Travers

bushfire & ecology

flora & fauna assessment

Lot 229 DP 847847
Kanangra Drive
Gwandalan

December 2013
(REF: A13096F)

Flora & Fauna Assessment

Lot 229 DP 847847
Kanangra Drive
Gwandalan

DECEMBER 2013

Report Authors: Michael Sheather-Reid *B. App. Sc.* – Senior Ecologist
Lindsay Holmes *B. Sc.* - Botanist
Corey Mead *B. App. Sc.* - Fauna Ecologist
Plans prepared: Peter Tolley, Trent Matheson
Checked by: John Travers *B. App. Sc. / Ass. Dip. / Grad. Dip.* Managing Director

Date: 23 December 2013
File: A13096F

Disclaimer:

This report has been prepared to provide advice to the client on matters pertaining to the particular and specific development proposal as advised by the client and / or their authorised representatives. This report can be used by the client only for its intended purpose and for that purpose only. Should any other use of the advice be made by any person including the client then this firm advises that the advice should not be relied upon. The report and its attachments should be read as a whole and no individual part of the report or its attachments should be interpreted without reference to the entire report.

The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

ABN 64 083 086 677
PO Box 7138
Kariong NSW 2250

38A The Avenue
Mt Penang Parklands
Central Coast Highway
Kariong NSW 2250

t: 02 4340 5331
e: info@traversecology.com.au
www.traversecology.com.au

Executive Summary

Travers bushfire & ecology has been engaged to undertake a flora and fauna assessment for a planning proposal to rezone the subject site which would allow for a future residential subdivision development within Lot 229 DP 847847 located on the corner of Kanangra Drive and Parraweena Road, Gwandalan.

Recorded threatened flora, fauna and endangered ecological communities (EECs)

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the *Environmental Planning and Assessment Act (EP&A Act)*, the *Threatened Species Conservation Act (TSC Act)*, the *Environment Protection and Biodiversity Conservation Act (EPBC Act)* and the *Fisheries Management Act (FM Act)*.

In respect of matters required to be considered under the *EP&A Act* and relating to the species / provisions of the *TSC Act*, no threatened fauna species, one (1) threatened flora species *Cryptostylis hunteriana*, and no EECs were recorded within the study area.

In respect of matters required to be considered under the *EPBC Act*, no threatened fauna species, no protected migratory bird species, one (1) threatened flora species *Cryptostylis hunteriana*, and no EECs listed under this Act were recorded within the study area.

Conservation significance

The ecological assessment has identified that:

- the southern portions and other cleared areas of the site to have low conservation significance,
- the central and northern portions have medium conservation significance due to the higher density of hollows within the existing vegetation and potential hollow dependent threatened species habitat. This classification is subject to the completion of a second fauna survey session for hollow dependent threatened species, and
- the western landscape buffer easement has higher conservation significance due to the observation of the *Cryptostylis hunteriana* and other *Cryptostylis* species.

Subject to a second summer target session for this species a further buffer may be required to provide for an orchid protection area.

Significance assessment conclusions

A preliminary assessment of significance of impact has been undertaken as in accordance with Section 5A of the *EPA Act* and matters of national environmental significance (NES) under the *EPBC Act*. These assessments determine if the proposed development of the site is not likely to have a significant effect on threatened species, populations and / or EECs.

In consideration of the above survey findings it is concluded that the proposed subdivision development of Lot 229 DP 847847 located on the corner of Kanangra Drive and Parraweena Road, Gwandalan is unlikely to result in a significant impact on any threatened species, populations or EECs or their habitats. This conclusion is subject to completion of trapping survey and assessment of impacts on Squirrel Glider. Despite the need for trapping

for the Squirrel Glider to determine site use, it is considered unlikely that the results of the survey will determine the site as being critical to this species given the extent of similar habitat in the immediate vicinity. An SIS should not be required for future proposed development on the lands.

The location of the one (1) *Cryptostylis hunteriana* is situated within a proposed landscape buffer easement. The vegetation where it occurs does not need to be removed for development, however surrounding areas may be managed as asset protection zones. Provided that that immediate surrounds of the orchid can be maintained as a small remnant of bushland, the proposal should not have a significant impact upon this species.

In respect of matters required to be considered under the *EPBC Act:*

- One (1) individual of *Cryptostylis hunteriana* was observed. No other threatened flora species were observed;
- No protected migratory fauna species listed under the *EPBC Act* were recorded within or in close proximity to the subject site;
- No endangered populations were recorded within the subject site; and
- No EECs were recorded within the subject site.

Consideration of these species within Section 4 and Appendix 3 of this report concluded that the proposed development was not considered to have a significant impact on matters of NES. As such a referral to SEWPAC should not be required.

In respect of matters relative to the *FM Act,* no suitable habitat for threatened aquatic species was observed within the subject site, and there are no matters requiring further consideration under this Act.

Recommendations and mitigation measures

The following additional target flora and fauna survey is recommended to be completed for exhibition of the planning proposal:

- A second session for *Cryptostylis hunteriana* during the summer flowering period of this species (mid-January to mid-February 2014); and
- A second survey session is completed for hollow dependent threatened species. This would include further nocturnal and diurnal survey sessions to repeat survey effort to date onsite. In particular based on the habitat present, and observation of sap feeding sites, target trapping survey for Squirrel Gliders is highly recommended including the inspection of hollows for recent use or nesting activity.

On the basis of the current ecological survey results the following mitigation measures are proposed:

- Protect the recorded *Cryptostylis hunteriana* within the easement for a landscape buffer and minimise vegetation removal in close proximity due to the presence of other orchid species recorded in its vicinity;
- Establish an orchid protection zone that protects the *Cryptostylis hunteriana* and other observed *Cryptostylis* species along the edge of Kanangra Drive;

- To minimise the removal of hollow bearing trees through the prioritised retention of good condition and high quality hollows;
- Inspect all suitable hollows for hollow dependent threatened species and retain high quality hollow bearing trees subject to tree condition; and
- Supervise the removal of any affected hollow bearing trees and relocate insitu fauna as appropriate into adjoining conservation areas.

To assist with prioritising the retention and removal of habitat trees for a future subdivision, *Travers bushfire & ecology* recommends that a tree condition assessment (SULE) is undertaken for all habitat trees. This will enable the retention of high quality habitat trees within the development area that are in good condition.

List of abbreviations

DCP	development control plan
DEC	NSW Department of Environment and Conservation (superseded by DECC from 4/07)
DECC	NSW Department of Environment and Climate Change (superseded by DECCW from 10/09)
DECCW	NSW Department of Environment, Climate Change and Water (superseded by OEH from 4/11)
EEC	endangered ecological community
EP&A Act	*Environmental Planning and Assessment Act* 1979
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESMP	ecological site management plan
FF	flora and fauna assessment
FM Act	*Fisheries Management Act 1994*
HTA	habitat tree assessment
LEP	local environment plan
LGA	local government area
NES	national environmental significance
NPWS	NSW National Parks and Wildlife Service
NSW DPI	NSW Department of Industry and Investment
OEH	Office of Environment and Heritage (Part of the NSW Department of Premier and Cabinet)
ROTAP	rare or threatened Australian plants
SEPP 44	*State Environmental Protection Policy No 44 – Koala Habitat Protection*
SEWPAC	Federal Department of Sustainability, Environment, Water, Population and Communities
SIS	species impact statement
SULE	safe useful life expectancy
TPO	tree preservation order
TPZ	tree preservation zone
TRRP	tree retention and removal plan
TSC Act	*Threatened Species Conservation Act 1995*
VMP	vegetation management plan

Table of Contents

Figures

Tables

Appendices

Introduction 1

Travers bushfire & ecology has been engaged to undertake a flora and fauna assessment to support a planning proposal to rezone the subject site to residential which would allow for a future residential subdivision development on the corner of Kanangra Drive and Parraweena Road, Gwandalan. It includes an assessment of the conservation significance of the habitats present and a preliminary 7 part test of significance.

The proposed rezoning is contained within Lot 229 DP 847847 which will hereafter be referred to as the 'subject site' (see Figure 2). The study area includes the entirety of Lot 229 DP 847847.

1.1 Aims of the assessment

The aims of the flora and fauna assessment are to:

- Carry out a botanical survey to describe the vegetation communities and their conditions;
- Carry out a fauna survey for the detection and assessment of fauna and their habitats;
- Complete target surveys for threatened species, populations and ecological communities;
- Identify the requirements for any further target threatened species surveys;
- Prepare a flora and fauna impact assessment in accordance with the requirements of the EPBC Act, the *TSC Act,* the *FM Act* and *Threatened species assessment guidelines, the assessment of significance* (DECC 2007); and
- Undertake a preliminary assessment of significance using the 7 part test of significance.

1.2 Statutory requirements

1.2.1 Threatened Species Conservation Act (TSC Act)

The specific requirements of the *TSC Act* must be addressed in the assessment of impacts on threatened flora and fauna, populations and ecological communities. The factors to be taken into account in deciding whether there is a significant effect are set out in Section 5A of the *EP&A Act* and are based on a 7 part test of significance. Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, a species impact statement (SIS) is required to be prepared.

1.2.2 Fisheries Management Act (FM Act)

The *FM Act* provides a list of threatened aquatic species that require consideration when addressing the potential impacts of a proposed development. Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, an SIS is required to be prepared.

1.2.3 Environment Protection and Biodiversity Conservation Act (EPBC Act)

The *EPBC Act* requires that Commonwealth approval be obtained for certain actions. It provides an assessment and approvals system for actions that have a significant impact on matters of national environmental significance (NES). These may include:

- World Heritage Properties and National Heritage Places
- Wetlands of International Importance protected by international treaty
- Nationally listed threatened species and ecological communities
- Nationally listed migratory species
- Commonwealth marine environment

Actions are projects, developments, undertakings, activities, and series of activities or alteration of any of these. An action that needs Commonwealth approval is known as a controlled action. A controlled action needs approval where the Commonwealth decides the action would have a significant effect on an NES matter.

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, then the matter needs to be referred to the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) for assessment. In the case where no listed federal species are located on site then no referral is required. The onus is on the proponent to make the application and not the Council to make any referral.

A threshold criterion applies to specific NES matters which may determine whether a referral is or is not required, such as for the *EPBC Act* listed ecological communities Cumberland Plain Woodland and Shale-Gravel transition Forest. Consultation with SEWPAC may be required to determine whether a referral is or is not required. If there is any doubt as to the significance of impact or whether a referral is required, a referral is generally recommended to provide a definite decision under the *EPBC Act* thereby removing any further obligations in the case of 'not controlled' actions.

A significant impact is regarded as being:

> *important, notable, or of consequence, having regard to its context or intensity and depends upon the sensitivity, value, and quality of the environment which is impacted and upon the duration, magnitude, and geographical extent of the impacts. A significant impact is likely when it is a real or not a remote chance or possibility.*
>
> *Source: EPBC Policy Statement*

Guidelines on the correct interpretation of the actions and assessment of significance are located on the department's web site http://www.environment.gov.au/epbc/publications.

1.3 Proposed rezoning

The proposal is to rezone the subject site to a residential zone which will allow future residential subdivision for residential lots, mostly between 580m^2 and 1,100m^2 in size. A single 4,500m^2 lot incorporating a landscape buffer has been provided as an easement.

1.4 Site description

Table 1.1 provides a summary of the planning, cadastral, topographical, and disturbance details of the subject site.

Table 1.1 – Site features

Location	Kanangra Drive, Gwandalan
Local government area	Wyong Shire Council
Grid reference	367675E 6331770N
Elevation	30m AMSL
Topography	Situated on a mostly flat landscape with a small slope on the north - western boundary.
Geology and soils	Munmorah conglomerate – conglomerate, pebbly sandstone, grey to green shale.
Catchment and drainage	Catchment - Lake Macquarie The subject site drains north west in to Bonny Boy Gully and then into Lake Macquarie. It can also drain straight into Lake Macquarie in heavy storm weather.
Vegetation	Where present, native vegetation has a woodland structure. Trees are around 13-20m tall in most areas where present and with a canopy coverage of 20-30% on average. Some areas contained little or no trees with a sparse mid-storey and grassy groundcover. The vegetation on the corner of Kanangra Drive and Parraweena Road has been planted on a road verge mound, evident by a line of trees and an unusual occurrence of *Casuarina glauca*.
Existing land use	Natural bushland with some internal foot / bicycle trails
Clearing	Parts of the study area have been previously cleared for indicated land uses.

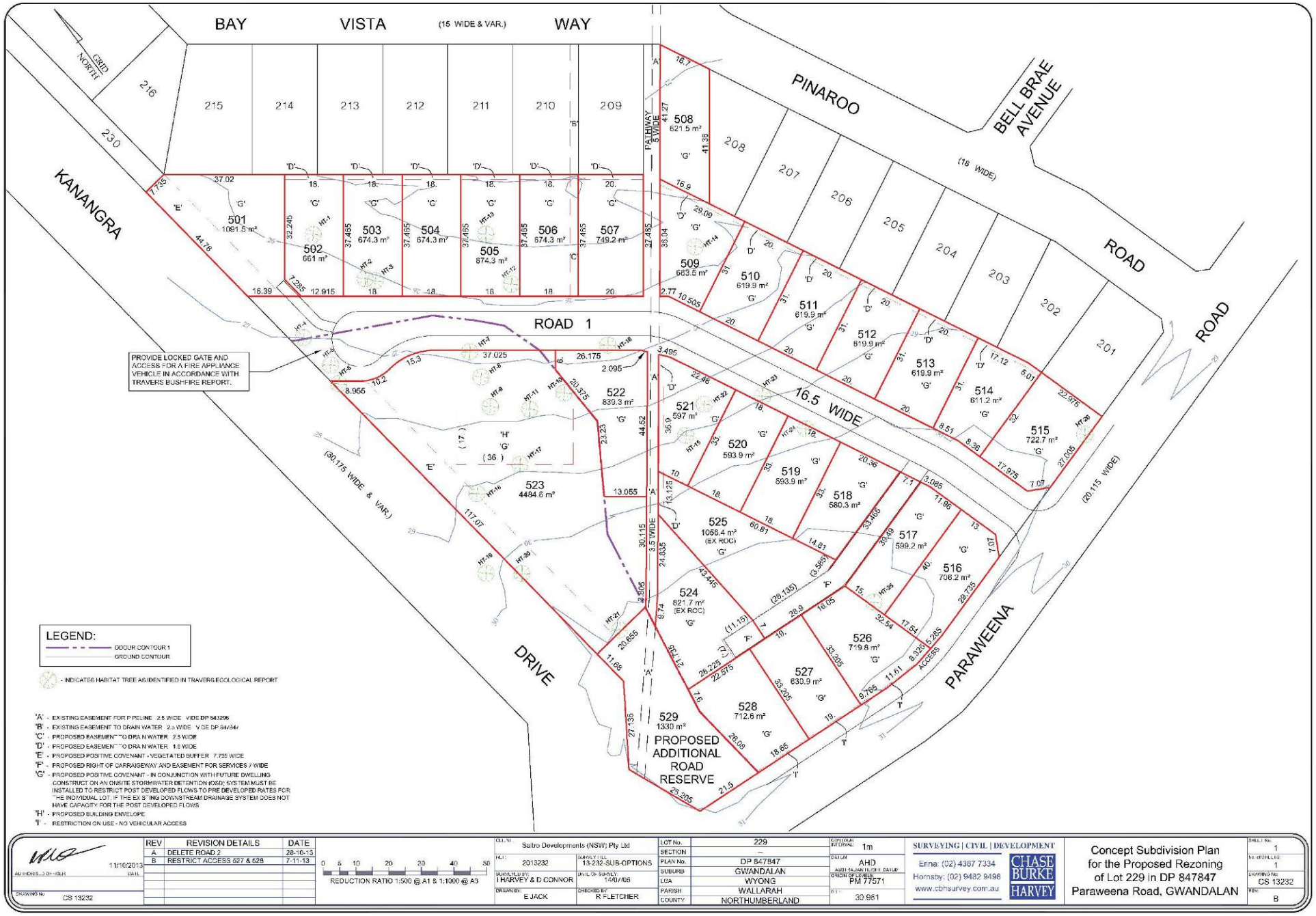

Figure 1 – Proposed subdivision (Source: *Chase Burke & Harvey* 2013)

Survey Methodology 2

2.1 Information collation, technical resources, desktop assessments, specialist identification and licences

A review of the relevant information pertinent to the subject site was undertaken.

Client documents reviewed include:

- Subdivision plan provided by *Optima Developments Pty Ltd*

Standard technical resources utilised:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities 2004* (working draft), Department of Environment and Conservation (DEC)
- Aerial photographs (*Google Earth Pro* / *Spatial Information Exchange*)
- Topographical maps (scale 1:25,000)
- *Threatened Species Conservation Act* (*TSC Act*)
- *Fisheries Management Act* (*FM Act*)
- *Environment Protection and Biodiversity Conservation Act* (*EPBC Act*)
- Rare or Threatened Australian Plants (ROTAP)
- LHCCREMS (2003) vegetation mapping
- Bell (2002 and 2008) The Natural Vegetation of the Wyong LGA
- Wyong Council Flora and Fauna Survey Guidelines (1999)
- Lake Macquarie Flora and Fauna Guidelines (2012).

Desktop assessment:

To determine the likely and actual occurrence of flora species, fauna species and plant communities on the subject site, desktop assessments were undertaken including:

- ***A literature review*** – A review of readily available literature for the area was undertaken to obtain reference material and background information for this survey.

- ***A data search*** – A search of the *Atlas of NSW Wildlife* (OEH 2013) was undertaken to identify records of threatened flora and fauna species located within a 10km radius of the site. Searches were also undertaken on the SEWPAC 'protected matters search tool' website to generate a report to help determine whether matters of national environmental significance or other matters protected by the *EPBC Act* are likely to occur in the area of interest. The search was broadened to a 10km radius in accordance with the *Atlas of NSW Wildlife* search. These two (2) searches combined, enabled the preparation of a list of threatened flora and fauna species that could potentially occur within the habitats found on the site (Tables A2.1, A2.2 and A2.3).

Accuracy of identification:

Specimens of plants not readily discernible in the field were collected for identification. Structural descriptions of the vegetation were made according to Specht *et al* (1995).

***Licences*:**

Individual staff members of *Travers bushfire & ecology* are licensed under Clause 20 of the *National Parks and Wildlife (Land Management) Regulation 1995* and Sections 120 & 131 of the *National Parks and Wildlife Act 1974* to conduct flora and fauna surveys within service and non service areas. NPWS Scientific Licence Numbers: SL100848.

Travers bushfire & ecology staff are licensed under an Animal Research Authority issued by the Department of Agriculture. This authority allows *Travers bushfire & ecology* staff to conduct various fauna surveys of native and introduced fauna for the purposes of environmental consulting throughout New South Wales.

2.2 Flora survey effort and methodology

A review of the *Atlas of NSW Wildlife* (OEH 2013) and *EPBC Act* coordinate search was undertaken prior to the botanical survey to identify threatened species previously recorded within 10km of the subject site and determine whether target searches were required.

On 17 October 2013, a random meander search was undertaken in accordance with Cropper (1993) to create a broad species list.

Four (4) 20x20m biometric style quadrats were undertaken within vegetated portions of the study area. Target searches for threatened species were also undertaken where applicable during the random meander and stratified surveys.

Target threatened orchid and cryptic flora survey was undertaken on 18 September 2008 with a flowering period of late winter and early spring. This included searches for *Genoplesium insignis, Caladenia tessellata, Tetratheca juncea, Tetratheca glandulosa* and the locally significant species *Caladenia catenata.* The site inspection was undertaken across the entire study area for a duration of approximately 4hrs.

A second targeted threatened species search was undertaken on 1 September 2013, then an orchid target search was conducted on 30 November 2013 for *Cryptostylis hunteriana* and the species *Tetratheca juncea.* One (1) single specimen of *Cryptostylis hunteriana* was observed at that time. A brief search of approximately 30-40min was conducted on 3 December 2013 to GPS the observed *Cryptostylis* specimens and to search for further *Cryptostylis* specimens within a 50m radius of the new recording.

Table 2.1 – Flora survey effort

Flora survey	Survey technique(s)	Dates
Vegetation communities	Survey of the boundaries of all communities by biometric field method (5 hours)	17/10/13
Stratified sampling	20x20m quadrats in all existing bushland areas	17/10/13
Target searches	Target searches in known habitats	18/09/08, 01/09/13, 17/10/13, 30/11/13, 3/12/13

2.3 Fauna survey effort and methodology

Site survey effort accounting for techniques deployed, duration, and weather conditions are outlined in Table 2.2 and are depicted on Figure 2.

Current standard fauna survey techniques employed by *Travers bushfire & ecology* in line with relevant survey guidelines as well as current survey knowledge are provided in Appendix 1. Fauna survey techniques that have been tailored to the site are provided in Section 2.6.

Table 2.2 – Fauna survey effort

Fauna group	Date	Weather conditions (refer note1)	Survey technique(s)	Survey effort / time (24hr)
Diurnal birds	19/9/13	0/8 cloud, mod NW wind, no rain, temp 22°C	Diurnal census points (x5) opportunistic	6hrs 30min 1145 - 1815
Nocturnal birds	19/9/13	0/8 cloud, light wind, no rain, 4/4 moon, temp 22-17°C	Spotlighting Call playback (Section 2.5 species)	1hr 25min 1820 - 1945 Commenced @ 1845
Arboreal mammals	19/9/13	0/8 cloud, light wind, no rain, 4/4 moon, temp 22-17°C	Spotlighting Call playback (Section 2.5 species)	1hr 25min 1820 - 1945 Commenced @ 1845
Terrestrial mammals	19/9/13	0/8 cloud, light wind, no rain, 4/4 moon, temp 22-17°C 0/8 cloud, mod NW wind, no rain, temp 22°C	Spotlighting Surveillance camera (x1)	1hr 25min 1820 - 1945 1hr 30min 1810 - 1940
Bats	19/9/13	0/8 cloud, light wind, no rain, 4/4 moon, temp 22-17°C	Spotlighting *Anabat* recorder - passive monitoring (x2) – total 2 hour 50mins recording time	1hr 25min 1820 - 1945 1hr 25min 1815 - 1940
Reptiles	19/9/13	0/8 cloud, mod NW wind, no rain, temp 22°C	Habitat search, opportunistic	6hrs 30min 1145 - 1815
Amphibians	19/9/13	0/8 cloud, light wind, no rain, 4/4 moon, temp 22-17°C	Spotlighting & call identification	1hr 25min 1820 - 1945
Note 1 - 0/8 refers to cloudless weather. 4/8 refers to half the sky containing cloud cover. 8/8 refers to full cloud cover				

2.5 Site specific survey techniques

Diurnal birds

Five (5) diurnal bird census points were undertaken within the subject site. A minimum of 30 minutes of survey was undertaken at each census point in an area radiating out to between 30-50m. Bird census points were selected to give an even spread and representation across the site (see Figure 2). Census points were also commenced in locations where bird activity was apparent, as often different small bird species are found foraging together. Opportunistic diurnal bird survey was conducted between census points and whilst undertaking other diurnal surveys.

Given the suitability of foraging habitat for Glossy Black-Cockatoo (*Calyptorhynchus lathami*), searches were undertaken below *Allocasuarina* trees for chewed cones indicating foraging use.

Nocturnal birds

Given the suitability of habitat present Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*) and Barking Owl (*Ninox connivens*) were targeted by call-playback techniques.

Habitat trees

Hollow bearing trees were identified and recorded within the subject site on a *Trimble* handheld GPS unit during surveys. All data such as hollow types, hollow size, tree species, diameter at breast height (DBH), canopy spread and overall height were collected and a metal tag with the tree number placed on the trunk for field relocation purposes. Other habitat features such as nests and significant sized mistletoe for foraging were also noted. Given the observed presence of glider chew markings on Red Bloodwood (*Corymbia gummifera*) trees, the locations of these were identified on GPS also.

A summary of hollow bearing tree results is provided in Table 4.4. Locations of hollow bearing trees and glider sap trees are shown on Figure 2.

2.6 Survey limitations

It is important to note that field survey data collected during the survey period is representative of species occurring within the subject site for that occasion. Due to effects of fire, breeding cycles, migratory patterns, camouflage, weather conditions, time of day, visibility, predatory and / or feeding patterns, increased species frequency or richness may be observed within the subject site outside the nominated survey period. Habitat assessments based on the identification of micro-habitat features for various species of interest, including regionally significant and threatened species, have been used to minimise the implications of this survey limitation.

Flora survey limitations

Whilst there are very limited records of *Cryptostylis hunteriana* within the Gwandalan and Summerland Point peninsula, it was initially thought the likelihood of their occurrence on site was low. Despite this, a single specimen was observed on December 1, 2013. The only likely limitation is that survey for *Cryptostylis hunteriana* has been limited to a single session during its flowering period.

Fauna survey limitations

No mammal trapping has been undertaken within the subject site. Given the suitability of habitat and glider chew markings on trees, trapping survey is warranted to determine presence or absence of Squirrel Glider (*Petaurus norfolcensis*). Other threatened species are expected to frequent the site seasonally, particularly given the high quality habitat present.

2.7 Compliance with Wyong shire Council (WSC) ecological survey guidelines

The following sections compare the survey undertaken onsite with the *Wyong Flora and Fauna Guidelines for Development* (WSC 1999). Please note that for a proposed rezoning study the ecological survey has been undertaken as a preliminary assessment of ecological constraints. Further survey is recommended based on the suitability of habitat present and the likelihood of recording threatened species within the site.

2.7.1 Flora survey compliance

Guideline	Comment
Flora survey – 1 to 10ha – 3 walking transects + plots	Compliant - 4 transects/plots undertaken, Biometric survey methodology
Minimum no. of plots is equivalent to 4% of the subject site	Compliant - 3 plots required for 3ha, 4 plots were undertaken
Acacia bynoeana – summer flowering period	Compliant - survey undertaken 1/12/13
Cryptostylis hunteriana – preferred survey in December and January	Compliant - survey undertaken 1/12/13, 3/12/13
Diuris praecox – July to early September	Compliant - survey undertaken 1/9/13
Tetratheca juncea – August to November in dry years and August to January in wet years. Repeat survey 2-3 times	Compliant - survey undertaken 18/09/08, 01/09/13, 17/10/13, 01/12/13, 3/12/13

Flora survey is compliant with the *Wyong Flora and Fauna Guidelines for Development* (WSC 1999).

2.7.2 Fauna survey compliance

Fauna group	Survey technique	Survey season	Survey effort per vegetation community	Comments
Birds				
Diurnal birds	Formal Census	Summer & winter	One point or plot census	Not compliant – survey conducted in spring, although multiple survey points conducted
Nocturnal birds	Formal Census	Summer & winter	One point census	Not compliant – survey conducted in spring, although multiple survey points conducted
Mammals				
Small terrestrial	Small mammal traps	All year	40 trap nights over 4 night	Not compliant – no trapping undertaken
Medium terrestrial	Cage B Elliot traps	All year	6 trap nights over 4 nights	Not compliant – no trapping undertaken

Large mammals	Opportunistic observations	All year	Walking transects	Compliant
Arboreal mammals	B Elliot traps	All year	Density of 6 traps per ha for 4 consecutive nights	Not compliant – no trapping undertaken
	Spotlighting	All year	1 person hour	Compliant – spotlighting undertaken for 1hr25m
Microchiropteran Bats	Harp traps	September – April	2 nights	Not compliant – no repeat survey
	Echolocation call	September – April	45 minute continuous recording or call activated at night	Compliant
Megachiropteran Bats	Spotlighting and listening	All year, when food is available	Refer to spotlighting for arboreal mammals	Compliant
Reptiles and amphibians				
Diurnal searches	Systematic searches	September – February	One person hour per 0.5ha on 3 days	Not compliant – no repeat survey
Nocturnal searches	Spotlight searches	September – February	One person hour in appropriate habitat on 3 nights	Not compliant – no repeat survey
Specific habitats	Diurnal and nocturnal searches	September – February	One person hour diurnal and one person hour nocturnal on 3 occasions	Not compliant – no repeat survey

The current survey effort onsite is not compliant with the *Wyong Flora and Fauna Guidelines for Development* (WSC 1999). Consequently, it is recommended that a second survey session is undertaken to achieve compliance.

2.8 Compliance with Lake Macquarie City Council (LMCC) survey guidelines

The following sections compare the survey undertaken onsite with the Lake Macquarie City Council *Flora and Fauna Survey Guidelines* - Version 4.2 December 2012. WSC advised *Travers bushfire & ecology* that they are intending to adopt the LMCC flora and fauna survey guidelines. Consequently, we have completed a comparison against the LMCC guidelines.

Note that for the purposes of this study the survey has been undertaken as a preliminary assessment of ecological constraints. Further survey is recommended based on the suitability of habitat present and the likelihood of recording threatened species within the site.

The following table identifies the typical presence absence survey guidelines for Lake Macquarie City Council (*Flora and Fauna Survey Guidelines* - Version 4.2 December 2012).

Area of Land (hectares)	Survey Type	Minimum Survey Effort
Cleared Site/Area	**Flora Survey**	A flora species inventory (list) of the site
Limited habitat present 50% native ground cover and less than 25% native canopy cover (or canopy trees >50 m apart, or >90% ground cover cleared)	Fauna Survey	Diurnal inspection for aquatic habitat (if present conduct amphibian survey and refer to Section 5 for aquatic surveys
	Diurnal bird + reptile search	No searches if totally cleared and no reptile habitat
	Mapping of all habitat trees	No survey if no habitat trees
	Anabat + stagwatch habitat trees	No stag watch survey if no habitat trees no anabat if no trees or native understorey and potential microbat roost sites (natural and man-made) are absent
Highly Disturbed Site/Area	**Flora Survey**	A flora species inventory for the site
Habitat present	Fauna Survey	2 nights spotlight search
	Pond or steam present	Specific searches for *Crinia tinnula* on 2 nights + 1 diurnal search Refer to Section 5 for aquatic surveys
	Reptile diurnal search	Site <5 ha – 1 morning >5 ha - minimum of 2 mornings
	Diurnal bird census	Site <5 ha – 1 morning >5 ha - minimum of 2 mornings
	Mapping of all habitat trees	Each habitat tree mapped with species, number and size of hollow recorded
	Anabat + stagwatch habitat trees	2 all-night recordings + 2 nights stagwatch - if very good bat roosts are present, it is recommended that detector time is doubled to 4 all-night recordings or 4 hrs of unattended detector on 2 separate evenings, including the first 2hrs after dusk and targeting potential roost sites
>50% Undisturbed (Remnant Vegetation and Habitat Present on site or in part of the site)		

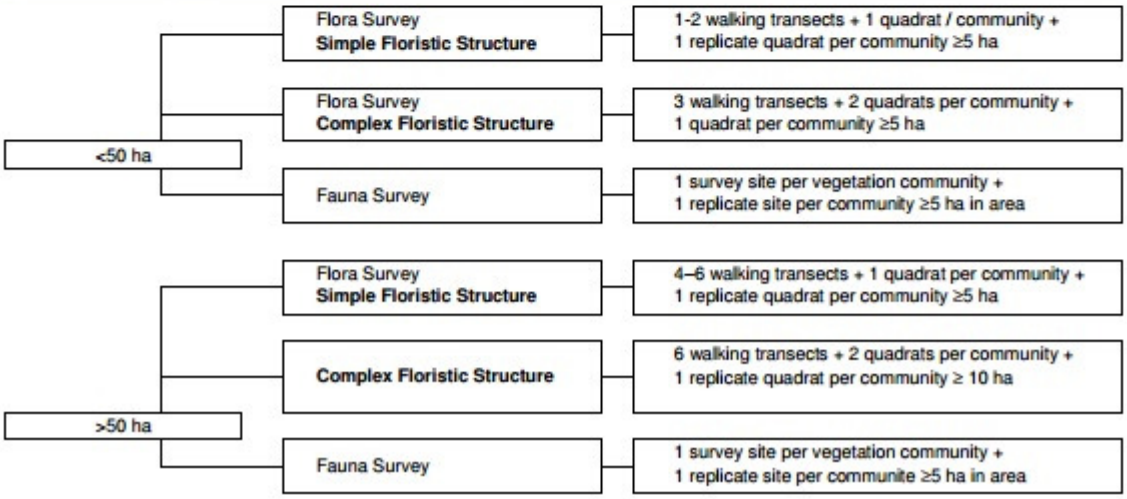

Figure 2 – Survey requirements in accordance with LMCC Survey Guidelines (2012)

2.8.1 Comparison against LMCC survey guidelines

(a) Floristic survey

Flora survey is compliant with Lake Macquarie City Council *Flora and Fauna Survey Guidelines* - Version 4.2 (December 2012). The study area is <50 ha and four (4) biometric quadrats were undertaken which includes a 20x20m plot and a 50m transect. Quadrats were not undertaken in cleared or planted areas due to the lack of any significant native vegetation.

Travers bushfire & ecology will undertake random meander searches for threatened species in cleared areas subject to the presence of any scattered native trees or remnant native groundcovers. Where cleared areas are bare, highly weed infested or dominated by exotic pasture species, survey is not likely to observe any threatened species. Further survey in cleared areas of the site is not warranted in this case.

(b) Fauna survey

Fauna group	Survey technique	Survey period (refer to species specific information for targeted surveys)	Minimum survey <100 h	Comment
Birds				
Diurnal birds	Formal census	Summer & winter 1 ha	Sample plot per site for 20 mins	Compliant - Five (5) diurnal bird census points were undertaken within the subject site. A minimum of 30 minutes of survey was undertaken at each census point in an area radiating out to between 30-50m.
Nocturnal birds	Quiet listening on a ridge near suitable habitat	Late February to mid August depending on species	Refer to Appendix 8.7	Not compliant - Survey undertaken in mid-September. The site is not considered to have any suitable Owl breeding habitat due to the absence of suitable hollows. No further survey is recommended
	Formal census (call playback)	Best undertaken outside breeding season (October to January depending on species) or if no response to two consecutive nights of quiet listening during breeding season.	One point census / km^2 repeated minimum of 3 visits on non-consecutive nights Note: Alternative methods to playback particularly during breeding season (refer Appendix 8.7 and 8.6)	Not compliant - One survey undertaken commencing at dusk. No repeat survey undertaken. Not considered necessary based on absence of breeding habitat. No further survey is recommended
	Pellet / roost / nest tree searches	Best in breeding season as pellets decompose	Searches of potential roost / nest trees.	Compliant - Habitat tree surveys undertaken with no suitable nesting / roosting hollows recorded. Pellet searches were undertaken opportunistically in the breeding season but not focusing on any potential breeding areas.
	Stagwatch potential roost / nest trees	Best undertaken in breeding season	Observing potential roost hollows for 30 mins - prior to sunset and 60 mins following sunset 3-4 nights and / or mornings, or more if owls are recorded in order to identify nest / roost sites	Compliant - No potential roost trees present

Fauna group	Survey technique	Survey period (refer to species specific information for targeted surveys)	Minimum survey <100 h	Comment
Mammals				
All Mammals (terrestrial, arboreal and aquatic)	Spotlighting Any time of year	Any time of year	2 x 30 min searches on 2 separate nights at walking rate of 1 km/hr per site	Not compliant - Spotlighting undertaken for 1h25m on 1 night
	Faecal pellet counts & predator scats	Any time of year	Opportunistic – during all site activities	Compliant - predator scats opportunistic searches were undertaken
	Stagwatch potential roost trees / foraging areas	Any time of year	Observing potential roost hollows / foraging areas for 30 mins - prior to sunset and 60 mins following sunset	Not compliant - Stag-watching of two quality and close hollow-bearing trees suitable for Squirrel Glider was undertaken but not documented. Stag-watching of all remaining hollows within the site suitable for any arboreal mammal has not been undertaken.
Arboreal mammals	B *Elliott* traps	Any time of year	Trapping grid of 1 ha sampling per vegetation type, with 10 traps opened for 3 consecutive nights - trapping grid sample each suitable vegetation community	Not compliant - No trapping undertaken.
	Stagwatching	Any time of year	Observing hollow for 30 mins prior to sunset until 60 mins after sunset for 3-4 nights and / or mornings	Not compliant – Stag watching of two quality and close hollow bearing trees suitable for Squirrel Glider was undertaken but not documented. Stag-watching of all remaining hollows within the site suitable for any arboreal mammal has not been undertaken.
	Koala quadrats (if potential habitat is present)	Any time of year	Follow relevant guidelines in Appendix 6 of the Port Stephens Comprehensive Koala Plan of Management 2001and Australian Koala Foundation (AKF) guidelines (refer to Appendix 8.7).	Not compliant - A Koala Habitat Assessment has been provided. The spot assessment technique (SAT) has however not been undertaken. SATs are a measure of Koala activity but are too labour intensive as a measure of presence absence in the first instance. Pellets were searched for opportunistically where any scratches consistent with Koala are found; however no scratches consistent with

Fauna group	Survey technique	Survey period (refer to species specific information for targeted surveys)	Minimum survey <100 h	Comment
				Koala were observed on any smooth-barked Scribbly Gums. Koalas are considered unlikely to occur within the site as part of core home ranges. No further survey is recommended
Microchiropteran bats	Harp traps	October – May	2 harp trap nights per site, over two consecutive nights; 4 harp trap nights over 2 consecutive nights in target *habitat (if high quality roosting habitat is present for a threatened species that is known to be captured by harp traps)*	Not compliant - No trapping undertaken
	Echolocation call	Anytime of year (in suitable conditions). October – May preferred as reduced activity in winter.	2 separate nights continuous recording from dusk per site (minimum 4 hrs); 4 separate nights continuous recording from dusk per site (minimum 4 hours) unattended detectors **or** 3 separate nights for 1-2 hrs after dusk if detectors are attended in target habitat *(if high quality roosting habitat is present for a threatened species that is known to be identified by echolocation call)*	Not compliant - *Anabat* recorder - passive monitoring (x2) – total 2 hour 50mins recording time over a single night. Undertaken mid-September
	Stag watching and diurnal roost search	October – May	Potential threatened species roost sites that may be	Not compliant - spotlighting undertaken in mid-September for 1hr25m

Fauna group	Survey technique	Survey period (refer to species specific information for targeted surveys)	Minimum survey <100 h	Comment
			impacted by proposal should be targeted and investigated – for stag watching, observe roost entrance from 30 min prior to sunset until 60 min after sunset – cameras may also be used for this purpose if they are able to be positioned in a suitable location	
Reptiles				
Diurnal searches	Habitat searches	September – April	1 ha search for 30 mins on 2 separate days, vegetation community or habitat type.	Compliant - approximately 6.5hrs opportunistic searches undertaken
Nocturnal searches	Spotlight searches	September – April	2 x 30 min searches on 2 separate nights at walking rate of 1 km/hr per site (may be done in conjunction with spotlighting for mammals)	Not compliant – searches undertaken with spotlighting on only 1 night. No threatened reptile species habitat. No further survey is recommended.
Specific habitats (targeted surveys)	Diurnal + nocturnal searches	September – April	1 ha diurnal search for 30 mins on 2 separate days + 30 min spotlight search on 2 nights	Compliant
Amphibians				
Nocturnal searches	Spotlight searches	September – March	2 x 30 mins on 2 separate nights per vegetation community where suitable habitat occurs (may be done in conjunction with spotlighting for other taxa if weather conditions suitable for both)	Not compliant – repeat survey required. One (1) search undertaken in mid-September for 1hr25m around dusk. No threatened frog species habitat. No further survey is recommended.

Fauna group	Survey technique	Survey period (refer to species specific information for targeted surveys)	Minimum survey <100 h	Comment
	Playback of recorded calls / call recording	September – March	Once on each of 2 separate nights (preferably within the first 2 hrs after dusk) per site, where suitable habitat is present.	Not compliant - repeat survey required. Playback undertaken in mid-September for 1hr25m around dusk. No threatened frog species habitat. No further survey is recommended.
	Specific habitat searches	September - March	2 hrs per 200m of water body edge	Compliant - No waterbodies present No further survey is recommended.
Diurnal searches	Opportunistic search	September - March	Opportunistic searches should take place if frogs are heard calling during the day, until identified	Compliant -Opportunistic searches undertaken No further survey is recommended.

The current survey effort onsite is not compliant with the Lake Macquarie City Council *Flora and Fauna Survey Guidelines* - Version 4.2 (December 2012). Consequently it is recommended that a second survey session is undertaken to achieve compliance.

(c) Compliance with specific flora and fauna groups

Guideline	Compliance
Squirrel glider - arboreal B *Elliott* traps 6-10 traps per ha/veg community for three consecutive nights. Surveyed outside winter and preferably August-September or February-March. If detected, or if records occur within vegetation continuous with the site, then surveys to address DECCs TS guideline to: Quantify quality and type of habitat i.e. vegetation type, habitat hollow density, den trees. Quantify the expected distribution of the local population. Quantify the impact of the development in relation to habitat loss and loss of connectivity.	Not compliant - trapping effort is required
Threatened arboreal owls - nocturnal surveys completed when calling between late February to mid May. If detected or if records occur within vegetation continuous with the site, then surveys to identify and map any potential roost or nest tree on or within 100 m of the site.	Not compliant - survey for threatened arboreal owls was undertaken in spring. All hollow-bearing trees were noted during surveys. No large hollows suitable for nesting or roosting by threatened large forest owls or Barking Owls were recorded present within the subject site.
Threatened arboreal and cave dwelling bats - inclusion of nocturnal surveys and identification of potential habitat. **Hollow dwelling -** greater broad nosed bat (*Scoteanax rueppellii*), Large-footed Myotis (*Myotis macropus*), East Coast Freetail Bat (*Mormopterus norfolkensis*); Yellow-bellied Sheath Tailed Bat (*Saccolaimus flaviventris),* Eastern Falsistrelle (*Falsistrellus tasmaniensis*). **Cave dwelling** – Large-footed Myotis (*myotis macropus*), Little	Compliant - *Anabat* detectors were utilised for bat surveys at two (2) locations within the study area. Habitat attributes identified. No cave habitat present.

Bent-wing (*Miniopterus australis*), Eastern Bent-wing (*Miniopterus schreibersii oceanensis*), Eastern falsistrelle (*Falsistrellus tasmaniensis*), Large-eared Pied Bat (*Chalinolobus dwyeri*); Eastern Cave Bat (*Vespadelus troughtoni*).	
***Tetratheca juncea* -** survey during peak flowering period from mid September to mid October. If detected, surveys to: Quantify extent of population and proportion impacted i.e. 75% should be retained in core with 20 m buffer. Thoroughly search within 500 m of the population to address stepping stone conservation. Identify whether the population is a large population or of conservation significance. Determine if the population sets viable seed.	Compliant - target searches for the species have been undertaken on the following dates: 18/09/08, 01/09/13, 17/10/13
Diuris praecox - survey when in flower from mid July through to beginning of September.	Compliant - considered having marginal habitat. Survey undertaken 01/09/13, 18/09/08
Rutidosis heterogama - survey when in flower from September to October (occurs in dry Sclerophyll forest)?	Compliant - Considered to have marginal habitat. Survey undertaken 18/09/08, 01/09/13, 17/10/13
Caladenia tessellata - survey from mid September and to mid October	Compliant - not considered to have suitable habitat
Microtis angusii - expected east side of lake known from Chain Valley Bay. Survey from late September to October.	Compliant - not considered to have suitable habitat
***Grevillea parviflora subsp. parviflora* -** survey from July to February.	Compliant - not considered to have suitable habitat

The current survey effort onsite is not compliant with the Lake Macquarie City Council *Flora and Fauna Survey Guidelines* - Version 4.2 (December 2012). Consequently it is recommended that a second survey session is undertaken to achieve compliance.

Survey Results 3

3.1 Flora results

3.1.1 Flora species

The plants observed within the vegetation communities of the subject site are listed in the Table 3.1 below.

Table 3.1 – Flora observations for the subject site

Family	Scientific name	Common name
Trees		
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak
Myrtaceae	*Angophora costata*	Smooth-barked Apple
Casuarinaceae	*Casuarina glauca*	Swamp Oak
Myrtaceae	*Corymbia gummifera*	Red Bloodwood
Myrtaceae	*Eucalyptus haemastoma*	Scribbly Gum
Santalaceae	*Exocarpos cupressiformis*	Native Cherry
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum
Shrubs		
Mimosaceae	*Acacia falcata*	Sickle Wattle
Mimosaceae	*Acacia longifolia* var. *longifolia*	Sydney Golden Wattle
Mimosaceae	*Acacia myrtifolia*	Red Stem Wattle
Mimosaceae	*Acacia suaveolens*	Sweet Scented Wattle
Mimosaceae	*Acacia ulicifolia*	Prickly Moses
Proteaceae	*Banksia oblongifolia*	-
Proteaceae	*Banksia spinulosa*	Hairpin Banksia
Fabaceae	*Bossiaea heterophylla*	Variable Bossiaea
Myrtaceae	*Callistemon rigidus*	Stiff Bottlebrush
Myrtaceae	*Callistemon linearis*	Narrow-leaved Bottlebrush
Asteraceae	*Chrysanthemoides monilifera* subsp. *monilifera**	Bitou Bush
Polygalaceae	*Comesperma ericinum*	Matchheads
Fabaceae	*Dillwynia retorta* var. *retorta*	Eggs and Bacon
Sapindaceae	*Dodonaea triquetra*	Hop Bush
Epacridaceae	*Epacris pulchella*	NSW Coral Heath
Fabaceae	*Gompholobium minus*	Dwarf Wedge-pea
Proteaceae	*Grevillea sericea*	Pink Spider Flower
Proteaceae	*Hakea dactyloides*	Broad-leaved Hakea
Proteaceae	*Hakea teretifolia*	Dagger Hakea
Proteaceae	*Isopogon anemonifolius*	Flat-leaved Drumsticks
Myrtaceae	*Kunzea ambigua*	Tick Bush
Proteaceae	*Lambertia formosa*	Mountain Devil
Verbenaceae	*Lantana camara**	Lantana
Myrtaceae	*Leptospermum trinervium*	Flaky-barked Tea-tree
Epacridaceae	*Leucopogon juniperinus*	Prickly Beard-heath
Myrtaceae	*Melaleuca thymifolia*	Thyme Honey Myrtle
Ericaceae	*Melichrus procumbens*	Jam Tarts

Table 3.1 – Flora observations for the subject site

Family	Scientific name	Common name
Fabaceae	*Mirbelia rubiifolia*	-
Rubiaceae	*Opercularia aspera*	Common Stinkweed
Asteraceae	*Osteospermum fruticosum**	Shrubby Daisy-bush
Proteaceae	*Persoonia lanceolata*	Lance-leaved Geebung
Proteaceae	*Persoonia levis*	Broad-leaved Geebung
Proteaceae	*Petrophile pulchella*	Conesticks
Rhamnaceae	*Pomaderris sp.*	-
Fabaceae	*Pultenaea daphnoides*	Large-leaf Bush Pea
Groundcovers		
Asteraceae	*Actinotus minor*	Lesser Flannel Flower
Poaceae	*Aira cupaniana**	Silvery Hairgrass
Poaceae	*Andropogon virginicus**	Whisky Grass
Poaceae	*Aristida vagans*	Three-awn Speargrass
Anthericaceae	*Arthropodium milleflorum*	Pale Vanilla Lily
Asparagaceae	*Asparagus aethiopicus**	Asparagus Fern
Poaceae	*Austrodanthonia sp.*	-
Poaceae	*Austrostipa pubescens*	Tall Speargrass
Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Poaceae	*Briza maxima**	Quaking Grass
Poaceae	*Briza minor**	Shivery Grass
Colchicaceae	*Burchardia umbellata*	Milkmaids
Orchidaceae	*Calochilus paludosus*	Red Beard Orchid
Gentianaceae	*Centaurium erythraea**	Pink Stars
Apiaceae	*Centella asiatica*	Indian Pennywort
Asteraceae	*Cirsium vulgare**	Spear Thistle
Asteraceae	*Conyza sumatrensis**	Fleabane
Asteraceae	*Coreopsis lanceolata**	-
Poaceae	*Cortaderia selloana**	Pampas Grass
Orchidaceae	*Cryptostylis subulata*	Large Tongue Orchid
Poaceae	*Cynodon dactylon*	Common Couch
Goodeniaceae	*Dampiera stricta*	Blue Dampiera
Phormiaceae	*Dianella caerulea* var. *caerulea*	Flax Lily
Poaceae	*Dichelachne micrantha*	Short-hair Plume Grass
Iridaceae	*Dietes grandiflora**	-
Iridaceae	*Dietes bicolor**	Spanish Iris
Orchidaceae	*Diurus alba*	-
Poaceae	*Echinopogon caespitosus* var. *caespitosus*	Tufted Hedgehog Grass
Poaceae	*Ehrharta erecta**	Panic Veldtgrass
Poaceae	*Entolasia marginata*	Bordered Panic
Poaceae	*Entolasia stricta*	Wiry Panic
Orchidaceae	*Epidendrum* sp.*	Crucifix Orchid
Poaceae	*Eragrostis brownii*	Brown's Lovegrass
Poaceae	*Eragrostis curvula**	African Lovegrass
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge
Haloragaceae	*Gonocarpus teucroides*	Raspwort
Goodeniaceae	*Goodenia hederacea* subsp. *hederacea*	Ivy-leaved Goodenia
Dilleniaceae	*Hibbertia obtusifolia*	-
Apiaceae	*Hydrocotyle bonariensis**	Kurnell Curse / Pennywort
Asteraceae	*Hypochaeris radicata**	Flatweed
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge
Restionaceae	*Leptocarpus tenax*	Slender Twine-rush
Lindsaeaceae	*Lindsaea linearis*	Screw Fern
Lomandraceae	*Lomandra glauca*	-

Table 3.1 – Flora observations for the subject site

Family	Scientific name	Common name
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Lomandraceae	*Lomandra obliqua*	Twisted Mat-rush
Orchidaceae	*Microtis unifolia*	Common Onion Orchid
Poaceae	*Panicum simile*	Two Colour Panic
Poaceae	*Paspalum dilatatum**	Paspalum
Iridaceae	*Patersonia sericea*	Wild Iris
Poaceae	*Pennisetum clandestinum**	Kikuyu
Thymelaeaceae	*Pimelea linifolia* subsp. *linifolia*	Slender Rice Flower
Plantaginaceae	*Plantago lanceolata**	Ribwort
Orchidaceae	*Prasophyllum elatum*	Tall Leek Orchid
Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Cyperaceae	*Ptilothrix deusta*	-
Cyperaceae	*Schoenus moorei*	-
Asteraceae	*Senecio madagascariensis**	Fireweed
Poaceae	*Setaria parviflora**	-
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle
Caryophyllaceae	*Stellaria media**	Common Chickweed
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass
Stylidiaceae	*Stylidium graminifolium*	Trigger Plant
Asteraceae	*Taraxacum officinale**	Dandelion
Orchidaceae	*Thelymitra ixioides*	Dotted Sun Orchid
Poaceae	*Themeda australis*	Kangaroo Grass
Verbenaceae	*Verbena bonariensis**	Purpletop
Iridaceae	*Watsonia meriana**	Wild Watsonia
Xanthorrhoaceae	*Xanthorrhoea latifolia* subsp. *latifolia*	-
Vines		
Pittosporaceae	*Billardiera scandens* var. *scandens*	Apple Dumplings
Lauraceae	*Cassytha pubescens*	Common Devil's Twine
Fabaceae	*Glycine clandestina*	Twining Glycine
Fabaceae	*Hardenbergia violacea*	False Sarsparilla
Apocynaceae	*Parsonsia straminea*	Common Silkpod
Passifloraceae	*Passiflora edulis**	Common Passionfruit
*** denotes non-native species**		

3.1.2 Vegetation communities

Three (3) vegetation communities were identified within the subject site.

- Vegetation Community 1 – Scribbly Gum / Bloodwood Woodland
- Vegetation Community 2 – Planted Vegetation
- Vegetation Community 3 – Cleared

Scribbly Gum / Bloodwood Woodland

This vegetation community most closely relates to Bell (2002) Map Unit 31 – Narrabeen Doyalson Coastal Woodland.

This vegetation community occupies approximately 2.55ha or 85% of the subject site. Whilst variable in canopy coverage, where trees are dominant, the canopy coverage is usually 20-30%. In some areas the Eucalypt, Angophora and Corymbia layer may be replaced by patches of Allocasuarinas and mid-storey heath species with a dense groundcover of grasses and cyperoids. *Eucalyptus haemastoma* and *Corymbia gummifera* dominate the canopy layer, 13-20m in height with less influence of *Angophora costata.*

The mid-storey is dominated by young or short Allocasuarina trees, *Banksia oblongifolia, Lambertia formosa, Leptospermum trinervium, Dodonaea triquetra* and *Persoonia levis* to 3m (up to 12m for *Allocasuarina littoralis*) and a projected foliage cover of 15-40%

The ground layer contains a dense cover of grasses, cyperoids, herbs and small shrubs under 1m in height. Common species include *Entolasia* spp., *Themeda australis, Xanthorrhoea latifolia* subsp. *latifolia, Patersonia sericea, Dianella caerulea, Lepidosperma laterale, Epacris pulchella* and *Mirbelia rubiifolia.*

Weed invasion of the community is low and native species richness was considered moderate. Weed invasion of remnant vegetation was highest in the eastern portion of the subject site within 15m of the boundary between the remnant community and the cleared area adjoining existing residences.

This vegetation type is relatively common in upper Wyong and lower Lake Macquarie LGAs and does not form any current EEC.

Photo 1 – Woodland vegetation looking west from Quadrat 1

Photo 2 – *Allocasuarina* dominated woodland near Quadrat 3

Planted vegetation

This vegetation community occurs near the corner of Kanangra Drive and Parraweena Drive, occupying approximately 0.05ha, or less than 2% of the subject site. Planted vegetation occurs largely just outside of the south eastern boundary of the subject site on mounded dirt. Planted vegetation consists of largely native trees including *Eucalyptus haemastoma* and *Casuarina glauca,* although in this location away from moist soils, *Casuarina glauca* is outside of its natural habitat. A few specimens were also noted within the remnant vegetation.

Planted vegetation has limited habitat attributes as there are no tree hollows and limited, if any, ground refugia.

Photo 3 – *Casuarina glauca* trees on mound, part of the planted vegetation near the corner of Kanangra Drive and Parraweena Road

Cleared

This description includes land which has been cleared and largely contains exotic grasses with occasional regrowth shrubs or trees. It is limited to the northern and eastern boundaries of the site where clearing has been previously undertaken for 5-10m behind existing residential properties. There has also been a clearing of land in the south western corner of the subject site, which contains limited regrowth. There are tracks throughout the site also but given that they are usually less than 3m in width, they have been incorporated into the woodland vegetation community. Cleared lands comprise approximately 0.4ha of the subject site (13%).

Photo 4 – Cleared vegetation dominated by exotic grasses along the north eastern site boundary

3.2 Fauna results

Fauna species observed throughout the duration of fauna surveys are listed in Table 3.2.

Table 3.2 – Fauna observations for the study area

Common name	Scientific name	Method observed
Birds		**Sept 2013**
Australian Magpie	*Gymnorhina tibicen*	O
Australian Raven	*Corvus coronoides*	W
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	O W
Brown Thornbill	*Acanthiza pulsilla*	O W
Eastern Spinebill	*Acanthorhynchus tenuirostris*	O W
Galah	*Cacatua roseicapilla*	W
Grey Butcherbird	*Cracticus torquatus*	W
Grey Fantail	*Rhipidura fuliginosa*	O W
Grey Shrike-thrush	*Colluricincla harmonica*	W
Laughing Kookaburra	*Dacelo novaeguineae*	O W
Leaden Flycatcher	*Myiagra rubecula*	O W
Little Wattlebird	*Anthochaera chrysoptera*	O W
Magpie-lark	*Grallina cyanoleuca*	W
Masked Lapwing	*Vanellus miles*	W
Noisy Miner	*Manorina melanocephala*	O W

Common name	Scientific name	Method observed
Pied Currawong	*Strepera graculina*	W
Rainbow Lorikeet	*Trichoglossus haematodus*	O W
Red-browed Finch	*Neochmia temporalis*	W
Spotted Pardalote	*Pardalotus punctatus*	O W
Spotted Turtle-Dove *	*Streptopelia chinensis*	W
Striated Thornbill	*Acanthiza lineata*	O W
Striated Pardalote	*Pardalotus striatus*	W
Sulphur Crested Cockatoo	*Cacatua galerita*	W
Variegated Fairy-wren	*Malurus lamberti*	O
Welcome Swallow	*Hirundo neoxena*	O
White-browed Scrubwren	*Sericornis frontalis*	W
Willie Wagtail	*Rhipidura leucophrys*	W
Yellow-faced Honeyeater	*Lichenostomus chrysops*	O W
Mammals		
Common Ringtail Possum	*Pseudocheirus peregrinus*	O
Gould's Wattled Bat	*Chalinolobus gouldii*	U
Glider	*Petaurus sp.*	F
Little Forest Bat	*Vespadelus vulturnus*	U
Reptiles		
Delicate Skink	*Lampropholis delicata*	O
Jacky Lizard	*Amphibolurus muricatus*	O

Note: * indicates introduced species
TS indicates threatened species

All species listed are identified to a high level of certainty unless otherwise noted as:

PR indicates species identified to a 'probable' level of certainty – more likely than not
PO indicates species identified to a 'possible' level of certainty – recorded to a moderate to high level of uncertainty usually applied to a threatened species of note.

E - Nest/roost	H - Hair/feathers/skin	P - Scat	W - Heard call
F - Tracks/scratchings	K - Dead	Q - Camera	X - In scat
FB - Burrow	O - Observed	T - Trapped/netted	Y - Bone/teeth/shell
G - Crushed cones	OW - Obs & heard call	U - Anabat/ultrasound	Z - In raptor/owl pellet

Figure 2 – Flora and fauna survey effort and results

Ecological Assessment 4

4.1 Previous surveys reviewed

The following regional vegetation mapping was examined to identify the potential vegetation community's onsite.

*Lower Hunter and Central Coast Regional Environment Management Strategy Vegetation Survey, Classification and Mapping; Lower Hunter and Central Coast Region (LHCCREMS) (*NPWS 2003*)*

The Lower Hunter and Central Coast vegetation mapping (LHCCREMS) identified the vegetation as a combination of Map Unit 30 – Coastal Plains Smooth-barked Apple Woodland and Map Unit 31 – Coastal Plains Scribbly Gum Woodland.

A comparison of the positive and uninformative species lists for both map units would suggest that Coastal Plains Scribbly Gum Woodland is more accurate.

The *Natural Vegetation of the Wyong LGA (Bell 2002* and *2008)*

This mapping identifies vegetation within the site as Map Unit 31 – Narrabeen Doyalson Coastal Woodland. This map unit is widespread over Doyalson and Gorokan Soil Landscapes in the northern part of the shire.

A high number of positive and uninformative species from this map unit was observed during the botanical survey.

4.2 Flora

One hundred and twenty (120) species were observed during the botanical survey.

One (1) specimen of *Cryptostylis hunteriana* was observed just within the western boundary of the site approximately 10m from the edge of bitumen road of Kanangra Drive. No other threatened flora species were observed.

All species are listed in Table 3.1 of section 3 of the report.

4.2.1 Local / regional flora matters

The following species, listed as Keystone Species in Development Control Plan (DCP) 14 Tree Management, were observed within the study area:

Botanical name	Potential schedule 1 or 2 fauna
Acacia longifolia	Squirrel Glider
Angophora costata	Squirrel Glider
Banksia oblongifolia	Squirrel Glider
Banksia spinulosa	Squirrel Glider
Eucalyptus haemastoma	Masked Owl / Squirrel Glider
Melaleuca biconvexa and other local Melaleuca species	Ringtail Possum
Xanthorrhoea species	Squirrel Glider

4.2.2 State legislative flora matters

(a) Threatened flora species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH 2013) indicated a list of species that have been recorded within a 10 km radius of the study area. Those species are considered for suitable habitat and potential to occur in Table A2.1 (Appendix 2).

Based on the habitat assessment within Appendix 2, it is considered that the subject site provides varying levels of potential habitat for the following state listed threatened flora species:

Table 4.1 – State listed threatened flora species with suitable habitat present

Scientific name DATABASE SOURCE	Suitable habitat present (✓)	Potential to occur	CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
Acacia bynoeana	✓	✓	✓
Angophora inopina	✓	✓	✓
Corunastylis sp. Charmhaven	marginal	low	✓
Cryptostylis hunteriana	✓	low	✓
Diuris praecox	marginal	low	✓
Rutidosis heterogama	marginal	low	✓
Tetratheca juncea	poor	low	✓

Note: Full habitat descriptions for these species are provided in Appendix 2

No state listed threatened flora species were observed during survey(s) undertaken.

(b) Endangered flora populations (NSW)

There are two (2) known endangered populations within Wyong Shire, *Eucalyptus parramattensis* subsp. *parramattensis* in the Wyong and Lake Macquarie LGAs and *Eucalyptus oblonga* at Bateau Bay.

Eucalyptus oblonga at Bateau Bay is well away from the subject site and not represented within the study area. *Eucalyptus parramattensis* subsp. *parramattensis* in the Wyong and Lake Macquarie LGAs may have potential habitat in the local area, it was not observed during the botanical surveys.

(c) Endangered ecological communities (NSW)

Vegetation associated with LHCCREMS (2003) Map Unit 30 and 31, and with Bell's (2004) Map Unit 31 are not representative of EEC vegetation.

4.2.3 SEPP 14 / 26 / 71

SEPP 14 – Wetlands

A SEPP 14 Coastal Wetland is a wetland that is included on a map contained in State Environmental Planning Policy – Coastal Wetlands. These mapped wetlands can include the following vegetation types;

- mangroves
- sedgelands
- saltmarsh
- melaleuca forests
- casuarina forests
- brackish and freshwater swamps
- wet meadows

The aforementioned vegetation types are not present within the study area and as such, the rezoning of the study area has no implications upon SEPP 14. The nearest SEPP 14 area is located approximately 2.25km to the south east in Crangan Bay.

SEPP 26 – Littoral Rainforest

There are no rainforest elements present within the study area. Littoral rainforest is typically found in close proximity to sand dunes or within 2km of the coastline. The nearest remnant mapped by Wyong Council is approximately 8km to the south at Magenta in Wyrrabalong National Park.

SEPP 44 – Koala Habitat Protection

This policy is addressed in the fauna assessment within Section 4.3.4(c).

SEPP 71 – Coastal Protection

This Policy aims:

(a) to protect and manage the natural, cultural, recreational and economic attributes of the New South Wales coast, and
(b) to protect and improve existing public access to and along coastal foreshores to the extent that this is compatible with the natural attributes of the coastal foreshore, and
(c) to ensure that new opportunities for public access to and along coastal foreshores are identified and realised to the extent that this is compatible with the natural attributes of the coastal foreshore, and
(d) to protect and preserve Aboriginal cultural heritage, and Aboriginal places, values, customs, beliefs and traditional knowledge, and

(e) to ensure that the visual amenity of the coast is protected, and
(f) to protect and preserve beach environments and beach amenity, and
(g) to protect and preserve native coastal vegetation, and
(h) to protect and preserve the marine environment of New South Wales, and
(i) to protect and preserve rock platforms, and
(j) to manage the coastal zone in accordance with the principles of ecologically sustainable development (within the meaning of section 6 (2) of the *Protection of the Environment Administration Act (PEO Act)*), and
(k) to ensure that the type, bulk, scale and size of development is appropriate for the location and protects and improves the natural scenic quality of the surrounding area, and
(l) to encourage a strategic approach to coastal management.

Very few of the above items are relevant to this study area but the aims still need consideration in local area planning on the coast.

The subject site does not fall within a sensitive coastal location as defined under SEPP 71. These areas are typically refined to a buffer area of the coast line or around floodplain areas.

4.2.4 Matters of national environmental significance (NES) - flora

(a) Threatened flora species (national)

A review of the schedules of the *EPBC Act* indicated the potential for a list of threatened flora species to occur within a 10km radius of the site. These species have been considered for habitat presence and potential to occur within Appendix 2.1.

Based on the habitat assessment within Appendix 2.1, it is considered that the subject site provides varying levels of potential habitat for the following nationally listed threatened flora species:

Table 4.2 – Nationally listed threatened flora species with suitable habitat present

Scientific name DATABASE SOURCE	**Suitable habitat present (✓)**	**Potential to occur**	**CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)**
Acacia bynoeana	✓	✓	✓
Angophora inopina	✓	✓	✓
Cryptostylis hunteriana	✓	observed	✓
Diuris praecox	marginal	low	✓
Rutidosis heterogama	marginal	low	✓
Tetratheca juncea	poor	low	✓

Cryptostylis hunteriana was observed within the study area as explained above. The likelihood of retention is high as the proposal does not require the removal of habitat in its location, although APZs may be necessary. In that instance, it is proposed that an orchid protection zone be administered within the landscape buffer easement within a selected

location where APZ management can be omitted for the conservation of the specimen, along with other noted *Cryptostylis* species within its vicinity.

(b) Endangered ecological communities (national)

Vegetation within the subject site does not form part of any nationally listed EEC.

4.2.5 Flora and EEC assessment conclusions

In accordance with Section 5A of the *EP&A Act*, the 7 part test of significance (Appendix 3) concluded that the proposed development will not have a significant impact on any state listed threatened species, populations or EECs. No threatened flora, EECs or endangered populations occur within the subject site. Impacts of the proposal relate to the cumulative loss of potential habitat only.

One (1) individual *Cryptostylis hunteriana* has been recorded, however, many other *Cryptostylis subulata* and *Cryptostylis erecta* specimens were observed within the general vicinity along the fringe of the bushland abutting Kanangra Drive. There is opportunity to afford protection to some of the local population of *Cryptostylis* within the dedicated landscape buffer easement as an orchid protection area. The proposed development will not require the direct removal of vegetation within the area where the *Cryptostylis hunteriana* has been recorded.

The proposed development was not considered to have a significant impact on matters of NES listed under the *EPBC Act*. As such, a referral to SEWPAC should not be required in respect to flora.

4.3 Fauna

All fauna species recorded during survey are listed in Table 3.2.

4.3.1 Fauna habitat

The fauna habitats present within the site are identified within Table 4.3. This table is used by the fauna ecologist to provide a summary of key habitat features that may be cross referenced at any time in considering habitat suitability for select threatened fauna species. The presence (or absence) of these features may also determine the degree of suitability having direct relevance to the selection of threatened species to be assessed within the 7 part test of significance.

Table 4.3 – Observed fauna habitat

Topography				
Flat ✓	Gentle ✓	Moderate	Steep	Drop-offs
Vegetation structure				
Closed Forest	Open Forest ✓	Woodland ✓	Heath	Grassland ✓
Disturbance history				
Fire	Under-scrubbing	Cut and fill works		
Tree clearing ✓sml	Grazing			
Soil landscape				
DEPTH:	Deep ✓	Moderate ✓	Shallow	Skeletal
TYPE:	Clay	Loam ✓	Sand ✓	Organic
VALUE:	Surface foraging ✓	Sub-surface foraging ✓	Denning/burrowing ✓	
WATER RETENTION:	Well Drained ✓	Damp / Moist	Water logged	Swamp / Soak
Rock habitat				
None				
Feed resources				
FLOWERING TREES:	Eucalypts ✓	Corymbias ✓	Melaleucas ✓	
	Banksias ✓	Acacias ✓		
SEEDING TREES:	Allocasuarinas ✓	Conifers		
WINTER FLOWERING EUCALYPTS:	C. maculata	E. crebra	E. globoidea	E. sideroxylon
	E. squamosa	E. grandis	E. multicaulis	E. scias
	E. robusta	E. tereticornis	E. agglomerata	E. siderophloia
FLOWERING PERIODS:	Autumn ✓	Winter	Spring ✓	Summer ✓
OTHER:	Mistletoe ✓	Figs / Fruit	Sap / Manna ✓	Termites ✓
Foliage protection				
UPPER STRATA:	Dense	Moderate ✓	Sparse ✓	
MID STRATA:	Dense	Moderate ✓	Sparse ✓	
PLANT / SHRUB LAYER:	Dense ✓	Moderate ✓	Sparse	
GROUNDCOVERS:	Dense	Moderate ✓	Sparse	
Hollows / logs				
TREE HOLLOWS:	Large	Medium ✓	Small ✓	
TEE HOLLOW TYPES	Spouts / branch ✓	Trunk ✓	Broken Trunk ✓	Basal Cavities ✓	Stags ✓
GROUND HOLLOWS:	Large	Medium ✓	Small ✓	
Vegetation debris				
FALLEN TREES:	Large ✓	Medium ✓	Small ✓	
FALLEN BRANCHES:	Large ✓	Medium ✓	Small ✓	
LITTER:	Deep ✓	Moderate ✓	Shallow ✓	
HUMUS:	Deep	Moderate ✓	Shallow ✓	
Drainage catchment				
WATER BODIES	Wetland(s)	Soak(s)	Dam(s)	Drainage line(s)	Creek(s)	River(s)
RATE OF FLOW:	Still	Slow	Rapid	
CONSISTENCY:	Permanent	Perennial	Ephemeral	
RUNOFF SOURCE:	Urban / Industrial	Parkland	Grazing	Natural
RIPARIAN HABITAT:	High quality	Moderate quality	Low quality	Poor quality
Artificial habitat				
STRUCTURES:	Sheds	Infrastructure	Equipment	
SUB-SURFACE	Pipe / culvert(s)	Tunnel(s)	Shaft(s)	
FOREIGN MATERIALS:	Sheet ✓	Pile / refuse		

4.3.2 Habitat trees

A comprehensive survey of the location of habitat trees and the size of hollows within was undertaken. Table 4.4 below provides hollow bearing tree data. Given the observed presence of glider chew markings for sap on Red Bloodwood trees, these trees were located by GPS. Figure 2 provides locations of habitat trees overlayed with the tree survey plan.

No large hollows suitable for nesting or roosting by threatened large forest owls or Barking Owls were recorded present within the subject site. No hollow dependent threatened fauna species were recorded present during survey. Hollow dependent threatened fauna species with most potential to occur based on habitat suitability and local records include the Squirrel Glider, Little Lorikeet and East-coast Freetail Bat.

Trees considered likely to be suitable for Squirrel Glider have been indicated with a "*" in Table 4.4 and total seventeen (17) trees. However, the use of any trees by threatened species is subject to identifying any recent use of the hollows by visual inspection and survey.

Table 4.4 – Habitat tree data

Survey tag No. (note1)	Habitat tree No.	Common name	Scientific name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows recorded	Habitat tree significance (subject to inspection and trapping survey)
61	HT1	Scribbly Gum	*Eucalyptus haemastoma*	50/50	4	10	60	3x 5-10cm trunk (good quality)*, 1x 10-15cm trunk	High
58	HT2	Scribbly Gum	*Eucalyptus haemastoma*	45	2	7	15	1x 5-10cm trunk	Low
59	HT3	Red Bloodwood	*Corymbia gummifera*	55/45	5	11	70	1x 5-10cm trunk (good quality)*	Medium
-	HT4	Scribbly Gum	*Eucalyptus haemastoma*	70	5	11	75	2x 0-5cm branch	Low
-	HT5	Red Bloodwood	*Corymbia gummifera*	55	5	12	15	1x 10-15cm arboreal termite nest	Low
54	HT6	dead	stag	50	1	6	0	1x 5-10cm low trunk	Low
74	HT7	Scribbly Gum	*Eucalyptus haemastoma*	40	2	7	20	1x 0-5cm trunk	Low
73	HT8	Scribbly Gum	*Eucalyptus haemastoma*	40	2	6	20	2x 10-15cm trunk (good quality)*	High
44	HT9	Scribbly Gum	*Eucalyptus haemastoma*	45	3	9	70	1x 5-10cm low trunk (good quality)*, 2x 10-15cm trunk (good quality)*	High
69	HT10	Scribbly Gum	*Eucalyptus haemastoma*	25	2	9	60	1x 5-10cm low trunk (good quality)*	Medium
67	HT11	Scribbly Gum	*Eucalyptus haemastoma*	45	5	13	80	1x 5-10cm low trunk (good quality)*	Medium
-	HT12	Scribbly Gum	*Eucalyptus haemastoma*	55	4	16	50	1x 5-10cm trunk, 3x 10-15cm trunk (good quality)*	High
85	HT13	Scribbly Gum	*Eucalyptus haemastoma*	20/60	5	13	75	2x 5-10cm branch (good quality), 1x 5-10cm trunk (good quality)*, 3x 10-15cm trunk (good quality)*	High
103	HT14	Scribbly Gum	*Eucalyptus haemastoma*	70	4	13	60	1x 5-10cm branch 3x 15-20cm branch	Medium
30	HT15	Scribbly Gum	*Eucalyptus haemastoma*	75	6	14	75	2x 0-5cm branch	Medium
80	HT16	Scribbly Gum	*Eucalyptus haemastoma*	45	4	11	70	1x 5-10cm trunk (good quality)*	Medium
40	HT17	Scribbly Gum	*Eucalyptus haemastoma*	35	2	10	70	1x 5-10cm trunk (good quality)*	Medium
36	HT18	Scribbly Gum	*Eucalyptus haemastoma*	80	5	14	60	2x 15-20cm trunk (good quality)*, 1x 20-30cm trunk	High
-	HT19	Red Bloodwood	*Corymbia gummifera*	65/30	6	16	70	1x 5-10cm branch (good quality)*, 1x 10-15cm trunk	High
6	HT20	Scribbly Gum	*Eucalyptus haemastoma*	55	5	14	75	1x 5-10cm trunk (good quality)*	Medium
22	HT21	Scribbly Gum	*Eucalyptus haemastoma*	30	2	6	5	1x 5-10cm low trunk*	Low
101	HT22	Scribbly Gum	*Eucalyptus haemastoma*	40/60/	6	11	80	1x 5-10cm branch	Low

Survey tag No. (note1)	Habitat tree No.	Common name	Scientific name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows recorded	Habitat tree significance (subject to inspection and trapping survey)
				25					
115	HT23	Scribbly Gum	*Eucalyptus haemastoma*	20/35	5	9	65	1x 5-10cm trunk (good quality)*	Medium
-	HT24	Red Bloodwood	*Corymbia gummifera*	65	5	10	40	2x 0-5cm branch, 1x 5-10cm branch, 1x 10-15cm branch*	Medium
155	HT25	Scribbly Gum	*Eucalyptus haemastoma*	60	5	12	40	1x 0-5cm branch	Low
141	HT26	Scribbly Gum	*Eucalyptus haemastoma*	70/60	5	13	70	1x 15-20cm trunk (good quality)*, 1x 15-20cm branch	Medium

Note 1

***** indicates trees considered likely suitable for Squirrel Glider

? indicates that the tree survey plan did not locate the tree or no tag number was recorded

4.3.3 Local fauna matters

4.3.3.1 Squirrel Glider habitat assessment

Squirrel Glider habitat on the subject site is assessed according to the *Interim Ecological Assessment Information Required to Assess Clearing Impacts within Squirrel Glider Habitat in Wyong Shire* (Wyong Shire Council, August 2000). A standardised field proforma providing consideration to this document is filled out during field surveys undertaken within the Wong LGA (see Appendix 5).

The assessment of Squirrel Glider habitat considers the following:

(a) Habitat quality (vegetation type)
(b) Remnant patch size
(c) Density of habitat trees
(d) Abundance of food plants
(e) Habitat vulnerability
(f) Disturbance factors

The available habitat for Squirrel Gliders occupies approximately 95% of the subject site.

(a) Habitat quality

Based on *Travers bushfire & ecology* previous experience with Squirrel Gliders, the available habitat within the subject site and adjacent similar areas is considered to be highly suitable. This is considered based particularly on recordings from similar type of habitat. Such habitat provides the presence of spring, summer and autumn nectar foraging resources, sap resources, the availability and high density of medium hollows and the connective woodland structure for gliding.

Red Bloodwood trees also contribute to foraging resources by providing sap flows for gliders, with chew markings from either Squirrel Glider or Sugar Glider observed on several trees during survey (see Figure 2 for locations).

Prominent trees occurring within the site include Scribbly Gum (*Eucalyptus haemastoma*), Red Bloodwood (*Corymbia gummifera*) and Smooth-barked Apple (*Angophora costata*) Native shrubs that may contribute to available foraging resources include *Acacia longifolia*, *Banksia oblongifolia, Banksia spinulosa, Melaleuca thymifolia* and *Xanthorrhoea latifolia* subsp. *latifolia*.

(b) Remnant patch size

The remnant patch size of usable habitat for the Squirrel Glider within the subject site area is approximately 2.55ha.

(c) Density of habitat trees

The density of habitat trees within the Woodland remnant is approximately 10 per ha.

(d) Abundance of food plants of Squirrel Glider

The abundance of Squirrel Glider food resources within the subject site is provided in Table 4.5 for the woodland vegetation community.

Table 4.5 – Squirrel Glider food resource abundance

Food plants	Food item	Estimated average no. of plants / hectare		
		Scribbly Gum / Bloodwood Woodland	Planted vegetation	Cleared
Angophora costata	Sap, nectar & pollen	25	5	1
Eucalyptus haemastoma	Sap, nectar & pollen	75	10	1
Corymbia gummifera	Sap, nectar & pollen	50	0	1
Acacia spp.	Seeds & gum	25	5	1
Banksia oblongifolia	Nectar & pollen	100	0	1
Banksia spinulosa	Nectar & pollen	2	0	0
Xanthorrhoea spp.	Nectar & gum	200	0	1

(e) Edge to width ratio

The subject site is a rectangle shape with the northern boundary on a strong angle. The total length is about twice the average width, however, given that the width is generally greater than 120m it may be concluded that the site has a low edge to width ratio.

(f) Habitat disturbance

Only small areas of the subject site have been previously subject to clearance including the internal walking / bicycle trails. The perimeter is subject to edge effects and disturbance by weed species including exotic grasses, annuals and Pampas Grass. The remaining and major portions of the subject site have had little disturbance and are in a natural condition.

(g) Proximity to existing or future residential development

The subject site is bounded to the immediate north and east by the residential development of Gwandalan. To the remaining aspects, the subject site fronts Kanangra Drive, Rural Fire Service buildings, a car park to the west and Parraweena Road to the south. Whilst dividing the site from remaining local natural habitat, these roads, buildings and car parks would not act as a barrier for movement for gliders.

Figure 3 shows the local land zonings. A small shopping village across Parraweena Road is the only existing development within the 4(b) Light Industrial zoning to the south which is otherwise surrounded by natural vegetation. These shops have a frontage of trees within a narrow 6(a) Open Space corridor, permitting achievable gliding distances across Parraweena Road and remaining surrounds.

The remaining bushland areas to the west continue as mostly natural bushland within Special Use, Open Space and Environmental Protection zonings. Therefore, the natural habitats of these areas, which provide the major local connective pathways for gliders and wildlife, are relatively secure from residential development.

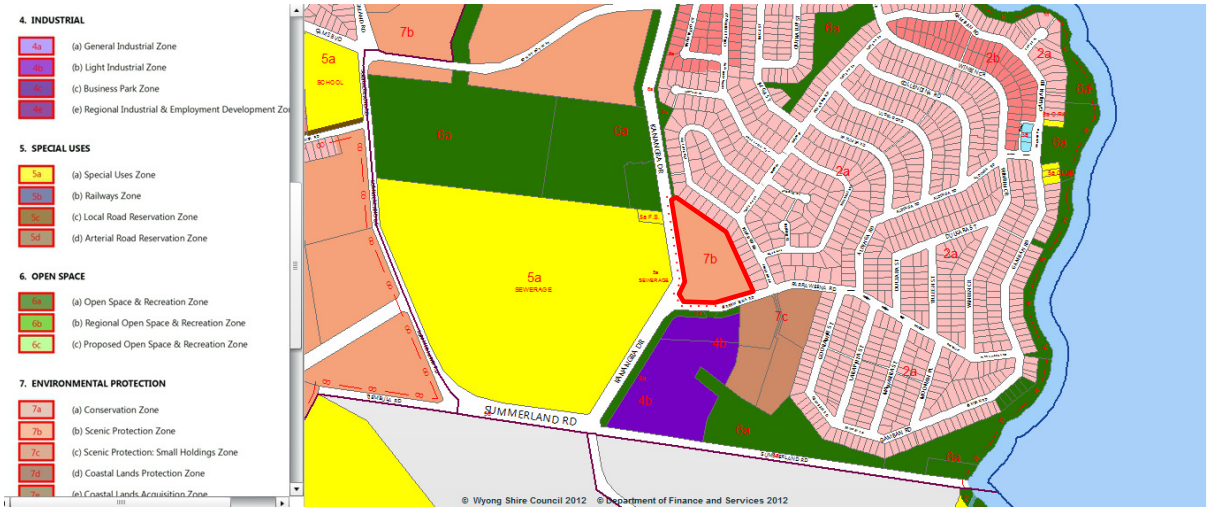

Figure 3 - Local land zonings (Wyong LEP 1991)

It is considered that the habitat available within the subject site provides high quality habitat for the Squirrel Glider. Squirrel Glider was not visually observed during survey undertaken, however, this survey was limited to spotlighting and call-playback.

There are one-hundred and twenty-nine (129) records of this species within 10km of the subject site indicating a high density or population within the local area. Of the three (3) records around the Gwandalan end of the peninsula, two (2) of these are within 1km from 2001 and 1997. More records exist around Chain Valley Bay nearby to the south, with the most recent of these being from 2007 (see Figure 4 for nearby recordings).

Based on habitat available and previous records it is considered that there is potential for Squirrel Gliders to be utilising this habitat seasonally or in future population movements. Glider sap chew marks on Red Bloodwood trees was observed during survey, however, Sugar Gliders are also know in the locality. It is recommended that trapping survey is undertaken during a period consistent with flowering of predominant trees *Corymbia gummifera* (January-April) or *Eucalyptus haemastoma* (September-December). This is particularly to meet survey effort requirements but will also direct mitigation measures to reduce impacts.

The site does not provide any major contribution to connectivity for Squirrel Gliders, particularly also given that gliders need to glide across roads to access the site and the site is not en-route to other habitat areas. Development of the site will not isolate or fragment habitat available to gliders and local movements, excluding the site, will remain unchanged. The impact of the proposal is the removal of habitat suitable for denning, foraging and breeding. This habitat is not unique in the local context and is well represented to the immediate west.

The recording of gliders present within the site will highlight the need for strict mitigation measures to relocate / reconstruct denning resources and ensure no gliders are harmed during habitat removal.

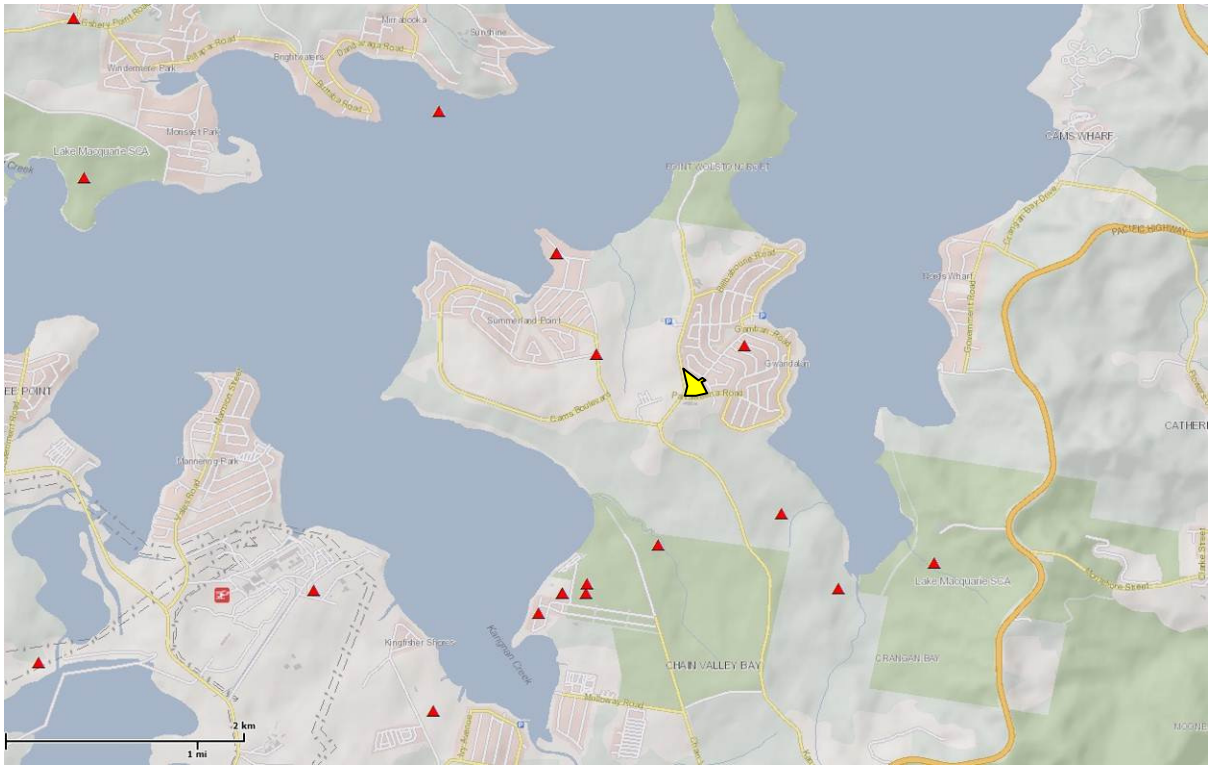

Figure 4 - Local Squirrel Glider records (OEH 2013)

4.3.4 State legislative fauna matters

(a) Threatened species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH, 2013) provided a list of threatened fauna species previously recorded within a 10km radius of the subject site. These species are listed in Table A2.2 (Appendix 2) and are considered for potential habitat within the subject site.

Based on the habitat assessment within Appendix 2, it is considered that the subject site provides varying levels of potential habitat for the following state listed threatened fauna species:

Table 4.6 – State listed threatened fauna species with suitable habitat present

COMMON NAME	*TSC Act*	Potential to occur
Little Lorikeet	V	✓
Barking Owl	V	✓
Powerful Owl	V	✓
Masked Owl	V	✓
Varied Sittella	V	✓
Spotted-tailed Quoll	V	✓
Squirrel Glider	V	✓
Grey-headed Flying-fox	V	✓
East-coast Freetail Bat	V	✓
Little Bentwing-bat	V	✓
Eastern Bentwing-bat	V	✓
Glossy Black-Cockatoo	V	low
Yellow-bellied Sheathtail-bat	V	low

COMMON NAME	*TSC Act*	Potential to occur
Eastern Falsistrelle	V	low
Greater Broad-nosed Bat	V	low
Little Eagle	V	unlikely
Turquoise Parrot	V	unlikely
Scarlet Robin	V	unlikely
Koala	V	unlikely
Eastern Pygmy Possum	V	unlikely
Eastern Cave Bat	V	unlikely

Note: Full habitat descriptions for these species are provided in Appendix 2

No state listed threatened fauna species were recorded within the subject site during surveys. All species with considered potential are assessed in detail within Appendix 3.

FM Act – No habitats suitable for threatened aquatic species were observed within the subject site and as such the provisions of this act do not require any further consideration.

(b) Endangered populations (NSW)

There are no endangered fauna populations within the Wyong LGA.

(c) SEPP 44 Koala Habitat Protection

SEPP 44 Koala Habitat Protection applies to land within LGAs listed under Schedule 1 of the policy. In addition, Part 2 of the policy outlines a three (3) step process to assess the likelihood of the land in question being potential Koala habitat (PKH) or core Koala habitat (CKH). Part 2 applies to land which has an area of greater than 1ha or has, together with any adjoining land in the same ownership, an area of more than 1ha.

The subject site is required to be considered under SEPP 44 as it falls within the Wyong LGA, which is listed on Schedule 1 of this policy. In addition, the total area of the subject site is greater than 1ha, hence Part 2 – Development Control of Koala Habitats, of the policy applies.

PKH is defined as land where at least 15% of the total number of trees in the upper or lower strata constitutes any of the tree species listed in Schedule 2 of the policy.

CKH is defined as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (i.e. females with young) and recent sightings of and historical records of a population.

Step 1 – Is the land PKH?

One (1) Koala food tree species (*Eucalyptus haemastoma*) listed on Schedule 2 of State Environmental Planning Policy No. 44 - Koala Habitat Protection, was recorded within the subject site. This species comprised greater than 15% of the total number of trees within the natural Scribbly Gum / Red Bloodwood Woodland vegetation community and therefore is classified under SEPP 44 as PKH.

Step 2 – Is the land CKH?

No Koalas were observed at the time of fauna survey, which included diurnal searches of trees and spotlighting. In addition, there was no secondary evidence of Koala habitation in the area including characteristic scratches on smooth-barked trees present. Smooth-barked

Scribbly Gums were well represented within the site and provided the only occurring feed tree present under this legislation. Typically where such scratches are located consistent with Koalas, searches for scats beneath these trees would then be undertaken.

A search of the *Atlas of NSW Wildlife* (OEH 2013) found twenty (20) records of Koala habitation within a 10km radius of the subject site. The four (4) closest records are located just over 2.5km away to the south in 2003.

Target survey incorporating spotlighting, call-playback and observations for characteristic scratches on trees was undertaken, with no recorded presence or signs of use. As such, the subject site is not considered to comprise CKH, as defined under SEPP 44.

4.3.5 National environmental significance (NES) - fauna

(a) Threatened species (national)

EPBC Act – A review of the schedules of the *EPBC Act* identified a list of threatened fauna species or species habitat likely to occur within a 10km radius of the subject site. These species have been listed in Table A2.2 (Appendix 2), and those with potential habitat within the subject site are considered in the 7 part test of significance within Appendix 3.

Based on the habitat assessment within Appendix 2, it is considered that the subject site provides varying levels of potential habitat for the following nationally listed threatened fauna species:

Table 4.7 – Nationally listed threatened fauna species with suitable habitat present

COMMON NAME	EPBC Act	Potential to occur
Spotted-tailed Quoll	E	✓
Grey-headed Flying-fox	V	✓
Koala	V	unlikely
New Holland Mouse	V	unlikely

No nationally listed threatened fauna species were recorded within the subject site during survey.

The significant impact criteria for a vulnerable species listed under the *EPBC Act* (Appendix 4) was reviewed to assess the impacts on nationally listed species with potential to occur. It is concluded that there will not be any significant impact on nationally listed threatened fauna species with potential to occur, as a result of the subdivision proposal.

(b) Protected migratory species (national)

The *EPBC Act Protected Matters Report* provides additionally listed terrestrial, wetland and marine migratory species of national significance likely to occur, or with habitat for these species likely to occur, within a 10km radius of the subject site. These migratory species are considered for habitat suitability in Table A2.3 (Appendix 2). Threatened migratory species are assessed for habitat suitability in Table A2.2 (Appendix 2).

No nationally protected migratory bird species were recorded present during the survey or are considered likely to constrain development within the study area.

4.3.6 Fauna assessment conclusions

In accordance with Section 5A of the *EP&A Act*, the 7 part test of significance (Appendix 3) concluded that the proposed development will not have a significant impact on any state listed threatened fauna species or threatened fauna populations. This is provided that the mitigation measures outlined with the recommendations of this report are undertaken. Therefore, an SIS should not be required for the proposed development in respect to fauna.

The proposed development was not considered to have a significant impact on threatened or migratory fauna species listed as matters of national environmental significance under the *EPBC Act 1999*. As such, a referral to SEWPAC should not be required in respect to fauna.

4.4 Vegetation connectivity

The vegetation within the subject site is separated from extensive local connective natural landscapes only by Kanangra Drive to the immediate west and Parraweena Road to the immediate south. These roads are not very busy during the full nocturnal period but do combine to support all traffic entering and leaving Gwandalan. The site's remaining frontage is within the urban landscape of Gwandalan to the east and north.

These local roads do not form a barrier, but likely restrict movement for a number of small terrestrial fauna species. Despite this, the 2.55ha of high quality natural habitat present within the site is capable of supporting habitat for most species capable of making the passage. Alternatively, some large terrestrial fauna species, such as macropods, are limited by the small size of the site and would therefore rely on cross-road movements for full home range requirements etc.

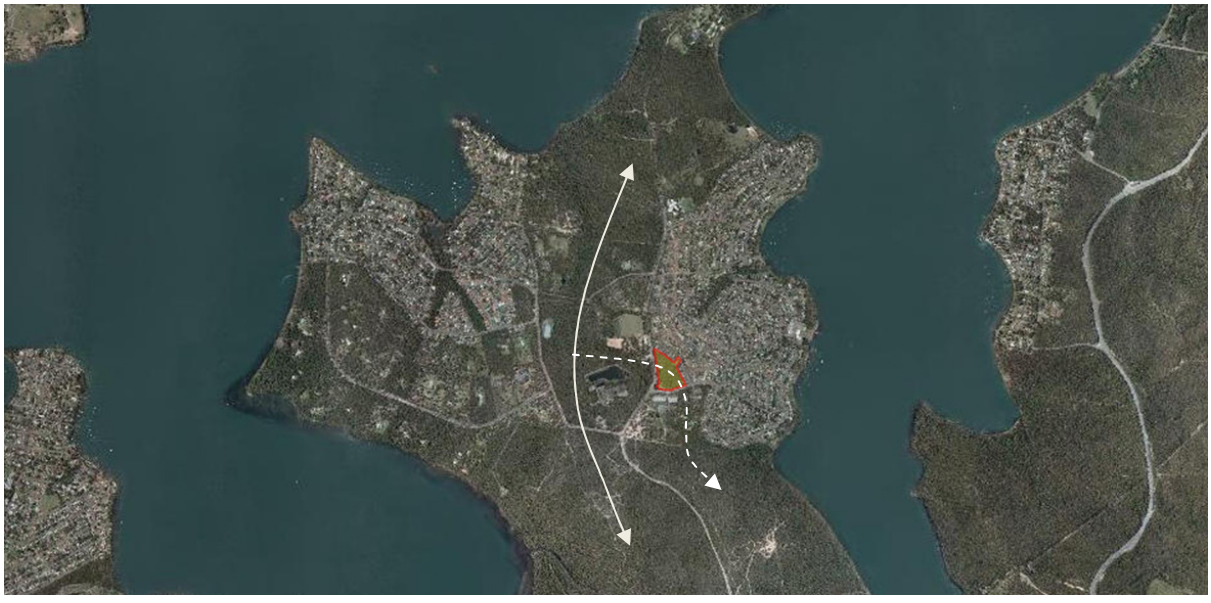

Figure 5 - Local connectivity

The connective landscape across Kanangra Drive to the west extends approximately 4.7km north to the end of the peninsula at Point Wolstoncroft and the same distance south to the Pacific Highway. This habitat on the other side of Kanangra Drive, and surrounding the nearby sewerage treatment works, provides the major movement corridor for wildlife along the Summerland Point / Gwandalan / Point Wolstoncroft peninsula (see Figure 5). The site may provide a secondary movement corridor for passage to the south east of Kanangra Drive (Figure 5). However, *Travers bushfire & ecology* notes that the Gwandalan Estate

(Coal and Allied) Holding has recently been approved as a residential zone and future connectivity to the south east will be compromised due to development.

4.5 Potential ecological impact

The key ecological impacts are as follows:

- **Flora diversity** is relatively high on site which contains habitat for a number of orchid species. One (1) specimen of *Cryptostylis hunteriana* was observed along the central western edge of the site (near the road reserve) on 1 December 2013. Searches for orchids during spring in 2009 and 2013 failed to locate any other threatened orchid species. Whilst the study area also provides habitat for a number of locally recorded threatened flora species such as *Angophora inopina, Acacia bynoeana, Tetratheca juncea* (and potentially others but very low likelihood), none of these species have been observed.

- **Threatened fauna species habitat** - No threatened fauna were recorded or observed during survey, however, some threatened fauna species are considered to have potential to occur seasonally and particularly due to the presence of suitable foraging habitat. Habitat values specifically include the presence of a number of high quality hollows within Scribbly Gums (*Eucalyptus haemastoma*) as well as spring / summer / autumn flowering resources. The habitat present is most suitable for Squirrel Glider, with potential for this species to occur.

The site contains suitable habitat for Squirrels Gliders although none were visually observed. This is in the absence of target trapping effort specific to this species. To accurately assess the actual or potential use of the site, target trapping is recommended for Squirrel Gliders. These survey works are not seasonally dependent and can be undertaken now. The 7 part test of significance has concluded that the proposed development is not likely to have a significant impact on Squirrel Gilders.

However, conservation of specific habitat or hollows onsite may be required subject to the findings of target survey. Should survey indicate usage of the site by Squirrel Gliders, the identification of actual breeding hollows may be needed which cannot be readily determined without tracking Squirrel Gliders. This approach is not warranted on this site. However, higher quality hollows may be identified through visual inspection of the hollows.

4.5 Proposed mitigation measures

On the basis of the current ecological survey results, the following mitigation measures are proposed:

- Protect the recorded *Cryptostylis hunteriana* within the dedicated landscape buffer easement and minimise vegetation removal due to the presence of other orchid species recorded in its vicinity.
- Establish an orchid protection zone that protects the *Cryptostylis hunteriana* and other observed *Cryptostylis* species.
- To minimise the removal of hollow bearing trees through the prioritised retention of good condition and high quality hollows.

4.6 Recommended target survey

On the basis of a review of the Wyong Shire Council and Lake Macquarie City Council survey guidelines, a second session of survey for *Cryptostylis hunteriana* during the summer flowering period is recommended. As *Cryptostylis hunteriana* is known to occur in isolated populations of a few individuals, this session is intended to locate any other individuals that may be present but are not yet flowering onsite. Further floristic survey for all other species is considered to comply with the guidelines.

With respect to fauna survey, *Travers bushfire & ecology* recommends a second survey session is completed for hollow dependent threatened species. This would include further nocturnal and diurnal survey sessions to repeat survey effort to date onsite. In particular based on the habitat present and observation of sap feeding sites, target trapping survey for Squirrel Gliders is highly recommended including the inspection of hollows for recent use or nesting activity. Once a second fauna survey session is completed, the survey effort will be largely compliant with the Wyong Shire Council and Lake Macquarie City Council flora and fauna survey guidelines.

4.7 Conservation significance of the site

Figure 6 provides a preliminary conservation significance of the site subject to a second fauna survey session and target threatened species searches. The site has been categorised based on:

(a) the presence of the threatened orchid - *Cryptostylis hunteriana* and nearby other *Cryptostylis* species at moderate to high densities; and
(b) the density of hollows within the site and sap feeding sites which may be of importance to hollow dependent threatened species.

Figure 6 categorises the western site edge to be of high conservation significance for *Cryptostylis hunteriana;* medium conservation significance in the central and northern portions due to the presence of hollows for potential hollow dependent threatened species; and low conservation significance for the southern portions of the site due to the low density of hollows present.

Should a second survey session identify the presence of any hollow dependent threatened species or further orchid occurrences then the conservation significance may change to reflect the results. In the absence of any further observations of threatened species, the conservation significance of the site may be downgraded.

Figure 6 indicates that the southern portions of the site can most likely be developed without ecological constraints, whereas the central and northern portions would potentially require a higher level of tree retention focussing on the retention of higher quality hollow bearing trees.

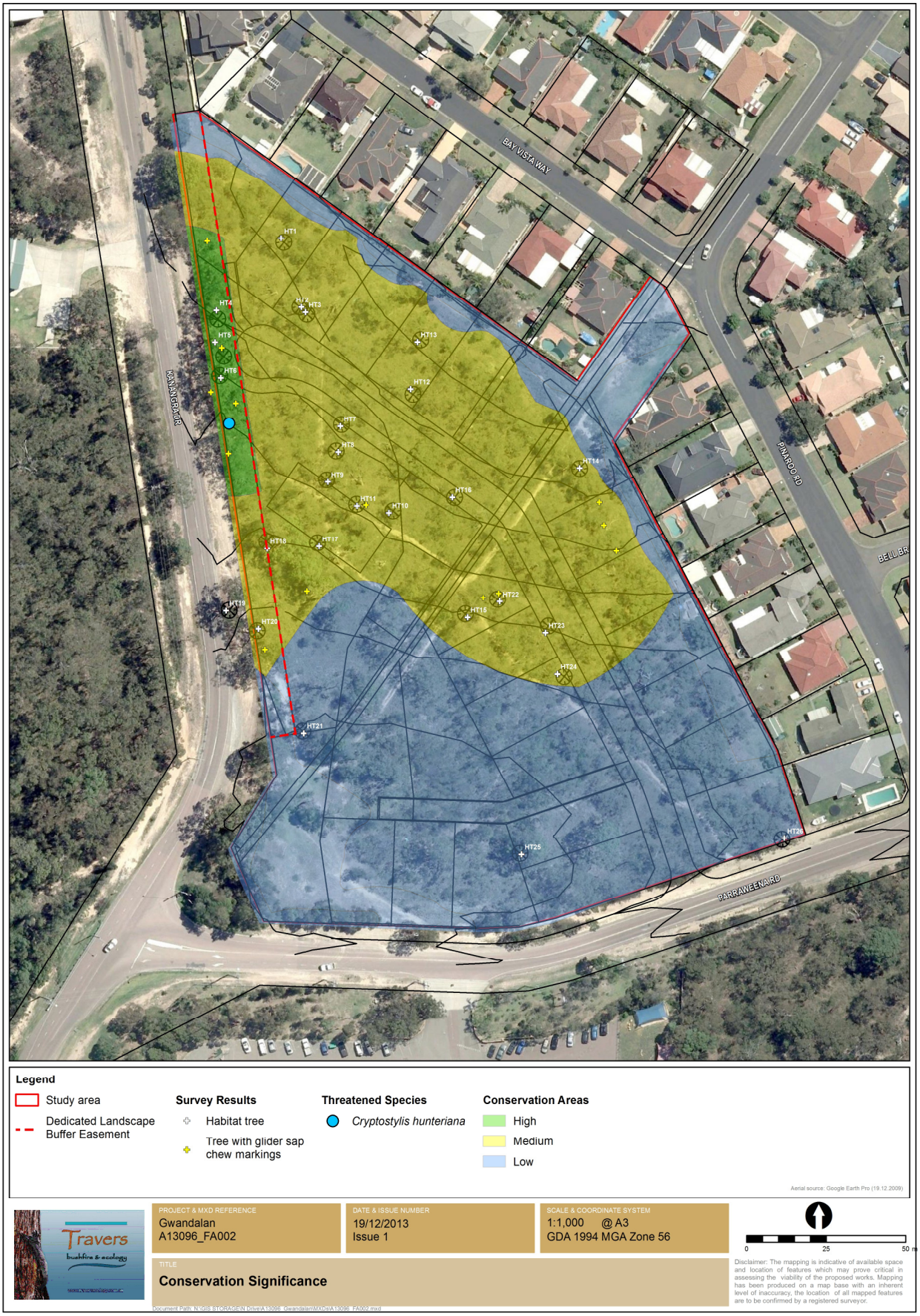

Figure 6 – Conservation significance of the site

Conclusions & Recommendations 5

5.1 Conclusions

The dedicated landscape buffer easement provides protection for the existing observed *Cryptostylis hunteriana.* Subject to a second summer target session for this species, a buffer may be required to provide for an orchid protection area.

5.1.1 Observed and potential threatened species

In respect of matters required to be considered under the *EPA Act* and relating to the species / provisions of the *TSC Act*:

- No threatened fauna species were recorded within, or in close proximity to, the subject site;
- One (1) individual of *Cryptostylis hunteriana* was observed. No other threatened flora species were observed;
- No EECs were recorded within the subject site; and
- No endangered populations have been observed.

Notwithstanding this, the site contains suitable habitat for Squirrels Gliders and in the absence of a targeted trapping effort specific to this species their use of the site cannot be ruled out. To accurately assess the actual or potential use of the site, target trapping is recommended for this species. These survey works are not seasonally dependent and can be undertaken at any time.

Despite the need for trapping for the Squirrel Glider to determine site use, it is considered unlikely that the results of the survey will determine the site as being critical to this species, given the extent of similar habitat in the immediate vicinity.

The location of the one (1) *Cryptostylis hunteriana* is situated within a proposed landscape buffer easement and does not need to be removed for development; however surrounding areas may be managed as APZs. Provided that that immediate surrounds of the orchid can be maintained as a small remnant of bushland, the proposal should not have a significant impact upon this species.

5.1.2 7 part test of significance assessment conclusions

A preliminary assessment of significance of impact has been undertaken as in accordance with Section 5A of the *EP&A Act* and matters of NES under the *EPBC Act*. These assessments determine that the proposed development of the site is not likely to have a significant effect on threatened species, populations and / or EECs.

In consideration of the above survey findings, it is concluded that the proposed subdivision of Lot 229 DP 847847, located on the corner of Kanangra Drive and Parraweena Road, Gwandalan is unlikely to result in a significant impact on any threatened species, populations or EECs or their habitats. This conclusion is subject to completion of trapping survey and assessment of impacts on Squirrel Glider. An SIS should not be required for future proposed development on the lands.

5.1.3 Matters of national environmental significance (NES)

In respect of matters required to be considered under the *EPBC Act:*

- One (1) individual of *Cryptostylis hunteriana* was observed. No other threatened flora species were observed;
- No protected migratory fauna species listed under the *EPBC Act* were recorded within, or in close proximity to, the subject site;
- No EECs were recorded within the subject site.

Consideration of these species within Section 4 and Appendix 3 of this report concluded that the proposed development was not considered to have a significant impact on matters of NES. As such, a referral to SEWPAC should not be required.

5.1.4 Aquatic threatened species

In respect of matters relative to the *FM Act,* no suitable habitat for threatened aquatic species was observed within the subject site, and there are no matters requiring further consideration under this act.

5.2 Recommendations

Based on the observed ecological constraints, the site appears to be suitable for residential development. The southernmost portions of the site have low conservation significance whereas the central and northern portions have potential to be ecologically constrained subject to completion of the second survey sessions as recommended below. Development of these portions would be subject to completion of target surveys for hollow dependent threatened species.

The dedicated landscape buffer along the western edge of the site contains habitat for the threatened flora species *Cryptostylis hunteriana* and should be protected in some form, subject to completion of a second summer survey session.

The following additional target flora and fauna survey is recommended to be completed for exhibition of the planning proposal:

- A second session for *Cryptostylis hunteriana* during the summer flowering period of this species (mid-January to mid-February 2014); and
- A second survey session is completed for hollow dependent threatened species. This would include further nocturnal and diurnal survey sessions to repeat survey effort to date onsite. In particular, based on the habitat present, and observation of sap feeding sites, target trapping survey for Squirrel Gliders is highly recommended, including the inspection of hollows for recent use or nesting activity.

On the basis of the current ecological survey results, the following mitigation measures are proposed:

- Protect the recorded *Cryptostylis hunteriana* within the easement for a landscape buffer and minimise vegetation removal in close proximity due to the presence of other orchid species recorded in its vicinity;
- Establish an orchid protection zone that protects the *Cryptostylis hunteriana* and other observed *Cryptostylis* species along the edge of Kanangra Drive;
- To minimise the removal of hollow bearing trees through the prioritised retention of good condition and high quality hollows;
- Inspect all suitable hollows for hollow dependent threatened species and retain high quality hollow bearing trees subject to tree condition; and
- Supervise the removal of any affected hollow bearing trees and relocate insitu fauna as appropriate into adjoining conservation areas.

To assist with prioritising the retention and removal of habitat trees for a future subdivision, *Travers bushfire and ecology* recommends that a tree condition assessment (SULE) is undertaken for all habitat trees. This will enable the retention of high quality habitat trees within the development area that are in good condition.

Bibliography

Ambrose, S. (2007) *Supplementary Fauna Survey and Assessment – Proposed Plant Nursery, Enterprise Drive, Glenning Valley*, Ambrose Ecological Services.

Auld, B. A. & Medd, R. W. (1996) *Weeds.* Inkata Press.

Barker, J., Grigg, G. C. & Tyler, M. J. (1995) *A Field Guide to Australian Frogs.* Surrey Beatty & Sons.

Barnett, J. L., Howe, R. A. and Humphreys, W .F. (1978) The use of habitat components by small mammals in eastern Australia. *Australian Journal of Ecology*. 3: 277-285.

Bell (2002 and 2008) *The Natural Vegetation of the Wyong LGA.*

Bennett, A. F. (1990a) Habitat Corridors: *Their Role in Wildlife Management and Conservation* (Department of Conservation and Environment, Victoria).

Bennett, A. F. (1990b) Habitat corridors and the conservation of small mammals in a fragmented forest environment. Landscape Ecology. 4: 109-122.

Bentley, J. M. and Catteral, C. P. (1997) The use of bushland, corridors and linear remnants by birds in south-eastern Queensland, Australia. *Conservation Biology*. 11: 1173-1189.

Bishop, T. (1996) *Field Guide to the Orchids of New South Wales and Victoria.* UNSW Press.

Briggs, J. D. & Leigh, J. H. (1995) *Rare or Threatened Australian Plants.* CSIRO.

Caterall, C. P., Green, R. J. and Jones, D. N. (1991) Habitat use by birds across a forest-suburb interface in Brisbane: implications for corridors. In: Saunders, D.A. & Hobbs, R.J. (eds). *Nature Conservation 2: The Role of Corridors*. Surrey Beatty & Sons, Chipping Norton.

Churchill, S. (2008) *Australian Bats*, 2nd Ed., Jacana Books, Crows Nest, Sydney.

Cogger, H. G. (1996) *Reptiles and Amphibians of Australia*. Reed Books Australia.

DEC (2004) *Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft),* New South Wales Department of Environment and Conservation, Hurstville, NSW

DECC (2008) *Bio-banking Methodology*.

Ehmann, H. (1997) *Threatened Frogs of New South Wales.* FATS Group.

EPBC (1999) Environmental Protection and Biodiversity Conservation Act 1999 - Interactive Map Database Search - http://epbcweb.ea.gov.au/image/otherbatch.html

Griffiths, K. (1997) *Frogs and Reptiles of the Sydney Region.* University NSW Press.

Harden, G. (1993) *Flora of New South Wales.* University NSW Press.

Hoser, R. (1989) *Australian Reptiles and Frogs.* Pierson & Co.

Lamp, C. & Collett, F. (1996) *A Field Guide to Weeds in Australia.* Inkata Press.

LHCCREMS (2003) Vegetation Survey and Mapping Hunter, Central and Lower North Coast Region of NSW.

Lindenmayer, D. B. (1994) Wildlife Corridors and the mitigation of logging impacts on fauna in wood production forests in south-eastern Australia: a review. Wildlife Resources. 21:323-340.

Lindenmayor, D. B. Cunningham, R. B., Donnelly, C. F., Triggs, B. J. and Belvedere, M. (1994) The conservation of arboreal marsupials in montane ash forests of the Central Highlands of Victoria, south-eastern Australia. Patterns of use and the microhabitat requirements of the Leadbeater's Possum *Gymnobelidus leadbeateri* in linear retained habitats (wildlife corridors). Biological Conservation. 68 43-51.

Lunney, D., Urquart, C .A. & Reed, P. (1988) *Koala Summit,* NPWS.

Lynch, D. & Saunders, D. A. (1991). Responses of bird species to habitat fragmentation in the wheatbelt of Western Australia: interiors, edges and corridors. In: Saunders, D.A. & Hobbs, R.J. (eds). *Nature Conservation 2: The Role of Corridors* (Surrey Beatty & Sons, Chipping Norton).

Marchant, S., & P. J. Higgins (Eds) (1990). *Handbook of Australian, New Zealand and Antarctic Birds.* Volumes 1-7 Oxford University Press, Melbourne.

Morrison, R. G. B. (1981) *A Field Guide to the Tracks & Traces of Australian Animals.* Rigby.

OEH (2013) *Atlas of NSW Wildlife* for the relevant 1:100,000 scale map sheet.

Parnaby, H. (1992) *An interim guide to identification of insectivorous bats of south-eastern Australia.* The Australian Museum, Sydney, Technical Report, No. 8.

Pizzey, G. & Knight, F. (1997) *A Field Guide to the Birds of Australia.* Angus & Robertson.

Reader's Digest (1976) *Complete Book of Australian Birds.*

Richardson, F. J., Richardson, R. G. & Shepherd, R. C. H (2007) *Weeds of the South-East: an Identification Guide for Australia.* Everbest Printing Co. Pty. Ltd. China.

Robinson, L. (1994) *Field Guide to the Native Plants of Sydney.* Kangaroo Press.

Robinson, M. (1996) *A Field Guide to Frogs of Australia.* Reed.

Saunders, D. A. and de Rebeira, C. P. (1991). Values of corridors to avian populations in a fragmented landscape. In: Saunders, D.A. & Hobb, R.J. (eds). *Nature Conservation 2: The Role of Corridors* (Surrey Beatty & Sons, Chipping Norton).

Schodde, R. and Tidemann, S. (Eds) (1986). Readers Digest complete book of Australian Birds. Second Edition. Reader's Digest Services Pty Ltd, Sydney.

Simpson & Day (1996) *Field Guide to the Birds of Australia.* Viking.

Smith (2002) Squirrel Glider (*Petaurus norfolcensis*) Conservation Management Plan: Wyong Shire. Wyong Shire Council, Wyong

Specht, R. L., Specht, A., Whelan, M. B. & Hegarty, E. E. (1995) *Conservation Atlas of Plant Communities in Australia.* Southern Cross University Press, Lismore.

Triggs, B. (1996) *Tracks, Scats & Other Traces: A Field Guide to Australian Mammals*. Oxford University Press, Melbourne.

Trounson, Donald & Molly (1998) *Australian Birds Simply Classified*. Murray David Publishing Pty Ltd, NSW.

Van Dyke, S. and Strahan, R. (Eds) (2008) *The Mammals of Australia* (3rd Edn). Reed New Holland: Sydney.

Wheeler, D. J. B., Jacobs, S. W. L. & Norton, B. E. (1994) *Grasses of New South Wales.* University of New England.

Wilson, K. W. and Knowles, D. G. (1988) *Australia's Reptiles - A Photographic Reference to the Terrestrial Reptiles of Australia*. Cornstalk Publishing.

Fauna Survey Methodologies

A1

The fauna survey methods outlined within this Appendix are techniques employed by *Travers bushfire & ecology,* based on industry standards as well as additional methods found to be effective for select fauna groups. The fauna survey techniques deployed for each specific site are outlined within the survey effort table in the main body of this report. The techniques selected will depend upon the site characteristics and extent of available habitat as well as restrictions such as available survey time and weather conditions.

If any additional or target survey techniques for fauna species are undertaken, beyond the methods outlined within this Appendix, the details of these will be described within the main body of this report.

1 Standard survey techniques

1.1 Diurnal birds

Diurnal birds are typically identified visually and / or by calls during diurnal surveys. Habitat searches to identify nests, feathers, eggs, or signs of foraging may be utilised more specifically for identifying threatened diurnal bird species.

Visual observations are made more accurate with the use of binoculars and where necessary or practical, with the use of a spotting scope. Binoculars are carried by the fauna surveyor at all times during nocturnal and diurnal fauna surveys. A birding field guide is always available in the field when required for verifications.

Calls are identified in the field by the fauna surveyor. If an unknown call is heard it is cross-matched to comprehensive bird call reference libraries taken into the field. A call library of birds occupying the NSW coastal areas is also stored into a mobile phone for a quick reference. This phone is carried into the field at all times and may be used for call-playback methods and recording calls for later analysis.

Diurnal bird census points may be undertaken at large sites where the total area may not be effectively covered during the survey period, or as a measure to ensure focused bird only survey.

1.2 Nocturnal birds

Searches for evidence of Owl roosts, key perches and potential Owl roosting / breeding hollows are made during diurnal site searches. Whitewash, feathers or regurgitated pellets give key information. Pellets are sent for analysis of contents to assist in identification where necessary.

The presence of nocturnal birds during the nocturnal period is first determined by quiet listening after dusk for calls by individuals emerging from diurnal roosts. Following this, and provided no calls are heard, call-playback techniques are employed for threatened species that have suitable habitat present.

Threatened nocturnal birds known to provide response to call-playback techniques include Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Sooty Owl (*Tyto tenebricosa*), Grass Owl (*Tyto capensis*), Black Bittern (*Ixobrychus flavicollis*), Australian Bittern (*Botaurus poiciloptilus*) and Bush Stone-curlew (*Burhinus grallarius*).

Each call is typically played for five minute periods with five minute intervals of quiet listening for a response. This is followed with spotlighting and periods of quiet listening throughout the nocturnal survey.

Separation distances between broadcasting stations during a single night of survey are advised for different species within survey guidelines. These include 1km between Owl calls and 3km between Bush Stone-curlew calls. Subsequent to this, separate broadcasting stations will be deployed on the same night where sites of significant size are surveyed. Separations for bitterns are not advised and these may be broadcast at a number of stations along suitable habitat areas.

Stag watching will be undertaken where suitable large hollows for Owl nesting / roosting show signs of activity or are located within development areas. Stag watching of nesting trees should be undertaken during the recognised nesting period for Owls with potential to occur.

1.3 Arboreal mammals

Arboreal mammals may be surveyed using *Elliott* type A, B and / or C traps, small and / or large hair tubes, spotlighting, call-playback techniques, scat searches or searches for other signs of activity.

Baiting and layout for *Elliott* trapping and hair tubing are typically incorporated into terrestrial trapping and hair tubing effort, unless where target survey is undertaken. Standard baiting and layout is therefore described in Section A1.3.2 below within terrestrial survey methods. Where gliders are targeted, the standard bait mix may be additionally laced with a nectarivor powder mix used for feeding captive birds. Where Brush-tailed Phascogales are targeted the standard bait mix may be additionally laced with an insectivore powder mix. Where Eastern Pygmy Possum is targeted, the bait mix will be more heavily laced with honey.

Elliott traps for arboreal captures are placed onto tree mounted platforms that are attached to the trunk 2-3m above the ground, at an incline to facilitate drainage during inclement weather. Plastic sleeves are placed around or over traps when there is a possibility of wet weather in the forecast. Arboreal hair tubes are attached to the trunk of trees using rubber bands with the tube entry facing down, preventing water entry.

For all arboreal traps and hair tubes a mixture of honey and water is sprayed onto the trunk up to 8m above the trap and around the trap as a lure. Where Eastern Pygmy Possum is targeted, a high concentrate honey water mix is also sprayed from the base of trunk up and along connective branches.

Arboreal traps and hair tubes are placed in trees selected to bias target species. These are often flowering or sap flow trees for gliders, rough-barked trees for the Brush-tailed Phascogale and Banksias for the Eastern Pygmy Possum.

Where habitat is suitable, the presences of Koala (*Phascolactos cinereus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) may be targeted by call-playback techniques. Calls are played for five minute periods during nocturnal surveys. This is followed by quiet listening and spotlighting.

1.3.1 Koala survey

Koala survey is undertaken where the site is considered to provide potential habitat under the definitions of SEPP 44 - Koala Habitat Protection, or in the presence of feed trees listed in Appendix 1 of the Recovery Plan for the Koala. Habitat may also be defined according to locally prepared Koala Plans of Management.

SEPP 44 is applied to land within local government areas (LGAs) listed under Schedule 1 of the policy. Part 2 is applied to land which has an area of greater than 1ha or has, together with any adjoining land in the same ownership, an area of more than 1ha.

To determine potential Koala habitat (PKH) under the definitions of SEPP 44 an estimate of the percentage density of each tree species within vegetation communities is determined by averaging the percentage of stems counted. PKH is defined as land where at least 15% of the total number of trees in the upper or lower strata constitutes any of the tree species listed in Schedule 2 of the policy.

Where Koala habitat is considered to be present, the site will be surveyed on foot, with known Koala food trees being inspected for signs of use. Trees are inspected for characteristic scratch and claw marks on the trunk and scats around the base of each tree. Koalas may also be targeted during nocturnal survey involving call-playback techniques and spotlighting.

For large sites, Koala search quadrats may be employed within portions of communities where feed trees are present at suitable densities. All Koala feed trees within quadrats are searched for signs of activity including characteristic claw marks on the trunk and faecal pellets around the base. Pellet searches are undertaken according to the tree base search methods described in Phillips & Callaghan (2008). Search quadrats are less labour intensive than the spot assessment technique (SAT) techniques described below but may only be an initial survey effort to determine presence / absence.

Where any Koala activity is recorded the complete SAT described by Phillips & Callaghan (2008) may be undertaken as a measure of Koala activity. This technique may also be employed in the first instance as an indicator of presence / absence, particularly where a site has potential Koala activity based on previous records.

For any survey technique, the location and density of Koala droppings, if found, are documented.

1.4 Terrestrial mammals

Various traps may be used to survey for the presence of terrestrial mammals. These include *Elliott* trapping, medium and large cage trapping, small and large hair tubing and pitfall traps. Other survey methods for terrestrial mammals include the use of camera surveillance, spotlighting and activity searches.

Arboreal and terrestrial *Elliott* traps and hair tubes are placed in grids, or more commonly along trap-lines of 5-10 traps separated by distances of 20-50m, depending on site size and variation of habitat. Trap or hair tube sizes selected at each trap station may alternate or may have an emphasis on certain sizes according to target species.

Selection of terrestrial *Elliott* trap, cage trap, hair tube or pitfall trap locations has an emphasis on nearby foliage, runways, shelters and signs of activity.

Standard bait mix for all *Elliott* traps, medium cage traps and hair tubes is a mixture of rolled oats, honey and peanut butter. Standard bait mix may be supplemented with sardines in large hair tubes or cage traps to simultaneously target Spotted-tailed Quoll. Cage traps may also be baited solely with meat or road kill to target Spotted-tailed Quoll. Where Potoroos or Bandicoots are targeted, truffle oil may be used to lace the standard bait mix or used on its own.

Where difficult to access, sensitive or extended trapping periods are undertaken, surveillance cameras can be used in terrestrial mammal surveys. The surveillance camera is mounted on a tree and directed towards a closed baited cage trap. Surveillance cameras may also be used to detect use or monitor activity at burrows, hollows, nests, etc.

During diurnal site searches, assessment is made of found scats, markings, diggings, runways and scratches located. Any scats or pellets not readily identifiable (particularly predator scats) may be collected and sent to identification expert, Barbara Triggs for identification of contents, hair or bone fragments.

1.5 Bats

Micro-chiropteran bats are surveyed by echolocation using *Anabat* detectors or trapped using harp (*Constantine*) traps, mist nets or trip lines. Microchiropteran bats are also surveyed by searches of subterranean habitats such as caves, tunnels or shafts where present, or by searching structures such as under bridges and abandoned buildings or wall / ceiling cavities, where entry is possible.

Anabat Mk 2 and SD-1 detectors are used in fixed passive monitoring positions and / or during active nocturnal monitoring. Active monitoring is used in conjunction with spotlighting or during stag-watching for greater accuracy of recorded call identification.

Bat call recordings are interpreted through *Anabat V* and *Anabat CF* Storage and Interface Module ZCAIM devices and analysed using *Anabat 6* and *Analook 3.3q* computer software packages.

Harp traps and mist nets are placed along suitable flyways such as along open narrow road / river corridors to maximise the likelihood of captures. Traps may be purpose set to capture bats emerging from roosts by being placed at the entry of tunnels / caves or draped over the edge of bridges. Trip lines are placed over water to trip low flying drinking bats into the water. These bats are collected as they swim to the water's edge.

Harp traps are checked during early nocturnal survey, as well as each morning. Mist nets and trip lines require constant monitoring. Captured bats are identified using field identification guides. Bats are released at the point of capture after dusk or placed under trunk bark / splits of nearby trees.

Mega-chiropteran bat species, such as Grey-headed Flying-fox, are surveyed by targeting flowering / fruiting trees during spotlighting activities and by listening to distinctive vocalisations. Suitable roosting habitat is searched for presence of small or large established camps during diurnal survey periods.

1.6 Amphibians

Amphibians are surveyed by vocal call identification, call-playback, spotlighting along the edge of water-bodies, pitfall trapping, funnel trapping, by driving along sealed roads near waterways, habitat searches and collection of tadpoles.

Calls are identified in the field by the fauna surveyor. For similar calling species, or if an unknown male call is heard, it is cross-matched to frog call reference libraries taken into the field. A call library of frogs occupying the NSW coastal areas is also stored into a mobile phone for a quick reference. This phone is carried into the field at all times and may be used for call-playback methods and recording calls for later analysis.

All threatened frog species may be targeted by use of call-playback techniques where suitable habitat exists, with some species more reliable than others in providing a response. Red-crowned Toadlet may also be targeted by clapping and loud retort along suitable habitat drainages in order to evoke a call response.

Any amphibians found are visually identified and, when required to be examined, are handled with latex gloves and kept moist until release. Any tadpoles requiring capture are collected with a scoop net and placed within a snap-lock clear plastic bag for analysis of colour and morphological features.

Amphibian survey yields best results during or following wet periods with seasonal breeding and subsequent male calling varying according each species. Targeted survey is thus undertaken in appropriate seasons.

1.7 Reptiles

Reptiles are surveyed opportunistically during diurnal site visit(s), but also by habitat searches, pitfall trapping, funnel trapping, by driving along roads on humid nights and by camera surveillance at burrows.

Habitat searches for reptiles are undertaken in likely localities such as under logs, rocky slabs on rock surfaces, under sheet debris, under bark exfoliations and leaf litter at the base of trees and along the edge of wetlands. Aspect and land surface thermal properties are considered to determine best search locations particularly along rocky escarpments.

During warmer months spotlighting may assist survey effort particularly during humid conditions.

1.8 Invertebrates

Target survey is undertaken for the Cumberland Plain Land Snail (*Meridolum corneovirens*) when in proximity to previous *Atlas of NSW Wildlife* records and particularly where its typical host vegetation community is present. The most appropriate areas of observed habitat are searched. Dense areas of leaf litter with likely moisture retaining properties are scraped using a three pronged rake. Logs, stumps, artificial refuse and rocks are also turned over. In large survey areas, search quadrats are undertaken evenly across highest quality habitat areas to estimate population size.

The top (spiral side), side (showing aperture) and underside (showing umbilicus) of snail specimens found are photographed and sent to Michael Shea of the Australian Museum Malacology Unit for confirmation of identification.

2 Habitat trees

Hollow bearing tree surveys use a *Trimble* handheld GPS unit to log both field reference location as well as tree data. Data such as hollow types, hollow size, tree species, diameter at breast height, canopy spread and overall height are documented. A metal tag with the tree number is placed on the trunk for field relocation purposes. Other habitat features such as nests and significant sized mistletoe for foraging are also noted.

3 Survey effort table descriptors:

Target - Where effort is specifically concentrated towards an individual species. Selected target species will be identified within the survey effort table and where necessary described within the report.

Opportunistic - Where birds are identified by observation, call or indirect methods as the opportunity arises.

Habitat search - Where suitable areas of habitat for selected fauna groups such as frogs, reptiles and invertebrates are specifically searched.

Diurnal bird census point(s) - Are bird surveys undertaken within a specified area surrounding a point (or in a quadrat) for a specified amount of time. Size and time will be specified in the survey effort table. These are more typically undertaken across larger sites where the total area cannot be effectively covered during the survey period. Subsequently census points are selected to adequately represent each of the habitat areas present and particularly areas designated for proposed development. Often census points are commenced at locations where bird activity is noticeably high.

Spotting-scope outlook - A *Nikon* spotting scope with 16~47 zoom at x60 magnification on a mounted tripod is used for distant inspections of diurnal birds. This is undertaken at wetlands for viewing waterfowl and waders but also other difficult to access areas. It may also be used for inspecting activity at nests, hollows and combined with spotlight for a panoramic search in open areas.

Call-playback - This involves broadcasting recorded calls through a 15 watt Toa 'Faunatech' amplifier to evoke a response from species known to reply. Species selected for call-playback will be indicated in the survey effort table.

Spotlighting - Is carried out using a hand held 55 watt spotlight powered by a 12 volt rechargeable battery. This technique involves walking amongst the woodland areas, forest fringes, along roads, trails and fence lines so that a maximum number of trees can be observed. Spotlighting around water-bodies and particularly along the shallow fringes is used for finding frogs. Spotlighting is used in combination with binoculars or spotting scope for closer night inspections.

Stag watching - Involves watching hollows in the dusk period approximately 15 minutes prior to dark until 30 minutes following dark. Placement of the observer on the ground allows for a silhouette of any emerging fauna to be seen against the lighter sky background such that a spotlight is not required, which would likely to disrupt emergence behaviour. Where any movement is observed, a spotlight may then be used for identification purposes.

Search quadrats - Are undertaken within a specified area surrounding a point (or in a quadrat) for a specified amount of time. These are more typically undertaken across larger sites where the total area cannot be effectively covered during the survey period. Subsequently quadrats are selected to adequately represent each of the suitable habitat areas present and particularly areas designated for proposed development. The use of this technique simply as an initial time-effective suitable indicator of presence / absence of Koalas has been discussed with Koala expert, Stephen Phillips.

Koala spot assessment technique (SAT) - Method outlined by *Phillips & Callaghan* (2008) and accepted by the *Australian Koala Foundation* to determine Koala activity levels. Activity levels are calculated from the proportion of trees showing signs of Koala use as indicated by the presence of scats as well as site location within the state.

***Elliott* trapping** - Using *Elliott* type A (33x10x10cm) and Type B (45x15x15cm), B and / or Type C traps for trapping small sized mammals. Trapping nights' effort will be indicated in the survey effort table. Trapping layout, trap sizes, baiting and trapping period will be outlined within the site specific methodology section.

Medium cage trapping - Using medium sized cage traps (17x17x45cm foldout cages with tread-plate mechanism or 22x25x58cm rigid cage with tread-plate mechanism) for trapping up to cat / bandicoot sized mammals. Trapping layout, target species, baiting and trapping period will be outlined within the site specific methodology section.

Large cage trapping - Using large sized cage traps (25x25x50cm foldout cages with pull lever (meat) mechanism, 28x28x60cm foldout cages with tread-plate mechanism or 30x30x70cm rigid cage with tread-plate mechanism) for trapping up to quoll sized mammals. Trapping layout, target species, baiting and trapping period will be outlined within the site specific methodology section.

Hair tubing - Using small (40mm diameter x 120mm long) and/or large (90mm diameter x 200mm long) PVC pipe sections for collecting mammal hair samples. At one end of each tube is an enclosed chamber where the bait is placed and capped. Small drill holes in the inside face of the chamber allow the smell of the bait to permeate out through the tube without allowing access to the bait. At the other open entry end, double-sided tape is attached around the inner rim so hair samples of animals entering the tube are collected. Hair samples collected are sent to Barbara Triggs for identification. Trapping layout, tube sizes, baiting and trapping period will be outlined within the site specific methodology section.

Pitfall trapping - Is used to survey for small terrestrial mammals, frogs, reptiles and invertebrates. Pitfall trapping involves the use of 15cm diameter and 60cm long PVC stormwater pipe sections placed vertically into pre dug holes. The pipe is placed and set firm with surrounding soil so that the top rim is level with the ground surface. Drift fences made of damp-proof-course 270mm wide are held tight and upright by wooden and steel pegs and run along the length of each trap-line. Drift fences are run over the middle of each pit in the trap line ensuring at least 5m of fencing is run along each side of each pit. Ground fauna passing beyond the pitfall transect are diverted towards the pits along the fence line.

Funnel trapping - Is used to survey mainly for frogs and reptiles. Funnel traps are 18cm x 18cm x 75cm long and constructed of shade cloth with an internal spring and wire frame in a similar design to yabby traps. At each end an inward facing funnel directs fauna through a 4cm hole and into the trap. Herpetofauna search the walls and corners for an exit and discover it difficult to re-find the internal exit hole. As with pitfall traps, funnel traps are used with drift fences that divert fauna towards the trap entry. At least 5m of fencing is run between each funnel trap which may be placed on either side of the fence. Trapping layout, target species, fence lengths and trapping period will be outlined within the site specific methodology section.

Passive *Anabat* monitoring - Involves leaving the bat recorder in a fixed mounted position to record call-sequences of passing bats. Recording locations are determined in order to represent different available foraging structures for various micro-chiropteran bat species. Dams, cleared flyways, high insect activity areas, forest edges and ecotones are particularly targeted.

Active *Anabat* monitoring - Is a method of active microbat recording during stag-watching or during complete nocturnal survey. Active monitoring involves an SD-1 recorder allied with a PDA for viewing call-sequences in real-time. When calls are heard the transducer microphone is actively directed towards the calling animal with the aid of a spotlight, so longer and clearer call sequences may be recorded. When calls of a potential threatened species are observed on the PDA screen a view by spotlight of the bat size and wing morphology is attempted for greater identification accuracy.

Active vehicle *Anabat* monitoring - Is a method of active microbat recording deployed when large distances need to be covered in a nocturnal survey period. A Hi-mic extension cable allows the transducer microphone to be placed on a bracket on the roof of a travelling vehicle so calls may be viewed whilst driving. The vehicle travels at no more than 40km/h to

prevent wind interference. When calls of a potential threatened species are observed on the dash mounted PDA screen active spotlighting is undertaken.

Harp trapping - Is used to capture microchiropteran bats. Harp traps have an aluminium frame with a two-bank 4.2m^2 area and calico capture bag set along the base area.

Mist netting - Is used to capture microchiropteran bats. The mist net capture area is 2.4m high and 9m wide and supported by two 3.5m poles which are braced with ropes and pegs. Design is a 0.08mm ultrafine nylon monofilament thread arranged in a 14x14mm mesh, with four horizontal capture pockets. These features are specific for the use to capture micro-chiropteran bat species and are sourced from the only known supplier in Poland.

Trip lining - Is used to capture microchiropteran bats. Fishing line is strung tight on pegs in a zig-zag pattern across open water-bodies just above the water surface to trip drinking bats into the water.

Camera surveillance - Is used to monitor activity at burrows, hollows, etc. or to survey for species presence at baited stations. A *Reconyx Hyperfire* digital weatherproof camera is used with a passive infrared motion detector and a night-time infrared illuminator. The camera is mounted on a tree or tripod and takes three consecutive photo frames on the detection of movement up to 30m away or the detection of a heat / cold source different to the ambient temperature.

Weather conditions - Survey effort for each fauna group accounting for methods undertaken, duration, and weather conditions are provided in the survey effort table. Weather details are documented for all survey techniques and include:

- Air temperature
- Cloud cover
- Rain (e.g. none, light drizzle, heavy drizzle, heavy rain)
- Recent rain events (where relevant)
- Wind strength e.g. calm, light (leaves rustle), moderate (moves branches), strong (moves tree crowns)
- Wind direction
- Moon (where relevant) (e.g. none, 1/4 moon, 1/2 moon, 3/4 moon, full moon)

Threatened & Migratory Species Habitat Assessment

A2

Table A2.1 provides an assessment of potential habitat within the subject site for state and nationally listed threatened flora species recorded within 10km on the *Atlas of NSW Wildlife* (OEH) or indicated to have potential habitat present within 10km on the *EPBC Act Protected Matters Tool.*

Table A2.1 – Threatened flora habitat assessment

Scientific name DATABASE SOURCE	***TSC Act***	***EPBC Act***	**GROWTH FORM AND HABITAT REQUIREMENTS**	**RECORDED ON SITE (✓)**	**IF NOT RECORDED ON-SITE**				**CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Acacia bynoeana OEH EPBC	E1	V	Erect or spreading shrub to 0.3m high growing in heath and dry sclerophyll Open Forest on sandy soils. Often associated with disturbed areas such as roadsides. Distribution limits N-Newcastle S-Berrima.	x	✓	Many records but 7km minimum distance away	✓	✓	✓
Angophora inopina OEH EPBC	V	V	Small tree in open sclerophyll forest growing on deep sandy soils with associated lateritic outcrops. Distribution limits N-Wyee S-Gorokan with a disjunct population near Karuah.	x	✓	✓	✓	✓	✓

Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Caladenia tessellata OEH EPBC	E1	V	Terrestrial orchid. Clay-loam or sandy soils. Distribution limits N-Swansea S-south of Eden.	x	marginal	x	x	unlikely	x
Callistemon linearifolius OEH	V	-	Shrub to 4m high. Dry sclerophyll forest on coast and adjacent ranges. Distribution limits N-Nelson Bay S-Georges River.	x	x	-	-	x	x
Corybas downlingii OEH	E1	-	An orchid that forms clonal colonies and typically grows in gullies in tall open forest on well-drained gravelly soil at elevations of 10-200m. Known from 4 localities including Port Stephens (2 localities), Bulahdelah and Freemans Waterhole.	x	x	-	-	x	x
Chamaesyce psammogeton OEH	E1	-	Prostrate herb. Coastal dunes. Distribution limits N-Tweed Heads S-Jervis Bay	x	x	-	-	x	x
Corunastylis sp. Charmhaven OEH	E4	-	It is a recently discovered orchid species only known from the Gorokan / Charmhaven area in low woodland to heathland with a shrubby understorey and ground layer. Dominants include *Allocasuarina littoralis, Leptospermum juniperinum, Melaleuca nodosa, Callistemon linearis* and *Schoenus brevifolius.*	x	marginal	x	✓	low	✓

Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Cryptostylis hunteriana OEH EPBC	V	V	Saprophytic orchid. Grows in heath on sandy soils, sometimes damp areas. Distribution limits N-Gibraltar Range S-south of Eden.	✓	✓	Many records but 7km minimum distance away	✓	recorded	✓
Diuris praecox OEH EPBC	V	V	Terrestrial orchid. Grows in sclerophyll forest near the coast. Distribution limits N-Nelson Bay S-Ourimbah.	x	marginal	✓	✓	low	✓
Eucalyptus camfieldii OEH EPBC	V	V	Stringybark to 10m high. Grows on coastal shrub heath and woodlands on sandy soils derived from alluviums and Hawkesbury sandstone. Distribution limits N-Norah Head S-Royal NP.	x	x	-	-	x	x
Eucalyptus parramattensis subsp. *decadens* OEH	V	V	Red gum to 15m high. Grows in dry open forest on sandy to clay soils often in lowly elevated moist sites. Distribution limits N-Port Macquarie S-Kurri Kurri.	x	x	-	-	x	x
Genoplesium insignis OEH	E1	-	Terrestrial orchid. Found in *Themeda* patches among shrubs and sedges in heathland and forest. Known from 3 localities in Wyong-Charmhaven area.	x	x	-	-	x	x
Grevillea parviflora subsp. *parviflora* OEH EPBC	V	V	Open to erect shrub to 1m. Grows in woodland on light clayey soils Distribution limits N-Cessnock S-Appin.	x	x	-	-	x	x

Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Melaleuca biconvexa OEH EPBC	V	V	Tall shrub. Grows in wetlands adjoining perennial streams and on the banks of those streams, generally within the geological series known as the Terrigal Formation. Distribution limits N-Port Macquarie S-Jervis Bay.	x	x	loss-	-	x	x
Microtis angusii EPBC	E1	E	Terrestrial orchid which is known from two populations, Mona Vale and Sunny Corner.	x	x	-	-	x	x
Pelargonium sp. *Striatellum* EPBC	E1	E	Herb to 90cm tall which grows in damp places especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. Varied distribution from SE NSW to QLD.	x	x	-	-	x	x
Pterostylis gibbosa EPBC	E1	E	Terrestrial orchid which occurs near Wollongong and in Hunter Valley in sclerophyll forest, sometimes with paperbarks.	x	x	-	-	x	x
Pultenaea maritima OEH	V	V	Erect shrub. Grows in moist, sheltered section of dry sclerophyll forest on sandstone in Higher Blue Mountains and Glen Davis areas.	x	x	-	-	x	x
Rutidosis heterogama OEH EPBC	V	V	Erect herb to 30cm. Grows mostly in heath, often along roadsides. Distribution limits N-Maclean S-Wyong.	x	marginal	Many records but 6km minimum distance away	✓	low	✓

Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Streblus pendulinus EPBC	-	E	Tree or large shrub to 6m tall. Coastal species along watercourses in warmer rainforest area.	x	x	-	-	x	x
Syzygium paniculatum OEH EPBC	V	V	Small tree. Subtropical and littoral rainforest on sandy soil. Distribution limits N-Forster S-Jervis Bay.	x	x	-	-	x	x
Tetratheca glandulosa OEH EPBC	V	V	Spreading shrub to 0.2m high. Sandy or rocky heath or scrub. Distribution limits N-Mangrove Mountain S-Port Jackson.	x	x	-	-	x	x
Tetratheca juncea OEH EPBC	V	V	Prostrate shrub to 1m high. Dry sclerophyll forest and heath. Distribution limits N-Bulahdelah S-Port Jackson.	x	poor	✓	✓	low	✓

OEH	- Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildlife*
EPBC	- Denotes species listed within 10km of the subject site in the *EPBC Act* habitat search
V	- Denotes vulnerable listed species under the relevant Act
E or E1	- Denotes endangered listed species under the relevant Act
NOTE:	1. This field is not considered if no suitable habitat is present within the subject site 2. 'records' refer to those provided by the *Atlas of NSW Wildlife* 3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle

A detailed assessment in accordance with Section 5A of the *EPA Act* will be completed for these species in Appendix 3 of this report.

Table A2.2 provides an assessment of potential habitat within the subject site for state and nationally listed threatened fauna species recorded within 10km on the *Atlas of NSW Wildlife* (OEH) or indicated to have potential habitat present within 10km on the *EPBC Act Protected Matters Tool.*

Table A2.2 – Threatened fauna habitat assessment

COMMON NAME **Scientific name** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**PREFERRED HABITAT** **Distribution limit**	**RECORDED ON SITE (✓)**	**IF NOT RECORDED ON-SITE**				**CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Wallum Froglet *Crinia tinnula* OEH	V	-	Found in acidic paperbark swamps and wallum country with dense groundcover. Breeds in temporary and permanent pools and ponds of high acidity. *Distribution Limit: N-Tweed Heads S-Kurnell.*	×	×	-	-	×	×
Giant Burrowing Frog *Heleioporus australiacus* EPBC	V	V	Inhabits open forests and riparian forests along non-perennial streams, digging burrows into sandy creek banks. *Distribution Limit: N-Near Singleton S-South of Eden.*	×	×	-	-	×	×
Giant Barred Frog *Mixophyes iteratus* EPBC	E	E	Terrestrial inhabitant of rainforest and open forests. *Distribution Limit: N-Border Ranges National Park. S-Narooma.*	×	×	-	-	×	×
Green and Golden Bell Frog *Litoria aurea* OEH EPBC	E	V	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. *Distribution Limit: N-Byron Bay S-South of Eden.*	×	×	-	-	×	×

COMMON NAME Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	PREFERRED HABITAT Distribution limit	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Littlejohn's Tree Frog *Litoria littlejohnii* EPBC	V	V	Found in wet and dry sclerophyll forest associated with sandstone outcrops at altitudes 280-1,000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. *Distribution Limit: N-Hunter River S-Eden.*	×	×	-	-	×	×
Broad-headed Snake *Hoplocephalus bungaroides* EPBC	E	V	Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. *Distribution Limit: N-Mudgee Park. S-Nowra.*	×	×	-	-	×	×
Stephens' Banded Snake *Hoplocephalus stephensii* OEH	V	-	A nocturnal and partly arboreal species that inhabits open and closed forest communities sheltering under bark, in hollows and under exfoliating slabs of granite. *Distribution Limit: N-Border Ranges National Park. S-Gosford.*	×	×	-	-	×	×
Blue-billed Duck *Oxyura australis* OEH	V	-	A completely aquatic species occurring mainly throughout the Murray-Darling basin in cool to warm temperate deep permanent freshwater lakes, lagoons and swamps with extensive reed-beds. *Distribution Limit: N-Tenterfield. S-Albury.*	×	×	-	-	×	×

COMMON NAME Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	PREFERRED HABITAT Distribution limit	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Freckled Duck *Stictonetta naevosa* OEH	V	-	Occurs mainly within the Murray-Darling basin and the channel country within large cool temperate to sub-tropical swamps, lakes and floodwaters with cumbungi, lignum or melaleucas. *Distribution Limit: N- Tenterfield. S-Albury.*	×	×	-	-	×	×
Rose-crowned Fruit-dove *Ptilinopus regina* OEH	V	-	Occurs in dense rainforests with a substantial understorey where it feeds entirely on fruit. *Distribution Limit" N-Tweed Heads. S-Wollongong.*	×	×	-	-	×	×
Superb Fruit-dove *Ptilinopus superbus* OEH	V	-	Rainforests, adjacent mangroves, eucalypt forests, scrubland with native fruits. *Distribution Limit: N-Border Ranges National Park. S-Bateman's Bay.*	×	×	-	-	×	×
Black-necked Stork *Ephippiorhynchus asiaticus* OEH	E	-	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats such as mangroves, tidal mudflats, floodplains, open woodlands, irrigated lands, bore drains, sub-artesian pools, farm dams and sewerage ponds. *Distribution Limit: N-Tweed Heads. S-Nowra.*	×	×	-	-	×	×

COMMON NAME **Scientific name** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**PREFERRED HABITAT** **Distribution limit**	**RECORDED ON SITE (✓)**	**IF NOT RECORDED ON-SITE**				**CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Australasian Bittern *Botaurus poiciloptilus* OEH EPBC	E	E	Found in or over water of shallow freshwater or brackish wetlands with tall reedbeds, sedges, rushes, cumbungi, lignum and also in ricefields, drains in tussocky paddocks, occasionally saltmarsh, brackish wetlands. *Distribution Limit: N-North of Lismore. S- Eden.*	×	×	-	-	×	×
Black Bittern *Ixobrychus flavicollis* OEH	V	-	Found in shadowy, leafy waterside trees such as callistemons, casuarinas, paperbarks, eucalypts, mangroves and willows along tidal creeks, freshwater and brackish streams and ponds, sheltered mudflats and oyster slats. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
Spotted Harrier *Circus assimilis* OEH	V	-	Utilises grassy plains, crops and stubblefields; saltbush, spinifex associations; scrublands, mallee, heathlands; open grassy woodlands. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
Little Eagle *Hieraaetus morphnoides* OEH	V	-	Utilises plains, foothills, open forests, woodlands and scrublands; river red gums on watercourses and lakes. *Distribution Limit - N-Tweed Heads. S-South of Eden.*	×	✓	×	×	unlikely	✓

COMMON NAME Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	PREFERRED HABITAT Distribution limit	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Eastern Osprey *Pandion cristatus* OEH	V	-	Utilises waterbodies including coastal waters, inlets, lakes, estuaries and offshore islands with a dead tree for perching and feeding. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
Red Goshawk *Erythrotriorchis radiatus* EPBC	E	V	Inhabits tall open forests and woodlands. Breeds in tall trees adjacent to watercourses of wetlands. *Distribution Limit: N-Border Ranges National Park. S-Foster.*	×	×	-	-	×	×
Bush Stone-curlew *Burhinus grallarius* OEH	E	-	Utilises open forests and savannah woodlands, sometimes dune scrub, savannah and mangrove fringes. *Distribution Limit: N-Border Ranges National Park. S-Near Nowra.*	×	×	-	-	×	×
Australian Painted Snipe *Rostratula australis* EPBC	E	V	Most numerous within the Murray-Darling basin and inland Australia within marshes and freshwater wetlands with swampy vegetation. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
Gang-gang Cockatoo *Callocephalon fimbriatum* OEH	V	-	Prefers wetter forests and woodlands from sea level to > 2,000m on the Great Dividing Range, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. *Distribution Limit: mid north coast of NSW to western Victoria.*	×	marginal	×	×	Not likely	×

COMMON NAME Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	PREFERRED HABITAT Distribution limit	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Glossy Black-Cockatoo *Calyptorhynchus lathami* OEH	V	-	Open forests with *Allocasuarina* species and hollows for nesting. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	✓	×	×	low	✓
Little Lorikeet *Glossopsitta pusilla* OEH	V	-	Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelterbeds, and street trees. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	✓	✓	×	✓	✓
Swift Parrot *Lathamus discolour* OEH EPBC	E	E	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. *Distribution Limit: N-Border Ranges National Park. S-South of Eden.*	×	×	-	-	×	×
Turquoise Parrot *Neophema pulchella* OEH	V	-	Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands. *Distribution Limit: N-Near Tenterfield. S-South of Eden.*	×	Sub-optimal	×	✓	unlikely	✓
Barking Owl *Ninox connivens* OEH	V	-	Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting. *Distribution Limits: N-Border Ranges National Park. S-Eden.*	×	✓	✓ x1	✓	✓	✓

COMMON NAME Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	PREFERRED HABITAT Distribution limit	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Powerful Owl *Ninox strenua* OEH	V	-	Forests containing mature trees for shelter or breeding and densely vegetated gullies for roosting. *Distribution Limits: N-Border Ranges National Park. S-Eden.*	×	✓	✓	✓	✓	✓
Masked Owl *Tyto novaehollandiae* OEH	V	-	Open forest and woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. *Distribution Limit: N-Border Ranges National Park. S-Eden.*	×	✓	✓	✓	✓	✓
Sooty Owl *Tyto tenebricosa* OEH	V	-	Tall, dense, wet forests containing trees with very large hollows. *Distribution Limit: N-Border Ranges National Park. S-South of Eden.*	×	×	-	-	×	×
Brown Treecreeper *Climacteris picumnus victoriae* OEH	V	-	Occupies Eucalypt woodlands, open woodland lacking a dense understorey with fallen dead timber. *Distribution Limit: (Sub species victoriae) Central NSW west of Great Div. Cumberland Plains, Hunter Valley, Richmond, Clarence, and Snowy River Valleys.*	×	×	-	-	×	×
Speckled Warbler *Chthonicola sagittata* OEH	V	-	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. *Distribution Limit: N-Urbanville. S-Eden.*	×	×	-	-	×	×

COMMON NAME Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	PREFERRED HABITAT Distribution limit	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
White-fronted Chat *Epithianura albifrons* OEH	V	-	Found in open damp ground, grass clumps, fence lines, heath, samphire saltmarshes, mangroves, dunes, saltbush plains. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
Regent Honeyeater *Xanthomyza Phrygia* OEH EPBC	E4A	E	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. *Distribution Limit: N-Urbanville. S-Eden.*	×	×	-	-	×	×
Grey-crowned Babbler *Pomatostoomus temporalis temporalis* OEH	V	-	Found in dry open forests, woodland scrubland, farmland with isolated trees. Distribution Limit mostly west of Great Dividing Range except Hunter Valley. *Distribution Limit: N-Qld widespread. S-Mornington Pen. E-se SA.*	×	×	-	-	×	×
Varied Sittella *Daphoenositta chrysoptera* OEH	V	-	Open eucalypt woodlands / forests (except heavier rainforests); mallee, inland acacia, coastal tea-tree scrubs; golf courses, shelterbelts, orchards, parks, scrubby gardens. *Distribution Limit: N-Border Ranges National Park. S-South of Eden.*	×	✓	✓	✓	✓	✓

COMMON NAME **Scientific name** DATABASE SOURCE	***TSC Act***	***EPBC Act***	**PREFERRED HABITAT** **Distribution limit**	**RECORDED ON SITE (✓)**	**IF NOT RECORDED ON-SITE**				**CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)**
					Suitable habitat present (✓)	**Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3*	**Record(s) from recent years (✓)** *Notes 1,2 & 3*	**Potential to occur**	
Scarlet Robin *Petroica boodang* OEH	V	-	Found in foothill forests, woodlands, watercourses; in autumn-winter, more open habitats: river red gum woodlands, golf courses, parks, orchards, gardens. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	✓	×	×	unlikely	✓
Diamond Firetail *Stagonopleura guttata* OEH	V	-	Found in Eucalypt woodlands, forests and mallee where there is grassy understorey west of the Great Div. also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence River Valleys. *Distribution Limit: N-Rockhampton Q. S-Eyre Pen Kangaroo Is. SA.*	×	×	-	-	×	×
Spotted-tailed Quoll *Dasyurus maculatus* OEH EPBC	V	E	Dry and moist open forests containing rock caves, hollow logs or trees. *Distribution Limit: N-Mt Warning National Park. S-South of Eden.*	×	✓	✓	✓	✓	✓
Koala *Phascolarctos cinereus* OEH EPBC	V	V	Inhabits both wet and dry eucalypt forest on high nutrient soils containing preferred feed trees. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	✓	×	×	unlikely	✓

COMMON NAME Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	PREFERRED HABITAT Distribution limit	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Eastern Pygmy Possum *Cercatetus nanus* OEH	V	-	Found in a variety of habitats from rainforest through open forest to heath. Feeds on insects but also gathers pollen from banksias, eucalypts and bottlebrushes. Nests in banksias and myrtaceous shrubs. *Distribution Limit: N-Tweed Heads. S-Eden.*	×	✓	×	×	unlikely	✓
Squirrel Glider *Petaurus norfolcensis* OEH	V	-	Mixed aged stands of eucalypt forest & woodlands including gum barked & high nectar producing species & hollow bearing trees. *Distribution Limit: N-Tweed Heads. S-Albury.*	×	✓	✓	✓	✓	✓
Long-nosed Potoroo *Potorous tridactylus* EPBC	V	V	Coastal heath and dry and wet sclerophyll forests with a dense understorey. *Distribution Limit: N-Mt Warning National Park. S-South of Eden.*	×	×	-	-	×	×
Brush-tailed Rock-wallaby *Petrogale penicillata* EPBC	E	V	Found in rocky gorges with a vegetation of rainforest or open forests to isolated rocky outcrops in semi-arid woodland country. *Distribution Limit: N-North of Tenterfield. S-Bombala.*	×	×	-	-	×	×

COMMON NAME Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	PREFERRED HABITAT Distribution limit	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Grey-headed Flying-fox *Pteropus poliocephalus* OEH EPBC	V	V	Found in a variety of habitats including rainforest, mangroves, paperbark swamp, wet and dry open forest and cultivated areas. Forms camps commonly found in gullies and in vegetation with a dense canopy. *Distribution Limit: N-Tweed Heads. S-Eden.*	×	✓	✓	✓	✓	✓
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* OEH	V	-	Rainforests, sclerophyll forests and woodlands. *Distribution Limit: N-North of Walgett. S-Sydney.*	×	✓	×	✓	low	✓
East-coast Freetail Bat *Micronomus norfolkensis* OEH	V	-	Inhabits open forests and woodlands foraging above the canopy and along the edge of forests. Roosts in tree hollows, under bark and buildings. *Distribution Limit: N-Woodenbong. S-Pambula.*	×	✓	✓	✓	✓	✓
Eastern Falsistrelle *Falsistrellus tasmaniensis* OEH	V	-	Recorded roosting in caves, old buildings and tree hollows. *Distribution Limit: N-Border Ranges National Park. S-Pambula.*	×	✓	×	✓	low	✓
Little Bentwing-bat *Miniopterus australis* OEH	V	-	Roosts in caves, old buildings and structures in the higher rainfall forests along the south coast of Australia. *Distribution Limit: N-Border Ranges National Park. S-Sydney.*	×	✓	✓	✓	✓	✓

COMMON NAME Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	PREFERRED HABITAT Distribution limit	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
Eastern Bentwing-bat *Miniopterus orianae oceansis* OEH	V	-	Prefers areas where there are caves, old mines, old buildings, stormwater drains and well-timbered areas. *Distribution Limit: N-Border Ranges National Park. S-South of Eden.*	×	✓	✓	✓	✓	✓
Large-footed Myotis *Myotis macropus* OEH	V	-	Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water. *Distribution limits: N-Border Ranges National Park. S-South of Eden.*	×	×	-	-	×	×
Greater Broad-nosed Bat *Scoteanax rueppellii* OEH	V	-	Inhabits areas containing moist river and creek systems, especially tree lined creeks. *Distribution Limit: N-Border Ranges National Park. S-Pambula.*	×	✓	×	✓	low	✓
Eastern Cave Bat *Vespadelus troughtoni* OEH	V	-	Inhabits drier open forests and woodlands. Roosts in well-lit parts of caves and mineshafts. *Distribution Limit: Along GDR from N-Tweed Heads. S-Kempsey.*	×	✓	×	✓	unlikely	✓

COMMON NAME Scientific name DATABASE SOURCE	*TSC Act*	*EPBC Act*	PREFERRED HABITAT Distribution limit	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST OF SIGNIFICANCE (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3*	Record(s) from recent years (✓) *Notes 1,2 & 3*	Potential to occur	
New Holland Mouse *Pseudomys novaehollandiae* OEH EPBC	-	V	Occurs in heathlands, woodlands, open forest and paperbark swamps and on sandy, loamy or rocky soils. Coastal populations have a marked preference for sandy substrates, a heathy understorey of leguminous shrubs less than 1m high and sparse ground litter. Recolonise of regenerating burnt areas. *Distribution Limit: N-Border Ranges National Park. S-South of Eden.*	×	✓	×	✓	unlikely	× Nationally listed species only
Australian Greyling *Prototroctes maraena* EPBC	Part 2, Section 19 – Protected Fish (FM Act 1994)	V	Clear, moderate to fast flowing water in the upper reaches of rivers (sometimes to altitudes above 1,000m). Typically found in gravel bottom pools. Often forming aggregations below barriers to upstream movement (e.g. weirs, waterfalls).	×	×	-	-	×	×

OEH	-	Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildlife*
EPBC	-	Denotes species listed within 10km of the subject site in the *EPBC Act* habitat search
V	-	Denotes vulnerable listed species under the relevant Act
E	-	Denotes endangered listed species under the relevant Act
NOTE:	1.	This field is not considered if no suitable habitat is present within the subject site
	2.	'records' refer to those provided by the *Atlas of NSW Wildlife*
	3.	'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle

A detailed assessment in accordance with Section 5A of the *EPA Act* will be completed for these species in Appendix 3 of this report.

Table A2.3 provides an assessment of potential habitat within the subject site for nationally *protected* migratory fauna species recorded within 10km on the *EPBC Act Protected Matters Tool*. Nationally threatened migratory species are considered in Table A2.2.

Table A2.3 – Migratory fauna habitat assessment

COMMON NAME ***Scientific name***	**PREFERRED HABITAT** ***Migratory breeding***	**Suitable habitat present (✓)**	**Recorded on site (✓)**	**COMMENTS**
White-bellied Sea Eagle (*Haliaeetus leucogaster*)	Coasts, islands, estuaries, inlets, large rivers, inland lakes, reservoirs. *Sedentary; dispersive.*	marginal	×	-
White-throated Needletail (*Hirundapus caudacutus*)	Airspace over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies forage often along favoured hilltops and timbered ranges. *Breeds Siberia, Himalayas, east to Japan. Summer migrant to eastern Australia.*	✓	×	-
Rainbow Bee-eater (*Merops ornatus*)	Open woodlands with sandy, loamy soil; sandridges, sandspits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves, rainforest, woodlands, golf courses. *Breeding resident in northern Australia. Summer breeding migrant to south east and south west Australia.*	marginal	×	-
Black-faced Monarch (*Monarcha melanopsis*)	Rainforests, eucalypt woodlands; coastal scrubs; damp gullies in rainforest, eucalypt forest; more open woodland when migrating. *Summer breeding migrant to coastal south east Australia, otherwise uncommon.*	×	-	-
Spectacled Monarch (*Monarcha trivirgatus*)	Understorey of mountain / lowland rainforest, thickly wooded gullies, waterside vegetation, mostly well below canopy. *Summer breeding migrant to south-east Qld and north-east NSW down to Port Stephens from Sept/Oct to May. Uncommon in southern part of range.*	×	-	-
Satin Flycatcher (*Myiagra cyanoleuca*)	Heavily vegetated gullies in forests, taller woodlands, usually above shrub-layer; during migration, coastal forests, woodlands, mangroves, trees in open country, gardens. *Breeds mostly south east Australia and Tasmania over warmer months, winters in north east Qld.*	×	-	-
Rufous Fantail (*Rhipidura rufifrons*)	Undergrowth of rainforests / wetter eucalypt forests / gullies; monsoon forests, paperbarks, sub-inland and coastal scrubs; mangroves, watercourses; parks, gardens. On migration, farms, streets buildings. *Breeding migrant to south east Australia over warmer months. Altitudinal migrant in north east NSW in mountain forests during warmer months.*	marginal	×	-

COMMON NAME *Scientific name*	PREFERRED HABITAT *Migratory breeding*	Suitable habitat present (✓)	Recorded on site (✓)	COMMENTS
Great Egret (*Ardea alba*)	Shallows of rivers, estuaries; tidal mudflats, freshwater wetlands; sewerage ponds, irrigation areas, larger dams, etc. *Dispersive; cosmopolitan.*	×	-	-
Cattle Egret (*Ardea ibis*)	Stock paddocks, pastures, croplands, garbage tips, wetlands, tidal mudflats, drains. *Breeds in summer in warmer parts of range including NSW.*	×	-	-
Latham's Snipe (*Gallinago hardwickii*)	Soft wet ground or shallow water with tussocks and other green or dead growth; wet parts of paddocks; seepage below dams; irrigated areas; scrub or open woodland from sea-level to alpine bogs over 2,000m; samphire on saltmarshes; mangrove fringes. *Breeds Japan. Regular summer migrant to Australia. Some overwinter.*	×	-	-
Fork-tailed Swift (*Apus pacificus*)	Aerial: over open country, from semi-arid deserts to coasts, islands; sometimes over forests, cities. *Breeds Siberia, Himalayas, east to Japan south east Asia. Summer migrant to east Australia. Mass movements associated with late summer low pressure systems into east Australia. Otherwise uncommon.*	✓	×	-

7 Part Test of Significance

A3

Council is required to consider the impact upon threatened species, populations and / or EECs from any development or activity via the process of a 7 part test of significance. The significance of the assessment is then used to determine the need for a more detailed SIS.

The following preliminary 7 part test of significance relies on the ecological assessment provided in Sections 3 and 4 of this report and should be read as such. It assumes that the development impact includes the entirety of the site subject to selective tree and habitat retention. The entire site will be managed to APZ standards but all vegetation removal will be minimised such that it is APZ compliant but retains important habitat features.

Detailed flora and fauna investigations of the subject site, together with habitat assessments, have resulted in the identification of potential habitat for a variety of threatened species. An assessment of these species is as follows:

Threatened flora

- *Acacia bynoeana*
- *Angophora inopina*
- *Corunastylis* sp. Charmhaven
- *Cryptostylis hunteriana**
- *Diuris praecox*
- *Rutidosis heterogama*
- *Tetratheca juncea*

Endangered ecological communities

- nil

Threatened fauna

- Little Eagle
- Glossy Black-Cockatoo
- Little Lorikeet
- Turquoise Parrot
- Barking Owl
- Powerful Owl
- Masked Owl
- Varied Sittella
- Scarlet Robin
- Spotted-tailed Quoll
- Koala
- Eastern Pygmy Possum
- Squirrel Glider
- Grey-headed Flying-fox
- Yellow-bellied Sheathtail-bat
- East-coast Freetail Bat
- Eastern Falsistrelle
- Little Bentwing-bat
- Eastern Bentwing-bat
- Greater Broad-nosed Bat
- Eastern Cave Bat

Endangered populations

- There are two (2) known endangered populations within Wyong Shire. *Eucalyptus parramattensis* subsp. *parramattensis* in the Wyong and Lake Macquarie LGAs and *Eucalyptus oblonga* at Bateau Bay.

The 7 part test of significance is as follows.

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

No threatened species were recorded within the subject site during surveys with the exception of *Cryptostylis hunteriana*. The following statement applies to all species except for *Cryptostylis hunteriana:* It is considered that the proposal is unlikely to disrupt the life cycle for any of these listed species such that a viable local population would be placed at risk of extinction.

Within the local area and containing similar and better quality habitats is the Lake Macquarie State Conservation Area. Adjoining conservation and open space lands also provide similar habitats.

Species with a considered high potential to occur

The Squirrel Glider habitat assessment (Section 4.3.3) has highlighted that the subject site provides high quality and high potential Squirrel Glider habitat. Habitat present is suitable for foraging, denning and breeding. No gliders were identified at the time of survey, however, glider activity was evident by chew marks on numerous Red Bloodwood trees (see Figure 2 for locations). This activity may also be the non-threatened Sugar Glider, or both species.

The removal of 2.55ha of the suitable habitat is not considered likely to significantly impact on the Squirrel Glider such that the viable local population is likely to be placed at risk of extinction. This is simply based on the quantity of habitat removed and the availability of similar habitat in the local surrounds. The site does no doubt provide potential for use, particularly as seasonal foraging resources permit.

In consideration of the Squirrel Glider habitat assessment, trapping survey is considered necessary to best determine presence or absence of Squirrel Glider and establish further appropriate mitigation measures including the offsetting of habitat lost.

Cryptostylis hunteriana

Despite limited records locally and thus indicating that there was a low likelihood of occurrence, the species was recorded during its flowering period on 1 December 2013. Survey was conducted over the entire site but only one (1) observation was noted, on the edge of the bushland abutting Kanangra Drive, approximately 1m from an existing track on the western edge of the site. A brief target survey within a 50m radius of the specimen was conducted on 3 December 2013.

The location of the individual is within a dedicated landscape buffer easement of the site that is not subject to clearing by the proposal. To ensure the longevity of the species, it needs to be conserved insitu. An orchid protection zone within the dedicated landscape buffer easement would ensure no clearance is undertaken in the immediate vicinity for APZs. If this can be achieved, then the proposal is unlikely to disrupt the life cycle of the species such that a viable local population would be placed at risk of extinction.

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

There are no endangered fauna populations within the Wyong LGA.

There are two endangered flora populations within the Wyong LGA, These are:

- *Eucalyptus parramattensis* subsp. *parramattensis* in the Wyong and Lake Macquarie LGAs
- *Eucalyptus oblonga* at Bateau Bay

Despite searches undertaken for both of these species within the subject site, no specimens were located.

Therefore, it is considered that the action proposed is not likely to have an adverse effect on the life cycle of these species that constitute the endangered populations such that a viable local population of these species is likely to be placed at risk of extinction.

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

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

Vegetation within the subject site is not part of any EEC.

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

Vegetation within the subject site is not part of any EEC.

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

It is considered that the habitat attributes of the subject site provide known or potential habitat for *Acacia bynoeana, Angophora inopina, Corunstylis* sp. Charmhaven, *Cryptostylis hunteriana, Diuris praecox, Rutidosis heterogama, Tetratheca juncea,* Little Eagle, Glossy Black-Cockatoo, Little Lorikeet, Turquoise Parrot, Barking Owl, Powerful Owl, Masked Owl, Varied Sittella, Scarlet Robin, Spotted-tailed Quoll, Koala, Eastern Pygmy Possum, Squirrel Glider, Grey-headed Flying-fox, Yellow-bellied Sheathtail-bat, East-coast Freetail Bat, Eastern Falsistrelle, Little Bentwing-bat, Eastern Bentwing-bat, Greater Broad-nosed Bat and Eastern Cave Bat.

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

The subject site has an area of 3ha, which comprises approximately 2.55ha of natural vegetation and 0.4ha of cleared vegetation and 0.05ha of planted vegetation. There is some connectivity to adjoining bushland to the west and south east but there is perceived fragmentation, or a barrier, due to Kanangra Drive and Parraweena Road. Infrastructure and commercial premises adjoin the property to the west and south, and residential development adjoins to the north and east.

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

The subject site is not expected to provide a well utilised corridor in the local area given the surround land uses and well utilised roads adjoining. The proposal is not likely going to fragment or isolate habitats of any significance in the long term.

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

The lack of any threatened species records, lack of any EECs and lack of any endangered populations suggests the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population and ecological communities in the locality is considered to be minimal.

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

The site has not been identified as critical habitat within the provisions of the *TSC Act.* Therefore this matter does not require any further consideration at this time.

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

Draft state recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- Barking Owl (*Ninox connivens*) (NPWS 2003)

Approved state recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- Koala (*Phascolarctos cinereus*) (DEC 2008)
- Large Forest Owls ((Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*) (DEC 2006).

It is considered that the proposed development is generally consistent with the objectives or actions of the abovementioned draft and approved recovery plans.

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

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

The current list of key threatening processes under the *TSC Act*, and whether the proposed activity is recognised as a threatening process, is shown below.

Listed key threatening process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Alteration of habitat following subsidence due to longwall mining			✓
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands			✓
Anthropogenic Climate Change			✓
Bushrock removal			✓
Clearing of native vegetation	✓		
Competition and habitat degradation by feral goats			✓
Competition and grazing by the feral European Rabbit (*Oryctolagus cuniculus*)			✓
Competition from feral honeybees			✓
Death or injury to marine species following capture in shark control programs on ocean beaches			✓
Entanglement in, or ingestion of anthropogenic debris in marine and estuarine environments			✓
Forest Eucalypt dieback associated with over-abundant psyllids and bell miners			✓
High frequency fire resulting in the disruption of life-cycle processes in plants and animals and loss of vegetation structure and composition			✓
Herbivory and environmental degradation caused by feral deer			✓
Importation of red imported fire ants into NSW			✓
Infection by *Psittacine circoviral* (beak and feather) disease affecting endangered psittacine species and populations			✓
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis			✓
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae		✓	
Infection of native plants by *Phytophthora cinnamomi*		✓	
Introduction of the large earth bumblebee (*Bombus terrestris*)			✓
Invasion and establishment of exotic vines and scramblers			✓
Invasion and establishment of Scotch Broom (*Cytisus scoparius*)			✓
Invasion and establishment of the Cane Toad (*Bufo marinus*)			✓
Invasion, establishment and spread of *Lantana camara*			✓
Invasion of native plant communities by bitou bush & boneseed *Chrysanthemoides monilifera*			✓
Invasion of native plant communities by exotic perennial grasses		✓	
Invasion of native plant communities by African Olive (*Olea europaea* subsp. *cuspidata*)			✓
Invasion of the Yellow Crazy Ant (*Anoplolepis gracilipes*)			✓
Loss of hollow bearing trees	✓		

Listed key threatening process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	**Possible**	**Unlikely**
Loss and / or degradation of sites used for hill-topping by butterflies			✓
Predation and hybridisation by feral dogs (*Canis lupus familiaris*)			✓
Predation by the European Red Fox (*Vulpes vulpes*)			✓
Predation by the Feral Cat (*Felis catus*)			✓
Predation by Plague Minnow or Mosquito Fish (*Gambusia holbrooki)*			✓
Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island			✓
Predation, habitat degradation, competition & disease transmission from Feral pigs (*Sus scofa*)			✓
Removal of dead wood and dead trees	✓		

Summary of "likely" or "possible" Key Threatening Processes

Where a threatening process is likely of possible mitigation measures are recommended to minimise any potential adverse impacts.

Clearing of native vegetation - Approximately 2.55ha of native vegetation is proposed for removal. *Mitigation measure - retention of native vegetation within the road corridor, selective tree retention in landscape and planting of local native species in landscaping and street-scaping works.*

Infection of native plants by Phytophthora cinnamomi - The proposal may temporarily increase the risk of fungal infection on site as it may be spread via vehicular movement and relocation of soil and vegetation. *Mitigation measure - standard Phytophthora cinnamomi protocol applies to the cleaning of all plant, equipment, hand tools and work boots prior to delivery onsite to ensure that there is no loose soil or vegetation material caught under or on the equipment and within the tread of vehicle tyres. Any equipment found to contain soil or vegetation material is to be cleaned in a quarantined work area or wash station and treated with anti-fungal pesticides.*

Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae - Myrtle Rust may be spread via machinery, animals and humans as well as by environmental factors such as wind. The presence of machinery and construction works is likely to slightly increase the potential for spread of this newly listed key threatening process. *Mitigation measure - similar protocols as to Phytophthora cinnamomi should be applied.*

Invasion of native plant communities by exotic perennial grasses - The proposal is of a class of development recognised as a threatening process due to possible incursions of grasses such as *Pennisetum clandestinum* (Kikuyu) and *Stenotaphrum secundatum* (Buffalo Grass). These species tend to occur on the northern and eastern perimeter of the site and in the south western corner. *Mitigation measure - undertake weed control will minimise the extent of such grasses in retained native vegetation.*

Loss of hollow bearing trees – Hollow bearing tree surveys identified twenty-six (26) hollow bearing trees containing medium (10-30cm) and small (0-10cm) sized hollows within the subject site. Seventeen (17) of these trees contain hollows considered suitable for use by Squirrel Glider. The proposal will require the removal of hollow bearing trees and, as such, is of a class of development recognised as a threatening process. Threatened species with suitable habitat within the site and dependant on hollows of this nature include Glossy Black-Cockatoo, Little Lorikeet, Turquoise Parrot, Spotted-tailed Quoll, Squirrel Glider, Eastern Pygmy Possum, Eastern Falsistrelle, East-coast Freetail Bat, Greater Broad-nosed Bat and Yellow-bellied Sheathtail-bat. None of these species were recorded during surveys undertaken. *Mitigation measure – inspection of hollows to determine recent occupation, retain high quality hollow bearing trees and preferentially remove low quality and poor condition hollow bearing trees. Relocate impacted high quality hollows (particularly those with recorded use) and / or replacement of hollows with nest boxes is recommended to supplement the loss of hollow bearing trees.*

Removal of dead wood and dead trees - The proposal will require the removal of deadwood and / or dead trees and as such is of a class of development recognised as a threatening process. Threatened fauna species with potential habitat within the subject site and likely dependent on dead wood or dead trees include Varied Sittella and Scarlet Robin. These species have not been recorded to date within the subject site. *Mitigation measure – retain deadwood in trees and on ground where possible in locations that do not create a safety hazard*

National - Significant Impact Criteria

A4

Under the *EPBC Act,* an action will require approval from the Australian Government Environment Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. The following significant impact criteria were sourced from the *EPBC Act* Policy Statement 1.1 (May 2006):

CRITICALLY ENDANGERED AND ENDANGERED SPECIES

Significant impact criteria

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- Lead to a long-term decrease in the size of a population;
- Reduce the area of occupancy of the species;
- Fragment an existing population into two or more populations;
- Adversely affect habitat critical to the survival of a species;
- Disrupt the breeding cycle of a population;
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
- Introduce disease that may cause the species to decline; or
- Interfere with the recovery of the species.

>> What is a population of a species?

A 'population of a species' is defined under the *EPBC Act* as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:
- a geographically distinct regional population, or collection of local populations; or
- a population, or collection of local populations, that occurs within a particular bioregion.

>> What is habitat critical to the survival of a species or ecological community?

'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:
- For activities such as foraging, breeding, roosting, or dispersal;
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- To maintain genetic diversity and long term evolutionary development; or
- For the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the *EPBC Act.*

VULNERABLE SPECIES

Significant impact criteria

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species;
- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
- introduce disease that may cause the species to decline; or
- interfere substantially with the recovery of the species.

>> What is an important population of a species?

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and / or that are:

- Key source populations either for breeding or dispersal;
- Populations that are necessary for maintaining genetic diversity; and / or
- Populations that are near the limit of the species range.

CRITICALLY ENDANGERED AND ENDANGERED ECOLOGICAL COMMUNITIES

Significant impact criteria

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- Reduce the extent of an ecological community;
- Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;
- Adversely affect habitat critical to the survival of an ecological community;
- Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;
- Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;
- Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
  - assisting invasive species, that are harmful to the listed ecological community, to become established; or
  - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or
- Interfere with the recovery of an ecological community.

MIGRATORY SPECIES

Significant impact criteria

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

>> What is important habitat for a migratory species?

An area of 'important habitat' for a migratory species is:

a) Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and / or
b) Habitat that is of critical importance to the species at particular life-cycle stages; and / or
c) Habitat utilised by a migratory species which is at the limit of the species range; and / or
d) Habitat within an area where the species is declining.

>> What is an ecologically significant proportion?

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

>> What is the population of a migratory species?

'Population', in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.

Squirrel Glider Habitat Assessment

A5

HABITAT QUALITY (VEGETATION TYPE)	Habitat area	% Habitat type
Stringybark / Gum with Acacia / Melaleuca / Grass Understorey		
Spotted Gum / Ironbark / Gum		
Stringybark with Banksia / Allocasuarina / Melaleuca understorey		
Sydney Red Gum / Scribbly Gum with Allocasuarina / Melaleuca understorey	½	100
Sydney Red Gum / Scribbly Gum with Banksia understorey	½	
Other 1:-		
Other 2:-		

REMNANT PATCH SIZE – (Measured from air photo / topographic map)	
Patch <5ha	✓
Patch >5 and <10ha	
Patch >10 and <30ha	
Patch >30 and <90ha	

DENSITY OF HABITAT TREES – (Refer to habitat tree assessment)	
Average number of trees with hollows / ha **<2** habitat trees / ha	
Average number of trees with hollows / ha **>2** habitat trees / ha	✓

ABUNDANCE OF FOOD PLANTS – (From transect and quadrat data)

Quantitatively assessed using plot based data, the proportion of Squirrel Glider food plants which occur on the site and show plot locations on map. Effort should be applied as per Council's *Flora and Fauna Guidelines for Development* (see section on survey effort for vegetation plots).

Food plants	Food item	Av. No. of plants / hectare	% of Vegetation assemblage
Angophora costata	Sap, nectar & pollen	25	5
Eucalyptus haemastoma	Sap, nectar & pollen	75	30
Eucalyptus racemosa	Sap, nectar & pollen	-	
Eucalyptus robusta	Sap, nectar & pollen	-	
Eucalyptus siderophloia	Sap, nectar & pollen	-	
Eucalyptus paniculata	Sap, nectar & pollen	-	
Eucalyptus fibrosa	Sap, nectar & pollen	-	
Corymbia gummifera	Sap, nectar & pollen	50	10
Corymbia maculata	Nectar & pollen	-	
Melaleuca linariifolia	Nectar & insects	-	
Melaleuca nodosa	Nectar & insects	-	
Melaleuca quinquenervia	Nectar & insects	-	
Melaleuca sieberi	Nectar & insects	-	
Acacia spp.	Seeds & gum	25	5
Banksia spinulosa	Nectar & pollen	2	<1
Banksia serrata	Nectar & pollen	-	

Banksia integrifolia	Nectar & pollen	-	
Banksia oblongifolia	Nectar & pollen	-	
Xanthorrhoea spp.	Nectar & gum	200	5

1.2 HABITAT VULNERABILITY

a) Edge to width ratio

Which shape is the patch size most similar to? (e.g. square, round, oval, rectangular, triangular, narrow/linear)

rectangle

b) Habitat disturbance

What % of the patch area has experienced disturbance by weed invasion, underscrubbing, fire or other understorey disturbance?

<10%

c) Proximity to existing or future residential development

Is the fragment within 200m of an existing or future residential development?

Yes ✓ No ☐

2.3 RESIDENT BREEDING SQUIRREL GLIDERS

Presence / absence of resident breeding Squirrel Gliders in patch

Yes ☐ No ☐

Squirrel Gliders have not been recorded present to date but have potential to occur based on records.

Applicants must supply details from trapping programme.

Not undertaken

Date	Method	Transect	Number of Individuals	Male or female (with young?)