Retained Area	
			Area (ha)	Cleared (%)	Area (ha)	Retained (%)
	1079)					
13	Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion (BVT SR516 / PCT 694)	43.21	10.92	25%	32.29	75%
14	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion (BVT SR648 / PCT 1231)	5.21	1.29	25%	3.93	75%
21	Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (BVT SR614 / PCT 1126)	4.22	0.00	0%	4.22	100%
24	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR651 / PCT 1236)	0.74	0.17	23%	0.57	77%
29	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion (BVT SR648 / PCT 1231)	12.72	4.01	32%	8.70	68%
	TOTAL	188.09	32.40	17%	155.69	83%

ii. Habitat Features

The vegetation occurring within the subject site provides habitat for a range of flora and fauna, including species that are listed as threatened under the TSC Act and/or EPBC Act. The vegetation communities also support specific habitat features that provide foraging, shelter and breeding opportunities for fauna. The proposed development will result in the removal of some of these habitats and features within the subject site.

The removal of these habitat features is considered to have only minor implications for fauna species due to the presence of available habitat features remaining within the study area and wider locality as well as the high mobility of the species likely to utilise these habitats. It is anticipated that these features will continue to provide habitat for the suite of species within the study area.

The ephemeral drainage lines within the subject site will only be disturbed temporarily during construction. Furthermore, the ephemeral drainage lines do not provide significant habitat for the affected species identified within the subject site.

iii. Impacts on Lake Wollumboola and Associated Watercourses

The impacts on aquatic biota and other habitat resources as a result of the altered hydrology have been addressed in the Revised SIS. Some additional information associated with the altered hydrology can be found under indirect impacts. There are no anticipated direct impacts on Lake Wollumboola by the proposed development, since any clearing or earthworks are set back at least 150m from the shoreline of the lake. Furthermore, water runoff from the golf course will have a neutral or beneficial effect (NorBE) on the water quality of Lake Wollumboola and associated watercourse (Martens 2017).

S1.5.2 Indirect Impacts

The indirect impacts of the proposed development have been documented in the Revised SIS. Additionally, a suite of management plans are proposed within the Revised SIS to be prepared, following consent of the DA. One of these management plans, i.e. the Draft "Golf Course Plan of Management (GCPoM)" has been submitted in Appendix D2 of the Revised SIS.

Rather than having several management plans, one comprehensive Environmental Management Plan (EMP) is recommended.

S1.5.3 Impacts on Threatened Ecological Communities

Four TECs have been recorded within the study area, of which only two, namely Swamp Sclerophyll Forest and Swamp Oak Floodplain Forest, occur within the subject site and will be directly impacted by the proposed development. The extent of these TECs within the subject site and study area is indicated in the table below.

Table S.3 Area in hectares of TECs to be removed and retained

TEC/Vegetation Community	Status	Study Area (ha)	Subject Site		Retained Area	
			Area (ha)	Cleared (%)	Area (ha)	Retained (%)
Bangalay Sand Forest of the Sydney Basin and South East Corner Bioregions (Bangalay Sand Forest).	TSC Act: EEC; EPBC Act: Not listed	3.66	0	0%	3.66	100%
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Coastal Saltmarsh).	TSC Act: EEC; EPBC Act: Vulnerable	4.22	0	0%	4.22	100%

Table S.3 Area in hectares of TECs to be removed and retained

TEC/Vegetation Community	Status	Study Area (ha)	Subject Site		Retained Area	
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Oak Floodplain Forest).	TSC Act: EEC, EPBC Act: Not listed	34.29	2.24	7%	32.05	93%
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest).	TSC Act: EEC, EPBC Act: Not listed	39.19	7.92	20%	31.27	80%

S1.5.4 Assessment of Species Likely to be affected

Affected species/populations means those threatened species and endangered populations that are likely to be affected, either directly or indirectly by the proposed development.

The 17 affected species listed below have all been recorded in the locality and will have some potential habitat removed as a result of the development.

No threatened flora species are considered likely to occur within the subject site based on the previous surveys discussed in the Revised SIS, the unpublished BioBanking Assessment conducted by ELA (2016a) and the additional surveys carried out by Cumberland Ecology. As such no threatened flora species are included in the assessment in this chapter.

Table S.4 Species considered to be "affected species"

Common Name	Scientific Name	TSC Act Status	EPBC Act Status
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V	-
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V	-
Little Lorikeet	*Glossopsitta pusilla*	V	-
Masked Owl	*Tyto novaehollandiae*	V	-
Powerful Owl	*Ninox strenua*	V	-
Square-tailed Kite	*Lophoictinia isura*	V	-
Swift Parrot	*Lathamus discolor*	E	CE
Varied Sittella	*Daphoenositta chrysoptera*	V	-
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	V	-
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	-

Table S.4 Species considered to be "affected species"

Common Name	Scientific Name	TSC Act Status	EPBC Act Status
Eastern Freetail-bat	*Mormopterus norfolkensis*	V	-
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V
Little Bentwing-bat	*Miniopterus australis*	V	-
Southern Myotis	*Myotis macropus*	V	-
Yellow-bellied Glider	*Petaurus australis*	V	-
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-

S1.6 Mitigation Measures

A range of mitigation measures have been developed for the proposed development to mitigate the impacts that are unable to be avoided during construction. These mitigation measures will be applicable under the GCPoM and include:

- Vegetation clearance and fauna management protocols;
- Weed management;
- Dust management;
- Noise management; and
- Stormwater, erosion and sedimentation management.

Additionally long-term management of the study area will be conducted via the implementation of an Environmental Management Plan, Vegetation Management Plan and Compensatory strategies such as offsetting.

Compensatory strategies for the proposed development will consist of the majority of vegetation retained on-site to become an onsite offset that will be managed in perpetuity or the acquisition of credits from an offsite BioBanking site. The residual impacts of the proposed development have been quantified in a preliminary BioBanking assessment. While BioBanking is not required for the proposed development, it nevertheless provides a scientific approach to quantify impacts and assess the offset liability in order to compensate for the loss of biodiversity by the proposed development. The on-site offset area has also been quantified, which resulted in approximately two thirds of the offset liability being met.

Alternatively credits may be acquired by creating new offsite BioBanking sites or by the retirement of credits from existing BioBanking sites. Recommendations are included in this report on how the offset liability can be fully met.

S1.7 Conclusion

The proposed development will occupy approximately 18% of land within the study area. There will be clearing of 35.7 ha of native vegetation and this will mean some impacts to some TECs and threatened species. The remaining vegetation will be retained within the study area and permanently conserved and managed.

The proposed development has been designed in such a way to avoid impacts on TECs, threatened species and Lake Wollumboola. The proposal also entails substantial mitigation measures such as the development of an EMP.

If the proposed mitigation measures are implemented then no significant impact is likely to threaten flora and fauna listed either by the State TSC Act or the Commonwealth EPBC Act as a result of the proposed development.

cumberland ecology

Chapter 1

Introduction

Cumberland Ecology was commissioned by Allen Price & Scarratts to prepare an addendum ecological report to provide supplementary information for the Species Impact Statement (SIS) prepared by Gunninah (2015) for the Culburra Golf Course Project (the 'proposed development'). As such, this addendum report needs to be read in conjunction with the Gunninah SIS.

The proposed development involves the construction and operation of an 18-hole golf course on Long Bow Point. This addendum report will accompany the Gunninah SIS (2015) and form part of the Development Application (DA) documentation being submitted to Shoalhaven City Council.

1.1 Purpose

The purpose of this report is to provide additional ecological information as requested after reviews of the SIS prepared by Gunninah (2015). The following letters are addressed in this addendum SIS:

- Shoalhaven City Council (Council), dated 1 December 2015; and
- Letter from NSW Office of Environment and Heritage (OEH), dated 30 May 2016.

The letter from OEH includes issues and recommendations not pertaining to biodiversity, such as planning, water management and aboriginal cultural heritage. This report only addresses ecological issues.

Shoalhaven City Council states in their letter that the SIS is not compliant with the DGRs, specifically regarding the following issues:

- Inadequate boundaries and description of areas directly and indirectly impacted by the development;
- Some threatened species potentially affected by the proposal are not discussed (i.e. Diamond Firetail and White-fronted Chat);
- Lack of survey effort for threatened orchids;
- Lack of documentation and/or survey effort for the following species:
    - 7-part test to assess habitat removal for the Glossy Black-Cockatoo;

- 7-part test for loss of habitat for microbats;
- Lack of survey effort for Southern Brown Bandicoot, Long-nosed Potoroo, White-footed Dunnart, Eastern Pygmy Possum, Tiger Quoll; and Brush-tailed Phascogale;

- Council disagrees with the conclusion in the SIS of no significant impacts and deems that TECs are present on site;
- Assessment of likelihood of occurrence of subject species is required;
- Discussion of regional abundance, habitat utilisation and conservation status for affected species is missing;
- Description of the condition of different vegetation communities is required;
- Description of feasible alternatives is lacking detail and considered inadequate; and
- Inadequate compensatory strategy.

In summary, OEH makes the following recommendation and comments:

- SIS does not adequately address the DGRs;
- A golf course is deemed to have potential significant and irreversible flow-on effects on habitat and food sources for resident and migratory bird species;
- Lack of survey efforts for species potentially affected by the proposed development;
- Lack of survey effort for threatened orchids; and
- Lack of consideration of potential direct and indirect impacts along 100m buffer strip along Lake Wollumboola.

All of these items are addressed in this report, by providing additional ecological information on the following matters:

- Additional surveys for threatened species;
- Impact assessment on vegetation communities, flora and fauna;
- Ameliorative measures; and
- Offset strategy.

This report also documents the methods and results of recent field surveys, re-assesses the impacts of the proposed development on threatened species and communities in light of the latest field data and provides additional amelioration measures for adverse impacts resulting from the proposed development.

Furthermore, for the purpose of this report all references have been made to the TSC Act, which has been repealed, and not the NSW Biodiversity Conservation Act 2016.

1.2 Background

1.2.1 Location

The proposed developments located within parts of Lots 5 and 6 in DP 1065111, i.e. the parts that are located south of Culburra Road and at Long Bow Point, Culburra Beach (**Figure 1.1**). It is located on the southern side of the estuary of the Shoalhaven and Crookhaven Rivers, approximately 15 km southeast of the town of Nowra, within the Shoalhaven City Local Government Area (LGA). The Culburra Beach township is also located on the northern periphery of Lake Wollumboola, which is now part of the Jervis Bay National Park.

The two lots occur within a tract of privately owned land to the south of Culburra Road and together are approximately 196.1 ha in area. They are mostly naturally vegetated, with significant disturbance being limited to the central parts of the land where clearing has occurred for grazing purposes.

The surrounding land in areas adjacent to the two lots include Lake Wollumboola to the south and south-east, residential development to the north-east and bushland to the north and west.

1.2.2 Assessment History

Several previous reports have been prepared for the two lots since 2011, which are summarised in **Table 1.1**.

A Flora and Fauna Assessment report was first prepared for the subject site (defined in ***Section 1.3.2***) by Environmental InSite (July 2011), which concluded that an SIS was not considered necessary. This report was submitted with a DA to Council in 2011. Following that DA submission, Council requested preparation of a SIS for the proposed development.

An SIS was subsequently prepared by SLR Consulting Australia Pty Ltd (SLR) and was submitted to Council. In their review of the SIS, Council identified numerous non compliances with the DGRs and suggested that the SIS was amended to align with the DGRs prior to re-submission. The DGRs are included in **Appendix A**. Additionally a table of compliance with the DGRs is included in **Appendix B**.

Gunninah then prepared a revised SIS (the 'Revised SIS') based on the review by Council. The revised SIS was submitted to Council in 2015. Subsequently, Council reviewed the Revised SIS and the letter DA11/1728-04 (dated 1 December 2015) that stated that the majority of comments made in Council's previous review related to non-compliance with the DGRs were still relevant. Council has stated that further information will be required for the revised SIS to meet the requirements of the DGRs.

Additionally, OEH reviewed the revised SIS and provided additional information on 30 May 2016. The response raised a number of concerns in relation to biodiversity and the SIS concurrence with the DGRs.

In September 2016, Eco Logical Australia (ELA) carried out a BioBanking Assessment within the study area and provided updated vegetation mapping as well as identifying the vegetation communities likely to be affected by the proposed development.

Table 1.1 Previous documents consulted for this SIS

Year	Assessment Type	Organisation
2011	Flora and Fauna Assessment	Environmental InSite
2012	Supplementary Ecological Assessment Report	SLR Consulting Australia Pty Ltd
2014	Species Impact Statement	SLR Consulting Australia Pty Ltd
2015	Revised Species Impact Statement	Gunninah Environmental Consultants
2016	Vegetation Mapping	Eco Logical Australia

1.3 Description of the Proposed Development, Subject Site and Study Area

1.3.1 Proposed Development

The proposed development includes the construction of an 18-hole golf course within the subject site. This includes the following components:

- Construction of an 18-hole golf course including, fairways, greens and tees;
- Maintenance shed,
- Toilets
- Support services including power and sewer;
- Car park;
- Access roads; and
- Security entrance.

A detailed description of the proposed development and associated components can be found in the Revised SIS. Allowance has been made in the layout of the proposed development for a clubhouse; however construction of the clubhouse does not form part of the DA. An overview and plan of the golf course can be seen in **Appendix C**.

1.3.2 Subject Site

As defined in the DGRs (see **Appendix A**), the subject site is "*the area directly affected by the proposal*". The subject site referred to in the Revised SIS has been amended to include all areas that are likely to be directly impacted by the proposed development. The subject site referred to in this addendum report is 35.7 ha in area and its extent is shown in **Figure 1.1**.

The subject site refers to the area to be occupied by the Culburra Golf Course and its associated features. This also includes areas that will be utilised during construction such as temporary tracks used to transport machinery and materials as well as areas to be used for temporary storage, fencing, stockpiled refuse, and stockpiles of imported materials.

1.3.3 Study Area

The study area has been redefined for this addendum report. The DGRs define the study area as "*the subject site and any additional areas that are likely to be affected by the proposal, either directly or indirectly*". Based on a review of comments from Council the study area has been revised to encompass the land within Lots 5 and 6 DP DP1065111 that is south of Culburra Road, as well as a 100 m buffer zone along the shores of Lake Wollumboola (**Figure 1.1**). The study area comprises 226.1 ha, which comprises 196.1 ha of land and 30.5 ha of shoreline and water. It is considered that the surrounding land and water, outside the boundary of the study area, is unlikely to be affected by the proposed development.

1.4 Provision of Relevant Plans and Maps

The following maps are provided at the end of each chapter within this addendum report:

Chapter 1:

- **Figure 1.1.** Aerial view of the study area and subject site

Chapter 2:

- **Figure 2.1.** Threatened flora species recorded within the locality
- **Figure 2.2.** Threatened fauna species recorded within the locality
- **Figure 2.3.** OEH mapping of threatened ecological communities within the study area

Chapter 3:

- **Figure 3.1.** 2017 targeted threatened orchid surveys within the study area
- **Figure 3.2.** 2017 targeted threatened fauna surveys within the study area

Legend

Subject Site

Study Area

Coordinate System: MGA Zone 56 (GDA 94)

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0 500 1,000 1,500 2,000 m

I:\...\16087\Figures\RP1\20171212\Figure 1.1. Aerial view of the study area and subject site

Figure 1.1. Aerial view of the study area and subject site

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Chapter 2

Initial Assessment

2.1 Assessment of Available Information

Additional research was conducted to supplement the Revised SIS and ensure all subject species, populations and communities potentially occurring within the study area were identified.

OEH mapping of TECs of the Shoalhaven, Eurobodalla and Bega Valley LGA (OEH, 2013), as well as mapping of the Long Bow Point Property prepared by ELA (2016a), were consulted to assist in determining TECs to be included within the list of subject communities.

Database analyses and review of the current literature for records of threatened species occurring within the locality were examined to determine the likelihood of threatened species to occur in the study area. Database analysis was undertaken using the OEH Atlas of NSW Wildlife Database (OEH, 2017a), the BioBanking Credit Calculator and the Commonwealth Protected Matters Search Tool (DoEE, 2017). The Atlas of NSW Wildlife Database search was used to generate records of threatened flora and fauna species and populations listed under the NSW *Threatened Species Conservation Act 1995 (*TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) within the locality of the study area. Migratory avifauna protected under the EPBC Act were also included in the Atlas of NSW Wildlife search. The BioBanking Credit Calculator was used to generate a list of species that are predicted to occur based on Plant Community Types (PCTs). The Protected Matters Search Tool generated a list of potentially occurring Matters of National Environmental Significance (MNES) listed under the EPBC Act within a 5 km radius of the study area.

Records of threatened flora and fauna from the OEH Atlas of NSW Wildlife are shown in **Figure 2.1** and **Figure 2.2**, respectively. Additionally, migratory species listed under the EPBC Act were considered. The abundance, distribution and age of records generated within the search area also provided supplementary information for the assessment of likelihood of occurrence of those threatened species within the study area. Consideration was also given to those threatened species listed in the DGRs.

Appendix D lists all flora and fauna species and populations considered within this assessment and indicates those which are considered to be subject species. The determination of whether a community, species or population is considered a subject species is based on records, habitat types present in the study area and species distributions.

2.2 Identifying Subject Species, Populations and Communities

2.2.1 Threatened Ecological Communities

The TECs potentially occurring within the study area have been updated from the Revised SIS. Vegetation mapping by OEH in 2013 for TECs in the Shoalhaven, Eurobodalla and Bega Valley and LGAs as well as vegetation mapping conducted by ELA were consulted to refine the list of subject communities within the study area. The list of subject communities occurring within the study area includes the following:

- Bangalay Sand Forest of the Sydney Basin and South East Corner Bioregions (Bangalay Sand Forest);
- Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Coastal Saltmarsh);
- Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion (Illawarra Lowlands Grassy Woodland);
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Oak Floodplain Forest); and
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest).

The TEC mapping by OEH (2013) also includes "*Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*" which is listed as an Endangered Ecological Community (EEC) under the TSC Act. This 6 ha patch of vegetation in the study area was subsequently mapped as Swamp Sclerophyll Forest during the field surveys by ELA. The TEC mapping by OEH (2013) is replicated in **Figure 2.3**, while the vegetation mapping by ELA is shown in **Figure 3.3**.

2.2.2 Threatened Species and Populations

This addendum report provides an updated list of the subject species previously identified in Table 7.1 and 7.2 of the Revised SIS. Additional species have been added to the list of subject species due to a review of habitat requirements, results of recent surveys and results of updated database searches. The threatened species and populations considered as subject species for this addendum report are as follows:

- Threatened flora species:
  - East Lynne Midge Orchid *(Genoplesium vernale)*;
  - Eastern Australian Underground Orchid *(Rhizanthella slateri);*
  - Illawarra Greenhood *(Pterostylis gibbosa)*;

- Leafless Tongue Orchid *(Cryptostylis hunteriana)*;
- *Pterostylis ventricosa*;
- Thick-lip Spider Orchid *(Caladenia tessellate)*; and
- Villous Mint-bush *(Prostanthera densa)*.

➢ Threatened fauna species:

- Green and Golden Bell Frog (*Litoria aurea*);
- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*);
- Little Lorikeet (*Glossopsitta pusilla*);
- Masked Owl (*Tyto novaehollandiae*);
- Powerful Owl (*Ninox strenua*);
- Regent Honeyeater (*Anthochaera phrygia*);
- Scarlet Robin (*Petroica boodang*);
- Square-tailed Kite (*Lophoictinia isura*);
- Swift Parrot (*Lathamus discolor*);
- Turquoise Parrot (*Neophema pulchella*);
- Varied Sittella (*Daphoenositta chrysoptera*);
- White-fronted Chat (*Epthianura albifrons*);
- Square-tailed Kite (*Lophoictinia isura*);
- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Regent Honeyeater (*Anthochaera phrygia*);
- White-fronted Chat (*Epthianura albifrons*);
- Varied Sittella (*Daphoenositta chrysoptera*);
- Scarlet Robin (*Petroica boodang*);
- Little Lorikeet (*Glossopsitta pusilla*);
- Swift Parrot (*Lathamus discolor*);

- Turquoise Parrot (*Neophema pulchella*);
- Powerful Owl (*Ninox strenua*);
- Masked Owl (*Tyto novaehollandiae*);
- Brush-tailed Phascogale (*Phascogale tapoatafa*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*);
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Eastern Freetail-bat (*Mormopterus norfolkensis*);
- Eastern Pygmy Possum (*Cercartetus nanus*);
- Eastern Quoll (*Dasyurus viverrinus*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Greater Glider (*Petauroides volans*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Koala (*Phascolarctos cinereus*);
- Little Bentwing-bat (*Miniopterus australis*);
- Southern Brown Bandicoot (*Isoodon obesulus obesulus*);
- Southern Myotis (*Myotis macropus*);
- Spotted-tailed Quoll (*Dasyurus maculatus*);
- Squirrel Glider (*Petaurus norfolcensis*);
- White-footed Dunnart (*Sminthopsis leucopus*);
- Yellow-bellied Glider (*Petaurus australis*); and
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

A number of migratory birds have been recorded within the study area which utilise habitats on the foreshore of Lake Wollumboola. The Integrated Water Management Plan for Culburra Golf Course demonstrates that groundwater seepage and stormwater runoff will not have significant or irreversible flow on effects on the water quality of the lake or associated habitats. As stated by Martens (2017), the NorBE requirements will be met. Therefore, there will be no significant impact on the migratory birds that utilise the lake. As these species will not be impacted by the proposed development they are not considered as subject species.

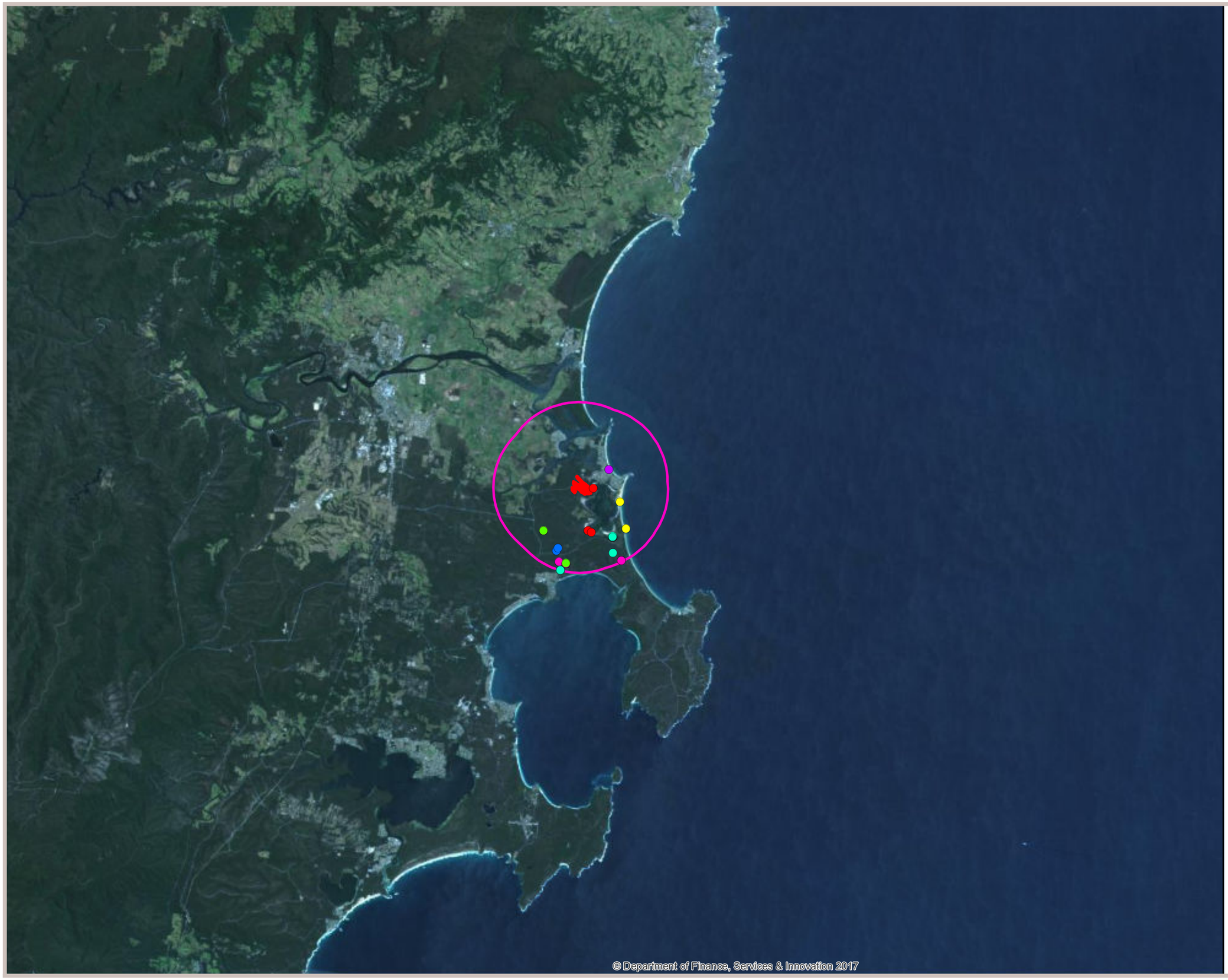
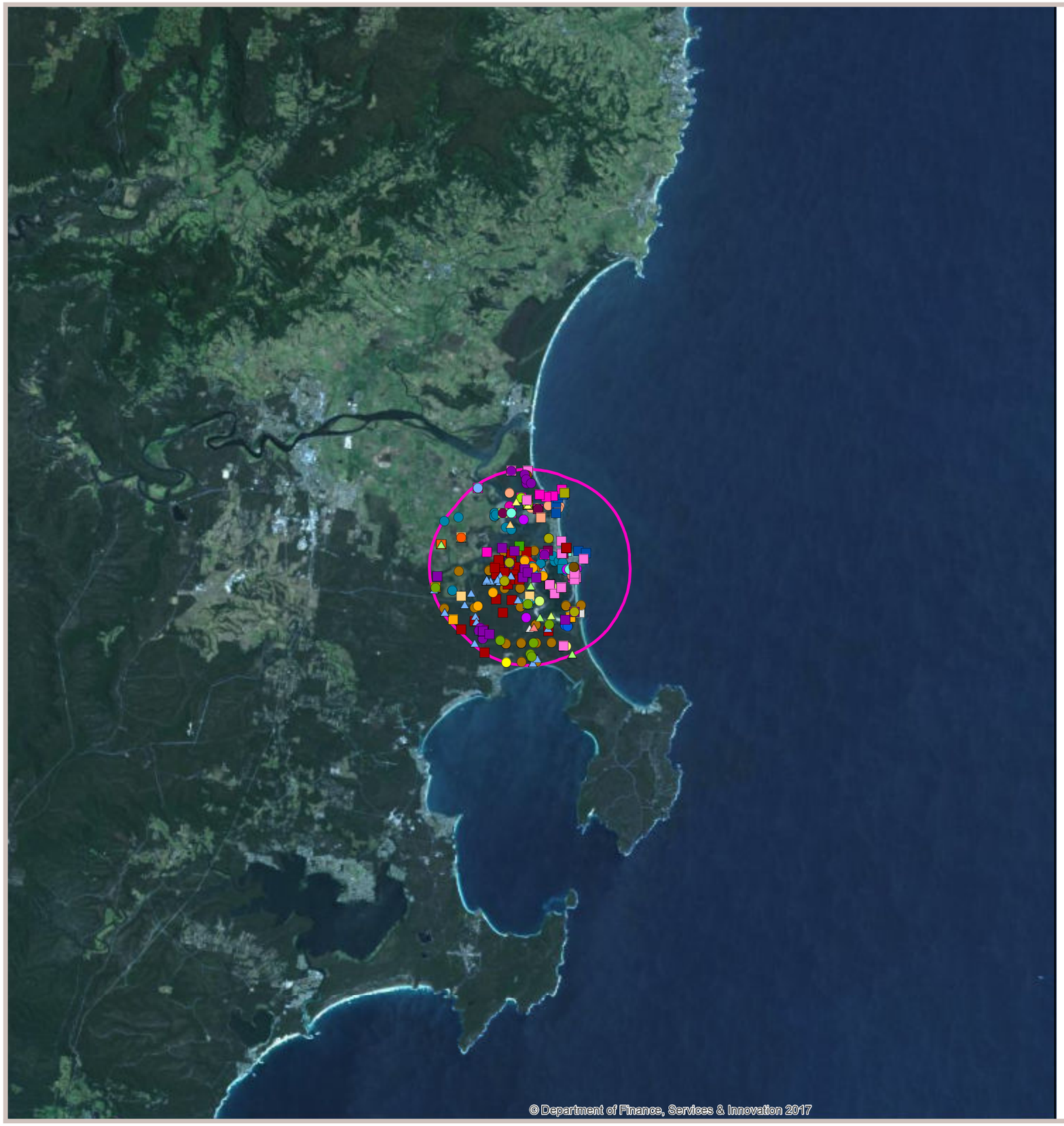


Figure 2.1. Threatened flora species recorded within the locality



Legend

- Subject Site
- 5km Radius

Threatened Fauna

- Bar-tailed Godwit
- Beach Stone-curlew
- Black Bittern
- Black-tailed Godwit
- Broad-billed Sandpiper
- Buff-breasted Sandpiper
- Caspian Tern
- Cattle Egret
- Common Greenshank
- Common Tern
- Curlew Sandpiper
- Dusky Woodswallow
- Eastern Bentwing-bat
- Eastern Bristlebird
- Eastern Curlew
- Eastern False Pipistrelle
- Eastern Freetail-bat
- Eastern Ground Parrot
- Eastern Osprey
- Eastern Reef Egret
- Fork-tailed Swift
- Gang-gang Cockatoo
- Glossy Black-Cockatoo
- Greater Broad-nosed Bat
- Greater Glider
- Greater Sand-plover
- Green and Golden Bell Frog
- Grey Plover
- Grey-headed Flying-fox
- Grey-tailed Tattler
- Gull-billed Tern
- Hooded Plover
- Koala
- Latham's Snipe
- Lesser Sand-plover
- Little Curlew
- Little Eagle
- Little Lorikeet
- Little Shearwater
- Little Stint
- Little Tern
- Marsh Sandpiper
- Masked Owl
- Northern Giant-Petrel
- Oriental Plover
- Pacific Golden Plover
- Pectoral Sandpiper
- Pied Oystercatcher
- Powerful Owl
- Providence Petrel
- Red Knot
- Red-necked Stint
- Ruddy Turnstone
- Sanderling
- Scarlet Robin
- Sharp-tailed Sandpiper
- Short-tailed Shearwater
- Sooty Oystercatcher
- Southern Myotis
- Square-tailed Kite
- Swift Parrot
- Varied Sittella
- Wandering Albatross
- Wedge-tailed Shearwater
- Whimbrel
- White-bellied Sea-Eagle
- White-fronted Chat
- White-throated Needletail
- White-winged Black Tern
- Yellow-bellied Glider

Data Source:
BioNet Atlas of NSW Wildlife
© NSW Office of Environment and Heritage
dated 1/1/1980 - 30-10-2017

Coordinate System: MGA Zone 56 (GDA 94)

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0 2 4 6 8 10 Km

I:\...\16087\Figures\RP1\20171212\Figure 2.2. Threatened Fauna Species_Study Area

Figure 2.2. Threatened fauna species recorded within the locality

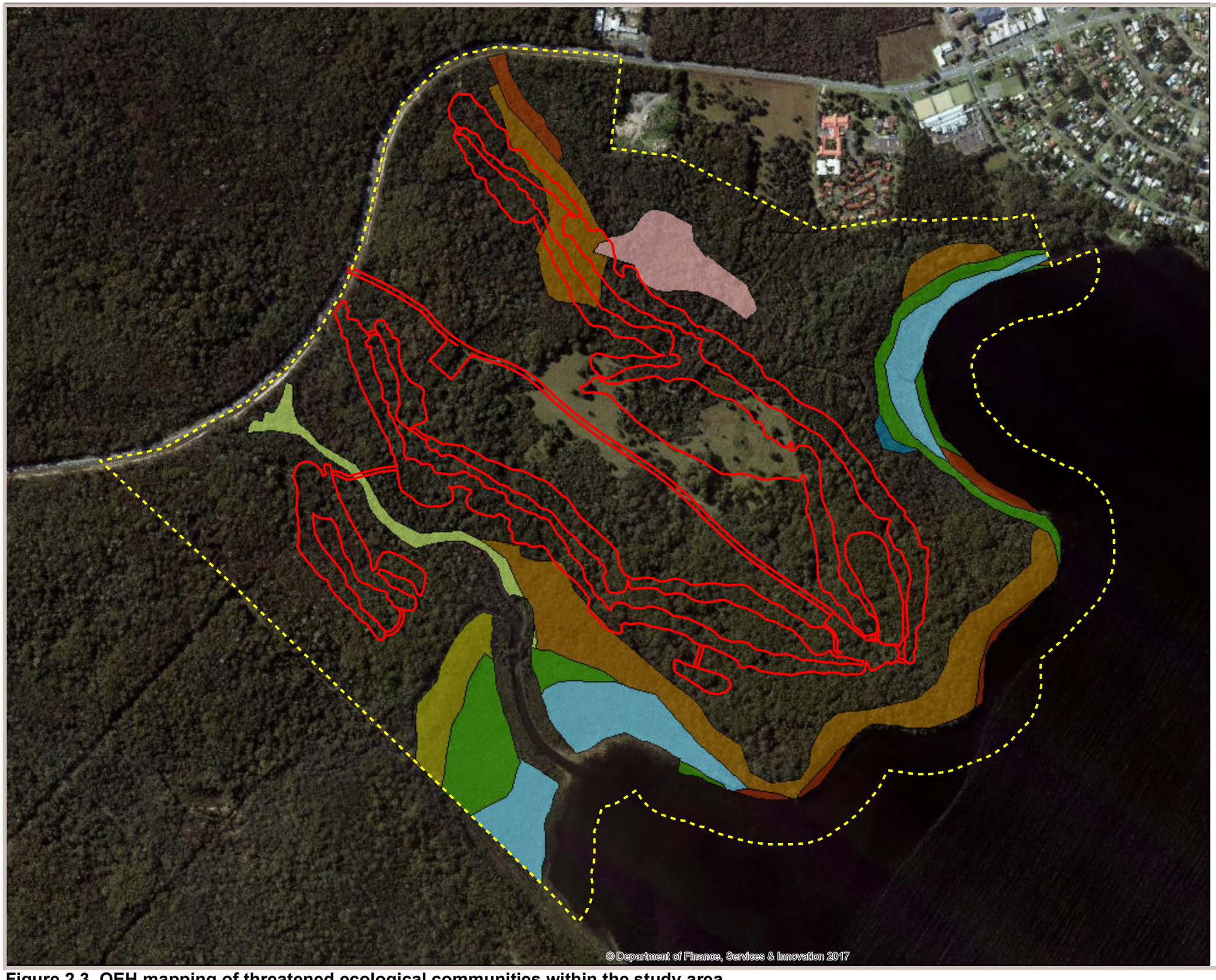

Figure 2.3. OEH mapping of threatened ecological communities within the study area

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Chapter 3

Additional Surveys

This chapter presents the background of ecological studies in the study area, details of the procedures for the additional surveys undertaken for the purposes of this addendum report, and a summary of the results of past and current surveys.

3.1 Survey Requirements

3.1.1 Flora and Fauna Species

An array of flora and fauna surveys has been carried out within the study area and surrounding lands between 1993 and 2015, which provide a comprehensive database of the native flora and fauna present. Each of these studies, including the methods used, as well as the survey efforts can be found in the Revised SIS (Gunninah, 2015).

Some threatened flora and fauna species, however, still lack the survey effort required to meet the DGRs as identified in the SIS review by Council. As such, targeted searches for threatened flora and fauna were carried out by Cumberland Ecology in 2017 to provide supplementary information on threatened species within the study area. As the water quality of Lake Wollumboola will not be impacted by the proposed development (Martens 2017) there will be no impact on aquatic flora and fauna species. As such, no aquatic surveys have been conducted as part of this report. The methods utilised by Cumberland Ecology and survey effort are described within ***Section 3.2***.

3.1.2 Vegetation Communities

The vegetation communities within Lots 5 and 6 in DP1065111 at Long Bow Point have been mapped as part of previous assessments for the subject site. The most recent vegetation mapping was completed by ELA in 2016 as part of a BioBanking Assessment, which is discussed further in ***Section 3.3***. Additionally, the vegetation mapping by OEH in 2013 for TECs in the Shoalhaven, Eurobodalla and Bega Valley LGAs has been considered.

3.2 Survey Effort and Techniques

3.2.1 Vegetation Mapping

Vegetation mapping for the study area has been updated since the Revised SIS. ELA conducted vegetation mapping in 2016 as part of a Strategic Biodiversity Assessment (Eco Logical Australia, 2016a), which was carried out on the study area to calculate the impacts of

the proposed development on biodiversity values using the BioBanking Assessment Methodology (BBAM). The vegetation mapping produced by ELA has been used in this report to assess the vegetation communities within the study area.

3.2.2 Flora Survey

Previous studies have been conducted to provide a detailed list of flora species occurring within the study area. Targeted searches have been carried out for threatened species with potential to occur within the subject site. The SIS adequately addresses the majority of threatened flora species except for threatened orchids.

Surveys for threatened orchids have been conducted within the subject site for each of the orchids considered as subject species. To satisfy outstanding requirements of the DGRs a targeted threatened orchid survey was conducted within the subject site by a botanist from Cumberland Ecology on 21 and 22 September 2017. The areas directly impacted by the proposed development were the primary focus of the survey. The methods are described in detail below.

i. Targeted Threatened Orchid Surveys

To guide the threatened species searches, a list of candidate species was determined through analysis of database records and consideration of available habitat. The candidate species are equivalent to the subject species identified in the Revised SIS. Targeted surveys were undertaken for the following species:

- Eastern Australian Underground Orchid (*Rhizanthella slateri*) – flowering September to November;
- Illawarra Greenhood (*Pterostylis gibbosa*) – flowering June to September;
- Thick Lip Spider Orchid (*Caladenia tessellata*) – flowering September to October.

As identified by the BioBanking Credit Calculator, these species have specific survey periods throughout the year. Other candidate species have been adequately surveyed and are documented in the Revised SIS

Systematic parallel transects were used to survey the subject site for these targeted threatened orchids. These transects were carried out according to the OEHs' *NSW Guide to Surveying Threatened Plants* (OEH, 2016), as well as the *Draft survey guidelines for Australia's threatened orchids* (DoE, 2013), which involved two observers systematically traversing the subject site in parallel transects five to ten meters apart. Transects especially focused on areas directly impacted by the proposed development, as well as ensuring transects were conducted within each of the vegetation communities within the study area. The locations of transects within the study area is shown in **Figure 3.1**. Each of these transects had two observers traversing along either side within 10 meters of each other.

ii. Survey Effort for Threatened Orchids

The targeted surveys for threatened orchids carried out by Cumberland Ecology in September 2017 are summarised in **Table 3.1** below.

Table 3.1 Survey effort for threatened orchids

Date	Number of Transects	Person Hours
21/09/2017	13	14
22/09/2017	15	14

3.2.3 Fauna Survey

Previous fauna surveys that have been conducted for the subject species are outlined in the Revised SIS (Gunninah, 2015). These surveys, however, did not adequately assess all of the subject species. Furthermore, recent surveys conducted by ELA recorded threatened species on adjacent land that had not been considered as subject species. As such, additional fauna surveys were carried out by Cumberland Ecology to target species that required further assessment.

Surveys conducted by Cumberland Ecology were focused primarily on the following species:

- Southern Brown Bandicoot (*Isoodon obesulus obesulus*);
- Long-nosed Potoroo (*Potorous tridactylus tridactylus*);
- White-footed Dunnart (*Sminthopsis leucopus*);
- Eastern Pygmy Possum (*Cercartetus nanus*);
- Spotted-tailed Quoll (*Dasyurus maculatus*); and
- Brush-tailed Phascogale (*Phascogale tapoatafa*).

All remaining subject species are believed to have been adequately surveyed in previous surveys.

Targeted threatened fauna surveys were conducted in two rounds by two ecologists from Cumberland Ecology. Surveys were carried out between September and November 2016 and again between October and November 2017. The surveys were conducted, where appropriate, in accordance with the *Survey Guidelines for Australia's Threatened Mammals* (SEWPaC, 2011) and included the following survey methods:

- Infra-red (IR) camera trapping;
- Elliot and pitfall trapping; and

- Nest box monitoring.

The fauna survey methods are described in the following sections. The locations of all additional fauna survey sites within the study area are shown in **Figure 3.2**.

i. IR Camera Trapping

Two rounds of IR camera trapping were conducted by Cumberland Ecology. The first round in 2016 involved the installation of 14 IR cameras near likely foraging areas for terrestrial fauna. Cameras were set up for 56 nights from 21 September to 16 November 2016. These cameras were placed in areas containing native vegetation within the study area and consisted of three arboreal cameras and two terrestrial cameras. The cameras were baited with a mixture of peanut butter, oats and honey.

The second round involved the installation of 10 IR cameras at potential foraging areas for arboreal mammals. The arboreal mammals targeted were the Eastern Pygmy Possum and the Brush-tailed Phascogale. Cameras were left for 29 nights from 10 October to 8 November 2017. Cameras were placed across five sites, with two cameras in each site, targeting different vegetation communities within the study area. At each site, one IR camera was focused on a on a hollow bearing tree baited with a sipper bottle containing a honey/water solution and the other on a flowering banksia, a known feed source of the Eastern Pygmy Possum.

ii. Elliot and Pitfall Trapping

Elliot and pitfall traps were set up at five sites across the study area targeting small terrestrial mammals. Within each site two 50m transects were set up with approximately 25m between transects. One transect consisted of four pitfall traps, which were distributed along transect at approximately 10m intervals. Each pitfall trap had 10m of drift fencing installed along each side. The second transect consisted of five Elliot A traps set up at 10m intervals. Elliot traps were baited with a mixture of peanut butter, oats and honey.

Elliot and pitfall traps were installed for four nights with traps being checked within two hours of sunrise each day. After traps were checked they were closed/covered during the day and reset within two hours of sunset.

iii. Nest Box Monitoring

Eastern Pygmy Possum nest boxes were installed at five sites across the study area. A total of ten nest boxes were installed with two nest boxes at each site. Each nest box was installed at approximately breast height on trees that were in close proximity to flowering banksias. Nest boxes were checked each morning for four consecutive days and then left for 25 nights before a final check.

iv. Survey Effort for Threatened Fauna

Fauna survey methods and survey effort are summarised in **Table 3.2**.

Table 3.2 Fauna survey dates and effort

Survey Technique	Survey Dates	Total Survey Effort
IR camera trapping	21/09/2017 - 16/10/2017	784 trap nights (14 cameras for 56 nights)
	10/10/2017 - 08/11/2017	290 trap nights (10 IR cameras for 29 nights)
Elliot trapping	10/10/2017 - 14/10/2017	100 trap nights
Pitfall trapping	10/10/2017 - 14/10/2017	80 trap nights
Nest box monitoring	10/10/2017 - 03/11/2017	480 nights

3.2.4 Weather Conditions

Weather conditions during flora and fauna surveys were appropriate for detection of a variety of flora and fauna. Surveys were undertaken during spring in 2016 and 2017 (September to November). A summary of weather conditions in the wider locality of the study area during the flora and fauna survey periods is provided in **Table 3.3**. Weather station data was obtained from station 068151 – Jervis Bay (Point Perpendicular AWS) NSW (Bureau of Meteorology, 2017).

Table 3.3 Weather conditions during surveys

Date	Temperature (Min.)	Temperature (Max.)	Rainfall (mm)
2016			
21/09/2016	12.9	16.6	0.4
22/09/2016	12.2	17	6.4
23/09/2016	12.7	17.3	7
24/09/2016	14.3	19.3	0
25/09/2016	14.9	19.2	1
26/09/2016	11.4	16.7	3.8
27/09/2016	10.6	18	0
28/09/2016	9	17.6	1.2
29/09/2016	14	18.6	6.4
30/09/2016	10.7	17.5	5.8
1/10/2016	11	19.3	0
2/10/2016	12.3	23.5	0
3/10/2016	16.4	21.6	0
4/10/2016	13	19.9	0
5/10/2016	10.4	18.7	0
6/10/2016	12.7	25.2	0
7/10/2016	18	26.6	0

Table 3.3 Weather conditions during surveys

Date	Temperature (Min.)	Temperature (Max.)	Rainfall (mm)
8/10/2016	15.6	15.9	0
9/10/2016	11.1	20.7	0.6
10/10/2016	14.2	25.5	0
11/10/2016	11.7	17	0
12/10/2016	9	18.4	0
13/10/2016	10	14.8	4.8
14/10/2016	10.4	17.6	0.2
15/10/2016	11.4	24.2	0
16/10/2016	16.5	26.2	0
17/10/2016	16.1	19.1	0.4
18/10/2016	11.5	22	1.2
19/10/2016	12.2	17.4	0
20/10/2016	11.8	21	0.6
21/10/2016	14.7	23.7	0
22/10/2016	12.9	13.2	20.6
23/10/2016	9.3	14	2.6
24/10/2016	9.5	17	0
25/10/2016	10.1	22.7	0
26/10/2016	15.5	24.4	0
27/10/2016	16.2	16.6	0
28/10/2016	11.7	18	1.8
29/10/2016	13	21.7	4.4
30/10/2016	17.7	24.2	1.4
31/10/2016	13.2	18.8	1
1/11/2016	10.4	19.4	0
2/11/2016	13.9	20.8	0
3/11/2016	12.6	21.2	0
4/11/2016	13.2	27.8	0
5/11/2016	15.7	22	0
6/11/2016	14.2	21.2	0
7/11/2016	15.7	28.2	0
8/11/2016	16.5	17.7	0
9/11/2016	13.4	16.9	7.4
10/11/2016	13.7	20.4	1.6
11/11/2016	14.7	20.6	1.2

Table 3.3 Weather conditions during surveys

Date	Temperature (Min.)	Temperature (Max.)	Rainfall (mm)
12/11/2016	16.4	28.7	22
13/11/2016	16.9	24.5	0
14/11/2016	15.3	19	1.4
15/11/2016	14.6	18.9	0
16/11/2016	12.5	20.1	0
2017			
10/10/2017	15	19.8	0.4
11/10/2017	15.6	22.9	1
12/10/2017	18.5	20.9	0.8
13/10/2017	12.3	20.4	0
14/10/2017	15	17.7	0
15/10/2017	12.5	20.7	0
16/10/2017	14.1	21.4	0
17/10/2017	12.8	23.8	0
18/10/2017	15.9	23.9	0
19/10/2017	16.7	23.1	0
20/10/2017	14.6	16	7.2
21/10/2017	11.9	16.7	0
22/10/2017	13.1	18.6	0
23/10/2017	12.9	19.4	1
24/10/2017	12.5	25.5	0
25/10/2017	16.3	26.1	0.2
26/10/2017	15.7	19.6	2
27/10/2017	15.1	19.3	14.8
28/10/2017	14.8	24	2.2
29/10/2017	18.9	28	0
30/10/2017	19.5	31.9	0
31/10/2017	11.3	16.7	5
1/11/2017	12.2	18	0
2/11/2017	13.8	20.4	0
3/11/2017	14.5	25.4	0
4/11/2017	13.1	16.6	0
5/11/2017	13.8	17	0
6/11/2017	13.8	18.9	36.6
7/11/2017	13.1	17.9	12.6

3.2.5 Survey Personnel

Cumberland Ecology staff are licensed to conduct surveys under the following licences:

- Animal Research Authority, Trim 17/1197;
- NSW Scientific Licence (Section 132 C), SL100103; and
- BioBanking Accreditation, David Robertson, Accreditation BAAS17027/ID 0057.

The qualifications and experience of Cumberland Ecology staff who conducted the additional target surveys are provided in **Table 3.4**, all of which can be contacted on (02) 9868 1933.

Table 3.4 Qualifications and experience

Survey Personnel	Role	Qualification	Experience (years)
Matt Freeman	Project Manager / Ecologist	Bachelor of Natural Science, Major in Nature Conservation	4 years
Mikael Peck	Ecologist	Bachelor of Science, Master of Marine Science and Management	5 years
Bryan Furchert	Botanist	Bachelor of Biodiversity and Conservation	5 years
Adriana Corona Mothe	Ecologist	Bachelor of Science (thesis) in Biology, Masters in Biology of Aquatic Systems and Resources and a PhD in Marine Ecology	1 year

3.2.6 Survey Limitations

Adequate ecological data exists for the assessment of the ecological impacts for the proposed development. The flora and fauna of the study area have been subject to a series of surveys over several years. Consequently, the biodiversity values of the study area are well known and the additional surveys were supplementary of the existing suite of data.

i. Flora

The weather conditions at the time of the flora surveys were favourable for plant growth and production of features required for identification of target species. Some species of orchids, however, can be extremely variable and are known to only flower at specific times of year. Additionally, some orchid species do not necessarily flower every year and can remain dormant across multiple years due to environmental conditions (DoE, 2013). It is possible that some of the target species were not in flower however it is considered that sufficient information has been collected to assess conservation significance of all target species.

ii. Fauna

The vertebrate fauna of the locality is well known based on a sizeable database of past records and various published reports. The surveys by Cumberland Ecology added to the existing database and helped to provide an indication of the likelihood of occurrence of target species.

In general, all of the surveys undertaken for fauna provide a good indication of the fauna likely to utilise the habitat within the study area. However, it is acknowledged that not all fauna utilising the study area are likely to have been recorded, therefore, the data produced by the surveys is not an absolute census of all vertebrate fauna species occurring within the study area. An assessment of the likelihood of occurrence of threatened and migratory fauna species listed for the locality in the database searches was undertaken to supplement the fauna surveys (**Appendix E**). The combination of these techniques is considered appropriate for assessing the habitat values of the site for threatened fauna within the study area.

3.3 Vegetation Survey Results

The BioBanking Assessment undertaken by ELA identified nine Biometric Vegetation Types (BVT's) that were present within the study area. Due to the fact that BVTs have since been phased out, Plant Community Type (PCT) codes are included as well. Each of the BVTs has been linked to a vegetation community identified under the South Coast – Illawarra Vegetation Integrations (SCIVI) Project. Furthermore, where a BVT conforms to a TEC, the name of the TEC has been identified.

The nine vegetation communities have been divided into fifteen vegetation zones in order to further stratify the vegetation by condition. The description by ELA (2016b) of each vegetation zone (excluding Zone 32, which comprises cleared land) within the study area are reproduced below.

The extent of each vegetation zone within the study area is provided in **Table 3.5** and shown in **Figure 3.3**.

Table 3.5 Vegetation zones and communities within the study area

Zone	BVT	PCT	BVT Description	Area (ha)
1	SR592	1079	Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion	58.62
2	SR648	1231	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion	13.84
3	SR669	1326	Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	7.43

Table 3.5 Vegetation zones and communities within the study area

Zone	BVT	PCT	BVT Description	Area (ha)
4	SR650	1234	Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	5.05
5	SR649	1232	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	4.02
6	SR649	1232	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	15.35
7	SR651	1236	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	14.04
8	SR512	659	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion	3.66
9	SR592	1079	Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion	0. 00
13	SR516	694	Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion	43.21
14	SR648	1231	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion	5.21
21	SR614	1126	Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	4.22
24	SR651	1236	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	0.74
29	SR648	1231	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion	12.72
32	N/A	N/A	Cleared (SR592)	0.11
0	N/A	N/A	Cleared	7.87
0	N/A	N/A	Cleared (Water)	30.47
TOTAL				**226.55**

**Note: Zone 9 contains 0.000689 ha. Areas within the table have been rounded up.*

3.3.1 Zone 1

BVT	SR592 - Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion
PCT	1079
Ancillary Code	Logged/advanced regrowth with scattered old-growth trees

Condition	Moderate to Good
SCIVI	Currambene-Batemans Lowlands Forest.
Description	Currambene-Batemans Lowlands Forest dominates the assessment area and the Jervis Bay hinterland generally. The community is characterised by a very diverse suite of canopy species, and also a diverse but generally dry sclerophyll aligned shrub layer. The Currambene-Batemans Lowlands Forest within the assessment area is characteristically variable floristically. In places, the canopy is dominated, sometimes completely, by a single eucalypt species, generally *Eucalyptus pilularis* or *Eucalyptus sclerophylla*, although it is often a mix of up to six to eight eucalypt species. Zone 1 also includes occurrences of Currambene-Batemans Lowlands Forest where *Corymbia maculata* is co-dominant and the understorey and groundcover are relatively patchy and comprise a mix of heathy and more mesic shrubs, forbs and graminoids. These occurrences typically occur at Sussex Inlet, but also occur to the west of Callala.
TEC	No

3.3.2 Zone 2

BVT	SR648 - Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion
PCT	1231
Ancillary Code	Swamp Forest occurs along broad drainage lines usually dominated by Woollybutt, but also Swamp Mahogany with a very sedgy and swampy small tree and shrub layer
Condition	Moderate to Good
SCIVI	Coastal Sand Swamp Forest
Description	Coastal Sand Swamp Forest occurs on flats adjacent to drainage lines and behind estuaries, where drainage is impeded. The community is characterised by a canopy that is dominated by *Eucalyptus longifolia,* or *Eucalyptus robusta*. Other eucalypts may be present. There may be a sub-canopy of *Melaleuca decora* however there is typically a dense understorey of sedges, shrubs or small trees associated with swamps. Groundcovers comprise sedges, rushes, forbs and grasses associated with coastal swamps. The BVT selected is a best fit, however does not well describe the floristic and

	structural diversity of the community within the assessment area, particularly those occurrences where the canopy is dominated by *Eucalyptus longifolia*, the sub-canopy dominated by *Melaleuca decora* and the understorey which is often dominated by *Callistemon linearis*. However a more suitable fit BVT is not available and the zone is accurately described by the Coastal Swamp Forests class.
TEC	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

3.3.3 Zone 3

BVT	SR669 - Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin and South East Corner
PCT	1326
Ancillary Code	Grassy swamp forest with *Melaleuca decora* dominated sub-canopy, open understorey and graminoid dominated groundcover
Condition	Moderate to Good
SCIVI	South Coast Lowland Swamp Woodland.
Description	South Coast Lowland Swamp Woodland occurs on loamy flats adjacent to drainage lines, where drainage is impeded to some extent. It is typically replaced closer to estuaries in swampier areas by SR648. Where drainage is better (generally upslope) it is typically replaced by Currambene-Batemans Lowlands Forest. The community is characterised by a canopy that is dominated by *Eucalyptus longifolia,* but often also includes *Eucalyptus globoidea, Eucalyptus paniculata, Eucalyptus botryoides* or *Eucalyptus robusta*. Other eucalypts may be present. There is typically a patchy sub-canopy of *Melaleuca decora* with a sparse to patchy and typically mesic understorey. The groundcover is grassy, with a range of forbs, however there is usually a high cover of sedges and rushes, given the impeded drainage. The zone could also be typed as SR642 - Spotted Gum - Grey Ironbark - Woollybutt grassy open forest on coastal flats, southern Sydney Basin Bioregion and South East Corner Bioregion (Murramarang-Bega Lowlands Forest), and most of the plots that have been undertaken in the zone have a similar proportion of the positive diagnostic species for both communities. It has been typed as SR669 primarily given the predominance of *Melaleuca decora*, and it fits better in the Coastal Valley Grassy Woodlands class

	(swamp/grass woodlands) than the Southern Lowland Wet Sclerophyll forests. It is typically in excellent condition.
TEC	Affiliated with the swampy occurrences of the Illawarra Lowlands Grassy Woodland of the Sydney Basin Bioregion (such as those which occur around Albion Park) but may not comprise the EEC given its restricted geographic distribution in the Final Determination. Some parts may be considered to comprise the EEC Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

3.3.4 Zone 4

BVT	SR650 - Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
PCT	1234
Ancillary Code	Fringe forest sometimes with some Lantana
Condition	Moderate to Good
SCIVI	Estuarine Fringe Forest.
Description	*Casuarina glauca* dominated forest fringing estuaries with a groundcover dominated by salt tolerant species such as *Baumea juncea*. It typically is in excellent condition although around Culburra the weed *Lantana camara* is present in places.
TEC	Is considered part of the Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

3.3.5 Zone 5

BVT	SR649 - Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion
PCT	1232
Ancillary Code	Regrowth

Condition	Moderate to Good
SCIVI	Floodplain Swamp Forest
Description	Floodplain Swamp Forest is a *Casuarina glauca* dominated forest which occurs on the lower parts of drainage lines and behind estuaries. It has a more diverse range of small trees, shrubs, groundcovers and climbers than the Estuarine Fringe Forest. Zone 5 comprises relatively young regrowth Floodplain Swamp Forest which is dominated by *Casuarina glauca*, sometimes with a dense understorey of *Gahnia clarkei*.
TEC	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

3.3.6 Zone 6

BVT	SR649 - Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion
PCT	1232
Ancillary Code	Good condition
Condition	Moderate to Good
SCIVI	Floodplain Swamp Forest
Description	*Casuarina glauca* dominated forest on the lower parts of drainage lines and behind estuaries with a more diverse range of small trees, shrubs, groundcovers and climbers than the Estuarine Fringe Forest. It is typically in excellent condition although around Culburra the weed *Lantana camara is* present in places.
TEC	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

3.3.7 Zone 7

BVT	SR651 - Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion

PCT	1236
Ancillary Code	Good condition
Condition	Moderate to Good
SCIVI	Estuarine Creek Flat Scrub
Description	Dense scrub on the fringes of estuaries usually dominated by *Melaleuca ericifolia* with scattered *Casuarina glauca* and sedges in the groundcover. It often adjoins Estuarine Saltmarsh. It is typically in excellent condition.
TEC	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

3.3.8 Zone 8

BVT	SR512 - Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion
PCT	659
Ancillary Code	Coastal Sand Forest.
Condition	Moderate to Good
SCIVI	Coastal Sand Forest.
Description	Coastal Sand Forest occurs patchily within the assessment area where there are accumulations of relatively well drained marine sands. The most extensive occurrences are on adjacent land where the community comprises a relatively tall forest dominated by *Eucalyptus pilularis*, predominately on marine sand that appears to be aeolian in origin, as it occurs on the low scarp above St Georges Basin. It is also extensive on the inward margins of the shores of St Georges Basin on sands that are reasonably well drained. With increasing proximity to the estuary shores and poorer drainage *Eucalyptus botryoides* dominates the canopy. Where drainage is most impeded it typically grades into Coastal Sand Swamp Forest. In adjacent lots, it has a mesic, almost littoral rainforest sub-canopy, and is more typical of the Bangalay Sand Forest EEC. It also shares affinities with the Illawarra Gully Wet Forest and is ecotonal with it in places. There is considerable variability within the community throughout the

	assessment area, however the variability is more floristic and structural rather than condition. However some areas where weeds are common may warrant separate zones.
TEC	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions

3.3.9 Zone 9

BVT	SR592 - Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion
PCT	1079
Ancillary Code	Young Shrub Regrowth in Grazing Paddocks
Condition	Moderate to Good
SCIVI	Currambene-Batemans Lowlands Forest
Description	The zone comprises young shrub regrowth in paddocks that have not been slashed in recent times. Much of the zone has been recently burnt and slashed and plots undertaken in the future may not meet the moderate to good condition threshold.
TEC	No

3.3.10 Zone 13

BVT	SR516 - Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion
PCT	694
Ancillary Code	Moister Forest in sheltered locations
Condition	Moderate to Good
SCIVI	Illawarra Gully Wet Forest
Description	Illawarra Gully Wet Forest occurs in the most sheltered locations within the assessment area. The community is characterised by a canopy that is dominated by *Eucalyptus pilularis*, with an understorey that includes small trees and shrubs associated with mesic habitats such as *Pittosporum*

	undulatum and *Livistona australis*. The groundcover typically includes a relatively high fern cover, particularly the ferns *Calochlaena dubia* and *Adiantum aethiopicum* which are not common in the Currambene-Batemans Lowlands Forest, and a suite of characteristic forbs, creepers and climbers. There is considerable ecotone between the Illawarra Gully Wet Forest and Currambene-Batemans Lowlands Forest in places throughout the assessment area, and plots in both communities sometimes have more than the minimum positive diagnostic species for both communities. Only the most sheltered sites where a mesic understorey has developed have been typed as the community. It typically comprises logged forest with scattered old-growth trees.
TEC	No

3.3.11 Zone 14

BVT	SR648 - Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion
PCT	1231
Ancillary Code	Swamp Forest dominated by Swamp Mahogany or Bangalay with very dense swamp understorey immediately behind estuaries
Condition	Moderate to Good
SCIVI	Coastal Sand Swamp Forest.
Description	Coastal Sand Swamp Forest occurs on flats adjacent to drainage lines and behind estuaries, where drainage is impeded. Zone 2 is characterised by a canopy that is dominated by *Eucalyptus botryoides* or *Eucalyptus robusta*. Zone 14 was initially separated from Zone 2 because of the restriction to very near estuarine occurrences, general paucity of *Eucalyptus longifolia*, and more consistently dense swampy sub-canopy and understorey. However with increasing data collection it is likely that Zone 2 and Zone 14 will be merged. It typically is in excellent condition.
TEC	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

3.3.12 Zone 21

BVT	SR614 - Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion
PCT	1126
Ancillary Code	Saltmarsh
Condition	Moderate to Good
SCIVI	Estuarine Saltmarsh
Description	Estuarine Saltmarsh
TEC	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

3.3.13 Zone 24

BVT	SR651- Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion
PCT	1236
Ancillary Code	Regrowth
Condition	Moderate to Good
SCIVI	Estuarine Creek Flat Scrub
Description	Dense young regrowth of M*elaleuca ericifolia.*
TEC	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

3.3.14 Zone 29

BVT	SR648- Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion

PCT	1231
Ancillary Code	Swamp Forest regrowth
Condition	Moderate to Good
SCIVI	Coastal Sand Swamp Forest.
Description	Swamp Forest regrowth.
TEC	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

3.3.15 Endangered Ecological Communities

The BVTs listed above conform to four TECs, which all have the potential to be either directly or indirectly impacted by the proposed development. The TECs identified within the study area include:

- Bangalay Sand Forest of the Sydney Basin and South East Corner Bioregions (Bangalay Sand Forest) (TSC Act: EEC; EPBC Act: Not listed);
- Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Coastal Saltmarsh) (TSC Act: EEC; EPBC Act: Vulnerable Ecological Community (VEC));
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Oak Floodplain Forest) (TSC Act: EEC, EPBC Act: Not listed); and
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest) (TSC Act: EEC, EPBC Act: Not listed).

One of the vegetation zones assessed by ELA (2016b) was described as having affinities with the Illawarra Lowlands Grassy Woodland of the Sydney Basin Bioregion, and some parts may conform to Swamp Sclerophyll Forest on Coastal Floodplains. Following review of distribution information and geological mapping, Cumberland Ecology has determined that this vegetation zone conforms to Swamp Sclerophyll Forest on Coastal Floodplains.

The extent of each vegetation zone within the study area is provided in **Table 3.6** and shown in **Figure 3.4**.

Table 3.6 TECs within the study area

Zone	BVT Description	TSC Act Status	EPBC Act Status	Area (ha)
Bangalay Sand Forest				
Zone 8	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR512 / PCT 659)	EEC	-	3.66
Coastal Saltmarsh				
Zone 21	Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (BVT SR614 / PCT 1126)	EEC	VEC	4.22
Swamp Sclerophyll Forest				
Zone 2	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion (BVT SR648 / PCT 1231)	EEC	-	13.84
Zone 14	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion (BVT SR648 / PCT 1231)	EEC	-	5.21
Zone 29	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion (BVT SR648 / PCT 1231)	EEC	-	12.72
Zone 3	Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin and South East Corner (BVT SR669 / PCT 1326)	EEC	-	7.43
Subtotal Swamp Sclerophyll Forest				*39.19*
Swamp Oak Floodplain Forest				
Zone 5	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR649 / PCT 1232)	EEC	-	4.02
Zone 6	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR649 / PCT 1232)	EEC	-	15.35
Zone 4	Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR650 / PCT 1234)	EEC	-	5.05
Zone 7	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner	EEC	-	14.04

Table 3.6 TECs within the study area

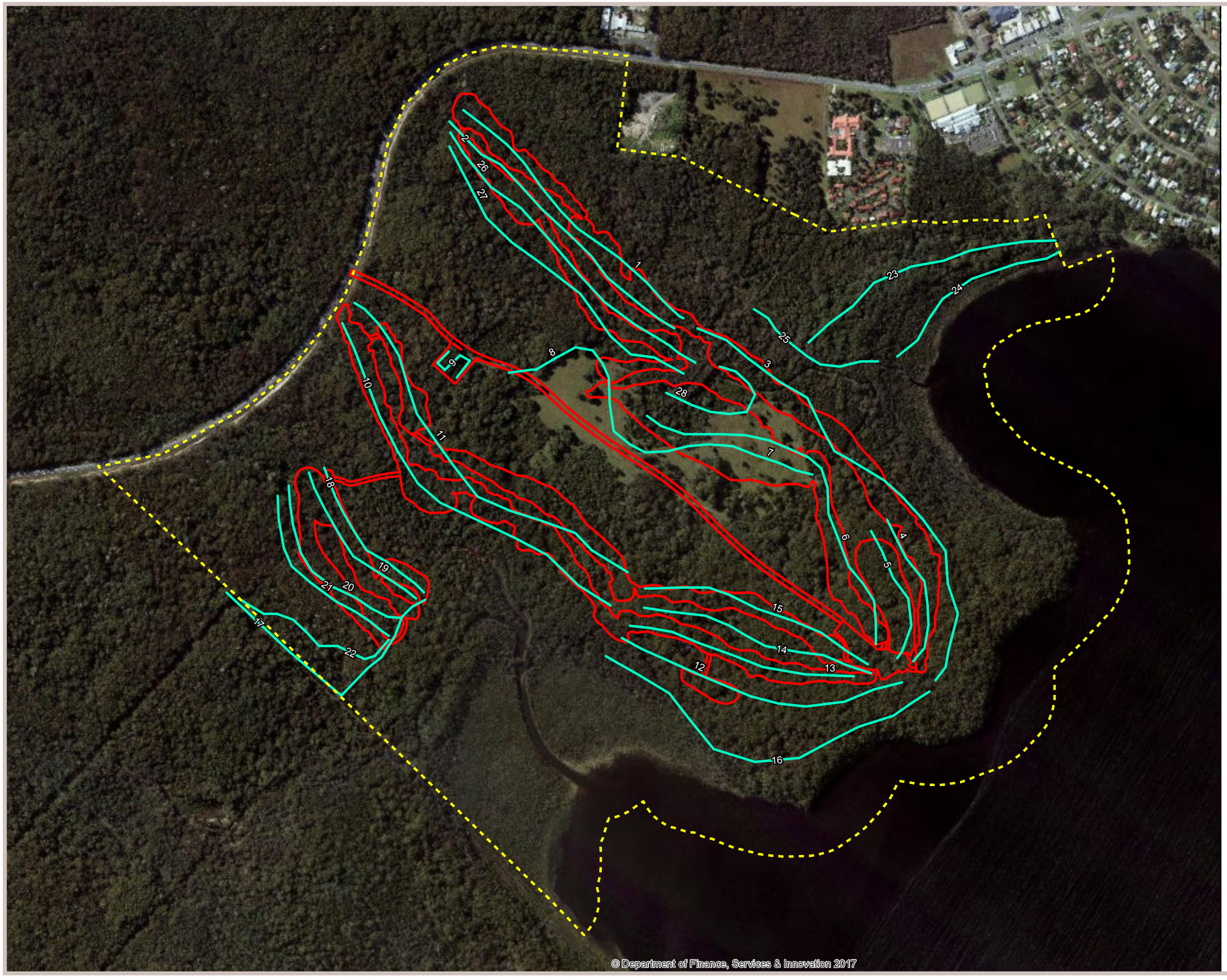
Zone	BVT Description	TSC Act Status	EPBC Act Status	Area (ha)
	Bioregion (BVT SR651 / PCT 1236)			
Zone 24	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR651 / PCT 1236)	EEC	-	0.74
Subtotal Swamp Oak Floodplain Forest				*39.20*

3.4 Flora Survey Results

No threatened orchids were recorded during the targeted surveys. Three orchids that were previously recorded within the study area were recorded during the surveys. These included the Large Tongue Orchid (*Cryptostylis subulata)*, Bonnet Orchid *(Cryptostylis erecta)* and Pink Fairy Orchid *(Caladenia carnea)*. Additionally one common orchid, the White Caladenia *(Caladenia catenata)*, was recorded that was not previously recorded within the study area. This species was only detected in one location along the western boundary of the study area.

3.5 Fauna Survey Results

No threatened fauna species listed under the TSC Act and/or EPBC Act were recorded during surveys within the study area. All of the fauna species recorded during the additional surveys undertaken for the purpose of this assessment have previously been recorded within the study area. All of the fauna recorded during the targeted threatened fauna surveys can be seen in **Appendix F**. Completed survey proformas are provided in **Appendix G**



Coordinate System: MGA Zone 56 (GDA 94)

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0 100 200 300 400 m

I:\...\16087\Figures\RP1\20171212\Figure 3.1. 2017 targeted threatened orchid surveys within the study area

Figure 3.1. 2017 targeted threatened orchid surveys within the study area

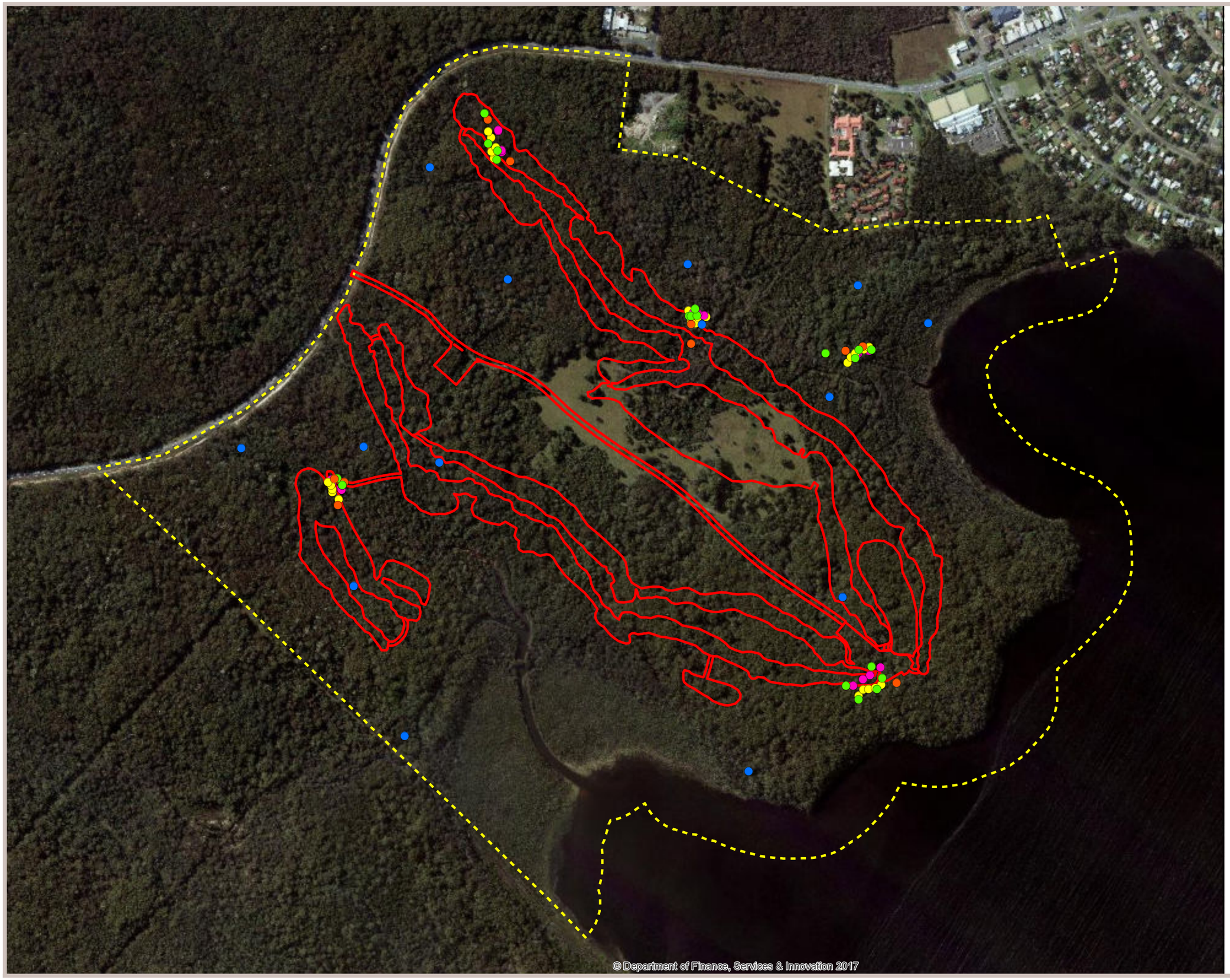
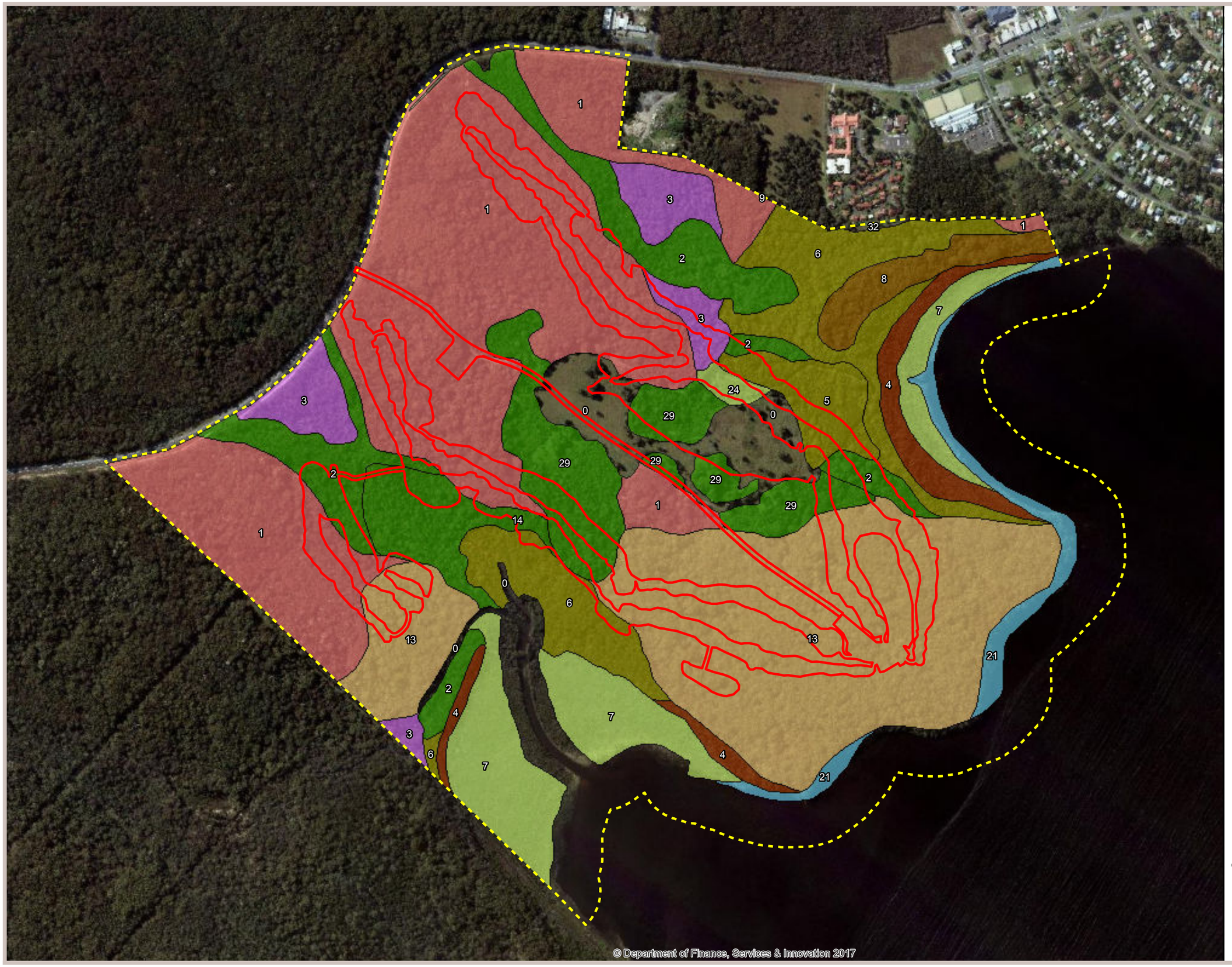


Figure 3.2. 2017 targeted threatened fauna surveys within the study area



Legend

Subject Site

Study Area

Vegetation Community

SR512 - Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion

SR516 - Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion

SR592 - Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion

SR614 - Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion

SR648 - Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion

SR649 - Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion

SR650 - Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion

SR651 - Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East

SR669 - Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion

Data Source:
EcoLogical Australia 2017

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\16087\Figures\RP1\20171212\Figure 3.3. Vegetation Zones_BVT's_study area

Figure 3.3. Vegetation zones and Biometric Vegetation Types within the study area

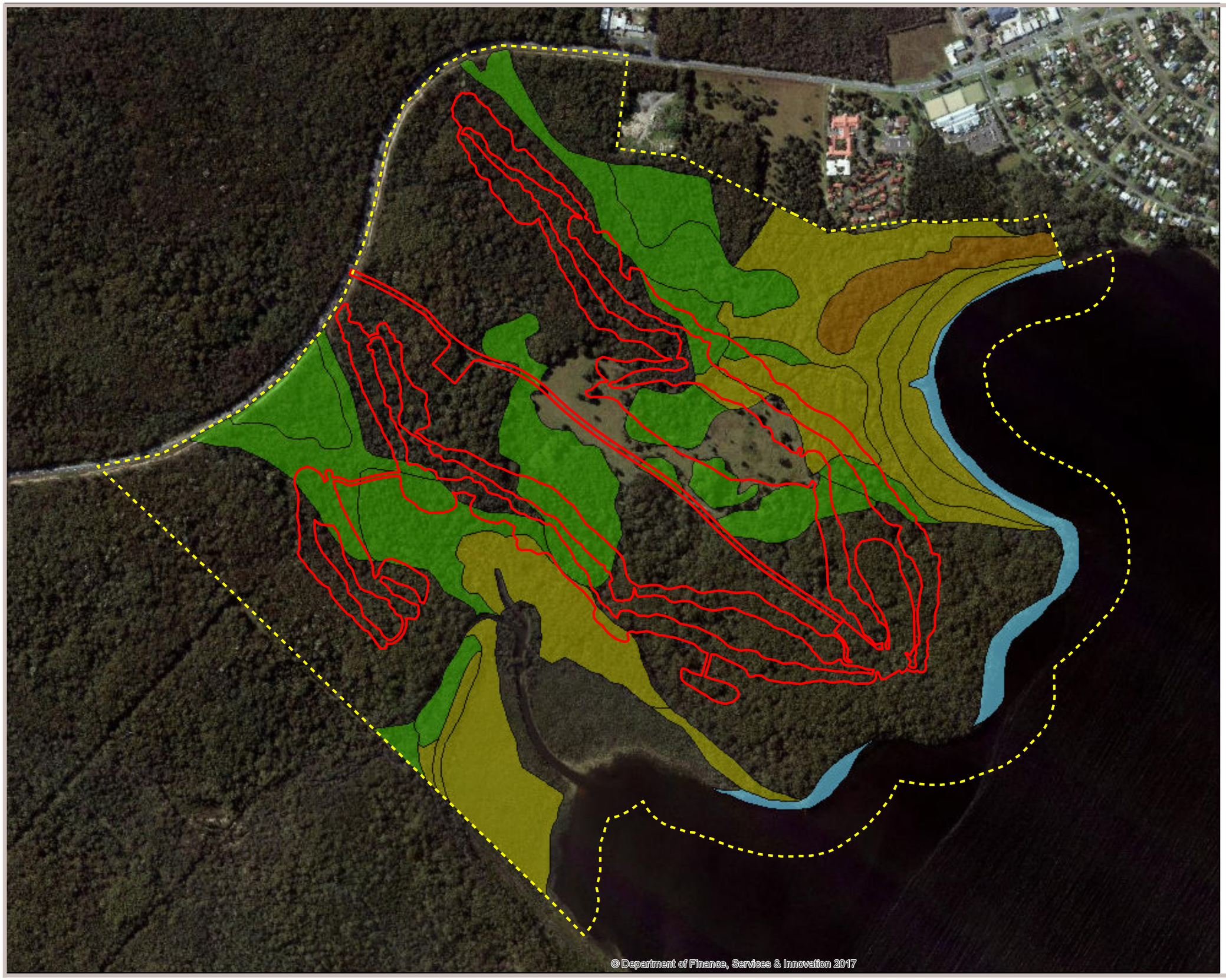


Figure 3.4. Threatened ecological communities within the study area

Chapter 4

Impact Assessment

The impacts of the proposed development on threatened species and populations have been discussed in the Revised SIS. Each of the matters identified in the DGRs has been addressed, however, the following sections provide some additional information on the impacts to support the conclusions made by Gunninah (2015).

4.1 Direct Impacts of the Proposed Development

The primary and direct impact resulting from the proposed development is the loss of vegetation and associated habitat within the subject site. **Figure 4.1** shows the extent and type of vegetation communities to be removed within the footprint of the proposed development.

4.1.1 Impacts on Vegetation Communities

The land within the study area is approximately 196.1 ha and the subject site is 35.7 ha in size (i.e. 18%). **Table 4.1** provides a summary of the areas of each vegetation community to be cleared or modified within the subject site. It also shows the proportions of each community to be retained within the study area. Note that the vegetation to be retained includes the conservation area and vegetation strips retained between the fairways.

The subject site, which is proposed to be cleared, comprises four native vegetation communities and areas of cleared land. Small areas of two TECs are proposed for removal within the subject site, which include Swamp Sclerophyll Forest and Swamp Oak Floodplain Forest.

In order to quantify the direct impact of vegetation clearing, a preliminary BioBanking Assessment has been conducted, which is provided in **Appendix H.** While BioBanking is not required for the proposed development, it nevertheless provides a scientific approach to quantify impacts of the proposed development. **Table E.5** in **Appendix H** shows the type and number of biodiversity credits required to offset the loss of native vegetation.

Table 4.1 Area in hectares of vegetation zones and communities to be removed and retained (does not include cleared areas or water)

Zone	BVT Description	Study Area (ha)	Subject Site		Retained Area	
			Area (ha)	Cleared (%)	Area (ha)	Retained (%)
1	Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion (BVT SR592 / PCT 1079)	58.62	11.33	19%	47.29	81%
2	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion (BVT SR648 / PCT 1231)	13.84	2.06	15%	11.78	85%
3	Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin and South East Corner (BVT SR669 / PCT 1326)	7.43	0.57	8%	6.86	92%
4	Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR650 / PCT 1234)	5.05	0.00	0%	5.05	100%
5	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR649 / PCT 1232)	4.02	0.00	0%	4.02	100%
6	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR649 / PCT 1232)	15.35	2.06	13%	13.28	87%
7	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR651 / PCT 1236)	14.04	0.00	0%	14.04	100%
8	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR512 / PCT 659)	3.66	0.00	0%	3.66	100%
9	Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion (BVT SR592 / PCT 1079)	0.00	0.00	0%	0.00	100%
13	Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion	43.21	10.92	25%	32.29	75%

Table 4.1 Area in hectares of vegetation zones and communities to be removed and retained (does not include cleared areas or water)

Zone	BVT Description	Study Area (ha)	Subject Site		Retained Area	
			Cleared Area (ha)	Cleared (%)	Area (ha)	Retained (%)
	(BVT SR516 / PCT 694)					
14	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion (BVT SR648 / PCT 1231)	5.21	1.29	25%	3.93	75%
21	Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (BVT SR614 / PCT 1126)	4.22	0.00	0%	4.22	100%
24	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion (BVT SR651 / PCT 1236)	0.74	0.17	23%	0.57	77%
29	Swamp Mahogany swamp sclerophyll forest on coastal lowlands of the Sydney Basin Bioregion and South East Corner Bioregion (BVT SR648 / PCT 1231)	12.72	4.01	32%	8.70	68%
	TOTAL	188.09	32.40	17%	155.69	83%

4.1.2 Loss of Specific Habitat Features

The vegetation occurring within the subject site provides habitat for a range of flora and fauna, including species that are listed as threatened under the TSC Act and/or EPBC Act. The vegetation communities also support specific habitat features that provide foraging, shelter and breeding opportunities for fauna. The proposed development will result in the removal of some of these habitats and features within the subject site.

Fauna habitat features that will be disturbed and/or removed as a result of the proposed development include:

- Terrestrial habitat features such as ground and shrub layer vegetation, leaf litter, coarse woody debris;
- Hollow-bearing trees;
- Blossom-producing trees and shrubs; and
- Ephemeral drainage lines.

The potential loss of habitat features as a result of the proposed development is discussed in the Revised SIS, which states that the proposed layout of the golf course has taken into consideration the presence of habitat features to ensure impacts on fauna species is minimal.

The Revised SIS identified five hollow-bearing trees within subject site. Additionally, a number of feed trees have been identified within the subject site for species identified as 'affected species', which will be removed. The removal of these habitat features is considered to have only minor implications for fauna species due to the presence of available habitat features remaining within the study area and wider locality as well as the high mobility of the species likely to utilise these habitats. It is anticipated that these features will continue to provide habitat for the suite of species within the study area.

The ephemeral drainage lines within the subject site will only be disturbed temporarily during construction. Furthermore, the ephemeral drainage lines do not provide significant habitat for the affected species identified within the subject site.

4.1.3 Impacts on Lake Wollumboola and Associated Watercourses

The impacts on aquatic biota and other habitat resources as a result of the altered hydrology have been addressed in the Revised SIS. Some additional information associated with the altered hydrology can be found in ***Section 4.2*** as these are identified as indirect impacts. There are no anticipated direct impacts on Lake Wollumboola by the proposed development, since any clearing or earthworks are set back at least 150m from the shoreline of the lake.

4.2 Indirect Impacts of the Proposed Development

The indirect impacts of the proposed development have been documented in the Revised SIS. Additionally, a suite of management plans are proposed within the Revised SIS to be prepared, following consent of the DA. One of these management plans, i.e. the Draft "Golf Course Plan of Management (GCPoM)" has been submitted in Appendix D2 of the Revised SIS.

Rather than having several management plans, one comprehensive Environmental Management Plan (EMP) is recommended, the details of which are discussed in ***Section 5*** of this report.

The following sections provide additional information to complement the Revised SIS.

4.2.1 Habitat Fragmentation

An indirect impact associated with the loss of vegetation will be habitat fragmentation. Habitat fragmentation is the process whereby habitat loss results in the division of large, continuous habitats into small, isolated habitat fragments (Ewers and Didham, 2006). The area between fragments is typically man-made and largely inhabitable by the species that previously existed in the area. The ecological impacts of habitat fragmentation include (Andrews, 1990):

- Changes in the number of species in fragments;
- Changes to the composition of faunal assemblages; and
- Changes to ecological processes in fragments such as food chains, predator-prey interactions, plant-animal pollination and dispersal associations.

Although the proposed development will cause some habitat to become fragmented, a significant 83% of forest and woodland habitat will be retained within the study area. Additionally, tracts of vegetation that do become fragmented all have large areas of vegetation within close proximity. The retained vegetation in the study area is connected to large areas of native vegetation to the north, west and south. As the 'affected species' are all highly mobile species, minor habitat fragmentation caused by the proposed development will not have a significant impact on threatened species or populations.

4.2.2 Edge Effects

Edge effects are impacts that occur at the interface between natural habitats, especially forests and disturbed or developed land (Yahner, 1988). When an edge is created between woodland and a cleared area, changes to ecological processes within the vegetation can extend between 10 m and 100 m from the edge (Yahner, 1988). These include microclimatic changes in light, temperature, humidity and wind, which can favour a suite of different species and therefore cause significant changes to the ecology of the patch (Lindenmayer and Fischer, 2006). These changes include; invasion by weeds, increase in feral animals, reduction in tree health, and barriers to dispersal or distribution (Yahner, 1988). Edge effects

are typically more pronounced in small habitat fragments and they may extend throughout small patches, rendering them unsuitable for some species. In particular, small patches of woodland habitat may be unfavourable for species which require interior habitat. As habitat loss progresses, the understanding of edge effects on ecological processes becomes increasingly important (Rand *et al.*, 2006).

The study area consists of vast areas of vegetation with some small cleared areas within the central portion. Some minor edge effects are currently present along the cleared areas. Further clearing for the proposed development will create additional edge effects, however, the associated impacts are unlikely to be exacerbated due to the implementation of appropriate management plans. With the preparation and implementation of management programs listed below, edge effects such as those listed in the DGRs are unlikely to have a significant impact on threatened species.

Due to the nature of a golf course with tee boxes, fairways and putting greens, separated by retained strips of vegetation, the perimeter-to area ratio immediately surrounding the subject site will be increased. The vegetation retained between fairways will not provide the same quality of habitat as the intact vegetation elsewhere. Nevertheless, the total vegetation cleared is approximately 18% of the native vegetation within the study area. While the retained strips of vegetation between fairways provide a lower quality habitat due to edge effects, they still provide excellent stepping stones for movement by most fauna species. Most of the fauna species known to be present on the subject site are sufficiently mobile to take advantage of these stepping stone habitats. Furthermore, many of Australia's mammals and birds are nocturnal or crepuscular and will be active when human activities on the golf course have ceased.

4.2.3 Pest Animals

A number of management plans have been suggested for the proposed development in the Revised SIS, to be prepared following consent for the proposed development. The management plan will contain specific and detailed regimes for the control and eradication of feral animals during and post construction.

4.2.4 Alteration to Hydrological Regimes

Changes to drainage lines can affect the integrity, structure and composition of habitat and thus, have secondary impacts on the species that rely on them. This is particularly relevant to the subject site due to the presence of TECs and the close proximity of Lake Wollumboola.

The proposed golf course has been developed with particular regard to maintaining and improving the hydrological regime in the study area. With the implementation of the Integrated Water Management Plan (Martens Consulting Engineers, 2017), it is expected that vegetation communities within the study area as well as Lake Wollumboola are unlikely to be impacted by the proposed development. The Integrated Water Management Plan has been developed to ensure that the discharge of water from the proposed golf course is has a neutral or beneficial effect (NorBE) on the water quality which has been documented in the letter by Martens Consulting Engineers dated 30 November 2017 (Martens 2017).

The proposed EMP will require the inclusion of measures to avoid, minimise and/or manage indirect impacts in the long term.

i. Soil Erosion and Pollution

Increased sediment and eroded material can smother retained vegetation, cause dieback of herbs and shrubs and reduce regeneration of groundcover species. Sedimentation has the potential to reduce water quality in wetland and riverine environments sediment and eroded material can also contain weed matter and nutrients. In the absence of appropriate mitigation measures, the proposed development has the potential to result in increased sedimentation and runoff as a result of soil disturbance from construction activities.

Golf courses have been under a lot of scrutiny in the past due to the use of large quantities of fertilisers, pesticides and water. Over recent years, golf course operators have been making efforts to become more environmentally responsible by improving management and maintenance practices. These include choice of environmentally friendlier fertilisers, increase efficiency of chemical use, water quality monitoring, stormwater filtering and adaptive management, to name a few.

The project has been developed utilising best practice measures to prevent and minimise sedimentation and erosion on adjacent vegetation and Lake Wollumboola. This includes the implementation of sediment control and reduction measures such as the implementation of sediment fences and sediment basins. Martens (2017) provides detailed information on the control and management of soil erosion and pollution. Additionally the proposed EMP requires the inclusion of detailed measures to avoid or minimise the discharge of contaminants such as fertilisers, chemicals and pesticides in the long term.

ii. Feeding, Nesting and Breeding Fauna

The indirect impact on feeding, nesting and breeding of fauna within the study area is discussed in the Revised SIS. However additional information on feeding, nesting and breeding of fauna species can be found in ***Section 4.1.2*** as these are primarily linked with habitat removal, which is a direct impact.

iii. Light

The proposed development has the potential to increase the level of artificial light in the natural environment during the construction phase and after the completion of construction. Increased light levels may adversely impact wildlife by direct glare, chronic or periodic increased illumination and temporary unexpected fluctuations in light levels (Saleh, 2007; Longcore and Rich, 2010).

Research into impacts from altered lighting indicates that it can trigger behavioural and physiological responses that include but are not limited to:

- Changes in foraging behaviour;

- A disruption of seasonal day length cues which trigger critical behaviours (Longcore and Rich, 2004; Saleh, 2007; Longcore and Rich, 2010);
- Disorientation and/or temporary blindness; and
- Interference with predator-prey relationships.

The potential impacts of light pollution will be temporary and cease after the construction is completed. Nevertheless, due to the open fairways, the natural light levels in the retained vegetation will be permanently altered. As discussed in ***Section 4.2.2***, this will reduce the quality of habitat due to edge effects in these strips of vegetation. The proposed EMP will require inclusion of measures to avoid, minimise and/or manage indirect impacts in the long term.

iv. Noise

Noise can affect animal physiology and behaviour, and if it becomes an ongoing stress, it can be injurious to an animal's energy budget, reproductive success and long-term survival. There are other potential impacts that include habitat loss through avoidance, reduced reproductive success and a retreat away from favourable habitats (AMEC, 2005).

Noise also affects the way that animal-created sounds are heard and interpreted by other animals. This can include mating calls, territorial calls and alarm calls. Interference with these calls by noise generated by the project has the potential to disrupt the species relying on these calls with deleterious results including reduced reproductive success and mortality (AMEC, 2005).

The noise created by the construction of the proposed development is unlikely to significantly affect native species, and the value of the habitats that remain in the study area. It is expected that some species are likely to relocate in response to noise, and this has the potential effect of increasing the amount of habitat for native species that will be displaced as a result of the proposal. However, it is likely that most animal species will habituate to the periodic noise disturbance (AMEC, 2005), and the construction phase of the project are likely to cause only temporary disturbance to fauna.

4.3 Impacts to Threatened Ecological Communities

4.3.1 Introduction

Four TECs have been recorded within the study area, of which only two, namely Swamp Sclerophyll Forest and Swamp Oak Floodplain Forest, occur within the subject site and will be directly impacted by the proposed development. The extent of these TECs within the subject site and study area is indicated in **Table 4.2** and shown in **Figure 4.2**. A discussion of the potential impacts to these communities is provided below.

Table 4.2 Area in hectares of TECs to be removed and retained

TEC/Vegetation Community	Status	Study Area (ha)	Subject Site		Retained Area	
			Area (ha)	Cleared (%)	Area (ha)	Retained (%)
Bangalay Sand Forest of the Sydney Basin and South East Corner Bioregions (Bangalay Sand Forest).	TSC Act: EEC; EPBC Act: Not listed	3.66	0	0%	3.66	100%
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Coastal Saltmarsh).	TSC Act: EEC; EPBC Act: Vulnerable	4.22	0	0%	4.22	100%
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Oak Floodplain Forest).	TSC Act: EEC, EPBC Act: Not listed	34.29	2.24	7%	32.05	93%
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest).	TSC Act: EEC, EPBC Act: Not listed	39. 19	7.92	20%	31.27	80%

4.3.2 Significance of the Threatened Ecological Communities

i. Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is listed as an EEC under Schedule 2 of the TSC Act.

This community is associated with associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. It generally occurs below 20 m elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates or coastal sand plains. The boundaries between floodplain communities, such as Swamp Sclerophyll Forest, Coastal Saltmarsh and other EECs on coastal floodplains, are dynamic and may shift in response to changes in hydrological regimes, fire management and land use. The structure of the community is typically open forest, although partial clearing may have reduced the canopy to scattered trees. It usually includes an open to dense tree layer of eucalypts and paperbarks, which may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. The composition of this EEC is primarily determined by the frequency and duration of waterlogging and the texture, salinity, nutrient and moisture

content of the soil. The community is characterised by an assemblage of 59 species, including dominant trees such as *Eucalyptus robusta* (Swamp mahogany), *Melaleuca quinquenervia* (Paperbark) and, south from Sydney, *Eucalyptus botryoides* (Bangalay) and *Eucalyptus longifolia* (Woollybutt) (NSW Scientific Committee, 2011).

The distribution of this TEC is known to extend from northern NSW, along the coast to Shoalhaven. The original extent, prior to European settlement, is unknown but is assumed to also include floodplains of major rivers along the NSW coast. The current extent of Coastal Floodplain Wetlands, which include Swamp Sclerophyll Forests, is estimated at 800 to 1,400 km2 (i.e. 80,000 to 140,000 ha), which represents just under 30% of the estimated original extent. Other estimates are as low as 12,000 ha, due extensive clearing and modification. The vegetation mapping by OEH in 2013 (Shoalhaven_EECs_v2_E_3901) includes 3,224 ha of this community within the Shoalhaven, Eurobodalla and Bega Valley LGAs (OEH, 2013).

Remaining stands of this TEC are often fragmented by past clearing and further threatened by continuing fragmentation and degradation, flood mitigation and drainage works, landfilling and earthworks associated with urban and industrial development, pollution from urban and agricultural runoff, weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock and feral animals including pigs, activation of 'acid sulfate soils', removal of dead wood and rubbish dumping.

The proposed development will result in the removal of 7.92 ha of this TEC, which constitutes 0.07% of the estimated 12,000 ha extent, 0.006% of the 140,000 ha extent and 0.25% of the 3,224 ha extent mapped within the Shoalhaven, Eurobodalla and Bega Valley LGAs, respectively. Some small areas of this TEC could potentially be indirectly impacted due to being located in close proximity to the proposed development.

ii. Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions is listed as an endangered ecological community under Schedule 2 of the TSC Act. It forms part of the “Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales”, which is currently a proposed EEC under the EPBC Act (DoEE, 2014)

This community is with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. In the NSW North Coast, Sydney Basin and South East Corner bioregions it generally occurs below 20 m elevation. Typically this community forms mosaics with other floodplain forest communities and treeless wetlands. It may adjoin or intergrade with several other endangered ecological communities, which collectively cover all remaining native vegetation on the coastal floodplains of New South Wales. The community often fringes treeless floodplain lagoons or wetlands with semi-permanent standing water. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees. The composition of Swamp Oak Floodplain Forest is primarily determined by the frequency and

duration of waterlogging and the level of salinity in the groundwater. It is characterised by an assemblage of 45 native species with a canopy usually dominated by *Casuarina glauca* (Swamp oak), as well as *Acmena smithii* (Lilly Pilly), *Glochidion* spp. (Cheese trees) and *Melaleuca spp.* (Paperbarks) (NSW Scientific Committee, 2011).

The distribution of this community is, as the name suggests, within the NSW North Coast, Sydney Basin and South East Corner bioregions. Historically, large areas of habitat formerly occupied by Swamp oak floodplain forest have been directly drained by construction of artificial channels or The current extent of Coastal Floodplain Wetlands, which include Swamp oak floodplain forests, is estimated at 800 to 1,400 km2 (i.e. 80,000 to 140,000 ha), which represents just under 30% of the estimated original extent. As with the Swamp sclerophyll forest EEC, other estimates are as low as 12,000 ha, due extensive clearing and modification. The vegetation mapping by OEH in 2013 (Shoalhaven_EECs_v2_E_3901) includes 6,125 ha of this community within the Shoalhaven, Eurobodalla and Bega Valley LGAs (OEH, 2013).

Remaining stands of this community mostly occur on productive agricultural land or in close proximity to rural centres. Key threatening processes to this community are clearing, alteration to hydrological flow regimes, invasion of exotic perennial grasses, anthropogenic climate change and high fire frequency.

The proposed development will result in the removal of 2.24 ha of this TEC, which constitutes 0.019% of the estimated 12,000 ha extent, 0.0016% of the 140,000 ha extent and 0.037% of the 6,125 ha extent mapped within the Shoalhaven, Eurobodalla and Bega Valley LGAs, respectively. Some small areas of this TEC could potentially be indirectly impacted due to being located downstream of the proposed development.

The "*preliminary draft conservation advice (incorporating listing advice) of the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*" under the EPBC Act includes the key diagnostic characteristics and the minimum condition thresholds required for this community to be considered an MNES (DoEE, 2014). Since "Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales" is currently a proposed TEC under the EPBC Act, impacts on this community are not required to be assessed or referred to the Commonwealth.

iii. Bangalay Sand Forest of the Sydney Basin and South East Corner Bioregions

Bangalay sand forest, Sydney Basin and South East Corner bioregions EEC is listed as an endangered ecological community under Schedule 2 of the TSC Act.

The community typically has a dense to open tree canopy, approximately 5 - 20 m tall, depending on exposure and disturbance history. It is associated with coastal sand plains of marine or aeolian origin and occurs on deep, freely draining to damp sandy soils on flat to moderate slopes within a few km of the sea and at altitudes below 100 m. Structurally, it typically comprises a relatively dense or open tree canopy, an understorey of mesophyllous or sclerophyllous small trees and shrubs, and a variable groundcover dominated by sedges, grasses or ferns. This EEC is characterised by the assemblage of 50 species, including

dominant canopy species, such as *Eucalyptus botryoides* (Bangalay) and *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia), while *Eucalyptus pilularis* (Blackbutt) and *Acmena smithii* (Lilly Pilly) may occur in more sheltered situations, and *Casuarina glauca* (Swamp Oak) may occur on dunes exposed to salt-bearing sea breezes or where Bangalay Sand Forest adjoins Swamp Oak Floodplain Forest (NSW Scientific Commitee, 2011a).

The known distribution of this TEC is within the Sutherland, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley LGAs. Near its northern limit in the Bundeena area, Bangalay Sand Forest TEC co-occurs with Kurnell Dune Forest TEC. The current extent of this EEC is unknown. The vegetation mapping by OEH in 2013 (Shoalhaven_EECs_v2_E_3901) mapped 7,188 ha of this community within the Shoalhaven, Eurobodalla and Bega Valley LGAs (OEH, 2013).

The main threats to this community comprise land clearing, degradation and disturbance associated with heavy recreational use, frequent burning, rubbish dumping and weed invasion. These threats are generally associated with existing and proposed urban development along the coast.

Under the proposed development, no vegetation of this TEC will be removed. It is unlikely that the proposed development will have any indirect impacts on the 3.66 ha of this community within the study area, due to its location in the north-eastern corner of the property.

iv. Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions EEC is listed as an endangered ecological community under Schedule 2 of the TSC Act. It also conforms to the federally listed community of "*Subtropical and Temperate Coastal Saltmarsh*", which is listed as vulnerable under the EPBC Act.

This community occurs in the intertidal zone on the shores of estuaries and lagoons including when they are intermittently closed along the NSW coast.

Characteristic vascular plant species of Coastal Saltmarsh include an assemblage of 10 species. The community is frequently found as a zone landward of mangrove stands. Occasional scattered mature *Avicennia marina* trees occur through saltmarsh at some sites and *Avicennia* (and less frequently *Aegiceras corniculatum*) seedlings may occur throughout saltmarsh. In brackish areas dense stands of tall reeds (*Phragmites australis*, *Bolboschoenus* spp., *Schoenoplectus* spp. and *Typha* spp.) may occur as part of the community. Species composition within Coastal Saltmarsh varies within geographic locations and elevation due to varying frequency of flooding (NSW Scientific Commitee, 2011b).

An estimate of the current extent of this community is approximately 5,700 ha distributed in fragmented patches of mostly less than 100 ha. The vegetation mapping by OEH in 2013 (Shoalhaven_EECs_v2_E_3901) mapped 2,052 ha of this community within the Shoalhaven, Eurobodalla and Bega Valley LGAs.

Historically, substantial areas of saltmarsh have been infilled for roads, aerodromes, residential dwellings, recreational areas, waste disposal, as well as industrial and agricultural purposes. Current threatening processes include infilling, modified tidal flow, weed invasion, damage by domestic and feral animals, human disturbance, altered fire regimes, encroachment by mangroves and climate change. Furthermore, patterns of tidal flow are often restricted by artificial structures and discharge of stormwater alters salinity regimes, increases nutrient levels and facilitates the spread of Phragmites and weeds.

Under the proposed development, no vegetation of this EEC will be removed. The retained 4.22 ha of this community could, however, be indirectly impacted, due to its downstream location of the proposed development. The implementation of an the Integrated Water Management Plan (Martens Consulting Engineers, 2017) for the proposed development will ensure that runoff from the proposed development meets the NorBE requirements and does not have a negative impact on this community.

The extent, distribution and characteristics of "*Subtropical and Temperate Coastal Saltmarsh*" under the EPBC Act is significantly different from the NSW listed EEC, since this community extends along coastal areas around Australia. Key diagnostic characteristics and condition thresholds provided in the conservation advice assist in identifying if the community retains sufficient conservation values to be considered as a MNES (DoEE, 2013). The conservation advice for "*Subtropical and Temperate Coastal Saltmarsh*" under the EPBC Act recommends that buffer zones be applied to this TEC, which will allow saltmarshes to naturally retreat landward rather than disappear with sea level rise due to climate change. Furthermore, buffers enhance protection by avoiding or minimising potential disturbance from surrounding land uses or activities. The recommended width for a buffer zone is at least 30m from the edge of the clearing. The narrowest buffer between this TEC and the proposed clearing on the subject site is approximately 120m.

4.3.3 Direct Impact on Threatened Ecological Communities

The following TECs will be directly impacted by the proposed development:

- Clearing of 7.92 ha of Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC;
- Clearing of 2.24 ha of Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC.

The direct impacts comprise removal of 35.7 ha of native vegetation (i.e. 18% of all native vegetation on site), which includes 10.16 ha of TECs. The design of the golf course has been adjusted to minimise direct impacts by design considerations, such as retention of threatened ecological communities where possible and retention of hollow-bearing trees where possible (see Gunninah 2015). This is made obvious when consulting the mapping of threatened vegetation communities by OEH in 2013 (Shoalhaven_EECs_v2_E_3901) as shown in **Figure 3.4** and vegetation mapping by ELA (2016a).

4.3.4 *Indirect Impact on Threatened Ecological Communities*

The following TECs could be indirectly impacted by the proposed development:

- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC;
- Illawarra lowlands grassy woodland in the Sydney Basin Bioregion EEC;
- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC;
- Bangalay sand forest, Sydney Basin and South East Corner bioregions EEC; and
- Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions EEC.

Due to the nature of the design of golf courses, the indirect impacts to retained vegetation include the following:

- Increase in edge-effect and fragmentation of vegetation;
- Isolation of small patches of remnant vegetation;
- Reduction of resilience of remnant vegetation;
- Altered hydrology and water quality;
- Potential increase in nutrients due to fertilizers;
- Potential for acid sulphate soils disturbance;
- Encroachment of weeds and feral animals;
- Altered fire regimes;
- Increase noise and light pollution; and
- Use of fertilisers, pesticides and other chemicals on the golf course.

Indirect impacts have been considered during the design of the golf course and mitigation measures have been applied, such as implementation of stormwater and water quality control management systems, retention of vegetation buffer zones, creation of additional fauna habitat and management plans (see Gunninah 2015). The proposed EMP will require inclusion of measures to avoid, minimise and/or manage indirect impacts in the long term.

Furthermore, some indirect impacts and some ameliorative actions, will require inclusion in the EMP, are discussed below:

- Manage and monitor stormwater runoff (Section 6 of Draft GCPoM);

- Prevent changes to tidal regimes along foreshore: There will be a >100m wide permanent buffer zone of native vegetation between the proposed development and the foreshore, which will prevent any indirect impacts on the tidal regimes and provide room for potential sea-level rise due to climate change;

- Implement water quality management systems (Sections 5 and 6 of Draft GCPoM) such as:

  - Construction of bio-retention swales to filter out pollutants from run-off entering the wetlands;

  - Restricting the use of fertilisers and herbicides on the golf course;

  - Establishing native plant varieties that require less water and chemicals; and

  - Utilising a highly adaptive irrigation system to minimise irrigation throughout the golf course.

- Maintenance of vegetation buffer zones to minimise disturbance and increase resilience of retained vegetation communities;

- Soil testing to avoid disturbance of potential acid sulphate soils that may expose them to the atmosphere (see Acid Sulfate Soils Assessment report);

- Ensure that chemicals such as fertilisers and pesticides do not have adverse impacts on native vegetation (Section 5 of Draft GCPoM);

- Minimise and monitor nutrient levels in run-off (Section 5 of Draft GCPoM);

- Monitor floristic composition of vegetation communities to prevent transitions into other communities;

- Implement management plans for the control of major weed infestation; and

- Management plan for appropriate fire regimes and maintenance of asset protection zones (Bushfire Risk Assessment Report).

4.4 Assessment of Species Likely to be affected

Affected species/populations means those threatened species and endangered populations that are likely to be affected, either directly or indirectly by the proposed development.

The list of species considered to be affected species by this project has been refined from the list of subject species (see **Chapter 3**) based on their listing in the DGRs, their known occurrence in the study area or their likelihood of occurrence. Information in relevant Scientific Committee determinations, OEH threatened species profiles, recovery plans and draft recovery plans, and vegetation assessment and mapping has also been utilised in determining which species are considered to be affected species.

The threatened species considered to be affected species are those that have potential to be affected by the proposed development and are assessed in subsequent sections of this chapter. The remaining subject species listed in **Chapter 3** are not analysed further as they are not considered likely to occur in the study area (based on general species distribution information) and/or are not known to utilise the habitat types of the study area.

4.4.1 Affected Species/Populations

Relatively few of the subject species are considered likely to be affected by the proposed development. The affected species are those known from the study area or are likely to occur that will experience a loss of habitat. In summary, the affected species that are considered in detail within the following impact assessment chapter are listed in **Table 4.2**.

The 17 affected species listed above have all been recorded in the locality and will have some potential habitat removed as a result of the development.

No threatened flora species are considered likely to occur within the subject site based on the previous surveys discussed in the Revised SIS, the unpublished BioBanking Assessment conducted by ELA (2016a) and the additional surveys carried out by Cumberland Ecology. As such no threatened flora species are included in the assessment in this chapter.

Table 4.3 Species considered to be "affected species"

Common Name	Scientific Name	TSC Act Status	EPBC Act Status
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V	-
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V	-
Little Lorikeet	*Glossopsitta pusilla*	V	-
Masked Owl	*Tyto novaehollandiae*	V	-
Powerful Owl	*Ninox strenua*	V	-
Square-tailed Kite	*Lophoictinia isura*	V	-
Swift Parrot	*Lathamus discolor*	E	CE
Varied Sittella	*Daphoenositta chrysoptera*	V	-
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	V	-
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	-
Eastern Freetail-bat	*Mormopterus norfolkensis*	V	-
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V
Little Bentwing-bat	*Miniopterus australis*	V	-
Southern Myotis	*Myotis macropus*	V	-
Yellow-bellied Glider	*Petaurus australis*	V	-
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-

4.5 Analysis of Affected Species

The Revised SIS provides information on some of the affected species identified in ***Section 4.4***. The following sections provide information on the affected species to supplement the Revised SIS. Furthermore, additional species that have been identified within this report as affected species have also been addressed in the following sections.

4.5.1 Gang-gang Cockatoo

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There have been nine records of the Gang-gang Cockatoo within the locality. Additionally, this species was recorded within the subject site during field surveys in 2001 (see Appendix R in the Revised SIS). Furthermore, there is suitable foraging and roosting habitat present for the species within the subject site.

b. Discussion of habitat utilisation

The Gang-gang Cockatoo favours old growth forest and woodland attributes for nesting and roosting. They feed primarily on seeds of native and introduced trees and shrubs; with a preference for Eucalypts, wattles and introduced hawthorns (OEH, 2017e). The subject site contains areas of suitable foraging habitat for the species. Only five of approximately 200 hollow-bearing trees identified within the study area will be directly impacted by the proposed development. The hollows on these trees range in size and the loss of these hollow-bearing trees could potentially impact the Gang-gang Cockatoo.

The Gang-gang Cockatoo is wide-ranging and highly mobile, and would utilise home ranges of several kilometres radius from a nest or roost site. The vegetation present on the subject site, therefore, represents only a very small proportion of the home range for this species.

c. Discussion of corridors

Suitable habitat for the Gang-gang Cockatoo to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Gang-gang Cockatoo is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Gang-gang Cockatoo inhabits eucalypt open forests and woodlands with an Acacia understorey (NSW Scientific Committee, 2008a). In summer, generally found in tall

mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests (OEH, 2017e). In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas, and often found in urban areas (OEH, 2017e). It feeds on seeds obtained in trees and shrubs, particularly eucalypts and acacias, and is also known to feed on seeds of introduced trees and shrubs as well as insect larvae (OEH, 2017e). This species nests in hollows in the trunks, limbs or dead spouts of tall living trees, especially eucalypts, often near water (OEH, 2017e). The subject site provides potential foraging and roosting habitat for the Gang-gang Cockatoo.

b. Distribution and condition of regional habitats

The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee (OEH, 2017e).

There are 320 records of the Gang-gang Cockatoo throughout the Shoalhaven LGA (OEH, 2017a). Suitable foraging and roosting habitat is conserved within the Shoalhaven LGA and National Parks and Reserves such as the Jervis Bay National Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristics. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Gang-gang Cockatoo is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Gang-gang Cockatoo:

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

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017e):

- Loss of key breeding and foraging habitat from intensive wildlife events and inappropriate hazard reduction burns;

- Loss and degradation of breeding and foraging habitat from rural and urban development;
- Loss of breeding and foraging habitat from forestry management practices;
- Climate change impacts to habitat suitability and distribution
- Psittacine cirovirus disease (PCD);
- Lack of knowledge of locations of key breeding habitat and breeding ecology and success;
- Infestation of habitat by invasive weeds; and
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners.

c. Other documentation

No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species. The Gang-gang Cockatoo has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.5.2 Glossy Black-Cockatoo

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There have been 86 records of the Glossy Black-Cockatoo within the locality. Additionally, this species was recorded within the subject site during surveys for the proposed development (see Appendix R in the Revised SIS). Furthermore, there is suitable foraging and roosting habitat present for the species within the subject site.

b. Discussion of habitat utilisation

The Glossy Black-Cockatoo is dependent on large hollow-bearing eucalypts for nest sites, where they lay eggs between March and May. The Glossy Black Cockatoo feeds almost exclusively on the seeds of several species of shoe-oak (*Casuarina* and *Allocasuarina* species) including the Black She-oak (*Allocasuarina littoralis*) and Forest She-oak (*A. torulosa*) (OEH, 2017f). The subject site contains areas of suitable foraging habitat for the species. Only five of approximately 200 hollow-bearing trees identified within the study area will be directly impacted by the proposed development. The hollows on these trees range in size and the loss of these hollow-bearing trees could potentially impact the Glossy Black-Cockatoo.

The Glossy Black-Cockatoo is wide-ranging and highly mobile, and would utilise home ranges of several kilometres radius from a nest or roost site. The vegetation present on the subject site, therefore, represents only a very small proportion of the home range for this species.

c. Discussion of corridors

Suitable habitat for the Glossy Black-Cockatoo to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Glossy Black-Cockatoo is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

This species feeds almost exclusively on the seeds of several species of She-oak (*Casuarina* and *Allocasuarina* species), shredding the cones with their large bill (OEH, 2017f). Key food species on the coast and tablelands are *Allocasuarina torulosa* (Forest Oak) and *Allocasuarina littoralis* (Black She-oak), with some *Allocasuarina distyla* taken (Scrub She-oak) (NSW Scientific Committee, 2008b). Inland, its key food species include *Allocasuarina verticillata* (Drooping Sheoak) and *Casuarina cristata* (Belah), as well as *Allocasuarina inophloia* (Stringybark She-oak), *Allocasuarina diminuta*, *Allocasuarina gymnanthera*, and sometimes *Allocasuarina luehmannii* (Buloke) (NSW Scientific Committee, 2008b). Nesting occurs in large hollows (26 cm wide and up to 1.4 m deep) within live or dead eucalypts, commonly in a dead spout in a living tree (NSW Scientific Committee, 2008b). The subject site provides potential foraging and roosting habitat for the Gang-gang Cockatoo.

b. Distribution and condition of regional habitats

The Glossy Black-Cockatoo is widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina (OEH, 2017f).

There are 1,388 records of the Gang-gang Cockatoo within the Shoalhaven LGA. Records are more concentrated along the east coast, particularly around Jervis Bay (OEH, 2017a). Suitable foraging and roosting habitat is conserved within the Shoalhaven LGA and National Parks and Reserves such as the Jervis Bay Nation Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristics. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Glossy Black-Cockatoo is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Gang-gang Cockatoo:

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

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017f):

- Reduction of suitable habitat through clearing for development;
- Decline of hollow bearing trees over time due to land management activities;
- Excessively frequent fire which eliminates she-oaks from areas, prevents the development of mature she-oak stands, and destroys nest trees;
- Firewood collection resulting in loss of hollow bearing trees, reduced recruitment of hollow bearing trees, and disturbance of breeding attempts;
- Decline in extent and productivity of she-oak foraging habitat due to feral herbivores;
- Limited information on the location of nesting aggregations and the distribution of high quality breeding habitat;
- Disturbance from coal seam gas and open cut coal mining causing loss of foraging and breeding habitat as well as disturbing reproductive attempts;
- Forestry activity resulting in loss of hollow bearing trees, reduced recruitment of hollow bearing trees, degradation of foraging habitat, and disturbance of breeding attempts;
- Decline in extent and productivity of shoe-oak foraging habitat caused by moisture stress due to climate change;
- Degradation of foraging habitat and reduced regeneration of shoe-oak stands due to grazing by domestic stock;
- Loss of foraging habitat due to slashing/underscrubbing;

- Change in the spatial and temporal distribution of foraging resources due to global warming;
- Illegal bird smuggling and egg-collecting; and
- Habitat infestation by weeds such as African boxthorn, Gazania, buffel grass and other invasive grasses.

c. Other documentation

No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species. The Glossy Black-Cockatoo has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.5.3 Little Lorikeet

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There has been one record of the Little Lorikeet within the locality. This species has not previously been recorded within the study area however potential foraging and nesting habitat is available.

b. Discussion of habitat utilisation

The Little Lorikeet nests in proximity to foraging habitat, typically selecting hollows in the limb or trunk of smooth barked Eucalypts. The hollows utilised by the Little Lorikeet are very small, with an approximate diameter of 3 cm. The nest sites are often used repeatedly for decades (OEH, 2017j).

The subject site contains areas of suitable nesting and foraging habitat for the Little Lorikeet. Only five of approximately 200 hollow-bearing trees identified within the study area will be directly impacted by the proposed development. The hollows on these trees range in size and the loss of these hollow-bearing trees could potentially impact the Little Lorikeet.

The Little Lorikeet is a highly mobile species, and would utilise habitat throughout the study area and wider locality. As such, the vegetation present on the subject site represents only a very small proportion of habitat available for this species.

c. Discussion of corridors

Suitable habitat for the Little Lorikeet to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather

than creating fragmented habitat patches. As the Little Lorikeet is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Little Lorikeet is considered to be a nomadic species mostly occurring in dry, open eucalypt forests and woodlands. Isolated flowering trees in open country are also utilised by this species (OEH, 2017j). The Little Lorikeet feeds 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 (OEH, 2017j). In some parts of its range, *Eucalyptus albens* (White Box) and *Eucalyptus melliodora* (Yellow Box) are particularly important food sources for pollen and nectar respectively (OEH, 2017j). This species nests in hollow-bearing trees, particularly those within smooth-barked eucalypts. Hollows utilised by the Little Lorikeet are very small, with an approximate diameter of 3 cm (NSW Scientific Committee, 2009a). The subject site provides potential foraging and nesting habitat for the Little Lorikeet.

b. Distribution and condition of regional habitats

This species is widely distributed across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia, with NSW providing a large portion of the species' core habitat (OEH, 2017j). The nomadic movement of the species is influenced by season and food availability, although some areas retain residents for much of the year (OEH, 2017j).

There are 104 records of the Little Lorikeet within the Shoalhaven LGA. Records are more concentrated along the east coast, particularly around Sussex Inlet (OEH, 2017a). Suitable habitat is managed within the Shoalhaven LGA within National Parks and Reserves such as the Jervis Bay National Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristics. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Little Lorikeet is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Little Lorikeet:

- Clearing of native vegetation;
- Loss of hollow-bearing trees;

- Removal of dead wood and dead trees; and
- Invasion of native plant communities by exotic perennial grasses.

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017j):

- Infestation of habitat by invasive weeds;
- Inappropriate fire regimes;
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners; and
- Degradation of woodland habitat and vegetation structure due to overgrazing.

c. Other documentation

No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species. The Little Lorikeet has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.5.4 Masked Owl

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There have been five records of the Masked Owl within the locality. This species has not previously been recorded within the study area however potential foraging and roosting habitat is available.

b. Discussion of habitat utilisation

The Masked Owl roosts in hollows in live or occasionally dead eucalypts, dense foliage in gullies and caves or recesses in cliffs. The hollows utilised by the Masked Owl are greater than 40 cm wide and greater than 100 cm deep (OEH, 2017k).

The subject site contains areas of potential roosting and foraging habitat for the Masked Owl. Only five of approximately 200 hollow-bearing trees identified within the study area will be directly impacted by the proposed development. The hollows on these trees range in size and the loss of these hollow-bearing trees could potentially impact the Masked Owl.

The Masked Owl is wide-ranging and highly mobile, and would utilise home ranges of several kilometres radius from a nest site in an evening. The vegetation present on the subject site, therefore, represents only a very small proportion of the home range for this species.

c. Discussion of corridors

Suitable habitat for the Masked Owl to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Masked Owl is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Masked Owl inhabits dry eucalypt forests of the tablelands, western slopes and the undulating wet-dry forests of the coast. Optimal habitat includes an open understorey and a mosaic of sparse (grassy) and dense (shrubby) ground cover on gentle terrain (DEC (NSW), 2006). This species hunts within forests and well as along their edges, and is a specialist predator of terrestrial mammals, particularly native rodents (OEH, 2017k). The diet is supplemented by bandicoots, arboreal mammals (Sugar Glider, Common Ringtail Possum), and some birds. Roosting occurs in hollows in live or occasionally dead eucalypts; dense foliage in gullies; and caves or recesses in cliffs (DEC (NSW), 2006). This species nests in old hollow eucalypts, live or dead but commonly live, in a variety of topographic positions from gully to upper slope, with hollows greater than 40 cm wide and greater than 100 cm deep; there is no relationship with distance to streams (DEC (NSW), 2006). The subject site provides potential foraging and roosting habitat for the Masked Owl.

b. Distribution and condition of regional habitats

The Masked Owl occurs from the coast to the western plains, with records of this species throughout much of NSW, excluding the most arid north-western corner (DEC (NSW), 2006). Furthermore there is no seasonal variation in its distribution.

There are 153 records of the Masked Owl within the Shoalhaven LGA. Records are more concentrated along the east coast between Sussex Inlet and East Lynne (OEH, 2017a). Suitable habitat is managed within the Shoalhaven LGA within National Parks and Reserves such as the Jervis Bay National Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristics. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Masked Owl is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Masked Owl:

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

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017k):

- A combination of grazing and regular burning is a threat, through the effects on the quality of ground cover for mammal prey, particularly in open, grassy forests;
- Secondary poisoning from rodenticides; and
- Being hit by vehicles.

c. Other documentation

The *Recovery Plan for Large Forest Owls* (DEC (NSW), 2006), including the Masked Owl, contains a number of objectives with the overall aim to ensure that viable populations of the large forest owls continue in the wild in NSW in each region where they presently occur. No threat abatement plan is relevant to this species and no critical habitat has been identified by the Chief Executive of the OEH. The Masked Owl has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.5.5 Powerful Owl

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There have been 47 records of the Powerful Owl within the locality. This species has not previously been recorded within the study area however potential foraging and roosting habitat is available.

b. Discussion of habitat utilisation

The Powerful Owl roosts in old hollow eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines, with hollows greater than 45 cm diameter and greater than 100 cm deep (OEH, 2017m).

The subject site contains areas of potential roosting and foraging habitat for the Powerful Owl. Only five of approximately 200 hollow-bearing trees identified within the study area will

be directly impacted by the proposed development. The hollows on these trees range in size and the loss of these hollow-bearing trees could potentially impact the Powerful Owl.

The Powerful Owl is wide-ranging and highly mobile, and would utilise home ranges of several kilometres radius from a nest site in an evening. The vegetation present on the subject site, therefore, represents only a very small proportion of the home range for this species.

c. Discussion of corridors

Suitable habitat for the Powerful Owl to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Powerful Owl is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest (OEH, 2017m). Optimal habitat includes a tall shrub layer and abundant hollows supporting high densities of arboreal marsupials (DEC (NSW), 2006). The main prey items of this species are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider, with birds and flying foxes occasionally being consumed (OEH, 2017m).

Roosting occurs in groves of dense mid-canopy trees or tall shrubs in sheltered gullies, typically on wide creek flats and at the heads of minor drainage lines, but also adjacent to cliff faces and below dry waterfalls (DEC (NSW), 2006). This species nests in old hollow eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines, with hollows greater than 45 cm diameter and greater than 100 cm deep; surrounded by canopy trees and sub-canopy or understorey trees or tall shrubs (DEC (NSW), 2006). The subject site provides potential foraging and roosting habitat for the Masked Owl.

b. Distribution and condition of regional habitats

The Powerful Owl is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains (OEH, 2017m)

There are 445 records of the Powerful Owl within the Shoalhaven LGA. Records within the Shoalhaven LGA are more concentrated along the east coast (OEH, 2017a). Suitable habitat is managed within the Shoalhaven LGA within National Parks and Reserves such as

the Jervis Bay National Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristics. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Powerful Owl is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Powerful Owl:

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

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017m):

- Historical loss and fragmentation of suitable forest and woodland habitat from land clearing for residential and agricultural development;
- Disturbance during the breeding period;
- Road kills;
- Secondary Poisoning; and
- Predation of fledglings by foxes, dogs and cats.

c. Other documentation

The *Recovery Plan for Large Forest Owls* (DEC (NSW), 2006), including the Powerful Owl, contains a number of objectives with the overall aim to ensure that viable populations of the large forest owls continue in the wild in NSW in each region where they presently occur. No threat abatement plan is relevant to this species and no critical habitat has been identified by the Chief Executive of the OEH. The Powerful Owl has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.5.6 Square-tailed Kite

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There have been two records of the Square-tailed Kite within the locality. Additionally this species has been identified within the study area. Potential nesting and foraging habitat is available within the subject site.

b. Discussion of habitat utilisation

The Square-tailed Kite builds nests using sticks in a live tree in open forest or woodland, or near edges or openings in forest vegetation (OEH, 2017o). An active nest has previously been identified on the western side of the study area suggesting that suitable foraging and nesting habitat is available within the subject site.

The Square-tailed Kite is wide-ranging and highly mobile, and would utilise home ranges of several kilometres radius from a nest site in an evening. The vegetation present on the subject site, therefore, represents only a very small proportion of the home range for this species.

c. Discussion of corridors

Suitable habitat for the Square-tailed Kite to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Square-tailed Kite is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Square-tailed Kite inhabits coastal and subcoastal eucalypt-dominated open forests and woodlands, and inland riparian woodland (NSW Scientific Committee, 2009b). Favoured habitat include productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes and Coolibah/River Red Gum on the inland plains (NSW Scientific Committee, 2009b). It is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage (OEH, 2017o). Nests are built using sticks in a live tree in open forest or woodland, or near edges or openings in forest vegetation (NSW Scientific Committee, 2009b). The subject site provides potential foraging and roosting habitat for the Square-tailed Kite.

b. Distribution and condition of regional habitats

In NSW, scattered records of the Square-tailed Kite throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March (OEH, 2017o).

There are 104 records of the Square-tailed Kite within the Shoalhaven LGA. These records are more concentrated along the east coast around Nowra and Sussex Inlet (OEH, 2017a). Suitable habitat for this species is managed within the Shoalhaven LGA within National Parks and Reserves such as the Jervis Bay National Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristics. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Square-tailed Kite is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Square-tailed Kite:

- Clearing of native vegetation; and
- Removal of dead wood and dead trees.

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017o):

- Disturbance to or removal of potential nest trees near watercourses; and
- Illegal egg collection and shooting.

c. Other documentation

The Square-tailed Kite has been assigned to the 'Landscape species' management stream under the 'Saving our Species' program. The major objective of the program is to ensure that the species is secure in the wild in NSW and that its' NSW geographic range is extended or maintained (OEH, 2017o). No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species.

4.5.7 Swift Parrot

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There has been one record of the Swift Parrot within the locality. This record included 28 individuals. This species has not previously been recorded within the study area however potential foraging and nesting habitat is available.

b. Discussion of habitat utilisation

The Swift Parrot breeds in Tasmania from September to January and migrates to the Australian south-east mainland between March and October. The species occurs in areas where eucalypts are flowering profusely or where there are abundant lerp infestations (OEH, 2017p). Favoured feed trees include *Eucalyptus robusta* (Swamp Mahogany), *Corymbia maculata* (Spotted Gum), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus sideroxylon* (Mugga Ironbark) and *Eucalyptus albens* (White Box) (OEH, 2017p).

The Swift Parrot is a highly mobile species, and would utilise habitat throughout the study area and wider locality. As such, the vegetation present on the subject site represents only a very small proportion of habitat available for this species.

c. Discussion of corridors

Suitable habitat for the Swift Parrot to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Swift Parrot is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Swift Parrot is semi nomadic during winter, foraging in dry woodlands, primarily in Victoria and NSW (OEH, 2017p). The Swift Parrot migrates from its Tasmanian breeding grounds to overwinter in the box-ironbark forests and woodlands of Victoria, NSW and southern Queensland (OEH, 2017p). The principal wintering grounds are the inland slopes of the Great Dividing Range and along the eastern coastal plains (OEH, 2017p). They occur in areas where eucalypts are flowering profusely or where there are abundant lerp infestations (OEH, 2017p). Favoured feed trees include Eucalyptus robusta (Swamp Mahogany), Corymbia maculata (Spotted Gum), Corymbia gummifera (Red Bloodwood), Eucalyptus sideroxylon (Mugga Ironbark) and Eucalyptus albens (White Box) (OEH, 2017p). The subject site provides potential foraging habitat for the Swift Parrot.

b. Distribution and condition of regional habitats

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

There are 11 records of the Swift Parrot within the Shoalhaven LGA. Records range from as far north as Berry and as far south as Termeil (OEH, 2017a). Suitable habitat is managed within the Shoalhaven LGA within National Parks and Reserves such as the Jervis Bay National Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristic. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Swift Parrot is listed as Endangered under the TSC Act and Critically Endangered under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Swift Parrot:

- Clearing of native vegetation;
- Loss of hollow-bearing trees;
- Removal of dead wood and dead trees; and
- Invasion of native plant communities by exotic perennial grasses.

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017p):

- Changes in spatial and temporal distribution of habitat due to climate change;
- Reduced food availability due to drought conditions;
- Competition from introduced bees and large, aggressive honeyeaters for food resources;
- Collisions with human made structures resulting in death or injury;
- Vulnerability to Psittacine Beak and Feather Disease;
- Infestation of habitat by invasive weeds;
- High fire frequency impacting on food resources

- Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners;
- Predation by cats; and
- Illegal capture and trade of wild birds for aviculture

c. Other documentation

No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species. The Swift Parrot has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.5.8 Varied Sittella

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There has been one record of a Swift Parrot within the locality. This record included six individuals. This species has not previously been recorded within the study area however potential foraging and nesting habitat is available.

b. Discussion of habitat utilisation

The Varied Sittella builds nests from plant fibres and cobwebs in an upright tree fork high in the living tree canopy. It feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy (OEH, 2017q).

The subject site contains areas of suitable foraging habitat for the Varied Sittella however, it is wide-ranging and highly mobile species, and would utilise home ranges of several kilometres radius from a nest site. The vegetation present on the subject site, therefore, represents only a very small proportion of the home range for this species.

c. Discussion of corridors

Suitable habitat for the Varied Sittella to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Varied Sittella is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Varied Sittella inhabits eucalypt forests and woodlands, especially where rough-barked species and mature smooth-barked gums with dead branches are present, as well as mallee and Acacia woodland (OEH, 2017q). This species feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy (OEH, 2017q). Nests are built from plant fibres and cobwebs in an upright tree fork high in the living tree canopy (OEH, 2017q). The subject site provides potential foraging and nesting habitat for the Varied Sittella.

b. Distribution and condition of regional habitats

The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands (OEH, 2017q). Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades (OEH, 2017q).

There are 60 records of the Varied Sittella within the Shoalhaven LGA. These records are primarily along the east coast from Kiola to Barrengarry (OEH, 2017a). Suitable habitat is managed within the Shoalhaven LGA within National Parks and Reserves such as the Jervis Bay National Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristic. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Varied Sittella is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Varied Sittella:

- Clearing of native vegetation;
- Loss of hollow-bearing trees;
- Removal of dead wood and dead trees; and
- Invasion of native plant communities by exotic perennial grasses.

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017q):

- Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners;
- Infestation of habitat by invasive weeds;
- Inappropriate fire regimes;
- Climate change impacts including reduction in resources due to drought; and
- Overgrazing by stock impacting on leaf litter and shrub layer.

c. Other documentation

No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species. The Varied Sittella has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.5.9 Eastern Bentwing-bat

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There have been ten records of the Eastern Bentwing-bat within the locality. Additionally the species has been recorded within the study area. Only marginal roosting habitat is available within the subject site so it is likely that this species would utilise the subject site to forage. Due to the number of records in the locality and considering that colonies can number from 100 to 150,000 individuals (OEH, 2017b), it is likely that the locality records are from the same population. Therefore, any individuals utilising the study area would form a component of the broader population ranging outside the locality.

b. Discussion of habitat utilisation

No roosting habitat is available within the subject site due to the absence of caves, buildings and other man-made structures. However the subject site provides a small area of potential foraging habitat for the Eastern Bentwing-bat as the species could potentially forage above the shrub canopy.

The Eastern Bentwing-bat is a highly mobile species, and would utilise habitat throughout the study area and wider locality. As such, the vegetation present on the subject site represents only a very small proportion of habitat available for this species.

c. Discussion of corridors

Suitable habitat for the Eastern Bentwing-bat to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Eastern Bentwing-bat is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Eastern Bentwing-bat occurs along the entire east coast of NSW in a variety of habitats, but prefers well-timbered valleys. Other suitable vegetation types include wet and dry sclerophyll forest, open woodland, paperbark forest, rainforests and grasslands. It primarily utilises caves for roosting, but is known to utilise culverts, derelict mines and other manmade structures. Foraging requirements for the species include forested areas that contain flying insects (OEH, 2017b).

The subject site provides a small area of potential foraging habitat for the Eastern Bentwing-bat as the species could potentially forage above the shrub canopy.

b. Distribution and condition of regional habitats

The Eastern Bentwing-bat occurs along the entire east coast of NSW and as far inland as Dubbo. This species is known to occur throughout the entire Shoalhaven LGA (OEH, 2017b). Potential roosting and foraging habitat is available throughout its known distribution with numerous areas of currently managed within National Parks and reserves such as the Jervis Bay National Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristic. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Eastern Bentwing-bat is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following key threatening process is known to affect the Eastern Bentwing-bat:

- Clearing of native vegetation.

In addition to the above listed key threatening process, the following threats have also been identified for the species (OEH, 2017b):

- Disturbance by recreational cavers and general public accessing caves and adjacent areas particularly during winter or breeding;
- Loss of high productivity foraging habitat;
- Introduction of exotic pathogens, particularly white-nose fungus;
- Cave entrances being blocked for human health and safety reasons, or vegetation (particularly blackberries) encroaching on and blocking cave entrances; and
- Hazard reduction and wildfire fires during the breeding season.

c. Other documentation

The Eastern Bentwing-bat has been assigned to the 'Landscape species' management stream under the 'Saving our Species' program. The major objective of the program is to ensure that the species is secure in the wild in NSW and that its' NSW geographic range is extended or maintained (OEH, 2017b). No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species.

4.5.10 Eastern False Pipistrelle

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There have been five records of the Eastern False Pipistrelle within the locality. Previous surveys for the proposed development have recorded this species within the study area. Furthermore, there is suitable foraging and roosting habitat present for the species within the subject site.

b. Discussion of habitat utilisation

The Eastern False Pipistrelle prefers moist habitats with trees taller than 20m. Roosting habitat occurs in tree hollows, under bark on trees and buildings. It forages above or just below the tree canopy eating beetles, moths, weevils and other flying insects. The subject site provides potential foraging and roosting habitat for the Eastern False Pipistrelle (OEH, 2017c).

The Eastern False Pipistrelle is a highly mobile species, and would utilise habitat throughout the study area and wider locality. As such, the vegetation present on the subject site represents only a very small proportion of habitat available for this species.

c. Discussion of corridors

Suitable habitat for the Eastern False Pipistrelle to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Eastern False Pipistrelle is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Eastern False Pipistrelle occurs in most moist habitats with trees generally greater than 20 metres in height. Known roosting habitat includes tree hollows, loose bark and buildings (OEH, 2017c).

The Eastern False Pipistrelle forges above or just below the tree canopy eating beetles, moths, weevils and other flying insects. The subject site contains areas of suitable foraging habitat for the species (OEH, 2017c). Only five of approximately 200 hollow-bearing trees identified within the study area will be directly impacted by the proposed development. The hollows on these trees range in size and the loss of these hollow-bearing trees could potentially impact the Eastern False Pipistrelle. Additionally, loose bark on trees within the subject site have the potential to provide roosting habitat for the Eastern False Pipistrelle...

b. Distribution and condition of regional habitats

The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from Southern Queensland to Victoria and Tasmania (OEH, 2017c). There are 62 records of the Eastern False Pipistrelle within the Shoalhaven LGA, stretching from Barrengarry in the north to Kiola State Forest in the South and Coolumburra to the West (OEH, 2017a). Suitable habitat is managed within the Shoalhaven LGA within National Parks and Reserves such as the Jervis Bay National Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristic. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Eastern False Pipistrelle is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Eastern False Pipistrelle:

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

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017c):

- Disturbance to winter roosting and breeding sites;
- Loss of roosting habitat, primarily hollow-bearing eucalypts; and
- Loss and fragmentation of foraging habitat, particularly extensive areas of continuous forest and areas of high productivity.

c. Other documentation

No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species. The Eastern False Pipistrelle has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.5.11 Eastern Freetail-bat

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There have been four records of the Eastern Freetail-bat within the locality. Previous surveys for the proposed development have recorded this species within the study area. Furthermore, there is suitable foraging and roosting habitat present for the species within the subject site.

b. Discussion of habitat utilisation

The Eastern Freetail-bat occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roosting habitat occurs in tree hollows, under bark on trees or in man-made structures. It forages above or just below the tree canopy (OEH, 2017d). The subject site provides potential foraging and roosting habitat for the Eastern Freetail-bat.

The Eastern Freetail-bat is a highly mobile species, and would utilise habitat throughout the study area and wider locality. As such, the vegetation present on the subject site represents only a very small proportion of habitat available for this species.

c. Discussion of corridors

Suitable habitat for the Eastern Freetail-bat to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Eastern Freetail-bat is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Eastern Freetail-bat occurs in occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Known roosting habitat includes tree hollows, loose bark on trees or in man-made structures (OEH, 2017d).

The Eastern Freetail-bat forges above or just below the tree canopy. The subject site contains areas of suitable roosting and foraging habitat for the species. Only five of approximately 200 hollow-bearing trees identified within the study area will be directly impacted by the proposed development. The hollows on these trees range in size and the loss of these hollow-bearing trees could potentially impact the Eastern Freetail-bat. Additionally, loose bark on trees within the subject site have the potential to provide roosting habitat for the Eastern Freetail-bat.

b. Distribution and condition of regional habitats

The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW (OEH, 2017d). There are 77 records of the Eastern Freetail-bat within the Shoalhaven LGA, stretching from Barrengarry in the north to Kiola in the south (OEH, 2017a). Suitable habitat is managed within the Shoalhaven LGA within National Parks and Reserves such as the Jervis Bay National Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristic. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Eastern Freetail-bat is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Eastern Freetail-bat:

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

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017d):

- Loss of foraging habitat;
- Application of pesticides in or adjacent to foraging areas;
- Artificial light sources spilling onto foraging and/or roosting habitat; and
- Large scale wildfire or hazard reduction burns on foraging and/or roosting habitat.

c. Other documentation

No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species. The Eastern Freetail-bat has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.5.12 Greater Broad-nosed Bat

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There have been four records of the Greater Broad-nosed Bat within the locality. Previous surveys for the proposed development have recorded this species within the study area. Furthermore, there is suitable foraging and roosting habitat present for the species within the subject site.

b. Discussion of habitat utilisation

The Greater Broad-nosed Bat utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Roosting habitat occurs in tree hollows and buildings (OEH, 2017g). It forages after sunset, flying slowly and directly along creek and river corridors at an altitude of three to six metres (OEH, 2017g). The subject site provides potential foraging and roosting habitat for the Greater Broad-nosed Bat.

The Greater Broad-nosed Bat is a highly mobile species, and would utilise habitat throughout the study area and wider locality. As such, the vegetation present on the subject site represents only a very small proportion of habitat available for this species.

c. Discussion of corridors

Suitable habitat for the Greater Broad-nosed Bat to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Greater Broad-nosed Bat is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Greater Broad-nosed Bat occurs in utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Known roosting habitat includes tree hollow and buildings (OEH, 2017g).

The Greater Broad-nosed Bat forages after sunset along creek and river corridors where it searches for beetles and other large, slow-flying insects (OEH, 2017g). The subject site contains areas of suitable foraging habitat for the species. Only five of approximately 200 hollow-bearing trees identified within the study area will be directly impacted by the proposed development. The hollows on these trees range in size and the loss of these hollow-bearing trees could potentially impact the Greater Broad-nosed Bat.

b. Distribution and condition of regional habitats

The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m (OEH, 2017g).

There are 71 records of the Greater Broad-nosed Bat within the Shoalhaven LGA, stretching from Barrengarry in the north to the Kiola State Forest in the South and Bulee to the west (OEH, 2017a). Suitable habitat is conserved within the Shoalhaven LGA and National Parks and Reserves such as the Jervis Bay Nation Park, Woollamia Nature Reserve and Jerrawangala National Park These areas are within close proximity to the study area and contain areas of similar floristic. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Greater Broad-nosed Bat is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Greater Broad-nosed Bat:

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

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017g):

- Disturbance to roosting and summer breeding sites;
- Clearing for residential and agricultural developments, including clearing by residents within rural subdivisions
- Pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individuals' fat stores; and
- Changes to water regimes which are likely to impact food resources, as is the use of pesticides and herbicides near waterways.

c. Other documentation

No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species. The Greater Broad-nosed Bat has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.5.13 Grey-headed Flying Fox

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There are 10 records of the Grey-headed Flying-fox from the locality. The species roosts in colonies known as 'camps'. No known camps are located within the locality, but two camps are present in the Shoalhaven LGA within 30km of the study area. The two camps are located at Bomaderry Creek and Wandandian, Bewong Creek, being located approximately 15km and 24km to the northwest and southwest of the study area, respectively (DoE, 2012) The 10 records from the locality are primarily distributed to the west of the study area as areas to the east are coastal and lack preferred foraging habitat or camps.

Although individuals have been recorded foraging within the subject site during previous surveys the low number of records within the locality suggest that the habitat within the

subject site is likely to be limited to opportunistic foraging habitat as part of a larger foraging range and is unlikely to exclusively support a local population.

b. Discussion of habitat utilisation

The subject site is unlikely to be utilised for roosting purposes as no camp is present. Although no known roost camps are present in the locality, the presence of the Bomaderry Creek camp 15 km away, along with the presence of potential suitable foraging vegetation suggests that the subject site may be utilised as foraging habitat on occasion by this species. As the species is known to travel up to 50 km from its roosting site to forage (OEH, 2017h), this species is unlikely to be entirely dependent on the study area for foraging and it likely only forms a very small portion of a much larger foraging range.

The Grey-headed Flying-fox is wide-ranging and highly mobile, and would utilise home ranges of several kilometres radius from a roost site in an evening. The vegetation present on the subject site, therefore, represents only a very small proportion of the home range for this species.

c. Discussion of corridors

Suitable habitat for the Eastern Bentwing-bat to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Grey-headed Flying-fox is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Grey-headed Flying-fox occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps, and in urban gardens and fruit crops. Roosting camps are typically located in vegetation with a dense canopy that is close to water and often in a gully. Camps are also usually located within 20 km of a regular food source preferring native Eucalyptus, Melaleuca and Banksia trees, but will also forage on rainforest trees, cultivated gardens and fruit crops (OEH, 2017h).

The study area does not contain a roosting camp for this species but a small area of potential suitable foraging habitat is present. Suitable foraging habitat exists as native *Euaclyptus, Melaleuca* and *Banksia* trees and shrubs.

b. Distribution and condition of regional habitats

There are two additional Grey-headed Flying-fox camps in the Shoalhaven LGA (DoE, 2012). These camps are located to the south in Kiola and Yatte Yattah. Additionally, there

are a number of camps to the north of the study area with one camp in Wollongong and approximately 18 camps in the Sydney metropolitan area (Ku-ring-gai Bat Conservation Society, 2017).

Suitable foraging habitat for this species is available throughout their distribution and more specifically, within 20km of their roost camps. Foraging habitat, including favourable *Eucalyptus, Melaleuca* and *Banksia* trees, is available in higher condition throughout the Shoalhaven LGA. Areas of higher condition are currently maintained within National Parks and reserves such as the Jervis Bay Nation Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristic. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Grey-headed Flying-fox is listed as Vulnerable under both the TSC Act and EPBC Act.

b. Threatening processes

The following key threatening process listed under the TSC Act is likely to affect the Grey-headed Flying-fox:

- Clearing of native vegetation.

In addition to the above listed key threatening process, the following threats have also been identified for the species (OEH, 2017h):

- Loss of roosting and foraging sites;
- Electrocution on powerlines, entanglement in netting and on barbed-wire;
- Heat stress;
- Conflict with humans; and
- Incomplete knowledge of abundance and distribution across the species' range.

c. Other documentation

The Grey-headed Flying-fox has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained (OEH, 2017h).

A Draft National Recovery Plan has also been developed for the Grey-headed Flying Fox. The relevant objectives of the plan are (DECCW, 2009).

- Objective 1: To identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes throughout their range.

  The study area does not provide foraging habitat critical to the survival of Grey-headed Flying-foxes as identified in the Draft National Recovery Plan for this species. For habitat to be identified as critical to this species survival, one or more of the following criteria must be met:

  - productive during winter and spring, when food bottlenecks have been identified (Parry-Jones and Augee, 1991).
  - known to support populations of > 30 000 individuals within an area of 50 km radius (the maximum foraging distance of an adult);
  - productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May);
  - productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions); and/or
  - known to support a continuously occupied camp.

- Objective 2: To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes.

  Key winter and spring foraging habitat for the Grey-headed Flying-fox includes the following species: *Eucalyptus tereticornis, E. albens, E. crebra, E. fibrosa, E. melliodora, E. paniculata, E. pilularis, E. robusta, E. siderophloia, Banksia integrifolia, Castanospermum australe, Corymbia citriodora, C. eximia, C. maculata* (south from Nowra), *Grevillea robusta* and *Melaleuca quinquenervia.*

  The study area contains a number of these species including: *Eucalyptus. tereticornis, E. paniculata, E. pilularis, Banksia integrifolia* and *Corymbia maculata.*

- Objective 3: To identify roosting habitat critical to the survival of Grey-headed Flying-foxes.

  According to the Draft National Recovery Plan for the Grey-headed Flying-fox, at least one of the following criteria must be met for roosting habitat to be considered as critical to the survival of the species must:

  - is used as a camp either continuously or seasonally in > 50% of years;
  - has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 10 000 individuals, unless such habitat has been used only as a temporary refuge, and the use has been of limited duration (i.e. in the order of days rather than weeks or months); and/or

- has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 2 500 individuals, including reproductive females during the final stages of pregnancy, during lactation, or during the period of conception (i.e. September to May).

The study area does not contain critical roosting habitat as the habitat present does not meet one of the above criteria.

➢ Objective 4: To protect and enhance roosting habitat critical to the survival of Grey-headed Flying-foxes.

The study area does not contain roosting habitat critical to the survival of Grey-headed Flying-foxes.

4.5.14 Little Bentwing-bat

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There has been one record of the Little Bentwing-bat within the study area. No other records of the species occur within the locality. There is only marginal suitable roosting habitat present for the species within the subject site and this species is more likely to utilise the subject site for foraging.

b. Discussion of habitat utilisation

The Little Bentwing-bat requires areas with dense vegetation, often near water, where it forages for insects beneath the canopy. Roosting habitat occurs in caves, tunnels, tree hollows, mines, stormwater drains, culverts, bridges and buildings. The species has also been frequently recorded roosting with the Common Bentwing-bat (OEH, 2017i).

The subject site provides potential foraging habitat and some marginal roosting habitat. The Little Bentwing-bat would most likely utilise the study area for foraging. The Little Bentwing-bat is a highly mobile species, and would utilise habitat throughout the study area and wider locality. As such, the vegetation present on the subject site represents only a very small proportion of habitat available for this species.

c. Discussion of corridors

Suitable habitat for the Little Bentwing-bat to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Little Bentwing-bat is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Little Bentwing-bat primarily occurs in moist areas with dense vegetation which is utilises for foraging. Known roosting habitat includes mine shafts, caves, tunnels, tree hollows, storm water channels, buildings, under bridges and in dense foliage (OEH, 2017i).

The subject site contains areas of dense vegetation which could provide suitable foraging habitat for the species. Only five of approximately 200 hollow-bearing trees identified within the study area will be directly impacted by the proposed development. The hollows on these trees range in size and the loss of these hollow-bearing trees could potentially impact the Little Bentwing-bat.

b. Distribution and condition of regional habitats

The Little Bentwing-bat mainly occurs in moist areas including rainforest, melaleuca swamps, coastal forests and moist eucalypt forest. Its primary distribution is in coastal areas along most of the east coast of NSW (OEH, 2017i). There are no known populations within the Shoalhaven LGA, with only one previous record approximately ten kilometres north-west of Nowra (OEH, 2017a). Suitable foraging habitat is conserved within the Shoalhaven LGA and National Parks and Reserves such as the Jervis Bay Nation Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristic. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Little Bentwing-bat is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Little Bentwing-bat:

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

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017i):

- Disturbance of colonies, especially in nursery or hibernating caves, may be catastrophic;

- Destruction of caves that provide seasonal or potential roosting sites;
- Changes to habitat, especially surrounding maternity /nursery caves and winter roosts;
- Pesticides on insects and in water consumed by bats bio accumulates, resulting in poisoning of individuals;
- Predation from foxes, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges
- Predation from feral cats, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges;
- Introduction of exotic pathogens such as the White-nosed fungus;
- Hazard reduction and wildfire fires during the breeding season;
- Large scale wildfire or hazard reduction can impact on foraging resources; and
- Poor knowledge of reproductive success and population dynamics.

c. Other documentation

No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species. The Little Bentwing-bat has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.5.15 Southern Myotis

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There are 30 records of the Southern Myotis within the locality and four records within the study area. Additionally, this species was recorded within the study area during previous surveys for the proposed development. There is no foraging habitat present for the Southern Myotis within the subject site however this species potentially uses the subject site for roosting.

b. Discussion of habitat utilisation

The Southern Myotis forages over streams and pools catching insects and small fish by raking their feet across the water surface. Roosting habitat occurs close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage (OEH, 2017n).

The subject site provides potential roosting habitat in the form of hollow-bearing trees. Additionally foraging habitat is located within the study area at Lake Wollumboola. The proposed development will implement management plans to ensure that impacts on hollow-bearing trees are kept to a minimum and where trees are lost during clearing, can be salvaged and re-used within the study area. The proposed development is unlikely to have an impact on Lake Wollumboola which would affect the foraging habits of the Southern Myotis.

The Southern Myotis is a highly mobile species, and would utilise habitat throughout the study area and wider locality. As such, the vegetation present on the subject site represents only a very small proportion of habitat available for this species.

c. Discussion of corridors

Areas of suitable habitat for the Southern Myotis identified for removal within the subject site have connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Southern Myotis is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers (OEH, 2017n). The Southern Myotis is typically known to roost in groups of 10-15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage (OEH, 2017n).

The subject site does not provide suitable foraging habitat for the Southern Myotis. Likely foraging habitat is located within the study area at Lake Wollumboola. Only five of approximately 200 hollow-bearing trees identified within the study area will be directly impacted by the proposed development. The hollows on these trees range in size and the loss of these hollow-bearing trees could potentially impact the Southern Myotis.

b. Distribution and condition of regional habitats

The Southern Myotis mainly occurs in coastal areas along most of the east coast of NSW (OEH, 2017n). There are 144 records of the Southern Myotis within the Shoalhaven LGA with records as far west as Burrier, along the Shoalhaven River (OEH, 2017a). Roosting and foraging habitat is available throughout the Shoalhaven LGA which is conserved within National Parks and Reserves such as the Jervis Bay Nation Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the

study area and contain areas of similar floristic. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Southern Myotis is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Little Bentwing-bat:

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

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017n):

- Loss or disturbance of roosting sites;
- Clearing adjacent to foraging areas;
- Application of pesticides in or adjacent to foraging areas; and
- Reduction in stream water quality affecting food resources.

c. Other documentation

No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species. The Southern Myotis has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.5.16 Yellow-bellied Glider

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There are 36 records of the Yellow-bellied Glider within the locality and two records within the study area. Additionally, this species was recorded within the study area during past surveys. Foraging and nesting habitat is present within the subject site and wider study area.

b. Discussion of habitat utilisation

Yellow-bellied Gliders occur in tall mature eucalypt forest, generally in areas with high rainfall and nutrient rich soils. It is known to live in small family groups which nest in hollows of large trees. The Yellow-bellied Glider feeds on plant and insect excudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. (OEH, 2017s)

The subject site provides potential roosting habitat in the form of hollow-bearing trees. The proposed development has taken hollow bearing trees into account and has been design to have minimal impact on these trees within the subject site. The proposed development will implement management plans to ensure that impacts on hollow-bearing trees are kept to a minimum and where trees are lost during clearing, can be salvaged and re-used within the study area. Additionally foraging habitat is located within the subject site. The Yellow-bellied Glider has a large home range, is highly mobile and is likely to utilise numerous habitat resources within the study area and wider locality (OEH, 2017s). The vegetation present on the subject site, therefore, represents only a very small proportion of the home range for this species.

c. Discussion of corridors

Areas of suitable habitat for the Yellow-bellied Glider identified for removal within the subject site have connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Yellow-bellied Glider is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from Southern Queensland to Victoria. It occurs in tall mature eucalypt forest, generally in areas with high rainfall and nutrient rich soils. Furthermore, habitat preferences vary with latitude and elevation. In the north, the Yellow-bellied Glider prefers forest types from mixed coastal forests to dry escarpment forests, where as in the south they vary between moist coastal gullies and creek flats to tall montane forests (OEH, 2017s).

The Yellow-bellied Glider is typically known to live in family groups of two to six in hollows of large trees (OEH, 2017s). The subject site provides suitable nesting habitat in the form of hollow bearing trees as well as foraging habitat for the Yellow-bellied Glider. Only five of approximately 200 hollow-bearing trees identified within the study area will be directly impacted by the proposed development. The hollows on these trees range in size and the loss of these hollow-bearing trees could potentially impact the Yellow-bellied Glider.

b. Distribution and condition of regional habitats

The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from Southern Queensland to Victoria. Within the Shoalhaven LGA there are 1,533 records of the Yellow-bellied Glider. Records of the species can be seen throughout the Shoalhaven LGA from Morton National Park to the west, Kangaroo Valley to the North and Depot Beach to the south (OEH, 2017a). Suitable nesting and foraging habitat is available throughout the Shoalhaven LGA which is conserved within National Parks and Reserves such as the Jervis Bay Nation Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristic. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Yellow-bellied Glider is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Yellow-bellied Glider:

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

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017s):

- Loss and fragmentation of habitat; and
- Loss of feed trees.

c. Other documentation

No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species. The Yellow-bellied Glider has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.5.17 Yellow-bellied Sheathtail-bat

i. Discussion of Local and Regional Abundance and Distribution

a. Discussion of other known local populations

There are no published records of the Yellow-bellied Sheathtail-bat within the locality. Previous surveys for the proposed development have however recorded this species within the study area. There is suitable foraging and roosting habitat present for the species within the subject site.

b. Discussion of habitat utilisation

The Yellow-bellied Sheathtail-bat forages in most habitats across its very wide range, with and without trees and is believed to defend an aerial territory. Roosting habitat occurs in tree hollows and buildings where it is known to roost singly or in groups of up to six. Furthermore, in treeless areas it is known to utilise mammal burrows for roosting (OEH, 2017t).

The subject site provides potential foraging and roosting habitat for the Yellow-bellied Sheathtail-bat.

The Yellow-bellied Sheathtail-bat is a highly mobile species, and would utilise habitat throughout the study area and wider locality. As such, the vegetation present on the subject site represents only a very small proportion of habitat available for this species.

c. Discussion of corridors

Suitable habitat for the Yellow-bellied Sheathtail-bat to be removed within the subject site has connectivity to larger patches of habitat to the north, including Jervis Bay National Park and to the west within privately owned land. The habitat to be removed as part of the proposal will cause minimal habitat fragmentation, as it primarily requires clearing at the edge of treed habitat. As such, clearing of the subject site is likely to encroach further into remaining habitat rather than creating fragmented habitat patches. As the Yellow-bellied Sheathtail-bat is highly mobile, potential corridors created as a result of the proposed development are unlikely to impact the movement of this species.

ii. Assessment of Habitat

a. Description of habitat values

The Yellow-bellied Sheathtail-bat occurs in most habitats, with and without trees. Known roosting habitat includes tree hollows and buildings (OEH, 2017t).

When foraging for insects, the Yellow-bellied Sheathtail-bat flies high and fast when over forest canopy however lower in more open country (OEH, 2017t). The subject site contains areas of suitable foraging habitat for the species. Only five of approximately 200 hollow-bearing trees identified within the study area will be directly impacted by the proposed development. The hollows on these trees range in size and the loss of these hollow-bearing trees could potentially impact the Yellow-bellied Sheathtail-bat.

b. Distribution and condition of regional habitats

The Yellow-bellied Sheathtail-bat occurs in most areas across northern and eastern Australia. In the most southerly part of its range, most of Victoria, south-western NSW and adjacent South Australia, it is a rare visitor in late summer and autumn (OEH, 2017t). There are scattered records of this species across the New England Tablelands and North West Slopes There are 13 records of the Yellow-bellied Sheathtail-bat within the Shoalhaven LGA, from Sussex Inlet to the south, Berry to the north and Georges Yard to the west (OEH, 2017a). Suitable habitat is managed within the Shoalhaven LGA within National Parks and Reserves such as the Jervis Bay Nation Park, Woollamia Nature Reserve and Jerrawangala National Park. These areas are within close proximity to the study area and contain areas of similar floristic. Additionally, previous records of this species can be found in some of these conserved habitats.

iii. Discussion of Conservation Status

a. Local, regional and state-wide status

The Yellow-bellied Sheathtail-bat is listed as Vulnerable under the TSC Act. It is not listed under the EPBC Act.

b. Threatening processes

The following threatening processes are known to affect the Yellow-bellied Sheathtail-bat:

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

In addition to the above listed key threatening processes, the following threats have also been identified for the species (OEH, 2017t):

- Disturbance to roosting and summer breeding sites;
- Foraging habitats being cleared for residential and agricultural developments, including clearing by residents within rural subdivisions;
- Loss of hollow-bearing trees; clearing and fragmentation of forest and woodland habitat;
- Pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individuals' fat stores.

c. Other documentation

No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Chief Executive of the OEH for this species. The Yellow-

bellied Sheathtail-bat has been included as a 'Landscape species' in the 'Saving our Species' program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that it's NSW geographic range is extended or maintained.

4.6 Feasible Alternatives

Feasible alternatives are discussed in the Revised SIS, which include the potential to redesign and/or relocate the golf course. The following sections provide additional alternatives for the proposed development and supplementary information which support the conclusions made in the Revised SIS.

There are four broad alternatives to the proposal:

- Do nothing;
- Reduced scale;
- Relocation of development; or
- Alternative development

These are discussed below.

4.6.1 Do Nothing

If nothing is done and no development occurs, the areas of vegetation within the subject site are likely to survive in the long term *in situ*, however, there is currently no guaranteed funding for ongoing management. The study area has previously been subject to timber harvesting and partial clearing for grazing purposes. Additional clearing has continued within the study area for access tracks, fencing and maintenance. As such, areas within the study area have become subject to edge effects and increase in weed and feral animal abundance. In the long term, the current land management practices have the potential to continue to degrade the vegetation within the study area and result in further increases of weeds and feral animals.

Furthermore, the majority of the subject site is zoned R2 Residential, and to do nothing would not be inconsistent with its intended use. Although the development of a Golf Course is not considered 'residential', it would have fewer impacts in the long term than those from typical residential developments. For example, larger areas of native vegetation will remain within the study area, all of which will be managed under a Vegetation Management Plan (see **Chapter 5**),

The do nothing option is not likely to lead to viable long term management of native flora and fauna within the study area.

4.6.2 Reduced Scale

The Revised SIS discusses the potential to redesign the Culburra Golf Course. The current layout has been designed through a comprehensive and iterative process to ensure vegetation clearing is minimised and habitat features are retained whilst creating a high quality championship standard golf course.

In theory, it would be possible to reduce the scale of the golf course and utilise all of the already cleared land. This could conserve some more native vegetation and prevent disturbance to TECs and/or Downs Creek. However, the areas of cleared land form a mosaic pattern and to utilise all 8.41 ha of the cleared land would not be practical for the proposed development. Additionally, if the development layout was to be modified to utilise more of the cleared land then it would be more likely to impact habitat features such as hollow bearing trees. The current layout has taken important habitat features into consideration and is the most effective design to prevent impacts on habitat features. If additional fauna habitat was removed or disrupted it could result in a significant impact on threatened fauna.

Additionally, further reductions to the scale of the development could jeopardise the financial viability of the proposed development.

4.6.3 Relocation of the Development

Relocation of the proposed development would require a suite of ecological surveys to make a determination as to whether or not threatened species, populations, or communities would be significantly impacted by relocating the proposed development to another site in the locality that is under the same land ownership. However, an analysis of background information from sources such as OEH Atlas of NSW Wildlife Database (OEH, 2017a) and the EPBC Protected Matters Search Tool (DoEE, 2017) suggest that relocating the golf course to another location within the locality will have similar ecological impacts to those currently imposed by the proposed development.

As the proposed development is not considered to have any significant effects on threatened species, populations or communities, and without further survey effort, the relocation of the golf course cannot be justified.

4.6.4 Alternative Development

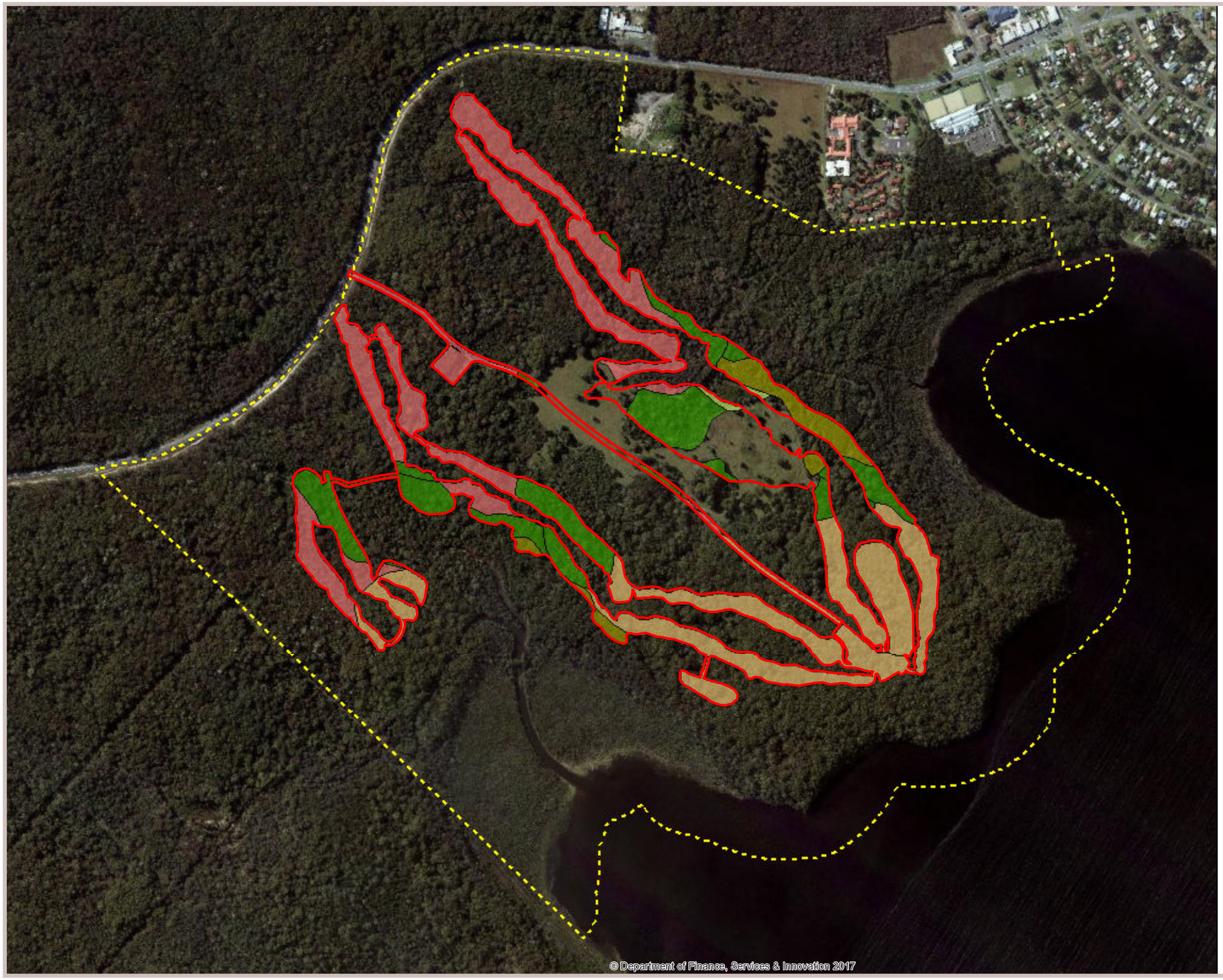
Two separate DA's have been accepted for Lots 5 and 6 DP1065111, within the study area, which would allow for the construction of two residential dwellings. The DA's for each lot allow the land to be on-sold to future residents who can build one dwelling within each lot.

This option will increase the potential for vegetation within the study area to be impacted without the requirement for long-term management. Additionally, landscaping as part of the development process and the associated flora species planted are unlikely to be native species typical of the surrounding vegetation communities. As such these species could further impact surrounding vegetation within the study area as exotic and non-endemic

species could spread onto adjacent land. Additionally, unauthorised clearing is also more likely to occur as a result of the alternative development.

Furthermore, water management plans such as the IWMP will not be required for the alternative developments which have the potential to negatively impact Lake Wollumboola.

The impacts on vegetation within the study area as well as those on Lake Wolumboola are considered to be less than those associated with the alternative development due the implementation of management plans such as the Environmental Management Plan and Vegetation Management Plan which are identified in the Previous SIS as well as this Addendum report.



Legend

Subject Site

Study Area

Vegetation Community

SR516 - Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion

SR592 - Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion

SR648 - Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

SR649 - Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

SR651 - Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Data Source:
EcoLogical Australia 2017

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

I:\...\16087\Figures\RP1\20171212\Figure 4.1 Areas of vegetation to be removed_Subject Site

0 100 200 300 400 m

Figure 4.1. Areas of vegetation to be removed

cumberland ecology

Chapter 5

Impact Amelioration

A suite of management plans are proposed by Gunninah (2015) to be prepared, following consent of the DA. One of these management plans, i.e. the Draft "Golf Course Plan of Management (GCPoM)" has been submitted in Appendix D2 of the Revised SIS. Rather than having several management plans, one comprehensive Environmental Management Plan (EMP) is recommended, the details of which are discussed below.

Ameliorative measures for the proposed development include:

- Mitigation measures;
- Long-term management strategies; and
- Compensatory strategies.

These measures are detailed below.

5.1 Mitigation Measures

Pre-construction measures such as pre-clearance surveys to check for any nesting or roosting fauna and move them to adjacent habitat will be required due to the presence of habitat features suitable for native fauna with the subject site.

Potential impacts to flora and fauna occurring in the construction phase relating to the proposed development and which can be managed, include runoff, sedimentation, erosion, spread of weeds and pollution. Precautions need to be taken to minimise the drainage impacts downslope. Sediment control and reduction measures should be implemented to reduce sediment runoff into the waterways present in the study area. A Stormwater and Sedimentation and Erosion Management Plan will be developed, which addresses the aforementioned potential impacts to flora and fauna.

During construction, precautions should be taken to ensure that no pollution escapes the construction site. Pollution traps and regular removal of pollution to an offsite location would assist to minimise pollution impacts. A Waste Management Plan will be developed to mitigate waste and pollution entering the surrounding development.

A range of mitigation measures have been developed for the proposed development to mitigate the impacts that are unable to be avoided using the measures outlined previously, including vegetation clearance and fauna management protocols and weed management measures. These measures are discussed in more detail below.

5.1.1 Vegetation Clearance and Fauna Management Protocols

i. Delineation of Clearing Areas

To avoid unnecessary removal or damage to vegetation adjacent to the subject site, including the areas of retained vegetation, such as those between fairways, the clearing area should be clearly demarcated and signed, where appropriate, to ensure no vegetation beyond these boundaries is removed.

Areas that require clearance will be flagged and clearly delineated by temporary fencing to ensure that no areas intended to be retained will be inadvertently cleared during the construction process. No machinery will be parked on areas beyond the temporary fencing and no access will be allowed during construction. Ancillary facilities such as stockpile sites, site compounds and construction zones will not be located beyond the limits of clearing.

ii. Pre-clearance and Clearance Surveys

Pre-clearing surveys are to be undertaken by a suitably qualified ecologist. Pre-clearing surveys will include:

- Demarcation of key habitat features, such as hollow-bearing trees and fallen logs (>10cm diameter);
- Checking trees for the presence of bird nests and arboreal mammals, such as possums, and bats, prior to felling;
- Animals found to be occupying trees and habitat will be safely removed before the clearing of trees and relocated into nearby woodlands;
- Provision of a report following the completion of a pre-clearing survey, detailing the location and type of each habitat feature;
- To minimise impacts to native fauna species, clearing should be undertaken in the following two-stage process under the supervision of a suitably qualified ecologist:
    - The initial phase of clearing will involve clearing around identified habitat features and leaving the features overnight; and
    - The second stage will involve clearing of the habitat features left overnight followed by an inspection.

An ecologist should investigate all fallen trees for the presence of hollows not detected prior to clearing. Inspections should be undertaken of these hollows for native fauna.

An ecologist should be present while clearing to rescue animals injured during the clearance operation. Provisions will be made to protect any native fauna during clearing activities by the following means:

- All staff working on the vegetation clearing will be briefed about the possible fauna present and should avoid injuring any present;
- Animals disturbed or dislodged during the clearance but not injured should be assisted to move to the adjacent bushland or other specified locations; and
- If animals are injured during the vegetation clearance, appropriate steps will be taken to humanely treat the animal (either taken to the nearest veterinary clinic for treatment, or if the animal is unlikely to survive, it will be humanely euthanized).

5.1.2 Weed Management

In order to minimise the spread of weeds throughout the subject site and into adjoining areas, appropriate weed control activities will be undertaken. Prior to construction, weeds present in the subject site will be identified and controlled if necessary to prevent spread.

A wash-down station will be established and all construction vehicles entering and leaving the site will be required to be washed down to prevent weed seeds entering or leaving the site. These procedures will also assist in preventing the introduction of *Phytophthora cinnamomi*, which is a fungal pathogen of native vegetation that is carried in contaminated soil.

5.1.3 Other Relevant Measures

The following general construction mitigation measures are proposed to be undertaken during the construction phase

- Dust management - to minimise the impacts to vegetation and habitat quality;
- Noise management - to minimise impacts to fauna species; and
- Stormwater, erosion and sedimentation management - to minimise the impact to adjacent vegetation.

5.2 Long-term Management Strategies

5.2.1 Environmental Management Plan

Due to the sensitivity and ecological values of the study area an EMP is required. The target audience of the EMP will be the owners or managers of the golf course. An EMP will be required to comprise the following details:

- Site description;
- Objectives of the EMP;
- Environmental management roles and responsibilities;
- Qualification requirements of operators;

- Emergency contacts and procedures;
- Environmental risk assessment, including potential threats, impacts, likelihood of occurrence and consequences;
- Management measures, including activities, performance indicators, maps, monitoring tasks and corrective actions;
- Environmental monitoring and reporting; and
- Audit and review process and responsibilities.

It is important to note that Coastal Saltmarsh communities have an additional set of requirements compared to other vegetation communities, which include, but are not limited to:

- Minimising disturbance;
- Protection of fauna habitat, especially for local and migratory birds;
- Protection of ecological integrity by managing stormwater runoff, nutrient flow and monitoring of water quality; and
- Monitoring vegetation communities and habitats.

The EMP is to include a Vegetation Management Plan (VMP), which details the management tasks for different vegetation zones within the retained vegetation. Details to be included in a VMP are discussed below.

5.2.2 Vegetation Management Plan

The target audience of a VMP are the bushland management and landscaping contractors of the golf course. All retained vegetation will be managed under the VMP, which includes vegetation within the conservation area (**Figure 5.1**), as well as other vegetation to be retained between fairways (**Figure 5.2**). The reason for differentiating between the two is due to the difference in management actions. The vegetation to be retained between the fairways will be impacted by edge effects and their management will be based on prioritising the safety of golfers rather than environmental values. The conservation area, however, will not be accessible and will be managed for biodiversity. Furthermore, an area of 4.66 ha of cleared land, 0.11 ha of which is located within the conservation area, will be planted with locally indigenous species in order to be revegetated and merged into the adjacent vegetation community type. The VMP will include planting species lists, planting densities and detailed actions and timing of maintenance works. The vegetation retained but not included in the conservation area comprises narrow strips of vegetation between fairways and a 5 m buffer around all cleared areas.

The purpose of the VMP is to guide property owners on how to manage the retained vegetation in order to maintain or improve the ecological value of vegetation communities in

perpetuity. This will assure ecological functioning of wildlife habitat and natural recruitment and propagation of flora species.

It is expected that the VMP will be included in the conditions of consent for the proposed development, if approved. The VMP prepared for the study area includes the following items that are likely to be required by Council prior to being approved:

- Site description;
- Objectives of the VMP;
- Roles and responsibilities;
- Qualification requirements of operators;
- Costing of the VMP for twenty years;
- Map of vegetation zones;
- List of management actions for each vegetation zone, including weed removal techniques;
- Details of actions before, during and after construction;
- Species composition, seed collection, plant sourcing and planting density for revegetation zones;
- Key performance indicators and including corrective actions;
- Installation and identification of monitoring plot locations;
- Design, installation and inspection of sediment controls, erosion control, fencing and signage;
- Schedule of works including actions, time frames, responsibilities, monitoring and reporting; and
- Reporting requirements.

It is important to note that Coastal Saltmarsh communities require an additional number of management actions, such as, but not limited to the following:

- Protection of aquatic and fish nursery habitat;
- Protection of habitat for frogs, as well as local and migratory birds;
- Monitoring and management of ecological functioning of the wetland and tidal areas.

These management and monitoring actions are to be included and detailed in the VMP.

5.3 Compensatory Strategy

Compensatory strategies for the proposed development will consist of the majority of vegetation retained on-site to become an onsite offset that will be managed in perpetuity or the acquisition of credits from an offsite BioBanking site. The residual impacts of the proposed development have been quantified in a preliminary BioBanking assessment (**Appendix H**). While BioBanking is not required for the proposed development, it nevertheless provides a scientific approach to quantify impacts and assess the offset liability in order to compensate for the loss of biodiversity by the proposed development. The on-site offset area has also been quantified, which resulted in approximately two thirds of the offset liability being met. The remaining offset liability will have to be met by acquiring additional biodiversity credits or by increasing the size of the offset. Additionally, remaining land within Lots 5 and 6 DP1065111 located to the north of Culburra Rd (outside of the study area), may be utilised as an offsite offset as discussed in Revised SIS (Gunninah, 2015). The details of the BioBanking assessment for impact and on-site offset areas are in **Appendix H**, the on-site offset boundary is shown in **Figure 5.1** and the vegetation to be retained within the study area, including vegetation within the on-site offset are shown in **Figure 5.2**. The management of the retained vegetation will be according to a Vegetation Management Plan (VMP) as discussed in ***Section 5.2.2***.

If the conservation areas onsite are not used as an offset to create credits then the required credits may be acquired through an off-site BioBanking site. This may be either a new BioBanking site where credits are created or an existing site where credits can be retired. The conservation area will continue to be managed under a VMP even if credits are acquired from offsite offsets.

5.4 Adequacy of Compensatory Strategies

Below is a list of OEH's *Principles for the Use of Biodiversity Offsets in NSW* (OEH, 2017l) followed by a description of how the proposed development and compensatory measures (i.e. implementation of the VMP) are consistent with each principle.

1. Impacts must be avoided first by using prevention and mitigation measures.

Impacts on native vegetation, including each of the TEC's have been avoided where possible through design. As stated in the Revised SIS, the proposed development has been situated primarily within the cleared areas of the study area to minimise impacts on native vegetation. Avoiding native vegetation altogether is not feasible when considering the nature of the proposed development. The cleared areas have been utilised as much as possible when planning for the proposed development, i.e. 42% of already cleared land is within the subject site. However, designing a layout that was suitable for a golf course still resulted in impacts on native vegetation, including TECs. The native vegetation to be removed has been reduced to 35.7 ha, which is 18% of all native vegetation within the study area. As a result, the current development footprint was determined to be feasible while maintaining the biodiversity values of the study area. Additionally, a number of mitigation measures will be implemented to minimise impacts on retained vegetation.

2. All regulatory requirements must be met.

All regulatory requirements have been met.

3. Offsets must never reward ongoing poor performance.

The retained vegetation that will be subject to a VMP is comprised primarily of vegetation equal to or of higher condition to that within the subject site. Therefore, it is highly unlikely that the client has mismanaged the offset area in hopes of degrading the offset and increase its offset value as the offset is primarily comprised of the best condition vegetation.

4. Offsets will complement other government programs.

The proposed retained vegetation that will be managed in perpetuity will complement government programs as it will conserve vegetation conforming to listed TECs. Conserving this land will increase the TECs likelihood of survival in the long-term in the locality.

5. Offsets must be underpinned by sound ecological principles.

The vegetation to be retained will be managed under a VMP in perpetuity. The overall objectives of the VMP will be to maintain and/or improve areas of native vegetation to high condition and rehabilitate areas of cleared land. Rehabilitating areas of cleared land back to native vegetation which conforms to TEC communities within the study area will lead to an increase in the total area of the TECs within the study area.

6. Offsets should aim to result in a net improvement in biodiversity over time.

Although areas of native vegetation will be removed as a result of the proposed development, the implementation of a VMP that requires the management of existing vegetation and the rehabilitation of cleared areas, as well as non-native vegetation into native vegetation will improve the biodiversity of the study area over time. The additional off-site offsets will complete the offset liability of the proposed development. The offset liability was established under the NSW BioBanking scheme (DECC, 2007), which is designed with the “improve or maintain” principle.

7. Offsets must be enduring – they must offset the impact of the development for the period that the impact occurs.

The proposed retention of vegetation that will be managed under an ongoing VMP will be funded by the Land Owner, ensuring that the offset is enduring.

8. Offsets should be agreed prior to the impact occurring.

The proposed development and associated offset must be approved prior to any impacts occurring.

9. Offsets must be quantifiable – the impacts and benefits must be reliably estimated.

The total areas of vegetation to be impacted, retained and rehabilitated have been quantified (see **Table 4.1** and **Appendix H**). The BioBanking for the impact area quantifies the required offset and the assessment for the offset shows that the type and number of biodiversity credits is adequate. The on-site offset will be managed under a VMP. The requirement of a VMP will ensure that ongoing monitoring will occur for all retained areas, which will result in data being collected that can be compared with baseline data and assessed if the pre-determined key performance indicators are being met. If they are not being met, actions will be implemented to ensure the efficacy of the VMP.

10. Offsets must be targeted.

The VMP for the study area will include a list of key performance indicators, which provide specific targets for the proposed works outlined in the VMP. These key performance indicators will ensure that the ecological communities being impacted will be offset with like-for-like vegetation. If the key performance indicators are not being met, management actions will be implemented to conserve and /or enhance the condition of offsets.

11. Offsets must be located appropriately.

The proposed on-site offset is appropriately located as it is within the same LGA, immediately adjacent to the proposed development and the vegetation to be retained has similar characteristics as the vegetation to be removed.

12. Offsets must be supplementary.

The proposed onsite offset is supplementary as the land within the study area is privately owned and not subject to a current management or offset scheme.

13. Offsets and their action must be enforceable through development consent conditions, licence conditions, conservation agreements or contracts.

The proposed offset areas will be secured by an appropriate mechanism such as a restriction on title, land zoning or other alternative means. A VMP will be prepared to manage the offset areas and will include provisions for ongoing monitoring and maintenance. When the offsets are formalised and a VMP is in place, it is anticipated the land owners will oversee and coordinate activities for the purposes of biodiversity management.

5.5 Impacts When Amelioration is Considered

Assessments of Significance (seven part tests) are threshold tests of significance that are prepared as a requirement of Section 5A of the EP&A Act for impacts arising from development applications. Assessments of significance determine whether there is likely to be a significant impact on any threatened flora and fauna in order to determine whether to proceed to prepare a SIS. Notwithstanding this, the seven part tests can be repeated within an SIS to consider whether a significant negative impact will occur once avoidance,

mitigation and compensation measures are considered. This has been done for all TECs and threatened species identified as affected species and can be found in **Appendix E**.

The seven part tests verify that no threatened species are considered to be significantly impacted by the proposed development. Additionally, although the proposal will remove occurrences of two TECs from the subject site, the overall impact in the wider locality is not considered to be of major ecological significance. Nevertheless, the loss of these TECs will be satisfactorily addressed by the proposed amelioration measures and onsite offsets. As a result a larger area of these TECs will be conserved and enhanced in perpetuity.

Figure 5.1. Vegetation management areas

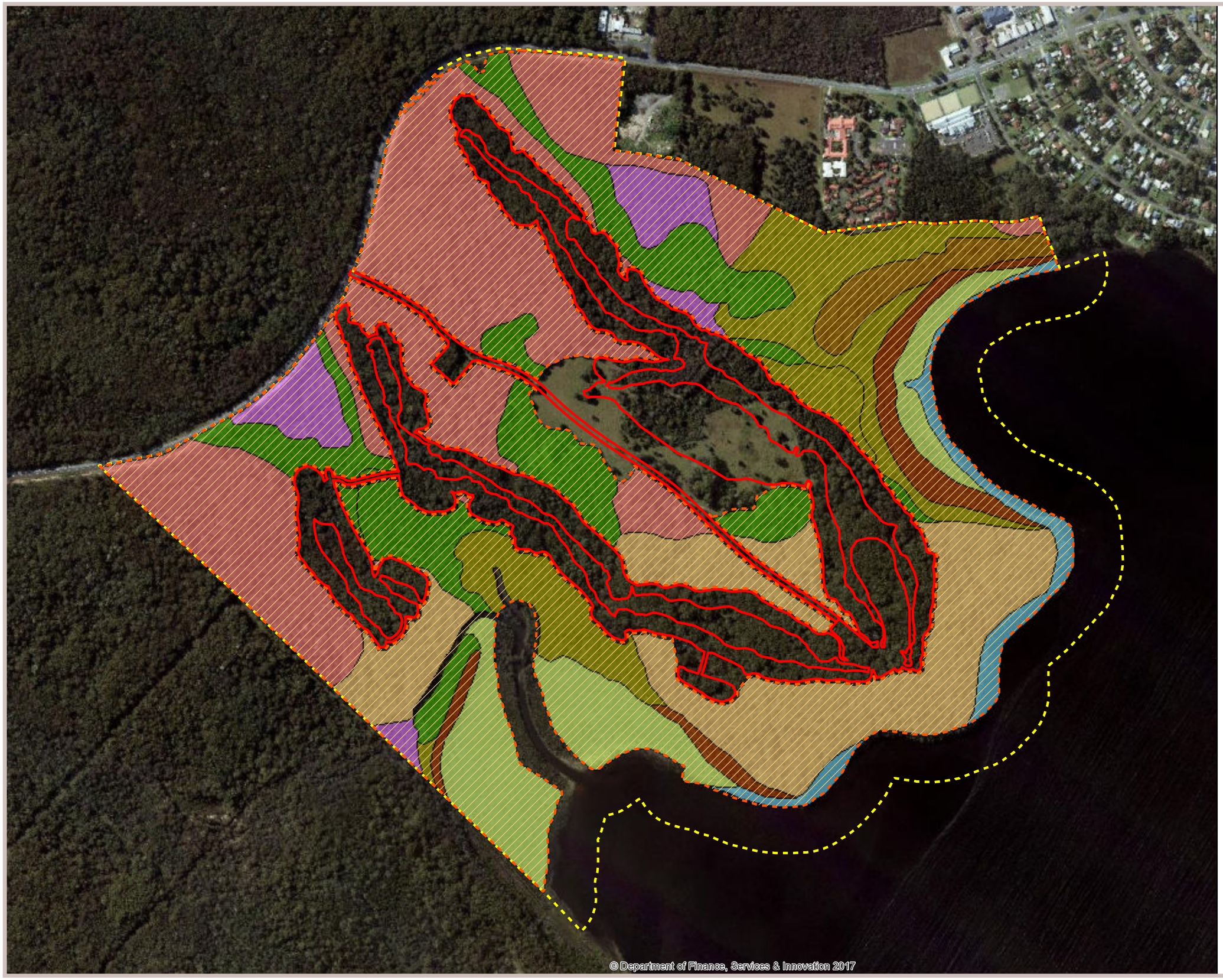


Figure 5.2. Vegetation areas to be retained within the study area

Chapter 6

Conclusion

The proposed development will occupy approximately 18% of land within the study area. There will be clearing of some native vegetation and this will mean some impacts to some TECs and threatened species. The remaining vegetation will be retained within the study area and permanently conserved and managed.

The proposed development has been designed in such a way to avoid impacts on TECs, threatened species and Lake Wollumboola. The proposal also entails substantial mitigation measures which will include the preparation of an EMP. The EMP will contain further documentation including:

- Vegetation Management Plan
- Weed Management Plan
- Bushfire Management Plan
- Stormwater, Erosion and Sedimentation Management Plan
- Waste Management Plan
- Dust Management Plan
- Noise Management Plan
- Hollow-bearing Tree Protocols; and
- Vegetation Clearance and Fauna Management Protocols.

If the proposed mitigation measures are implemented then no significant impact is likely to threatened flora and fauna listed either by the State TSC Act or the Commonwealth EPBC Act as a result of the proposed development.

cumberland ecology

Chapter **7**

References

AMEC (2005). *Mackenzie Gas Project: Effects of Noise on Wildlife*. AMEC Americas Limited.

Andrews, A. (1990). "Fragmentation of Habitat by Roads and Utility: A Review." *Australian Zoologist* **26**(3 & 4): 130-141.

Bureau of Meteorology (2017). "Climate Data Online." Retrieved 15/02/2017, 2017, from http://www.bom.gov.au/climate/data/.

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

DECC (2007). *BioBanking - Biodiversity Banking and Offsets Scheme: Scheme Overview*. Department of Environment and Climate Change, Sydney South, NSW.

DECCW (2009). *Draft National Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus*. Department of Environment, Climate Change and Water, Sydney, NSW.

DoE (2012). "National Flying-fox monitoring viewer." Retrieved 23/2/2017, 2017, from http://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf.

DoE (2013). *Draft survey guidelines for Australia's threatened orchids*, Canberra.

DoEE (2013). *Draft conservation advice for Subtropical and Temperate Coastal Saltmarsh*. Department of the Environment and Energy, Canberra.

DoEE (2014). *Preliminary draft conservation advice (incorporating listing advice) of the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*. Department of the Environment and Energy, Canberra.

DoEE (2017). "EPBC Protected Matters Search Tool." 2017, from http://www.environment.gov.au/webgis-framework/apps/pmst/pmst-coordinate.jsf.

Eco Logical Australia (2016a). *Strategic Biodiversity Assessment - Jervis Bay Area*, Sydney

Eco Logical Australia (2016b). *Zone Descriptions - Golf Course August 2016 DRAFT*. Vegetation Zone Descriptions – Strategic Biodiversity Assessment – Halloran Trust – Jervis Bay Area,, Sydney.

Ewers, R. M. and Didham, R. K. (2006). "Confounding factors in the detection of species responses to habitat fragmentation." *Biological Reviews* **81**: 117-142.

Gunninah (2015). *Species Impact Statement: Culburra Golf Course - Long Bow Point Part Lots 5 and 6 in DP 1065111*. Gunninah Environmental Consultants, Crows Nest.

Ku-ring-gai Bat Conservation Society (2017). "Flying-fox Camps in Sydney." 2015, from http://www.sydneybats.org.au/flying-foxes/where-to-see-flying-foxes-in-sydney/.

Lindenmayer, D. B. and Fischer, J. (2006). *Habitat fragmentation and landscape change: An Ecological and Conservation Synthesis*. Island Press, Washington D.C.

Longcore, T. and Rich, C. (2004). "Ecological Light Pollution." *Frontiers in Ecology and the Environment* **2**(4): 191-198.

Longcore, T. and Rich, C. (2010). *Light Pollution and Ecosystems*, ActionBioscience.org original article.

Martens Consulting Engineers (2017). *Integrated Water Management Plan - Proposed Golf Course Development, Culburra Road, West Culburra, NSW*.

NSW Scientific Commitee (2011a). *Bangalay sand forest, Sydney Basin and South East Corner bioregions - endangered ecological community listing*. Office of Environment and Heritage (NSW), Hurstville.

NSW Scientific Commitee (2011b). *Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing*. Office of Environment and Heritage, Hurstville.
NSW Scientific Committee (2008a). *Gang-gang Cockatoo Callocephalon fimbriatum. Review of current information in NSW. December 2008. Unpublished report arising from the Review of the Schedules of the Threatened Species Conservation Act 1995.* . NSW Scientific Committee, Hurstville.
NSW Scientific Committee (2008b). *Glossy Black-Cockatoo Calyptorhynchus lathami. Review of Current Information in NSW. September 2008. Unpublished report arising from the Review of the Schedules of the Threatened Species Conservation Act 1995*. NSW Scientific Commitee, Hurstville.
NSW Scientific Committee (2009a). *Little Lorikeet - vulnerable species listing*. Department of Environment and Climate Change, Hurstville, NSW.
NSW Scientific Committee (2009b). *Square-tailed Kite Lophoictinia isura. Review of current information in NSW. June 2009. Unpublished report arising from the Review of the Schedules of the Threatened Species Conservation Act 1995.* NSW Scientific Committee, Hurstville.
NSW Scientific Committee (2011). *Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological listing*. Office of Environment and Heritage (NSW), Hurstville.
OEH (2013). *Endangered ecological communities (EECs) of the Shoalhaven, Eurobodalla and Bega Valley local government areas. VIS ID 3901*. Office of Environment and Heritage, Hurstville.
OEH (2014a). *BioBanking Assessment Methodology 2014*. Office of Environment and Heritage, Sydney.
OEH (2014b). *Online BioBanking Credit Calculator Version 4.0*. Office of Environment and Heritage, Sydney.
OEH (2016). *NSW Guide to Surveying Threatened Plants*. Office of Environment and Heritage,, Sydney.
OEH (2017a). "Atlas of NSW Wildlife." 2017, from http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx?who=ddb86a5f-2881-40ec-b09d-5b2c6ce0d614.
OEH (2017b). *Eastern Bentwing-bat - profile*. Office of Environment and Heritage, Hurstville.
OEH (2017c). *Eastern False Pipistrelle – Profile*. NSW Office of Environment and Heritage, Hurtsville.
OEH (2017d). *Eastern Freetail-bat - profile*. Office of Environment and Heritage, Hurstville.
OEH (2017e). *Gang-gang Cockatoo - profile*. NSW Office of the Environment and Heritge, Hurtsville.
OEH (2017f). *Glossy Black Cockatoo - profile*. NSW Office of the Environment and Heritage, Hurstville.
OEH (2017g). *Greater Broad-nosed Bat – Profile*. NSW Office of Environment and Heritage, Hurtsville.
OEH (2017h). *Grey-headed Flying-fox - profile*. Office of Environment and Heritage, Hurstville.
OEH (2017i). *Little Bentwing-bat - Profile*. NSW Office of the Environment and Heritage, Hurtsville.
OEH (2017j). *Little Lorikeet - Profile*. Office of the Environment and Heritage, Hurtsville.
OEH (2017k). *Masked Owl - profile*. NSW Office of the Environment and Heritage, Hurtsville.
OEH (2017l). "OEH principles for the use of biodiversity offsets in NSW." 28 November 2017, from http://www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm.
OEH (2017m). *Powerful Owl - profile*. Office of Environment and Heritage, Hurstville.
OEH (2017n). *Southern Myotis - Profile*. NSW Office of the Environment and Heritage, Hurtsville.
OEH (2017o). *Square-tailed Kite - Profile*. Office of Environment and Heritage, Hurstville.
OEH (2017p). *Swift Parrot - Profile*. NSW Office of the Environment and Heritage, Hurtsville.
OEH (2017q). *Varied Sittella – Profile*. NSW Office of Environment and Heritage, Hurtsville.

OEH (2017r). "Vegetation Information System: Classification." from http://www.environment.nsw.gov.au/research/Visclassification.htm.

OEH (2017s). *Yellow-bellied Glider – profile*. NSW Office of the Environment and Heritage, website: http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10601

OEH (2017t). *Yellow-bellied Shethtail-bat - Profile*. NSW Office of the Environment and Heritage, Hurtsville.

Parry-Jones, K. A. and Augee, M. (1991). "Food selection by Grey-headed Flying-foxes (*Pteropus poliocephalus)* occupying a summer colony site near Gosford, NSW." *Wildlife Research* **18**: 111-124.

Rand, T. A., Tylianakis, J. M. and Tscarntke, T. (2006). "Spillover edge effects: the dispersal of agriculturally subsidized natural enemies into adjacent natural habitats." *Ecology Letters* **9**: 603-614.

Saleh, T. (2007). "Effects of Artificial Lighting on Wildlife." *The Road-RIPorter (Summer Solstice Issue)* **12**(2).

SEWPaC (2011). *Survey guidelines for Australia's threatened mammals*. Commonwealth Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Yahner, R. H. (1988). "Changes in wildlife communities near edges." *Conservation Biology* **2**: 333-339.

Appendix A

Director General's Requirements

NSW GOVERNMENT | Office of Environment & Heritage

Your reference : 25437MJPmrf
Our reference : FIL118312 DOC 12/34477
Contact :Allison Treweek 62297082

Applicant(s):

ALLEN PRICE AND ASSOCIATES,
ABN 13 236 275 350,
PO Box 73 ,
NOWRA NSW 2541
STANDARD POST

Dear Sir/Madam

DIRECTOR-GENERAL'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT FOR THE CULBURRA GOLF COURSE

Issued pursuant to s. 111 Threatened Species Conservation Act 1995

Thank you for your letter dated 09 November 2012 requesting Director-General's (DGRs) requirements for a species impact statement (SIS) for the proposal cited above. Please find enclosed a copy of the DGRs (Attachment A) issued on behalf of the Director General.

The Office of Environment and Heritage (OEH) has reviewed the information supplied with the request for DGR's and considers there are still some outstanding issues not adequately covered by the flora and fauna survey work previously carried out. In particular an assessment of potential links between habitat on the subject site and habitats in the locality needs to be conducted, particularly identifying routes used by threatened species already identified within and adjacent to the subject site.

Surveys to date have identified that the site is highly constrained by biodiversity values including at least 22 threatened species that were identified on or within close proximity to the subject site. It is considered the subject site is not only utilised by these threatened species, but it also provides potential suitable habitat for a number of other threatened flora and fauna species. OEH also notes that the land proposed to be used for the golf course is part of the catchment for Lake Wollumboola which is utilised by a number of threatened birds including migratory species, The construction and operation of the golf course has the potential to effect the water quality of this lake and thus the species utilising it. These species will therefore also need to be considered by the SIS.

Referrals

Whilst OEH is unable to provide comment on draft SISs in their entirety, OEH will provide comment to proponents and their consultants on key issues arising in the drafting process. The ability of OEH to provide such advice is dependent on the availability of OEH resources and on other statutory priorities.

Please note that it is the determining or consent authority's responsibility to ensure that a draft or final SIS complies with the requirements issued by the Director-General.

Concurrence

If Council decides to determine the development application by way of approval following a review of the final SIS lodged by the applicant, then the concurrence of the Director-General of OEH is required before consent can be granted. A concurrence application is not required should Council decide to refuse the development application.

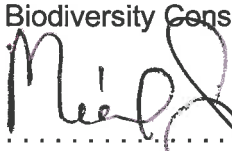
In assessing any request for concurrence, OEH will adopt the policy of avoid, mitigate and as a last resort offset the impacts of the development to "maintain or improve" biodiversity values on site. To achieve this outcome the proponent will be required to demonstrate how a biodiversity offset managed in perpetuity (eg Council reserve, Biobank site, National Park, or CMA approved Property Vegetation Plan (PVP)) can be secured.

Other Information

I refer you to the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EPBC Act requires the approval of the Federal Minister for the Environment (in addition to any State or Local Government approval or determination) for an action that will have, or is likely to have, a significant impact on a matter of national environmental significance. Threatened species and communities listed by the EPBC Act are considered to be a matter of national environmental significance. OEH had identified at least 13 migratory bird species listed under the EPBC Act and under various International Conventions including JAMBA, CAMBA, ROKAMBA and Bonn that have been recorded within or close to the study area.

Many of the species and ecological communities listed in the *Threatened Species Conservation Act 1995* (NSW) are also listed in the Commonwealth EPBC Act. I therefore strongly recommend that you contact the Commonwealth Department of Sustainability, Environment, Water, Population and Communities on 1800 803 772 or http://www.environment.gov.au/biodiversity/contacts/index.html to determine whether this proposal should be considered under the EPBC Act.

Should you require any additional information please contact Allison Treweek, Regional Biodiversity Conservation Officer, on (02) 62297082.



Mr Michael Saxon

Regional Co-ordination Officer

South

(by Delegation)

Dated: 28-Nov-2012

Enclosure:

Attachment A: Director General's requirements for a Species Impact Statement Culburra Golf Course Culburra

Appendix 1: Survey Requirements for Subject Species – DGRs for Culburra Golf Course

Appendix 2: Examples of suitable survey pro-formas

ATTACHMENT A

DIRECTOR GENERAL'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT

CULBURRA GOLF COURSE CULBURRA

INTRODUCTION

The purpose of a Species Impact Statement (SIS) in the development assessment process as it relates to your application is:

- to allow you, as applicant, to identify the issues pertaining to threatened species, populations, ecological communities or their habitats, and provide appropriate amelioration for adverse impacts resulting from the action; and
- to assist the consent or approval authorities in the assessment of your proposal pursuant to the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Section 111(1) of the *Threatened Species Conservation Act 1995* (TSC Act) requires that it must be either the applicant for the development consent or the proponent of the activity who makes the request for Director-General's Requirements (DGRs). The Office of Environment and Heritage (OEH) notes that in this instance, Mr Matt Philpott from Allen Price and associates, made the request for the DGRs. Please advise the OEH contact officer, Allison Treweek, Regional Biodiversity Conservation Officer, on (02) 62297082, if it is not intended that Mr Matt Philpott will be the applicant or proponent.

It is also essential to note that Section 111(1) requires that the applicant must, in preparing the SIS, comply with the requirements of the Director-General. As any consent or approval granted where the Director-General's requirements are not met may be invalid, it is strongly recommended that Allen Price and associates ensure that all of the requirements detailed below are complied with.

The following requirements are based on the standards developed for other SISs prepared elsewhere in NSW. As per normal practice, specific requirements have been identified for threatened species, populations and ecological communities that are known to occur on the subject site.

DEFINITIONS

The definitions given below are relevant to these requirements:

- **Development** has the same meaning as in the EP&A Act.
- **Activity** has the same meaning as in the EP&A Act
- **Proposal** is the development, activity or action proposed
- **Subject Site** means the area directly affected by the proposal.
- **Study Area** means the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. The study area should extend as far as is necessary to take all potential impacts into account.
- **Subject Species, Populations or Ecological Communities** means those threatened species, populations or ecological communities that are known or considered likely to occur in the study area. The SIS is to explicitly consider the impacts of the proposal on each of these entities.

- **Direct Impacts** are those that directly affect habitat and individuals, usually within the footprint of the proposal. They include, but are not limited to, clearing and habitat removal. Consideration must be given to all of the likely direct impacts of the proposed activity or development.

- **Indirect Impacts** occur when project-related actions affect species, populations or ecological communities in a manner other than direct loss, usually beyond the footprint of the proposal. Indirect impacts can include loss of individuals through predation by domestic and/or feral animals, deleterious hydrological changes (including increased runoff and raising or lowering of the water table), erosion, weed invasion, pollution, trampling or other impacts due to increased human activity within or directly adjacent to sensitive habitat areas, altered fire regimes, habitat fragmentation and disruption of wildlife movement corridors. As with direct impacts, consideration must be given to all of the likely indirect impacts of the proposed activity or development.

- **Life Cycle** is the series or stages of reproduction, growth, development, aging and death of an organism.

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

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

- **Local Population** is the population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions.

  - The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.
  - The local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area.
  - The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time.

  In cases where multiple populations occur in the study area, each population should be assessed separately.

- **Local Occurrence** means the ecological community that occurs within the study area. However the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.
- **Composition** means both the plant and animal species present, and the physical structure of the ecological community. Note that while many ecological communities are identified primarily by their vascular plant composition, an ecological community consists of all plants and animals as defined under the TSC Act that occur in that ecological community.

All other definitions are the same as those contained in the TSC Act.

MATTERS WHICH HAVE BEEN LIMITED OR MODIFIED

The SIS need not address Section 110(2)(g) and 110(3)(d) of the TSC Act. The matters raised in these sections of the TSC Act have been clarified by these DGRs.

The following matters from Section 110 of the TSC Act need only be addressed where relevant:

- All reference to threat abatement plans. There are no threat abatement plans relevant to the key threatening processes associated with the *proposal*.

- All reference to recovery plans. There are approved and draft recovery plans relevant to the *subject species* listed in Tables 1 and 2 and the *subject ecological community* listed in Section 3.2 of these DGRs. However, if other entities should be deemed as *subject species, populations or ecological communities* by analysis in accordance with these DGRs, then any relevant recovery plans pertaining to these entities will need to be addressed in the SIS.

- All reference to key threatening processes. Only the following key threatening processes are relevant to this proposal:
  - Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands
  - Bushrock removal
  - Clearing of native vegetation;
  - Invasion of native plant communities by exotic perennial grasses
  - Removal of dead wood and dead trees;
  - Loss of hollow-bearing trees;
  - Infection of native plants by *Phytophthora cinnamomi*

For each *subject species, population or ecological community* likely to be affected by any of these key threatening processes, the SIS shall address whether the action will increase this threat, and shall describe proposed measures to ameliorate such threats.

Please note that recovery plans may be approved, critical habitat may be declared and key threatening processes may be listed between the issue of these DGRs and the determination of the *proposal*. If this occurs, these additional matters will need to be addressed in the SIS and considered by the consent, determining or concurrence authority.

MATTERS TO BE ADDRESSED

The TSC Act provides that the SIS must meet all the matters specified in Sections 109 and 110 of the Act with the exception of those matters limited above. Some of the requirements outlined in Sections 109 and 110 (excluding the matters limited above) have been repeated below (italics) along with the specific Director-General's Requirements for your *proposal*.

Previous surveys and assessments may be used to assist in addressing these requirements. All references used throughout the SIS must be cited and detailed in a reference list.

1 FORM OF THE SPECIES IMPACT STATEMENT

A species impact statement must be in writing [Section 109 (1)]

A species impact statement must be signed by the principal author of the statement and by:

(a) the applicant for the licence, or

(b) if the species impact statement is prepared for the purposes of the Environmental Planning and Assessment Act 1979, the applicant for development consent or the proponent of the activity proposed to be carried out (as the case requires) [Section 109(2)].

The SIS must include the following declaration signed by the applicant or proponent:

"I…[insert name], of ..[address], being the applicant for the [choose one of the following development consent for/proponent of] the action proposed…[insert DA number, Lot & DP numbers, street, suburb and LGA names] have read and understood this species impact statement. I understand the implications of the recommendations made in the statement and accept that they may be imposed as conditions of consent or concurrence for the action proposed."

2 CONTEXTUAL INFORMATION

2.1 Description of proposal, subject site and study area

A species impact statement must include a full description of the action proposed, including its nature, extent, location, timing and layout [Section 110 (1)]

A full description of the action proposed includes a description of all associated actions. These actions may occur on or off the *subject site*. In describing the action proposed, the proportion of the *subject site* and the *study area* that will be affected is to be provided, including details of the location of any auxiliary infrastructure and all component parts of the *proposal* including, but not restricted to,

(i) roadworks and temporary access and egress routes,

(ii) cycleways, walkways, drainage and settling ponds, stockpile areas, diversion banks, vehicle parking areas and temporary buildings,

(iii) changes in surface water flows

(iv) location of any powerlines, water and sewerage infrastructure .

The type of action proposed shall be detailed, including the timetable for the construction of the *proposal*. If a staged construction approach is adopted then the timetable shall clearly indicate this.

If subsequent development of adjacent land is proposed by the proponent in the future, including any additional road construction then this shall be identified to the extent that it is known at the time of preparing the SIS. If existing structures such as the pipelines and transmission line are to be relocated, this should also be described and assessed.

The vegetation within the study that is to be retained is to be fully documented, and shown on the relevant plans and maps. The proposed management regimes for such areas are also to be documented.

2.2 Provision of relevant plans and maps

A detailed plan of the study area shall be provided at a preferred scale of 1:4,000 or finer. This plan shall show the proposal, the location and type of vegetation communities present within the *study area*, the full extent of vegetation clearing anticipated, and the scale of the plan.

This plan shall also show the location of any key habitat resources for threatened species, such as Glossy Black-cockatoo feed trees, trees used as nesting sites by large forest owls and Gang-gang cockatoo, Yellow-bellied Glider feed trees, micro bat roosting or nest trees, and trees bearing hollows.

Colour aerial photography of the locality (or reproduction of such photography) shall be provided. This aerial photograph shall clearly show the *subject site* and the scale of the photograph.

A topographic map of the subject site and immediate surrounds at a scale of 1:25000 shall be provided. This map shall detail the location of the proposal and location of works on site.

A map of the locality, showing landscape features including rivers, swamps, wetlands, any locally significant areas for threatened species such as parks and reserves, and areas of high human activity such as townships, regional centres and major roads will also be provided. The location, size and dimensions of the study area shall be provided. This map shall represent the area within at least a radius of 5 km from the subject site.

2.3 Land tenure information

The land tenure across the *study area* is to be described and any limitations to sampling across the *study area* resulting from this tenure (e.g. denied access to private land) shall be noted.

3 INITIAL ASSESSMENT

A general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action [Section 110 (2)(a)].

3.1 Identifying subject species and populations

For the purposes of this SIS, the species listed in Table 1 are to be addressed as *subject species*:

Table 1. List of *subject species*.

SPECIES	SCIENTIFIC NAME	STATUS in NSW*
Fauna		
Southern Brown Bandicoot	*Isoodon obesulus*	E
Long-nosed Potoroo	*Potorous tridactylus*	V
White-footed Dunnart	*Sminthopsis leucopsis*	V
Eastern Pygmy-possum	*Cercartetus nanus*	V
Squirrel Glider	*Petaurus norfolcensis*	V
Yellow-bellied Glider	*Petaurus australis*	V
Spotted-tailed Quoll	*Dasyurus maculatus*	V
Large-footed Myotis	*Myotis adversus*	V
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V
Eastern Bent-wing Bat	*Minopterus schreibersii oceanensis*	V
Eastern Freetail-bat	*Mormopterus norfolkensis*	V
Large-eared Pied Bat	*Chalinolobus nanus*	V
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V
Golden-tipped Bat	*Kerivoula papuensis*	V
Grey-headed Flying fox	*Pteropus poliocephalus*	V
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V
Green and Golden Bell Frog	*Littoria aurea*	E
Beach Stone-curlew	*Esacus magnirostris*	V
Sooty Oystercatcher	*Haematopus fuliginosus*	V

SPECIES	SCIENTIFIC NAME	STATUS in NSW*
Pied Oystercatcher	*Haematopus longirostris*	E
Hooded Plover	*Thinornis rubricollis*	CE
Greater Sand-plover	*Charadrius leschenaultii*	V
Lesser Sand-plover	*Charadrius mongolus*	V
Sanderling	*Calidris alba*	V
Curlew Sandpiper	*Calidris ferruginea*	E
Great Knot	*Calidris tenuirostris*	V
Broad-billed Sandpiper	*Limicola falcinellus*	V
Black-tailed Godwit	*Limosa limosa*	V
Terek Sandpiper	*Xenus cinereus*	V
Little Tern	*Sternula albifrons*	E
Little Shearwater	*Puffinus assimilis*	V
Painted Snipe	*Rostratula australis*	E
Square-tailed Kite	*Lophoictinia isura*	V
Little Eagle	*Hieraaetus morphnoides*	V
Spotted Harrier	*Circus assimilis*	V
Osprey	*Pandion cristatus*	V
Powerful Owl	*Ninox strenua*	V
Barking Owl	*Ninox connivens*	V
Sooty Owl	*Tyto tenebricosa*	V
Masked Owl	*Tyto novaehollandiae*	V

SPECIES	SCIENTIFIC NAME	STATUS in NSW*
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V
Gang–gang Cockatoo	*Callocephalon fimbriatum*	V
Swift Parrot	*Lathamus discolor*	E
Little Lorikeet	*Glossopsitta pusilla*	V
Orange-bellied Parrot	*Neophema chrysogaster*	CE
Turquoise Parrot	*Neophema pulchella*	V
Regent Honeyeater	*Anthochaera phrygia*	E
Pink Robin	*Petroica rodinogaster*	V
Scarlet Robin	*Petroica boobang*	V
Flame Robin	*Petroica phoenicea*	V
Hooded Robin	*Melanodryas cucullata cucullata*	V
White-fronted Chat	*Epthianura albifrons*	V
Varied Sittella	*Daphoenositta chrysoptera*	V
Olive Whistler	*Pachycephala olivacea*	V
Flora		
Thick-lipped spider orchid	*Caladenia tessellate*	
Pretty Beard Orchid	*Calochilus pulchellus*	
Illawarra greenhood	*Pterostylis gibbosa*	
Pterostylis ventricosa	*Pterostylis ventricosa*	
Narrow-leafed Wilsonia	*Wilsonia backhousia*	
Round-leafed Wilsonia	*Wilsonia rotundifolia*	

SPECIES	SCIENTIFIC NAME	STATUS in NSW*
Bauer's Midge Orchid	*Genoplesium baureri R.Br*	V
Tangled Bedstraw	*Galium australe*	E
Leafless Tongue-orchid	*Cryptostylis hunteriana*	V
Magenta Lilly Pilly	*Syzigium paniculatum*	E
Eastern Australian Underground Orchid	*Rhizanthella slateri*	V
Endangered Ecological Communities		
Swamp Oak floodplain forest of the NSW North Coast Sydney basin and South East Corner Bio Region.		
Littoral rainforest in the NSW North Coast, Sydney Basin and South East Corner bioregions		
Bangalay sand forest in the Sydney Basin and South East Corner bioregions		
Freshwater wetlands on Coastal Floodplains		
Illawarra Lowlands grassy woodland of the Sydney Basin Bioregion		
Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions		
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions		

One of the roles of a SIS is to determine which species, populations or ecological communities may be utilising, or present, on a development site. The entities to be considered for inclusion in the list of subject species, populations and ecological communities are listed in Table 1 This list is not exhaustive and other entities may also need to be included for assessment in this SIS on the basis of desktop and habitat analyses and the outcomes of fieldwork.

In determining whether the entities listed in Table 1, as well as other entities, should also be addressed as *subject species, populations and ecological communities*, consideration shall be given to the habitat types present within the *study area*, recent records of threatened species, populations or ecological communities in the *locality* and the known distributions of threatened species, populations and ecological communities. This analysis and its conclusion are to be documented in the SIS.

Databases such as the Atlas of NSW Wildlife, the Atlas of Living Australia (http://www.ala.org.au/), and the Australian Government's "Protected Matters Search Tool" (http://www.environment.gov.au/epbc/pmst/index.html) should be consulted to assist in compiling the list of possible entities to be analysed. It should be noted that if the OEH Atlas is the only database that is referred to, due to data exchange agreements, the data provided by OEH will only include that for which OEH is a custodian. In many cases, this may only be a small subset of the data available. Other databases must also be consulted to create a comprehensive list of entities for consideration as *subject species, populations or ecological communities*.

3.2 Identifying habitats

In describing the *study area*, consideration shall be given to the previous land uses and the effect of these land uses on the *study area*. Relevant historical events may include fire, clearing, logging, slashing, recreational use and agricultural activities.

A description of habitats including such components as the frequency of tree hollows, the presence of wetlands, the density of understorey vegetation, the composition of the ground cover, the soil type and the presence of heath and permanent or ephemeral swamps shall be given. The condition of these habitats within the *study area* shall be discussed, including the prevalence of introduced species. A description of the habitat requirements of threatened species, populations or ecological communities likely to occur in the *study area* shall be provided.

Any areas which may provide habitat connectivity between the *study area* and adjacent areas of likely habitat for *subject species, populations or ecological communities* shall be identified and described.

In defining the *study area*, consideration shall be given to possible *indirect impacts* of the proposed action on species/habitats in and surrounding the *subject site*. These could include impacts arising from altered fire and hydrology regimes, soil erosion or pollution, fencing, habitat fragmentation and disruption of wildlife movement corridors, edge effects, altered light and noise regimes, disturbance of roosting areas or other impacts due to increased use of the area by humans, and the impacts of increased levels of domestic and feral predators.

4 SURVEY

4.1 Requirement to survey

A flora and fauna survey is to be conducted in the *study area*. Targeted surveys shall be conducted for all *subject species, populations and ecological communities* determined in accordance with Section 3. Previous surveys and assessments may be used to assist in addressing this requirement. However, the efficacy of such previous surveys and assessments in meeting this requirement must be described in full. These previous surveys do not negate the need for the additional targeted survey work set out in Appendix 1 of these DGRs.

Particular attention shall be paid to the timing and climatic conditions for conducting fauna surveys, as many of the *subject species* will only be present or detectable for a few months each year or during certain climatic conditions. Additional advice on these matters should be sought from the OEH contact officer.

Identification of all species is essential. Identification to genus only is not acceptable. Species of taxonomic uncertainty shall be confirmed by a recognised authority such as the Australian Museum or National Herbarium at the Royal Botanic Gardens, Sydney.

4.2 Documentation of survey effort and technique

Survey technique(s) shall be described and a reference given, where available, outlining the survey technique employed.

Survey site(s) shall be identified on a map with a clear legend. The size, orientation and dimensions of quadrat or length of transect shall be clearly noted for each type of survey technique undertaken. Full AMG grid references for the survey site(s) shall be provided.

OEH survey proformas are to be used by field staff when applying a range of standard fauna survey techniques. Copies of standard proformas are included in Appendix 2 to these DGRs. Digital copies of these proformas can be requested from the nominated OEH contact officer. These proformas shall be used by field staff when undertaking fauna surveys and completed data sheets are to be included as an appendix to the SIS.

The time invested in each survey technique shall be summarised in the SIS, based on completed proformas, e.g. number of person hours / transect, duration of call playback, number of nights that traps are set.

It is not sufficient to aggregate all time spent on all survey techniques. Effort must be expressed separately for each survey technique that is applied.

Personnel details including name of surveyor(s), contact phone number, qualifications and experience must be included. The person who identified records (e.g. Anabat, hair tubes, scat analysis) shall also be identified in this manner.

Environmental conditions during the survey shall be noted from the commencement of each survey technique until its completion. These conditions must be documented in the SIS.

An assessment of the efficacy of each survey regime in detecting each species under the intensity utilised by the study is to be provided. The effect of the season and weather at the time of the field survey shall be considered with respect to the adequacy of survey results. An assessment will also be made of the adequacy of the survey and background information used to assess the likely area of use (home range) for each subject species, population or ecological community, and the areas providing habitat connectivity.

A full list of all flora and fauna species (threatened and non-threatened) recorded during the course of surveys shall be included in the SIS as this information provides an indication of the habitat diversity and quality of the site. OEH also requires that all flora and fauna records be placed on the Atlas of NSW Wildlife using the ATLAS spreadsheets found at the following link:

http://www.environment.nsw.gov.au/resources/atlas/AtlasDatasheet.xls

4.3 Specific survey requirements

Appendix 1 details the specific survey requirements for the subject species, populations or ecological communities identified in Table 1 of these DGRs. These survey requirements can determine the presence of subject species, populations or ecological communities known or likely to be in the study area and/or can provide contextual information on habitats to allow appropriate assessment of impacts at a broader scale. The flora and fauna survey of the study area must include the use of these survey methods.

It is recommended that the consultant(s) engaged to prepare the SIS contact OEH to discuss deriving an appropriate survey regime for some of these requirements, and to confirm the survey regimes proposed for any additional subject species, populations and ecological communities derived by analysis as part of this SIS.

5 ASSESSMENT OF LIKELY IMPACTS ON THREATENED SPECIES, POPULATIONS AND ECOLOGICAL COMMUNITIES

For all *subject species, populations and ecological communities*, the SIS shall describe the following:

a. the location, nature and extent of habitat removal or modification which will result from the action proposed;

b. the likely and potential direct and indirect impacts of the removal of habitat. Particular attention shall be given to the loss of:

   i. Habitat for Swamp Oak floodplain forest of the NSW North Coast Sydney basin and South East Corner Bio Region, Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions and River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions

   ii. the number and proportion of hollow-bearing trees, Yellow-bellied Glider feed trees and other trees known to be utilised for breeding, roosting or denning by threatened fauna such as micro-chiropteran bats, gliders, threatened parrots and large forest owls

   iii. Similarly, attention is to be given to the likelihood of and extent of loss of food resources (e.g. *Allocasuarina littoralis*, nectar-rich tree and shrub species) and the impact this may have on the *subject species, populations or ecological communities*.

   iv. Changes occurring to aquatic biota and other habitat resources as a result of altered hydrology and increased nutrient loads occurring within Lake Wollumboola and associated watercourses.

c. any indirect impacts of the proposal including:

   i. the fragmentation or isolation of *local populations* and/or *local occurrences*, and the increased distance required for the movement of individuals/genetic material between habitat patches,

   ii. edge effects from creating gaps in contiguous woody vegetation, including incursion of weeds, dieback from *Phytophthera cinnamomi* and the potential impacts of aggressive overabundant species such as the Noisy Miner *Manorina melanocephala* that are favoured by clearing and simplification of habitat structure.

   iii. Ingress of pest animal species and possible consequential increase in predation pressure, loss of habitat condition or displacement of habitat arising from habitat clearance and fragmentation.

   iv. change in vegetation floristics and structure resulting from edge effects,

   v. altered hydrology regimes to the Lake Wollumboola catchment (including increased runoff and raising or lowering of the water table, increased nutrient loads),

   vi. altered hydrology regimes to the Endangered Ecological Communities known to occur both onsite and adjacent to the development and the predicted impacts to these communities.

   vii. soil erosion and pollution,

   viii. disturbance to feeding or nesting/breeding of species,

ix. trampling or other impacts due to increased use of the area by humans, particularly on Endangered Ecological communities

x. increased mortality rates due to road deaths,

xi. habitat fragmentation and disruption of wildlife movement corridors and pollination mechanisms,

xii. change in fire behaviour as a result of clearing of native vegetation

xiii. altered light and noise regimes,

xiv. the likely contribution of the action proposed to the threatening processes already acting on populations of those *subject species or populations* and occurrences of *subject ecological communities* in the *locality*.

All of the above contextual information (which can be incorporated into Sections 5.1 - 5.5 below) will assist with the assessment of cumulative impacts on the *subject species, populations and ecological communities*.

5.1 Assessment of species likely to be affected

An assessment of which threatened species or populations known or likely to be present in the area are likely to be affected by the action [Section 110(2)(b)].

This requirement allows refinement of the list of *subject species or populations* (given the outcome of survey and analysis of likely impacts) in order to identify which threatened species or populations may be affected, and the nature of the impact.

The remaining requirements in this section (5.2 – 5.5) need only be addressed for those threatened species or populations that are likely to be affected by the proposal.

5.2 Discussion of local and regional abundance

An estimate for the local and regional abundance of those species or populations [Section 110 (2)(d)]

5.2.1 Discussion of other known local populations

A discussion of other known *local populations* in the *locality* shall be provided. The long-term security of other habitats shall be examined as part of this discussion. The relative significance of the *subject site* for the *subject species, populations and ecological communities* in the *locality* shall be discussed. It is essential that the SIS includes some surveys conducted beyond the *study area* to clarify the conservation significance of the *subject site* to the *subject species and populations*.

The need for off-site surveys to provide context to the anticipated impacts of the *proposal* may also be required for other threatened species recorded during the surveys of the *study area.*

5.2.2 Discussion of habitat utilisation

An estimate of the number of individuals of each *subject species* utilising the *study area* shall be provided as well as a description of how these individuals use the *study area* (e.g. residents, transients, adults, juveniles, nesting, foraging). A discussion of the significance of these individuals to the viability of the *subject species* in the *locality* shall be provided.

5.2.3 Description of vegetation

The vegetation present within the *study area* and the surface area covered by each vegetation community shall be mapped and described. Reference to the vegetation classification system used (e.g. Specht, Benson, Keith) and to the ecological communities determined as endangered by the NSW Scientific Committee shall be provided. Classification must have regard to both structural and floristic elements.

5.2.4 Discussion of corridors

Particular attention shall be given to identifying movement corridors for *subject species* within the *study area.* The impact of the proposal on these corridors and the resulting impact on the resident *subject species* shall be discussed.

5.3 Assessment of habitat

A full description of the type, location, size and condition of the habitat (including critical habitat) of those species, populations and ecological communities and details of the distribution and condition of similar habitats in the region [Section 110 (2)(f) and Section 110 (3)(c)]

5.3.1 Description of habitat values

Specific habitat features in the *study area* shall be described and quantified (e.g. frequency and location of stags, hollow bearing trees, culverts, rock shelters, rock outcrops, crevices, caves, drainage lines, soaks, area of ecological communities etc.), as well as the density of understorey vegetation and groundcover.

The condition of the habitats and different vegetation communities or types within the *study area* shall be discussed, including the prevalence of introduced species, species of weeds present and an estimate of the total weed cover as a percentage of each vegetation community, whether trampling or grazing is apparent, effects of erosion, prevalence of rubbish dumping, history of resource extraction or logging and proximity to roads. Details of the *study area's* fire history (e.g. frequency, time since last fire, intensity) and the source of fire history (e.g. observation, local records), shall be provided.

5.3.2 Distribution and condition of regional habitats

For the habitats of *subject species and populations* found in the study area, the SIS shall discuss the distribution and condition of similar habitats in the region. For the *subject ecological communities* found in the study area, the SIS shall discuss the distribution and condition of these ecological communities in the region. Regional information may be obtained from existing datasets and from other sources.

5.4 Discussion of conservation status

For each species or population likely to be affected, and for each ecological community present, details of its local, regional and State-wide conservation status,...[and]... its habitat requirements ... [Section 110(2)(c) and Section 110(3)(b)]

Assessment shall include reference to the threatening processes that are generally accepted by the scientific community as affecting the *subject species, population or ecological community* and which are likely to be caused or exacerbated by the *proposal.* Assessment shall also include reference to any approved or draft recovery plans which may be relevant to the *proposal.* Up-to-date lists and copies of approved and draft recovery plans are available on the OEH website www.environment.nsw.gov.au by following the links to threatened species.

5.5 Description of feasible alternatives

A description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development [Section 110(2)(h) and Section 110(3)(e)].

In this instance, any other relevant planning proposals for the site, shall be provided to support this description.

6 IMPACT AMELIORATION

6.1 Description of ameliorative measures

A full description and justification of the measures proposed to mitigate any adverse effect of the action on the species, populations and ecological communities including a compilation (in a single section of the statement) of those measures [Section 110 (2)(i) and Section 110 (3)(f)].

6.1.1 Long term management strategies

Consideration shall be given to the information contained in approved and draft recovery plans or threat abatement plans for existing taxa, known or likely to occur in the *study area*, and whether any recommendation is applicable to the *proposal*.

The development of long-term management strategies shall be considered to protect areas within the study area which are of particular importance for the *subject species, populations or ecological communities* likely to be affected by the *proposal*. This may include proposals to restore or improve habitat on site where possible. If mitigation is to include rehabilitation of the site, then the rehabilitation strategy shall be detailed.

Any measures proposed to mitigate the effect of the proposal on *local populations* of threatened species and populations and/or *local occurrences* of ecological communities shall be described. The potential effectiveness of any such amelioration in maintaining a viable *local population* and/or *local occurrence* in the short, medium and long term shall be discussed (e.g. fauna underpasses, vegetation management).

6.1.2 Compensatory strategies

If significant modification of the *proposal* to minimise impacts on *subject species, populations or ecological communities* is not possible, then offset strategies shall be considered. These may include other off-site or local area proposals that contribute to long term conservation of the *subject species, populations or ecological communities*. These areas should be assessed in accordance with the Principles for the use of biodiversity offsets in NSW, which can be found on the following link on the OEH website http://www.environment.nsw.gov.au/biocertification/offsets.htm.

The areas proposed to be used for compensatory strategies must be described in full including a detailed description of their biodiversity. A complete description of how the area will be managed for conservation in perpetuity must also be provided.

Where such proposals involve other lands, or where involvement of community groups is envisaged in such proposals, landholders, land managers and/or community groups are to be consulted and *proposals* shall contain evidence of support from these stakeholders and relevant land managers.

Compensatory benefits likely to result from such measures proposed for alternative sites are to be discussed and evaluated along with a discussion of the mechanisms through which they might best occur.

6.1.3 Ongoing monitoring

Any proposed pre-construction monitoring plans or on-going monitoring of the effectiveness of the mitigation measures shall be outlined in detail, including the objectives of the monitoring program, method of monitoring, reporting framework, duration and frequency. Generally, ameliorative strategies that have not been proved effective should be undertaken under experimental design conditions and appropriately monitored.

6.1.4 Translocation

OEH does not consider that translocation of threatened species, populations and ecological communities is an appropriate ameliorative strategy for the purposes of considering impacts of a particular development/activity. It strongly supports the view that development proposals which may impact on significant local populations of *subject species and populations* or significant local occurrences of *subject ecological communities* as determined by the SIS should aim to:

i. minimise the impacts by considering all possible alternatives to the *proposal*, such that a significant impact is not likely; and

ii. manage the remaining habitat (if any) to ensure that the *local population* and/or *local occurrence* continues to exist in the long term.

The translocation of *subject species, populations and ecological communities* is only supported by OEH in specific conservation programs (e.g. recovery planning).

7. ASSESSMENT OF SIGNIFICANCE OF LIKELY EFFECT OF PROPOSED ACTION

An assessment of significance (s5A EP&A Act) is to be provided for each *subject species, population or ecological community* identified in the SIS, incorporating relevant information from sections 5.1 to 7 of the SIS. On the basis of these assessments, a conclusion is to be provided concerning whether, based on more detailed assessment through the SIS process and consideration of alternatives and/or ameliorative measures proposed in the SIS, the proposal is still considered likely to have a significant effect on threatened species, populations or ecological communities or their habitats.

8 ADDITIONAL INFORMATION

8.1 Qualifications and experience

A species impact statement must include details of the qualifications and experience in threatened species conservation of the person preparing the statement and of any other person who has conducted research or investigations relied on in preparing the statement [Section 110(4)]

8.2 Other approvals required for the development or activity

A list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species or population or ecological community [Sections 110(2)(j) and 110(3)(g)]

In providing a list of other approvals the following shall be included:

- Where consent is required under Part 4 of the *Environmental Planning and Assessment Act 1979*, the name of the consent authority and the timing of the development application shall be included; or

- Where approval is required under Part 5 of the *Environmental Planning and Assessment Act 1979*, the name of the determining authority, the basis for the approval and when the approval is proposed to be obtained shall be included.
- Where consent or approval is required under any other Act, the name of the consent or determining authority and the timing of the development application, basis for the approval and when the approval is proposed to be obtained shall be included

8.3 Licensing matters relating to flora and fauna surveys

Persons conducting flora and fauna surveys must have appropriate licences or approvals under relevant legislation. The relevant legislation and associated licences and approvals that may be required are listed below:

National Parks and Wildlife Act 1974:

- General Licence (Section 120) to harm or obtain protected fauna (this may include threatened fauna).
- Licence to pick protected native plants (Section 131).
- Scientific Licence (Section 132C) to authorise the carrying out of actions for scientific, educational or conservation purposes.

Threatened Species Conservation Act 1995:

- Licence to harm threatened animal species, and/or pick threatened plants and/or damage the habitat of a threatened species (Section 91).

Animal Research Act 1985:

- Animal Research Authority to undertake fauna surveys.

8.4 Reports of State-wide conservation status

Section 110(5) of the *Threatened Species Conservation Act 1995* has the effect of requiring OEH to provide available information regarding the State-wide conservation status of the subject species, populations or ecological communities, in order to satisfy ss.110(2)&(3) of the Act.

The State-wide conservation status of all threatened species, communities and populations is detailed on the OEH threatened species website (www.threatenedspecies.environment.nsw.gov.au). Reference to these profiles can be taken to have satisfied the requirements of ss.110(2)&(3) in relation to the State-wide conservation status of the listed species, populations and ecological communities.

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Marsupials					
Potorous tridactylus	Long-nosed Potoroo	V	Survey methods for the Southern Brown Bandicoot are still being clarified however the following methods may used for this species	All year	Forest, woodland, coastal banksia scrub, heath.
Isoodon obesulus	Southern Brown Bandicoot	E	Digital Infra-red Cameras are considered to be the most effective and cost-efficient technique. 10 cameras at 10-20m spacing with alternating horizontal and vertical mounting, per 100ha of habitat. Cameras should be in place (and functioning) for a minimum of 14 days. A further 5 tree mounted cameras per 100ha targeting key resources (i.e. habitat trees, flowering banksias etc.). Attractants or baits should be used with the cameras. Appropriate cameras techniques are important please contact OEH Queanbeyan to obtain a copy of the manual for the use of cameras in wildlife surveys. Alternatively, a program of small cage trapping could be employed, using at least 25 cage traps set over at least 4 nights, to provide coverage of the areas required for targeted survey. The Environmental consultant should discuss the appropriate survey methods for OEH prior to undertaking the survey.		

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Marsupials					
Cercartetus nanus *Sminthopsis leucopus*	Eastern Pygmy Possum White-footed Dunnart	V V	Surveys for these species must be conducted with pitfall traps. Pitfall trapping must be conducted with two litre buckets (at least 40 cm deep) set in clusters of three with each pit/trap in a cluster being approximately 5 m apart. These trap clusters should be spaced at 50 m intervals along transects at least 200 m in length (i.e 15 pitfalls per 200 m). Pitfall trapping must be conducted for a minimum of two (but preferably three) separate sessions of 5 consecutive nights. This can be combined with elliot trapping. The status of the White-footed Dunnart and Eastern Pygmy Possum in the region is poorly known. If either of these species is found on the subject site, then additional surveys in the locality must be undertaken to determine the significance of the population on the subject site. Alternatively the use of infra red cameras as described above may also be used for these species	December to February inclusive.	Forest, woodland, coastal banksia scrub, heath.
Petaurus norfolcensis	Squirrel Glider	V	The consultant needs to determine the distribution and abundance of the species on the subject site and its status in the region. Squirrel Gliders may occur across a wide variety of forest and woodland vegetation types. Live-trapping in trees is the preferred survey method for detecting Squirrel Gliders. Traps should be either large Elliott box traps or wire mesh 'bandicoot' traps (200 mm wide x 170 mm tall x 500 mm long; Figure 2) (manufactured by R.E. Walters Pty. Ltd., Sunshine, VIC). Live-trapping is a preferred sampling technique as it allows for unequivocal identification of animals. This is particularly important as the Squirrel Glider is very similar in appearance to the smaller Sugar Glider, *P. breviceps*. Cameras may also be placed on a star picket at selected trapping sites, aimed a the trees with the trap at an appropriate focal distance to assist definitive identification of	All year	Eucalypt forest and woodland.

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Marsupials					
			attracted species/ individuals which may not be trapped. If definite identification cannot be made then any captured animals should be photographed and measured. Subsequent identification of the animal in question can then be made by an appropriate expert. Bait should consist of a mixture of peanut butter, honey and rolled oats. A honey and water solution may be sprayed above and below the trap entrance. The number of traps set at a site will vary according to the extent of suitable habitat, the area over which possible den sites are present, and the scale of the proposed clearing or activity. Traps should ideally be positioned horizontally in low tree branches. Traps must be attached to trees and spaced approximately 50-100 m apart in a transect or grid layout, as the habitat allows. Traps must be set for a minimum period of 3-4 consecutive nights. On each day traps should be set at dusk and checked the following morning. Where possible, traps should not be left open during daylight hours, particularly during periods of hot weather. In situations where the same animals are being repeatedly trapped, individual trap stations may need to be closed.		
Petaurus australis	Yellow-bellied Glider	V	Map the location of den sites and feed trees within and adjacent to the study area. All trees to be removed or isolated by the development must be assessed to determine if they are being used as den or feed trees. Map the location and size of the areas occupied by Yellow-bellied Glider family groups in the locality. Surveys must consist of stag watching, spotlighting, call play-back and habitat assessment. Spotlighting and call play-back surveys must be undertaken on foot. At each call play-back site, the call of the Yellow-bellied Glider should be played	All year	Eucalypt forest and woodland. Feed trees are characterised by 'v'-shaped scars on the trunks and branches where gliders have incised the surface to extract sap.

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Marsupials					
			through a megaphone for 5 minutes, followed by at least 10 minutes of listening. An assessment of potential links between habitat on the subject site and habitats in the locality must be conducted particularly identifying routes used by the resident Yellow-bellied Gliders within and adjacent to the subject site. Surveys for yellow bellied gliders are to be undertaken over different seasons to identify family groups and home ranges. Call playback for YBG is not to be undertaken during the same period as call back for large forest owls.		
Dasyurus maculatus	Spotted-tailed Quoll	V	Live cage traps using platform cat traps 30cmx 30cmx60cm. Trapping should be undertaken from late March over a 10 day period. Drainage lines should be targeted for surveys. 5 cage traps per drainage lines should be placed 50m apart. Repeat surveys should be undertaken in may using the same methods March	March through winter	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Mostly nocturnal, although will hunt during the day; spends most of the time on the ground, although also an excellent climber and may raid possum and glider dens and prey on roosting birds. Use 'latrine sites', often on flat rocks among boulder fields and rocky cliff-faces; these may be visited by a number of individuals; latrine sites can be recognised by the accumulation of the sometimes characteristic 'twisty-shaped' faeces deposited by animals. Consumes a variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects;

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Marsupials					
					also eats carrion and takes domestic fowl.

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Bats					
Pteropus poliocephalus	Grey Headed Flying Fox	V	Diurnal transect or traverse to look for camps is sufficient. Including spotlighting focusing on flowering trees should be used to identify foraging habitat.	All year	Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Can travel up to 50 km from the camp to forage; commuting distances are more often <20 km. Feed on the nectar and pollen of native trees, in particular *Eucalyptus, Melaleuca* and *Banksia*, and fruits of rainforest trees and vines.
Minopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	Surveys using anabat recorders and stag watching should aim to identify the number and location of roost and identify important foraging habitat in the study area and the locality. If required, OEH can provide further advice on bat survey techniques to acquire this information.	Spring, Summer, Autumn	Forage in forests and woodlands. Roost in caves or rock cavities.
Mormopterus norfolkensis	Eastern Freetail-bat	V	Surveys using anabat recorders and stag watching should aim to identify the number and location of roost and identify important foraging habitat in the study area and the locality. If required, OEH can provide further advice on bat survey techniques to acquire this information.	Spring, Summer, Autumn	Forage in forests and woodlands. Roost in tree hollows.
Falsistrellis tasmaniensis	Eastern False pipistrelle				Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. Hunts beetles, moths, weevils and other flying insects above or just below the tree canopy.

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Bats					
Saccolaimus flaviventris	*Yellow Bellied Sheathtailed bat*	V			Roosts singly or in groups of up to six, in tree hollows and buildings Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Breeding has been recorded from December to mid-March.
Chalinolobus nanus	Large-eared Pied bat	V			Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (Hirundo ariel), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies. The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy. Likely to hibernate through the coolest months. It is uncertain whether mating occurs early in winter or in spring.

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Bats					
Scoteanax rueppellii	Greater Broad nosed bat	V			Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Roosts in hollow Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species.
Kerivoula papuensis	Golden Tipped bat	V			Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Also recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests.
Myotis adversus	Large-footed Myotis	V			Forage over streams and pools. Roost close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Birds					
Calyptorhynchus lathami	Glossy Black Cockatoo	V	Diurnal bird surveys across the study area for breeding activity in woodland/forest with hollow-bearing trees. Nesting surveys involve listening for birds returning to nests and stagwatching and must be undertaken from 1 to 3 hours prior to dusk until dusk. Areas/groups of suitable nesting trees (with hollows 15 cm in diameter or larger) are targeted initially and then narrowed down by more targeted approaches should the species be recorded. Waterbodies	Breeding activity - March to May. Non-breeding and foraging habitat surveys - all year	Nest in large hollow-bearing trees (dead and alive) with hollows 15 cm in diameter or larger in forest and woodland. Forage in forest, woodland or heath with *Allocasuarina littoralis*

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Birds					
			(dams, creeks, pools, puddles) on the subject site can also be targeted in the first few hours of after sunrise and the last three hours before sunset, as birds drink from these waterbodies. With careful observation, their movements to nests and roosts can then be tracked after their departure from drinking. Diurnal bird surveys across the study area in vegetation with *Allocasuarina littoralis* understorey for foraging activity (or signs of foraging from chewed Allocasuarina cones). Map foraging habitat, including locations with foraging sign, on subject site and in the locality. Identify and map all hollow-bearing trees with hollows of 15 cm diameter or larger (potential nest trees) on the subject site and estimate the availability of hollow-bearing trees in the locality. Target survey potential nests during known breeding season of species to determine any parts of the site need to be excluded from development ie nest trees and appropriate vegetated buffers of hollow bearing trees		
*Lathamus discolour**	Swift Parrot	V	The regional significance of the subject site for the Swift Parrot is unknown. The site may provide suitable winter foraging habitat in some areas. Diurnal fixed-width transect or point-count surveys between March and September should be conducted across the subject site, with emphasis on areas of flowering trees and shrubs.	March to September	Eucalypt forest and woodland
*Anthochaera phrygia**	Regent Honeyeater	E	The regional significance of the subject site for the Regent Honeyeater is unknown. There are potential breeding and foraging habitats on the subject site that should be surveyed using diurnal fixed-width transect or point-count surveys. Call playback techniques can be applied, as the species responds to taped calls during the breeding season. Whilst surveys can be conducted at any time of the year, the optimal time is spring and summer during the breeding season, with emphasis on areas of flowering trees and shrubs.	All year, but Sept-Jan prefential for breeding season	Eucalypt forest and woodland

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Birds					
Callocephalon fimbriatum	Gang-gang Cockatoo	V	Diurnal bird surveys across the study area. Nesting surveys involve listening for birds returning to nests and stagwatching and must be undertaken from 1 to 3 hours prior to dusk until dusk. Areas/groups of suitable nesting trees (with hollows of 10 cm diameter or larger) are targeted initially and then narrowed down by more targeted approaches should the species be recorded. Identify and map all hollow-bearing trees with hollows of 10 cm diameter or larger (potential nest trees) on the subject site and estimate the availability of hollow-bearing trees in the locality. Target the survey to potential nests during known breeding season of species to determine any parts of the site which need to be excluded from development ie nest trees and appropriate vegetated buffers of hollow bearing trees	Breeding surveys in Oct-Jan. Non-breeding foraging habitat surveys all year	Eucalypt forest and woodland.
Ninox connivens	Barking Owl	V	Nocturnal call playback (1 site per 100 ha) with an initial listening period of 10 min then play the call of each subject species separated by at least a 2 min listening period, then finish with a 10 minute listening period. Identify and map all hollow-bearing trees with hollows of 20 cm diameter or larger (potential nest trees) on the subject site and estimate the availability of hollow-bearing trees in the locality. Target the survey to potential nests during known breeding season of species to determine any parts of the site which need to be excluded from development ie nest trees and appropriate vegetated buffers of hollow bearing trees. Nesting surveys involve listening for birds leaving nests and stagwatching and must be undertaken from sunset for a period of at least 1.5 hours on each occassion. Areas/groups of suitable nesting trees (with hollows of 20 cm diameter or larger) are targeted initially and then narrowed down by more targeted approaches should the species be recorded.	All year	Eucalypt forest and woodland.
Ninox strenua	Powerful Owl	V	Nocturnal call playback is intermittent with short calls and short listening periods, with long wait periods afterwards as Powerfuls Owls are reticent to respond	Call playback from March to June. Nesting starts in July. No call playback when	Eucalypt forest and woodland. Found in a variety of timbered habitats including dry woodlands and open

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Birds					
			(e.g. one hour later. I site per vegetation stratification unit . Identify and map all hollow-bearing trees (potential nest trees) on the subject site and estimate the availability of hollow-bearing trees in the locality. Target the survey to potential nests (trees with hollows of 45 cm diameter or larger) during known breeding season of species to determine any parts of the site which need to be excluded from development ie nest trees and appropriate vegetated buffers of hollow bearing trees. Nesting surveys involve listening for birds leaving nests and stagwatching and must be undertaken from sunset for a period of at least 1.5 hours on each occasion. Areas/groups of suitable nesting trees (with hollows of 45 cm diameter or larger) are targeted initially and then narrowed down by more targeted approaches should the species be recorded. Drainage lines should also be searched for evidence of 'white-wash' indicating roost sites. Roost sites detected during this period may indicate nearby breeding habitat (large trees with large hollows often close to drainage lines) that should be retained and buffered from disturbance. Searches for pellets must be conducted at any roost or nest tree that is located. These are to be analysed to identify key prey items. This information should be used to identify strategies to protect prey species on the site. Opportunistic surveys should be conducted in the locality given the large home range of the species.	nesting starts	forests. Shows a particular preference for timbered watercourses. Nests are generally located in trees along or near watercourses, in a fork or on large horizontal limbs.
Tyto novaehollandiae	Masked Owl	V	Nocturnal call playback (1 site per within each vegetation stratification) with an initial listening period of 10 min then play the call of each subject species separated by at least a 2 min listening period,	June to September for breeding habitat surveys	Eucalypt forest and woodland. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Birds					
			then finish with a 10 minute listening period. Identify and map all hollow-bearing trees (potential nest trees) on the subject site and estimate the availability of hollow-bearing trees with hollow of 40 cm diameter or larger in the locality. Target the survey to potential nests (tree with hollows of 40 cm diameter or larger) during known breeding season of species to determine any parts of the site which need to be excluded from development ie nest trees and appropriate vegetated buffers of hollow bearing trees. Nesting surveys involve listening for birds leaving nests and stagwatching and must be undertaken from sunset for a period of at least 1.5 hours on each occassion. Areas/groups of suitable nesting trees are targeted initially and then narrowed down by more targeted approaches should the species be recorded. Drainage lines should also be searched for evidence of 'white-wash' indicating roost sites. Roost sites detected during this period may indicate nearby breeding habitat (large trees with large hollows often close to drainage lines) that should be retained and buffered from disturbance. Searches for pellets must be conducted at any roost or nest tree that is located. These are to be analysed to identify key prey items. This information should be used to identify strategies to protect prey species on the site. Opportunistic surveys should be conducted in the locality given the large home range of the species.		for timbered watercourses. Nests are generally located in trees along or near watercourses, in a fork or on large horizontal limbs.
Tyto tenebricosa	Sooty Owl	V	Nocturnal call playback (1 site per 100 ha) with an initial listening period of 10 min then play the call of each subject species separated by at least a 2 min listening period, then finish with a 10 minute listening period.	June to September for breeding habitat surveys	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Birds					
			Identify and map all hollow-bearing trees with hollows 30 cm in diameter or larger (potential nest trees) on the subject site and estimate the availability of hollow-bearing trees in the locality. Target the survey to potential nests (trees with hollows of 30 cm diameter or larger) during known breeding season of species to determine any parts of the site which need to be excluded from development ie nest trees and appropriate vegetated buffers of hollow bearing trees. Nesting surveys involve listening for birds leaving nests and stagwatching and must be undertaken from sunset for a period of at least 1.5 hours on each occasion. Areas/groups of suitable nesting trees are targeted initially and then narrowed down by more targeted approaches should the species be recorded. Drainage lines should also be searched for evidence of 'white-wash' indicating roost sites. Roost sites detected during this period may indicate nearby breeding habitat (large trees with large hollows often close to drainage lines) that should be retained and buffered from disturbance. Searches for pellets must be conducted at any roost or nest tree that is located. These are to be analysed to identify key prey items. This information should be used to identify strategies to protect prey species on the site. Opportunistic surveys should be conducted in the locality given the large home range of the species.		
Lophoictinia isura	Square-tailed Kite	V	Diurnal bird surveys across the subject area targeting woodland and forest for nesting sites. Opportunistic surveys should be conducted in the locality given the large home range of the species.	July to February	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Nests are generally located in trees along or near watercourses, in a fork or on large horizontal limbs.

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Birds					
Esacus magnirostris	Beach stone curlew	v	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area.	All year (Oct-Mar for breeding season)	Beaches, islands, reefs and in estuaries, and may often be seen at the edges of or near mangroves.
Haematopus fuliginosus	Sooty oystercatcher	V	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area.	All year (Oct-Jan for breeding season)	Rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries
Haematopus longirostris	Pied Oystercatcher	E	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area.	All year (Aug-Jan for breeding season)	Intertidal flats of inlets and bays, open beaches and sandbanks
Charadrius leschenaultii	*Greater Sand-plover*	V	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area.	Sep-Mar	Sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks
Charadrius mongolus	*Lesser Sand-plover*	V	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area.	Sep-May	Beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats.
Calidris alba	*Sanderling*	V	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area.	Sep-May	Coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons.
Calidris ferruginea	*Curlew Sandpiper*	E	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area.	Oct-Mar	Intertidal mudflats of sheltered coasts.
Calidris tenuirostris	*Great Knot*	V	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area.	Oct-Mar	Coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons.

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Birds					
Limicola falcinellus	*Broad-billed Sandpiper*	V	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area.	Sep-Mar	Sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs.
Limosa limosa	*Black-tailed Godwit*	V	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area.	Sep-Mar	Sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats.
Xenus cinereus	*Terek Sandpiper*	V	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area.	Sep-Apr	Coastal mudflats, lagoons, creeks and estuaries.
Sternula albifrons	*Little Tern*	E	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area, including observations across the open water of the lake.	Sep-Mar (peak breeding season Nov-Jan)	Sheltered coastal habitats, harbours, inlets and rivers (with occasional offshore islands or coral cay records).
Puffinus assimilis	*Little Shearwater*	V	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area, with focus on open water habitat on the lake.	All year	Marine, coastal lakes, offshore islands
Rostratula australis	*Painted Snipe*	E	Diurnal bird survey using transect or point count method. To be conducted along the shoreline of Lake Wollumboola and associated watercou0rses within the Study Area. This species is difficult to detect due to its cryptic behaviour and is usually observed when it is flushed from vegetation cover.	Sep-Dec	Shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire.
Hieraaetus morphnoides	*Little Eagle*	V	Diurnal bird survey using standardised fixed width transect or point count methods within study area, with particular attention on large emergent trees with stick nests.	All year (breeding in spring and summer)	Occupies open eucalypt forest, woodland or open woodland and riparian forest

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Birds					
Circus assimilis	*Spotted Harrier*	V	Diurnal bird survey using standardised fixed width transect or point count methods within study area, with particular attention to more open habitats including the foreshore and open water of Lake Wollumboola.	All year (breeding usually in Spring)	Open habitats, including the edge of wetlands
Pandion cristatus	*Osprey*	V	Diurnal bird survey using transect or point count methods. To be conducted along the shoreline of Lake Wollumboola and associated watercourses within the Study Area, with focus on open water habitat on the lake. Also conduct searches for large emergent trees with stick nests.	All year (Jul-Oct for breeding)	Coastal wetlands, watercourse, open water for foraging. Tall trees (dead or alive) for nesting habitat
Glossopsitta pusilla	*Little Lorikeet*	V	Diurnal bird survey using standardised fixed width transect or point count methods within study area, with particular attention to areas with flowering trees and shrubs and potential suitable nest trees with hollows 3 cm in diameter or larger	All year (breeding June to December)	Eucalypt forests and woodlands
Neophema chrysogaster	*Orange-bellied Parrot*	CE	Diurnal bird survey using standardised fixed width transect or point count methods within study area, with particular attention to the foreshore of Lake Wollumboola and associated watercourse within the Study Area.	Autumn and Winter	Coastal saltmarsh
Neophema pulchella	*Turquoise Parrot*	V	Diurnal bird survey using standardised fixed width transect or point count methods within study area.	All year (breeding Sep-Jan)	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.
Anthochaera phrygia	*Regent Honeyeater*	CE	Diurnal bird survey using standardised fixed width transect or point count methods within study area, with particular attention on areas with flowering trees and shrubs.	All year (breeding Sep-Jan)	Eucalypt forest and woodland, riparian Gallery Forest
Petroica rodinogaster	*Pink Robin*	V	Diurnal bird survey using standardised fixed width transect or point count methods within study area.	All year (breeding Oct-Jan)	Tall eucalypt forest and woodland
Petroica boobang	*Scarlet Robin*	V	Diurnal bird survey using standardised fixed width transect or point count methods within study area.	All year (breeding Jul-Jan)	Eucalypt forest and woodland

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Birds					
Petroica phoenicea	*Flame Robin*	V	Diurnal bird survey using standardised fixed width transect or point count methods within study area.	Autumn and Winter (altitudinal migrant)	Eucalypt forest and woodland
Melanodryas cucullata cucullata	*Hooded Robin*	V	Diurnal bird survey using standardised fixed width transect or point count methods within study area.	All year (breeding Sep-Jan)	Eucalypt woodland with dead fallen woody debris
Epthianura albifrons	*White-fronted Chat*	V	Diurnal bird survey using standardised fixed width transect or point count methods within study area, with particular focus on the shoreline of Lake Wollumboola and associated watercourses.	All year (breeding Jul – Dec)	Saltmarshes, wetlands, open grassy areas
Daphoenositta chrysoptera	*Varied Sittella*	V	Diurnal bird survey using standardised fixed width transect or point count methods within study area.	All year (breeding Aug-Feb)	Eucalypt forest and woodland
Pachycephala olivacea	*Olive Whistler*	V	Diurnal bird survey using standardised fixed width transect or point count methods within study area.	All year (breeding Sep-Jan)	Wet forests

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Frogs					
Litoria aurea	Green and Golden Bell frog		Survey suitable habitat using spotlight/headlamp searches, call playback, diurnal visual searches and dip-netting surveys for tadpoles. Surveys must be conducted on 3 visits separated by at least 2 weeks. Small areas of habitat (<0.3 ha) should be surveyed for a minimum of 1 hr for both nocturnal (spotlight and call playback) and diurnal (visual searches and dip-netting) visits (i.e. 1 hr nocturnal survey, 1 hr diurnal survey X 3 visits). Larger areas should be surveyed at a rate of 3 hrs per ha of habitat. Optons for movement corridors between the known Green and Golden Bell frog populations between the Culburra STP and Wattle Creek must be identified. Including suitable refuge habitat and suitable	Spring and summer. Call mainly between September and January but may call through to March in favourable weather. Calling and breeding is stimulated by rainfall.	Natural and artificial wetlands with emergent or fringing vegetation

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
			moisture gradients.		

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Flora Survey Requirements					
Round-leafed Wilsonia	*Wilsonia rotundifolia*		Known from the foreshore of Lake Wollumboolla. This species occurs within the Endangered Coastal Salt marsh community. Surveys are required to determine the size and extent of the populations. All occurrences of *Wilsonia rotundifolia* should be mapped and GPS reference points also provided. Surveys need to be done at low tide to ensure full extent of distribution is detected.	All year round. Although identifiable from vegetative characteristics, identification is best confirmed when flowering. Flowering is predominantly from September until February.	Grows in mud in coastal saltmarsh and inland saline or brackish lake beds. In undisturbed habitat, it can be a good coloniser as the creeping stems root from the nodes.
Wilsonia backhousia	*Narrow-leafed Wilsonia*		Known from the foreshore of Lake Wollumboolla. This species occurs within the Endangered Coastal Salt marsh community. Surveys are required to determine the size and extent of the populations. All occurrences of *Wilsonia rotundifolia* should be mapped and GPS reference points also provided..	All year round. Although identifiable from vegetative characteristics, identification is best confirmed when flowering. Flowering is predominantly from September until February.	This is a species of the margins of coastal and inland salt marshes and lakes.
Pterostylis ventricosa	Pterostylis ventricosa		This species can only be satisfactorily surveyed when it is flowering. Exact flowering time should be confirmed at the nearest known site prior to surveys being undertaken. Searches of the study area should be undertaken at about fortnightly intervals during the confirmed flowering period for that season. Systematic surveys using evenly spaced transects located about 5m apart through all areas of suitable habitat must be undertaken	March, April and May	Predominantly in more open areas of tall coastal eucalypt forest often dominated by one or more of the following tree species:- Terpentine, Spotted Gum, Grey Ironbark, Blackbutt, White Stringybark, Scribbly Gum and Sydney Peppermint. Often favours more open areas such as along powerline easements and on road verges where the tree overstorey has been removed or thinned. Grows in a range of groundcover types, including moderately dense low heath, open sedges and grasses, leaf litter, and mosses on outcropping rock. Soil type ranges from moisture retentive grey silty loams to grey sandy loams. Sometimes found in skeletal soils on sandstone rock shelves

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Calochilus pulchellus	Pretty Beard Orchid		This species can only be satisfactorily surveyed when it is flowering. Exact flowering time should be confirmed at the nearest known site prior to surveys being undertaken. Searches of the study area should be undertaken at about fortnightly intervals during the confirmed flowering period for that season. Systematic surveys using evenly spaced transects located about 5m apart through all areas of suitable habitat must be undertaken. This species can only be satisfactorily surveyed when it is flowering.	Flowering occurs from late October to late November	The habitat of the species varies considerably. At Vincentia the species grows in dense low wet heath in wet sand over sandstone. In Booderee National Park it grows in a tall heathy association. In Morton National Park on the Little Forest Plateau it occurs in low heath among scattered clumps of emergent eucalypts and Banksia in shallow coarse white sand over sandstone, in a near-escarpment area subject to strong orographic precipitation.
Pterostylis gibboosa	Illawarra greenhood		This species can only be satisfactorily surveyed when it is flowering. Exact flowering time should be confirmed at the nearest known site prior to surveys being undertaken. Searches of the study area should be undertaken at about fortnightly intervals during the confirmed flowering period for that season. Systematic surveys using evenly spaced transects located about 5m apart through all areas of suitable habitat must be undertaken. The Illawarra Greenhood is a deciduous orchid that is only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. The leaf rosette grows from an underground tuber in late summer, followed by the flower stem in winter. After a spring flowering, the plant begins to die back and seed capsules form (if pollination has taken place).	Late August to late September	In the Illawarra region, the species grows in woodland dominated by Forest Red Gum *Eucalyptus tereticornis*, Woollybutt *E. longifolia* and White Feather Honey-myrtle *Melaleuca decora*. Near Nowra, the species grows in an open forest of Spotted Gum *Corymbia maculata*, Forest Red Gum and Grey Ironbark *E. paniculata*. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark *E. crebra*, Forest Red Gum and Black Cypress Pine *Callitris endlicheri*.
Genoplesium baueri	Bauer's Midge Orchid	V	This species can only be satisfactorily surveyed when it is flowering. Exact flowering time should be confirmed at the nearest known site prior to surveys being undertaken. Searches of the study area should be undertaken at about fortnightly intervals during the confirmed flowering period for that season. Systematic surveys using evenly spaced transects located about 5m apart through all areas of suitable habitat must be undertaken	February to March	The habitat requirements of this species are poorly known. It has been recorded in forest and woodland comprising Hard-leaved Scribbly Gum *Eucalyptus sclerophylla*. and Red Bloodwood *Corymbia gummifera* in the Shoalhaven.

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
Rhizanthella slateri	Australian Underground Orchid -		This species is almost completely subterranean although flowering heads may protrude up to 2cm above the ground. Detection of this species is thus difficult. It appears to prefer locations around the bases of tree species such as Hard-leaved Scribbly Gum *Eucalyptus sclerophylla*. and Red Bloodwood *Corymbia gummifera* Surveys must be undertaken in the flowering period which is between October and April in this part of its range. Systematic surveys using evenly spaced transects located about 100 m apart through all areas of suitable habitat must be undertaken and the leaf-litter around the bases of trees within 5m either side of each transect carefully raked back to a distance of up to 2m from the base of the tree whilst searching for evidence of flowers and stems.	September to November	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. It has been recorded at the bases of Hard-leaved Scribbly Gum *Eucalyptus sclerophylla*. and Red Bloodwood *Corymbia gummifera*.
ylis hunteriana.	Tongue Orchid		This species can only be satisfactorily surveyed when it is flowering. The exact flowering time is unpredictable and the species can flower anytime between early December and mid March. Exact flowering should be confirmed at the nearest confirmed population prior to surveys being undertaken. Searches of the study area should be undertaken at about three weekly intervals over this period. Systematic surveys using evenly spaced transects located about 5m apart must be undertaken through all areas of suitable habitat.	Early December to mid March	The larger populations typically occur in woodland dominated by Hard-leaved Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black She-oak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*).
ı Lilly Pilly	Syzigium paniculatum		Systematic surveys in remanent areas of littoral rainforest	All year round for those familiar with the species. Flowering occurs from November to February and the distinctive fruit mature in May.	On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest.
ıustrale	Tangled bedstraw		This species can only be satisfactorily surveyed when it is flowering or fruiting. Systematic surveys using evenly spaced transects located about 10 m apart must be undertaken through all areas of suitable habitat	December to February	In NSW Tangled Bedstraw has been found in moist gullies of tall forest, *Eucalyptus tereticornis* forest, coastal Banksia shrubland, and *Allocasuarina nana* heathland. In other States the species is found in a range of near-coastal habitats, including

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Scientific Name	Common Name	Legal status	Survey Requirements	Survey Season	Habitat
					sand dunes, sand spits, shrubland and woodland.

Endangered Ecological Communities	
General Considerations and Mitigation	
	Surveys shall identify the extent and condition of ecological communities in the subject site, study area and locality. This shall involve the use of vegetation surveys in the subject site and the study area. The use of existing datasets held by OEH in combination with ground-truthing of selected sites within areas mapped by OEH as the ecological community is recommended for surveys of the locality. The sites sampled shall be used to provide context to the ecological community affected by the action proposed. . Establishing vegetated buffers to EECs is essential for mitigating the impacts of proposal. OEH acknowledges that whilst there are no set standards for buffer widths, buffers should be set at the greatest possible width in order to provide the best long-term security for the biodiversity assets buffered. In this case the vegetated buffers would need to be capable of adequately protecting biodiversity assets by mitigating the edge effects from the development areas as well as nutrient influx from the effluent disposal areas.
	Where development area is located upslope of EECs, OEH would require buffers for biodiversity assets to be at their widest in this part of the site. A minimum buffer width of 50m for development upslope of biodiversity assets has been the standard that OEH has advocated for other proposals in the Shoalhaven.

Endangered Ecological Communities					
Survey requirements					
Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion			Surveys shall identify the extent and condition of this ecological community in the subject site, study area and locality. This shall involve vegetation surveys in the subject site and the study area to identify the distribution of each vegetation type. Each vegetation type is to be mapped and any that equate to listed EECs need to be identified.	All year	This community comprises vegetation types that occupy the Illawarra coastal plain and escarpment foothills. Characteristic tree species include Forest Red Gum *Eucalyptus tereticornis*, Thin-leaved Stringybark *Eucalyptus eugenioides*, Woollybutt *Eucalyptus longifolia*, Coast Grey Box *Eucalyptus bosistoana* and White Feather Honey-myrtle *Melaleuca decora*. The understorey is not necessarily grassy as moist forest vegetation types are also included within this broad community. Common shrub species include *Acacia mearnsii* and *Dodonaea viscosa* subsp. *angustifolia*. Floodplain vegetation dominated by *Casuarina* species or rainforests on latite soils are not part of this community.

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Endangered Ecological Communities					
Survey requirements					
ainforest			Surveys shall identify the extent and condition of this ecological community in the subject site, study area and locality. This shall involve the use of vegetation surveys in the subject site and the study area Surveys can be undertaken at any time of the year under varied seasonal conditions.	All year	Littoral Rainforest is generally a closed forest, the structure and composition of which is strongly influenced by its proximity to the ocean. The plant species of this community are predominantly rainforest species. Several species have compound leaves, and vines may be a major component of the canopy. These features differentiate littoral rainforest from forest or scrub, but while the canopy is dominated by rainforest species, scattered emergent individuals of sclerophyll species, such as *Angophora costata*, *Banksia integrifolia*, *Eucalyptus botryoides* and *Eucalyptus tereticornis* occur in many stands.
y sand forest in the Sydney Basin and South East Corner bioregions			Surveys shall identify the extent and condition of this ecological community in the subject site, study area and locality. This shall involve the use of vegetation surveys in the subject site and the study area Surveys can be undertaken at any time of the year under varied seasonal conditions.	All Year	Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions typically has a dense to open tree canopy, approximately 5 - 20 m tall, depending on exposure and disturbance history. The most common tree species include *Eucalyptus botryoides* (Bangalay) and *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia), while *Eucalyptus pilularis* (Blackbutt) and *Acmena smithii* (Lilly Pilly) may occur in more sheltered situations, and *Casuarina glauca* (Swamp Oak) may occur on dunes exposed to salt-bearing sea breezes or where Bangalay Sand Forest adjoins Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions, as listed under the Threatened Species Conservation Act 1995
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions			Surveys shall identify the extent and condition of this ecological community in the subject site, study area and locality. This shall involve the use of vegetation surveys in the subject site and the study area. Surveys can be undertaken at any time of the year under varied seasonal conditions.		This EEC is associated with river flats of the coastal floodplains. It has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include *Eucalyptus tereticornis (forest red gum)*, *E. amplifolia* (cabbage gum), *Angophora floribunda* (rough-barked apple) and *A. subvelutina* (broad-leaved apple). *Eucalyptus baueriana* (blue box), *E. botryoides* (bangalay) and *E. elata* (river peppermint) may be common south from Sydney, *E. ovata* (swamp gum) occurs on the far south coast, *E. saligna* (Sydney blue gum) and *E. grandis* (flooded gum) may occur north of Sydney, while *E. benthamii* is restricted to the Hawkesbury floodplain.
Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner			Surveys shall identify the extent and condition of this ecological community in the subject site, study area and locality. This shall involve the use of vegetation surveys in the subject site and the study area Surveys can be undertaken at any time of the year under varied seasonal conditions.		Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Generally occurs below 20 m (though sometimes up to 50 m) elevation.

Appendix 1: Survey Requirements for Subject Species - DGRs for Culburra Golf Course

Endangered Ecological Communities					
Survey requirements					
bioregions					The composition of the community is primarily determined by the frequency and duration of waterlogging and the texture, salinity nutrient and moisture content of the soil, and latitude. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.
Oak flood Plain forest of the NSW North Coast, Sydney Basin and South East corner Bioregion			Surveys shall identify the extent and condition of this ecological community in the subject site, study area and locality. This shall involve the use of vegetation surveys in the subject site and the study area. Surveys can be undertaken at any time of the year under varied seasonal conditions.		This community is associated with the coastal floodplains of NSW. It has a dense to sparse tree layer in which *Casuarina glauca* (swamp oak) is the dominant species northwards from Bermagui. Other trees including *Acmena smithii* (lilly pilly), *Glochidion* spp. (cheese trees) and *Melaleuca* spp. (paperbarks) may be present as subordinate species, and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude, and *Melaleuca ericifolia* is the only abundant tree in this community south of Bermagui.