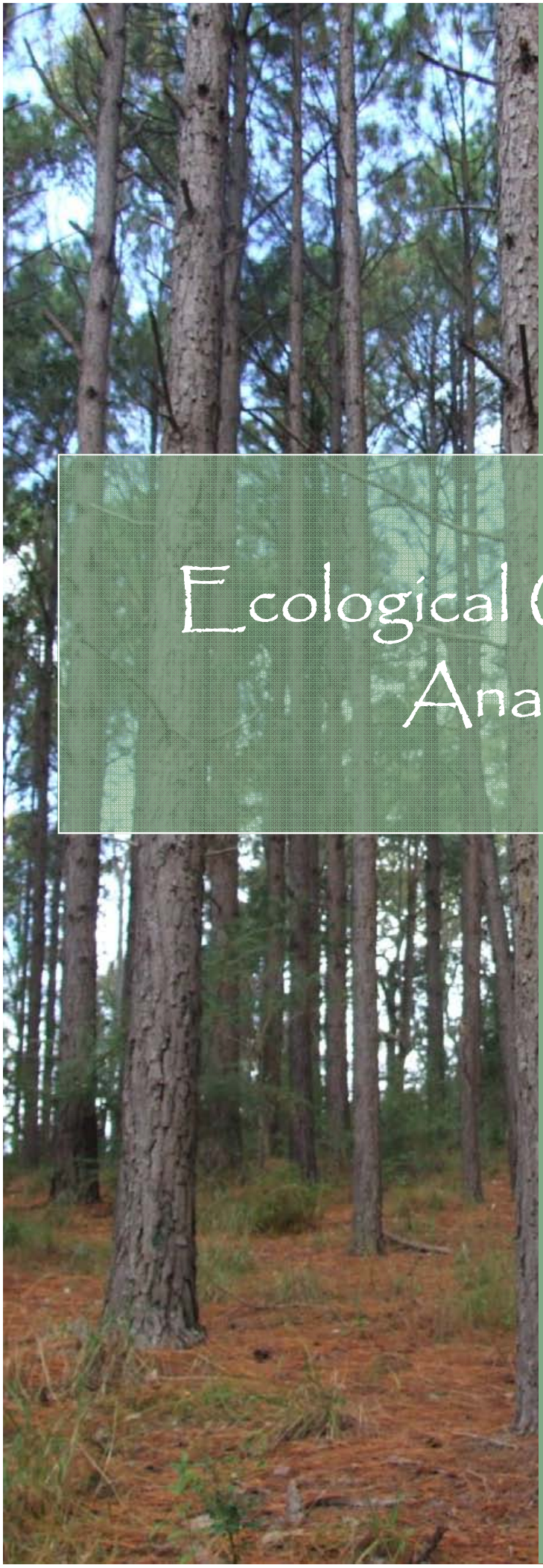

Travers

bushfire & ecology

Ecological Constraints Analysis

BUNDEENA ROAD
GLENNING VALLEY

SEPTEMBER 2010
(REF: A10031F)

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ECOLOGICAL CONSTRAINTS ANALYSIS

Lot 2 DP 1100181, Lot 4 DP 1078468, Lot 455 DP 786675, Lot 413 & 414 DP 808340, Lot 52 1037187, Lot 1111 DP 1143167, Lot 21 DP 740435, Lot 22 DP 740435, Lot 513 DP 500951 and Lot 511 DP 205919 at Bundeena Road, Glenning Valley.

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Plans prepared:	Trent Matheson, Ben Barclay, Kath Alexander
Version:	27/9/10
File:	A10031F

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 relied upon as meaning it reflects any advice by this firm.

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EXECUTIVE SUMMARY

This assessment report has been prepared by *Travers bushfire & ecology* to identify the ecological characteristics and constraints of land comprising Lot 2 DP 1100181, Lot 4 DP 1078468, Lot 455 DP 786675, Lot 413 & 414 DP 808340, Lot 52 1037187, Lot 1111 DP 1143167, Lot 21 DP 740435, Lot 22 DP 740435, Lot 513 DP 500951 and Lot 511 DP 205919 located west of Bundeena Road and north of Berkeley Road at Glenning Valley.

The report has assessed a proposed rezoning from part 7(a) Conservation Zone, 7(f) Environmental Protection Zone and 7(g) Wetlands Management Zone to Part R2 (Low Density Residential) and part E3 (Environmental Management Zone).

The extensive ecological survey undertaken along with expert advice from external specialist consultants we believe the constraints plan represented in Figure 5 together with ecological offsetting provides an appropriate conservation / development balance.

John Travers *BSc / Ass Dip / Grad Dip.*
Managing Director

Licences

Individual staff members are licensed under Clause 20 of the *National Parks and Wildlife (Land Management) Regulation 1995* and Section 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: S10359.

The staff of *Travers bushfire & ecology* 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.

List of abbreviations

APZ	asset protection zone
BPA	bushfire protection assessment
CLUMP	conservation land use management plan
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
DEWHA	Federal Department of the Environment, Water, Heritage and the Arts
EEC	endangered ecological community
EPA	Environmental Protection Agency
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*
FMP	fuel management plan
HTA	habitat tree assessment
IPA	inner protection area
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
OPA	outer protection area
PBP	*Planning for Bush Fire Protection 2006: A Guide for Councils, Planners, Fire Authorities and Developers*
POM	plan of management
RF Act	*Rural Fires Act*
RFS	NSW Rural Fire Service
ROTAP	rare or threatened Australian plants
SEPP 44	*State Environmental Protection Policy No 44 – Koala Habitat Protection*
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

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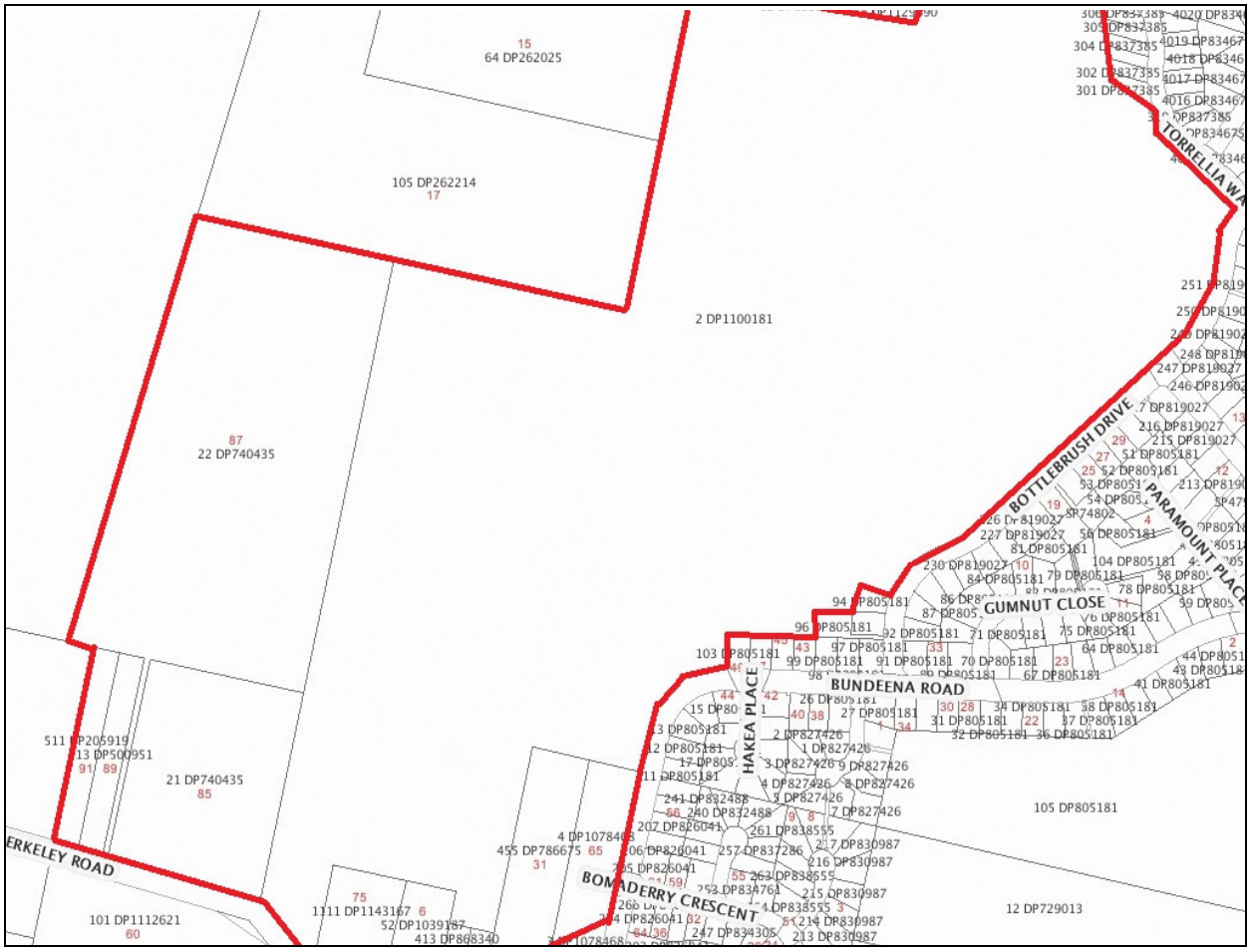
1 INTRODUCTION

Travers bushfire & ecology has been engaged by *Worley Parsons* to undertake an ecological constraints analysis for a proposed rezoning proposal being considered by a Local Environment Study (LES) at Glenning Valley - See insert 1.



Insert 1 – Approximate LEP boundary.

The following lots are the primary areas of investigation and will hereafter be referred to as the 'subject site':

- Lot 2 DP 1100181
- Lot 4 DP 1078468
- Lot 455 DP 786675
- Lot 413 & 414 DP 808340
- Lot 52 1037187
- Lot 1111 DP 1143167
- Lot 21 DP 740435
- Lot 22 DP 740435
- Lot 513 DP 500951
- Lot 511 DP 205919

The surrounding landscape to the subject site has also been incorporated into field investigations and desktop analysis, particularly the SEPP 14 wetland to the north, and these areas, combined with the subject site, will be referred to as the 'study area'.

This has included investigation over appropriate portions of the following lands;

- Part of Lot 504 DP 1134328
- Part of Lot 63 DP 262025
- Part of Lot 64 DP 262025
- Part of Lot 104 DP 262214
- Part of Lot 105 DP 262214

The study area is bounded by Torrellia Way (north-east), Bottlebrush Drive (east), Bundeena Road (south-east) and Berkeley Road (south) in the suburbs of Glenning Valley and Berkeley Vale.

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 in accordance with the guidelines adopted by Wyong Council

- Carry out a fauna survey for the detection and assessment of fauna and their habitats in accordance with the guidelines adopted by Wyong Council

- Complete target surveys for threatened species, populations and ecological communities

- Assess the conservation value of the site and the level of ecological connectivity occurring.

- Provide an analysis of the ecological constraints present.
- Review the subject site in regard to regional conservation planning initiatives.
- Make recommendations to the likely development area and the required buffer zones.

1.2 Information collation

A review of the relevant information pertinent to the subject site was undertaken prior to the initiation of field surveys as background to the study. Information sources reviewed include the following:

Site and client documents including:

- Correspondence Wyong Shire Council 1st April 2008
- Wyong Shire Council Directors Report to Council 26th March 2008
- Survey and mapping undertaken by *Worley Parsons*
- Soil, Water and Wastewater Management Plan prepared by *Martens Consulting Engineers*
- Soil, Water and Wastewater Management Plan prepared by *Worley Parsons*
- Bushfire Risk Assessment Report prepared by *South Pacific Consulting Services Pty Ltd* (date not specified)
- Assessment of Impact Using the 8-part test on *Melaleuca biconvexa* and Swamp Sclerophyll Forest on Coastal Floodplains prepared by *Anne Clements and Associates Pty Ltd* (2006)
- *Wyong Shire Council* Directors Report (2008)
- Koala Survey (SEPP 44 Assessment) Lot 2 DP 1100181 Bundeena Rd, Glenning Valley *Biolink*, (2008).
- *Rootzone* (2009) Specialist advice in respect of water transport
- Nursery Management Plan, *Horticultural Services* (2008)
- Flora and Fauna Assessment *Conacher Travers* 2003 (of the Study Area being Lot 2 DP 1100181)
- Habitat Tree Survey *Conacher Travers* 2003 (of the Study Area being Lot 2 DP 1100181)
- Flora Assessment, *Anne Clements and Associates Pty Ltd* (2006)
- Ecological Assessment, *Anne Clements and Associates Pty Ltd* (2006)
- Vegetation Management Plan *Anne Clements & Associates* (2006)

- Water Management Cycle *Martens Consulting Engineers* (2006)
- Fauna Survey and Assessment, *Ambrose Ecological Services Pty Ltd* (2007)
- Habitat Tree Survey *Travers bushfire & ecology* (2008)
- Target Survey for Koala, *Travers bushfire & ecology* (2008)
- Bushfire Protection Assessment *Travers bushfire & ecology* (March 2009)
- Water Management Cycle *Worley Parsons* (2009)

Standard technical resources

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities 2004* (working draft), Department of Environment and Conservation (DEC)
- *Flora and Fauna Guidelines for Development – Wyong Shire Council (1999)*
- Aerial photographs (scale 1:25,000) and Topographical maps (scale 1:25,000)
- *Atlas of NSW Wildlife 2010* (DECCW) 1:100,000 scale map sheet
- The schedules of the *Threatened Species Conservation Act, 1995*
- The schedules of the *Fisheries Management Act, 1994*
- Lists of threatened species and communities in the *Environmental Protection and Biodiversity Act 1999*
- Rare or Threatened Australian Plants (ROTAP)
- The natural vegetation maps for the study area including Wyong Local Government Area, Central Coast, New South Wales (Stephen Bell) and LHCCREMS Vegetation Mapping (House).

1.3 Statutory requirements

1.3.1 Threatened Species Conservation Act 1995

The specific requirements of the *TSC Act* must be addressed in the assessment of flora and fauna matters. This requires the consideration of potential impacts on threatened species, 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 *Environmental Planning and Assessment Act 1979* (EPA 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) may be prepared subject to due consideration by the determining authority.

Guidelines on the correct interpretation of the assessment of significance are located on the department's website – see *Threatened Species Assessment Guidelines* (DEC 2007).

1.3.2 Fisheries Management Act 1994

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, a Species Impact Statement may be required.

1.3.3 Environment Protection and Biodiversity Conservation Act 1999

The *Environmental Protection and Biodiversity Conservation Act* (EPBC) requires that Commonwealth approval be obtained for certain actions.

The process 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 the Environment, Water, Heritage and the Arts (DEWHA)* 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 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*.

1.4 Rezoning proposal

The report has assessed a proposed rezoning of the studied lands from part 7(a) Conservation Zone, 7(f) Environmental Protection Zone and 7(g) Wetlands Management Zone to Part R2 (Low Density Residential) and part E3 (Environmental Management Zone) as described in the Wyong Local Environmental Plan.

1.5 Site description

The planning and cadastral details of the subject site are provided in Table 1.1, while Table 1.2 summarises the geographical characteristics of the site.

Table 1.1 – Site details

Area	The proposed LEP boundary is approximately 53.38ha.
Topographic map	Wyong 1:25000
Grid reference	352910E and 6310090N
Local government area	Wyong Shire Council
Existing zoning / land use	The current zoning of the site is part 7(a) Conservation Zone, 7(f) Environmental Protection Zone and 7(g) Wetlands Management Zone.

Table 1.2 – Site characteristics

Elevation	The approximate elevation of the site is between 5-35 metres AHD.
Topography	The study area is situated on moderately to gently undulating land and is not crossed by any prominent watercourses. Gradients of the study area are generally less than 10%.
Aspect	Predominantly west with gradients increasing to the east.
Geology and soils	The geology of the study area is generally characterised by sediments of the Narrabeen Series, which is within the Triassic Period. The study area also contains a small area of quaternary alluvium. The soils are deep and sandy, generally with no rock outcrops except for a small area near Torrellia Way, where there are some rock exposures. The Gosford – Lake Macquarie 1:100,000 Soil Landscape map sheet (Murphy & Tille, 1993) shows that the study area is located within a combination of the Erina, Wyong and Woodburys Bridge Soil Landscapes.
Catchment	Ourimbah Creek
Drainage	The study area drains into the SEPP 14 wetland off Enterprise Drive and from there, by an unnamed watercourse, into Ourimbah Creek.

Table 1.2 – Site characteristics

Vegetation	The majority of the study area is vegetated with natural bushland which is part of an extensive area of natural bushland along Enterprise Drive and extending south west beyond Berkeley Road. An area in the north east has been previously cleared and is in the process of regenerating into the original vegetation community. An area in the south west has been cleared for agricultural purposes and is currently used for rural residential purposes.

The subject site has been affected by the following impacts:

Table 1.3 – Site disturbance

Clearing	Approximately 10% of the study area is cleared in the south western and north eastern ends of the study area. There is evidence of previous logging within the Blackbutt Open Forest areas of the site.A number of vehicular trails have been constructed. A prominent vehicular trail runs from south east to north west, through the north eastern part of the study area. The area north east of that trail has been underscrubbed and partially cleared in the past. That area is at present successfully regenerating. A residence and associated buildings have been erected in the south western section of the study area where the majority of clearing has occurred. A farm dam has been constructed in the south western section of the study area.
Agriculture / Pastoral	The south western end of the study area has been previously cleared for agricultural purposes but was not being used for any purpose at the time of the survey. There is evidence of previous logging throughout the study area.
Earthworks	Apart from the dam and minor works adjacent to Torrellia Way, no earthworks have been conducted within the study area.
Introduced weeds	The two previously cleared areas contain significant incursions of a variety of weeds. The natural bushland is relatively free from weeds except for scattered occurrences of *Lantana camara* (Lantana).
Evidence of feral, introduced or domestic fauna	Native fauna within the study area are likely to have been impacted upon by predation from European Red Fox (*Vulpes vulpes*), Cats (*Felis catus*) and Dogs (*Canis familiaris*). Donkey, Horse, Rabbit, Black Rat, Common Myna and Spotted Turtle-doves have also been recorded during surveys to date and likely provide impacts on native species.

2 SURVEY TECHNIQUES

2.1 Background

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 overcome this survey limitation.

2.2 Survey techniques

To determine the likely and actual occurrence of flora species, fauna species and plant communities on the subject site a variety of assessments were undertaken to supplement previous surveys of the area and literature reviews. The methods utilised included:

- ***Literature review*** – A review of readily available literature for the area was undertaken to obtain reference material and background information for this survey. Additional information sources include the references as identified in Section 1.2 above.

- ***Data search*** – A search of the *Atlas of NSW Wildlife* (DECCW, 2010) was undertaken to identify records of threatened flora and fauna species located within a 10km radius of the site. An EPBC coordinate search of the site was also undertaken to provide a list of nationally recognised threatened species with suitable habitat within a 10km radius. This enabled the preparation of a list of threatened flora and fauna species that could potentially occur within the habitats found on the site (Tables 4.1, 4.4 & 4.5).

- ***Aerial photograph interpretation*** – Aerial photographs at 1:25,000 scale were utilised to identify the extent of vegetation with respect to the site and surrounding areas.

- ***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). Scat and hair samples collected are sent to hair ID expert Barbara Triggs for identification. Invertebrates are sent to the Australian Museum.

- ***Flora Survey*** - Flora surveys using a systematic stratified sampling regime within each of the identified vegetation communities, incorporating the placement of 20x20 metre quadrats and 100 metre transects, were undertaken over portions of the study area on July 30th and September 18th 2003. The flora surveys targeted all vegetation communities present within the study area. Extensive random meander transects were undertaken. The locations of flora survey quadrats are shown in Figure 1. An additional

survey was undertaken on 10th Dec 2003 targeting *Cryptostylis hunteriana* within the study area in response to comments provided. No specimens were observed.

Due to the high degree of disturbance in several communities, no quadrats or transects were undertaken within those vegetation communities during the 2003 survey other than random meander transects. At that time, the development proposed was not centred on these communities so there would effectively be little to no impact. Because of the consistency of species within Vegetation Community 2, only one (1) transect was undertaken, although extensive random meander transects were undertaken within that community. One 91) quadrat of 20x20m was undertaken in the March 2009 survey inclusive of a targeted search for the threatened plant *Melaleuca biconvexa*.

Gaps in the data were amended through additional quadrat survey throughout and adjacent to the proposed nursery development area (now defunct), as well as targeted flora survey in March 2009 with the addition of a further twelve (12) quadrats of 20x20m. A targeted search for the threatened species *Melaleuca biconvexa* and *Prostanthera askania* was also undertaken in March 2009 focussing on the northern portion of the site inclusive of the proposed nursery development area and immediate surrounds up to 100m.

Further survey was undertaken in May 2010 survey and this survey focussed upon the western portion of Lot 2 DP1100181 as well as those lands to the immediate west that had not been subject to survey under previous assessments. The survey undertaken looked at vegetation community boundary definition as well as searching for *Melaleuca biconvexa.* Formal survey included six (6) 20x20m quadrats and four (4) linear transects.

In June 2010, refinement of the EEC vegetation communities was undertaken via a grid based quadrat assessment. The first step in the grid based assessment was to overlay points separated by 80m onto a *Trimble* GPS unit within the Swamp Mahogany Woodland, Disturbed Swamp Mahogany Open Woodland and the Disturbed Apple-Mahogany Woodland and areas immediately adjacent.

The percentage of indicative species was measured against the final determinations for the Swamp Sclerophyll Forest on Coastal Floodplains EEC. It was found that the quadrats within the EEC area had 50% or greater indicative species whilst those outside had less than 50% of indicative species. In total, 25 quadrats were undertaken around the EEC edges utilising the 'biometric method' for the collection of data such that if the quadrat was found to be an EEC, its condition as *low condition* or otherwise could be identified. Additional searches for *Melaleuca biconvexa* were also conducted during the grid based quadrat assessment.

In August 2010, target survey for *Diuris praecox* was undertaken during this species known flowereing period.

In August 2010, target survey for *Diuris praecox* was undertaken during this species' known flowering period.

In September 2010, additional biometric style data was collected upon the vegetation in preparation for potential offsetting measurements. Biometric data was collected in June 2010 but the target survey was to identify the EEC boundary and condition thus the data did not extend to all vegetation community types.

OTHER FLORA SURVEYS

Andrews Neil (1992) undertook an ecological assessment of the 7(f) lands which incorporate the current study area as well as 7(f) lands approximately 2km north-west.

They concluded:

> "Vegetation communities were described in the field both structurally and floristically according to the methodology of Specht (1981) and in the original style of Benson and Fallding (1981). The standard vegetation mapping of the National Herbarium of New South Wales was also used for the vegetation classification during the field reconnaissance and ground trothing task."
>
> "All areas, except the wetland areas, were field examined at a general detail level. This involved providing vegetation descriptions with characteristic species and noting plant species present along the foot traverse. Included in this detail were locations of plants of 'special conservation significance to the area' which is a list of plants that have a restricted distribution in the region, are threatened by future land use changes or have a special ecological association with a particular species of fauna. Preparation of this list for the Gosford-Wyong region has been established over many years by field research, data gathered by the National Herbarium of New South Wales (Benson, 1986) and the nationally rare and threatened plant list of Briggs and Leigh (1988)."

Specific field effort, dates and times were not provided within the extract of the report received.

2.3 Fauna survey methodology

2.3.1 Diurnal birds

2003, 2006, 2007 & 2010 - Visual observation and call identification of birds was carried out during visits to the site by *Conacher Travers, Ambrose Ecological Services* and *Travers bushfire & ecology*. Opportunistic bird counts are also made while undertaking other survey work and during spotlight surveys of the site.

Infra-red / motion surveillance camera detection was undertaken between May 21-24th and again on the 14-18th June 2010 by *Travers bushfire & ecology* for a total of eighteen (18) camera days and fourteen (14) camera nights. Camera locations are shown on Figure 3.

2003, 2008, 2009 & 2010 - Birds were observed and identified using handheld binoculars. Calls were generally identified in the field by the observer. If an unknown call was heard it is recorded and identified using reference libraries.

2007 - *Ambrose Ecological Services* undertook 12 x 2ha survey plots each for 30 minutes within the north-eastern portion of the subject site. The amounted to a total of 6 hours targeted bird survey.

2010 - John Young from *John Young Wildlife* (JYW) was engaged to undertake a site visit from the 10–13th August 2010 to undertake Powerful Owl nesting investigations. Given Mr Young's experience in ornithology, he was also asked to assist with the identification of a raptor nest and provide advice on White-bellied Sea Eagle site dependence.

2.3.2 Nocturnal birds

The presence of nocturnal birds was determined by quiet listening after dusk for calls by individuals emerging from diurnal roosts. Following this and provided no calls were heard call-playback techniques were employed. This involved broadcasting recorded calls through a 15 watt Toa 'Faunatech' amplifier to evoke a response from species known to reply.

2003, 2006, 2007, 2008, 2009 & 2010 - Given the suitability of habitat present Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*) and Sooty Owl (*Tyto tenebricosa*) were targeted.

2010 - Australian Bittern (*Botaurus poiciloptilus*) and Bush Stone-curlew (*Burhinus grallarius*) were targeted. Australasian Bittern calls were played at stations proximate to the SEPP 14 wetland.

Each call was played for 5-minute periods with 5-minute intervals of quiet listening for a response. This was followed with spotlighting and periods of quiet listening throughout the nocturnal survey.

2010 - Separation distances between broadcasting points 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 two (2) broadcast stations were undertaken for owls on the 17th March 2010 approximately 1km apart (in the far NE and SW extents of the site). Bush Stone-curlew was only broadcast once on any given night of survey.

Call-playback stations are provided on Figure 3.

All trees within the subject site (excluding the Swamp Mahogany Woodland community) were searched for hollows suitable for Powerful Owl. Where such hollows were found searches for signs of activity in the nearby surrounds was also undertaken. The opportunity to observe foliage roosting owls were increased during inspections of all limbs of large trees for hollows.

2010 - Surveys were undertaken in May and June 2010 both leading into and during the strict winter nesting period for Powerful Owl. This species is highly susceptible to nest disturbance (DEC 2006) and consideration to nesting should be made during survey (WSC 1999 & DEC 2004). Therefore, call-playback techniques during recent June survey was not undertaken until all hollows considered most suitable for nesting were stag-watched. Five (5) large hollow-bearing trees were stag-watched including trees numbered 72, 89, 95, 96 & 97 on Figure 3. Whilst other large trees were identified for potential use (also see Figure 3), these five (5) trees, particularly No. 89 were considered suitable.

2010 - An approach to listen for males calling to defend the nesting territory was the main focus for the three (3) consecutive nights of the June survey. Call-playback was only employed for the final night of survey, at a volume limited to the subject site area.

As Powerful Owl was recorded responding to call-playback during 2009 surveys and no evidence of Powerful Owl nesting was found during recent 2010 surveys it was considered necessary to further pursue this issue for a more precise assessment. Owl expert John Young was engaged to visit the site from the 10–13th August 2010. This was still within the fledgling period and suitable to determine any local nesting activity.

Prior to the visit Mr Young undertook a desktop analysis of aerial photographs to determine most suitable nearby habitats. The following methodologies were incorporated into the visit relative to the Powerful Owl:

- Site searches for signs of activity.
- An inspection of trees identified previously by *Travers bushfire & ecology* as being suitable for nesting. Mr Young provided advice on suitability which further narrowed down the number of trees considered suitable. These trees are shown on Figure 3.
- One (1) night of survey during the dusk period within the nearby Pleasant Valley, Fountaindale, considered more suitable.
- One (1) night of survey during the dusk period on the ridge that separates Pleasant Valley from the subject site.
- Searches within Pleasant Valley for the nesting tree location.

Mr Young's report is provided in Appendix 2.

2.3.3 Arboreal and terrestrial mammals

2003 - *Conacher Travers*

Elliott type A and B traps were used for trapping arboreal and terrestrial mammals. Traps were placed within the north-eastern and central-southern portions of the subject site subject to development applications at this time.

Arboreal trap-lines using 10-20 metre separations were placed in the most suitable trees along approximately 80m transects. Elliott type A traps were placed onto platforms that were attached to the trunks of trees 2-3 m above the ground at an incline of 10 degrees to facilitate drainage during inclement weather. A mixture of honey and water was then sprayed onto the trunk 3-5 metres above the trap and around the platform as a lure.

Terrestrial trap-lines of type A and B Elliott traps using 10-20 metre separations were placed along the same line as the arboreal traps in the most suitable terrestrial habitats. The traps were baited with a mixture of rolled oats, honey and peanut butter.

Seven (7) trap-lines were set on the nights of July 28th, 29th, 30th & 31st 2003. The location of the trap-lines is shown in Figure 3. Each trap-line consisted of 5 type A arboreal traps, 3 type B terrestrial traps and 2 type A terrestrial traps.

Six (6) trap-lines were set on the nights of September 15th, 16th, 17th and 18th, 2003. The location of the trap-lines is shown in Figure 3. Each trap-line consisted of 5 type A arboreal traps, 3 type B terrestrial traps and 2 type A terrestrial traps.

Elliott trapping in 2003 consisted of a total of 520 trap nights including 260 arboreal trap nights and 260 terrestrial trap nights.

2007- *Ambrose Ecological Services Pty Ltd*

Hair tube funnel surveys were undertaken for arboreal and terrestrial mammals from 24- 28th January, 2007. One hundred and two (102) hair tubes were placed for five (5) nights totalling five hundred and ten (510) hair tube nights.

Tubes were placed within the north-eastern portions of the subject site. Locations of hair tube transects have not been provided at this time and are awaiting supply following a request to Stephen Ambrose.

2009 - *Travers bushfire & ecology*

Cage trapping was undertaken to target the threatened Spotted-tailed Quoll (*Dasyurus maculatus*) as previous trapping efforts appeared deficient in this regard. Two (2) cage trap transects each containing five (5) traps were set along most suitable habitat areas fringing the development application at this time in the north-eastern portions of the subject site.

Cage trap line 1 contained five (5) foldout cages (26cm x 26cm by 60cm long). Cage trap line 2 contained two (2) rigid cage traps (25cm x 25cm by 50cm long), one (1) rigid cage trap (30cm x 30cm by 70cm long) and two (2) foldout cages (18cm x 18cm by 40cm long).

Cage trapping consisted of a total of forty (40) trap nights. Cage traps were placed in areas of dense shrub and ground cover at locations in proximity to suitable ground hollow shelters. The cage traps were baited with meat and sausage off-cuts with jelly meat cat food smeared to nearby trees as a scenting lure.

2010 – *Travers bushfire & ecology*

Elliott type A and B traps were used for trapping arboreal and terrestrial mammals. Traps were placed throughout the current subject site subject to the planning proposal as well as within areas where trapping was previously undertaken.

Arboreal trap-lines using 50-60 metre separations were placed in the most suitable trees along approximately 200m transects. On each transect five (5) Elliott type B traps were placed onto platforms that were attached to the trunks of trees 2-3 m above the ground. A mixture of honey and water was then sprayed onto the trunk up to 8 m above the trap and around the platform as a lure.

Terrestrial trap-lines of type A and B Elliott traps were placed along the same transect line as the arboreal traps in the most suitable terrestrial habitats. Trap lines 1, 3, 4, 6, 7, 8, 12 & 14 each contained five (5) terrestrial A type Elliott traps. Trap lines 2, 5, 9, 10, 11 & 13 each contained five (5) terrestrial B type Elliott traps.

The traps were baited with a mixture of rolled oats, honey and peanut butter. All traps were covered with clear plastic sleeves to maintain traps dry during wet weather.

Nine (9) trap-lines were set on the nights of May 19th, 20th, 24th & 25th 2010. Four (4) more trap-lines numbered in a continuing sequence from 10-14 were set on the nights of June 14th, 15th, 16th & 17th 2010. Trap line locations are depicted on Figure 3.

Elliott trapping in 2010 consisted of a total of 560 trap nights including 280 arboreal trap nights and 280 terrestrial trap nights a total of 1,120 trap nights.

Infra-red / motion surveillance camera detection was undertaken between May 21-24th and again on the 14-18th June 2010 by *Travers bushfire & ecology* for a total of twenty (20) camera days and sixteen (16) camera nights.

2003-2010 *Spotlighting within the subject site*

Spotlighting for nocturnal mammalian fauna was carried out using a hand held lamp of 750,000 candlelight power (100W halogen globe). This technique involved walking amongst the woodland areas of the subject site so that a maximum number of trees could be observed.

2010 *Call-playback techniques for nocturnal mammals*

The presences of Koala (*Phascolactos cinereus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) were targeted by broadcasting taped calls through a 15 watt Toa 'Faunatech' amplifier. Calls were played for 5-minute periods during nocturnal surveys. This was followed by quiet listening and spotlighting. Call-playback stations for nocturnal arboreal mammals are shown on Figure 3.

2003-2010 *Secondary indications within the subject site*

Assessment was made of 'found' scats, markings, diggings, runways and scratches during visits to the site. Any scats or pellets not readily identifiable were collected and analysed for contents, hair or bone fragments. Habitat was also assessed to determine the likelihood of threatened native species of fauna occurring within the subject site.

Koala survey & assessment

The subject area was assessed for activity by Koalas using the following methods:

- A search of the *Atlas of NSW Wildlife* (DECCW 2010) database.

- Identification and an assessment of the density of tree species listed as Koala feed trees in *State Environmental Protection Policy No. 44 – Koala Habitat Protection* (SEPP 44) was undertaken across the site. An estimate of the percentage density of each tree species within vegetation communities was determined by averaging the percentage of stems counted.

- 2008 - Given the presence of potential Koala habitat as defined by SEPP 44 and a previous recording of Koala located within the subject site in 2007, Koala targeted survey was undertaken. Initially two (2) Koala search quadrats were undertaken during within the development area of the previous nursery proposal located in the north-eastern portions of the site.

  These quadrats were located on either side of the previous Koala record within the Blackbutt Open Forest. No SEPP 44 Koala feed trees or 'primary feed' trees identified by The Koala Recovery Plan (NPWS 2003) are present within this community. The complete Spot Assessment Technique (SAT) described by *Phillips & Callaghan* (1995) was undertaken at each point as a measure of Koala 'activity'.

  A target search 30x30m quadrat was also undertaken within the Swamp Mahogany Woodland to the south-west of the development area and identified as 'potential koala habitat' under the definitions of SEPP 44. This involved a search for scats below all SEPP 44 Schedule 2 listed feed trees within.

  Subsequent to the identification of Koala within SAT points undertaken in the Blackbutt Open Forest, Koala experts *Biolink* were requested to undertake a comprehensive Koala survey across the current subject site area in 2008. This report is provided in Attachment 1. Stephen Phillips, the Director of *Biolink Ecological Consultants*, is the co-author of the Koala Spot Assessment Technique (recently revised in 2008) and is regarded as a Koala expert. *Biolink* survey, scat analysis and assessment were to supersede any previous Koala assessment for the site.

- Koalas were also targeted during spotlight surveys which included the use of call-playback techniques described above.

2.3.4 Bats

2003, 2006, 2007 & 2010 - Micro-chiropteran bats were surveyed by echolocation using Anabat Mk 2 and SD-1 detectors in fixed passive monitoring positions within the subject site.

Fixed passive monitoring involves leaving the bat recorder in a position to record call-sequences of passing bats. Fixed positions were set at locations of likely foraging lines for medium and larger microbats such as forest edges and trails within. Fixed monitoring positions are indicated on Figure 3.

2010 – Recent survey also incorporated the method of active monitoring for microchiropteran bats. Active monitoring involves an SD-1 recorder allied with a *Personal Digital Assistant (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, to enable longer and clearer call sequences to 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 recording was undertaken during stag-watching on the 15th, 16th & 17th June 2010 and along spotlighting transects undertaken on the 27th May and 15th June 2010. Stag-watching locations and spotlighting transects are provided on Figure 3. The assessment within this report therefore also considers nearby Atlas database and *Travers bushfire & ecology* / *Conacher Travers* survey records.

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

2010 - Harp (Constantine) traps were also used to survey for micro-chiropteran bat species. Two (2) harp traps were set on the nights of 19, 20, 24th & 25th May and a single harp trap was later setup on the 16th & 17th June 2010. Harp trapping consisted of a total of 10 trap nights. Harp traps were placed along suitable 'flyways' such as along open narrow corridors to maximise the likelihood of captures.

Harp traps were checked where possible after dark during nocturnal surveys or otherwise early each morning of the survey. Captured bats are identified using field identification guides. Bats are released at the point of capture immediately if retrieved at night or after dusk the following night if collected in the morning. Harp trap locations are shown on Figure 3.

2003, 2008, 2009 & 2010 - Mega-chiropteran bat species, such as Grey-headed Flying-fox (*Pteropus poliocephalus*), were surveyed by targeting flowering / fruiting trees during spotlighting activities.

2010 - Stag-watching was undertaken at four (4) trees containing large hollows e.g. Habitat trees (HT); HT89, HT95, HT96 & HT97) during recent surveys on the 15th, 16th & 17 June 2010. Whilst this survey was undertaken to target owl nesting activity, an active Anabat recorder was also on hand to identify any species of microchiropteran bats emerging.

2010 – Given the recording within the subject site of East-coast Freetail Bat (*Micronomus norfolkensis*) additional target survey incorporating both active and passive Anabat surveys were undertaken on the 25th & 26th August 2010 to get an indication of presence in the nearby locality.

Passive monitoring involved leaving recorders in fixed recording stations and left to record bat activity for one entire night at each station. Three recording stations were undertaken on

each night. Locations were within or along the fringes of forest habitats at varying aspects from the site. The closest station was located approximately 500m to the south of the site and the furthest located approximately 1.8km away to the south also (see Figure 3 for locations). Locations were selected to give even separation distances as well as representing different valleys, ridges, forest structure and flyways.

Active monitoring involved mobile recording transects undertaken in all major surrounding streets and fire trails to suitable forest areas extending out to 2km from the subject site. This was undertaken during the first few hours after dusk on both target search nights. Vehicle transects used a Hi-mic extension cable allowing the Anabat transducer microphone to be placed on a bracket on the roof of a vehicle so calls may be viewed on a dash mounted PDA screen whilst driving. When calls of a potential threatened species are observed active recording by foot transects and spotlighting was undertaken to confirm identification (see Figure 3 for transect locations).

2.3.5 Amphibians

2003, 2006, 2007 & 2010 - Amphibians were surveyed by vocal call identification and by habitat searches. Vocal call identification involves quiet listening for calling males undertaken during dusk and early after dark periods in locations near to suitable breeding activity such as still water bodies, soaks, swamp fringes and drainage lines. Vocal call identification is also undertaken opportunistically throughout diurnal and nocturnal surveys. Habitat searches were undertaken in locations found opportunistically as being suitable for shelter for both amphibians and also small reptiles.

2010 - Given the presence of a previous Wallum Froglet record within the SEPP 14 wetland to the north of the subject site in 1997 and suitability of dispersal/shelter habitat that fringes the subject site boundary, call-playback techniques were employed for this species. The Wallum Froglet may call at any time of year however its breeding peak is late winter and therefore the survey period of call-playback during May and June was appropriate for this species. Furthermore, call-playback was undertaken at various locations surrounding the SEPP 14 wetland during nocturnal surveys on the 26th May and 17th June 2010, as well as extending into the wetland area during the day on the 18th June 2010.

As with call-playback methods employed for nocturnal birds and mammals, call-playback for frogs involves broadcasting recorded calls through a 15 watt Toa 'Faunatech' amplifier. The calls are played for a 1-minute period with 1-minute quiet listening for response. This was followed with quiet listening and spotlighting. Call-playback stations are provided in Figure 3.

2010 - Amphibians were also surveyed by funnel trapping. Funnel traps were placed to target frog activity on the periphery of the SEPP 14 wetland within the subject site, and specifically any dispersal movements by Wallum Froglet into the subject site during the early winter period.

Two (2) funnel trap-lines each consisting of five (5) funnel traps were set for three (3) days and nights from the 15th until the 18th June 2010. Funnels were placed on either side of a 15m long fence line. The fence was made of damp-proof-course 270mm wide and held tight and upright by wooden and steel pegs. Funnel trapping amounted to a total of 30 trap days/nights.

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.

2.3.6 Reptiles

2003, 2006, 2007 & 2010 - Searches for reptiles in likely localities such as under logs, rubbish debris, and in deep leaf litter were carried out during diurnal visits to the site.

2003 & 2007 - Spotlighting of terrestrial habitats suitable for reptiles occurred during nocturnal surveys.

2007 - Surveys undertaken by *Ambrose Ecological Services Pty Ltd* (2007) used reptile funnel traps within the subject site to a total effort of 150 trap days.

Funnel traps were also placed during the recent winter surveys undertaken in 2010. Typically funnel traps are used to target reptile activity but were used on this occasion to target amphibians. This effort has not been included for reptiles given the unsuitability of the season for reptile activity.

2.3.7 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, 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.

The north-eastern portions of the subject site were subject to detailed hollow-bearing tree survey during 2008 for a previous development application within this area. Recent 2010 detailed hollow-bearing tree surveys have also been undertaken within areas surrounding this previous development area in the north-east as well as the complete south-western portions of the site.

Hollow-bearing tree surveys have thus far been undertaken in detail within the far north-eastern and south-western portions of the subject site (see Figure 3 for subjected areas). These areas were identified by earlier planning proposal mapping where development constraints are least. Figure 3 gives the impression that hollows are more concentrated within the north-eastern and south-western portions of the site, however this is only due to the remaining areas having not been subject to such detailed investigations.

A search for hollows suitable for Powerful Owl was also been undertaken for the remaining central portions of the subject site excluding the inner areas of Swamp Mahogany Woodland which is deemed generally unsuitable. All hollows identified from 2008 & 2010 surveys are shown on Figure 3. A summary of hollow-bearing tree data is provided in Table 4.2.

2.3.8 Survey Data Deficiencies

Fauna survey was undertaken and an assessment report was prepared by *Ambrose Ecological Services Pty Ltd* in 2007. Subsequently, survey details including weather conditions and locations where survey was undertaken has not been provided within this report and associated figures.

Field survey method

Tables 2.1 and 2.2 below detail the flora and fauna survey effort undertaken for the subject site.

Table 2.1 – Flora survey methodology and dates

Flora Survey	Method	Dates
Vegetation Communities	Survey of the boundaries of all communities	30/07/03 18/09/03 10/03/09 12/03/09 27/05/10 21/06/10 22/06/10
Stratified Sampling	20x20 metre quadrats in all existing vegetation communities	30/07/03 18/09/03 10/03/09 12/03/09 27/05/10 21/06/10 22/06/10 17/09/10
Target Searches	Target searches in known habitats (those with potential habitat in Table 4.1) *Tetratheca juncea*..... *Cryptostylis hunteriana*..... *Melaleuca biconvexa & Prostanthera askania*..... *Melaleuca biconvexa*…… *Diuris praecox*……	 30/07/03, 18/09/03, 10/12/03 10/12/03 10/03/09, 12/03/09, 27/05/10 21/06/10, 22/06/10 30/07/03, 17/08/10, 18/08/10

Specific refinement of EEC boundaries was undertaken by extensive grid based quadrat assessment and walking the edge of the community in June 2010.

Flora survey was undertaken across the study area by *Andrews Neil* in 1992. The methodology and target searches were not defined in the extracted portion of the report which was supplied by Council.

Table 2.2 – Fauna survey methodology and dates

Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort/Time (24hr)
Diurnal Birds	28/07/03	0/8 cloud, no wind, temp 17°C	Diurnal Opportunistic	2hrs 14.00 – 16.00
	29/07/03	1/8 cloud, 11-19kph SE, temp 14°C	Diurnal Opportunistic	4hrs 8.45 – 12.45
	29/07/03	2/8 cloud, 11-19kph SE, temp 18°C	Diurnal Opportunistic	1hr 45mins 13.45 – 15.30
	30/07/03	0/8 cloud, no wind, temp 13°C	Diurnal Opportunistic	1hr 15mins 08.45 – 10.00
	31/07/03	0/8 cloud, 0-7kph SE, temp 13°C	Diurnal Opportunistic	4hrs 15mins 08.45 – 13.00
	31/07/03	0/8 cloud, 11-19kph SE, temp 15°C	Diurnal Opportunistic	1hr 30mins 13.30 – 15.00
	01/08/03	0/8 cloud, 11-19kph NE, temp 13°C	Diurnal Opportunistic	2hrs 09.00 – 11.00
	15/09/03	1/8 cloud, 19-26kph S, temp 18°C	Diurnal Opportunistic	4hrs 15mins 13.15 – 17.30
	16/09/03	0/8 cloud, 11-19kph SW, temp 13-26°C	Diurnal Opportunistic	5hrs 08.15 – 13.15
	17/09/03	0/8 cloud, 11-19kph SE, temp 18°C	Diurnal Opportunistic	2hr 40 mins 08.30 – 11.10
	18/09/03	7/8 cloud 6-11kph S, temp 14°C	Diurnal Opportunistic	1hr 10 mins 08.20 – 09.30
	19/09/03	0/8 cloud, no wind, temp 17°C	Diurnal Opportunistic	1hr 30 mins 08.15 – 09.45
	06/12/06	0/8 cloud, no wind, no rain, temp 24°C	Diurnal Census, Opportunistic	2hr, 20min 17:40 – 20:00
	07/12/06	0/8 cloud, no wind, no rain, temp 23°C	Diurnal Census, Opportunistic	2hr 18.15 – 20.15
	24-29/01/07*	Not sourced	12x2ha survey plots (30min each)	6hrs
	19/05/10	7/8 cloud, no wind, light shower, temp 14-21°C	Diurnal Opportunistic	9hrs 20mins 07.10 – 17.30
	20/05/10	4/8 cloud, no wind, no rain, temp 16.5-21°C	Diurnal Opportunistic	5hr 10mins 09.00 – 14.30
	21/05/10	4/8 cloud, no wind, no rain, temp 18°C	Diurnal Opportunistic	3hrs 55mins 10.15 – 14.10
	24/05/10	7/8 cloud, no wind, no rain, temp 18°C	Diurnal Opportunistic	5hrs 35mins 10.00 – 15.35
	21-24/05/10	Various	Infra-red / Motion Surveillance Camera x 2	10 camera days + 8 camera nights
	25/05/10	8/8 cloud, no wind, previous rain, temp 16-18°C	Diurnal Opportunistic	3hrs 35mins 09.40 – 13.05
	26/05/10	8/8 cloud, no wind, no rain, temp 16.5-17°C	Diurnal Opportunistic	6hrs 15mins 09.15 – 15.30
	27/05/10	2/8 cloud, no wind, no rain, temp 16-20°C	Diurnal Opportunistic	6hrs 30mins 10.50 – 17.20
	14/06/10	0/8 cloud, no wind, no rain, temp 11-19°C	Diurnal Opportunistic	7hrs 50mins 08.40 – 16.30
	15/06/10	0/8 cloud, no wind, no rain, temp 10-20°C	Diurnal Opportunistic	8hrs 55mins 08.10 – 17.05
	16/06/10	0/8 cloud, no wind, no rain, temp 15-22°C	Diurnal Opportunistic	8hrs 40mins 08.30 – 17.10
	17/06/10	8/8 cloud, no wind, light showers, temp 12-18°C	Diurnal Opportunistic	8hrs 30mins 08.45 – 17.15
	18/06/10	0/8 cloud, no wind, no rain, temp 11°C	Diurnal Opportunistic	6hrs 55mins 08.25 – 14.30
	14-18/06/10	Various	Infra-red / Motion Surveillance Camera	10 camera days + 8 camera nights
	10/08/10	8/8 cloud, mod SE wind, showers, 18°C	Diurnal Opportunistic (with John Young)	1hr 50mins 1340 – 1630

Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort/Time (24hr)
	11/08/10	8-0/8 cloud, light SE wind, no rain, temp 17-22°C	Diurnal Opportunistic (with John Young)	6hrs 15mins 0830 – 1730
	12/08/10	0-5/8 cloud, mod SW wind, no rain, temp 17-20°C	Diurnal Opportunistic (with John Young)	3hrs 30mins 0830 - 1200
Nocturnal Birds	28/07/03	0/8 cloud, no wind, temp 15°C	Owl call playback	30mins 17.45 – 18.15
	29/07/03	0/8 cloud, 11-19kph NE, temp 14°C	Owl call playback	30mins 17.45 – 18.15
	15/09/03	0/8 cloud, 11-19kph S, temp 14°C	Owl call playback	30mins 18.10 – 18.40
	18/09/03	0/8 cloud, no wind, temp 15°C	Owl call playback	30mins 18.15 – 18.45
	06/12/06	0/8 cloud, no wind, no rain, temp 21°C	Owl call playback	50mins 20.30 – 21.20
	07/12/06	0/8 cloud, no wind, no rain, temp 21°C	Owl call playback	50mins 20.30 – 21.20
	09/07/08	8/8 cloud, no wind, temp 11.5°C	Owl call playback	30 mins 17.35 – 18.05
	24-29/01/07*	Not sourced	Owl call playback & spotlighting	16hrs
	16/03/09	0/8 cloud, no wind, temp 15°C	Owl call playback & spotlighting	1hr 30mins 20.25 – 21.55
	26/05/10	8/8 cloud, no wind, light rain, 3/4 moon, temp 16°C at finish	Call playback	40mins 18.20 – 19.00
	26/05/10	8/8 cloud, no wind, light rain, 3/4 moon, temp 16°C at finish	Spotlighting	1hr 45mins 17.15 – 19.00
	27/05/10	1-7/8 cloud, no wind, light rain, 4/4 moon, temp 14.5°C at finish	Call playback	1hr 20mins 18.20 – 19.40
	27/05/10	1-7/8 cloud, no wind, light rain, 4/4 moon, temp 14.5°C at finish	Spotlighting	3hrs 20mins 17.35 – 20.55
	15/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 11°C at finish	Call playback	2hrs 20mins 18.10 – 20.30
	15/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 11°C at finish	Spotlighting	2hrs 40mins 17.50 – 20.30
	15/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 11°C at finish	Stag-watching	45mins 17.10 – 17.55
	16/06/10	4/8 cloud, now wind, no rain, 2/4 moon, temp 15°C at finish	Sag-watching	40mins 17.10 – 17.50
	17/06/10	0/8 cloud, no wind, no rain, 2/4 moon, temp 12°C-11°C	Stag-watching	50mins 17.10 – 18.00
	17/06/10	0/8 cloud, no wind, no rain, 2/4 moon, temp 12°C-11°C	Call playback	2hrs 18.25 – 20.25
	17/06/10	0/8 cloud, no wind, no rain, 2/4 moon, temp 12°C-11°C	Spotlighting	2hrs 40mins 17.45 – 20.25
	11/08/10	0/8 cloud, nil - light SE wind, no rain, temp 15°C	Owl call identification (with John Young)	30mins 1730 – 1800
	12/08/10	0/8 cloud, light-mod SW wind, no rain, temp 16-15°C	Owl call identification (with John Young)	1hr 10mins 1700 - 1810

Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort/Time (24hr)
Arboreal Mammals	28/07/03	0/8 cloud, no wind, temp 15°C	Spotlighting	1hr 15mins 17.30 – 18.45
	29/07/03	1/8 cloud, 11-19kph SE, temp 14°C	Elliott trapping	35 trap nights
	29/07/03	0/8 cloud, 11-19kph NE, temp 13°C	Spotlighting	1hr 15mins 17.30 – 18.45
	30/07/03	0/8 cloud, no wind, temp 13°C	Elliott trapping	35 trap nights
	31/07/03	0/8 cloud, 0-7kph SE, temp 13°C	Elliott trapping	35 trap nights
	01/08/03	0/8 cloud, 11-19kph NE, temp 13°C	Elliott trapping	35 trap nights
	15/09/03	0/8 cloud, 11-19kph S, temp 13°C	Spotlighting	1hr 5mins 18.10 – 19.15
	15/09/03	0/8 cloud, 11-19kph SW, temp 13°C	Elliott trapping	30 trap nights
	16/09/03	0/8 cloud, 11-19kph S, temp 15°C	Elliott trapping	30 trap nights
	17/09/03	7/8 cloud 6-11kph S, 14°C	Elliott trapping	30 trap nights
	18/09/03	0/8 cloud, no wind, temp 16°C	Spotlighting	1hr 10 mins 18.10 – 19.20
	18/09/03	0/8 cloud, no wind, temp 15°C	Elliott trapping	30 trap nights
	06/12/06	0/8 cloud, no wind, no rain, temp 21°C	Spotlighting	1hr 25mins 20.20 – 21.45
	07/12/06	0/8 cloud, no wind, no rain, temp 21°C	Spotlighting, Call playback survey	1hr 40mins 20.30 – 22.10
	09/07/08	1/8 cloud, no wind, 17-12°C	Koala Spot Assessments & searches	5hrs 30mins 11.45 – 17.15
	09/07/08	8/8 cloud, no wind, temp 11.5°C	Spotlighting & Call-playback (Koala, Yellow-bellied Glider & Squirrel Glider)	1hr 1730 – 1830
	10/07/08	4/8 cloud, 0-7kph SE, temp 10-13°C	Koala Spot Assessments & searches	4hrs 15mins 07.25 – 11.40
	24-29/01/07*	Not sourced	Spotlighting	16hrs
	24-29/01/07*	Not sourced	Hair tubes	510 trap nights (incl. arboreal effort)
	29-30/10/08^	N/A	Koala SAT surveys - 250m^2 grid sampling	7 SAT points
	19/05/10	0-8/8 cloud, no wind, pos showers, 1/4 moon, 9°C min	Elliot B trapping: (9 lines)	45 trap nights
	20/05/10	0/8 cloud, no wind, no rain, 1/2 moon, 9°C min	Elliot B trapping: (9 lines)	45 trap nights
	24/05/10	8/8 cloud, no wind, later rain, 3/4 moon, 12°C min	Elliot B trapping: (9 lines)	45 trap nights
	25/05/10	8/8 cloud, no wind, later rain, 3/4 moon, 11°C min	Elliot B trapping: (9 lines)	45 trap nights
	26/05/10	8/8 cloud, no wind, light rain, 3/4 moon, temp 16°C at finish	Spotlighting	1hr 45mins 17.15 – 19.00
	26/05/10	8/8 cloud, no wind, light rain, 3/4 moon, temp 16°C at finish	Call playback	40mins 18.20 – 19.00
	27/05/10	1-7/8 cloud, no wind, light rain, 4/4 moon, temp 14.5°C at finish	Call playback	1hr 20mins 18.20 – 19.40
	27/05/10	1-7/8 cloud, no wind, light rain, 4/4 moon, temp 14.5°C at finish	Spotlighting	3hrs 20mins 17.35 – 20.55
	14/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 3°C min	Elliot B trapping (5 lines)	25 trap nights
	15/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 4°C min	Elliot B trapping (5 lines)	25 trap nights
	15/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 11°C at finish	Call playback	2hrs 20mins 18.10 – 20.30
	15/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 11°C at finish	Spotlighting	2hrs 40mins 17.50 – 20.30
	15/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 11°C at finish	Stag-watching	45mins 17.10 – 17.55
	16/06/10	4/8 cloud, now wind, no rain, 2/4 moon, temp 15°C at finish	Sag-watching	40mins 17.10 – 17.50
	16/06/10	0-8/8 cloud, light SE wind, no rain, 1/4 moon, temp 6°C min	Elliot B trapping (5 lines)	25 trap nights
	17/06/10	0/8 cloud, no wind, no rain, 2/4 moon, temp 12°C-11°C	Stag-watching	50mins 17.10 – 18.00
	17/06/10	0/8 cloud, light SE wind, no rain, 2/4 moon, temp 5°C min	Elliot B trapping (5 lines)	25 trap nights

Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort/Time (24hr)
	17/06/10	0/8 cloud, no wind, no rain, 2/4 moon, temp 12°C-11°C	Call playback	1hr 15 mins 19.10 – 20.25
	17/06/10	0/8 cloud, no wind, no rain, 2/4 moon, temp 12°C-11°C	Spotlighting	2hrs 40mins 17.45 – 20.25
Terrestrial Mammals	28/07/03	0/8 cloud, no wind, temp 15°C	Spotlighting	1hr 15mins 17.30 – 18.45
	29/07/03	1/8 cloud, 11-19kph SE, temp 14°C	Elliott trapping	35 trap nights
	29/07/03	0/8 cloud, 11-19kph NE, temp 13°C	Spotlighting	1hr 15mins 17.30 – 18.45
	30/07/03	0/8 cloud, no wind, temp 13°C	Elliott trapping	35 trap nights
	31/07/03	0/8 cloud, 0-7kph SE, temp 13°C	Elliott trapping	35 trap nights
	01/08/03	0/8 cloud, 11-19kph NE, temp 13°C	Elliott trapping	35 trap nights
	15/09/03	0/8 cloud, 11-19kph S, temp 13°C	Spotlighting	1hr 5mins 18.10 – 19.15
	15/09/03	0/8 cloud, 11-19kph SW, temp 13°C	Elliott trapping	30 trap nights
	16/09/03	0/8 cloud, 11-19kph S, temp 15°C	Elliott trapping	30 trap nights
	17/09/03	7/8 cloud 6-11kph S, 14°C	Elliott trapping	30 trap nights
	18/09/03	0/8 cloud, no wind, temp 16°C	Spotlighting	1hr 10 mins 18.10 – 19.20
	18/09/03	0/8 cloud, no wind, temp 15°C	Elliott trapping	30 trap nights
	06/12/06	0/8 cloud, no wind, temp 21°C	Spotlighting	1hr 25mins 20.20 – 21.45
	07/12/06	0/8 cloud, no wind, temp 21°C	Spotlighting	1hr 40mins 20.30 – 22.10
	09/07/08	8/8 cloud, no wind, temp 11.5°C	Spotlighting	1hr 1730 – 1830
	24-29/01/07*	Not sourced	Spotlighting	16hrs
	24-29/01/07*	Not sourced	Hair tubes	510 trap nights (incl. arboreal effort)
	11/03/09	0/8 cloud, no wind, temp ~17°C	Cage trapping	10 trap nights
	12/03/09	8/8 cloud, no wind, temp ~16°C	Cage trapping	10 trap nights
	17/03/09	0/8 cloud, no wind, temp ~12°C	Cage trapping	10 trap nights
	19/05/10	0-8/8 cloud, no wind, pos showers, 1/4 moon, 9°C min	Elliot A trapping (6 lines) Elliot B trapping (3 lines)	30 trap nights 15 trap nights
	19/05/10	0-8/8 cloud, no wind, pos showers, 1/4 moon, 9°C min	Cage trapping (18 traps)	18 trap nights
	20/05/10	0/8 cloud, no wind, no rain, 1/2 moon, 9°C min	Elliot A trapping (6 lines) Elliot B trapping (3 lines)	30 trap nights 15 trap nights
	20/05/10	0/8 cloud, no wind, no rain, 1/2 moon, 9°C min	Cage trapping (18 traps)	18 trap nights
	24/05/10	8/8 cloud, no wind, later rain, 3/4 moon, 12°C min	Elliot A trapping (6 lines) Elliot B trapping (3 lines)	30 trap nights 15 trap nights
	24/05/10	8/8 cloud, no wind, later rain, 3/4 moon, 12°C min	Cage trapping (18 traps)	18 trap nights
	21-24/05/10	Various	Infra-red / Motion Surveillance Camera x 2	10 camera days + 8 camera nights
	25/05/10	8/8 cloud, no wind, later rain, 3/4 moon, 11°C min	Elliot A trapping (6 lines) Elliot B trapping (3 lines)	30 trap nights 15 trap nights
	25/05/10	8/8 cloud, no wind, later rain, 3/4 moon, 11°C min	Cage trapping (18 traps)	18 trap nights
	26/05/10	8/8 cloud, no wind, light rain, 3/4 moon, temp, 16°C at finish	Spotlighting	1hr 45mins 17.15 – 19.00
	27/05/10	1-7/8 cloud, no wind, light rain, 4/4 moon, temp 14.5°C at finish	Spotlighting	3hrs 20mins 17.35 – 20.55

Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort/Time (24hr)
	14/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 3°C min	Elliot A trapping (2 lines) Elliot B trapping (3 lines)	10 trap nights 15 trap nights
	14/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 3°C min	Cage trapping (10 traps)	10 trap nights
	15/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 4°C min	Elliot A trapping (2 lines) Elliot B trapping (3 lines)	10 trap nights 15 trap nights
	15/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 11°C at finish	Spotlighting	2hrs 40mins 17.50 – 20.30
	15/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 4°C min	Cage trapping (10 traps)	10 trap nights
	16/06/10	0-8/8 cloud, light SE wind, no rain, 1/4 moon, temp 6°C min	Elliot A trapping (2 lines) Elliot B trapping (3 lines)	10 trap nights 15 trap nights
	16/06/10	0-8/8 cloud, light SE wind, no rain, 1/4 moon, temp 6°C min	Cage trapping (10 traps)	10 trap nights
	17/06/10	0/8 cloud, light SE wind, no rain, 2/4 moon, temp 5°C min	Elliot A trapping (2 lines) Elliot B trapping (3 lines)	10 trap nights 15 trap nights
	17/06/10	0/8 cloud, no wind, no rain, 2/4 moon, temp 12°C-11°C	Spotlighting	2hrs 40mins 17.45 – 20.25
	17/06/10	0/8 cloud, light SE wind, no rain, 2/4 moon, temp 5°C min	Cage trapping (10 traps)	10 trap nights
	14-18/06/10	Various	Infra-red / Motion Surveillance Camera	10 camera days + 8 camera nights
Bats	28/07/03	0/8 cloud, no wind, temp 15°C	Anabat II	1hr 15mins 17.30 – 18.45
	29/07/03	0/8 cloud, 11-19kph NE, temp 13°C	Anabat II	1hr 30mins 17.15 – 18.45
	15/09/03	0/8 cloud, 11-19kph S, temp 13°C	Anabat II	1hr 30mins 17.45 – 19.15
	18/09/03	0/8 cloud, no wind, temp 15°C	Anabat II	1hr 25mins 17.55 – 19.20
	06/12/06	0/8 cloud, no wind, temp 21°C	Anabat II x2	2hrs 20.15 – 21.50
	07/12/06	0/8 cloud, no wind, temp 21°C	Anabat II x2	3hrs 55mins 20.15 – 22.20
	24-29/01/07*	Not sourced	Anabat II	9hrs
	19/05/10	0-8/8 cloud, no wind, overnight shower, temp 15°C (at start), 1/4 moon	1 x Anabat II 1 x SD1	17.50 – o'night
	19/05/10	0-8/8 cloud, no wind, showers, 1/4 moon, 9°C min	2 x Harp traps	2 Harp trap nights
	20/05/10	0/8 cloud, no wind, no rain, 1/2 moon, 9°C min	2 x Harp traps	2 Harp trap nights
	24/05/10	8/8 cloud, no wind, later rain, 3/4 moon, 12°C min	2 x Harp traps	2 Harp trap nights
	24/05/10	8/8 cloud, no wind, later rain, temp 16°C (at start)	SD1	17.25 – o'night
	25/05/10	8/8 cloud, no wind, late rain, 3/4 moon, 11°C min	2 x Harp traps	2 Harp trap nights
	27/05/10	1-7/8 cloud, no wind, light rain, 4/4 moon, temp 16°C-14.5°C	1 x SD1 1 x Anabat II	3hrs 20mins 17.20 – 20.40 2hrs 25mins 18.10 – 20.35
	15/06/10	0/8 cloud, no wind, no rain, 1/4 moon, start temp 16.5°C	1 x SD1 1 x Anabat II	17.10 – o'night 17.00 – o'night
	16/06/10	0-8/8 cloud, light SE wind, no rain, 1/4 moon, temp 6°C min	1 x Harp trap	1 Harp trap night
	17/06/10	0/8 cloud, light SE wind, no rain, 2/4 moon, temp 5°C min	1 x Harp trap	1 Harp trap night
	17/06/10	0/8 cloud, no wind, no rain, 2/4 moon, start temp 11°C	1 x SD1 1 x Anabat II	20.20 – o'night 17.15 – o'night
	25/08/10	0/8 cloud, no wind, no rain, 4/4 moon, temp 15-14°C	Mobile transects (vehicle and foot)	1hr 35mins 17.45 – 19.20

Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort/Time (24hr)
		0/8 cloud, no wind, no rain, 4/4 moon, temp 15-3°C	3 x Anabat II	17.40 – o'night
	26/08/10	4/8 cloud, light NW wind, no rain, 4/4 moon, temp 15-13.5°C	Mobile transects (vehicle and foot)	1hr 50mins 17.50 – 19.40
		4-0/8 cloud, light NW - no wind, no rain, 4/4 moon, temp 15-7°C	3 x Anabat II	17.30 – o'night
Reptiles	28/07/03	0/8 cloud, no wind, temp 15°C	Spotlighting	1hr 15mins 17.30 – 18.45
	29/07/03	0/8 cloud, 0-6kph NE, temp 17°C	Habitat search	3hrs 45mins 11.45 – 15.30
	29/07/03	0/8 cloud, 11-19kph NE, temp 13°C	Spotlighting	1hr 15mins 17.30 – 18.45
	31/07/03	0/8 cloud, 11-19kph SE, temp 14°C	Habitat search	4hrs 10.30 – 15.00
	15/09/03	0/8 cloud, 11-19kph S, temp 13°C	Spotlighting	1hr 5mins 18.10 – 19.15
	16/09/03	0/8 cloud, 11-19kph NW, temp 16°C	Habitat search	1hr 10mins 18.10 – 19.20
	17/09/03	0/8 cloud, 11-19kph S, temp 21°C	Habitat search	3hrs 15 mins 10.00 - 13.15
	18/09/03	0/8 cloud, no wind, temp 16°C	Spotlighting	1hr 40 mins 09.30 – 11.10
	06/12/06	0/8 cloud, no wind, temp 24°C	Opportunistic	2hrs, 20 mins 17.40 – 20.00
	07/12/06	0/8 cloud, no wind, temp 23°C	Opportunistic	2hrs 18.15 – 20.15
	24-29/01/07*	Not sourced	Active & incidental surveys	8.5hrs
	24-29/01/07*	Not sourced	Reptile Funnel Traps	150 trap days
	19/05/10	7/8 cloud, no wind, light shower, temp 14-21°C	Habitat search / Opportunistic	9hrs 20mins 07.10 – 17.30
	20/05/10	4/8 cloud, no wind, no rain, temp 16.5-21°C	Habitat search / Opportunistic	5hr 10mins 09.00 – 14.30
	21/05/10	4/8 cloud, no wind, no rain, temp 18°C	Habitat search / Opportunistic	3hrs 55mins 10.15 – 14.10
	24/05/10	7/8 cloud, no wind, no rain, temp 18°C	Habitat search / Opportunistic	5hrs 35mins 10.00 – 15.35
	25/05/10	8/8 cloud, no wind, previous rain, temp 16-18°C	Habitat search / Opportunistic	3hrs 35mins 09.40 – 13.05
	26/05/10	8/8 cloud, no wind, no rain, temp 16.5-17°C	Habitat search / Opportunistic	6hrs 15mins 09.15 – 15.30
	27/05/10	2/8 cloud, no wind, no rain, temp 16-20°C	Habitat search / Opportunistic	6hrs 30mins 10.50 – 17.20
	14/06/10	0/8 cloud, no wind, no rain, temp 11.4-19°C	Habitat search / Opportunistic	7hrs 50mins 08.40 – 16.30
	15/06/10	0/8 cloud, no wind, no rain, temp 10-20°C	Habitat search / Opportunistic	8hrs 55mins 08.10 – 17.05
	16/06/10	0/8 cloud, no wind, no rain, temp 15-22°C	Habitat search / Opportunistic	8hrs 40mins 08.30 – 17.10
	17/06/10	8/8 cloud, no wind, light showers, temp 12-18°C	Habitat search / Opportunistic	8hrs 30mins 08.45 – 17.15
	18/06/10	0/8 cloud, no wind, no rain, temp 11-20°C	Habitat search / Opportunistic	6hrs 05mins 08.25 – 14.30

Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort/Time (24hr)
Amphibians	28/07/03	0/8 cloud, no wind, temp 15°C	Spotlight + call detection	1hr 15mins 17.30 – 18.45
	29/07/03	0/8 cloud, 0-6kph NE, temp 17°C	Habitat search	3hrs 45mins 11.45 – 15.30
	29/07/03	0/8 cloud, 11-19kph NE, temp 13°C	Spotlight + call detection	1hr 15mins 17.30 – 18.45
	31/07/03	0/8 cloud, 11-19kph SE, temp 14°C	Habitat search	4hrs 10.30 – 15.00
	15/09/03	0/8 cloud, 11-19kph S, temp 13°C	Spotlight + call detection	1hr 5mins 18.10 – 19.15
	16/09/03	0/8 cloud, 11-19kph NW, temp 16°C	Habitat search	1hr 10 mins 18.10 – 19.20
	17/09/03	0/8 cloud, 11-19kph S, temp 21°C	Habitat search	3hrs 15 mins 10.00 - 13.15
	18/09/03	0/8 cloud, no wind, temp 16°C	Spotlighting + call detection	1hr 40 mins 09.30 – 11.10
	06/12/06	0/8 cloud, no wind, temp 24°C	Opportunistic	2hr 20 mins 17.40 – 20.00
		0/8 cloud, no wind, temp 21°C	Spotlighting + Call Detection	1hr 25 mins 20.20 – 21.45
	07/12/06	0/8 cloud, no wind, temp 23°C	Opportunistic	2hrs 18.15 – 20.15
		0/8 cloud, no wind, temp 21°C	Spotlighting + Call Detection	1hr 40 mins 20.30 – 22.10
	24-29/01/07*	Not sourced	Spotlighting + call playback	8hrs
	26/05/10	8/8 cloud, no wind, light rain, 3/4 moon, temp 16°C at finish	Spotlighting and call detection	1hr 45mins 17.15 – 19.00
	26/05/10	8/8 cloud, no wind, light rain, 3/4 moon, temp 16°C at finish	Call playback	40mins 18.20 – 19.00
	27/05/10	1-7/8 cloud, no wind, light rain, 4/4 moon, temp 14.5°C at finish	Call playback	1hr 20mins 18.20 – 19.40
	27/05/10	1-7/8 cloud, no wind, light rain, 4/4 moon, temp 14.5°C at finish	Spotlighting and call detection	3hrs 20mins 17.35 – 20.55
	15/06/10	0/8 cloud, no wind, no rain, 1/4 moon, temp 11°C at finish	Spotlighting and call detection	2hrs 40mins 17.50 – 20.30
	17/06/10	0/8 cloud, no wind, no rain, 2/4 moon, temp 12°C-11°C	Spotlighting and call detection	2hrs 40mins 17.45 – 20.25
	17/06/10	0/8 cloud, no wind, no rain, 2/4 moon, temp 12°C-11°C	Call-playback (Wallum Froglet)	35mins 18.45 – 19.20
	15-17/06/10	Various	Funnel Trapping (2x lines of 5x funnels)	30 funnel trap nights
	18/06/10	0/8 cloud, no wind, no rain, 13-18°C	Call-playback (Wallum Froglet)	1hr 09.00 – 10.00
	11/08/10	8-0/8 cloud, light SE wind, no rain, temp 17-22°C	Diurnal call detection in SEPP 14 wetland	2hrs 15mins 0830 – 1045

* Survey effort undertaken by *Ambrose Ecological Services Pty Ltd* (2007). Full survey details including locations and weather conditions have not been provided despite repeated requests for this information.

^ Survey effort undertaken by *Biolink* (2008).

3 SURVEY RESULTS

3.1 Flora results

Six (6) vegetation communities were identified within the subject site through aerial photographic interpretations and extensive ground truthing. These are described in Section 4 of this report.

The plants observed within the vegetation communities of the study area are listed in Table 3.1 and 3.2. A total of one hundred and ninety six (196) natives and seventy eight (78) exotic species were observed in the study area.

Table 3.1 – Native flora observations for the study area

Scientific Name	Common Name	Family
Trees		
Acacia irrorata	-	Fabaceae
Allocasuarina littoralis	Black She-oak	Casuarinaceae
Allocasuarina torulosa	Forest Oak	Casuarinaceae
Alphitonia excelsa	Red Ash	Rhamnaceae
Angophora floribunda	Rough-barked Apple	Myrtaceae
Archontophoenix cunninghamiana	Bangalow Palm	Areaceae
Corymbia gummifera	Red Bloodwood	Myrtaceae
Corymbia maculata	Spotted Gum	Myrtaceae
Eucalyptus deanei	Mountain Blue Gum	Myrtaceae
Eucalyptus paniculata subsp. *paniculata*	Grey Ironbark	Myrtaceae
Eucalyptus pilularis	Blackbutt	Myrtaceae
Eucalyptus resinifera	Red Mahogany	Myrtaceae
Eucalyptus robusta	Swamp Mahogany	Myrtaceae
Eucalyptus umbra	Broad-leaved White Mahogany	Myrtaceae
Exocarpus cupressiformis	Native Cherry	Santalaceae
Livistona australis	Cabbage Tree Palm	Arecaceae
Melia azedarach var. *australasica*	White Cedar	Meliaceae
Syncarpia glomulifera	Turpentine	Myrtaceae
Tristaniopsis laurina	Water Gum	Myrtaceae
Shrubs		
Acacia falcata	Sickle Wattle	Fabaceae
Acacia floribunda	Sally Wattle	Fabaceae
Acacia implexa	Hickory	Fabaceae

Table 3.1 – Native flora observations for the study area

Scientific Name	Common Name	Family
Acacia longifolia	Sydney Golden Wattle	Fabaceae
Acacia myrtifolia	Red-stem Wattle	Fabaceae
Acacia schinoides	-	Fabaceae
Acacia stricta	-	Fabaceae
Acacia suaveolens	Sweet Scented Wattle	Fabaceae
Acacia terminalis	Sunshine Wattle	Fabaceae
Acacia ulicifolia	Prickly Moses	Fabaceae
Aotus ericoides	Common Aotus	Fabaceae
Banksia robur	Swamp Banksia	Proteaceae
Banksia serrata	Old Man Banksia	Proteaceae
Banksia spinulosa	Hairpin Banksia	Proteaceae
Bossiaea obcordata	Spiny Bossiaea	Fabaceae
Breynia oblongifolia	Coffee Bush	Euphorbiaceae
Callicoma serratifolia	Black Wattle	Cunoniaceae
Callistemon citrinus	Crimson Bottlebrush	Myrtaceae
Callistemon linearis	Narrow-leaved Bottlebrush	Myrtaceae
Callistemon salignus	Willow Bottlebrush	Myrtaceae
Ceratopetalum gummiferum	Christmas Bush	Cunoniaceae
Daviesia ulicifolia	Gorse Bitter-pea	Fabaceae
Dodonaea triquetra	Hop Bush	Sapindaceae
Duboisia myoporoides	Corkwood	Solanaceae
Elaeocarpus reticulatus	Blueberry Ash	Elaeocarpaceae
Epacris pulchella	-	Epacridaceae
Glochidion ferdinandi	Cheese Tree	Euphorbiaceae
Gompholobium latifolium	Golden Glory Pea	Fabaceae
Goodenia ovata	-	Goodeniaceae
Hakea salicifolia	Willow Hakea	Proteaceae
Hibbertia aspera	-	Dilleniaceae
Hibiscus diversifolius	-	Malvaceae
Kunzea ambigua	Tick Bush	Myrtaceae
Leptospermum juniperinum	Prickly Tea-tree	Myrtaceae
Leptospermum polygalifolium	Yellow Tea Tree	Myrtaceae
Leptospermum trinervium	Flaky-barked Tea Tree	Myrtaceae
Leucopogon juniperinus	Bearded Heath	Epacridaceae
Leucopogon lanceolatus	Lance-leaf Beard-heath	Epacridaceae
Maytenus silvestris	-	Celastraceae
Melaleuca biconvexa^{TS}	-	Myrtaceae
Melaleuca linariifolia	Snow in Summer	Myrtaceae
Melaleuca nodosa	-	Myrtaceae

Table 3.1 – Native flora observations for the study area

Scientific Name	Common Name	Family
Melaleuca sieberi	-	Myrtaceae
Melaleuca styphelioides	Prickly-leaved Tea Tree	Myrtaceae
Melaleuca thymifolia	-	Myrtaceae
Myrsine variabilis	Mutton Wood	Myrsinaceae
Notelaea longifolia	Mock Olive	Oleaceae
Ozothamnus diosmifolius	Ball Everlasting	Asteraceae
Persoonia lanceolata	Lance-leaved Geebung	Proteaceae
Persoonia levis	Broad-leaved Geebung	Proteaceae
Persoonia linearis	Narrow-leaved Geebung	Proteaceae
Phyllanthus gasstroemii	-	Euphorbiaceae
Phyllanthus hirtellus	Thyme Spurge	Euphorbiaceae
Pimelea linifolia	Slender Rice Flower	Thymelaeaceae
Pittosporum revolutum	Yellow Pittosporum	Pittosporaceae
Pittosporum undulatum	Sweet Pittosporum	Pittosporaceae
Polyscias sambucifolia	Elderberry Panax	Araliaceae
Pomaderris ferruginea	Rusty Pomaderris	Rhamnaceae
Pultenaea flexilis	-	Fabaceae
Pultenaea paleacea	-	Fabaceae
Pultenaea retusa	-	Fabaceae
Pultenaea villosa	-	Fabaceae
Rhodamnia rubescens	Brush Turpentine	Myrtaceae
Zieria smithii	Sandfly Zieria	Rutaceae
Vines		
Billardiera scandens	Apple Dumplings	Pittosporaceae
Cassytha glabella	Devil's Twine	Lauraceae
Cassytha pubescens	Devil's Twine	Lauraceae
Cissus antarctica	Native Grape	Vitaceae
Cissus hypoglauca	Water Vine	Vitaceae
Clematis aristata	Clematis	Ranunculaceae
Convolvulus erubescens	-	Convolvulaceae
Desmodium rhytidophyllum	Rusty Tick-trefoil	Fabaceae
Eustrephus latifolius	Wombat Berry	Luzuriagaceae
Geitonoplesium cymosum	Scrambling Lily	Luzuriagaceae
Glycine clandestina	Twining Glycine	Fabaceae
Glycine microphylla	Twining Glycine	Fabaceae
Glycine tabacina	Twining Glycine	Fabaceae
Hardenbergia violacea	False Sarsparilla	Fabaceae
Hibbertia dentata	Twining Guinea Flower	Dilleniaceae
Hibbertia scandens	Climbing Guinea Flower	Dilleniaceae

Table 3.1 – Native flora observations for the study area

Scientific Name	Common Name	Family
Kennedia rubicunda	Dusky Coral Pea	Fabaceae
Pandorea pandorana	Wonga Vine	Bignoniaceae
Parsonsia straminea	Common Silkpod	Apocynaceae
Smilax australis	Lawyer Vine	Smilacaceae
Smilax glyciphylla	Sarsparilla	Smilacaceae
Stephania japonica var. *discolor*	Snake Vine	Menispermiaceae
Herbs		
Acianthus fornicatus	Pixie Caps	Orchidaceae
Aristida vagans	Wire Grass	Poaceae
Austrostipa pubescens	Tall Spear Grass	Poaceae
Baloskion tetraphyllum	Tassel-rush	Restionaceae
Brachyscome angustifolia	-	Asteraceae
Caesia parviflora	Pale Grass Lily	Anthericaceae
Caesia parviflora	Pale Grass Lily	Anthericaceae
Carex appressa	Tall Sedge	Cyperaceae
Calochilus campestris	Bearded Orchid	Orchidaceae
Calochilus robertsonii	Bearded Orchid	Orchidaceae
Caustis pentandra	-	Cyperaceae
Centella asiatica	Swamp Pennywort	Apiaceae
Commelina cyanea	Scurvy Weed	Commelinaceae
Cryptostylis subulata	Large Tongue Orchid	Orchidaceae
Cymbidium suave	Native Cymbidium	Orchidaceae
Cynodon dactylon	Common Couch	Poaceae
Cyperus sphaeroideus	-	Cyperaceae
Dampiera purpurea	Purple Dampiera	Goodeniaceae
Dampiera stricta	Blue Dampiera	Goodeniaceae
Dianella caerulea	Flax Lily	Phormiaceae
Dichelachne crinita	Long-hair Plume Grass	Poaceae
Dichelachne micrantha	Short-hair Plume Grass	Poaceae
Dichondra repens	Kidney Weed	Convolvulaceae
Digitaria parviflora	Small-flowered Finger Grass	Poaceae
Drosera peltata	Sundew	Droseraceae
Drosera spatulata	Sundew	Droseraceae
Echinopogon caespitosus	Tufted Hedgehog Grass	Poaceae
Empodisma minus	-	Restionaceae
Entolasia marginata	Bordered Panic	Poaceae
Entolasia stricta	Wiry Panic	Poaceae
Eragrostis brownii	Brown's Lovegrass	Poaceae
Eurychorda complanata	-	Restionaceae

Table 3.1 – Native flora observations for the study area

Scientific Name	Common Name	Family
Gahnia clarkei	Saw Sedge	Cyperaceae
Gahnia erythrocarpa	Saw Sedge	Cyperaceae
Gahnia sieberiana	Red-fruited Saw-sedge	Cyperaceae
Geranium homeanum	Northern Cranesbill	Geraniaceae
Gonocarpus micranthus	Creeping Raspwort	Haloragaceae
Gonocarpus tetragynus	Poverty Raspwort	Haloragaceae
Gonocarpus teucrioides	Germainder Raspwort	Haloragaceae
Goodenia heterophylla subsp. *heterophylla*	Variable Leaved Goodenia	Goodeniaceae
Gymnostachys anceps	Settlers Flax	Araceae
Haemodorum corymbosum	Bloodroot	Haemodoraceae
Haemodorum planifolium	Bloodroot	Haemodoraceae
Hibbertia linearis	-	Dilleniaceae
Hydrocotyle peduncularis	Pennywort	Apiaceae
Imperata cylindrica	Blady Grass	Poaceae
Juncus continuus	-	Juncaceae
Juncus usitatus	Common Rush	Juncaceae
Lagenifera stipitata	Common Lagenifera	Asteraceae
Lepidosperma elatius	-	Cyperaceae
Lepidosperma filiforme	-	Cyperaceae
Lepidosperma laterale	Variable Sword-sedge	Cyperaceae
Lepidosperma urophorum	-	Cyperaceae
Lomandra filiformis	Wattle Mat-rush	Lomandraceae
Lomandra longifolia	Spiky-headed Mat-rush	Lomandraceae
Lomandra multiflora	Many-flowered Mat-rush	Lomandraceae
Lomandra obliqua	Twisted Mat-rush	Lomandraceae
Lomatia silaifolia	Crinkle Bush	Proteaceae
Microlaena stipoides	Weeping Grass	Poaceae
Oplismenus aemulus	-	Poaceae
Oxalis perennans	-	Oxalidaceae
Panicum simile	Two Colour Panic	Poaceae
Patersonia glabrata	Leafy Purple-flag	Iridaceae
Patersonia sericea	Wild Iris	Iridaceae
Poa sieberiana	Poa Tussock	Poaceae
Pomax umbellata	Pomax	Rubiaceae
Prasophyllum brevilabre	Short-lipped Leek Orchid	Orchidaceae
Pratia purpurascens	Whiteroot	Lobeliaceae
Pseuderanthemum variabile	Pastel Flower	Acanthaceae
Schoenus melanostachys	Black Bog-rush	Cyperaceae

Table 3.1 – Native flora observations for the study area

Scientific Name	Common Name	Family
Tetratheca thymifolia	Black-eyed Susan	Tremandraceae
Thelymitra ixioides	Spotted Sun Orchid	Orchidaceae
Themeda australis	Kangaroo Grass	Poaceae
Tricostularia pauciflora	-	Cyperaceae
Vernonia cinerea	-	Asteraceae
Veronica plebeia	Creeping Speedwell	Plantaginaceae
Xanthorrhoea latifolia	-	Xanthorrhoeaceae
Xanthorrhoea macronema	-	Xanthorrhoeaceae
Epiphytes		
Loranthaceae sp.	Mistletoe	Loranthaceae
Ferns		
Adiantum aethiopicum	Common Maidenhair	Adiantaceae
Blechnum cartilagineum	Gristle Fern	Blechnaceae
Blechnum indicum	Swamp Water Fern	Blechnaceae
Calochlaena dubia	Common Ground Fern	Dicksoniaceae
Cheilanthes sieberi	Mulga Fern	Sinopteridaceae
Cyathea australis	Rough Tree Fern	Cyatheaceae
Gleichenia dicarpa	Pouched Coral Fern	Gleicheniaceae
Hypolepis muelleri	Harsh Ground Fern	Dennstaedtiaceae
Lindsaea linearis	Screw Fern	Lindsaeaceae
Lindsaea microphylla	Lacy Wedge-fern	Lindsaeaceae
Pteridium esculentum	Bracken Fern	Dennstaedtiaceae
Selaginella uliginosa	Swamp Selaginella	Selaginellaceae
^{TS} = Threatened Species		

Table 3.2 – Exotic flora observations of the study area

Scientific Name	Common Name	Family
Acacia podalyriifolia	Queensland Silver Wattle	Fabaceae
Acer sp.	Maple	Aceraceae
Agapanthus praecox	Agapanthus	Agapanthaceae
Ageratina adenophora	Crofton Weed	Asteraceae
Anagalis arvensis	Pimpernel	Primunlaceae
Andropogon virginicus	Whisky Grass	Poaceae
Asparagus aetheopicus	Asparagus Fern	Asparagaceae
Axonopus fissifolius	Narrowleaf Carpet Grass	Poaceae
Bidens pilosa	Cobblers Pegs	Asteraceae
Briza maxima	Quaking Grass	Poaceae
Cerastium glomeratum	Mouse-ear Chickweed	Caryophyllaceae

Table 3.2 – Exotic flora observations of the study area

Scientific Name	Common Name	Family
Cestrum parqui	Green Cestrum	Solanaceae
Chloris gayana	Rhodes Grass	Poaceae
Chlorophytum comosum	-	Anthericaceae
Chrysanthemoides monilifera	Bitou Bush	Asteraceae
Cinnamomum camphora	Camphor Laurel	Lauraceae
Cirsium vulgare	Spear Thistle	Asteraceae
Conyza sumatrensis	Tall Fleabane	Asteraceae
Cortaderia selloana	Pampas Grass	Poaceae
Cyclospermum leptophyllum	Slender Celery	Apiaceae
Ehrharta erecta	Panic Veldtgrass	Poaceae
Euphorbia peplus	-	Euphorbiaceae
Facelis retusa	-	Asteraceae
Gladiolus sp.	Gladiolus	Iridaceae
Hedychium gardnerianum	Ginger Lily	Anthericaceae
Hydrocotyle bonariensis	Pennywort	Apiaceae
Hypochaeris radicata	Flatweed	Asteraceae
Ipomoea cairica	Coastal Morning Glory	Convolvulaceae
Jacaranda mimosifolia	Jacaranda	Bignoneaceae
Jasminum polyantyhum	Jasmine	Oleaceae
Juncus cognatus	-	Juncaceae
Lantana camara	Lantana	Verbenaceae
Ligustrum lucidum	Large-leaved Privet	Oleaceae
Ligustrum sinense	Small-leaved Privet	Oleaceae
Lonicera japonica	Japanese Honeysuckle	Caprifoliaceae
Lophostemon confertus	Brush Box	Myrtaceae
Lotus suaveolens	Hairy Birds-foot Trefoil	Fabaceae
Medicago sp.	Medic	Fabaceae
Melaleuca armillaris	-	Myrtaceae
Melaleuca hypericifolia	-	Myrtaceae
Monstera deliciosa	-	Araceae
Musa acuminata	Edible Banana	Musaceae
Nephrolepis cordifolia	Fish-bone Fern	Davalliaceae
Ochna serrulata	Mickey Mouse Plant	Ochnaceae
Osteospermum ecklonis	-	Asteraceae
Oxalis corniculata	Yellow Wood Sorrel	Oxalidaceae
Oxalis latifolia	-	Oxalidaceae
Paraserianthes lophantha	Crested Wattle	Fabaceae
Paspalum dilatatum	Paspalum	Poaceae
Paspalum urvillei	Vasey Grass	Poaceae

Table 3.2 – Exotic flora observations of the study area

Scientific Name	Common Name	Family
Passiflora edulis	Passionfruit	Passifloraceae
Pennisetum clandestinum	Kikuyu	Poaceae
Phyllostachys sp.	-	Poaceae
Pinus elliottii	Slash Pine	Pinaceae
Pinus radiata	Radiata Pine	Pinaceae
Plantago lanceolata	Ribwort	Plantaginaceae
Pyracantha angustifolia	-	Malaceae
Ranunculus repens	Creeping Buttercup	Ranunculaceae
Ricinus communis	Castor Oil	Euphorbiaceae
Rubus fruticosus	Blackberry Complex	Rosaceae
Rumex crispus	Curled Dock	Polygonaceae
Schefflera actinophylla	Umbrella Tree	Araliaceae
Senecio madagascariensis	Fireweed	Asteraceae
Senna pendula	Senna	Fabaceae
Setaria sphacelata	Setaria	Poaceae
Sida rhombifolia	Paddy's Lucerne	Malvaceae
Solanum mauritianum	Wild Tobacco	Solanaceae
Sonchus oleraceus	Common Sowthistle	Asteraceae
Sporobolus africanus	Parramatta Grass	Poaceae
Stellaria media	Chickweed	Caryophyllaceae
Stenotaphrum secundatum	Buffalo Grass	Poaceae
Tagetes minuta	Stinking Roger	Asteraceae
Taraxacum officinale	Dandelion	Asteraceae
Tradescantia albiflora	Wandering Jew	Commelinaceae
Trifolium repens	White Clover	Fabaceae
Verbena bonariensis	Purple Top	Verbenaceae
Verbena rigida	Veined Verbena	Verbenaceae
Vicia sativa	Common Vetch	Fabaceae

3.2 Fauna results

Species observed throughout the duration of fauna surveys within the subject site are listed in observation Columns 1, 2 & 5 of Table 3.2.
Five (5) observation columns are provided separating fauna recordings from previous surveys. Two (2) additional surveys undertaken by *Conacher Travers* and *Travers bushfire & ecology* have been included in Columns 3 & 4 as these surveys were undertaken within lands immediately adjacent to the subject site.

Specifically surveys include:

(1) *Conacher Travers* (2003) and *Travers bushfire & ecology* (2008/09) with a focus on the north-eastern portions of the subject site;
(2) *Ambrose Ecological Services* (2007) with a focus on the north-eastern portions of the subject site;
(3) *Conacher Travers* (2006) undertaken along Berkeley Road to the immediate south;
(4) *Conacher Travers* (2001) & *Travers bushfire & ecology* (2007) undertaken within Lots 5041-5043 to the immediate west;
(5) *Travers bushfire & ecology* (2010) undertaken throughout the subject site area and nearby surrounds.

Table 3.2- Fauna observations for the study area

Common name	**Scientific name**	**Method Observed**				
		***(1) Conacher Travers / Travers bushfire & ecology* (2003/2008/2009)**	***(2) Ambrose Ecological Services* (2007)**	***(3) Conacher Travers* (2006) Site: Berkeley Rd to the South**	***(4) Conacher Travers* (2001) & *Travers Environmental* (2007) Site: Lots 5041-5043 to the West**	***(5) Travers bushfire & ecology* (2010)**
Birds						
Australian Brush Turkey	*Alectura lathami*				SC	O Cg Sc
Australian King-Parrot	*Alisterus scapularis*			OC	OC	OC
Australian Magpie	*Gymnorhina tibicen*	OC	OC	OC	OC	OC
Australian Magpie-Lark	*Grallina cyanoleuca*	OC	OC	O	OC	C
Australian Pelican	*Pelecanus conspicillatus*	O				O
Australian Raven	*Corvus coronoides*	OC	OC		OC	C
Australian White Ibis	*Threskiornis molucca*	O	O			
Australian Wood Duck	*Chenonetta jubata*				OC	Sp C
Bell Miner	*Manorina melanophrys*	OC	OC	OC	OC	OC
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		O	O	OC	OC

Black-fronted Dotterel	*Elseyornis melanops*					Sp C
Black-faced Monarch	*Monarcha melanopsis*				C	
Brown Gerygone	*Gerygone mouki*				OC	OC
Brown Cuckoo-Dove	*Macropygia amboinensis*				O	
Brown Thornbill	*Acanthiza pulsilla*	O	OC		OC	OC
Brush Cuckoo	*Cacomantis variolosus*				C	
Cattle Egret	*Ardea ibis*				O	
Channel-billed Cuckoo	*Scythrops novaehollandiae*			OC		
Common Koel	*Eudynamys scolopacea*		OC	C		
Common Myna *	*Acridotheres tristis*	OC	OC	OC		OC
Crested Pigeon	*Ocyphaps lophotes*	O	O	OC	OC	OC
Dollarbird	*Eurystomus orientalis*		C		OC	
Eastern Rosella	*Platycercus eximius*	OC	OC	OC	O	OC
Eastern Spinebill	*Acanthorhynchus tenuirostris*				OC	OC
Eastern Whipbird	*Psophodes olivaceus*	C	C	C	OC	OC
Eastern Yellow Robin	*Eopsaltria australis*	O	OC		OC	OC
Fan-tailed Cuckoo	*Cacomantis flabelliformis*				OC	C
Galah	*Cacatua roseicapilla*	OC		O	OC	OC
Golden Whistler	*Pachycephala pectoralis*	OC	O		OC	OC
Green Catbird	*Ailuroedus crassirostris*				OC	E
Grey Butcherbird	*Cracticus torquatus*	OC	O	C	OC	C
Grey Fantail	*Rhipidura fuliginosa*	OC	OC		OC	OC
Grey Goshawk	*Accipiter novaehollandiae*			O	O	
Grey Shrike-thrush	*Colluricincla harmonica*				C	OC
Jacky Winter	*Microeca fascinans*	O	O			
Large-billed Scrub Wren	*Sericornis magnirostris*				OC	
Laughing Kookaburra	*Dacelo novaeguineae*	C	OC	C	OC	OC
Lewin's Honey-eater	*Meliphaga lewinii*	OC	O		OC	OC
Little Lorikeet[TS]	*Glossopsitta pusill*			OC		
Little Wattlebird	*Anthochaera chrysoptera*	OC		OC	OC	OC
Long-Billed Corella	*Cacatua tenuirostris*				OC	C
Masked Lapwing	*Vanellus miles*		OC		C	Sp C
Nankeen Kestrel	*Falco cenchroides*					O
Noisy Friarbird	*Philemon corniculatus*			OC	OC	C
Noisy Miner	*Manorina melanocephala*	OC	OC	OC	OC	C
Olive-backed Oriole	*Oriolus sagittatus*			OC	OC	
Pacific Baza	*Aviceda subcristata*				C	

Pheasant Coucal	*Centropus phasianinus*				OC	
Pied Currawong	*Strepera graculina*	OC	OC	C	OC	C
Powerful Owl [TS]	*Ninox strenua*	OC				
Rainbow Lorikeet	*Trichoglossus haematodus*	OC	OC	OC	OC	OC
Red Wattle Bird	*Anthochaera carunculata*	OC	O	C	OC	OC
Red-browed Finch	*Neochmia temporalis*	O	O		OC	OC
Rose Robin	*Petroica rosea*				C	
Rufous Fantail	*Rhipidura rufifrons*				OC	
Rufous Whistler	*Pachycephala rufiventris*				OC	
Sacred Kingfisher	*Todiramphus sanctus*				OC	
Satin Bowerbird	*Ptilonorhynchus violaceus*	O	O		OC	
Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*					OC
Scarlet Honeyeater	*Myzomela sanguinolenta*				C	
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*				OC	C
Silvereye	*Zosterops lateralis*	O	OC		OC	
Southern Boobook	*Ninox novaeseelandiae*		Sp			
Spangled Drongo	*Dicrurus bracteatus*	O				
Spotted Pardalote	*Pardalotus punctatus*	O	O		O	C
Spotted Turtle-dove *	*Streptopelia chinensis*	O	OC		OC	C
Striated Pardalote	*Pardalotus striatus*	O				
Striated Thornbill	*Acanthiza lineata*	O	O			
Sulphur-crested Cockatoo	*Cacatua galerita*	C	C	OC	OC	OC
Superb Fairy-wren	*Malurus cyaneus*	OC	OC	OC	OC	OC
Tawny Frogmouth	*Podargus strigoides*		Sp			
Varied Sittella [TS]	*Daphoenositta chrysoptera*				O	
Variegated Fairy Wren	*Malurus lamberti*				OC	OC
Weebill	*Smicrornis brevirostris*	O	O			
Welcome Swallow	*Hirundo neoxena*					O
Whistling Kite	*Haliastur sphenurus*	O	O			
White-bellied Sea Eagle	*Haliaeetus leucogaster*					OC
White-browed Scrubwren	*Sericornis frontalis*		OC		OC	OC
White-cheeked Honeyeater	*Phylidonyris nigra*	O				OC
White-faced Heron	*Egretta novaehollandiae*					O
White-headed Pigeon	*Columba leucomela*					O
White-throated Gerygone	*Gerygone olivacea*				C	
White-throated Treecreeper	*Cormobates leucophaeus*			C	OC	OC
Willie Wagtail	*Rhipidura leucophrys*				OC	
Wonga Pigeon	*Leucosarcia melanoleuca*			C	OC	O
Yellow Thornbill	*Acanthiza nana*	O				OC
Yellow-faced Honeyeater	*Lichenostomus chrysops*	OC	O		OC	OC

Yellow-tailed Black-cockatoo	*Calyptorhynchus funereus*	O	OC		OC	C
Yellow-throated Scrub Wren	*Sericornis citreogularis*				OC	OC
Mammals						
Brown Antechinus	*Antechinus stuartii*	E	Ht		E	E
Bush Rat	*Rattus fuscipes*	E	Ht		E	E Cm
Chocolate Wattled Bat	*Chalinolobus morio*		A			
Common Brushtail Possum	*Trichosurus vulpecula*		Sp	Sp	Sp	Cg E Cm Sp
Common Ringtail Possum	*Pseudocheirus peregrinus*	Sp	Sp Ht	Sp	Sp	Sp
Eastern Bentwing-bat [TS]	*Miniopterus orianae oceansis*	A	A	A		A
Eastern Broad-nosed Bat	*Scotorepens orion*			A	A	
Eastern Falsistrelle [TS]	*Falsistrellus tasmaniensis*			A	A	
Eastern Forest Bat	*Vespadelus pumilus*	A	A		A	A
Eastern Freetail-bat	*Mormopterus ridei*			A		
East-coast Freetail Bat	*Micronomus norfolkensis*					A
Feather-tailed Glider	*Acrobates pygmaeus*					Sp
Gould's Wattled Bat	*Chalinolobus gouldii*	A	A	A	A	A
Greater Broad-nosed Bat [TS]	*Scoteanax rueppelli*			A	A	
Grey-headed Flying-fox [TS]	*Pteropus poliocephalus*			Sp	Sp	Sp C
Large Forest Bat	*Vespadelus darlingtoni*			A		
Lesser Long-eared Bat	*Nyctophilus geoffroyii*				A	
Long-eared Bat	*Nyctophilus sp.*					A
Little Bentwing-bat [TS]	*Miniopterus australis*				A	A
Little Forest Bat	*Vespadelus vulturnus*				A	
Little Red Flying-fox	*Pteropus scapulatus*				Sp	OC
Long-nosed Bandicoot	*Perameles nasuta*				Sp Roadkill	
Macropod species	*Macropus sp.*	Sc			Sc	
Northern Brown Bandicoot	*Isoodon macrourus*	E	Ht		Cg	
Red-necked Wallaby	*Macropus rufogriseus*		Sp			
Southern Forest Bat	*Vespadelus regulus*			A		
Sugar Glider	*Petaurus breviceps*		Ht		E	Sp E C
Swamp Rat	*Rattus lutreolus*	E	Ht		E	E
Swamp Wallaby	*Wallabia bicolor*			Sp	Sp	O Sc Sp
White-striped Mastiff Bat	*Austronomus australis*					A
Yellow-bellied Glider [TS]	*Petaurus australis*				Sp C	
Black Rat *	*Rattus rattus*	E			E	Cg
Brown Rat *	*Rattus norvegicus*				E	
Cat *	*Felis cattus*		Sp			O Sp

Cow *	*Bos Taurus*				Sp O	O
Dog *	*Canis familiaris*	Sc			Sp O	C Sc
Donkey*	*Equus asinus*	Sp				
Fox *	*Vulpes vulpes*				Sp	Cm
Horse *	*Equus caballus*	Sc Sp				
Rabbit *	*Oryctolagus cuniculus*	Sp	O Sp		Sc Sp	Sp
Reptiles						
Copper-tailed Skink	*Ctenotus taeniolatus*		O RF			
Delicate Skink	*Lampropholis delicata*					O
Garden Skink	*Lampropholis guichenoti*	O	O RF		O	
Green Tree Snake	*Dendrelaphis punctulata*	O				
Eastern Water Skink	*Eulamprus quoyii*		O			
Jacky Lizard	*Amphibolurus muricatus*	O	O			
Lace Monitor	*Varanus varius*					Sc
Land Mullet	*Egernia major*	O				
Red-bellied Black Snake	*Pseudechis porphyriacus*	O	O		O	O
Red-throated Skink	*Acritoscincus platynotum*		O RF			
Amphibians						
Common Eastern Froglet	*Crinia signifera*	C	C		C	C
Dwarf Tree Frog	*Litoria fallax*	C		C	C	
Green Leaf Tree Frog	*Litoria phyllochroa*				C	
Peron's Tree Frog	*Litoria peronei*			C	C	
Laughing Tree Frog	*Litoria tyleri*			C		
Striped Marsh Frog	*Limnodynastes tasmaniensis*			O	C	S Sp
Tyler's Tree Frog	*Litoria tyleri*				C	
Whistling Tree Frog	*Litoria verreauxii*				C	C

Note: * indicates introduced species
[TS] indicates threatened species

A	-	Anabat	C	-	Call Identification
O	-	Observation	P	-	Call Playback Response
E	-	Elliott Trap	S	-	Habitat Search
Sp	-	Spotlight	Sc	-	Scat, Track or Sign Identification
Ht	-	Hair tube	RF	-	Reptile funnel trap
Cg	-	Cage Trap	H	-	Harp trap
Cm	-	Surveillance Camera			

4 ECOLOGICAL ASSESSMENT

4.1 Previous surveys reviewed

The site has had extensive ecological study undertaken since the year 2000. This has included the fields of ecology, environment and hydrological processes.

Lower Hunter and Central Coast Regional Environment Management Strategy Vegetation Survey, Classification and Mapping; Lower Hunter and Central Coast Region (LHCCREMS) (*NPWS 2000*)

An extensive vegetation mapping survey of the Lower Hunter and Central Coast in which the vegetation within the study area was identified as a combination of Coastal Narrabeen Moist Forest, Alluvial Tall Moist Forest and unclassified. Field inspections indicate that most of the natural bushland is more aligned with Coastal Ranges Open Forest and Wyong Paperbark Swamp Forest as defined by this reference.

The Natural Vegetation of the Wyong Local Government Area, Central Coast, New South Wales (*Bell 2002*)

An extensive vegetation mapping survey of the Wyong LGA in which the vegetation within the study area was identified as a combination of Narrabeen Coastal Blackbutt Shrubby Forest and Alluvial Floodplain Shrub Swamp Forest. *Travers bushfire & ecology* generally concurs with this assessment.

Flora and Fauna Assessment of Lot 50 DP 755263 Berkeley Road Fountaindale (*Conacher Travers* (2003)

Site survey was done on a parcel of land approximately 500 metres to the south west of the subject site. No threatened fauna species, one (1) threatened flora species, *Melaleuca biconvexa* and three (3) endangered ecological communities, *Swamp Sclerophyll Forest on Coastal Floodplains, River flat Eucalypt Forest on Coastal Floodplains* and Lowland Rainforest were recorded within or in close proximity to the subject site.

Enterprise Drive Environmental Study *Andrews Neil* (*1992*)

This brief study included the subject site and study area and identified that the study area contained a mixture of cleared land and Open Forest on Terrigal Formation. No other detailed flora and fauna information was provided.

Flora and Fauna Survey Proposed Subdivision Lots 30 and 31 DP 803761 Enterprise Drive, Berkeley Vale *Robert Payne Ecological Surveys and Management* (1998)

This site is located between Enterprise Drive and Apprentice Drive, Berkeley Vale. One (1) threatened flora species, *Melaleuca biconvexa* was recorded within the site. Two (2) threatened micro-chiropteran bat species, Eastern False Pipistrelle (*Falsistrellus*

tasmaniensis) and Greater Broad-nosed Bat (*Scoteanax rueppellii*) were recorded within the site. According to this report the Green-thighed Frog (*Litoria brevipalmata*) was recorded on the site in 1995 by Phillip Green and Ross Wellington. A suspect spotlighting observation of a large glider species was made during nocturnal surveys. It was considered that this may possibly be a Squirrel Glider however this identification was not confirmed.

Flora and Fauna Assessment *Conacher Travers* (of the Study Area being Lot 2 DP 1100181) (2003).

Conacher Travers identified five (5) vegetation communities and two (2) threatened species, *Melaleuca biconvexa* and the Eastern Bentwing-bat (*Miniopterus schreibersii*) and one (1) endangered ecological community, Sydney Coastal Estuary Swamp Forest Complex and Sydney Freshwater Wetlands (now Swamp Sclerophyll Forest on Coastal Floodplains) occupying the site. In addition forty (40) species of birds, fourteen (14) species of mammals, four (4) species of reptiles and two (2) species of amphibian occurred. No threatened bird species were recorded within the study area.

Fourteen (14) species of mammals were recorded within the study area. This included five (5) native terrestrial species, one (1) common arboreal species, three (3) micro-chiropteran bat species and five (5) introduced terrestrial species. Four (4) species of reptile and two (2) amphibians were recorded within the study area. *Conacher Travers* was not aware of a detailed development proposal at the time and did not provide ecological impact assessment advice. They advised that the:

- The stand of *Melaleuca biconvexa* be protected
- The Swamp Mahogany forest be retained and protected by a buffer
- Water quality runoff to be of pre-development standard

Habitat tree survey *Conacher Travers* 2003 (of the Study Area being Lot 2 DP 1100181)

Conacher Travers undertook a habitat tree survey over part of the site in 2003. Their report identified all habitat trees within the development envelope. *Conacher Travers* recommended habitat trees to be retained (if possible).

Flora Assessment *Anne Clements & Associates (2006)*

- This report was in reference to the same lands but for use as a nursery

In 2006 *Anne Clements & Associates* undertook a desk top analysis and advised on vegetation management' principles for the type of development being proposed. This report noted that *v*egetation clearing is restricted to the nursery facility, proposed dams, and the access road and it was noted that some trees are to be retained within the plant growing area and the bushfire asset protection zones and that there was little risk to the Swamp Mahogany Forest EEC and SEPP 14 landscape.

Ecological assessment *Anne Clements & Associates (2006)*

- This report was in reference to the same lands but for use as a nursery

Anne Clements & Associates prepared an *Assessment of Impact using the 8-part test on Melaleuca biconvexa and Swamp Sclerophyll Forest on Coastal Floodplains.* The report recommended:

- The nursery planting areas be bunded to further minimise risk to downslope bushland; and

- Water quality be monitored. Down slope areas be inspected for weed infestation on a regular basis.

Vegetation Management Plan *Anne Clements & Associates* (2006)

- This report was in reference to the same lands but for use as a nursery

In 2006 *Anne Clements & Associates* prepared a *Vegetation Plan of Management.* This brief plan applies to the managed bushland buffer zone downslope of the proposed nursery. The plan identified the known threats to the endangered ecological community *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions* and detailed actions to reduce these threats, such as;

- Maintaining pre-existing flow to the bushland downslope
- Maintaining high quality water to the bushland downslope
- Monitoring water quality downslope as part of the ongoing monitoring program to ensure that all fertiliser enriched waters be retained within the nursery area
- Maintaining the vegetation downslope of the nursery as a weed-free managed bushland buffer zone
- Monitoring and checking the implementation of corrective action requests

Flora and Fauna Assessment - Proposed Road Upgrade Berkeley Road, Berkeley Vale *Conacher Travers* (2006)

Conacher Travers undertook flora and fauna survey and assessment for the Section 1 upgrade of Berkeley Road, Berkeley Vale, located to the immediate south of the current subject site.

One (1) threatened flora species of (*Melaleuca biconvexa*) and four (4) threatened species, Grey-headed Flying-fox (*Pteropus poliocephalus*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Eastern Bentwing-bat (*Miniopterus schreibersii oceansis*) were recorded within the subject site.

The report concluded that the proposed upgrade of Berkeley Road, Berkeley Vale will not cause a significant impact upon threatened species, populations or endangered ecological communities.

Fauna survey and assessment *Ambrose Ecological Services Pty Ltd* (2007)

- This report was in reference to the same lands but for use as a nursery

Ambrose Ecological Services prepared *a Supplementary Fauna Survey and Assessment.* They advised that the development footprint is located within the north-eastern corner of a bushland remnant and that the proposed habitat clearance will not significantly fragment or isolate areas of this remnant to the extent that native fauna movement along local wildlife corridors will be significantly impeded.

They provided a *7 pt test of significance* for several species inclusive of Grey-headed Flying-fox, Microbats dependent on tree hollows, microbats dependent on caves and mine shafts. They concluded that there are not likely to be any significant impacts on the status of the Spotted–tailed Quoll, Yellow-bellied Glider, Squirrel Glider or their habitats resulting from the proposed development and a *species impact statement* was not required.

The report recommended, where possible, hollow-bearing trees should be retained and two (2) microchiropteran bat nest-boxes should be placed within the site for each hollow-bearing tree that requires removal.

Ecological Assessment of Lot 50 DP 755263 & Incorporation of a Conservation Plan at 70 Berkeley road, Fountaindale *Travers bushfire & ecology* (2008)

This site is located to the immediate west of the current subject site and extends to the other side of Berkeley Road encompassing an area of approximately 11 hectares. This survey and assessment was an update of previous survey and assessment by *Conacher Travers* (2003).

Five (5) threatened fauna species Grey-headed Flying-fox (*Pteropus poliocephalus*), Little Bentwing-bat (*Miniopterus australis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) and Yellow-bellied Glider (*Petaurus australis*) were recorded. Original fauna survey by *Conacher Travers* (2003) was undertaken in September 2001, updated fauna survey was undertaken in July and November 2007.

One (1) threatened flora species, *Melaleuca biconvexa* and three (3) endangered ecological communities, *Swamp Sclerophyll Forest on Coastal Floodplains, River-flat Eucalypt Forest on Coastal Floodplains* and Lowland Rainforest were recorded within or in close proximity to the subject site.

Building envelopes, asset protection zones, effluent management areas and retained vegetation areas have been designed for each of the three (3) lots to ensure that the bulk of the development has been contained within the already cleared portions of the site.

The 7 part test of significance for concluded that the proposed development and possible ecological and environmental benefits that may accrue from a conservation management regime will not have a significant impact on any threatened species, populations or endangered ecological communities.

Bushfire - *Travers bushfire & ecology* (March 2009)

- This report was in reference to the same lands but for use as a nursery

Travers bushfire & ecology prepared a bushfire protection assessment and advised that the whole of the site area was bushfire prone land and required asset protection zones to protect the development. No areas of native vegetation were required to be removed as a result of the assessment other than minor *outer pr*otection management on the periphery of access and egress roads/trails.

Water Management Cycle *Worley Parsons* (2009)

- This report was in reference to the same lands but for use as a nursery

Worley Parsons were engaged to prepare a water cycle management strategy in accordance with the principles of water sensitive urban design (*WSUD*), stormwater management and best practice nursery management to meet the objectives in minimising impacts on stormwater quality & quantity and minimise potable water use.

Water Management Cycle *Martens Consulting Engineers* (2009)

- This report was in reference to the same lands but for use as a nursery

In 2006 *Martens Consulting Engineers* prepared a *Soil, Water and Wastewater Management Plan.* This report identified the *Management of Stormwater Flows* and the *Management of Stormwater Quality.* This has been superseded by the *Worley Parsons* report.

Habitat tree survey *Travers bushfire & ecology* (2008)

- This report was in reference to the same lands but for use as a nursery

In 2008 undertook additional habitat tree survey inclusive of habitat resources on site and closer to the SEPP 14 wetland.

Koala Survey (SEPP 44 Assessment) *Biolink Ecological Consultants* (2008)

- This report was in reference to the same lands but for use as a nursery

Fauna surveys conducted by *Conacher Travers* (2003) and *Ambrose Ecological Services* (2007) concluded that the subject site contained *potential koala habitat* within the Swamp Mahogany Woodland. They also advised that the site was not *core koala habitat* according to the definitions of SEPP 44 Koala Habitat Protection.

Since the completion of these assessments a sighting and photographic evidence of a Koala scat and tracks was reported to Council and DECC in March 2007. This sighting was located in the north-eastern portions of the subject site (see Figure 3). Under the advice of DECC Council requested further targeted Koala surveys and assessment.
.
In 2008 *Travers bushfire & ecology* undertook further survey for Koala within the vegetation community in proximity to the previous Koala sighting as well as within the Swamp Mahogany Woodland using methods outlined in Section 2.3.3. Koala was recorded by evidence of scat analysis undertaken by Barbara Triggs. The location of this and the previous record was within the Blackbutt Open Forest community considered to provide no SEPP 44 - Schedule 2 tree species or primary feed trees identified by the Koala Recovery Plan (NPWS 2003).

Subsequent to *Travers bushfire & ecology* investigation of the site Dr Stephen Phillips of *Biolink* was consulted by *Travers bushfire & ecology* in relation to the presence of potential Koala habitat on the site. Subsequently Biolink was engaged to provide expert advice in regard to Koala activity on the site.

Biolink undertook survey on the 29–30 October 2008 during which time seven (7) SAT sites were assessed within the study area and lands covered by the public reserve to the south. Location of SAT sites is provided in Figure 3.

Collectively, a total of 178 trees were sampled, comprising 4 species from the genus *Eucalyptus* and at least 13 species of non-eucalypt. The Biolink survey report is attached in Appendix 1.

This report stated that:

> The 2007 koala record from the site likely represents the sighting of either a dispersing animal from a local resident population or a reflection of occasional transient use of the site. The location of the single faecal pellet recorded prior to this survey from within an area of limited importance to koalas (i.e. Blackbutt forest containing no preferred food tree species) also supports this assertion, and may have originated from the animal referred to above. It is also possible that the pellet was

misidentified as Brushtail and Ringtail Possum scats were common throughout this area and can be mistaken for koala scats in some cases.

The report concluded that:

> There was no evidence to suggest that *Core Koala Habitat* exists within the study area, and hence there is no need for a Koala Plan of Management to be prepared. That proportion of the study area containing Swamp Mahogany qualifies as *Potential Koala Habitat* and as such *Biolink* recommended, as a minimum, the maintenance of this portion of the study area in its current state in order to provide for continued availability of the habitat for future expansion and movement of koala populations in the local area.

Target Survey for Powerful Owl and White-bellied Sea Eagle at Berkeley Vale *John Young Wildlife* (2010)

- Same study area

This report has been attached as Appendix 2.

John Young Wildlife undertook a specialised survey on the site between the 10-13th of August 2010. He undertook an extensive search of the above development site to search for the White Breasted Sea-Eagles nest and more so – to clarify if indeed a pair of Powerful Owls (*Ninox Strenua)* occurred on or were utilizing the site.

The report advised that:

- The Powerfull Owl territory centre was approx' 1 kilometre west of the western boundary of the development site. Regarding the Powerful Owl that was drawn to the south eastern section of the site by call playback many months earlier John Young advised that this individual was drawn in from maybe more than 1 and a half kilometres to the west from a ridge top as it was patrolling the eastern border of its territory which we now know is in another valley well away from the development site.

- The White-bellied Sea Eagle was nesting within the SEPP 14 Wetland.

The report concluded;

- The rezoning area would have no impact upon the pair of Powereful Owls

- The few hollows on the site are of poor quality – except for 1 - and would only be used by Boobook Owls.

4.2 Flora species

A total of one hundred and ninety six (196) natives and seventy eight (78) exotic species were observed within the study area during the survey.

All species are listed in Table 3.1.

4.3 Vegetation communities

Six (6) vegetation communities were identified within the study area through aerial photographic interpretations and extensive ground truthing:

1. Blackbutt Open Forest (29.09ha)
2. Disturbed Apple/Mahogany Woodland (0.45ha)
3. Swamp Mahogany Woodland (6.90ha)
4. Grassland with Scattered Trees (9.26ha)
5. Disturbed Swamp Mahogany Open Woodland (2.79ha)
6. Disturbed Pine Forest (4.89ha)

Note: Areas are approximations based on ArcGIS measurements. They should have a 95%+ accuracy.

Vegetation Community 1 – Blackbutt Open Forest:

Occurrence - This vegetation community occurs over a large portion of the study area typically on the Erina Soil Landscape and above the 10m contour.

Photo 1 – Blackbutt Open Forest in the northern portion of the study area.

Structure - Open Forest with a canopy cover of approximately 20-50% and height of approximately 20-30 metres. There are occasional emergent old growth species that may be up to 35m tall. The understorey consists of a moderate to dense shrublayer to 6 metres high and a moderate to sparse groundcover of herbs, ferns and grasses. There may also be a

secondary upper stratum layer of younger Eucalypts and Turpentine's a few metres below the height of the main canopy.

Disturbances - This vegetation community has been impacted by a history of logging. An area in the north east has been previously cleared and appears to be regenerating into the original vegetation community. This community has a generally low incidence of weeds, except for scattered moderate incursions of Lantana, significant incursions in the formerly cleared area and moderate incursions along perimeters of roads and residential development. This vegetation community has also been impacted by a variety of rubbish dumping, principally garden refuse.

Common Species

Trees: *Allocasuarina torulosa* (Forest Oak), *Callistemon salignus* (Willow Bottlebrush), *Corymbia maculata* (Spotted Gum), *Eucalyptus pilularis* (Blackbutt), *Eucalyptus resinifera* (Red Mahogany), *Eucalyptus umbra* (Broad-leaved White Mahogany) and *Syncarpia glomulifera* (Turpentine).

Shrubs: *Bossiaea obcordata*, *Daviesia ulicifolia* (Gorse Bitter-pea), *Leptospermum polygalifolium* (Yellow Tea Tree) and *Melaleuca nodosa* (Prickly leaved Paperbark).

Groundcovers: *Entolasia stricta* (Wiry Panic), *Lomandra longifolia* (Spiky-headed Mat-rush), *Lomandra obliqua* (Twisted Mat-rush), *Pteridium esculentum* (Bracken Fern) and *Themeda australis* (Kangaroo Grass).

Weeds: *Andropogon virginicus** (Whisky Grass), *Hypochaeris radicata** (Flatweed), *Lantana camara** (Lantana), *Medicago sp.** (Medic) and *Melaleuca hypericifolia* (a native but out of its natural range).

Vegetation Community 2 – Disturbed Apple/Mahogany Woodland:

This vegetation community has been severely impacted by clearing, agricultural activities and weed incursion. This community is equivalent to the EEC – *Swamp Sclerophyll Forest on Coastal Floodplains*. The general native species presence is similar to the other Swamp Mahogany communities within the study area, and 50% or more of the native species within a quadrat undertaken in this community showed concurrence with the EEC.

Occurrence - This vegetation community is small and occurs in Lot 2 DP 1100181 in the western portion around the 15m contour. Its extent would have been larger but due to previous clearance and introduction of Pine Trees, the community has been reduced in size.

Structure – Woodland to open woodland with a canopy cover of 5-15% and height of approximately 15-20 metres. The understorey consists of a sparse shrublayer to 6 metres high and a dense groundcover of herbs, ferns and grasses.

Disturbances - This vegetation community highly disturbed by former clearing and agricultural activities, with the groundcover dominated by exotic species in some places (Paspalum and Kikuyu). There have been significant incursions of pines from the adjoining pine forest.

Common Species

Trees: *Eucalyptus robusta* (Swamp Mahogany) *Angophora floribunda* (Rough-barked Apple), *Pinus elliottii** (Slash Pine) and *Glochidion ferdinandi* (Cheese Tree).

Shrubs: *Acacia longifolia* (Sydney Golden Wattle), *Lantana camara** (Lantana), *Leptospermum polygalifolium* (Yellow Tea Tree) and *Melaleuca nodosa* (Prickly leaved Paperbark).

Groundcovers: *Centella asiatica* (Swamp Pennywort), *Paspalum sp.**, *Pennisetum clandestinum** (Kikuyu), *Pteridium esculentum* (Bracken Fern) and *Themeda australis* (Kangaroo Grass).

Photo 2 – Disturbed Apple/Mahogany Woodland showing a moderately cleared and weedy (grassed) understorey with occasional pine trees.

Vegetation Community 3 – Swamp Mahogany Woodland:

Occurrence - This vegetation community occurs generally on alluvial soils (Wyong Soil Landscape) in the centre of the study area, mostly below the 10m contour.

Structure - Woodland with a canopy cover of approximately 10-25% and height of approximately 12-22 metres. The understorey consists of a moderate to dense shrublayer to 6 metres high and a particularly dense groundcover of sedges, ferns and herbs. The height of the canopy layer decreases towards the SEPP 14 wetland.

Disturbances - This vegetation community appears to be relatively undisturbed.

Common Species

Trees: *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus resinifera* (Red Mahogany) and *Callistemon salignus* (Willow Bottlebrush).

Shrubs: *Acacia longifolia* (Sydney Golden Wattle), *Banksia spinulosa* (Hairpin Banksia), *Leptospermum polygalifolium* (Yellow Tea Tree), *Melaleuca linariifolia* (Snow in Summer), *Melaleuca nodosa* (Prickly leaved Paperbark) and *Melaleuca sieberi*.

Groundcovers: *Baloskion tetraphyllum* (Tassel-rush), *Pteridium esculentum* (Bracken), *Gahnia clarkei* (Saw Sedge), *Caustis pentandra, Gahnia sieberiana* (Red-fruited Saw-sedge), *Adiantum aethiopicum* (Common Maidenhair) and *Parsonsia straminea* (Common Silkpod).

Photo 3 – Good quality Swamp Mahogany Woodland approximately 200m northwest of the intersection between Bundeena Road and Bottlebrush Drive.

Vegetation Community 4 – Grassland with Scattered Trees:

This vegetation community prior to previous clearance would have most likely resembled the Blackbutt Open Forest community.

Occurrence - This vegetation community occurs broadly across the southern portion of the study area particularly in relation to existing residences within 250m of Berkeley Road. This community essential occurs on the Erina Soil Landscape – erosional.

Structure - Dense grassland with scattered trees to 25 metres.

Disturbances - This vegetation community is highly disturbed by former clearing and agricultural activities, with the groundcover dominated by exotic species. There have been significant incursions of pines from the adjoining pine forest.

Common Species

Trees: *Eucalyptus pilularis* (Blackbutt) and *Pinus elliottii* (Slash Pine).

Shrubs: *Acacia longifolia* var. *longifolia* (Sydney Golden Wattle).

Groundcovers: *Cynodon dactylon* (Common Couch), *Paspalum sp.* and *Pennisetum clandestinum* (Kikuyu).

Vegetation Community 5 – Disturbed Swamp Mahogany Open Woodland:

This vegetation community has been severely impacted by clearing, agricultural activities and weed incursion. The northern portion contains a higher over storey canopy foliage cover than the southern portion and the understorey generally becomes weedier to the south. Several *biometric assessment* quadrats have been undertaken in this vegetation community in order to determine the condition of the vegetation community as *low condition* or otherwise. That in low condition can be cleared. This vegetation community is commensurate with the EEC – Swamp Sclerophyll Forest on Coastal Floodplains.

Occurrence - This vegetation community occurs in part of the cleared land in the south western part of the study area. Parts of this vegetation unit occur on an alluvial soil landscape – Wyong Soil Landscape.

Structure - Open woodland with a canopy cover of 2-20% and height of approximately 15-20 metres. The understorey consists of a shrub layer to 6 metres high and a dense groundcover of herbs, sedges, ferns and grasses.

Disturbances - This vegetation community is highly disturbed by former clearing and agricultural activities, with the groundcover dominated by exotic species.

Common Species

Trees: *Eucalyptus robusta* (Swamp Mahogany).

Shrubs: *Acacia longifolia* (Sydney Golden Wattle) and *Leptospermum polygalifolium* (Yellow Tea Tree).

Groundcovers: *Gahnia clarkei* (Saw Sedge), *Imperata cylindrica* (Blady Grass), *Pennisetum clandestinum** (Kikuyu) and *Setaria sphacelata** (Setaria).

Photo 4 – Disturbed patch of Swamp Mahongany Open Woodland with vegetation clearing surrounding (to the left) and occasional pine tree.

Vegetation Community 6 – Disturbed Pine Forest:

Occurrence – This vegetation community occurs in the western portion of the study area in a place where most of the native vegetation has been cleared and then planted as a Pine Forest. Individuals or small groups of Pine Trees may be scattered throughout the general study area.

Structure – Moderate to dense Pine Forest with varying degrees of younger Eucalypts and Syncarpia trees. The height of the vegetation is close to 30m tall and the percentage foliage cover varies typically between 35-75%. Eucalypts and Syncarpia trees make up less than 50% of the over storey species. The understorey is sparse to moderate depending on light conditions.

Disturbances – This vegetation community is highly disturbed and occurs as a result of previous clearing and subsequent planting. Some areas have significant native vegetation regrowing up into the canopy but not comprising greater than 50% of the percentage foliage cover. Exotic species are very common in the mid and ground layers of vegetation.

Common Species

Trees: *Pinus elliottii* (Slash Pine), *Syncarpia glomulifera* (Turpentine), *Eucalyptus pilularis* (Blackbutt), *Angophora floribunda* (Rough-barked Apple) and *Glochidion ferdinandi* (Cheese Tree).

Photo 2 - Pine Forest within Lot 21 DP 740435.

Shrubs: *Breynia oblongifolia* (Coffee Bush), *Notelaea longifolia* (Mock Olive), *Polyscias sambucifolia* (Elderberry Panax), *Acacia longifolia* var. *longifolia* (Sydney Golden Wattle), *Pittosporum undulatum* (Sweet Pittosporum), *Banksia spinulosa* (Hairpin Banksia) and *Persoonia linearis* (Narrow-leaved Geebung).

Groundcovers: *Dianella caerulea* (Flax Lily), *Lomandra longifolia* (Spiny-headed Mat-rush), *Pratia purpurascens* (Whiteroot) and *Entolasia stricta* (Wiry Panic).

Weeds: *Pinus elliottii** (Slash Pine), *Lantana camara** (Lantana), *Senna pendula* (Senna), *Asparagus aethiopicus** (Asparagus Fern), *Ligustrum sinense** (Small-leaved Privet),

*Cinnamomum camphora** (Camphor Laurel), *Paspalum urvillei** (Vasey Grass), *Setaria sphacelata** (South African Pigeon Grass) and *Solanum mauritianum** (Wild Tobacco).

4.4 Threatened flora legislation

One threatened flora species, *Melaleuca biconvexa*, was observed during the survey.

One (1) endangered ecological community (EEC) – *Swamp Sclerophyll Forest on Coastal Floodplains* was observed within the subject site.

4.4.1 State legislative matters

TSC Act – A search of the *Atlas of NSW Wildlife* (DECCW 2010) database indicated that sixteen (16) species have been recorded within a 10 km radius of the study area. Those species are listed in Table 4.1.

Of those sixteen (16) threatened flora species, three (3) have the potential to occur within the subject site. Those species are *Diuris praecox, Melaleuca biconvexa* and *Prostanthera askania.*

Only marginal or limited habitat exists for *Diuris praecox* and *Prostanthera askania. Melaleuca biconvexa* was observed within the southern portion of the study area adjacent to a constructed dam within Lot 2 DP 1100181.

4.4.2 Endangered populations

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

They are not represented within the study area.

4.4.3 National legislative matters

A review of the schedules of the *EPBC Act* (1999) indicated the potential for thirteen (13) nationally listed threatened flora species to occur within a 10km radius of the site.

Of those thirteen (13) threatened flora species, two (2) have the potential to occur within the subject site. Those species include *Melaleuca biconvexa* and *Prostanthera askania.*

Of these, *Melaleuca biconvexa* was observed within the study area. Only marginal or limited habitat exists for *Prostanthera askania* within the higher elevations of the site where there might be presence of high canopy cover.

No EECs of national significance were recorded within the study area.

Notes

The habitat for *Diuris praecox* is within the Blackbutt Open Forest where there may be a higher association with Spotted Gums such as the very northern portion. The vegetation type is not ideal for this species and typically occurs in vegetation communities which are not present within the study area. They are known however from the Spotted Gum–Ironbark association. These species exist within the broader Blackbutt Open Forest, therefore *Diuris praecox* has been assigned as having marginal habitat. Targeted survey has been undertaken during its flowering period in July 2003; the known flowering period is during July

and August. Further target survey was undertaken on August 17th and 18th 2010. No specimens were recorded.

For *Tetratheca juncea* parts of the north-eastern portion of the study area which have a south to south-east facing slope appear potentially suitable. However there is a high soil moisture content and higher than preferred canopy coverage. Additionally, the soil type is not one that favours *Tetratheca juncea.* The preferred soil types in descending order are Awaba, Warners Bay, Gateshead, Norah Head, Doyalson and Killingworth soil landscapes. *Tetratheca juncea* has been surveyed on three (3) occasions within its flowering period with no specimens observed.

***Melaleuca biconvexa* assessment**

The population of *Melaleuca biconvexa* recorded within the subject site occurs in two (2) small patches, not as scattered individuals. There are several known populations of this species in close proximity to the study area along and adjacent to Enterprise Drive to the north-west and Berkeley Road to the south-east and to the south-west.

If the proposal is able to retain the specimens within a protected area, there will be no significant impact on the population of *Melalueca biconvexa* within the study area. As such, a referral to DEWHA should not be required. Should the remnant be required to be removed a referral to DEWHA will be required.

In regards to the assessment by DEWHA an *important population* is one that is necessary for a species' long term survival and recovery. This may include populations 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.

Due to the small size of the remnant it is not considered that the population of *Melaleuca biconvexa* within the study area constitutes an *important population.* This is due to:

- The population within the study area being unlikely to be a key source for breeding or dispersal as there are numerous local populations within 3km of the study area that are also likely to play an identical role in breeding and dispersal;

- The population within the study area being unlikely to be necessary for maintaining genetic diversity as there are numerous local populations within 3km of the study area that are also likely to play an identical role;

- The population is not at the limit of this species range.

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

Lead to a long-term decrease in the size of an important population of a species; or

Comment: The occurrence of *Melaleuca biconvexa* is not considered to constitute an *important population.*

Reduce the area of occupancy of an important population; or

Comment: The occurrence of *Melaleuca biconvexa* is not considered to constitute an *important population.*

Fragment an existing important population into two or more populations; or

Comment: The occurrence of *Melaleuca biconvexa* is not considered to constitute an *important population.*

Adversely affect habitat critical to survival of the species; or

Comment: All of the EEC (*Swamp Sclerophyll Forest on Coastal Floodplains*) vegetation would provide some form of suitable habitat for this species. It is expected that all of the higher quality portion of the EEC will be retained and that a suitable buffer is to be applied. Some medium and low quality EEC will also be retained which would provide fair habitat for *Melaleuca biconvexa.*

The location of the known specimens are on the edge of the Blackbutt Open Forest and the Disturbed Swamp Mahogany Open Woodland adjacent to an existing dam. This is not a typical location for the species however the moist soil conditions associated with overflow from the dam or a high water table may have triggered enough appropriate conditions for this species to grow. The second smaller population is along an existing driveway next to a residence in the far south-west corner of the study area.

The rezoning proposal will retain almost all of the most suitable habitat for this species, therefore the proposal is unlikely to adversely affect habitat critical to survival of the species.

Disrupt the breeding cycle of an important population; or

Comment: The proposal is unlikely to disrupt the local breeding cycle of this species. The occurrence of *Melaleuca biconvexa* is not considered to constitute an *important population.*

Modify, destroy, remove or isolate or decrease the availability of quality habitat to the extent that the species is likely to decline; or

Comment: The proposal will result in retention of the most suitable habitat (EEC vegetation) for this species which will have connectivity to other conserved lands of similar structure beyond the study area to the west and north-west.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat; or

Comment: The proposal is unlikely to result in further significant increases in the occurrence of invasive species that will be harmful to this species. Presently, there is a considerable amount of exotic grasses around the stand of *Melaleuca biconvexa*.

Interferes substantially with the recovery of the species.

Comment: The proposal is unlikely to interfere substantially with the recovery of the *Melaleuca biconvexa*.

Conclusion*:* A referral to DEWHA will only be required if the population is to be removed.

4.5 Regional significance

A number of specimens of *Eucalyptus robusta,* which is classed as a regionally significant species by Wyong Council, were observed during the survey.

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

Botanical Name	Common Name	Potential Schedule 1 or 2 Fauna
Acacia irrorata and other 'gum' producing *Acacia* species	Wattle	Squirrel Glider
Allocasuarina torulosa	Forest Oak	Glossy Black-Cockatoo
Corymbia maculata	Spotted Gum	Squirrel Glider / Yellow-bellied Glider
Eucalyptus deanei	Deanes Gum	Yellow-bellied Glider
Eucalyptus pilularis	Blackbutt	Koala / Greater Glider
Eucalyptus robusta	Swamp Mahogany	Yellow-bellied Glider / Squirrel Glider / Koala / Regent Honeyeater
Melaleuca biconvexa and other local Melaleuca species		Ringtail Possum

- Yellow-bellied Glider has not been recorded within the boundary of the proposed rezoning area, however this species has been recorded nearby to the west. There were very few *Corymbia maculata* and *Eucalyptus deanei* trees within the study area. The *Eucalyptus deanei* occurs more so to the west of the study area along the drainage line crossing Berkeley Road. The *Corymbia maculata* tends to occur in the highest elevations of the study area. *Eucalyptus robusta* will largely be conserved in-situ.

- Glossy Black-Cockatoo has not been recorded within the boundary of the proposed rezoning area, however this species has been recorded in the nearby locality. There is a moderate occurrence of Allocasuarina trees across the study area within the Blackbutt Open Forest.

- There is a significant stand of Swamp Mahogany vegetation that could provide suitable for the Regent Honeyeater and Squirrel Glider. Neither species have been recorded within the study area. Squirrel Glider is unlikely to occur based on the lack of local nearby records and the extensive trapping surveys undertaken to date. Due to no past records there is a low potential for the Regent Honeyeater to occur seasonally within the Swamp Mahogany areas of the site. The Swamp Mahogany trees occur within the EEC areas which will be largely conserved.

- There was a previous record of a Koala sighting within the subject site. Koala experts *Biolink* (2008) undertook survey and assessment for this species which concluded that whilst the site provided 'suitable Koala habitat' there was no evidence to indicate that the site provided 'core Koala habitat' under the definitions of SEPP 44 Koala Habitat Protection. Refer to Section 4.12 for the Koala assessment (SEPP 44). The feed species for the Koala will be conserved as they occur in the EEC area.

- The Common Ringtail Possum was observed within the study area. A large portion of Melaleuca species are restricted to the EEC area which will be largely conserved.

- Greater Glider has not been recorded in the subject site but has been recorded twice within 5km of the study area. The study area provides some potential habitat for this species however more suitable habitat exists to the south-west, south of Berkeley

Road where the vegetation is likely to be taller and have more suitable medium sized hollows.

4.6 Endangered ecological communities

One (1) EEC was located onsite, namely;

- Swamp Sclerophyll Forest on Coastal Floodplains

This endangered ecological community exists as the Swamp Mahogany Woodland (in good condition) the Disturbed Swamp Mahogany Open Woodland and Disturbed Apple/Mahogany Woodland (in low and medium condition) – see Figure 1.

Regional vegetation mapping undertaken by LHCCREMS (2003) shows Map Units 5, 6, 37 & 43 on the study area. The Scientific Committees determinations state that Map Units 37 & 43 within the Lower Hunter area are commensurate with the *Swamp Sclerophyll Forest on Coastal Floodplains* which is an endangered ecological community as listed under the *Threatened Species Conservation* Act.

Site specific survey has been undertaken to assess and verify the vegetation communities within the study area. It was noted that the equivalent EEC map units correspond to the vegetation communities mapped as Swamp Mahogany Woodland and Disturbed Swamp Mahogany Open Woodland.

Bell (2002) has mapped parts of the study area as equivalent EEC vegetation although the southern extent of the Disturbed Swamp Mahogany Open Woodland as mapped by *Travers bushfire & ecology* was mapped by Bell as Narrabeen Coastal Blackbutt Shrubby Forest, equivalent to the Blackbutt Open Forest mapped by *Travers bushfire & ecology.*

The rigorous grid based flora assessment under by *Travers bushfire & ecology* in June 2010 utilised the biometric field survey assessment technique to gather information.

This was undertaken using 20x20m quadrats with an 80m separation in the vicinity of those areas previously mapped by *Travers bushfire & ecology* as being equivalent to the EEC – Swamp Sclerophyll Forest on Coastal Floodplains.

By utilising this method, an assessment upon the quality of the vegetation was undertaken to determine whether the vegetation within the quadrat would be considered *high quality* or otherwise.

In accordance with the *Biometric Assessment Guidelines* (DECCW 2009), the criteria for determining low quality vegetation are as follows;

"Native woody vegetation with an:

1. Over-storey per cent foliage cover <25% of the lower value of the over-storey per cent foliage cover benchmark for that vegetation type; and
2. <50% of vegetation in the ground layer is indigenous species; or
3. >90% is ploughed or fallow.

Native grassland, shrub land, wetland or herb field with:

1. <50% of vegetation in the ground layer is indigenous species; or
2. >90% is ploughed or fallow.

Only patches of vegetation >0.25 ha are assessed separately (as distinct zones) from surrounding vegetation (e.g. a patch of vegetation with a benchmark over-storey cover that is <0.25 ha is not assessed separately from surrounding vegetation with sparser over-storey cover)".

The biometric assessment identified several quadrats within the Disturbed Swamp Mahogany Open Woodland as *low condition* due to the lack of native over-storey (up to 5%) and the ground layer containing in excess of 50% exotic species. The remainder of the Disturbed Swamp Mahogany Open Woodland was classed as a medium condition on the basis of a lower native species diversity, some exotic influences in all strata and a lower than benchmark native over-storey.

The Disturbed Apple/Mahogany Woodland was similar to the Disturbed Swamp Mahogany Open Woodland in condition in that the over-storey comprised varying degrees of Pine influence, a semi-cleared understorey and influences of exotic species in the mid-storey and ground layers of vegetation.

The issues associated with the definition of EEC and particularly floodplain EECs are complex and open to subjective interpretation. The points a) to f) in the following table are taken from the scientific committees' determinations in defining vegetation as an EEC or not.

The assessment relates specifically to the subject site as defined on Figure 1.

Assessment for Swamp Sclerophyll Forest on Coastal Floodplains		
	Comment on EEC elements	**EEC or Not**
a)	This EEC is associated with 'humic clay loams and sandy loams' but this vegetation is confirmed to occur on Aeolian sands within silty sand topsoil. • Wyong Soil Landscape – Alluvial based • Erina Soil Landscape – Erosional based – lower slopes may be an intergrade to an alluvial landscape.	Characteristic Partially characteristic
b)	This EEC is on 'waterlogged or periodically inundated alluvial flats and drainage lines'. • Around 50% of the vegetation characteristic of the EEC is on alluvial flats and drainage lines that may become periodically waterlogged or inundated. The remainder (much to the south of the main extent) containing the disturbed communities do not appear to be on waterlogged or periodically inundated alluvial flats and drainage lines. Some small depressions occur throughout the lower lying portion of the disturbed communities periodically containing water however they do not occur near the southern extent (uphill area) of the disturbed communities. • The disturbed communities may contain a high amount of soil moisture due to the presence of a dense ground layer of exotic grasses and sedges which may trap excess runoff from the southern portion of the study area.	Partially Characteristic
c)	This EEC is on land associated with coastal floodplains, which are 'defined as level landform patterns on which there may be active erosion and aggradation by channelled or overbank stream flow with an average recurrence interval of 100-years or less'.	Partially

Assessment for Swamp Sclerophyll Forest on Coastal Floodplains		
	• The EEC vegetation starts adjacent to the SEPP 14 wetland abutting the north-western corner of the study area and would be considered as having some lands within the 1 in 100 year flood level.	Characteristic
d)	This EEC occurs on land 'below 20 metres but sometimes up to 50 metres AHD' • The high quality EEC is below 10m AHD. Most of the low and medium condition vegetation is between 10-15m AHD.	Characteristic
e)	This EEC structure is 'typically open forest, although partial clearing may have reduced the canopy to scattered trees. In some areas the tree stratum is low density'. • The structure was found to be more characteristic of a woodland due to the percentage foliage cover generally being below 20% in the canopy and often a sporadic mid-storey comprised of Melaleuca spp. and *Acacia longifolia.* There has been a history of clearing or logging in some portions of the study area which would contribute to the lower percentage canopy cover.	Characteristic
f)	With regards to the characteristic species assemblage of this EEC, there is a list published in the final determination. • The canopy is dominated by *Eucalyptus robusta* with occasional *Angophora floribunda* and *Eucalyptus resinifera.* A number of Melaleuca species and *Acacia longifolia* are dominant in the mid-storey layer. The understorey species mix is comprised of sedges, ferns and grasses that are relatively consistent with that of the species list in the final determinations. All quadrats assessed (biometrically) within the EEC contain 50% or greater species that were listed on the final determinations.	Characteristic

With respect to the soil landscape, the *Swamp Sclerophyll Forest on Coastal Floodplains* should occur on alluvial soils. All of the disturbed vegetation communities comprising the EEC do not occur on such an alluvial landscape.

The Erina Soil Landscape is an erosional soil landscape with gentle to moderate slopes but containing usually sandy clays or sandy loams which is consistent with the Scientific Committee's determinations. Vegetation upon this soil type is typically a tall open-forest with a combination of Blackbutt, Forest Oak, Turpentine, Spotted Gum, Smooth-barked Apple, Grey Ironbark and Sydney Blue Gum. All of these species have been sighted within the study area or on lands adjacent, most of which comprise a part of the Blackbutt Open Forest vegetation community.

Notwithstanding this, it is noted that the Erina Soil Landscape may contain Swamp Mahogany and Swamp Oak in poorly drained areas, thus potentially containing EEC type vegetation.

The boundary of the EEC has been defined after a grid based field quadrat survey assessment was undertaken in June 2010. Each quadrat is 20x20m and there is a separation between the quadrats of 80m with the methodology consistent with the biometric assessment. Additional quadrat data from earlier in 2009 and 2010 has aided in defining the line as accurately as possible.

The edge of the Swamp Mahogany Forest was initially determined by aerial photographic assessment. The assessment on site in 2010 found that there was rarely a mix of Blackbutt

trees which defined the Blackbutt Open Forest and the Swamp Mahogany trees which defined the Swamp Mahogany Forest. Around the ecotone of the two communities, there was a band of mostly *Eucalyptus resinifera* (Red Mahogany) and *Syncarpia glomulifera* (Turpentine) trees.

Whilst the Red Mahogany may occur in a Swamp Sclerophyll EEC, the Turpentine is not. Essentially the mapped Swamp Mahogany Forest is the full or outermost extent of the Swamp Mahogany trees. Sedges such as *Gahnia clarkei* and *Caustis pentandra* (mainly) as well as the shrub species *Melaleuca nodosa* (and less frequently *Melaleuca linariifolia*) may occur further uphill for an extended period which has been used to help define a buffer to the EEC, the reason being as whilst they do not vegetatively constitute an EEC (given the dry sclerophyll over storey species) they give an indication that the vegetation may still be part of sufficient soil moisture retention in an otherwise dry forest landscape.

The Disturbed Swamp Mahogany Open Woodland has been given EEC status because of the presence of a canopy almost exclusively of Swamp Mahogany and an understorey (where native) of mostly sedges and ferns. It was found that the makeup of this community has in each quadrat at least 50% of the species listed on the Scientific Committee's final determinations. The northern portion of this vegetation community was found to occur on the Wyong Soil Landscape - alluvial. The southern portion was found to occur on the Erina Soil Landscape - erosional. A discussion on the soil types and their suitability for vegetation consistent with the EEC has been done previously.

The Disturbed Apple/Mahogany Woodland was again given EEC status because of the presence of greater than 50% of the species make up in the Scientific Committee's final determinations and similarities to that of the Disturbed Swamp Mahogany Open Woodland.

The flora field assessment in June 2010 determined an eco-tonal zone of sedges and Melaleuca species amongst a canopy of Blackbutt, Turpentine and Red Mahogany. This was not determined to be EEC vegetation as the percentage of indicative Swamp Sclerophyll Forest species for each quadrat in this zone was found to be below 50% and not contain typical over storey species commensurate with the EEC determination.

4.7 Threatened flora species habitat assessment

Table 4.1 provides an assessment of threatened flora species habitat likely to occur within the subject site.

Table 4.1 - Threatened Flora Habitat Assessment

Scientific name	Growth Form and Habitat Requirements	Conservation Status	Comments	TSC Act	EPBC Act
Acacia bynoeana EPBC	Erect or spreading shrub to 0.3 m 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.	Blue Mountains NP, Royal NP, Castlereagh NR, Agnes Banks NR, Lake Macquarie SRA, Dharawal NR, Marramarra NP, Parr SRA	No records within 10km of the site, not likely to occur.	E1	V

Table 4.1 - Threatened Flora Habitat Assessment

Scientific name	Growth Form and Habitat Requirements	Conservation Status	Comments	TSC Act	EPBC Act
Angophora inopina EPBC	Small tree in open sclerophyll forest growing on deep sandy soils with associated lateritic outcrops. Distribution limits N-Wyee S- Gorokan.	Lake Macquarie SRA, Karuah NR	No records within 10km of the site, not likely to occur.	V	V
Apatophyllum constablei EPBC	A small shrub up to 40cm tall that grows in dry sclerophyll forest on slopes with a north to north-westerly aspect usually near cliffs. It flowers from August to December. Most populations are restricted to Wollemi National Park near the town of Glen Davis. The species has been removed from the TSA Act since 2007.	Wollemi NP	No records within 10km of the site. No potential habitat present.	-	E
Caladenia tessellata DECCW EPBC	Terrestrial orchid. Clay-loam or sandy soils. Distribution limits N-Swansea S- south of Eden.	Munmorah SRA, Popran NP, Wyrrabalong NP	2 records 7-8km away more than 50yrs ago, not likely to occur.	E1	V
Chamaesyce psammogeton DECCW	Prostrate herb. Coastal dunes. Distribution limits N-Tweed Heads S- Jervis Bay.	Wamberal Lagoon NR Myall Lakes NP Booti Booti NP	Nearest record is 9km away. No potential habitat.	E1	-
Cryptostylis hunteriana EPBC	Saprophytic orchid. Grows in swamp heath on sandy soils. Distribution limits N-Gibraltar Range S- south of Eden.	Gibraltar Range NP, Ku-ring-gai Chase NP, Ben Boyd NP	No records within 10km of the site, not likely to occur.	V	V
Diuris praecox DECCW	Terrestrial orchid. Grows in sclerophyll forest near the coast. Distribution limits N - Nelson Bay S - Ourimbah.	Glenrock SRA, Munmorah SRA, Tomaree NP, Wyrrabalong NP	Nearest record is 6km away. Marginal habitat present. Not observed.	V	V
Epacris purpurascens var. purpurascens DECCW	Erect shrub to 1.5m high growing in sclerophyll forest and scrub and near creeks and swamps on Sandstone. Distribution limits N-Gosford S- Blue Mountains.	Ku-ring-gai Chase NP Muogamarra NR Brisbane Water NP Berowra Valley RP Bents Basin SRA	Nearest record is 4.5km away. Only one record within 10km. No potential habitat.	V	-
Eucalyptus camfieldii DECCW EPBC	Stringybark to 10 m 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.	Brisbane Water NP, Ku-ring-gai Chase NP, Royal NP, Sydney Harbour NP, Awabakal NR, Popran NP, Berowra Valley RP	Nearest record is 6km away. No potential habitat.	V	V

Table 4.1 - Threatened Flora Habitat Assessment

Scientific name	Growth Form and Habitat Requirements	Conservation Status	Comments	TSC Act	EPBC Act
Eucalyptus pumila DECCW	Mallee species only known from Pokolbin State Forest.	Pokolbin Flora Reserve	One record within 10km made in 1929. Outside of known geographic distribution.	V	V
Grevillea parviflora subsp parviflora DECCW EPBC	Open to erect shrub to 1 metre. Grows in woodland on light clayey soils. Distribution limits N – Cessnock S – Appin.	Werakata NP	Nearest record is over 9km away. No potential habitat.	V	V
Hibbertia procumbens DECCW	Prostrate shrub with linear leaves which occurs in heath on sandy soils but is only known from Mangrove Mountain.	Not currently known from conservation reserves.	Nearest record is over 9km away. No potential habitat.	E1	-
Maundia triglochinoides DECCW	A reed-like herb which grows in swamps and shallow fresh water on clay. Distribution Limits N-Qld border S-Wyong.	-	Nearest record is approximately 2.5km away. No potential habitat (potential habitat exists adjacent to the site in the SEPP 14 Wetland).	V	-
Melaleuca biconvexa DECCW EPBC	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.	Bouddi NP, Wyrrabalong NP	Ideal habitat for the species. Found adjacent to the dam on Lot 2 DP 1100181.	V	V
Prostanthera askania DECCW EPBC	Erect shrub. Grows in sclerophyll forest on ridges in or adjacent to Rainforest. Distribution limits Strickland SF region.	Not currently known from conservation reserves.	Nearest record is 1km away. Marginal habitat present limited to the Blackbutt Open Forest community however not observed.	E1	E
Prostanthera junonis EPBC	Small shrub. Grows in sclerophyll forest and heath in shallow soil on sandstone. Distribution limits Somersby region.	Brisbane Water NP	No records within 10km. Outside of known geographic distribution. No potential habitat.	E1	E

Table 4.1 - Threatened Flora Habitat Assessment

Scientific name	Growth Form and Habitat Requirements	Conservation Status	Comments	TSC Act	EPBC Act
Rhizanthella slateri EPBC	Underground orchid that is poorly known. Grows in sclerophyll forests. Usually only seen if the soil is disturbed. Flowers in Oct – Nov.	Unknown	No records within 10km. One occurrence on the Gosford map sheet, none on the Lake Macquarie map sheet. Unlikely to occur.	V	E
Rutidosis heterogama DECCW	Erect herb to 30cm. Grows mostly in heath, often along roadsides. Distribution limits N – Maclean S – Hunter Valley.	Werakata NP	Nearest record 9km away. Many records 10-13km away. No potential habitat.	V	V
Senecio spathulatus DECCW	Groundcover to less than 30cm grows on dunes. N- Myall Lakes NP S- Kurnell.	Nadgee Reserve, Myall Lakes NP	Nearest record is 9km away. No potential habitat.	E1	-
Senna acclinis DECCW	Shrub to 3 metres high which occurs in subtropical rainforest. Distribution limits N – Border Ranges S - Gloucester.	Darawank NR	Nearest record is 7km away. No potential habitat.	E1	-
Syzygium paniculatum DECCW EPBC	Small tree. Subtropical and littoral rainforest on sandy soil. Distribution limits N - Forster S - Jervis Bay.	Booti Booti NP, Myall Lakes NP, Wamberal Lagoon NR, Wyrrabalong NP, Captain Cooks Landing Place HS, Jervis Bay NP, Munmorah SRA, Glenrock SRA	Nearest record is 4km away. Known to occur in the nearby Ourimbah Creek catchment. No potential habitat.	V	V
Tetratheca juncea DECCW EPBC	Prostrate shrub to 1 m high. Dry sclerophyll forest and heath. Distribution limits N - Bulahdelah S - Port Jackson.	Glenrock SRA, Awabakal NR, Munmorah SRA, Lake Macquarie SRA, Karuah NR, Wallaroo NR	Nearest record is 5km away. Not observed during previous surveys. Soil landscape preference does not occur within the study area.	V	V
DECCW	- Denotes species listed within 10km of the subject site on the Atlas of NSW Wildlife database				
EPBC	- Denotes species listed within 10km of the subject site in the EPBC Act habitat search				

4.8 Fauna species

A total of one-hundred and twelve (112) fauna species were observed within or in close proximity to the subject site during 2003, 2006, 2007, 2008, 2009 & 2010 surveys focusing exclusively on the subject site. This number comprised seventy (70) species of bird, twenty eight (28) species of mammal, ten (10) species of reptile and four (4) species of amphibian.

All species are listed in Table 3.2.

A further nineteen (19) species of bird, eleven (11) species of mammal and four (4) species of amphibian have been recorded on adjacent lands to the immediate south and west of the subject site by *Conacher Travers* (2001) & (2006) and *Travers bushfire & ecology* (2007).

These species have been included into Table 3.2 given their potential to occur within the subject site and additional threatened species records. Threatened fauna species otherwise recorded in the nearby locality during other previous surveys are considered within Section 5

4.9 Habitat types

Specific fauna habitats present within the study area include:

- Vegetated areas of forest and woodland dominated by the September to March flowering *Eucalyptus pilularis* (Blackbutt) and the winter flowering *Eucalyptus robusta* (Swamp Mahogany)
- Vegetated areas of exotic grassland and pine plantation
- Hollow-bearing trees containing small (<10cm) to large (>30cm) hollows
- Internal trails, runways and flyways
- Areas of sparse to dense shrub layers
- Sparse to high density ground covers
- Fallen timber and hollow logs
- Loose soil suitable for burrowing
- Moderate litter layer
- Ephemeral drainage lines which provide marginal aquatic habitat during heavy rain.
- Artificial debris and refuse
- Farm dams

<u>Blackbutt Open Forest</u>

The Blackbutt Open Forest vegetation community occurs over the majority of the subject site particularly the north-eastern portions. This community is dominated by the September to March flowering *Eucalyptus pilularis* (Blackbutt). Other notable tree species for foraging or structural value within this community include *Allocasuarina sp.*, *Syncarpia glomulifera* (Turpentine), *Eucalyptus resinifera* (Red Mahogany), *Melaleuca sp.* and *Banksia sp*. The trees and floristics within this community provide a generally high representation of native plant species foraging for various birds, flying-foxes and arboreal mammals.

Hollow bearing trees occur in moderate density and these were observed at varying sizes and quality. Small (<10cm) hollows provide roosting and breeding opportunity for micro-chiropteran bats, small lorikeets and some arboreal reptile species. Medium hollows 10-30cm) provided potential denning habitat for gliders, possums, diurnal hollow-dependent birds, and some micro-chiropteran bat species. Large (>30cm) sized hollows provide potential roosting and nesting habitat for forest owls, cockatoos and some arboreal mammals. Hollow tree density was observed to increase in the lower slopes of this community (see Figure 3).

Generally large hollows were in very low density attributed to evidence of previous logging and given also that the major tree species occurring within this community (i.e. Blackbutt, Turpentine and Red Mahogany) are not known for providing regular large hollows.

The Powerful Owl is the only large hollow-dependent threatened fauna species recorded within the subject site during recent surveys. The large hollow-dependent Glossy Black-

Cockatoo and Spotted-tailed Quoll have also been recorded previously in the nearby locality but external ofteh study area.

The habitat trees containing large hollows and considered with potential for use by these species are considered to have higher potential for use within the Blackbutt Open Forest community (see Figure 3 for potential Powerful Owl nesting locations). This is mainly a result of lower potential of occurrence within the swamp and disturbed communities present.

Having said this, the presence of ideal large hollows for Powerful Owl within the Blackbutt Open Forest community is considered very limited. Whilst other large hollows were also observed to be present within the Blackbutt Open Forest community, these were considered to be unsuitable due to size of hollow, poor quality, exposure and/or height of hollow above ground level. Owl expert John Young further refined the number of trees considered suitable for Powerful Owl during his site visit in August 2010. During this visit Mr Young concluded that Powerful Owl was not utilising the site for nesting at that time and more suitable habitat for exists to the south-west of the subject site.

Medium and small hollow-depended threatened fauna species recorded within or near to the subject site and with potential to utilise hollows within this community include Little Lorikeet, Varied Sittella, Greater Broad-nosed Bat, East-coast Freetail Bat and Eastern Falsistrelle.

The far eastern upper slopes of the Blackbutt Open Forest community have undergone disturbance in the form of previous clearing and construction of fire trails. Higher quality habitat and subsequent biodiversity values occur nearby to the south-east of these trails where vegetation along the margins of an ephemeral drainage line provides very tall trees and moist understorey associations.

The presence of Turpentine (*Syncarpia glomulifera*) in the moister areas of this community increases roosting value as this preferred tree (noted by the Large Forest owl Recovery Plan 2006) provides dense groves of mid-storey foliage. Powerful Owl prey species Sugar Glider was also recorded at a number of locations within the lower elevations of this community which are proximate to Swamp Mahogany communities.

Of note also within this community is HT73 located in the central southern portions of the subject site, which is possibly the largest tree in the locality and of high ecological significance. This tree was stag-watched during recent 2010 surveys and a Sugar Glider and possible micro-chiropteran bats were recorded emerging from the numerous hollows present. John Young identified this tree as being suitable for Powerful Owl nesting.

Shrub layer density also increases in the lower elevations of this community which fringes with the Swamp Mahogany Woodland community. Dense shrub layers provide greater protective and foraging habitat for small birds, small arboreal mammals and terrestrial mammal species. Numerous runways for terrestrial mammals were observed (specifically the recorded Swamp Wallaby and other rodent species) and higher capture rates were recorded in these lower elevations.

This community continues beyond the subject site to the north-east and north-west. A Council reserve to the north-east is a terminal point for terrestrial species approximately 300m further east where Wyong Road occurs. Connectivity continues in fragmented areas beyond this road only for birds.

Although the connective areas to the north-east terminate for many species, it does contain sandstone rocky areas which are otherwise poorly represented in the nearby locality. Therefore a corridor allocation to allow continued passage for wildlife to this area is considered worthwhile. Species having dependence on these rocky habitats are likely

restricted to them (such as small reptiles) and these species are not as likely to require large dispersal areas. The corridor to the north-east would function more so for birds, microbats and small to medium mammals with importance particularly for those that may use the rock habitats as a habitat source (eg. for foraging).

This community, although often interspersed with pine forest in the north-western portions does provide good connectivity beyond the site to the west, where only Berkeley Road breaks connectivity with other extensive forest areas.

The remaining isolated portions of Blackbutt Open Forest located in the south-western portion of the study area provide little fauna value due to the low presences of hollows, fragmentation and disturbed understorey.

Swamp Mahogany Woodland

The Swamp Mahogany Woodland vegetation community occurs through the central-northern confines of the subject site. This community is dominated by the winter flowering *Eucalyptus robusta* (Swamp Mahogany) and varying species of *Melaleuca* flowering predominantly during warmer months. Swamp Mahogany is a locally significant tree providing high yield foraging resources for a diversity of nectar feeding species at a time of year when such resources are otherwise limited. The threatened Grey-headed Flying-fox was recorded foraging on swamp mahogany at various locations within this community during recent winter survey. Sugar Gliders, a Powerful Owl prey species, were also recorded within and fringing this community during recent survey.

As this is a threatened ecological community it will be largely protected from proposed development, however it should be noted that the fringes of this community and its association with the neighbouring Blackbutt Open Forest form an ecological gradient.

Hollow bearing trees occur in moderate density and these were observed at varying sizes and quality. Trees within this community do not appear to have been subject to logging or clearance such as the higher demand Blackbutt timber within the neighbouring community. Therefore, despite having a more woodland type structure there is a higher density of large hollows within the trees present. Of note, were a number of dead (stag) trees located in the outer fringes of this community, where the upper crown had broken off exposing large hollow spouts. Small (<10cm) and medium hollows (10-30cm) hollows within this community provide roosting and breeding opportunity for gliders, possums, diurnal hollow-dependent birds and some micro-chiropteran bat species.

Large (>30cm) sized hollows provide less habitat potential for large forest owls than within the neighbouring forests, yet are suitable for cockatoos and arboreal mammals. This community was not subject to a detailed hollow bearing tree survey and estimations of hollow numbers for comparison has been obtained from quadrat data.

Shrub layer and ground cover density in this community was generally very high due to presence of rushes, ferns and sedges within the understorey particularly *Gahnia sp*. This provides habitat for small birds, frogs, reptile and particularly terrestrial mammal species recorded in high density within these areas. Numerous runways for larger terrestrial mammals were also observed.

This community continues beyond the subject site to the north surrounding a higher density of various Paperbark trees within the SEPP 14 wetland, which is identified to the immediate north of the subject site boundary. This wetland and its associations with the fringing Swamp Mahogany Woodland play a very important habitat resource to a high diversity of fauna species.

The Wallum Froglet has been previously recorded in 1997 and again during recent 2010 surveys within suitable habitat for this species located within the SEPP 14 wetland areas to the north of the subject site. Target survey within and outside of the subject site was undertaken during suitable conditions of recent survey (see Figure 3 for locations). The species was not recorded within the subject site and breeding habitat is limited. It would be expected that the Swamp Mahogany Woodland provides dispersal, shelter and foraging habitat for this species outside of breeding aggregations. Potential to disperse further and make valued use of habitat beyond this community is considered low.

Disturbed Pine Forest

The pine forests located almost completely across Lots 21 and 22 also extend into the western portions of Lot 2 (see Figure 1). A hazard reduction burn has recently been undertaken within the understorey of Lot 22. Despite this all pine forest areas generally still provides low fauna activity, as reflected during surveys, particularly small nectar dependent birds. Pine needles deposited on the ground surrounding large and/or dense pine stands suppresses growth of both shrub and ground layers. Subsequently, much of the Disturbed Pine Forest community is devoid of terrestrial habitat.

All mature pines had a number of lower broken old limbs free of foliage and potential to provide small hollows for micro-chiropteran bats. Otherwise there were no other hollows greater than 10cm observed throughout Lots 21, 22 or nearby adjacent areas (see Figure 3 for hollow-bearing tree locations recorded in detail for the north-eastern and south-western portions of the subject site).

This subsequently provides an absence of breeding habitat for the Powerful Owl and an absence of habitat for arboreal mammal prey species in the form of denning hollows and foraging trees. Despite this it should be noted that a number of dreys (nests) belonging to the Common Ringtail Possum were observed within this community. This possum is a preferred food item of the Powerful Owl and was also recorded residing within the other communities present within the site.

Whitewash below a tall pine located in the north-western portions of the subject site was identified to belong to White-bellied Sea Eagle which was later recorded nesting nearby to the north.

Grassland with Scattered Trees

The Grassland with Scattered Trees vegetation community is located in large areas within the south-western portion of the subject site. This community provides very little fauna diversity value, a result of high disturbances, fragmentation, exotic trees and urban impacts (such as pets). There were no hollow-bearing trees recorded within this community and trees present provide minimal connectivity values, which is limited to bird species. The trees present provide in-situ foraging habitat for birds, flying-foxes and possum.

The farm dams within this community do not provide internal or fringing native vegetation and do not contribute as potential habitat for any threatened amphibians. The East-coast Freetail Bat was recorded foraging over a dam in the central southern portions of the site and likely utilises this dam for a drinking resource. This and other threatened microbat species would use the open areas of this for foraging particularly where they fringe forest/woodland communities.

Due to the absence of hollows, this community is unlikely to provide habitat of value or habitat which could be regarded as being central to the use of locally occurring threatened fauna species.

Disturbed Swamp Mahogany Open Woodland and Disturbed Apple / Mahogany Woodland

The Disturbed Swamp Mahogany Open Woodland and Disturbed Apple / Mahogany Woodland vegetation communities, whilst disturbed, provide representation of Swamp Mahogany (*Eucalyptus robusta*) which is a locally significant tree species. Swamp Mahogany is a SEPP 44 Koala tree and also flowers profusely in winter providing a valuable foraging resource for arboreal mammals, flying-foxes and numerous birds including the endangered migratory Regent Honeyeater and Swift Parrot.

Disturbance within these communities is the result of previous clearing and pine regrowth from nearby plantations. The understorey has incurred growth from exotic grasses and other weed species to varying levels. Both these communities become more disturbed towards the southern portions.

Target Wallum Froglet survey by call-playback within the northern portion of the Disturbed Swamp Mahogany Open Woodland was undertaken during optimum conditions of recent survey (see Figure 3 for location). This area was considered to provide no suitable breeding and low potential dispersal and shelter for the species.

Hollows and hollow-dependent species are again unlikely to be impacted within the Disturbed Apple / Mahogany Woodland due an absence of hollows recorded. An almost complete absence of hollows was recorded within the Disturbed Swamp Mahogany Open Woodland. This is likely is a reflection of the previous disturbance to both of these communities and the absence of old remnant trees to provide long-term developing hollow resources and an absence of damaged trees.

HT 62 provides an exception within the northern portion of the Disturbed Swamp Mahogany Open Woodland community. This tree is a large stag providing a prominent outlook and a large hollow giving it high ecological value. Otherwise, hollow-bearing trees were only recorded on the outer fringe of this community where it meets with the Blackbutt open Woodland.

In summary, the presence of Swamp Mahogany within these communities provides the only true value to local native fauna and threatened species with potential to occur. The restoration of the northern portions of the Disturbed Swamp Mahogany Open Woodland community could provide an offset to improve habitat values for such species which could also contribute to the conserved land area.

Summary of Quality Habitat

Non-EEC or low quality EEC habitat with potential to be subject to development may be separated into two (2) distinct large areas within the subject site, these being the north-eastern and south-western portions.

Within both of these portions the areas considered of higher quality habitat, subsequent biodiversity and also threatened species habitat are those that fringe the Swamp Mahogany Woodland EEC area. The availability of hollows, terrestrial habitat shelters and dense vegetative structure generally increase along this gradient. The different communities that border the Swamp Mahogany Woodland, particularly the Blackbutt Open Forest, also combine resources in this vicinity to increase habitat values. For example greater access to year-round nectar foraging is provided along this interface.

In respect to the complete south-western portion of the subject site the areas of Blackbutt Open Forest adjacent to the corner frontage with Bundeena Road and heading directly north towards the Swamp Mahogany Woodland also provides high habitat values.

In respect to the complete north-eastern portion of the subject site, the areas of Blackbutt Open Forest that line an ephemeral drainage line that runs west and eventually into the Swamp Mahogany Woodland, also provides high habitat values. This area of quality habitat commences near to HT27.

4.10 Habitat trees

An assessment of the location of habitat trees and the size of hollows was conducted during recent 2008 & 2010 surveys within the north-eastern and south-western portions of the subject site indicated on Figure 3. This is not a complete survey of all hollow-bearing trees.

Large hollows considered to provide potential for use by owls were also identified within the remaining areas of the subject site with the exclusion of the Swamp Mahogany Woodland community area.

Table 4.2 below provides hollow-bearing tree data and other habitat features recorded.

Hollow-bearing trees indicated by John Young as being suitable for nesting use by Powerful Owl are indicated on Figure 3.

Figure 5 shows the trees of most importance that had an association with fauna – roosts.

It should be noted that the Disturbed Pine Forest community provides numerous lower broken limbs on large mature pines present. Many of these limbs may contain hollows however a clear observation of hollows was not possible from ground level as these branches typically have an upward incline towards the broken ends. If hollows are present on these limbs they are mostly 0-5cm with a few that may reach up to 10cm.

Table 4.2 – Habitat tree data

Tree No.	Scientific Name	DBH (cm)	Spread (m)	Height (m)	Health (%)	Number and Size of Hollows / comments	Class
1	*Eucalyptus pilularis*	65	9	28	70	1x 5-10cm branch	Class 3
2	*Eucalyptus pilularis*	95	26	32	90	1x 0-5cm branch	Class 3
3	*stag*	25 / 45	7	23	0	1x 0-5cm branch	Class 3
4	*Corymbia gummifera*	65	9	13	15	1x 15-20cm broken trunk	Class 2
5	*Eucalyptus resinifera*	60	9	18	65	1x 5-10cm branch	Class 3
6	*Eucalyptus resinifera*	60	13	24	70	1x 5-10cm branch	Class 3
7	*Eucalyptus resinifera*	65	11	18	60	1x 5-10cm branch, 1x 10-15cm broken trunk, possibly more	Class 2
8	*Eucalyptus pilularis*	70	13	25	65	1x 5-10cm branch	Class 3
9	*Eucalyptus pilularis*	80	15	21	50	1x 0-5cm branch, 1x 10-15cm broken trunk	Class 2
10	*Eucalyptus resinifera*	70	10	13	30	1x 25-30cm broken trunk	Class 1
11	*Eucalyptus resinifera*	40	8	12	45	1x 5-10cm branch	Class 3
12	*Corymbia gummifera*	45	9	15	25	1x 0-5cm branch, 2x 5-10cm branch	Class 2
13	*Corymbia gummifera*	80	16	20	60	1x 0-5cm branch,	Class 3

Table 4.2 – Habitat tree data

Tree No.	Scientific Name	DBH (cm)	Spread (m)	Height (m)	Health (%)	Number and Size of Hollows / comments	Class
						possibly more	
14	*Corymbia gummifera*	110	13	18	25	4x 0-5cm branch, 2x 5-10cm branch, possibly more	Class 1
15	*Eucalyptus resinifera*	65	6	14	10	2x 15-20cm trunk, 1x 25-30cm trunk, 2x 15-20cm branch	Class 1
16	*Eucalyptus pilularis*	65	13	25	55	nest	
17	*Eucalyptus pilularis*	85	18	27	80	1x 5-10cm branch	Class 3
18	*Corymbia gummifera*	80	11	20	40	1x 30cm+ broken trunk	Class 1
19	*stag*	60	3	15	0	1x 10-15cm broken trunk, 1x 5-10cm trunk, 1x 0-5cm branch, 1x 0-5x15cm bark	Class 1
20	*Corymbia gummifera*	75	12	21	40	1x 0-5cm branch	Class 3
21	*stag*	25	1	9	0	1x 10-15cm broken trunk, 2x 5-10cm trunk, all hollows probably linking together as one	Class 2
22	*stag*	50	2	15	0	1x 0-5cm trunk, 1x 5-10cm branch	Class 2
23	*Eucalyptus resinifera*	60	10	17	25	1x 5-10cm branch	Class 3
24	*Syncarpia glomulifera*	115	12	20	45	1x 15-20cm branch (good quality)	Class 3
25	*Eucalyptus pilularis*	90	19	23	70	1x 5-10cm branch	Class 3
26	*Eucalyptus pilularis*	115 / 45	23	22	45	1x 0-5cm branch, 1x 10-15cm branch	Class 2
27	*Syncarpia glomulifera*	95	13	25	50	1x 5-10cm branch, 2x 10-15cm branch, 1x15-20cm branch	Class 1
28	*stag*	90	5	21	0	1x 0-5cm branch, 2x 5-10cm branch, 1x15-20cm branch	Class 1
29	*Eucalyptus resinifera*	130	17	28	35	1x 5-10cm branch, 2x 30cm+ branch, possibly more, Potentially suitable for Powerful Owl	Class 2
30	*Eucalyptus resinifera*	65	14	21	45	1x 10-15cm branch, 2x15-20cm branch	Class 2
31	*Eucalyptus resinifera*	70	11	20	20	1x 30cm+ broken trunk,	Class 1
32	*Syncarpia glomulifera*	95	9	19	20	1x 5-10cm branch, 1x15-20cm branch, possibly more	Class 3
33	*stag*	60	4	18	0	1x 5-10cm branch, 1x 10-15cm branch	Class 2
34	*Eucalyptus resinifera*	75	16	30	55	1x 0-5cm branch, 1x 10-15cm branch	Class 2
35	*stag*	40 / 15	5	18	0	2x 0-5cm branch, 1x 5-10cm branch	Class 2
36	*Eucalyptus resinifera*	85	15	31	60	1x 0-5cm branch, 1x 5-10cm branch, hollow termite nest	Class 2
37	*Eucalyptus resinifera*	70	12	27	60	2x 0-5cm branch, 1x 5-10cm branch	Class 2
38	*Eucalyptus umbra*	80	6	13	15	1x 15-20cm branch, 1x 10-15cm broken trunk, 1x 15-20cm broken trunk	Class 1

Table 4.2 – Habitat tree data

Tree No.	Scientific Name	DBH (cm)	Spread (m)	Height (m)	Health (%)	Number and Size of Hollows / comments	Class
39	*Eucalyptus umbra*	45	6	16	65	1x 0-5cm trunk, 1x 0-5cm branch	Class 2
40	*stag*	65	5	9	0	1x 25-30cm broken trunk, 1x 10-15cm branch, 1x20-25cm branch	Class 1
41	*Syncarpia glomulifera*	45	5	20	10	2x 0-5cm branch	Class 2
42	*stag*	65	6	25	0	1x 0-5cm branch	Class 3
43	*Corymbia maculata*	110	16	32	75	3x 0-5cm branch, 3x 5-10cm branch, 3x15-20cm branch, 1x20-25cm branch, 1x 25-30cm branch scratches on trunk	Class 1
44	*Eucalyptus resinifera*	100	5	19	5	1x 30cm+ broken trunk, 2x 5-10cm branch, 1x 10-15cm branch,	Class 1
45	*Eucalyptus pilularis*	85	15	29	80	3x 0-5cm trunk	Class 2
46	*Eucalyptus pilularis*	75	12	26	65	1x 0-5cm trunk, 2x 0-5cm branch	Class 1
47	*Eucalyptus pilularis*	45	7	22	30	1x 0-5cm trunk	Class 3
48	*Eucalyptus pilularis*	60	10	26	60	1x 0-5cm branch	Class 3
49	*Eucalyptus pilularis*	90	8	24	50	1x 0-5cm branch, 2x 5-10cm branch, 1x0-5x20cm bark	Class 1
50	*Eucalyptus pilularis*	75 / 50	12	23	85	1x 10-15cm branch	Class 3
51	*Eucalyptus pilularis*	70	9	19	70	1x 10-15cm branch	Class 3
52	*Eucalyptus pilularis*	85	13	22	70	1x 0-5cm trunk	Class 3
53	*Eucalyptus resinifera*	-	7	19	70	1x 0-5cm branch	Class 3
54	*Eucalyptus pilularis*	70	12	23	70	3x 0-5cm branch	Class 2
55	*Eucalyptus pilularis*	65	11	25	80	1x 5-10cm branch	Class 3
56	*Eucalyptus pilularis*	75	12	25	75	2x 0-5cm branch	Class 2
57	*stag*	80	3	15	0	1x 30cm+ broken trunk, 1x 5-10cm trunk, 1x 25-30cm trunk, 1x 0-5cm branch,	Class 1
58	*Eucalyptus pilularis*	70	13	25	65	1x 5-10cm branch	Class 3
59	*Eucalyptus resinifera*	85	13	23	65	1x 5-10cm branch	Class 3
60	*Eucalyptus resinifera*	65	6	20	10	1x 5-10cm branch, 1x 20-25cm broken trunk	Class 1
61	*Eucalyptus resinifera*	55	9	25	50	1x 15-20cm broken trunk	Class 2
62	*stag*	90	5	29	0	1x45-50cm broken trunk,	Class 1
63	*Eucalyptus resinifera*	0	80	26	80	2x0-5cm branch	Class 2
64	*Eucalyptus pilularis*	65	12	27		1x5-10cm branch (good quality)	Class 3
65	*stag*	40	1	19	0	1x0-5cm branch, 1x5-10cm branch	Class 3
66	*stag*	25	1	16	0	1x0-5cm cracked bark, 1x5-10cm broken trunk	Class 2
67	*stag*	65	6	25	0	2x0-5cm branch, 1x5-10cm branch	Class 1
68	*stag*	85	7	32	0	2x0-5cm branch	Class 2
69	*Eucalyptus resinifera*	65	7	28	25	1x5-10cm trunk split (good quality)	Class 3
70	*Eucalyptus resinifera*	70	4	31	35	1x5-10cm trunk base, 1x5-10cm trunk, 1x 10-15cm trunk	Class 2
71	*Angophora floribunda*	70	6	15	15	1x40-45cm broken trunk,	Class 1

Table 4.2 – Habitat tree data

Tree No.	Scientific Name	DBH (cm)	Spread (m)	Height (m)	Health (%)	Number and Size of Hollows / comments	Class
72	*stag*	65	1	5	0	1x35-40cm broken trunk	Class 1
73	*Syncarpia glomulifera*	115	11	40	55	2x0-5cm branch, 1x10-15cm branch, 3x10-15cm trunk, 2x35-40cm branch, Potentially suitable for Powerful Owl	Class 1
74	*Eucalyptus resinifera*	80	16	27	65	1x5-10cm branch, 2x15-20cm branch, 1x20-25cm branch	Class 1
75	*Eucalyptus pilularis*	75	14	35	90	1x0-5cm branch, 1x5-10cm branch	Class 3
76	*stag*	25	2	9	0	1x5-10cm branch	Class 3
77	*Eucalyptus resinifera*	35	4	15	45	1x0-5cm broken trunk	Class 3
78	*Eucalyptus resinifera*	75	9	24	30	1x0-5cm branch, 4x5-10cm branch, 1x10-15cm branch, 1x15-20cm branch	Class 1
79	*Eucalyptus pilularis*	90	13	26	70	1x15-20cm trunk split	Class 2
80	*Eucalyptus pilularis*	90	12	30	85	1x5-10cm branch (good quality)	Class 3
81	*Eucalyptus pilularis*	70	11	31	75	2x5-10cm branch, 1x15-20cm branch	Class 1
82	*Eucalyptus pilularis*	50/55	15	29	75	1x0-5cm branch	Class 3
83	*Eucalyptus pilularis*	55	11	38	75	1x10-15cm branch	Class 2
84	*Eucalyptus pilularis*	70	12	39	80	1x0-5cm branch	Class 3
85	*Eucalyptus resinifera*	60	11	22	65	1x10-15cm trunk	Class 2
86	*Eucalyptus pilularis*	100	13	27	60	1x0-5cm branch, 1x10-15cm branch, 1x15-20cm branch, 1x20-25cm trunk base	Class 1
87	*Syncarpia glomulifera*	70	6	13	35	1x 40-45cm broken trunk,	Class 1
88	*Eucalyptus robusta*	90	6	10	20	1x 30-35cm broken trunk,	Class 1
89	*Eucalyptus pilularis*	100	16	35	70	1x 50-55cm broken trunk, Potentially suitable for Powerful Owl	Class 1
90	*stag*	85	3	18	0	1x 40-45cm broken trunk,	Class 1
91	*Eucalyptus robusta*	80	11	19	60	1x 30-35cm branch,	Class 1
92	*Eucalyptus robusta*	90	10	12	30	1x 40-45cm broken trunk, Potentially suitable for Powerful Owl	Class 1
93	*Eucalyptus resinifera*	90	9	18	15	1x 50-55cm broken trunk,	Class 1
94	*Eucalyptus robusta*	110	12	15	70	1x 40-45cm branch,	Class 1
95	*Eucalyptus robusta*	115	5	20	10	1x 50-55cm broken trunk,	Class 1
96	*Eucalyptus robusta*	110	8	18	15	1x 50-55cm broken trunk,	Class 1
97	*stag*	95	9	26	0	1x 40-45cm branch spout,	Class 1
98	*Corymbia gummifera*	55	6	17	20	1x 15-20cm broken trunk	Class 2
99	*Eucalyptus resinifera*	50	10	21	55	1x 0-5cm branch	Class 3
100	*Angophora costata*	70	8	9	20	1x 0-5cm trunk crack, 1x 10-15cm branch, 1x 15-20cm broken trunk	Class 1
101	*Eucalyptus resinifera*	60	9	17	55	1x 5-10cm branch	Class 3

The grid based flora assessment to determine the EEC edge incorporated a total of 25 quadrats. Whilst undertaking these quadrats, the number of hollow-bearing trees was noted. Each vegetation quadrat of 20x20m was extended to 50x20m when undertaking hollow-bearing tree counts, thus making each quadrat 0.1ha. Figure 3 shows the location of the 25 quadrats.

33 hollow-bearing trees were recorded within the 25 x 0.1ha quadrats, thus 2.5ha was completely surveyed of the approximate 53ha site. Extrapolated, this would suggest there are around 700 hollow-bearing trees within the entire site. The data is very biased in that it represents particular vegetation types and does not include highly disturbed areas where the canopy has been removed. The survey area did contain a number of dead trees containing small sized hollows. Very few medium or large hollows were noted during the survey. Those which were larger in size have most likely already been picked up and are plotted individually onto Figure 3.

4.10.1 Class of habitat tree

All hollow-bearing trees identified within the subject site to date have been assigned a class rating. Class ratings for each habitat tree are indicated in Table 4.2.

Class ratings have not been transferred onto any figures to prevent bias due to areas within the site where habitat tree surveys have not been undertaken.

Class ratings are based on the following characteristics:

Class 1 – Ecological Significant Tree

Trees with 5 or more hollows of any size and/or containing hollows with potential for use by owls and/or showing evidence of notable fauna use.

Class 2 – Habitat Tree

Are hollow bearing trees that contains 2 to 4 hollows of any size.

Class 3 – Habitat Tree

Are hollow bearing trees that contain less than 2 small hollows

4.11 Squirrel Glider habitat assessment

Whilst the subject site contains potential foraging, denning and subsequent breeding habitat for the Squirrel Glider no gliders were captured, observed or otherwise recorded during fauna surveys. To date, surveys targeting this species within the subject site have been undertaken by *Conacher Travers* (2003), *Ambrose Ecological Services* (2007) and *Travers bushfire & ecology* (2008, 2009 & 2010).

Adequately sized hollows providing potential denning habitat were observed within the Blackbutt Open Forest and Swamp mahogany Woodland communities during surveys. There are several records of this species within 10km of the study area, of these the closest records were 1.6km to the north-east in 1995 (Ourimbah Creek) and 1.7km to the north-east in 2006 (Reserve within Chittaway Point) (DECCW 2010).

Squirrel Glider habitat on the subject site was assessed according to Appendix 1 of the Squirrel Glider Conservation Management Plan (Smith 2002). This habitat information to assist assessment of significance of development impacts on Squirrel Glider follows the previous assessment considerations outlined in the '*Wyong Shire Council Interim Ecological Assessment Information Required to Assess Clearing Impacts within Squirrel Glider Habitat in Wyong Shire' (2000)*.

The assessment includes consideration to 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.

(a) Habitat Quality

The Blackbutt Open Forest vegetation community contains two (2) Squirrel Glider food plant species occurring as dominants. These include *Eucalyptus pilularis* and *Melaleuca nodosa*.

The Swamp Mahogany Woodland vegetation community contains six (6) Squirrel Glider food plant species occurring as dominants within their strata layers. These include *Eucalyptus robusta* (Swamp Mahogany)*, Acacia longifolia* (Sydney Golden Wattle), *Banksia spinulosa* (Hairpin Banksia), *Melaleuca linariifolia* (Snow in Summer), *Melaleuca nodosa* (Prickly leaved Paperbark) and *Melaleuca sieberi*. These trees combine to form a high available density of foraging resources within this community. Furthermore this community is the only community present within the subject site which falls within one of the five (5) broadly classified community types identified for Squirrel Glider by Smith (2002).

The Disturbed Swamp Mahogany Open Woodland and Disturbed Apple / Mahogany Woodland vegetation communities both also contain the same six (6) Squirrel Glider food plant species mentioned within the Swamp Mahogany Woodland, however the *Melaleuca* species occur at lower incidence. This results in a moderate to high density of available foraging resources within these communities particularly in association with the nearby and extensive natural remnant of Swamp Mahogany Woodland.

The Grassland with Scattered Trees and Disturbed Pine Forest communities contain negligible Squirrel Glider resources.

(b) Remnant Patch Size

The remnant patch size within the study area is approximately 39.23ha (73% of the study area) which is not contiguous. The remnant vegetation within the study area has extensive adjoining vegetation and habitat. Within the subject site this comprises approximately

a. 29.09ha of Blackbutt Open Forest
b. 6.90ha of Swamp Mahogany Woodland
c. 2.79ha of Disturbed Swamp Mahogany Open Woodland
d. 0.45ha of Disturbed Apple/Mahogany Woodland
e. 0.00ha of Grassland with Scattered Trees
f. 0.00ha of Disturbed Pine Forest

(c) Density Habitat Trees

The density of suitable habitat trees within the Blackbutt Open Forest remnant is approximately 2.4 trees/ha. The community has been previously subject to logging.

The density of suitable habitat trees within the Swamp Mahogany Woodland remnant cannot be calculated from available data however would be expected to be approximately 5 trees / ha in the outer fringes and less than half of this within the inner portions containing less Eucalypts.

Only one (1) habitat tree was recorded present within the Disturbed Swamp Mahogany Open Woodland community however the northern portion of this community was not subject to detailed habitat tree survey and other habitat trees are likely to occur. The density of suitable habitat trees within the Disturbed Swamp Mahogany Open Woodland remnant is estimated at approximately 1 tree per ha.

No habitat trees suitable for Squirrel Glider were observed within the Disturbed Apple/Mahogany Woodland, Disturbed Pine Forest or Grassland with Scattered Trees communities.

Habitat trees calculated to provide suitable denning/nesting hollows for Squirrel Gliders are those that occur above 15cm entry. Typically hollows identified during field investigations tend to be over-estimated.

(d) Abundance of Food Plants of Squirrel Glider

The abundance of Squirrel Glider food resources principally on the basis of statistical analysis of the flora quadrats is provided in Table 4.3.

Table 4.3 – Squirrel Glider food resource abundance within the subject site

Food Plants	Food Item	Estimated Average Number of Plants / Hectare in Vegetation Communities					
		1	2	3	4	5	6
Angophora costata	Sap, nectar & pollen						
Eucalyptus haemastoma	Sap, nectar & pollen						
Eucalyptus racemosa	Sap, nectar & pollen						
Eucalyptus robusta	Sap, nectar & pollen		100	200		100	
Eucalyptus pilularis	Nectar & pollen	100			25		50
Eucalyptus siderophloia	Sap, nectar & pollen						
Eucalyptus paniculata	Sap, nectar & pollen	1			1		
Eucalyptus fibrosa	Sap, nectar & pollen						
Corymbia gummifera	Sap, nectar & pollen	10					
Corymbia maculata	Nectar & pollen	5			5		
Melaleuca linariifolia	Nectar & insects	20	50	300	10	50	20
Melaleuca nodosa	Nectar & insects	150	50	250	25	50	50
Melaleuca quinquenervia	Nectar & insects						
Melaleuca sieberi	Nectar & insects	10	25	50	5	25	25
Acacia spp.	Seeds & gum	250	100	250	150	250	150
Banksia spinulosa	Nectar & pollen	100	25	50	25	25	25
Banksia serrata	Nectar & pollen	10					
Banksia integrifolia	Nectar & pollen						
Banksia oblongifolia	Nectar & pollen						
Xanthorrhoea spp.	Nectar & gum	100			5		25

Note:

Vegetation Community 1 = Blackbutt Open Forest
Vegetation Community 2 = Disturbed Apple/Mahogany Woodland
Vegetation Community 3 = Swamp Mahogany Woodland
Vegetation Community 4 = Grassland with Scattered Trees
Vegetation Community 5 = Disturbed Swamp Mahogany Open Woodland
Vegetation Community 6 = Disturbed Pine Forest

(e) Edge to Width Ratio

The site forms a round shape of approximately 1.2km long and 500 metres wide when in combination with neighbouring connective habitats. The south-western end of the site is partially cleared and the eastern, south-eastern and southern limits are bound by residential areas. It is considered that the edge to width ratio is currently low. The perimeter is estimated to be 3.0km in length with the minimum width being 300m across the centre of the study area at the south-eastern corner of the SEPP 14 wetland to the bend on Bundeena Road.

(f) Habitat Disturbance

The Blackbutt Open Forest vegetation community has a generally low incidence of weeds, except for scattered incursions of Lantana. Locations of rubbish dumping and garden refuse occur however these disturbances constitute a negligible amount relative to the overall size of this community.

The Swamp Mahogany Woodland vegetation community appears to be relatively undisturbed.

The Disturbed Swamp Mahogany Open Woodland vegetation community is highly disturbed by former clearing and agricultural activities, with the groundcover dominated by exotic species.

The Disturbed Apple/Mahogany Woodland vegetation community is highly disturbed by former clearing and agricultural activities with the groundcover dominated by exotic species. This community is also subject to incursions of pine regrowth from the adjoining unmanaged pine forest.

The Grassland with Scattered Trees vegetation community is highly disturbed and contains negligible natural habitat.

(g) Proximity to Existing or Future Residential Development

The fragment is located adjacent to an existing residential areas located to the east along Torrellia Way and to the south-east along Bottlebrush and Bundeena Roads. Rural residential areas occur to the south along Berkeley Road.

Conclusion of Squirrel Glider Assessment

No Squirrel Gliders have been recorded within the subject site however habitat for these species does exist particularly the high quality habitats of the Swamp Mahogany Woodland and its association with the neighbouring Blackbutt Open Forest.

Habitat will be conserved within the subject site for this species as retention and buffers to the Swamp Mahogany Woodland EEC will occur. As such future proposed development as a result of rezoning is unlikely to have any significant impact on Squirrel Gliders.

4.12 SEPP 44 Koala Habitat Protection

SEPP 44 Koala Habitat Protection applies to land within Local Government Areas (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 or core koala habitat. Part 2 applies to land which has an area of greater than 1 hectare or has, together with any adjoining land in the same ownership, an area of more than 1 hectare.

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 1 hectare, hence Part 2 – Development Control of Koala Habitats, of the Policy applies.

Potential Koala Habitat (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.

Core Koala Habitat (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 Koala food tree species (*Eucalyptus robusta*) listed on Schedule 2 of State Environmental Planning Policy No. 44 - Koala Habitat Protection, was observed within the subject site. *Eucalyptus robusta* comprised of greater than 15% of the total number of trees within the Swamp Mahogany Woodland, Disturbed Swamp Mahogany Open Woodland and Disturbed Apple/Mahogany Woodland and therefore these communities are classified under SEPP 44 as 'potential Koala habitat'.

The Blackbutt Open Forest subject to development as a result of rezoning is not considered to provide 'Potential Koala Habitat' under the definitions of SEPP 44 - Schedule 2 based on the tree species present.

This area is considered to provide 'supplementary feeding habitat' as listed under the LHCCREMS survey guidelines (2002). This is given the high presence of Red Mahogany (*Eucalyptus resinifera*) within the lower elevations of this community.

Step 2 – Is the land CKH*?*

A search of the Atlas of NSW Wildlife (DECC 2010) database found 18 records of Koala habitation within a 10 km radius from the subject site since 1916. The most recent and closest record was located within the north-eastern portion of Lot 2 on February 15th 2007 (see Figure 3 for location). This is the only record within 2km; with one to the north in 1968 and one to the south in 2006, both at this distance.

The record obtained within the study area was following the Flora and Fauna Assessment Report prepared by *Conacher Travers* (2003) and the Supplementary Fauna Survey and Assessment prepared by *Ambrose Ecological Services Pty Ltd* (4th February 2007).

Both of these reports also concluded that the Blackbutt Open Forest vegetation community which contains the whole of the north-eastern proposed development area contains no "Potential Koala Habitat" under the provisions of SEPP 44.

Subsequent target surveys were undertaken by *Travers bushfire & ecology* where one (1) scat collected within the then proposed nursery area (within the north-eastern portion) was identified as Koala by hair and scat sample expert Barbara Triggs.

Koala experts *Biolink ecological services* were engaged to undertake further targeted survey. A grid based sampling technique was employed throughout Lot 2 with default sampling sites located also in adjacent lands (see Figure 3 for locations).

Biolink recorded no evidence of Koala habitation throughout Lot 2 and concluded that there was no evidence to suggest "Core Koala Habitat" exists within the study area and the previous scat was from a single individual in dispersal or was misidentified.

The *Biolink* assessment was requested to independently assess the subject site for Koala presence and or activity; and review the Koala target survey undertaken by *Travers bushfire & ecology* (2008) based on a scat identification discrepancy.

It is considered that the Koala record from the subject site in 2007, if authentic, could be the result of:

- A Koala in transition, being more likely a male in search of established population areas, given the extensive distances that may be covered by the species in such circumstances.

- An individual placed in an area considered as suitable habitat outside of established home ranges following the animal's care or otherwise.

SEPP 44 Conclusion

The Swamp Mahogany Woodland and Disturbed Swamp Mahogany Woodland communities' central to Lot 2 provide high quality Koala habitat. These communities are EEC's and will be conserved.

Development areas as a result of rezoning may extend into the more highly disturbed southern portions of the Disturbed Swamp Mahogany Woodland however this removal may be offset by restoration of remaining portions of this community. Thus, Potential Koala Habitat within the subject site will be well represented within a post rezoning and development landscape.

Although an individual has been recorded within the proposed north-eastern portions of the subject site, this area is not considered of value to Koalas and particularly a local population. Following surveys to date, including detailed target investigations by *Biolink* (2008), the Potential Koala Habitat within the subject site has not been found to contribute to Core Koala Habitat under the definitions of SEPP 44.

4.13 Threatened fauna legislation

Five (5) threatened fauna species – Eastern Bentwing-bat (*Miniopterus orianae oceansis*), Little Bentwing-bat (*Miniopterus australis*), East-coast Freetail Bat (*Micronomus norfolkensis*), Powerful Owl (*Ninox strenua*) and Grey-headed Flying-fox (*Pteropus poliocephalus*) – were recorded within the subject site during recent 2008-10 surveys by *Travers bushfire & ecology*.

Eastern Bentwing-bat was also recorded within the subject site during previous surveys by *Ambrose Ecological Services* (2007) and *Conacher Travers* (2003).

Koala has previously been recorded within the subject site as provided by an Atlas record of a single individual in 2007. Other threatened species recorded within neighbouring lands and likely utilising the subject site include the Little Lorikeet, Varied Sittella, Eastern Falsistrelle and Greater Broad-nosed Bat. Atlas records also provide nearby records of Glossy Black-Cockatoo, Spotted-tailed Quoll and Wallum Froglet. A nearby recording of the Green-thighed Frog is also known.

It is considered that the subject site provides suitable habitat for the following threatened fauna species previously recorded within 10km (see Table 4.5 for likelihood of each species presence based on available habitat and records):

- Wallum Froglet ^
- Green and Golden Bell Frog
- Green-thighed Frog ^
- Pale-headed Snake
- Stephens' Banded Snake
- Black-necked Stork
- Australasian Bittern
- Little Eagle
- Square-tailed Kite
- Bush Stone-curlew
- Comb-crested Jacana
- Australian Painted Snipe
- Gang-gang Cockatoo
- Glossy Black-Cockatoo ^
- Little Lorikeet ^
- Swift Parrot
- Barking Owl
- Powerful Owl *
- Masked Owl
- Sooty Owl
- Painted Honeyeater
- Regent Honeyeater
- Varied Sittella ^
- Flame Robin
- Spotted-tailed Quoll ^
- Koala *
- Eastern Pygmy Possum
- Yellow-bellied Glider ^
- Squirrel Glider
- Long-nosed Potoroo
- Parma Wallaby
- Grey-headed Flying-fox *
- Yellow-bellied Sheathtail-bat
- East-coast Freetail Bat *
- Large-eared Pied Bat
- Eastern Falsistrelle ^
- Little Bentwing-bat *
- Eastern Bentwing-bat *
- Large-footed Myotis
- Greater Broad-nosed Bat ^
- Giant Dragonfly

* denotes species recorded within the study area during surveys or to date or from previous records
^ denotes species recorded within 1km of the study area either on the Atlas database or during previous nearby surveys

4.13.1 State legislative matters

TSC Act – A search of the *Atlas of NSW Wildlife* (DECCW, 2010) database for threatened species resulted in records of fifty-five (55) threatened fauna species within a 10km radius of the subject site. These species are listed in Table 4.5 and are considered for potential habitat within the subject site.

Strictly coastal, estuarine and oceanic threatened species found within 10km have not been included.

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.

4.13.2 Endangered populations

There are no endangered fauna populations within the Wyong LGA.

4.13.3 National legislative matters

EPBC Act – A review of the schedules of the *EPBC Act* identified the presence of ten (10) threatened fauna species or species habitat likely to occur within a 10km radius of the subject site.

These species have been listed in Table 4.5 and are considered for potential habitat within the subject site.

Of those ten (10) species, six (6) were considered to have potential habitat within the subject site. Of these, one (1) nationally listed threatened fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*), was recorded foraging within the subject site during surveys. A discussion on this species is provided in Section 5.1.2.

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 are assessed in Table 4.4.

Table 4.4 - Migratory fauna habitat assessment

COMMON NAME ***Scientific Name***	**PREFERRED HABITAT**	**COMMENTS**
White-bellied Sea Eagle (*Haliaeetus leucogaster*)	Coasts, islands, estuaries, inlets, large rivers, inland lakes, reservoirs. *Sedentary; dispersive.*	Suitable roosting, nesting and sub-optimal foraging habitat present. This species was recorded on most days of recent surveys centring its activity around the northern areas of the SEPP14 wetland north of the subject site. Activity did extend into the subject site itself. This species was not recorded during any previous surveys however the level of vocalisations and presence by the species suggested that nesting occurred nearby. Nesting was found to be located approximately 87m to the north of the subject site boundary. Whitewash locations within the subject site were identified by John Young to be from this species and not from owls. Further discussion on this species is provided in Section 5.3.1.
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, Himilayas, east to Japan. Summer migrant to eastern Australia.*	Suitable foraging habitat present. This species was previously believed to remain 'on the wing' during the visit time in Australia. Radio-tracking has found that the species rests in trees. Not recorded during surveys. 21 records within 10km with 7 within 2km. No records since 2003. Potential to occur but no likely impact.
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 & south-west Australia.*	No suitable habitat present.

Table 4.4 - Migratory fauna habitat assessment

COMMON NAME ***Scientific Name***	PREFERRED HABITAT	COMMENTS
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*.	Suitable roosting, breeding and foraging habitat present. Not recorded during surveys within the subject site however was recorded within neighbouring lands to the west in 2007 by *Travers environmental consultants*. 98 records within 10km however the 2007 record is the only record within 3km in recent years. Potential to occur however habitat to be removed as part of the planning proposal is not considered likely to be of significant importance.
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 & Tasmania over warmer months, winters in north-east Qld.*	Suitable roosting and foraging on migration present. Not recorded during surveys. 7 records within 10km, the closest at 2.9km away in 1991. Low potential to occur. Habitat to be removed as part of the planning proposal is not considered likely to be of significant importance.
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.*	Suitable roosting, breeding and foraging habitat present. Not recorded during surveys within the subject site however was recorded within neighbouring lands to the west in 2007 by *Travers environmental consultants*. Numerous records within 10km. Habitat that is suitable for nesting is well represented in the locality and is not ideal within the subject site itself. No significant impact on this species in the locality is expected to be likely as a result of the planning proposal.
Great Egret (*Ardea alba*)	Shallows of rivers, estuaries; tidal mudflats, freshwater wetlands; sewerage ponds, irrigation areas, larger dams, etc. *Dispersive; cosmopolitan.*	Suitable habitat present within the protected SEPP 14 wetland to the north and fringing areas that will be protected within the subject site. Not recorded during surveys. Over 70 records within 10km. No likely significant impact as a result of the planning proposal.

Table 4.4 - Migratory fauna habitat assessment

COMMON NAME ***Scientific Name***	PREFERRED HABITAT	COMMENTS
Cattle Egret (*Ardea ibis*)	Stock paddocks, pastures, croplands, garbage tips, wetlands, tidal mudflats, drains. *Breeds in summer in warmer parts of range including NSW*.	Sub-optimal roosting and foraging habitat present due to the absence of host livestock. Nesting habitat is highly suitable within the SEPP 14 wetland area to the north and fringing areas that extend into the subject site. Not recorded during surveys within the subject site however was recorded within neighbouring lands to the west in 2007 by *Travers environmental consultants*. Low potential to occur within the subject site due to the absence of host livestock. No likely significant impact as a result of the planning proposal.
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 2000m; samphire on saltmarshes; mangrove fringes. *Breeds Japan. Regular summer migrant to Australia. Some overwinter.*	Marginally suitable foraging and roosting habitat present. Not recorded during surveys. 12 records within 10km all within 5km away prior to 2001. Not expected to occur. No likely significant impact as a result of the planning proposal.
Fork-tailed Swift (*Apus pacificus*)	Aerial: over open country, from semi-arid deserts to coasts, islands; sometimes over forests, cities. *Breeds Siberia, Himilayas, 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.*	Suitable roosting and foraging habitat present. Not recorded during surveys. 8 records within 10km, 1 within 1km in 1995. Low potential to occur. No likely significant impact as a result of the planning proposal.

The presence of four (4) protected migratory species of national significance within the nearby locality highlights the diversity and value of local habitats of which the subject contributes. The subject site has not been found to be of high value or central to the requirements of any of these species.

The presence of White-bellied Sea Eagle requires the greatest consideration in retaining appropriate areas of habitat as there is likely nesting activity to the north. In respect to the subject site, tall outlook perches surrounding the SEPP 14 wetland area should be preserved for this species. Such perches are provided by dead trees emerging from low Melaleuca forest and Swamp Mahogany woodland to the north and west of the SEPP 14 area outside of the subject site.

An aerial analysis of the subject site itself reveals that there is a sudden height increase to taller forest along the eastern fringe of the SEPP 14 wetland which would, as a whole provide such perching values.

These areas will be conserved within the Swamp Mahogany EEC contained within the subject site however other tall trees extending into the Blackbutt Open Forest could also be utilised by the species for perching as recorded by Council.

See Figure 3 for the approximate location of Council's observation of this species roost within the north-eastern portions as well as whitewash areas possibly belonging to this species elsewhere within the Blackbutt Open Forest community.

4.14 Threatened fauna species habitat assessment

Table 4.5 provides an assessment of threatened fauna species habitat likely to occur within the subject site.

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME ***Scientific Name***	**PREFERRED HABITAT**	**COMMENTS**	**TSC Act**	**EPBC Act**
Wallum Froglet *Crinia tinnula* DECCW	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.	Suitable habitat present within the protected SEPP 14 wetland to the north and fringing areas that will be protected within the subject site. Not recorded during target surveys however recorded opportunistically within the SEPP 14 wetland area to the north. Potential to occur within the subject site.	V	-
Giant Burrowing Frog *Heleioporus australiacus* DECCW EPBC	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.	No suitable habitat present.	V	V

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME ***Scientific Name***	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Green and Golden Bell Frog *Litoria aurea* DECCW EPBC	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.	Suitable habitat present within the protected SEPP 14 wetland to the north and fringing areas that will be protected within the subject site. Not recorded during surveys. 13 records within 10km, none of these occurring since 1999. Closest record located just within 1km to the SW in 1975. Low potential to occur based on local extinctions in recent decades.	E	V
Green-thighed Frog *Litoria brevipalmata* DECCW	Found in rainforests and open forests within or at the edge of streams, swamps, lagoons, dams and ponds. Distribution Limit - N-Border Ranges National Park. S-Near Gosford.	Suitable but not ideal habitat present within the protected SEPP 14 wetland to the north and fringing areas that will be protected within the subject site. Not recorded during surveys. 10 Atlas records within 10km, none of these occurring since 1997. Closest Atlas record located just within 2km to the NW in 1995. This could be the record noted by *Robert Payne* (1998) that was recorded on a nearby site to the north of Enterprise Dr in 1995 by Phillip Green and Ross Wellington. Potential to occur.	V	-
Littlejohn's Tree Frog *Litoria littlejohnii* DECCW EPBC	Found in wet and dry sclerophyll forest associated with sandstone outcrops at altitudes 280-1000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. Distribution Limit – N-Hunter River. S-Eden.	No suitable habitat present.	V	V

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME ***Scientific Name***	**PREFERRED HABITAT**	**COMMENTS**	**TSC Act**	**EPBC Act**
Stuttering Frog *Mixophyes balbus* DECCW EPBC	Terrestrial inhabitant of rainforest and wet sclerophyll forests. Distribution Limit - N-Near Tenterfield. S-South of Bombala.	No suitable habitat present.	E	V
Giant Barred Frog *Mixophyes iteratus* DECCW EPBC	Terrestrial inhabitant of rainforest and open forests. Distribution Limit- N-Border Ranges National Park. S-Narooma.	No suitable habitat present.	E	E
Red-crowned Toadlet *Pseudophryne australis* DECCW	Prefers sandstone areas, breeds in grass and debris beside non-perennial creeks or gutters. Individuals can also be found under logs and rocks in non breeding periods. Distribution Limit- N-Pokolbin S-Near Wollongong.	No suitable habitat present.	V	-
Pale-headed Snake *Hoplocephalus bitorquatus* DECCW	Occurs in a range of habitats from rainforest to open woodland. Usually occurs in hollow trees and beneath loose bark along watercourses. Partly arboreal and may use hollows in trees. Distribution Limit- N-Border Ranges National Park S-Sydney.	Suitable habitat present. Not recorded during surveys. 1 record within 10km at 6km west in 1997. Potential to occur difficult to determine based on the cryptic nature of the species. Low based on previous records alone.	V	-
Broad-headed Snake *Hoplocephalus bungaroides* EPBC	Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. Distribution Limit - N-Mudgee Park. S-Nowra.	No suitable habitat present.	E	E
Stephens' Banded Snake *Hoplocephalus stephensii* DECCW	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.	Suitable habitat present. Not recorded during surveys. 1 record within 10km at 6km to the NW in 2000. Potential to occur difficult to determine based on the cryptic nature of the species. Low based on previous records.	V	-

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME ***Scientific Name***	**PREFERRED HABITAT**	**COMMENTS**	**TSC Act**	**EPBC Act**
Rosenberg's Goanna *Varanus rosenbergi* DECCW	Hawkesbury sandstone outcrop specialist. Inhabits woodlands, dry open forests and heathland sheltering in burrows, hollow logs, rock crevices and outcrops. Distribution Limit- N-Nr Broke S-Nowra Located in scattered patches near Sydney, Nowra and Goulburn.	No suitable habitat present.	V	-
Little Eagle Hieraaetus morphnoides DECCW	Utilises plains, foothills, open forests, woodlands and scrublands; river red gums on watercourses and lakes. Distribution Limit - N-Tweed Heads. S-South of Eden.	Suitable habitat present. Not recorded during surveys. 7 records within 10km, the most recent in 2003 and the closest at 1.8km to the SE in 1989. Potential but not expected to occur.	V	-
Square-tailed Kite *Lophoictinia isura* DECCW	Utilises mostly coastal and sub-coastal open forest, woodland or lightly timbered habitats and inland habitats along watercourses and mallee that are rich in passerine birds. Distribution Limit - N-Goondiwindi. S-South of Eden.	Suitable habitat present. Not recorded during surveys. 1 record within 10km at 6km to the SW in 2007. Potential but not expected to occur.	V	-
Osprey *Pandion haliaetus* DECCW	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.	No suitable habitat present.	V	-
Australasian Bittern *Botaurus poiciloptilus* DECCW	Inhabits shallow freshwater or brackish wetlands with tall dense beds of reeds, sedges or rush species and swamp edges. Distribution Limit - N-North of Lismore. S- Eden.	Suitable habitat present within the protected SEPP 14 wetland to the north and fringing areas that will be protected within the subject site. Not recorded during surveys. 7 records within 10km, the most recent in 2002, the closest 4km east in 1987. Low potential to occur.	V	-
Black Bittern *Ixobrychus flavicollis* DECCW	Shadowy, leafy water side trees along tidal creeks and sheltered mudflats, oysterslats. Distribution Limit - N-Tweed Heads. S-South of Eden.	No suitable habitat present.	V	-

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME ***Scientific Name***	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Black-necked Stork *Ephippiorhynchus asiaticus* DECCW	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats. Distribution Limit - N-Tweed Heads. S-Nowra.	Suitable habitat present within the protected SEPP 14 wetland to the north and fringing areas that will be protected within the subject site. Also within the small farm dams present. Not recorded during surveys. 30 records within 10km, the most recent in 2002, the closest 1.5km east in 1994. Low potential to occur.	E	-
Comb-crested Jacana *Irediparra gallinacean* DECCW	Deep and permanent vegetation-choked tropical and warm temperate wetlands. Distribution Limit - N-Tweed Heads. S - Ku-ring-gai Chase National Park.	Sub-optimal habitat present within the protected SEPP 14 wetland to the north and to a lesser extent fringing areas that will be protected within the subject site. Not recorded during surveys. 3 records within 10km all in 1989, the closest being 3km north. Not likely to occur.	V	-
Bush Stone-curlew *Burhinus grallarius* DECCW	Utilises open forests and savannah woodlands, sometimes dune scrub, savannah and mangrove fringes. Distribution Limit- N-Border Ranges National Park S-Near Nowra.	Sub-optimal habitat present. Not recorded during surveys. 3 records within 10km all prior to 1998, the closest being 6km to the SE. Not likely to occur.	E	-
Wompoo Fruit-dove *Ptilinopus magnificus* DECCW	Inhabits large undisturbed patches of lowland and adjacent highland rainforest and moist eucalypt forests where it feeds on fruit. Distribution Limit - N-Tweed Heads. S-Sydney.	No suitable habitat present.	V	-
Black-tailed Godwit Limosa limosa DECCW	A mainly coastal species feeding along estuarine mudflats, beaches, mangroves and lagoons. Distribution Limit: N-Tweed Heads. S-South of Eden.	No suitable habitat present.	V	-

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME ***Scientific Name***	**PREFERRED HABITAT**	**COMMENTS**	**TSC Act**	**EPBC Act**
Superb Fruit-dove *Ptilinopus superbus* DECCW	Rainforests, adjacent mangroves, eucalypt forests, scrubland with native fruits. Distribution Limit - N-Border Ranges National Park. S-Bateman's Bay.	No suitable habitat present.	V	-
Glossy Black-Cockatoo *Calyptorhynchus lathami* DECCW	Open forests with *Allocasuarina* species and hollows for nesting. Distribution Limit - N-Tweed Heads. S-South of Eden.	Sub-optimal habitat present. Not recorded during surveys. 66 records within 10km. The closest being just within 1km to the west in 2004. Potential to occur.	V	-
Little Lorikeet Glossopsitta pusilla DECCW	Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelterbeds, and street trees. Distribution Limit: N-Tweed Heads. S-South of Eden.	Suitable foraging, nesting and roosting habitat present. Not recorded during surveys however previously recorded by *Conacher Travers* (2006) along Berkeley road to the immediate south. 25 other Atlas records within 10km. Likely to occur on occasion.	V	-
Gang-gang Cockatoo *Callocephalon fimbriatum* DECCW	Prefers wetter forests and woodlands from sea level to > 2000m on Divide, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. Distribution Limit – mid north coast of NSW to western Victoria.	Suitable roosting, foraging and nesting habitat present. Not recorded during surveys. 9 records within 10km all beyond 7km away. Not likely to occur.	V	-
Australian Painted Snipe Rostratula australis EPBC	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.	Suitable habitat present within the protected SEPP 14 wetland to the north and fringing areas that will be protected within the subject site. Not recorded during surveys or previously within 10km. Not likely to occur.	V	V

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME ***Scientific Name***	**PREFERRED HABITAT**	**COMMENTS**	**TSC Act**	**EPBC Act**
Swift Parrot *Lathamus discolour* DECCW EPBC	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. Distribution Limit - N-Border Ranges National Park. S-South of Eden.	Suitable foraging habitat present particularly within the Swamp Mahogany Woodland EEC areas that will be retained as part of future proposals. Not recorded during surveys. 58 records within 10km, with only 3 of these within 5km. Nearest records at 1.5km west in 1995 & 2002. Potential to occur.	E	E
Painted Honeyeater *Grantiella picta* DECCW	Found in open forest, woodland and scrubland feeding on mistletoe fruits. Distribution Limit- N-Boggabilla S-Albury.	Sub-optimal habitat present. Not recorded during surveys. 3 records within 10km beyond 6km north, all in 1980. Not likely to occur and not assessed any further.	V	-
Regent Honeyeater *Xanthomyza Phrygia* DECCW EPBC	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.	Suitable foraging habitat present particularly within the Swamp Mahogany Woodland EEC areas that will be retained as part of future proposals. Not recorded during surveys. 15 records within 10km, the closest at 1.5km to the east and SE in1991. Potential to occur.	E	E
Barking Owl *Ninox connivens* DECCW	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.	Suitable roosting, nesting and foraging habitat present. Not recorded during surveys. 9 records within 10km, all beyond 7km away. Most recent record 8km to the NE in 2009. Not likely to occur following the amount of target survey to date.	V	-

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME ***Scientific Name***	**PREFERRED HABITAT**	**COMMENTS**	**TSC Act**	**EPBC Act**
Powerful Owl *Ninox strenua* DECCW	Forests containing mature trees for shelter or breeding & densely vegetated gullies for roosting. Distribution Limits - N-Border Ranges National Park. S-Eden.	Suitable roosting, nesting and foraging habitat present. Recorded responding to call-playback during 2009 surveys. Numerous other records within 10km. Potential to utilise the subject site for foraging given identification of presence during the breeding season within the nearby Pleasant Valley to the south-west.	V	-
Masked Owl *Tyto novaehollandiae* DECCW	Open forest & woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. Distribution Limit - N-Border Ranges National Park. S-Eden.	Suitable roosting, nesting and foraging habitat present. Not recorded during surveys. 26 records within 10km, the closest at 3.5km to the NW in 1991. Low potential to occur following the amount of target survey to date.	V	-
Sooty Owl *Tyto tenebricosa* DECCW	Tall, dense, wet forests containing trees with very large hollows. Distribution Limit - N-Border Ranges National Park. S-South of Eden.	Sub-optimal foraging habitat present. Not recorded during surveys. Numerous records within 10km, the closest at 2.2km to the south in 1998. Not expected to occur based on available habitat and following the amount of target survey to date.	V	-

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Varied Sittella Daphoenositta chrysoptera DECCW	Open eucalypt woodlands/forests (except heavier rainforests); mallee, inland acacia, coastal tea-tree scrubs; golfcourses, shelterbelts, orchards, parks, scrubby gardens. N-Border Ranges National Park. S-South of Eden.	Suitable roosting, nesting and foraging habitat present. Not recorded during surveys within the subject site however previously recorded by *Conacher Travers* on neighbouring lands to the west in 2001. Recorded to the south-west of the subject site on the ridge on the other side of Berkeley Road during the John Young visit. 10 Atlas records within 10km, the closest at 1.5km to the north in 1995. Potential to occur within the subject site.	V	-
Flame Robin Petroica phoenicea DECCW	Summer: forests, woodlands, scrubs, from sea-level to c. 1800 m. Autumn-winter: open woodlands, plains, paddocks, golf courses, parks, orchards. Distribution Limit: N northern NSW tablelands. S-South of Eden.	Suitable roosting, nesting and foraging habitat present. Not recorded during surveys. 1 record within 10km at 6.5km to the NW in 1999. Not likely to occur.	V	-
Speckled Warbler *Chthonicola sagittata* DECCW	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.	No suitable habitat present.	V	-
Grey-crowned Babbler *Pomatostoomus temporalis* DECCW	Found in dry open forests, woodland scrubland, farmland with isolated trees. Distribution Limit mostly west of Great Divide except Hunter Valley. N – Qld widespread S-Mornington pen. E- se SA.	No suitable habitat present.	V	-
Spotted-tailed Quoll *Dasyurus maculatus* DECCW EPBC	Dry and moist open forests containing rock caves, hollow logs or trees. Distribution Limit-N-Mt Warning National Park S-South of Eden.	Suitable denning, breeding and foraging habitat present. Not recorded during target surveys. 26 records within 10km, the closest record within 0.5km to the north in 2001 and also 0.7km to the south in 2004. Potential to occur within the subject site.	V	V

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME ***Scientific Name***	**PREFERRED HABITAT**	**COMMENTS**	**TSC Act**	**EPBC Act**
Eastern Quoll *Dasyurus viverrinus* DECCW	Dry and moist sclerophyll forests containing hollow logs, rock caves, abandoned burrows or trees with open grazing land interspersed. Distribution Limit- N-Kempsey S-South of Eden.	Suitable denning, breeding and foraging habitat present. 1 record at 10km to the south in 1973, otherwise considered extinct from the local region. Not likely to occur and not considered any further.	E	-
Southern Brown Bandicoot *Isoodon obesulus* DECCW	Utilises a range of habitats containing thick ground cover - open forest, woodland, heath, cleared land, urbanised areas and regenerating bushland. Distribution Limit - N-Kempsey. S-South of Eden.	No suitable habitat present.	E	E
Long-nosed Potoroo *Potorous tridactylus* DECCW EPBC	Coastal heath and dry and wet sclerophyll forests with a dense understorey. Distribution Limit - N-Mt Warning National Park. S-South of Eden.	Suitable habitat present. Not recorded during target surveys. 3 records within 10km all at 7km south in 1992km. Not likely to occur.	V	V
Parma Wallaby *Macropus parma* DECCW	Inhabits rainforests and wet and dry sclerophyll forests with a dense understorey and associated grassy patches. Distribution Limit - N-Border Ranges National Park. S-Morton National Park.	Suitable habitat present. Not recorded during surveys. 1 record within 10km at 8km south in 1995km. Not likely to occur.	V	-
Brush-tailed Rock-wallaby *Petrogale penicillata* EPBC	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.	No suitable habitat present.	V	V
Koala *Phascolarctos cinereus* DECCW	Inhabits both wet & dry eucalypt forest on high nutrient soils containing preferred feed trees. Distribution Limit - N-Tweed Heads. S-South of Eden.	Suitable habitat present. Previous record of an individual within the subject site in 2007. Not recorded during updated target surveys by *Biolink* (2008).	V	-

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME ***Scientific Name***	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Squirrel Glider *Petaurus norfolcensis* DECCW	Mixed aged stands of eucalypt forest & woodlands including gum barked & high nectar producing species & hollow bearing trees. Distribution Limit - N- Tweed Heads S-Albury.	Suitable denning, breeding and foraging habitat present. Not recorded during target surveys. Over 55 records within 10km, only 5 of which are within 5km. The closest records at 1.4km to the north in 1995 and 1.6km to the NE in 2006. Not expected to occur within the subject site.	V	-
Yellow-bellied Glider *Petaurus australis* DECCW	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. Distribution Limit- N- Border Ranges National Park. S-South of Eden.	Suitable habitat present. Not recorded during surveys within the subject site, however recorded by *Travers environmental consultants* (2007) and during the recent John Young visit within neighbouring lands to the west. Numerous records within 10km with 6 of these within 2km. Potential to occur.	V	-
Eastern Pygmy Possum *Cercatetus nanus* DECCW	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.	Suitable habitat present. Not recorded during surveys. 2 records within 10km, none within 7km. Low potential to occur.	V	-
Grey-headed Flying-fox *Pteropus poliocephalus* DECCW EPBC	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.	Suitable foraging and low potential roosting/breeding habitat present. Recorded foraging on Swamp Mahogany at numerous locations surrounding the SEPP 14 wetland during 2010 surveys. Also recorded in flight overhead and within the far SW portion of the site.	V	V

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* DECCW	Rainforests, sclerophyll forests and woodlands. Distribution Limit - N-North of Walgett. S-Sydney.	Suitable foraging, roosting and breeding habitat present. Not recorded during surveys. 3 records within 10km none within 7km. Low potential to occur.	V	-
Large-footed Myotis *Myotis macropus* DECCW	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.	Marginally suitable habitat present. Not recorded during surveys. 14 records within 10km the closest at 1.8km to the NE in 1998. Not likely to occur.	V	-
Little Bentwing-bat *Miniopterus australis* DECCW	Roosts in caves, old buildings and tree hollows in the higher rainfall forests along the south coast of Australia. Distribution Limit - N-Border Ranges National Park. S-Sydney.	Suitable foraging habitat present. Recorded foraging within the subject site during 2010 surveys.	V	-
Eastern Bentwing-bat *Miniopterus schreibersii oceansis* DECCW	Prefers areas where there are caves, old mines, old buildings, stormwater drains & well timbered areas. Distribution Limit - N-Border Ranges National Park. S-South of Eden.	Suitable foraging habitat present. Recorded foraging within the subject site during 2003, 2007 & 2010 surveys.	V	-
Greater Broad-nosed Bat *Scoteanax rueppellii* DECCW	Inhabits areas containing moist river & creek systems especially tree lined creeks. Distribution Limit - N-Border Ranges National Park. S-Pambula.	Suitable foraging, roosting and breeding habitat present. Not recorded during surveys within the subject site however previously recorded in close proximity by *Conacher Travers* (2006), *Travers environmental consultants* (2007) and *Robert Payne Ecological Surveys and Management* (1998). 34 Atlas reords within 10km.	V	-
Golden-tipped Bat *Kerivoula papuensis* DECCW	Rainforest and adjoining moist open forest habitats, roosting in tree hollows and dense vegetation. Distribution Limit-N- Border Ranges Nation Park. S-South of Eden.	No suitable habitat present.	V	-

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME ***Scientific Name***	**PREFERRED HABITAT**	**COMMENTS**	**TSC Act**	**EPBC Act**
East-coast Freetail Bat *Micronomus norfolkensis* DECCW	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.	Suitable foraging, roosting and breeding habitat present. Recorded foraging within the subject site during 2010 surveys.	V	-
Eastern Falsistrelle *Falsistrellus tasmaniensis* DECCW	Recorded roosting in caves, old buildings and tree hollows. Distribution Limit- N-Border Ranges National Park S-Pambula.	Suitable foraging, roosting and breeding habitat present. Not recorded during surveys within the subject site however previously recorded in close proximity by *Conacher Travers* (2006), *Travers environmental consultants* (2007) and *Robert Payne Ecological Surveys and Management* (1998). 17 Atlas records within 10km.	V	-
Large-eared Pied Bat *Chalinolobus dwyeri* EPBC	Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. Distribution Limit - N-Border Ranges Nation Park. S-Wollongong.	Sub-optimal habitat present. Not recorded during surveys or previously within 10km. Not likely to occur. Not assessed any further.	V	V
Macquarie Perch *Macquaria australasica* EPBC	Occurs in south east Australia at moderate to high altitudes in rivers and reservoirs. Historical records show the species was widespread and abundant in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers and their tributaries. Allen (1989) states that introduced populations are present in Nepean River and water supply dams in the Sydney area. Occurs in lakes and flowing streams, usually in deep holes.	No suitable habitat present.	V	E
Australian Greyling *Prototroctes maraena* EPBC	Clear, moderate to fast flowing water in the upper reaches of rivers (sometimes to altitudes above 1000m). Typically found in gravel bottom pools. Often forming aggregations below barriers to upstream movement (eg weirs, waterfalls).	No suitable habitat present.	Part 2, Section 19 – Protected Fish	V

Table 4.5 - Threatened fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Giant Dragonfly *Petalura gigantean* DECCW	Inhabits large relatively deep permanent swamps and bogs with high water quality and moss or other soft vegetation along the edge for egg laying. It occurs in the far NE NSW, south to Kempsey, & in a patch between Gosford & Nowra.	Suitable habitat present within the Swamp Mahogany Woodland EEC areas that fringe the SEPP 14 wetland area and will be retained as part of future proposals. Not recorded during surveys. 1 record within 10km, at 5km to the SE in 2007. Potential to occur but limited to the areas described above.	E	-

DECCW	- Denotes species listed within 10km of the subject site on the Atlas of NSW Wildlife database
EPBC	- Denotes species listed within 10km of the subject site in the EPBC Act habitat search

Detailed discussions on each of the threatened fauna species recorded within or near to the subject site are provided within Section 5 of this report.

4.15 Vegetation connectivity and wildlife corridors

Previous Habitat Corridor Mapping Studies

Wyong LGA has been subject to several studies pertaining to the identification of habitat corridors and vegetation connectivity. These studies include:-

- Austeco Environmental Consultants (2002) *Fauna Habitat Modelling and Wildlife linkages in Wyong Shire.*
- Robert Payne (2002) *Wildlife Corridors Strategy – Field Evaluation of Linkages in Wyong Shire.*
- Regional fauna corridor mapping has been sourced from DECCW for the Wyong LGA.

Austeco Environmental Consultants mapped the site as part of a sub-regional 'Wet Forest Pathway' consisting of 3 main blocks, one north of the Wyong River valley, one south of the Wyong River Valley and one extending into Gosford in the south-east (Insert 1). Wet Forest Pathways act as a link between remnant native vegetation remnants that provide fragmented connectivity to larger securely conserved areas in National parks of conserved lands and to managed forests. Wet Forest Ecosystems are well represented in environmental protection zones on private lands and the balance in unprotected areas occurring mainly in Wyong and Ourimbah State Forests.

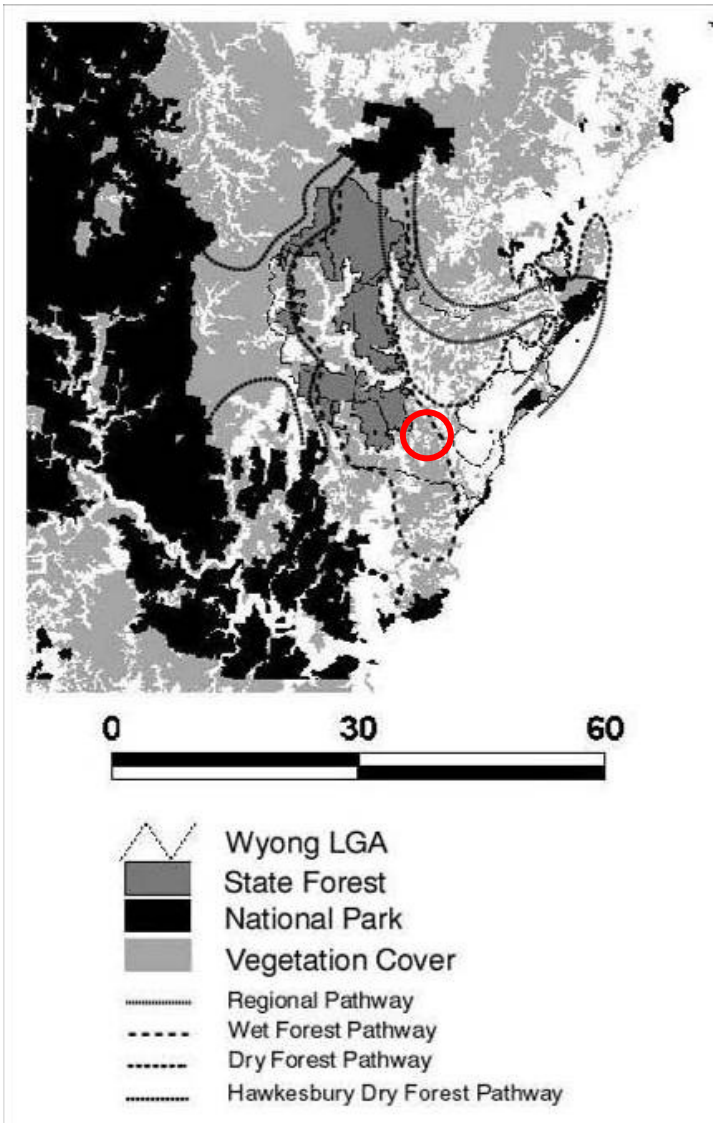
Austeco recommended that corridor design and management in this pathway focus on protection of existing fragments and restoration of corridor links between major fragments in the five broad regions (Figure 1). Austeco stated that there was a particular need to restore moist forest linkages across the Wyong River Valley Floor and to link moist foothill forests with remnant moist Gully Forests and riparian forests and at regular intervals along the major

river valleys. Austeco also considered two target fauna species including the greater glider and Yellow Bellied Glider by used as focus species for Wet Forest Pathways.

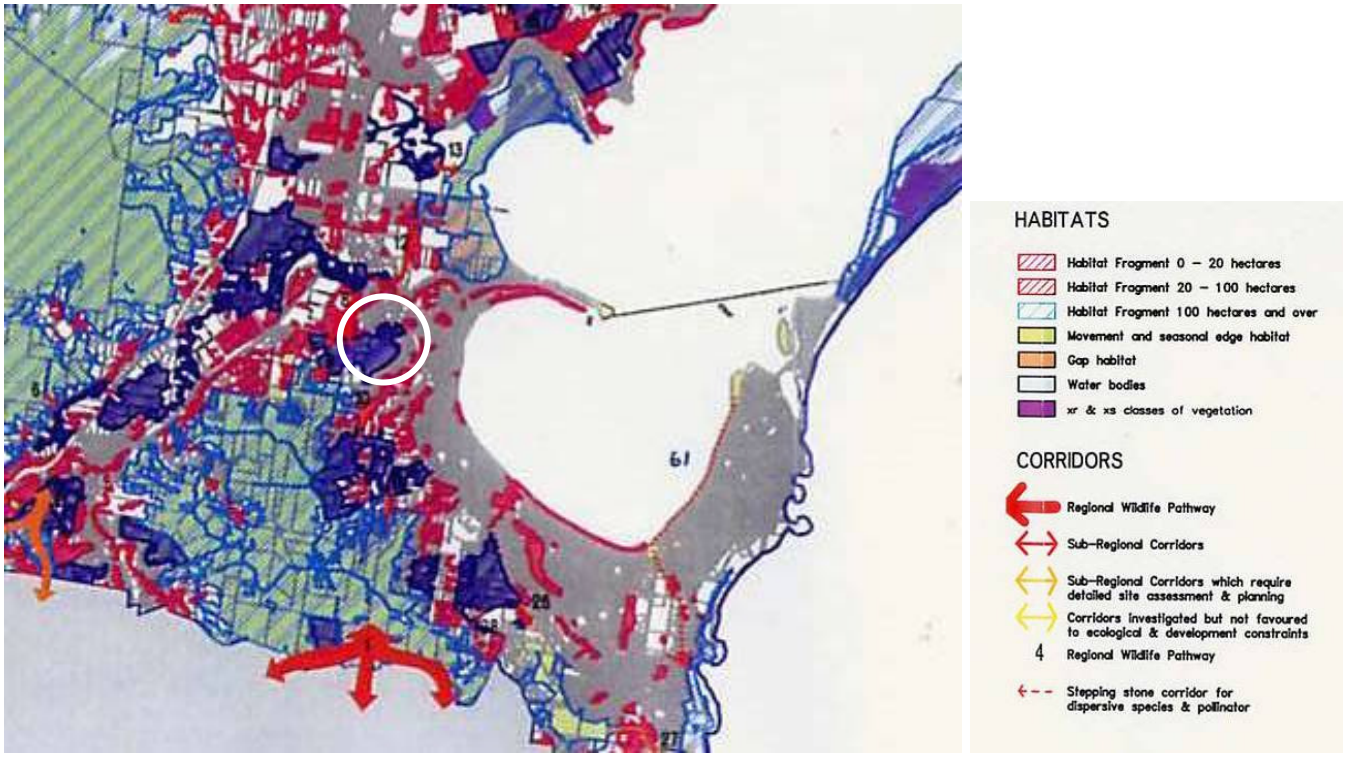
Robert Payne (2002) identified the site as remnant vegetation that forms part of an existing vegetation that is connected by subregional corridors across the Wyong Valley Floor. Subregional Corridor (WS8) occurs on the floodplains on the lower reaches of Ourimbah Creek which supports breeding habitat for many amphibian species, habitat for several threatened species and EEC's (insert 2).

Subregional Corridor 10 to the south is separated by existing urban area the South of Bundeena Road but is vegetatively connected to the site further to the south west.

DECCW identified that the site is mapped as a regional corridor covering approximately 33ha (60% of the subject site) was covered as part of a regional corridor (refer to Insert 3). The corridor runs north-south through the site, having a width of 800-1000m.



Insert 1 – Wet forest pathway as mapped by Austeco 2002, showing wet sclerophyll forest habitat to be connected and suggested corridor locations. (Source: Austeco 2002 – figure 7.2)



Insert 2 – Habitat Fragments Map
(Source: Extracted from Robert Payne, 2002, Corridors and Fragments Map)

Insert 3 – Regional Corridor mapping as sourced from DECCW – GIS Unit

A technical explanation of the mapped corridors was not supplied with the mapping and consequently the function of the corridor, the target species under consideration and how it is intended to be implemented is not known. However the mapped corridor appears to ignore private land ownership and or existing development. For example, a fauna corridor exists along the densely populated areas of the coastline e.g. through the suburbs of Long Jetty and The Entrance. It must be assumed that the regional mapping is indicative of a regional strategy but the location and dimensions of the proposed corridor has not been fully evaluated.

Existing Habitat Connectivity

In accordance with the *Biobanking Methodology and Credit Calculator Operational Manual*, vegetation transects and quadrats have been undertaken for the purposes of assessing the Site Value of vegetation to be retained and removed for the purposes of Biobanking if required.

In terms of evaluating habitat connectivity it is intended that 'Connectivity' will be assessed in accordance with Section 3.7.3 of the *Biobanking Methodology and Credit Calculator Operations Manual.*

The existing linkages to surrounding vegetation parcels is illustrated below in Insert 4. The most limited portions of the available linkages occur offsite. The site is connected offsite to the south and west through four linkages varying between 50 and 300 m in width. To the east the site is connected to adjoining vegetated areas by 1 link approximately 100m in width. The north the site is connected offsite by one link which splits into two with an approximate width of 30-50 m in width as it nears Ourimbah Creek.

On a local scale, approximately 39.23ha of naturally occurring forest and woodland habitats occur within the study area (53.38ha). This is connected to approximately 5.0ha of Blackbutt Open Forest located to the north-east of the study area which terminates for terrestrial species at the four (4) lane wide Wyong Road approximately 300m further east. Connectivity continues in fragmented areas beyond this road only for avian species. The subject site provides the only thoroughfare for fauna species utilising this minor corridor.

In remaining aspects the subject site is directly connected to an estimated 43ha of bushland to the west (bound by Berkeley Road and Enterprise Drive) and 475ha of bushland to the south-west of Berkeley Road as far south as the transmission line crossing between Peach Orchard Road and the vertex of Brush and Anderson Roads. Further partially fragmented connectivity continues to the south and south-west.

To the immediate north of Enterprise Drive the bushland is fragmented by several roads which service the industrial area. Ourimbah Creek approximately 500m north of Enterprise Drive has extensive connectivity along the creek embankments to the east and west, but the industrial subdivision between Enterprise Drive and Ourimbah Creek fragments the connectivity making it less viable for particular terrestrial species.

Ambrose (2007) postured that on a regional perspective the main wildlife corridor is formed by Ourimbah and Strickland State Forests and Brisbane Water National Park, west of the main Northern Railway Line. The subject site is at the north-eastern end of a parcel of bushland that links up with this regional corridor, even though the link is severely fragmented and dissected by the busy 3-4 lane Enterprise Drive and a new industrial park north of this road. This parcel of bushland extends south of Berkeley Road and links up with extensive areas of bushland to the south of this road and east of the main Northern Railway Line.

Insert 4 – Local Connectivity

Wildlife Corridors

Wildlife corridors are used to ensure wildlife can move between vegetation parcels that contain habitat characteristics suitable for different taxa. Wildlife requires dispersal and mating opportunities and for some wildlife movement opportunity is quite small as they are territorial whilst others are more opportunistic and migrate over larger areas.

Where wildlife numbers and diversity are in large quantities and require movement to and from large areas then a suitable large regional corridor linkage should be provided. Likewise if a small quantity of wildlife is present then that aggregation of wildlife can operate within a suitably reduced local corridor linkage.

The *Department of Conservation and Climate Change* have published advice (*Biobanking Methodology and Credit Calculator Operational Manual)* in respect of corridor widths (linkages) and have developed a series of categories. These being 0-5 metres, 5-30m, 30-100m, 100-500m and >500m.

The application of these classes allows a perspective relative to wildlife movement. For example the lowest class is relative to local wildlife traffic whilst the largest class relates to macro ecological system movement and genetic diversity continuance.

Ambrose (2007) advised that 'wildlife corridors allow movement of flora and fauna between patches of wildlife habitat (*Soule & Gilpin 1991*). The preservation or establishment of corridors to link habitats has been proposed as a practical conservation measure to ameliorate habitat loss and fragmentation effects (*Bennett 1990*). They also reported that it is essential for a corridor to have the following characteristics if they are to be effective:

- Vegetated corridors that comprise a mosaic of different habitats are considered more likely to contain the necessary food, shelter and nesting resources for fauna. Therefore, corridors that link patches over the entire ecological gradient from ridge to gully would conserve more species, especially those that have large home ranges and changing seasonal requirements (*Lindenmayer et al. 1994*).

- The quality of the habitat within the corridor is important. Some fauna would reluctantly utilise corridors of low quality, such as areas invaded by weeds or subject to frequent fires, or due to a reduction in the availability of essential resources (such as feeding, shelter, roosting and breeding sites).

- The size of the corridor is also important. For example, corridors with mature trees, but with little or no understorey may afford good habitat for birds, bats and some arboreal fauna but not for ground-dwelling fauna.

Ambrose further enunciated that the corridors that are 200 or more metres in width tend to facilitate the movement of all fauna by providing at least some core interior habitat that is not affected by edge environments (*Lindenmayer 1994*).

Corridors between 80-200 m width tend to be effective at moving many fauna, including some fauna that do not tolerate urban disturbance and fragmentation (such as Sugar Gliders and some forest-dependent birds) (Bennett 1990, Saunders & de Rebeira 1991, Catterall et al. 1991, Bentley & Catterall 1997).

Corridors less than 30m in width tend to be effective only for servicing the most tolerant of urban fauna (for instance, brushtail possums, bush rats, common urban birds, and fauna habitat generalists) (Bentley 1990, Lindenmayer 1994, Catterall *et al*. 1991, Bentley & Catterall 1998).

Ambrose also quoted the work of *Catterall el al*. (1991) 'who found that gaps greater than 15m in width represent a significant barrier to the movement of forest dependent birds. Barnett (1978) found that a small mammal's ability to cross an unvegetated gap was inversely proportional to the size of the gap. Lynch & Saunders (1991) found that the existence of a well-developed understorey was the single most important vegetation-related factor in corridor use by small bushland birds (*Sewell & Catterall 1998*)'.

In respect to the subject site and future rezoning, the width of corridors required to maintain connectivity to adjacent habitats should be selected on the following merits:

- Threatened species – The higher quality areas of each of the natural vegetation communities present within the subject site as well as any riparian/drainage channels should be represented within proposed corridor(s). Corridors containing forest and woodland representations provide foraging lines for hollow-dependent and non-hollow dependent threatened fauna species.

- Connectivity to adjacent remnant – any neighbouring remnant habitats should retain connectivity such that isolation of remnants does not occur. The selection of corridor width to these remnants is dependent on the size of remnant, their connectivity to further extensive areas of habitat, and likely threatened species habitat present within remnants.

- Ecosystem variation – Corridors should allow adequate representation of each of the naturally occurring vegetation communities present within the subject site and permit adequate connectivity to any additional nearby communities.

4.16 SEPP 14

State Environmental Planning Policy No 14 – Coastal Wetlands (SEPP 14) is designed to protect wetlands from ad hoc clearing, draining, filling and levee construction. Where a development is proposed to involve clearing, draining, filling or the construction of a levee, preparation of an environmental impact statement is required to be approved by the local Council and the *Department of Planning*.

This wetland is mapped by Wyong Council's DCP 30 as being located immediately to the north-west of Lot 2 DP 1100181, however approximately 0.1ha of the wetland occurs within this lot.

Development proposals as a result of rezoning will need to acknowledge the existence of the nearby SEPP 14 wetland and adhere to any DCP 30 requirements.

The adjoining *SEPP 14 Wetland* and *endangered ecological community* (Swamp Sclerophyll Forest on Coastal Floodplains) are required to be protected from *damaging and or harmful* impacts of a direct or an indirect nature. These impacts can take the form of;

- Environmental impacts from soil erosion, reduced vegetation, changes in soil acidity and exposure to increased fire frequency.

- Biodiversity impacts from reduced vegetation, simplified forest resources and recurrent ecological threshold imbalance (e.g. fire, flood, erosion, genetic diversity).

Specifically the most significant impact cause to the water body of the wetland can include;

- Impact on water quality and quantity at all stages of development
- Impact on the interactions between groundwater and surface water within the catchment
- Impact of increased storm water runoff due to increased impervious surfaces
- Impact from pollutants within groundwater and storm water runoff and changes in hydrological flows
- Impacts upon the peripheral endangered ecological community from pollutants within groundwater and storm water runoff and changes in hydrological flows.

These matters can be mitigated by;

- Maintaining the water quality within the wetland
- Minimising changes to surface drainage patterns
- Maintaining or potentially improving water quality.

Strategies that can be implemented include;

- Preparation and implementation of a storm water and groundwater management plan
- Implementation of a storm water treatment train, which may include gross pollutant traps, bio-retention swales, vegetated buffer zones and rainwater tanks and other sensitive urban design features
- Use of short term silt barriers to trap sediment during the construction phase
- Use of locally occurring native vegetation
- Buffer to the EEC and SEPP 14 Wetland (for example that shown on Figure 5).

A stormwater quality and quantity model prepared by *Worley Parsons* is to be set to model the stormwater treatment requirements for sensitive ecosystems i.e. fully vegetated natural catchment conditions. This is the highest possible standard.

Worley Parsons advise the proposed basin sizes and hence storage capacity can accommodate a minimum of 1 in 5 year for pipe drainage and a maximum of 1 in 20 year ARI for catchment drainage. The basins are currently estimated to be a maximum depth of 1.5m which allows the establishment of aquatic macrophyte wetlands in the stormwater basins.

To enable an assessment of downstream impacts on the SEPP14 Wetland a series of diagrams to demonstrate peak flow discharge behaviour pre and post urban development is required to support the case that the SEPP14 wetland will not be significantly affected by change in catchment flows. These are a series of peak flow charts (quantity vs. time) showing any change in peak flow behaviour at the 1 in 2, 1 in 5, 1 in 20, and 1 in 100 year ARI storm events. It is expected that these diagrams will show negligible difference in pre and post development conditions as a result of the proposed stormwater detention measures. This is conclusion is subject to finalisation of the road/concept super lot design for the site.

Water quality output tables are required to show the pre and post discharges of key water quality parameters. The water quality modelling needs to show no net change in base catchment flows i.e. subsurface groundwater discharge to the Wetland, as well as mid-range and peak flow discharges from the catchment.

5 THREATENED SPECIES & EEC CONSTRAINTS

5.1 Summary of threatened fauna species recorded

5.1.1 Powerful Owl (Ninox strenua)

The Powerful Owl breeds in open or closed sclerophyll forests and woodlands, including wet sclerophyll forest and dry sclerophyll forest and woodlands. They nest in hollows in large old trees; usually living Eucalyptus, within or below canopy in stumps or broken-off trunks. (Higgins 1999). Powerful Owls are sedentary within home ranges of about 1,000 hectares within open eucalypt, casuarina or Callitris pine forest and woodlands, though they often roost in denser vegetation, including rainforest or exotic pine plantations (Garnett & Crowley 2000). Powerful Owls feed mainly on those medium-sized species of arboreal marsupials that are most readily available at any given locality (Lavazanian et.al. 1994).

The Powerful Owl inhabits mature rainforest and wet and dry eucalypt forest. Optimal habitat includes a tall shrub layer and abundant hollows supporting high densities of arboreal mammals. Roosting is generally within dense foliage of mid-canopy trees in sheltered gullies. Large trees with hollows at least 45cm in diameter and 100cm deep are required for nesting. Mated pairs of Powerful Owl roost together or separately, maintaining several roost sites throughout their territory, which are used in rotation (Lindsey 1992), and shifting with the availability of prey. A pair is generally faithful to a traditional nesting hollow. Powerful Owls form pairs for life, and are strongly territorial. Estimates of the home range of this species vary greatly, but territories are known to range from 800-1500 hectares (Kavanagh 1997).

It is considered that the subject site provides suitable foraging, roosting and nesting habitat for the Powerful Owl. 'Maintain or Improve' calculations indicate that there will be an approximate 25.488 ha reduction in suitable habitat for this species within the subject site as a result of the current proposed rezoning proposal (see Table 6.1).

This species was recorded responding to call-playback during surveys undertaken by *Travers bushfire & ecology* on the 16th March 2009. An individual flew into the call playback station situated in the eastern portions of the subject site. An area of whitewash was found during these surveys near to the call-playback site but was not conclusively identified as Powerful Owl as it was not located below a typical roosting tree but rather a high perch.

Powerful Owl prey species recorded during survey include the Common Ringtail Possum, Sugar Glider, Grey-headed Flying-fox, Common Brushtail Possum and to a lesser extent large diurnal birds. These species were all recorded within the proposed conservation areas outlined in Figure 5 and/or outside of the subject site in the nearby locality. Development for rezoning will remove habitat for each of these species but will not likely put any pressures on local presence.

Recent 2010 surveys were undertaken in May and June both leading into and during the strict winter nesting period for this species. This species is highly susceptible to nest disturbance (DEC 2006) and consideration to nesting should be made during survey (WSC

1999 & DEC 2004). Therefore, call-playback techniques during recent June survey was not undertaken until all hollows considered most suitable for nesting were stag-watched.

Five (5) large hollow-bearing trees were stag-watched including trees numbered 73, 89, 95, 96 and 97 (as shown on Figure 3). Whilst other large trees were identified for potential use these five trees, particularly No. 89 were considered most suitable.

An approach to listen for males calling to defend the nesting territory was the main focus for the three consecutive nights of June survey. Call-playback was only employed for the final night of survey, at a volume limited to the subject site area. No Powerful Owls were observed or heard during the recent 2010 surveys which included at total of five nights of survey following dusk.

According to owl expert John Young, the White-bellied Sea Eagle whitewash is similar to that of Powerful Owl. Whitewash from a large raptor or owl (or both) was observed at five (5) locations within the subject site. It was considered possible that the whitewash belonged to Powerful Owl at two locations given this species previous recording and characteristics of the two trees typical for diurnal roosting. Whitewash at the most eastern location was below a large Turpentine (*Syncarpia glomulifera*) and the far western location was below a large Pine (*Pinus elliottii*) (see Figure 3 for all whitewash locations).

The other three (3) whitewash locations were also located near to the two already mentioned. The three other locations were below high perch branches considered suitable as an outlook for both species. Powerful Owl may utilise such a high perch during nocturnal foraging.

Whilst the whitewash observed overall may have been a combination of both species, it should be noted that all points were in tall trees located around the fringes of the wetland area. As White-bellied Sea Eagle was recorded by Council perching further upslope it was also considered likely that all whitewash belonged to White-bellied Sea Eagle making use of all prominent outlook points proximate to the wetland.

A focused search of signs of further activity surrounding large hollows near to all whitewash locations was undertaken. In addition to this all trees identified as providing suitable hollows for Powerful Owl were rubbed at the base with a plastic weave bag. This method has been described by owl expert John Young as a good technique to encourage the emergence of any residing female.

No whitewash locations showed any further conclusive evidence of being Powerful Owl such as pellets or other prey remains.

At this time it was considered that Powerful Owl was not utilising the subject site for nesting. It was thought that roosting and foraging may be taking place within the subject site by the local male recorded during 2009 surveys to support nesting elsewhere. It should be noted that call-playback may call-in an owl from outside of its typical home range. Suitable and higher quality habitat for this species in the form of gully forests extends to connective areas to the west and south.

As the source of whitewash could not be accurately determined and the nesting location for the Powerful Owl recorded in 2009 was not located (whether within or outside of the subject site), it was considered necessary to further pursue this issue for a more accurate assessment.

Owl expert John Young was engaged to visit the site from the 10–13th August 2010. This was still within the fledgling period and suitable to determine any local nesting activity.

John Young specifically identified trees 29, 73 & 89 as being suitable and ruling out a number of others previously identified as suitable with a precautionary approach.

Mr Young found no evidence of Powerful Owl activity within the subject site and recorded activity within Pleasant Valley, Fountaindale located approximately 1.4km to the south-west.

Mr Young considers that the recording of Powerful Owl during 2009 surveys was an individual that was called in from these areas located outside of the subject site. A copy of John Young's report is provided in Appendix 2. In summary, there are now no considered constraints within the subject site in respect to this species.

5.1.2 Grey-headed Flying-fox (Pteropus poliocephalus)

Grey-Headed Flying-foxes are canopy feeding frugivores and nectarvores, inhabiting a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas. This species roosts in camps, which may contain tens of thousands of individuals.

Camps are commonly formed in gullies, typically not far from water and usually in vegetation with a dense canopy (Tidemann 1998). Camps can be found in riparian rainforest patches, Melaleuca stands, mangroves, riparian woodland or modified vegetation in urban areas. Loyalty to a site is high and some camps in NSW have been used for over a century (NSW NPWS 2001). Some camps are used at the same time every year by hundreds of thousands of flying-foxes while others are used sporadically by a few hundred individuals (Strahan 1995). Generally foraging is within 20km of camps but individuals are known to commute up to 50km to a productive food source.

It is considered that the subject site provides suitable foraging and low potential roosting and subsequent low potential breeding habitat for the Grey-head Flying-fox. Suitable foraging habitat is present throughout the subject site where mature native flowering tree species occur. Low potential habitat for roosting camps is present within some areas of the Swamp Mahogany Woodland where dense vegetation fringe inundated areas as well as along the ephemeral drainage line located within focus area of owl investigation shown on Figure 5. 'Maintain or Improve' calculations indicate that there will be an approximate 24.891 ha reduction in suitable habitat for this species within the subject site as a result of the current proposed rezoning proposal (see Table 6.1).

There was no evidence of roosting activity within the subject site or nearby surrounds. Little Red Flying-foxes are sometimes recorded roosting with Grey-headed Flying-foxes. Two locations of Little Red Flying-fox have been found by *Travers bushfire & ecology* approximately 300m and 250m to the south-west and west of the western subject site boundary. Grey-headed Flying-fox are more loyal to larger and more permanent roosting locations and are unlikely to occur at these locations. The nearest roosting camps within the region are located at Wyoming, North Avoca and Matcham.

The Grey-headed Flying-fox was observed in flight over the subject site on different nights of recent May and June 2010 surveys. In May an individual was observed foraging at the dam located within Lot 22. In June, surveys were focused on areas closer to the Swamp Mahogany Woodland and areas surrounding the SEPP 14 wetland where Grey-headed Flying-fox were observed foraging on Swamp Mahogany at numerous locations extending up to and beyond Enterprise Drive to the north.

Swamp Mahogany is undoubtedly locally significant for this species. Swamp Mahogany will be well represented within the conserved Swamp Mahogany Woodland within the subject site and nearby locality. Other year round foraging resources will be conserved within the

EEC areas and EEC buffers depicted in Figure 5 as well as any other retained areas of native forest/woodland.

A proposal to rezoning within the subject site will remove areas of suitable foraging habitat for this species within all areas being cleared. Given the high mobility of this species, the absence of recorded roosting habitat and the representation of foraging habitat in the conserved areas and nearby locality, the rezoning proposal will unlikely result in a significant impact on a local population of the species.

5.1.3 East-coast Freetail Bat (Micronomus norfolkensis)

The East-coast Freetail Bat forages above the canopy of open forests and woodlands and in clearings at forest edges, feeding on small insects (Allison, Hoye & Law 2008). This species is thought to roost predominantly in tree hollows but also under loose bark and occasionally in houses and outbuildings (Allison, Hoye & Law 2008). Until recent findings of a roost within mangroves, all known natural roosts had occurred within hollow spouts of large mature eucalypts. The species is often found close to dams and waterholes. The East-coast Freetail Bat species will utilize paddock trees and isolated remnant vegetation when in proximity to larger forest remnants (Allison, Hoye & Law 2008).

This species was recorded during May-June 2010 surveys foraging along the outer fringe of the north-eastern portion as well as above the dam located central to the south-western portion of the subject site. The separation and locations of recordings are well within the subject site area. The call sequences at these locations showed definitive characteristics to conclude this species presence.

This species has recordings on Atlas representing presence at each kilometre extending out to 10km from the subject site in the last decade. However, recordings at each distance is limited to about 2, and therefore Atlas records cannot necessarily suggest any high representation in the locality.

This is a highly mobile species and local habitat would not be exclusive to the subject site. Hoy et. al (2008) suggest that despite a female recorded 6km from its roost, this species generally forages within a few kilometres of roosts. It would be expected that foraging would be restricted to areas closer to roosting locations during the colder months, which was around the period of all recent May-August surveys.

As Atlas data does not provide a high recorded presence in the locality, additional target survey effort was undertaken on the 25th & 26th August 2010 proximate to cleared and forest areas extending out to 2km from the subject site, in order to further determine local presence. During these surveys at six Anabat stations as well as mobile transects over two (2) consecutive nights, a high level of activity was recorded along Bundeena Road at the edge of the subject site as well as approximately 500m to the south.

It is considered that the subject site provides suitable foraging, roosting and breeding habitat for the East-coast Freetail Bat. In the experience of *Travers bushfire & ecology*, this species is more often recorded in the drier and more open areas of forest, woodland and nearby cleared landscapes. Hoy et. al (2008) also describe that most records are from dry eucalypt forest and woodland.

PhD student Anna McConvill from the University of Newcastle recently has undertaken a more formal and detailed analysis to investigate landscape habitat use by this species. She found that cleared and semi-cleared landscapes were found to have higher activity levels than urban or forested landscapes. Riparian sites were also found to have high activity levels.

Prior to McConvill's work, this species was known for its utilisation of paddock trees in disturbed landscapes where nearby forest and woodland habitats occur (Hoy et. al 2008). Hollow spouts which are preferred by the species are best represented within both the Blackbutt Open Forest and Swamp Mahogany Woodland communities.

An extensive study near Coffs Harbour found this species to be more active on upper slopes where flyways were large than along creeks (Hoy et. al 2008). Based on this, the Blackbutt Open Forest areas may be preferred over Swamp Mahogany Woodland.

The East-coast Freetail Bat was recorded foraging at four locations during recent surveys. Three of these locations were within or along the outer vegetated fringe of the subject site, with the remaining location being located 500m to the south. All recorded locations are made suitable due to previous forest disturbance/clearance with three of these locations being at the forest edge and one being over a constructed dam within a predominantly cleared landscape.

Whilst these are altered environments they provide what appears to be the more preferred open habitat for activity by this species.

'Maintain or Improve' calculations indicate that there will be an approximate 17.993 ha reduction of the existing 30.746 ha suitable habitat for this species within the subject site as a result of the current proposed rezoning proposal.

This is calculated considering that based on current knowledge the species is likely to forage throughout the full extent of the Grassland with Scattered Trees community and about 70% of disturbed woodland communities. The species is considered to utilise about 50% of the Blackbutt Open Forest and Swamp Mahogany Woodland communities based on activity recordings along the fringes of Blackbutt Open Forest and that these two communities provide almost the full extent of hollow resources within the site.

The current proposal will remove 9.26 ha of the existing Grassland with Scattered Trees community with only approximately 0.35 ha of this community retained for APZ's. 75% of Blackbutt Open Forest will be removed with approximately 4.69 ha of the remaining 7.295 ha portion being managed as APZ. APZ's are likely more suitable for foraging than open forest habitat however a reduction in available hollows within these areas could possibly occur. Approximately half of the existing disturbed woodland communities will remain as suitable areas for the species.

Available literature on this species and particularly recent findings by Anna McConvill also suggest that high activity levels are found close to dams, waterholes and riparian sites suggesting a level of dependence on open water habitat. One small dam is located within the Grassland with Scattered Trees community and a smaller dam is located in the far south-western corner of Lot 22. These dams provide the only open water habitat both within and in close proximity to the subject site. Field surveys included wading out into the SEPP 14 wetland area to the north which revealed that whilst this area is inundated at an average depth of 300mm, the density of *Melaleuca* throughout prevents any open water flyways for the larger microbats.

The East-coast Freetail Bat was recorded over the larger dam during survey. This dam will potentially be removed as part of the planning proposal. The planning proposal will alternatively rely on the provision of stormwater detention areas that will likely create additional open water foraging and drinking opportunity.

Current information on this species and survey records in the nearby locality suggest that there is potential that the subject site or other nearby forest/woodland/clearings provides important habitat for a local population. The recorded locations within the subject site and current species knowledge indicate that the Grassland with Scattered Trees, forest fringes and disturbed woodland communities are most appropriate for foraging activity. Hollows are minimal in these areas and therefore the significantly higher densities of hollows within the Blackbutt Open Forest and Swamp Mahogany Woodland may be utilised. Other roosting and activity areas in the locality may be present however an additional two (2) nights of survey in the nearby locality (out to 2km) has not recorded activity further than 500m from the site. Further survey is necessary in order to attempt to locate roosting locations and identifiy key foraging areas within the nearby locality.

5.1.4 Eastern Bentwing-bat (Miniopterus orianae oceanensis)

The Eastern Bentwing-bat forages above and below the canopy within open forests and woodlands, feeding on small flying insects, predominantly moths (Dwyer, 1995). The Eastern Bentwing-bat is known to roost in a range of habitats including stormwater channels, under bridges, occasionally in buildings, old mines and, in particular, caves (Dwyer, 1995). Caves are an important resource for this species, particularly for breeding where maternity caves must have suitable temperature, humidity and physical dimensions to permit breeding (Dwyer, 1995). Roost sites in tree hollows have not been reported within the literature reviewed.

The subject site provides suitable foraging habitat for the Eastern Bentwing-bat throughout. There is no suitable natural roosting and subsequent breeding habitat for this species present. Roosting habitat within artificial structures may be present but these were observed to be limited to existing residences and sheds located within the south-western portions of the subject site. 'Maintain or Improve' calculations indicate that there will be an approximate 26.172 ha reduction in suitable habitat for this species within the subject site as a result of the current proposed rezoning proposal (see Table 6.1).

This species was recorded foraging at five Anabat locations during 2010 surveys. All but one of these recordings was located at Anabat stations placed along forest edges subject to previous clearance. Three of these were also at the urban or industrial area interface to the site proximate to streetlights. Foraging along this interface is typical for the species. See Figure 3 for recorded locations.

This species has also been recorded previously within the subject site by *Conacher Travers* (2003) (see Figure 3 for location). The Atlas of NSW Wildlife Database (DECCW 2010) also provides nearby records of this species.

A proposal to rezone for development within the subject site will remove areas of suitable foraging habitat for this species particularly habitat that would support the life-cycle of prey species (predominantly moths and beetles) and forest edge structure. Given the high mobility, migration and foraging areas of this species such a proposal will unlikely result in a significant impact on a local population of the species.

5.1.5 Little Bentwing-bat (Miniopterus australis)

The Little Bentwing-bat forages below the canopy within open forests and woodlands, feeding on small insects (Dwyer, 1995). This species roosts in caves, tunnels, tree hollows and occasionally old buildings (Dwyer, 1995). Caves are an important resource for this species, particularly for breeding where maternity caves must have suitable temperature, humidity and physical dimensions to permit breeding (Dwyer, 1995). One record exists of

this species utilising a tree hollow however hollows are not currently considered as preferred habitat for this species (pers. com. Brad Law).

It is considered that the subject site provides suitable foraging habitat for the Little Bentwing-bat throughout and particularly within the forested and woodland areas. As with the similar Eastern Bentwing-bat, there is no available roosting habitat or in particular breeding habitat located within the subject site for this bat species. 'Maintain or Improve' calculations indicate that there will be an approximate 26.172 ha reduction in suitable habitat for this species within the subject site as a result of the current proposed rezoning proposal (see Table 6.1).

This species was recorded foraging at two Anabat locations during 2010 surveys. Both of these recordings were located at Anabat stations placed along forest edges at the urban interface proximate to streetlights. Foraging along this interface is typical for the species. See Figure 3 for recorded locations.

This species has also been recorded by *Travers environmental* in close proximity to the subject site across Berkeley Road to the south-west in 2007. The Atlas of NSW Wildlife Database (DECCW 2010) also provides three records of this species nearby to the south and west of the subject site in 2003, 2005 & 2006.

A proposal to rezone for development within the subject site will therefore remove areas of suitable foraging habitat for this species particularly habitat that would support the life-cycle of small insect prey items. Given the high mobility of this species as indicated by large seasonal migratory breeding movements and large foraging areas such a proposal will unlikely result in a significant impact on a local population of the species.

5.2 Summary of threatened fauna species previously recorded in close proximity

5.2.1 Wallum Froglet (Crinia tinnula)

The Wallum Froglet is mainly confined to acid paperbark swamps and "wallum" areas with poor drainage (Barker et al. 1995). This species is associated with melaleuca and wet heath (Robinson 2005, Cogger, 1996/2000) and also known from within sedge swamps (DECCW website). This species breeds in late winter and is restricted to coastal areas of southern Qld and NSW (Cogger, 2000).

The Wallum Froglet was recorded by *Andrews Neil* (1992) within the SEPP 14 wetland area located to the north of the subject site in 1997. Areas within and fringing the SEPP 14 wetland area support suitable habitat for this species.

Target survey by call-playback and nocturnal/diurnal call identification during or following rain both within and outside of the subject site was undertaken during recent 2010 surveys (see Figure 3 for call-playback locations). The species was not recorded during these target surveys however presence was recorded in the northern portions of the SEPP 14 wetland area on the 11th August 2010 during more recent field visits with John Young. The wetland provides consistent shallow depth and appropriate vegetation throughout with a number of fringing soaks and vegetated pockets suitable for breeding aggregations.

Subsequently, the Swamp Mahogany Woodland within the subject site may provide areas of breeding habitat but appears to more likely provide dispersal, shelter and foraging outside of breeding aggregations. Potential to disperse further and make valued use of habitat beyond this community is considered low. Therefore the retention of quality areas of Swamp Mahogany Woodland EEC and fringing buffers within the subject site will conserve all valuable habitats for this species. 'Maintain or Improve' calculations indicate that there will be an approximate improvement of 0.531 ha of suitable dispersal/shelter/foraging habitat for

this species within the subject site as a result of the current proposed rezoning proposal (see Table 6.1).

The retention of natural water quality and water quantity is an issue of consideration in regard to the SEPP 14 wetland and its resident fauna populations.

5.2.2 Glossy Black-Cockatoo (Calyptorhynchus lathami)

The Glossy Black-Cockatoo inhabits mountain forests, coastal woodland, open forest and trees bordering watercourses where there are substantial stands of *Allocasuarina*. They feed almost exclusively on the fruit of *Allocasuarina* species (Lindsey, 1992). They choose trees with larger cone crops but show no sign of selecting trees on the basis of cone size – concentrating foraging in trees with a high ratio of total seed weight to cone weight (Clout, 1989). They breed in hollow trees or stumps usually in Eucalypts.

Suitable foraging habitat for the Glossy Black-Cockatoo provided by mature seeding *Allocasuarina sp.* was observed within the Blackbutt Open Forest community as well as the Grassland with Scattered Trees and Disturbed Pine Forest communities. 'Maintain or Improve' calculations indicate that there will be an approximate 7.872 ha reduction in suitable habitat for this species within the subject site as a result of the current proposed rezoning proposal (see Table 6.1).

This species was not recorded during surveys within the subject site despite numerous days undertaking opportunistic recordings of birds and recent random searches for chewed cones throughout the above mentioned communities.

There are numerous records of the species within 10km of the subject site with one record located within 300m to the west in 2004; this is the only record within 2km.

Foraging habitat is well represented within the locality. Potential nesting habitat is provided within hollow-bearing trees providing dead broken spouts both within the Blackbutt Open Forest and Swamp Mahogany Woodland communities. The most notable tree observed to be suitable for nesting by this species was hollow-bearing tree HT62 located within the Disturbed Swamp Mahogany Woodland community (see Figure 3); however suitability is by no means limited to this tree alone with numerous broken trunk hollows providing dead large spouts observed throughout the communities mentioned above.

Suitable nesting, roosting and breeding habitat for this species will be removed as a result of a rezoning proposal within the subject site. Much of the areas providing mature seeding *Allocasuarinas* are located within the upper slopes of the Blackbutt Open Forest Community in the far eastern portion of the subject site which is most likely subject to development as a result of rezoning.

Given that this species has not been recorded during extensive survey time carried out within the subject site to date, there is unlikely to be a significant impact outcome on this species as a result of rezoning.

5.2.3 Little Lorikeet (Glossopsitta pusilla)

Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They are gregarious, usually foraging in small flocks, often with other species of lorikeet. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including Melaleucas and mistletoes.

There is no evidence of regular migration, but Little Lorikeets are generally considered to be nomadic (Higgins, 1999), with irregular large or small influxes of individuals occurring at any time of year, apparently related to food availability. Long term investigations indicate that breeding birds are resident from April to December, and even during their non-resident period, they may return to the nest area for short periods if there is some tree-flowering in the vicinity (Courtney & Debus, 2006).

Approximately 3cm diameter nest hollows are located mostly in living, smooth-barked eucalypts, and are kept open by the activities of the occupants, which use their beaks to bite away living bark from around the opening. When nest hollows are deserted, e.g. after storm-damage to trees, hollows can close over within 14 months (Courtney & Debus, 2006). Nest hollows are occasionally located in dead trees, but birds generally desert hollows within two years of tree death. Nest-hollows are used "traditionally", with the same hollow (not necessarily by the same individuals) (Courtney & Debus, 2006). The breeding season extends from May to September (Higgins, 1999) and, if eucalypt nectar and pollen are available throughout this period, two broods of fledglings can be raised in a season.

The major threats to Little Lorikeets are loss of breeding sites and food resources from ongoing land clearing. New nest hollows are not being recruited at a rate that compensates this loss. Traditional hollows, where found, subsequently require protection as removal of these have contributed to the species recent threatened listing.

Recent and previous survey within the subject site have been undertaken during periods when the species is most likely active close to nesting hollows. Despite this the species has not been recorded within the subject site but was recorded nearby to the south along Berkeley Road by *Conacher Travers* during adjacent surveys in 2006. This recording was in early December outside of the recognized breeding season and at the end of their resident period when the species is typically commencing nomadic movements.

Burls with small openings are often preferred to excavate for small hollows which need to be maintained from closing over. Smooth-barked Blackbutts generally don't provide such burls which are more commonly seen on more contorted growth trees such as Smooth-barked Apple. Whilst the areas likely subject to development as a result of rezoning do not provide what is expected as typical nesting resources, it should not be ruled out within the Blackbutt Open Forest community.

Rezoning will therefore result in the loss of what is considered suitable nesting habitat as well as suitable roosting hollows and foraging habitat. Foraging habitat is all areas of native forest and woodland communities present providing nectar producing resources. 'Maintain or Improve' calculations indicate that there will be an approximate 18.716 ha reduction in suitable habitat for this species within the subject site as a result of the current proposed rezoning proposal (see Table 6.1).

Significant impacts on this species can only result where the species has been recorded utilising hollows in small flocks within the subject site during the recognized nesting period, which has not been recorded during adequate survey effort to date.

5.2.4 Yellow-bellied Glider (Petaurus australis)

The Yellow-bellied Glider is an arboreal tree-dwelling mammal that utilises tall mature Eucalypt forests which contain high nectar producing species and hollow bearing trees (Russell 1988). The Yellow-bellied Glider is restricted to tall mature eucalypt forests found within high rainfall regions of temperate through to sub-tropical eastern Australia (Russell 1988).

The species is highly mobile travelling up to 2km in a night's foraging foray by gliding between trees generally 40 metres apart (whilst glides up to 140 metres have been recorded). Yellow-bellied Gliders occupy large exclusive home ranges between 30 and 65 hectares in size (Goldingay and Kavanagh, 1991). The species lives in family groups of two to six individuals (Goldingay, 2008).

The bulk of the diet of the Yellow-bellied Glider consists of plant and insect exudates including sap, nectar, honeydew and manna while arthropods and pollen are also eaten (Goldingay and Kavanagh, 1991). It uses its large lower incisor teeth to make distinctive cuts into a tree's trunk to feed on eucalypt sap. Only a small number of trees at a site are used in sap-feeding and their use is intermittent (Goldingay, 2008). Trees with such extensive scarring are known to have been used as sap trees for several decades, which is much longer than the 6-year lifespan of a glider (Goldingay, 2008).

This is the most vocal of Australian mammals with distinctive call heard up to 500 metres away. The typical 'moan' and 'gurgle' calls are only emitted during gliding, used during more than 80 per cent of glides (Goldingay, 1994).

It is considered that the subject site provides suitable habitat for the yellow bellied glider. 'Maintain or Improve' calculations indicate that there will be an approximate 5.991 ha reduction in suitable habitat for this species within the subject site as a result of the current proposed rezoning proposal (see Table 6.1). Having said this suitable habitat is restricted to the Blackbutt Open Forest which has been subject to previous logging resulting in lower than typical hollow tree densities and non-preferred sap producing trees. Given also the relative isolation of the suitable eastern areas of habitat the subject site is generally considered sub-optimal for the Yellow-bellied Glider.

This species has been previously recorded within neighbouring lands to the west by *Travers environmental consultants* (2007). During these surveys, the species was recorded emerging from habitats further up gully forest areas on the other side of Berkeley Road to the south and foraging on lower areas of forest. On one occasion the species was heard on the northern side of Berkeley Road considered to be en-route to flowering Swamp Mahogany at the time.

More recent site surveys with John Young concentrated night survey on the ridge to the south-west of Berkeley Road above where the species was recorded in 2007. On this occasion Yellow-bellied Glider was heard by John Young emerging from a den tree. Diurnal inspection revealed that the *Angophora costata* den tree was also a sap tree indicated by high incisions. This vocal species would have given up its presence within the subject site following the amount of surveys undertaken to date.

Based on these previous observations it is considered that the local activity of Yellow-bellied Glider is limited to habitats that occur to the west and south of the subject site and utilisation of the subject site itself is unlikely. The urban interface along the southern limits of the subject site, and disturbed forest communities within the western portions would limit any genuine connective options for the species to colonise the sub-optimal eastern habitats within the subject site.

5.2.5 Spotted-tailed Quoll (Dasyurus maculatus)

The southern subspecies of Spotted-tailed Quoll *D. m. maculatus* inhabits a range of treed habitats including rainforests, wet and dry sclerophyll forests, woodland and coastal heathland, scrub and dunes, swamp forest, mangroves, on beaches and sometimes in grassland or pastoral areas adjacent to forested areas (Belcher et al. 2008, Long & Nelson

2010). Relatively high densities of the species have been recorded from both wet and dry forest types.

Quolls favour areas with dense over storey and understorey and use hollow-bearing trees, hollow-tree buttresses, fallen logs, small caves, rock crevices, boulder fields, rocky-cliff faces and underground burrows as den sites for shelter / breeding (Long & Nelson 2010). Multiple dens are used and movement between these is every 1-4 days. It appears to prefer moist forest types and inland riparian habitat for movement. Despite its occurrence in inland riparian areas, it also ranges over dry ridges (NPWS 1999).

Female home ranges are generally non-overlapping and 88-1,515ha in size. Male home ranges are much larger, from 359-5512 ha in size, and overlap and encompass multiple female home ranges. The species is capable of covering large distances in a short period of time, with animals recorded at moving at least 8km in a day and 19 km in a week (Long & Nelson 2010). Habitat that is critical to the survival of the Spotted-tailed Quoll includes large patches of forest with adequate denning resources and relatively high densities of medium sized mammalian prey.

Of numerous threatening processes listed for this species, habitat loss and modification is probably the greatest threat (Long and Nelson 2010).

This species has been previously recorded on the Atlas database nearby to the north of the subject site and immediately west of the SEPP 14 wetland area in 2001. A discussion with a resident within Lot 511 revealed that approximately one year ago his chickens were taken. This is considered unlikely a fox as the predator was able to climb the pen and there was no remains found. Chicken is a recognized preferred prey item for this species.

It is considered that the subject site provides suitable foraging, denning and subsequent breeding habitat for the Spotted-tailed Quoll within the Blackbutt Open Forest, Swamp Mahogany Woodland and to a far lesser extent within the disturbed forest and woodland communities. 'Maintain or Improve' calculations indicate that there will be an approximate 21.527 ha reduction in suitable habitat for this species within the subject site as a result of the current proposed rezoning proposal (see Table 6.1).

The higher quality habitat areas for this species within the subject site is considered within the lower portions of Blackbutt Open Forest where a moister type understorey provides the more preferred dense terrestrial habitat with large hollow logs and access to a range of surrounding foraging opportunities. Given this suitability of habitat and a lack of previous targeted trapping effort, cage trapping effort was undertaken within this habitat area in the eastern portions of the subject site by *Travers bushfire & ecology* in March 2009. This trapping was at the periphery of a development proposal in this location at the time.

More recent survey continued extensive targeted trapping efforts for the species throughout the subject site. The species has not been recorded.

Due to the extensive home ranges of this species, and particularly males, the connective lands including the study area and other woodland / forest habitats confined by local roads is unlikely to confine an individual of this species. Given the absence during surveys, it is considered that this area may be utilised on occasion as part of extended foraging ranges but is not likely central to activity, an area of high use or an area providing overlapping home ranges. Given the nearby recording of the species and the extensive home ranges of this species, development as a result of rezoning is likely to result in further fragmentation of available habitat for the this species.

The lack of recordings of this species following sufficient survey effort to date would result in an assessment of no likely significant impact on the species.

5.2.6 Greater Broad-nosed Bat (Scoteanax rueppellii) and Eastern Falsistrelle (Falsistrellus tasmaniensis)

These two species are considered here together given their overlapping habitat preferences, similar roosting requirements and previous recordings.

The Greater Broad-nosed Bat inhabits a variety of habitats including moist gullies in mature coastal forest, rainforest, open woodland, *Melaleuca* swamp woodland, wet and dry sclerophyll forests, cleared paddocks with remnant trees and tree lined creeks in open areas (Churchill 2008). The Greater Broad-nosed Bat predominantly forages within open forest, woodlands, along vegetated creek lines and small river systems (Hoye and Richards, 1995). This species roost in tree hollows, cracks and fissures in trunks and dead branches, under exfoliating bark as well as the roof of old buildings (Churchill, 2008, Hoye & Richards, 1995).

The Eastern Falsistrelle inhabits warm to cool temperate moist and dry open forests (Strahan 1995) with a preference for wet high altitude forests and being less common on ridge-tops where fertility is low (Herr, Law & Phillips, 2008). It is one of the larger and less common forest bats, with wing morphology indicating it to be a highly mobile species with a large foraging range with recordings up to 12km from roosting sites (Law, Herr & Phillips, 2008) and home ranges up to 136ha (Churchill, 2008).

The Eastern Falsistrelle roosts mainly in tree hollows, occasionally utilising caves and abandoned buildings (Parnaby 1992; Phillips et al. 1985). Roosts in trees are generally in hollow trunks of eucalypt trees in colonies of 3 to 80 (Churchill, 2008). Cave roosting is recorded at Jenolan, NSW, with occasional roosts also recorded in old wooden structures (Churchill, 2008). Colonies are usually entirely male or female for reasons currently unknown.

Flight for both species is not very manoeuvrable and as such foraging takes places in open areas or along trails in forest environs. They hunt beetles but also moths and bugs.

These two hollow-dependent threatened bat species have not been recorded within the subject site to date. It should however be noted that current survey was not undertaken during warmer months recognized as the peak activity period for microchiropteran bats. Both of these species have been recorded within surveys undertaken on adjacent land to the immediate south and west of the study area by *Conacher Travers* (2001 and 2006) and *Travers Environmental Consultants* (2007). *Robert Payne Ecological Surveys and Management* (1998) also recorded both of these species within lands nearby to the north. The Atlas of NSW Wildlife database also provides other nearby records.

Given these recordings and the high foraging mobility of both of these large microbat species it is expected that foraging and possibly roosting/breeding habitat extends into the subject site and potential future development areas. Rezoning will therefore result in the loss of what is considered suitable roosting, foraging and breeding habitat for the Greater Broad-nosed Bat and Eastern Falsistrelle. 'Maintain or Improve' calculations indicate that there will be an approximate 26.172 ha reduction in suitable habitat for the Greater Broad-nosed Bat and an approximate 10.509 ha reduction in suitable habitat for the Eastern Falsistrelle as a result of the current proposed rezoning proposal (see Table 6.1).

It is very difficult to determine where microbat roosting and subsequent potential breeding hollows are located without costly surveys incorporating radio-tracking of captured individuals.

Although a determination on significance cannot be otherwise accurately determined, the assessment for hollow-dependent bat species is often based on the availability of suitable hollows outside of likely development areas within the nearby locality. In conclusion to this, there are a number of available hollows for the Greater Broad-nosed Bat and Eastern Falsistrelle within the conservation areas outlined in Figure 5 and the nearby locality. This should be sufficient in the absence of recordings within the subject site. Otherwise the survey suggested for the East-coast Freetail Bat above would apply to these species also.

5.3 Summary of nationally listed protected migratory fauna species recorded

5.3.1 The White-bellied Sea Eagle (*Haliaeetus leucogaster)*

White-bellied Sea-Eagles are most common in coastal and near coastal areas of Australia but may also be seen well inland. They also occur in New Guinea, Indonesia, China, south-east Asia and India. They are normally seen perched high in a tree, or soaring over waterways and adjacent land. Birds form permanent pairs that inhabit territories throughout the year.

The White-bellied Sea-Eagle feeds mainly off aquatic animals, such as fish, turtles and sea snakes, but it takes birds and mammals as well. It is a skilled hunter, and will attack prey up to the size of a swan. Sea-Eagles also feed on carrion (dead prey) such as sheep and fish along the waterline. They harass smaller birds, forcing them to drop any food that they are carrying. Sea-Eagles feed alone, in pairs or in family groups.

White-bellied Sea-Eagles build a large stick nest, which is used for many seasons in succession. The nest can be located in the tallest tree up to 30m above the ground, but may also be placed on the ground or on rocks, where there are no suitable trees. At the start of the breeding season, the nest is lined with fresh green leaves and twigs. The female carries out most of the incubation of the white eggs, but the male performs this duty from time to time.

The White-bellied Sea Eagle was recorded on most days during recent 2010 surveys. Recordings were made of a local pair from sightings and calling in flight, from observations at two perch trees and most often calling from distant perches to the north of the SEPP 14 wetland (possibly from the two perches where observed).

In flight the species was heard and seen in locations over the subject site. All low flight observations were central to the SEPP 14 wetland located to the north of the subject site. An observation was also made of the pair calling together high in flight. The species was seen perching twice, both locations to the north of the SEPP 14 wetland on prominent outlook dead trees. On this side of the wetland the surrounding trees are low in height and the dead perches emerge in height beyond the canopy. Figure 3 provides locations where the species was observed low in flight and perching.

The White-bellied Sea Eagle was not observed perching within the subject site during surveys; however Council has observed the species recently roosting in a tree located within the Blackbutt Open Forest community in the eastern portions of the site. This perching was likely within HT43 given the noted location on map and the prominent height of this tree as an outlook typical to the species (see Figure 3 for location).

Despite regular vocalisations and behaviour suggesting the species is in courtship leading up to breeding no nest was observed. Searches for nesting within the subject site itself were thorough. Given the size of nests constructed it was unlikely that a nest from this species was missed. An abandoned raptor nest too small and situated on a lower branch of a

Blackbutt within the eastern portions of the site was not consistent with the species (see Figure 3 for location).

As most calling from perches was located to the north of the SEPP 14 wetland nesting from this area was expected however could not be located. This species has only been recorded during recent 2010 surveys and not surveys undertaken only 1 to 2 years ago, so it was considered possible that the local pair was only recently taking up residence and courtship had not led into nest construction.

White-bellied Sea Eagle whitewash is similar to that of Powerful Owl. Whitewash from a large raptor or owl was observed at five locations within the subject site. It was considered that the whitewash belonged to Powerful Owl at two locations given this species previous recording and characteristics of the two trees typical for diurnal roosting.

The three other locations were below high perch branches considered suitable as an outlook for both species. Whilst the whitewash observed overall may have been a combination of both species, it should be noted that all points were in tall trees located around the fringes of the wetland area. As White-bellied Sea Eagle was recorded by Council perching further upslope it was considered likely that all whitewash belonged to White-bellied Sea Eagle making use of all prominent outlook points proximate to the wetland.

Although this species has a very large and overlapping foraging range of approximately 150km, the nesting area is well defended from other pairs. Given the level of activity recorded surrounding and particularly to the north of the SEPP 14 wetland it is considered that this area and the immediate locality provide an important central point to the activity of the local pair. Observations and frequent calling also suggest this pair is in courtship and nesting is likely to occur if not currently underway.

Nesting usually takes place near to suitable foraging areas. It is interesting to note that an effort to walk deep within the central inundated SEPP 14 wetland area during survey revealed no presence of open water areas suitable for foraging. The nearby Ourimbah Creek further north and more so Tuggerah Lakes further east are the most suitable nearby open water foraging habitats.

Owl expert John Young was engaged for additional Powerful Owl surveys. John is a highly experienced ornithologist and was asked also to assist in locating the White-bellied Sea Eagle nest and provide advice on site dependence.

During the site visit the White-bellied Sea Eagle nest was located approximately 87m to the north of the north-western site boundary. Mr Young undertook a site inspection of habitat, perches and whitewash indicating that all large areas of wash previously found were from the Sea Eagles and not from Powerful Owl.

A copy of John Young's report is provided in Appendix 2 and results shown on Figure 4. In summary Mr Young has advised the following conservation measures should be undertaken to protect White-bellied Sea Eagle nesting behaviour in the locality:

- A 60m wide corridor along the north-eastern site boundary;
- A 25m natural vegetation buffer along the eastern Blackbutt Open Forest fringe to the Swamp Mahogany Woodland.
- Protection of two important roost trees (a Turpentine and a Spotted Gum) with a 15m buffer around the Turpentine given the large degree of whitewash suggesting continued use; and a 5 metre buffer around the Spotted Gum.

An aerial analysis of the subject site itself reveals that there is a sudden height increase to taller forest along the eastern fringe of the SEPP 14 wetland which would, as a whole, provide perching values. This area will be conserved within the 25m natural vegetation buffer identified by John Young.

Assessment Conclusion

Rezoning will protect the Swamp Mahogany Woodland surrounding the wetland area as well as a continuation of a 25m buffer in all other surrounds. This combined with John Young's advice will protect a number of high outlook perching opportunities around the wetland.

The EPBC Act Policy Statement 1.1 – Significant Impact Guidelines, where relevant, states that 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, destroy or isolate an area of important habitat. Where relevant, an area of "important habitat" is defined as habitat that is of critical importance to the species at particular life-cycle stages.

Proposed development as a result of rezoning will remove other recorded perch trees (evident by small areas of whitewash) utilised for current roosting. These perches, whilst located nearby a likely nesting area, are not considered as important habitat as they are not likely critical to breeding activity. Given the retention of major perches and the availability of remaining areas of habitat for perching this habitat removal would not be regarded as having a significant impact on the species under the EPBC *Significant Impact Guidelines*.

5.4 Summary of threatened flora species recorded

5.4.1 Melaleuca biconvexa

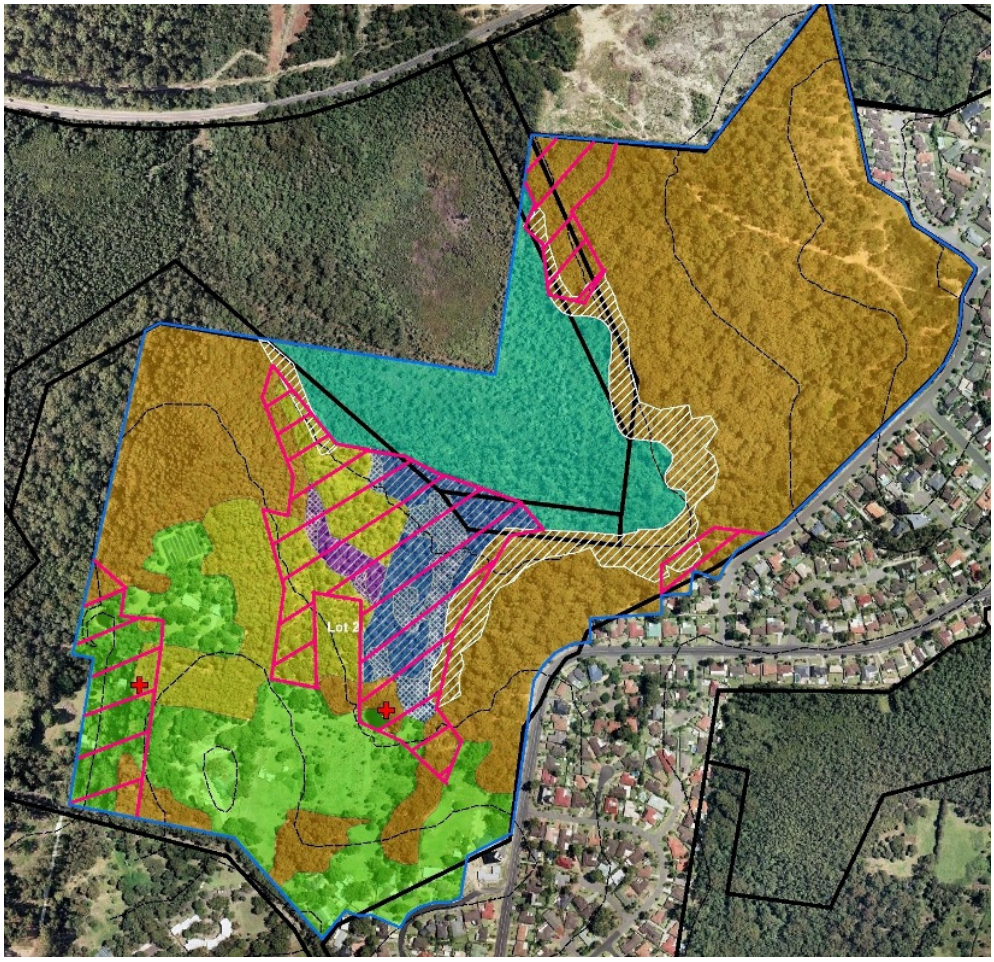
This species is listed as vulnerable under both the TSC Act (1995) and the EPBC Act (1999). *Melaleuca biconvexa* is a shrub or small tree usually up to 10m tall and less frequently up to 20m which occurs as dense stands along watercourses or as understorey in wet forests. It occurs from Jervis Bay to Port Macquarie with most populations in the Gosford / Wyong area. The species occurs in damp places, often on alluvial soil types of low slopes or sheltered aspects.

Previous observations of this species indicate that it is common in dense bushland on the banks of creeks which occur in the Terrigal formation geological unit. It frequently occurs in wetlands associated with the above creeks and in sheltered forest.

Harden (1991) advises that the species flowers in summer whilst the conservation advice provided by the then DEC (2008) notes the flowering period to be September to October. Estimations of the population size are difficult as multiple stems may arise from singular rootstocks.

The species does not often occur in the middle of undisturbed vegetation units but more so at the edge of a vegetation unit that may be partially disturbed and usually in clumps rather than being individuals. As such, the moist soil areas areas within the Grassland with Scattered Trees vegetation community adjoining remnant vegetation appear suitable, as does the Disturbed Swamp Mahogany Open Woodland, Disturbed Apple/Mahogany Woodland and possibly the edge of the Blackbutt Open Forest which shows some disturbance and immediately adjacent to an alluvial soil. The Disturbed Pine Forest provides no potential habitat within pure stands but may provide limited suitability where there is a mix of native species and pine trees in the canopy.

Insert 5 shows the more ideal areas in which the *Melaleuca biconvexa* may be located, indicating that approximately 10.42 ha of suitable habitat exists. Post development the suitable habitat area will reduce to approximately 3.56 ha. A portion of the habitat will be conserved within the EEC buffer and the wildlife corridor (60m wide) which occurs in the north-eastern corner of the subject site. A small portion of suitable habitat will also be able to be retained within asset protection zones in a managed context.



Insert 5 – Shows the most likely potential habitat areas for Melaleuca biconvexa for which the maintain or improve calculations were based on.

Typical threats to the species are;

- alterations to flow regimes and water tables
- too frequent fire
- grazing and trampling by stock.

Many populations occur on private land however there are known and conserved populations on the Central Coast including Bouddi NP in the Gosford LGA and Wyrrabalong NP in the Wyong LGA.

The onsite population occurs in a small concentrated area beside the existing dam within Lot 2 DP 1100181 as shown on Insert 6. There is a second smaller and more disturbed patch along an existing driveway adjacent to a residence in the south-west corner of the study area.

Insert 6 – Approximate location of the Melaleuca biconvexa specimens in relation to Bundeena Road.

The specimens are lower in elevation to the dam adjacent as there is a lip on the lower (north-eastern) side and a small depression which would catch excess water runoff or overflow from the dam. It is the small trough area in which the specimens were found. The vegetation immediately surrounding this clump is quite disturbed or cleared. Surrounding canopy trees are Blackbutts which occur on the lip of the dam and then Swamp Mahoganies to the immediately north. The clump is approximately 150m from Bundeena Road.

The smaller second patch occurs along an existing driveway in the far south-west corner of the study area. This patch is isolated and has limited chance of natural expansion given the existing residences and a weedy understorey surrounding.

There are numerous clumps within the local area as shown on Insert 7 from the Atlas of NSW Wildlife database (2010) and most of the optimal habitat areas for this species within the study area will be retained as it is within an EEC and unlikely to be developed. Within Section 4 of this report this population was we arrived at the conclusion that the clump does not constitute an *important population.*

Any removal of any *Melaleuca biconvexa* is not ideal but given there are numerous local populations (shown as Insert 7, Section 5), the species is not at its geographical limit and the majority of suitable habitat for this species shall be in a proposed conservation zone, the loss is not likely to be significant.

It should be noted that the Atlas of NSW Wildlife database does not contain every location of threatened species ever found. We can confirm local occurrences along Berkeley Road just to the south-west of the study area and across the road from Berkeley Vale High School that are also within 1km of the site.

Insert 7 – Occurrences of Melaleuca biconvexa within a 3 km radius from the Atlas of NSW Wildlife database (2010)

The removal of *Melaleuca biconvexa* is not likely to have a significant impact upon the lifecycle of the local population given that it is locally conserved and occurs on adjacent lands which may provide a future seed source for potential re-colonisation.

Whilst the loss of individuals on site may reduce the overall performance of pollination and dispersal of the local population, it will not halt or stop the process. The removal of weeds and pine trees may assist slightly on improving the dispersal mechanisms, as to retention of Grey-headed Flying-fox habitat as this species is commonly known to assist in pollination and dispersal.

Strategies for offsetting the decline in area in a maintain or improve assessment would be propagation of local material and use of brush from existing trees/shrubs as they are being removed in conserved areas. Landscaping post development may consider planting some specimens as street trees or revegetating part of the conservation area, for instance, replacement of a small section of Pine trees.

5.5 Summary of threatened flora species recorded nearby

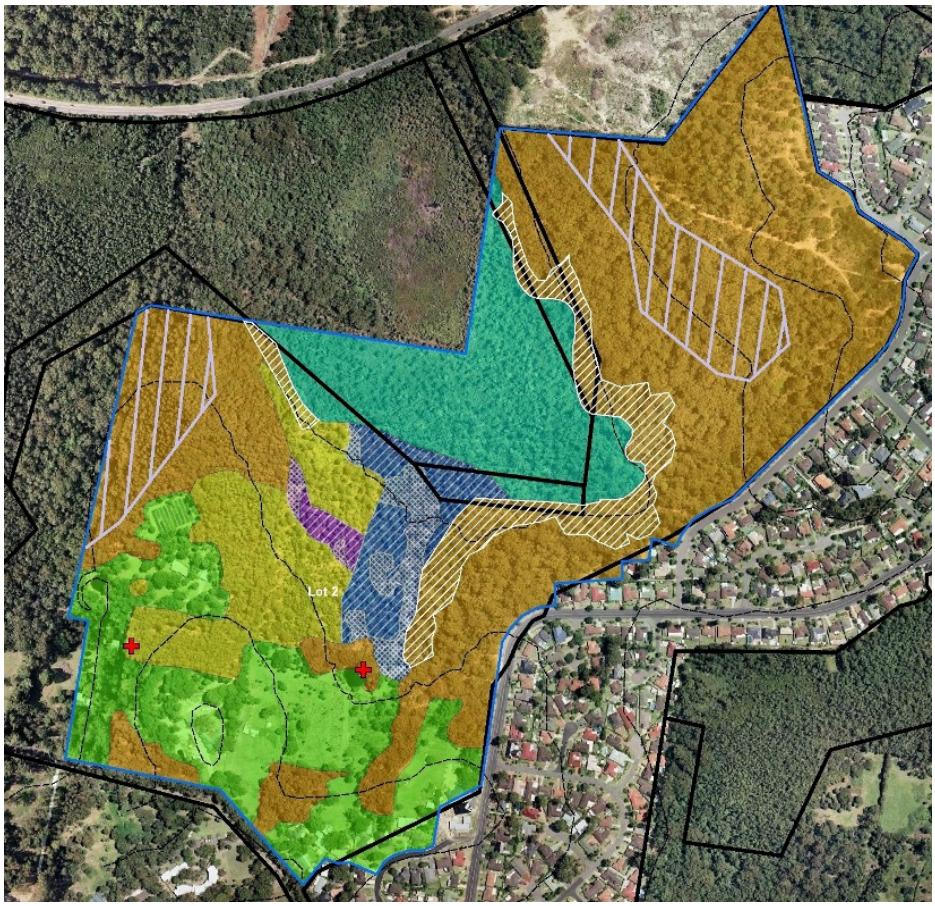
5.5.1 Prostanthera askania

This species is an erect open branched spreading shrub to 1 metre high with deeply toothed hairy leaves. *Prostanthera askania* flowers mainly December to February and grows in sclerophyll forest, often adjacent to rainforest in the Ourimbah to Narara area, chiefly on

sandstone. The somewhat sandy soil conditions at the site provide habitat for this species, however the vegetation is dry ridgetop through to moist alluvial flats rather than the rainforest or wet gully forest preferred by this species. The species typically occurs further to the south-west within gully vegetation which does not occur on site. Given that there are known records in very close proximity to the site with similar vegetation, the species has been considered as a possible subject species. Despite a detailed search for this species, it was not found on the subject site. Due to the absence of this species on site it is considered that the action proposed is not 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.

With respect to a maintain or improve assessment, potential habitat area pre development is estimated to be 5.49 ha, whilst post development which will remove a lot of the Blackbutt Open Forest which provides marginal or low quality habitat will see approximately 0.62 ha being retained, thus a decline. 0.51ha will be retained within a proposed conservation area – the north-eastern wildlife corridor. A further 1.14 ha of proposed asset protection zone provides marginal potential habitat for this species but as 90% of the biomass is usually removed, only 10% of this 1.14 ha calculation has been used to add to the conservation value area for the species.

Insert 8 shows the main area of marginal habitat for which the calculations were obtained (Table 6.1).



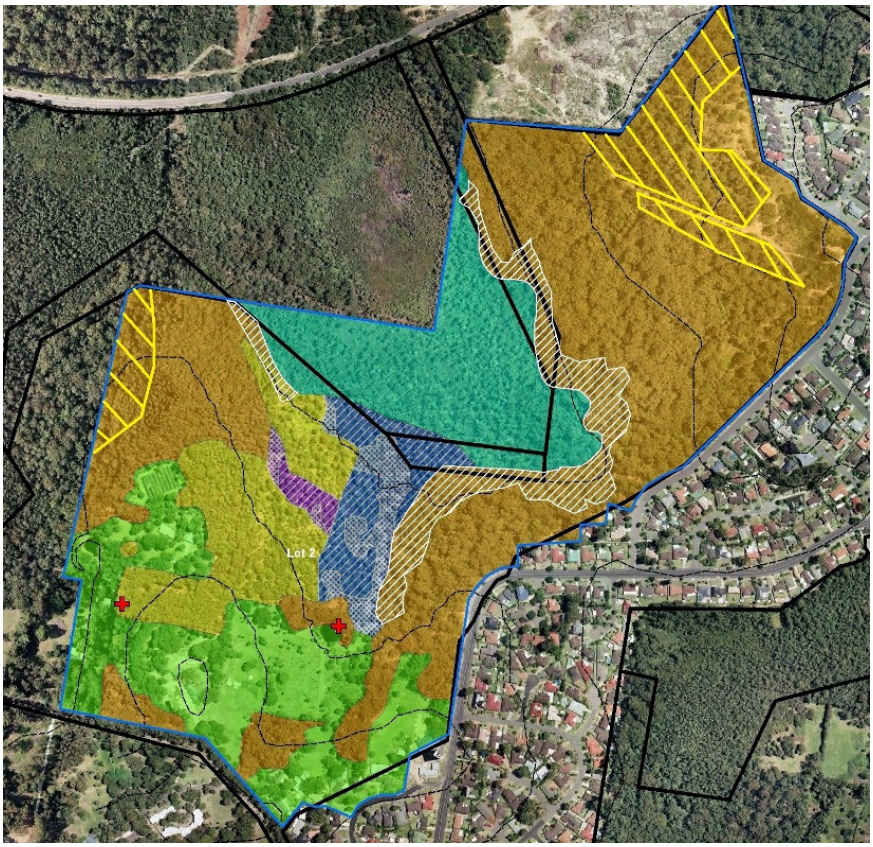
Insert 8 – The main potential marginal habitat areas for Prostanthera askania for which the calculation of habitat loss was made.

Given the low likelihood of potential occurrence and several site visits suggesting this species does not occur, there should not be a high reliance upon the figures in the maintain or improve assessment, but overall under this assessment, there would be a decline.

5.5.2 Diuris praecox

This species flowers mainly between July and August (Harden, 1994; Bishop, 2000). It occurs in coastal areas in Eucalypt Forest, often on hilltops or slopes (Bishop, 2000). The flora survey and targeted terrestrial orchid searches were conducted during the flowering period of this species. This species is known from coastal areas between Ourimbah and Nelson Bay. This species has not been recorded within a 5km radius of the subject site (DECC 2010). Whilst the vegetation community at the site may provide marginal conditions to those preferred by this species its absence from the locality indicates that the presence of this species is unlikely. Despite a detailed search this species was not found on the subject site during its flowering period. Due to the extent of similar habitat adjoining the site (amongst other limiting factors for its presence) it is considered that the action proposed is not 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.

With respect to the maintain or improve assessment, potential habitat area pre development is estimated to be 4.66 ha. Following on post development, this may be reduced to 1.71 ha. 1.60 ha of marginal habitat will be retained within the north-eastern wildlife corridor. A further 1.08 ha of marginal habitat will be retained within proposed asset protection zones for which only 10% has been used as additional habitat post development given that 90% of the biomass is likely to be removed.



Insert 9 - The main potential marginal habitat areas for Diuris praecox for which the calculation of habitat loss was made.

Given that the habitat present is only marginal based on vegetation and geographic factors, the lack of nearby specimens, and no specimens found during the known flowering period (conducted in 2003 and 2010), there should not be a high reliance upon the figures in the maintain or improve assessment, but overall under this assessment, there would be a decline.

5.6 Endangered ecological community considerations

5.6.1 'Swamp Sclerophyll Forest on Coastal Floodplains'

The ecological community associated with humic clay loams and sandy loams on waterlogged or periodically inundated alluvial flats and drainage lines of coastal floodplains.

Habitat Requirements

- Geology / Soils: Waterlogged or periodically inundated humic clay loams and sandy loams.
- Topography: Alluvial flats and drainage lines of coastal floodplains.
- The most widespread canopy species of Swamp Sclerophyll Forest on Coastal Floodplains include: *Eucalyptus robusta, Melaleuca quinquenervia and Eucalyptus botryoides.* Other prominent species are: *Callistemon salignus, Casuarina glauca*, *Eucalyptus resinifera subsp. hemilampra, Livistona australis,* and *Lophostemon suaveolens.*

Conservation Status and Distribution

Small areas of Subtropical Swamp Sclerophyll Forest on Coastal Floodplains are contained within existing conservation reserves, including: Bungawalbin NR, Tuckean NR, Moonee Beach NR, Hat Head NP, Crowdy Bay NP, Wallingat NP, Garigal NP and Myall Lakes NP.

Key Threatening Processes

Clearing of native vegetation; alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; invasion of native plant communities by exotic perennial grasses; predation, habitat destruction, competition and disease transmission by feral pigs; anthropogenic climate change; high frequency fire and removal of dead wood and dead trees.

Considerations

Section 4.6 of this assessment report found that each of the vegetation communities that contained the species Swamp Mahogany would be regarded as this EEC. A number of other criteria were also used to define the boundaries of the EEC including a biometric type assessment to break down the vegetation unit into a condition class.

As explained in Section 4.6, vegetation assessed as *low condition* can be removed (see section 4.6 for the definition of *low condition*).

The proposed conservation strategy (Figure 6) will enable the protection of all high quality EEC and a proportion of the medium quality condition. The low condition vegetation can be removed as the vegetation type (Swamp Mahogany Swamp Forest on Coastal Lowlands of the North Coast and northern Sydney Basin) has not reached its 70% removal threshold so it should not receive a *red flag* under a Biometric Assessment by the Catchment Management Authority (CMA).

The aim of this strategy would see 0.77ha of medium quality EEC removed however there is potential for replacement in the adjacent Disturbed Pine Forest of 0.77ha, therefore an equivalent area of EEC being removed will be restored. Should the conservation zone be lessened to remove more medium or high quality EEC there would definitely be a requirement to obtain land with similar characteristics (EEC) off site as an ecological offset.

Additionally described in section 4.6 was an ecotonal zone (shown on Figure 1). The width of the ecotonal zone has allowed *Travers bushfire & ecology* to provide suitable buffer widths to the EEC of 25m. The buffer zone is shown on Figure 5 – Ecological Constraints.

The aim of the buffer zone is to add protection to the edges of the EEC such that the future pressures of urban development are minimised in their impact before reaching the sensitive vegetation unit. The buffer provides added protection overall to the EEC by keeping direct impacts further away from the SEPP 14 wetland.

The management of the buffer zone should be formalised in a VMP however the following guidelines should apply;

- Future proposed asset protection zones should be kept out of the proposed buffer or at least the first 25m from the EEC edge.

- Construction of bushfire asset protection zones and or stormwater bio-swales or similar devises proposed for runoff filtration should also be kept out of the proposed buffer of at least the first 25m from the EEC edge.

- Weeds to be eradicated.

- Potential revegetation works in low and medium condition areas where the buffer passes through the EEC.

- Buffer areas not to be utilised for recreational purposes.

- Retention and protection of hollow-bearing trees.

5.7 General ecological principles

Hollow-bearing tree surveys have been undertaken extensively in the north-eastern and southern portions of the subject site (see Figure 3). All roost trees identified as having high ecological significance are plotted onto figure 5.

Figure 5 also depicts the nearby declared SEPP 14 wetland to the north of the subject site.

The subject site contributes a number of habitat values to local biodiversity. Rezoning and subsequent development within the subject site can occur without impacts on these values provided select measures are undertaken. Each threatened species and the endangered ecological community should be considered on their own merits. In regards to this site, as with many sites, much of the subsequent considerations for conservation are overlapping.

For example, the retention of higher quality EEC (Swamp Sclerophyll Forest on Coastal Floodplains) within the subject site also constitutes valuable habitat for valuable threatened frog, wading bird, migratory bird, koala and glider habitats. The recording of remaining threatened fauna species should allow for additional retentions to these particularly fringing areas of Blackbutt Open Forest. Figure 5 allows for a buffer from the EEC which would contain some fringing areas of Blackbutt Open Forest to the south and east of the EEC.

The proposed buffer does not contain many significant hollow-bearing trees. Subsequent retention of mixed size hollows and especially those defined as ecologically significant should be retained within the future zonings to provide habitat for microbats, gliders, birds and owl species. The loss of hollow-bearing trees is a key threatening process and as such, the losses should be kept to a minimum with a strategy in place to offset any loss, for example, the provision of mixed sized nest boxes.

The loss of *Melaleuca biconvexa* is unlikely to be significant due to the presence of several local populations (see Insert 7 in section 5); and the fact that it is not at its geographic distribution limit and also that there will be retained habitat within the proposed EEC conservation area.

The flora assessment determined there was a lack of suitable habitat on site for *Tetratheca juncea* because of aspect, soil moisture, high canopy cover and the presence of soil types not recognised as supporting the species. The assessment did find that parts of the area to support a residential zoning would provide marginal habitat for *Diuris praecox* and *Prostanthera askania.* To date, neither species have been observed.

Whilst the marginal habitat for *Prostanthera askania* is likely to be developed, given that the habitat present is only marginal, more ideal areas of its habitat are conserved in nearby reserves and none have been observed, there is no likely significant impact upon this species.

Diuris praecox is a cryptic orchid with a short flowering season in mid-late winter. There has been limited survey applied upon this species. The habitat on site provides only marginal potential for the species to occur. The proposed rezoning is unlikely to cause a significant impact upon this species however a 2010 survey during the species' flowering period of August will be undertaken.

In respect to fauna, five (5) threatened species have been recorded within the subject site during surveys. Ten (10) additional threatened fauna species have been either previously recorded within the subject site or in the nearby locality with potential to occur. The removal of non-EEC communities within the site has most potential to impact on hollow-dependent microchiropteran bats.

The East-coast Freetail Bat was the only hollow-dependent bat species recorded within the subject site. Despite this it should be noted that recent surveys across the complete subject site area were undertaken in the winter period and out of peak activity for microbats. The Greater Broad-nosed Bat and Eastern Falsistrelle have been recorded within the nearby locality and have high potential to occur however the proposal is not considered likely to cause significant impacts on these two species based on their presence within adjacent quality habitats.

The East-coast Freetail Bat alternatively does not have a high recorded presence in the locality outside of the subject site. Furthermore this species is considered more likely to utilise the drier open forest and moderately disturbed woodland communities over the protected EEC areas. Therefore retention of Blackbutt Open Forest containing large hollows specifically represented by spouts is recommended to ensure habitat is retained for this species. Buffers provided to the EEC area in combination with open asset protection areas for foraging could be sufficient for the East-coast Freetail Bat provided that such hollows are adequately represented and protected within these areas and the total area of buffers equates to an acceptable amount of foraging space.

Powerful Owl was recorded during survey in 2009 however May and June surveys failed to locate any nesting activity within the subject site during the recent breeding season. As the

source of whitewash found during recent surveys could not also be accurately determined, it was considered necessary to further pursue this issue for a more precise assessment. Owl expert John Young was engaged to visit the site during the fledgling period to determine any local nesting activity.

Mr Young found no evidence of Powerful Owl activity within the subject site and recorded activity within Pleasant Valley, Fountaindale located approximately 1.4km to the south-west. Mr Young considers that the recording of Powerful Owl during 2009 surveys was an individual that was called in from these areas located outside of the subject site. There are now no constraints identified for this species. A copy of John Young's report is provided in Appendix 2.

John Young (of John Young Wildlife) was also engaged to assist in locating the White-bellied Sea Eagle nest and providing advice on site dependence. Mr Young has advised the following conservation measures should be undertaken to protect White-bellied Sea Eagle nesting behaviour in the locality:

- A 60m wide corridor along the north-eastern site boundary;
- A 25m natural vegetation buffer along the eastern Blackbutt Open Forest fringe to the Swamp Mahogany Woodland.
- Protection of two important roost trees (a Turpentine and a Spotted Gum) with a 15m buffer around the Turpentine given the large degree of whitewash suggesting continued use.

John Young's advice is shown on Figure 4.

In view of the level of detail required to manage the potential impacts upon the SEPP 14 Wetland and the 7G wetland zoned areas a high degree of water quality analysis and advice will be required. Until such time as the comprehensive water quality assessment has been undertaken by *Worley Parsons* it is not possible to provide a competent ecological buffering analysis. In the mean time the constraints plan provided should be used as a basis for that water quality assessment.

Additionally, a review of possible development strategies should be undertaken to account for the requirements of the proposed zonings, water management designs and bushfire protection requirements.

5.8 Proposed wildlife dispersal

Wildlife dispersal will be maintained through the site via the following linkages:

- Retention of arboreal canopy in the form of dry eucalypt forest located on the periphery of the SEPP 14 Wetland; and along the western boundary north of the SEPP 14 zone into Council public reserve open forest (approx. 5 ha). This will enable mammals, amphibians, birds, reptiles and invertebrates to disperse to the north and to the south.

- Within, and through, the SEPP 14 Wetland landscape for a variety of birds, mammals, amphibians and invertebrates.

- Habitat tree retention in street design and or within-lot habitat.

- Native vegetation placement within stormwater swales.

The retention of the above habitat linkages will enable connectivity with;

- 5.0ha of Blackbutt Open Forest located to the north-east of the study area.

- 43ha of bushland to the west (bound by Berkeley Road and Enterprise Drive) and

- 475ha of bushland to the south-west of Berkeley Road as far south as the transmission line crossing between Peach Orchard Road and the vertex of Brush and Anderson Roads. Further partially fragmented connectivity continues to the south and south-west.

To the immediate north of Enterprise Drive the bushland is fragmented by several roads which service the industrial area. Ourimbah Creek approximately 500m north of Enterprise Drive has extensive connectivity along the creek embankments to the east and west, but the industrial subdivision between Enterprise Drive and Ourimbah Creek fragments the connectivity making it less viable for particular terrestrial species.

The above linkages will retain all significant insitu habitats along with appropriate buffer zones to ensure water quality is maintained. The work of *Worley Parsons* through MUSIC modelling and the application of DRAINS modelling have determined both water quantity and water quality will not impact the SEPP 14 Wetland zone and its inherent habitat.

5.9 Conservation strategy

The ecological constraints plan (figure 5) tied in with the conservation strategy and developable areas plan (figure 6) identifies the protection of the;

- SEPP 14 Wetland and the inherent water quality to protect Wallum Froglet habitat.

- Protection of the White-bellied Sea Eagle nest tree and a separate roost within SEPP 14 Wetland. They have a 125 metre separation distance to any possible development areas (S/W direction).

- Retention of important roost trees (2) for the White-bellied Sea Eagle.

- Retention of a vertical wildlife gradient along the western boundary for the While-bellied Sea Eagle and a variety of other wildlife.

- Protection of the high quality endangered ecological community 'Swamp Sclerophyll on coastal floodplains'.

- Retention of a peripheral buffer (25 metres wide) to the Swamp Sclerophyll on coastal floodplains'.

- Retention of high quality Swamp Mahogany tree species (Wyong Council significant tree and a host habitat resource for the Regent Honeyeater and the Swift Parrot).

- The retention of dry eucalypt forest for use by the East Coast Freetail bat in the 25m wide peripheral buffer and the western corridor.

- The capacity to enhance *Melaleuca biconvexa* on site through revegetation programs.

The conserved lands should be subject to appropriate zoning and managed under the guidance of a vegetation management plan (VMP) which would typically be attached to the

land title by a section 88B instrument (*Conveyancing Act*). The purpose of the VMP will be to manage the native vegetation and *in situ* habitat within the conservation zone in perpetuity.

5.10 Summary of possible ecological impacts

The potential impacts upon ecological resources from the development are as follows:

Impact Type	Yes / No	Affectation	Mitigation measures
1. Potential for the extinction of known threatened species	No	None	None required
2. Potential for the loss of threatened species habitat	Reduction in habitat for East Coast Freetail bat Loss of small remnant of *Melaleuca biconvexa*	Reduction in dry eucalypt forest and open grassland areas. Not considered significant to the local population	Retention of vegetated buffer 12,200 metres in length by 25 metres in width; and the retention of a 60 m wide vegetated corridor (2.66 ha) of dry eucalypt forest. Conserved potential habitat will exceed 3.5ha.
3. Potential for fragmenting threatened species habitat	Yes	Reduced connectivity across the site from south to north. No connectivity from west to east.	Retention of corridor in west of site.
4. Loss or fragmentation of lands through the construction of asset protection zones and or water quality quantity treatment devices.	No	None	A buffer zone is provided to the EEC and all APZ areas and other devises are to be external to that zone.
5. Potential for the loss of EEC vegetation	Yes	This should be minimal as areas potentially developed are lower quality and adjacent areas are proposed to be revegetated.	Restoration of the Pine Forest area within the 25m buffer to EEC vegetation such that it will ensure that any EEC vegetation NOT of 'low condition' will equal that which will be conserved and or restored.
6. Potential for the loss of *Aquatic Herbfield* (Creek line and dams)	Yes	Farm dam	None proposed
7. Potential for the loss of dry eucalypt forest	Yes	Possibly upon microbat roost	Retention of vegetation within the wildlife corridor, asset protection zones and the EEC buffer.
8. Loss of aquatic corridor	No	None	Not required
9. Loss of habitat trees for forest owls	No	None	Not required

Impact Type	Yes / No	Affectation	Mitigation measures
10. Loss of significant habitat trees for Arboreal mammals	Not likely	Not known at this stage	Key trees to be retained and artifical hollow replacement program
11. Loss of notable habitat trees	Yes	Not known at this stage	Key trees to be retained and artifical hollow replacement program
12. Loss of trees	Yes	Unspecified	Revegetation on degraded portions
13. Effect from direct impacts from development	None envisaged	None envisaged	Not applicable
14. Effect from indirect impact from development	None envisaged	None envisaged	Not applicable

6 MAINTAIN OR IMPROVE TEST

The 'maintain or improve' test is an ecological test applied in order to evaluate whether a development maintains and/or improves, or potentially degrades/removes, existing vegetation and insitu habitat resources.

The test evaluates the impact of a development upon threatened species and/or their habitats. The assessment includes the following steps:

- Step 1, (Section 6.1) – evaluates the *impacts of the proposal* on the extent of endangered ecological communities and suitable habitat for threatened species.
- Step 2, (Section 6.2) – discusses the proposed *mitigation measures* used within the development to protect endangered ecological communities and threatened species.
- Step 3, (Section 6.3) – discusses the proposed *restoration* for proposed riparian and wildlife corridors.
- Step 4, (Section 6.4) – provides a summary of the *maintain or improve* assessment for endangered ecological communities and threatened flora and fauna species.

Each step has been used to determine whether a potentially significant impact will occur as a result of the proposed development.

6.1 Evaluation of the impacts of the proposal

The proposed rezoning, its associated vegetation removal, restoration of habitats and consolidation of corridors across the subject site, will provide a decline in the amount of suitable/usable habitat for most threatened flora and fauna species in the locality. The decline in habitat is intended to be addressed through the application of ecological offsetting allowed for by contemporary legislation in the form of either the EPA Act 'planning agreements' and or the EPA Act section 5B for 'bio banking assessments'.

Table 6.1 provides a maintain or improve assessment summary for (1) threatened species recorded within the site during survey; (2) those recorded in the nearby locality and having potential to occur within the subject site; or (3) those recorded in the nearby locality with low potential to occur within the subject site. The table does not determine whether a significant impact will occur and does not indicate the presence of threatened species within the subject site. Rather the table 6.1 indicates that the site has suitable habitat for each of the listed species and the respective potential habitat loss for each of those species.

Criteria that have been used to assess the potential impacts of the proposed development on the extent of suitable habitat for each of these threatened flora and fauna species and endangered ecological communities include:

- Existing area of vegetation/habitat cover (ha) within each vegetation community

- Percentage (%) of existing area of vegetation/habitat cover likely to be suitable for each species
- Area of vegetation/habitat to be removed/retained (ha) within each vegetation community
- Area of vegetation/habitat to be restored (ha) within each vegetation community
- Resultant area of vegetation/habitat cover (ha) available for each species

Section 5 provides additional discussion of the occurrence and potential impacts on each of the species in Table 6.1.

As stated above, Table 6.1 does not indicate a significant impact on a species and the loss of potential habitat, may give a biased impression of that impact. An example of where the Table presents a biased impression is for the species *Melaleuca biconvexa.* The table displays the potential habitat of 10.42 ha of land yet this species, as confirmed by target survey, occurs only over an area of 1,500m^2 (0.15 ha).

It is proposed to retain approximately 2.53 ha of this species habitat on site (within the Disturbed Swamp Mahogany Open Woodland and Disturbed Pine Forest) and therefore increases the available area considerably. As there is also available potential habitat within proposed asset protection zones, considering 10% of the biomass is usually retained, this adds a further 0.19ha of potential conservation habitat for the species. Despite that the test assumes an original potential habitat area of 10.42 ha and the post-development potential to be effectively 3.56 ha, there will be conservation of this species' habitat in situ to offset the loss of only 0.15 ha of actual or known habitat within the site.

This approach to habitat loss is fraught with exaggeration and must be viewed carefully in light of species records and the real potential for occupation. In addition to this, asset protection zones provide considerable potential habitat for this species which can be conserved, however given that typically within an asset protection zone approximately 90% of the biomass is removed, we've only been able to effectively say that 10% of the potential area within an asset protection zone will be retained post development.

Table 6.1 – Maintain and/or improve test

Species / EEC	(A) Initial Extent of Vegetation Community (ha)	(B) Post-development Extent of Vegetation Community (ha)	(C) Suitable Portion of Usable Habitat within Community (%)	(D) Initial Extent of Habitat (ha) AxC	(E) Additional Areas of Habitat Following On-site Restoration (OSR) or APZ (ha)	(F) Post Development Extent of Habitat (ha) (BxC)+E	(G) Improve/maintain/ loss (F-D) - Potential Impact on Local Population
EEC's, Flora and Fauna species recorded within the subject site							
EEC – Swamp Sclerophyll Forest on Coastal Floodplains	Disturbed Apple / Mahogany Woodland (0.45) Swamp Mahogany Woodland (6.9) Disturbed Swamp Mahogany Open Woodland (2.79)	-	-	10.14	-	8.97	1.17 ha loss. This does not take into consideration that under the biometric assessment, low condition EEC can be removed. The conservation plan will remove an estimated 0.77ha of EEC not in low condition. This will be compensated through restoration of the equivalent amount of low condition EEC and restoration ofa small portion of the Pine forest. Review assessment in section 4.6
Melaleuca biconvexa		-	-	10.42	-	3.56	6.86 ha loss. 3.37 ha will occur in the EEC offset area, within the 25m buffer zone or within the wildlife corridor. A further 1.86ha will occur within a proposed APZ. Only 10% of the biomass is usually retained within an APZ so only 10% of 1.86 (0.19ha) has been added to the 3.37ha of conservation.

Table 6.1 – Maintain and/or improve test

Species / EEC	(A) Initial Extent of Vegetation Community (ha)	(B) Post-development Extent of Vegetation Community (ha)	(C) Suitable Portion of Usable Habitat within Community (%)	(D) Initial Extent of Habitat (ha) AxC	(E) Additional Areas of Habitat Following On-site Restoration (OSR) or APZ (ha)	(F) Post Development Extent of Habitat (ha) (BxC)+E	(G) Improve/maintain/ loss (F-D) - Potential Impact on Local Population
Grey-headed Flying-fox	Blackbutt Open Forest (29.09)	5.21	100%	29.09	1.17 (APZ)	6.38	24.891 ha loss of foraging habitat.
	Disturbed Apple / Mahogany Woodland (0.45)	0.03	30%	0.135	0.051 (APZ) + 0.015 (OSR)	0.075	
	Swamp Mahogany Woodland (6.9)	6.9	80%	5.52	-	5.52	
	Grassland with Scattered Trees (9.26)	0	20%	1.852	0.07 (APZ)	0.07	
	Disturbed Swamp Mahogany Open Woodland (2.79)	1.41	30%	0.837	0.06 (APZ) + 0.015 (OSR)	0.498	
				37.434	1.381	12.543	
East-coast Freetail Bat	Blackbutt Open Forest (29.09)	5.21	50%	14.545	4.69 (APZ)	7.295	17.993 ha loss of foraging habitat within cleared landscapes and roosting and breeding habitat where hollows exists in surrounding forest/woodland.
	Disturbed Apple / Mahogany Woodland (0.45)	0.03	70%	0.315	0.119 (APZ)	0.14	
	Swamp Mahogany Woodland (6.9)	6.9	50%	3.45	-	3.45	
	Grassland with Scattered Trees (9.26)	0	100%	9.26	0.35 (APZ)	0.35	
	Disturbed Swamp Mahogany Open Woodland (2.79)	1.41	70%	1.953	0.14 (APZ)	1.127	
	Disturbed Pine Plantation (4.89)	0.59	25%	1.223	0.095 (APZ) + 0.148 (OSR)	0.391	

Table 6.1 – Maintain and/or improve test

Species / EEC	(A) Initial Extent of Vegetation Community (ha)	(B) Post-development Extent of Vegetation Community (ha)	(C) Suitable Portion of Usable Habitat within Community (%)	(D) Initial Extent of Habitat (ha) AxC	(E) Additional Areas of Habitat Following On-site Restoration (OSR) or APZ (ha)	(F) Post Development Extent of Habitat (ha) (BxC)+E	(G) Improve/maintain/ loss (F-D) - Potential Impact on Local Population
				30.746	5.542	12.753	
Eastern Bentwing-bat	Blackbutt Open Forest (29.09)	5.21	100%	29.09	4.69 (APZ)	9.9	26.172 ha loss of foraging habitat.
	Disturbed Apple / Mahogany Woodland (0.45)	0.03	80%	0.36	0.136 (APZ)	0.16	
	Swamp Mahogany Woodland (6.9)	6.9	100%	6.9	-	6.9	
	Grassland with Scattered Trees (9.26)	0	50%	4.63	0.175 (APZ)	0.175	
	Disturbed Swamp Mahogany Open Woodland (2.79)	1.41	80%	2.232	0.16 (APZ) + 0.282 (OSR)	1.57	
	Disturbed Pine Plantation (4.89)	0.59	50%	2.445	0.19 (APZ) + 0.295 (OSR)	0.78	
				45.657	5.928	19.485	
Little Bentwing-bat	Blackbutt Open Forest (29.09)	5.21	100%	29.09	4.69 (APZ)	9.9	26.172 ha loss of foraging habitat.
	Disturbed Apple / Mahogany Woodland (0.45)	0.03	80%	0.36	0.136 (APZ)	0.16	
	Swamp Mahogany Woodland (6.9)	6.9	100%	6.9	-	6.9	
	Grassland with Scattered Trees (9.26)	0	50%	4.63	0.175 (APZ)	0.175	
	Disturbed Swamp Mahogany Open Woodland (2.79)	1.41	80%	2.232	0.16 (APZ) + 0.282 (OSR)	1.57	

Table 6.1 – Maintain and/or improve test

Species / EEC	(A) Initial Extent of Vegetation Community (ha)	(B) Post-development Extent of Vegetation Community (ha)	(C) Suitable Portion of Usable Habitat within Community (%)	(D) Initial Extent of Habitat (ha) AxC	(E) Additional Areas of Habitat Following On-site Restoration (OSR) or APZ (ha)	(F) Post Development Extent of Habitat (ha) (BxC)+E	(G) Improve/maintain/ loss (F-D) - Potential Impact on Local Population
	Disturbed Pine Plantation (4.89)	0.59	50%	2.445	0.19 (APZ) + 0.295 (OSR)	0.78	
				45.657	5.928	19.485	
Species recorded in the nearby locality & potential to occur within the subject site							
Prostanthera askania	See Insert 8 (section 5 of report)	-	-	5.49	-	0.62	4.87 ha loss. 0.51 ha will occur within the wildlife corridor in the north-east of the subject site. A further 1.14 ha of APZ contains habitat for the species of which only 10% will be accounted for in the calculations due to a typical 90% reduction of biomass. Species was not found to occur on site.
Powerful Owl	Blackbutt Open Forest (29.09)	5.21	100%	29.09	1.173 (APZ)	6.373	25.488 ha loss of foraging, roosting and nesting habitat. Not currently utilising the site for roosting or nesting.
	Disturbed Apple / Mahogany Woodland (0.45)	0.03	20%	0.09	0.034 (APZ)	0.014	
	Swamp Mahogany Woodland (6.9)	6.9	20%	1.38	-	1.38	
	Grassland with Scattered Trees (9.26)	0	10%	0.926	0.035 (APZ)	0.035	
	Disturbed Swamp Mahogany Open Woodland (2.79)	1.41	20%	0.558	0.04 (APZ)	0.322	

Table 6.1 – Maintain and/or improve test

Species / EEC	(A) Initial Extent of Vegetation Community (ha)	(B) Post-development Extent of Vegetation Community (ha)	(C) Suitable Portion of Usable Habitat within Community (%)	(D) Initial Extent of Habitat (ha) AxC	(E) Additional Areas of Habitat Following On-site Restoration (OSR) or APZ (ha)	(F) Post Development Extent of Habitat (ha) (BxC)+E	(G) Improve/maintain/ loss (F-D) - Potential Impact on Local Population
	Disturbed Pine Plantation (4.89)	0.59	40%	1.956	0.152 (APZ)	0.388	
				34	1.434	8.512	
Wallum Froglet	Disturbed Apple / Mahogany Woodland (0.45)	0.03	10%	0.045	0.012 (OSR)	0.15	0.531 ha Improvement of shelter and foraging habitat.
	Swamp Mahogany Woodland (6.9)	6.9	50%	3.45	-	3.45	
	Disturbed Swamp Mahogany Open Woodland (2.79)	1.41	10%	0.279	0.564 (OSR)	0.705	
				3.774	0.766	4.305	
Little Lorikeet	Blackbutt Open Forest (29.09)	5.21	80%	23.272	1.173 (APZ)	5.341	18.716 ha loss of foraging, roosting and nesting habitat. Species not utilising the site for roosting and nesting.
	Disturbed Apple / Mahogany Woodland (0.45)	0.03	30%	0.135	0.051 (APZ) + 0.012 (OSR)	0.072	
	Swamp Mahogany Woodland (6.9)	6.9	70%	4.83	-	4.83	
	Grassland with Scattered Trees (9.26)	0	10%	0.926	0.035 (APZ)	0.035	
	Disturbed Swamp Mahogany Open Woodland (2.79)	1.41	30%	0.837	0.06 (APZ) + 0.561 (OSR)	1.044	
	Disturbed Pine Plantation (4.89)	0.59	10%	0.489	0.038 (APZ) + 0.354 (OSR)	0.451	
				30.489	2.284	11.773	

Table 6.1 – Maintain and/or improve test

Species / EEC	(A) Initial Extent of Vegetation Community (ha)	(B) Post-development Extent of Vegetation Community (ha)	(C) Suitable Portion of Usable Habitat within Community (%)	(D) Initial Extent of Habitat (ha) AxC	(E) Additional Areas of Habitat Following On-site Restoration (OSR) or APZ (ha)	(F) Post Development Extent of Habitat (ha) (BxC)+E	(G) Improve/maintain/ loss (F-D) - Potential Impact on Local Population
Greater Broad-nosed Bat	Blackbutt Open Forest (29.09)	5.21	100%	29.09	4.69 (APZ)	9.9	26.172 ha loss of foraging roosting and breeding habitat.
	Disturbed Apple / Mahogany Woodland (0.45)	0.03	80%	0.36	0.136 (APZ)	0.16	
	Swamp Mahogany Woodland (6.9)	6.9	100%	6.9	-	6.9	
	Grassland with Scattered Trees (9.26)	0	50%	4.63	0.175 (APZ)	0.175	
	Disturbed Swamp Mahogany Open Woodland (2.79)	1.41	80%	2.232	0.16 (APZ) + 0.282 (OSR)	1.57	
	Disturbed Pine Plantation (4.89)	0.59	50%	2.445	0.19 (APZ) + 0.295 (OSR)	0.78	
				45.657	3.588	19.485	
Eastern Falsistrelle	Blackbutt Open Forest (29.09)	5.21	40%	11.636	0.469 (APZ)	2.553	10.509 ha loss of of foraging roosting and breeding habitat.
	Disturbed Apple / Mahogany Woodland (0.45)	0.03	10%	0.045	0.017 (APZ)	0.02	
	Swamp Mahogany Woodland (6.9)	6.9	10%	0.69	-	0.69	
	Grassland with Scattered Trees (9.26)	0	10%	0.926	0.035 (APZ)	0.035	
	Disturbed Swamp Mahogany Open Woodland (2.79)	1.41	10%	0.279	0.02 (APZ)	0.161	

Table 6.1 – Maintain and/or improve test

Species / EEC	(A) Initial Extent of Vegetation Community (ha)	(B) Post-development Extent of Vegetation Community (ha)	(C) Suitable Portion of Usable Habitat within Community (%)	(D) Initial Extent of Habitat (ha) AxC	(E) Additional Areas of Habitat Following On-site Restoration (OSR) or APZ (ha)	(F) Post Development Extent of Habitat (ha) (BxC)+E	(G) Improve/maintain/ loss (F-D) - Potential Impact on Local Population
	Disturbed Pine Plantation (4.89)	0.59	10%	0.489	0.038 (APZ)	0.097	
				14.065	0.579	3.556	
Species recorded in the nearby locality with low potential to occur within the subject site							
Diuris praecox	See insert 9 (section 5 of report)	-	-	4.66	-	1.71	2.95 ha loss. 1.60 ha will be conserved within the wildlife corridor in the north-east of the subject site. Whilst a further 1.14 ha exists within APZs, effectively only 10% (0.11ha) will be accounted for as conservation given that 90% of biomass is likely to be removed.
Glossy Black-Cockatoo	Blackbutt Open Forest (29.09)	5.21	30%	8.727	1.407 (APZ)	2.97	7.872 ha loss of foraging habitat.
	Grassland with Scattered Trees (9.26)	0	20%	1.852	0.07 (APZ)	0.07	
	Disturbed Pine Plantation (4.89)	0.59	10%	0.489	0.038 (APZ) + 0.059 (OSR)	0.156	
				11.068	1.574	3.196	
Yellow-bellied Glider	Blackbutt Open Forest (29.09)	5.21	30%	8.727	1.173 (APZ)	2.736	5.991 ha loss of foraging, denning and breeding habitat.

Table 6.1 – Maintain and/or improve test

Species / EEC	(A) Initial Extent of Vegetation Community (ha)	(B) Post-development Extent of Vegetation Community (ha)	(C) Suitable Portion of Usable Habitat within Community (%)	(D) Initial Extent of Habitat (ha) AxC	(E) Additional Areas of Habitat Following On-site Restoration (OSR) or APZ (ha)	(F) Post Development Extent of Habitat (ha) (BxC)+E	(G) Improve/maintain/ loss (F-D) - Potential Impact on Local Population
	Swamp Mahogany Woodland (6.9)	6.9	10%	0.69	-	0.69	
				9.417	1.173	3.426	
Spotted-tailed Quoll	Blackbutt Open Forest (29.09)	5.21	90%	26.181	-	4.689	21.527 ha loss of foraging and denning habitat.
	Disturbed Apple / Mahogany Woodland (0.45)	0.03	10%	0.045	0.017 (APZ)	0.02	
	Swamp Mahogany Woodland (6.9)	6.9	40%	2.76	-	2.76	
	Disturbed Swamp Mahogany Open Woodland (2.79)	1.41	10%	0.279	0.02 (APZ) + 0.423 (OSR)	0.484	
	Disturbed Pine Plantation (4.89)	0.59	10%	0.489	0.038 (APZ) + 0.177 (OSR)	0.274	
				29.754	0.675	8.227	

Note: - The *Suitable Portion of Usable Habitat within each Community* (Column C) is identified as a percentage which represents an area of cover likely available for each species. This has considered foraging, breeding and shelter values as a total. This percentage is a qualitative estimate based on species knowledge, personal experience and site knowledge.

- *Additional Areas of Habitat Following On-site Restoration or APZ* (Column E) is a column that considers additional habitat that will be provided either with the provision of APZ's or following on-site restoration.

APZ's are considered as habitat within this column as they are not considered as full quality habitat for comparison within column B (*Post-development Extent of vegetation community*). APZ calculations are based on Inner Protection Area standards considering that 90% of the understorey and 75% of the canopy will be removed from forest structure.

On-site restoration is considered only for Disturbed Apple / Mahogany Woodland, Disturbed Swamp Mahogany Open Woodland and Disturbed Pine Plantation which will each be restored to Swamp Mahogany Woodland (conforming to the EEC Swamp Sclerophyll Forest on Coastal Floodplains). If a species is said to utilise 80% of the Swamp Mahogany Woodland and only 50% of the Disturbed Swamp Mahogany Open Woodland then the restoration calculation will be the difference (30% of post-development Disturbed Swamp Mahogany Open Woodland).

6.2 Proposed mitigation measures

The mitigation and management strategies proposed include:

- conservation of habitat within the retained vegetation corridors and conserved EEC habitat
- maintaining connectivity between the existing vegetated landscapes to the west and the northeast
- restoration of affected EEC vegetation
- the provision of vegetated buffers to sensitive vegetation
- exclusion of grazing animals
- supervision of hollow tree and artificial structure removal such that appropriate action may be taken for residing fauna
- replacement of hollows removed via nest box installation at a ratio of 1:1
- weed control
- erosion control
- installation of protective fencing and signage
- stormwater quality and quantity control (bio-retention basins, bio-swales, gross pollutant traps, rainwater tanks and revegetation of watercourses)
- retention of dead timber and habitat supplementation
- retention of regrowth and
- strategic enrichment planting.

These measures are intended to maintain the quality of retained vegetation and associated fauna habitat and to minimise the impacts on any significant resident fauna.

6.3 Proposed restoration for proposed riparian and wildlife corridors

0.77ha of medium quality Swamp Mahogany Swamp Forest (EEC) will be restored within the proposed conservation area. The restoration works will involve a combination of target weed removal including pine trees, site preparation, replanting and seeding of local provenance plant stock that typically occur within the same EEC. These works will be implemented in accordance with an approved Vegetation Management Plan. Additional planting of *Melaleuca biconvexa* is to be encouraged within conservation areas where suitable soil conditions are present.

6.4 Summary of the 'maintain or improve' assessment

In consideration to available habitat for threatened species recorded either within or in close proximity to the subject site it is considered that there will be an improved outcome for the Wallum Froglet as a result of the planning proposal. There will be a loss for remaining species considered including *Melaleuca biconvexa, Prostantheria askania, Diuris praecox*, Grey-headed Flying-fox, East-coast Freetail Bat, Eastern Bentwing-bat, Little Bentwing-bat, Powerful Owl, Wallum Froglet, Little Lorikeet, Greater Broad-nosed Bat, Eastern Falsistrelle, Glossy Black-Cockatoo, Yellow-bellied Glider and Spotted-tailed Quoll.

It should be noted here that this list of species has been compiled out of caution as many of these species have not been recorded within the subject site. For the majority of species that have been recorded present, the subject site does not offer habitat of high local value. Section 5 of this report provides a detailed discussion of the impacts on each of the above listed species.

7 CONCLUSIONS

7.1 Conclusions

An ecological constraints plan has been prepared – see Figure 5 – Ecological Constraints.

This plan depicts the locations of endangered ecological communities, threatened species, protected migratory species, as well as EEC buffers recorded within the subject site.

Figure 6 identifies the preferred areas of conservation and depicts the most suitable area for development.

EP&A Act and TSC Act

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

- Five (5) threatened fauna species – Eastern Bentwing-bat (*Miniopterus orianae oceansis*), Little Bentwing-bat (*Miniopterus australis*), East-coast Freetail Bat (*Micronomus norfolkensis*), Powerful Owl (*Ninox strenua*) and Grey-headed Flying-fox (*Pteropus poliocephalus*) were recorded within the subject site during surveys.

  Koala (*Phascolarctos cinereous*) has also been previously recorded within the subject site. Little Lorikeet (*Glossopsitta pusilla*), Varied Sittella (*Daphoenositta chrysoptera*), Eastern Falsistrelle (*Falsistrellus tasmaniensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*) have been recorded within neighbouring lands during other surveys. Atlas records also provide records of Glossy Black-Cockatoo (*Calyptorhynchus lathami*), Spotted-tailed Quoll (*Dasyurus maculatus*), Green-thighed Frog (*Litoria brevipalmata*) and Wallum Froglet (*Crinia tinnula*) on nearby/neighbouring lands.

- One (1) threatened flora species *Melaleuca biconvexa* was recorded within to the subject site

- One (1) EEC *Swamp Sclerophyll Forest on Coastal Floodplains* was recorded within the subject site

- No endangered populations have been observed

EPBC Act

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

- One (1) threatened fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*), was recorded within the subject site

- One (1) protected migratory fauna species listed under the *EPBC Act* – White-bellied Sea Eagle (*Haliaeetus leucogaster*) – was recorded within the subject site. Black-faced Monarch (*Monarcha melanopsis*), Rufous Fantail (*Rhipidura rufifrons*) and Cattle Egret (*Ardea ibis*) have been recorded on neighbouring lands during previous surveys.

- One (1) threatened flora species – *Melaleuca biconvexa* – was recorded within the subject site

- No endangered populations or EECs listed under the *EPBC Act* were recorded within or in close proximity the subject site

FM Act

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.

Maintain or Improve Assessment

The proposed rezoning, its associated vegetation removal, restoration of habitats and consolidation of corridors across the subject site, will provide a decline in the amount of suitable/usable habitat for most threatened flora and fauna species in the locality. With the exception of the East-coast Freetail Bat (pending further information on the species local habitat utilisation), this loss is not considered to cause a significant impact such that it would put any local populations at risk of extinction. This is also countered for through the application of ecological offsetting allowed for by contemporary legislation in the form of either the EPA Act 'planning agreements' and or the EPA Act section 5B for 'bio banking assessments'.

There would be a 'maintained' outcome for the Endangered Ecological Community 'Swamp Sclerophyll Forest on Coastal Floodplains' on the provision that a portion of the Pine forest area could be restored.

Ecological offsetting would be required to be considered for loss of habitat in the form of a voluntary planning agreement or a biobanking offsetting approach.

Final Conclusion

In view of the extensive ecological survey and the comprehensive assessment undertaken and combined with the expert advice from external specialist consultants we believe the constraints plan represented in Figure 5 together with ecological offsetting provides an appropriate conservation / development balance.

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FIGURES

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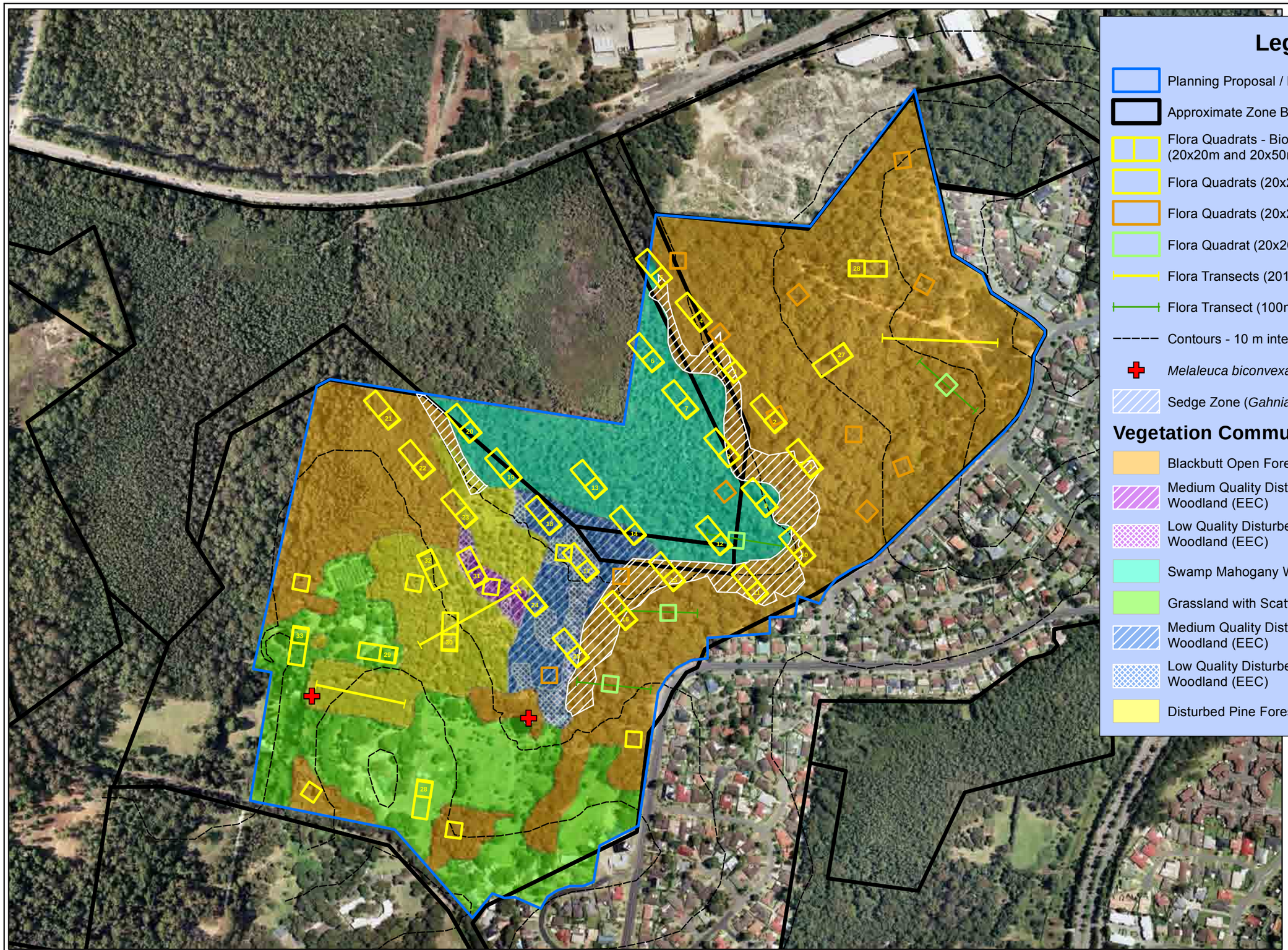

Flora and fauna survey locations are approximate and have not been fixed by land survey.

*Subject Site boundary subject to final survey

Travers bushfire & ecology

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Central Coast Highway, Kariong NSW 2250
Ph (02) 4340 5331 Fax (02) 4340 2151
e-mail: info@traversecology.com.au

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Original plan produced in A3 colour

Drawing No.	A10031F	Date	
Drawn By	BB/KA	24/09/10	
Amendment		Date	
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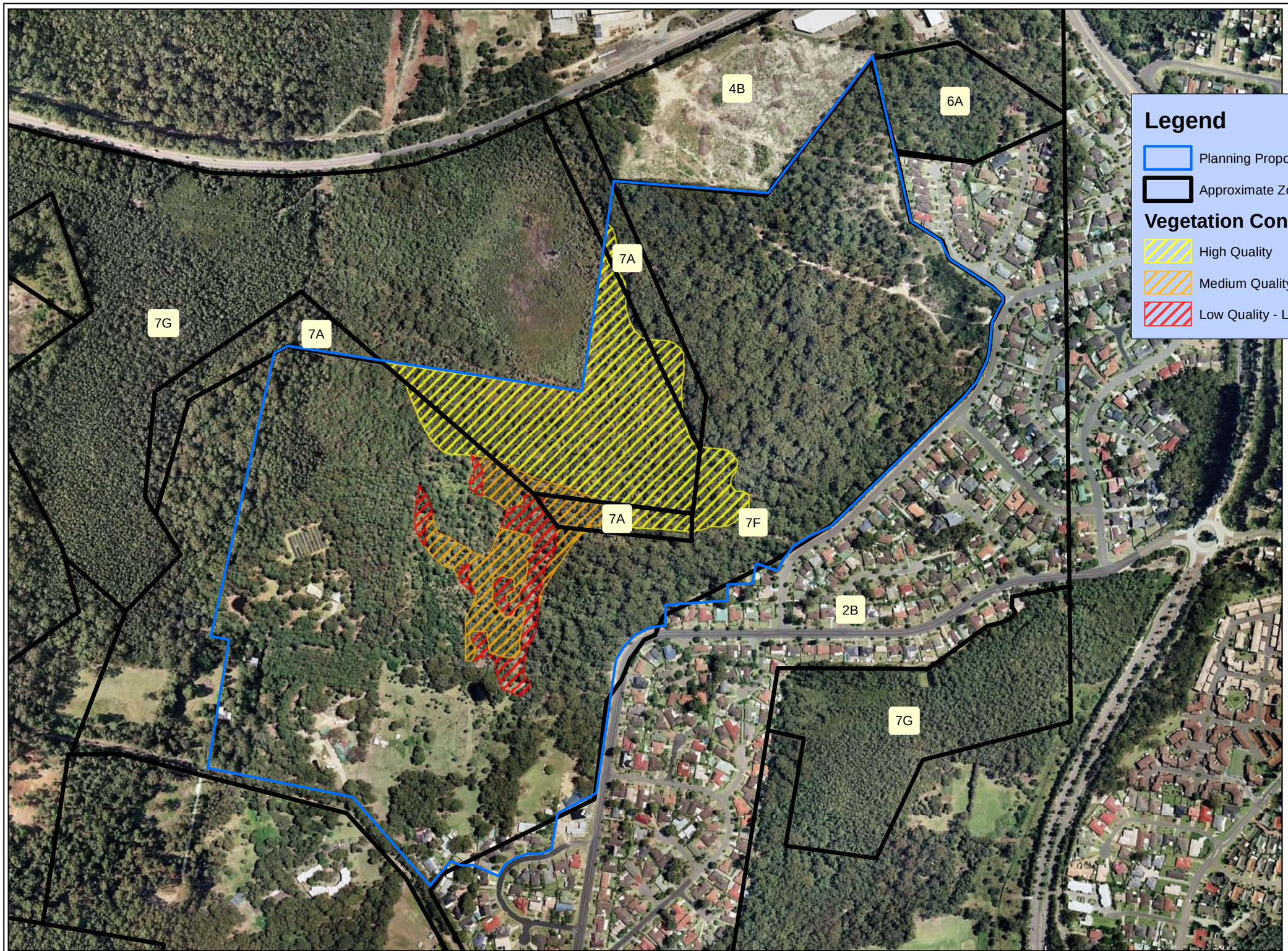
B			
C			

Figure 1 -
Flora Survey Effort, Threatened Species Locations & Vegetation Communities
Bundeena Road, Glenning Valley

Source: Google Earth Pro, Satellite Imagery. Location: N:/10031



Legend

- Planning Proposal / LEP boundary
- Approximate Zone Boundaries

Vegetation Condition

- High Quality
- Medium Quality
- Low Quality - Low Condition (Biometric Assessment)

N

Flora and fauna survey locations are approximate and have not been fixed by land survey.

*Subject Site boundary subject to final survey

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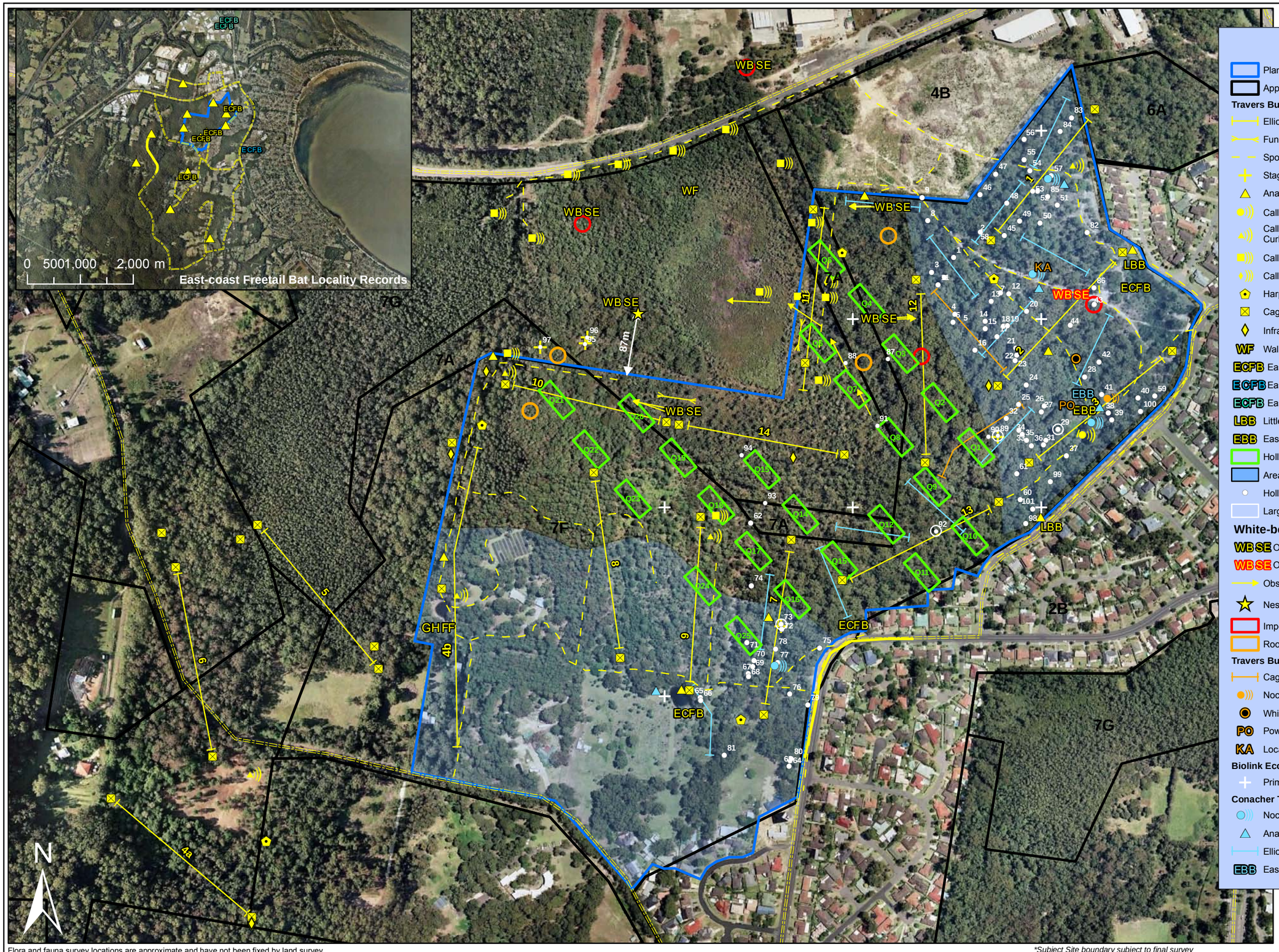
Figure 2 -

Condition of EEC Vegetation

Bundeena Rd, Glenning Valley

Source: Google Earth Pro, Satellite Imagery.

Location: N:/A10031



Legend

- Planning Proposal / LEP boundary (Subject Site)
- Approximate Zone Boundaries

Travers Bushfire and Ecology (2010)

- Elliott Traplines
- Funnel Trapline
- Spotlighting Transect
- Stag-watching
- Anabat station
- Call-playback (Forest Owls)
- Call-playback (Forest Owls, Bush Stone Curlew, Australian Bittern & arboreal mammal species)
- Call-playback (Wallum Froglet)
- Call-playback (Australasian Bittern & arboreal mammals)
- Harp traps
- Cage traps
- Infra-red motion camera
- WF Wallum froglet
- ECFB East-coast Freetail Bat
- ECFB East-coast Freetail Bat (Atlas 1997)
- ECFB East-coast Freetail Bat (Atlas 2004)
- LBB Little Bentwing-bat
- EBB Eastern Bentwing-bat
- Hollow-bearing Tree Quadrats (50mx20m)
- Areas subject to detailed habitat tree survey
- Hollow-bearing Tree
- Large Hollow (suitable for Powerful Owl nesting)

White-bellied Sea Eagle

- WB SE Observed by Travers Bushfire & Ecology
- WB SE Observed by Wyong Shire Council
- Observed flight direction
- Nest
- Important Roost
- Roost (evident by small whitewash)

Travers Bushfire & Ecology (2008/9)

- Cage Trapline
- Nocturnal Call-playback Location
- Whitewash
- PO Powerful Owl
- KA Location of previous Koala record (Atlas 2007)

Biolink Ecological Consultants (2008)

- Primary Koala sampling point (250m grid point)

Conacher Travers (2003)

- Nocturnal Call-playback Location
- Anabat Station
- Elliott Trapline
- EBB Eastern Bentwing-bat

Flora and fauna survey locations are approximate and have not been fixed by land survey.

*Subject Site boundary subject to final survey

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Drawing No.	A10031F	Date
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Amendment		Date
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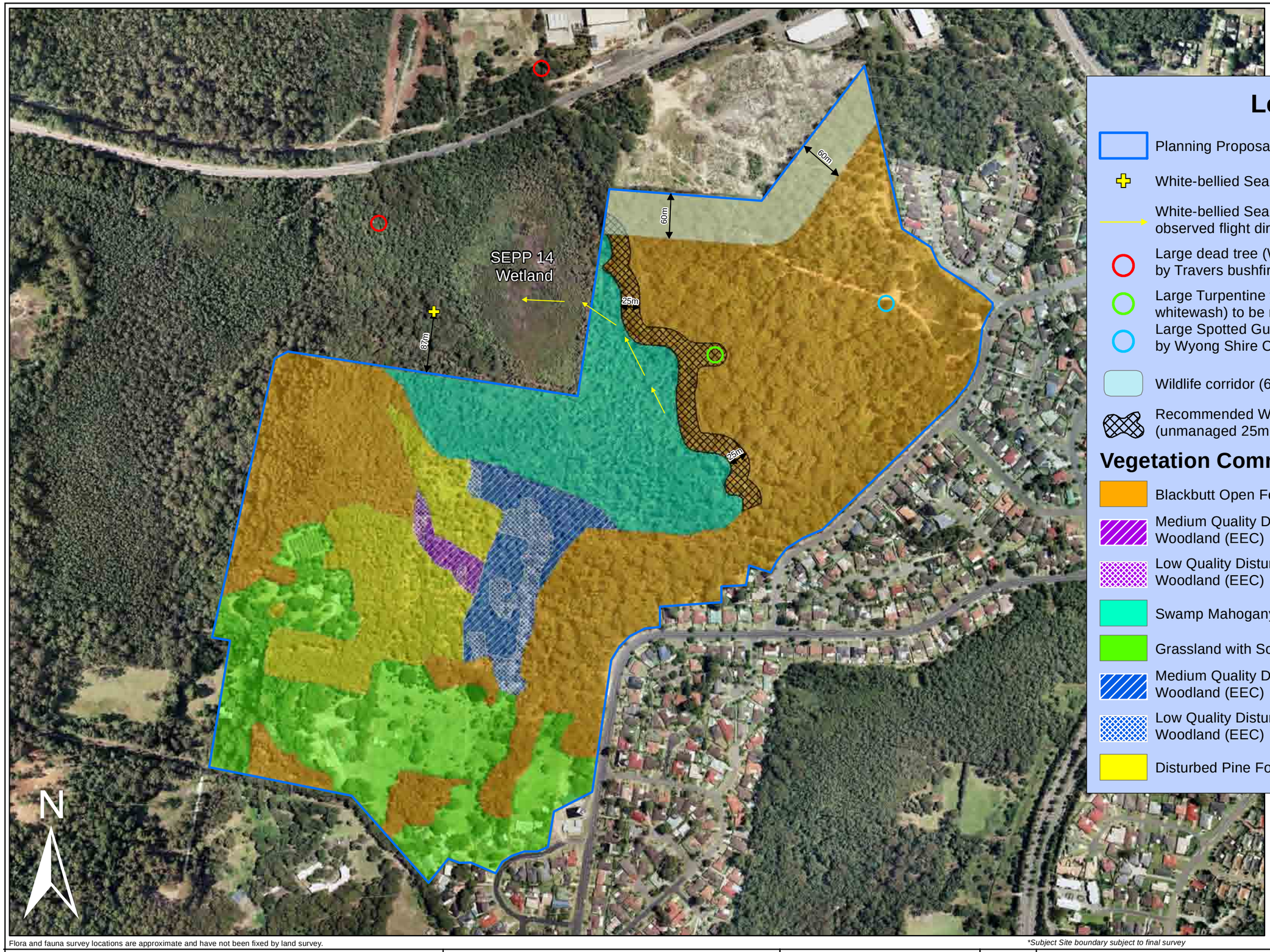
Figure 3 -
Fauna Survey Effort & Threatened Specieis Locations
Bundeena Road, Glenning Valley

Source: Google Earth Pro, Satellite Imagery. Location: N:/XXXX



Legend

- Planning Proposal / LEP boundary
- White-bellied Sea Eagle nest
- White-bellied Sea Eagle observed flight direction
- Large dead tree (WBSE observed roosting by Travers bushfire & ecology)
- Large Turpentine tree (WBSE large area of whitewash) to be retained with a 15m buffer
- Large Spotted Gum (WBSE observed roosting by Wyong Shire Council) to be retained
- Wildlife corridor (60m)
- Recommended White-bellied Sea Eagle buffer (unmanaged 25m vegetation buffer)

Vegetation Communities

- Blackbutt Open Forest
- Medium Quality Disturbed Apple/ Mahogany Woodland (EEC)
- Low Quality Disturbed Apple/Mahogany Woodland (EEC)
- Swamp Mahogany Woodland (EEC)
- Grassland with Scattered Trees
- Medium Quality Disturbed Swamp Mahogany Open Woodland (EEC)
- Low Quality Disturbed Swamp Mahogany Open Woodland (EEC)
- Disturbed Pine Forest

Flora and fauna survey locations are approximate and have not been fixed by land survey.

*Subject Site boundary subject to final survey

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Drawing No.		A10031F	
Drawn By		TM/BB/KA	09/09/10
Amendment			Date
A	WBSE buffer		23/08/10
B			
C			

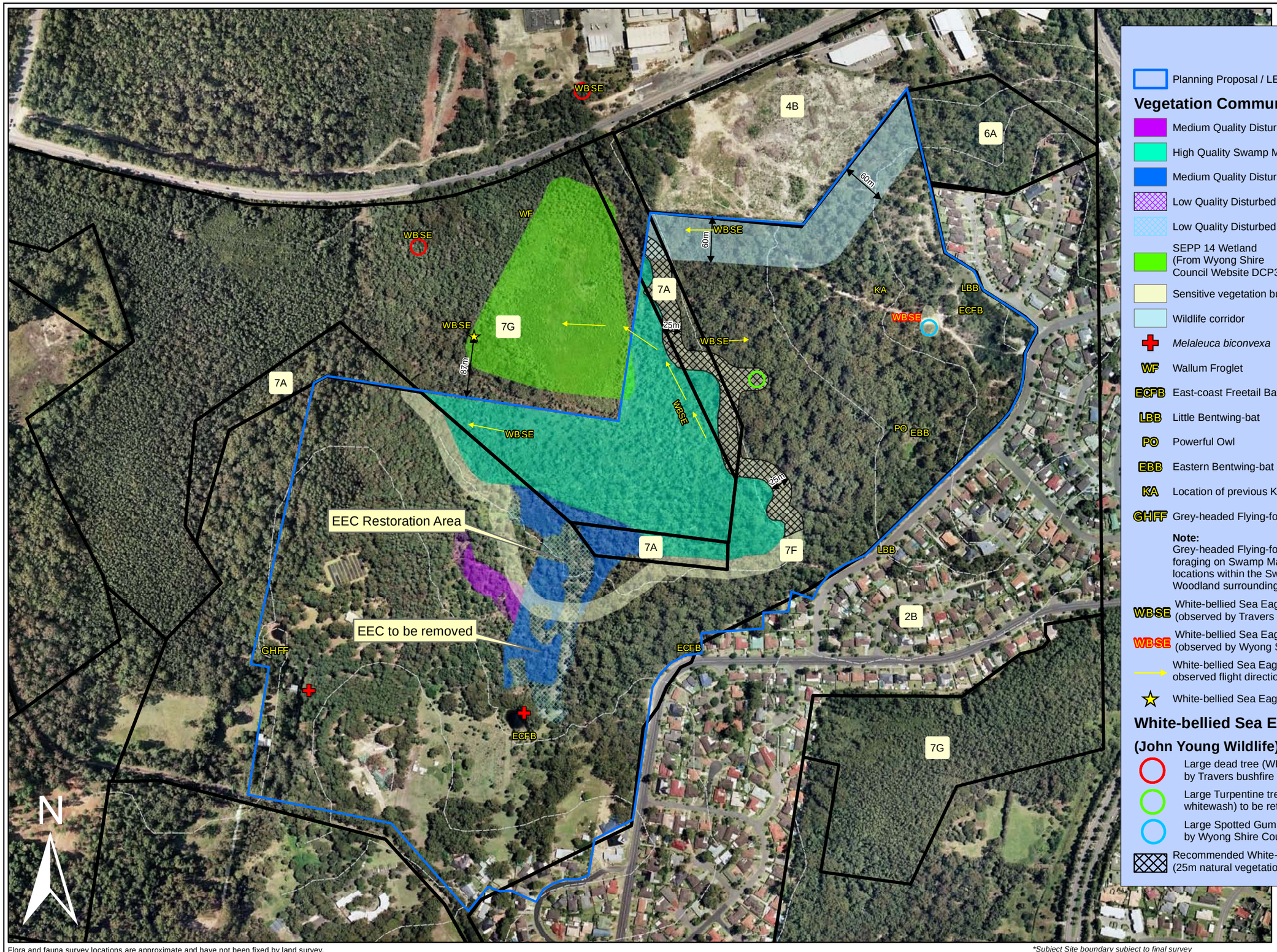
Figure 4 -

White-bellied Sea Eagle Constraints (John Young Wildlife)

Bundeena Road, Glenning Valley

Source: Google Earth Pro, Satellite Imagery.

Location: N:/10031



Legend

Planning Proposal / LEP boundary

Vegetation Communities

- Medium Quality Disturbed Apple/ Mahogany Woodland (EEC)
- High Quality Swamp Mahogany Woodland (EEC)
- Medium Quality Disturbed Swamp Mahogany Open Woodland (EEC)
- Low Quality Disturbed Apple/ Mahogany Woodland
- Low Quality Disturbed Swamp Mahogany Open Woodland
- SEPP 14 Wetland (From Wyong Shire Council Website DCP30)
- Sensitive vegetation buffer
- Wildlife corridor
- *Melaleuca biconvexa*
- WF Wallum Froglet
- ECFB East-coast Freetail Bat
- LBB Little Bentwing-bat
- PO Powerful Owl
- EBB Eastern Bentwing-bat
- KA Location of previous Koala Record (2007)
- GHFF Grey-headed Flying-fox (Foraging)

Note:
Grey-headed Flying-fox were also recorded foraging on Swamp Mahogany at numerous locations within the Swamp Mahogany Woodland surrounding the SEPP 14 wetland.

- WBSE White-bellied Sea Eagle (observed by Travers Bushfire & Ecology)
- WBSE White-bellied Sea Eagle (observed by Wyong Shire Council)
- White-bellied Sea Eagle observed flight direction
- White-bellied Sea Eagle nest

White-bellied Sea Eagle constraints

(John Young Wildlife)

- Large dead tree (WBSE observed roosting by Travers bushfire & ecology)
- Large Turpentine tree (WBSE large area of whitewash) to be retained with a 15m buffer
- Large Spotted Gum (WBSE observed roosting by Wyong Shire Council) to be retained
- Recommended White-bellied Sea Eagle buffer (25m natural vegetation)

Flora and fauna survey locations are approximate and have not been fixed by land survey.

*Subject Site boundary subject to final survey

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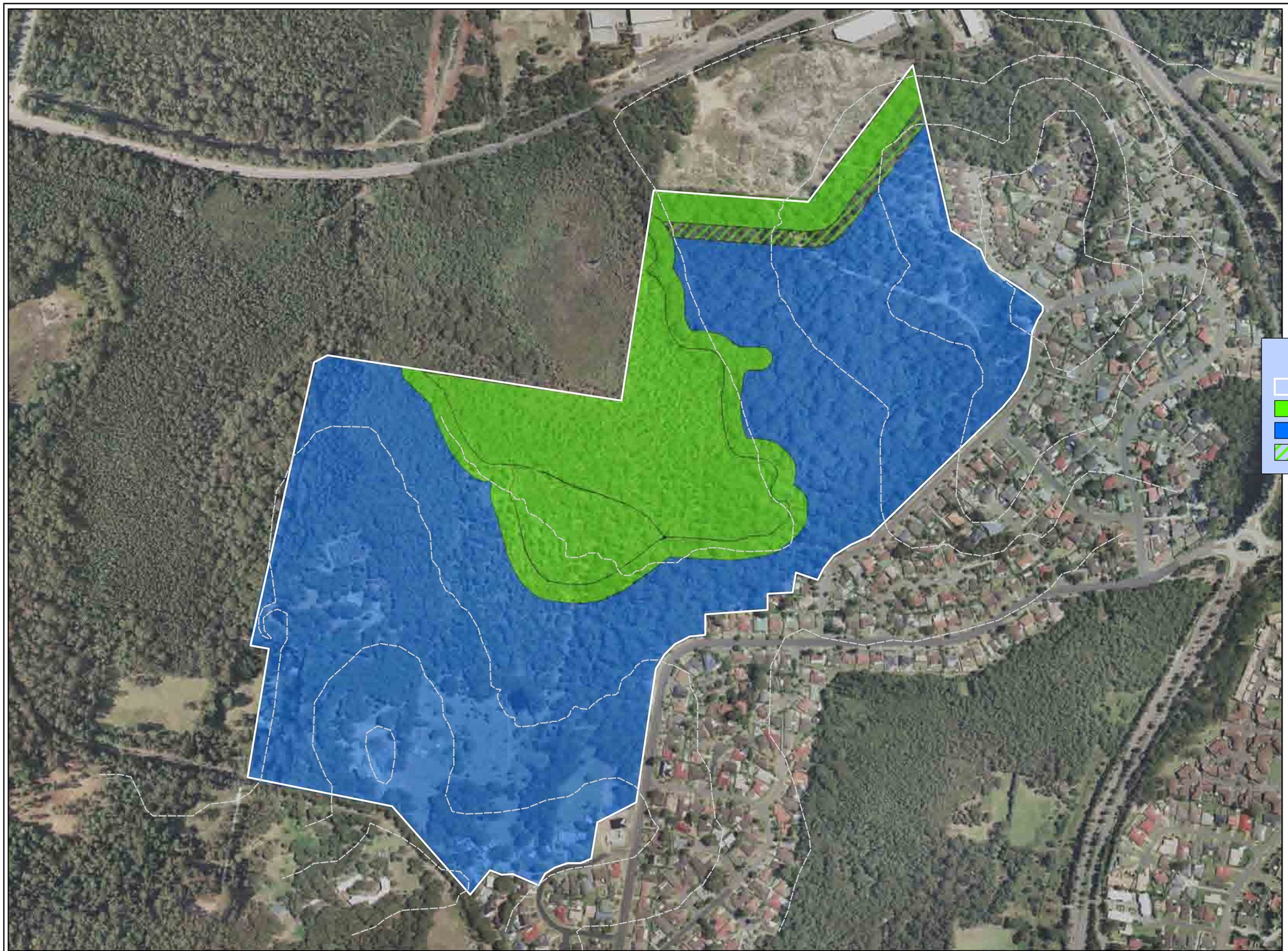
			Date
Drawing No.		A10031F	
Drawn By		TM/BB/KA	09/09/10
Amendment			Date
A	Sensitive vegetation buffer		23/08/10
B	Area calculations		02/09/10
C			

Figure 5 -
Ecological Constraints

Bundeena Road, Glenning Valley

Source: Google Earth Pro, Satellite Imagery.

Location: N:/10031



Flora and fauna survey locations are approximate and have not been fixed by land survey.

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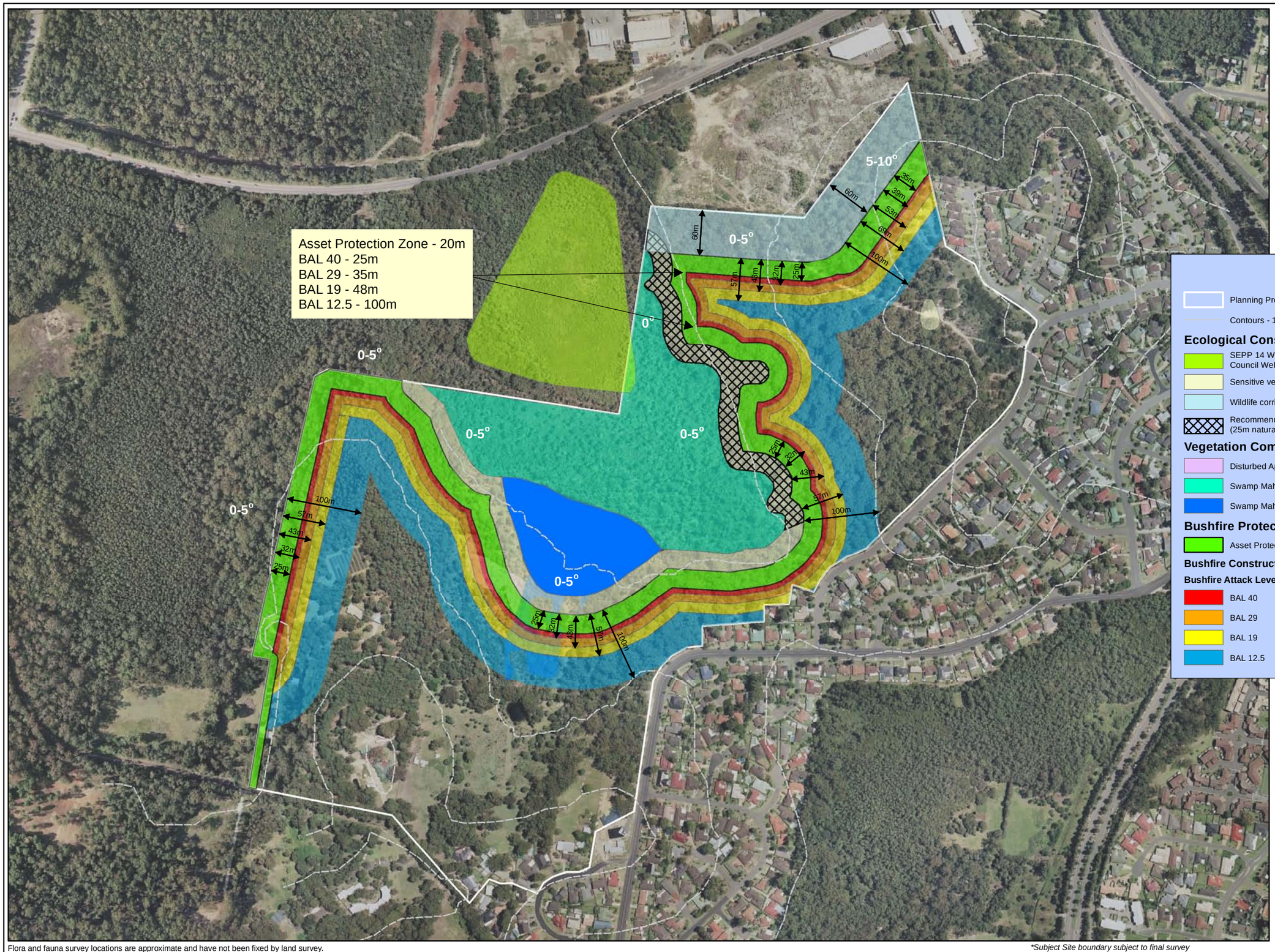
Figure 6 -
Recommended Conservation / Development Areas
Bundeena Road, Glenning Valley

Source: Google Earth Pro, Satellite Imagery.

Location: N:/10031B



Flora and fauna survey locations are approximate and have not been fixed by land survey.

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Figure 7 -

Bushfire Protection Measures

Bundeena Road, Glenning Valley

Source: Google Earth Pro, Satellite Imagery.

Location: N:/10031B

APPENDIX 1

Koala Survey (SEPP 44 Assessment) - Lot 2 DP 1100181.

Biolink Ecological Consultants (2008)

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Koala Survey (SEPP 44 Assessment)

Lot 2 DP 1100181 Bundeena Rd, Glenning Valley



Report to CMF Australia Ltd

November 2008

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Document Control

Draft #	1	**Date**	**Signature**
Prepared by	M. Hopkins	10th November 2008	
Reviewed by	S. Phillips		

Introduction

State Environmental Planning Policy No. 44 (Koala Habitat Protection) commenced on the 13th February 1995, its aim to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline:

a) by requiring the preparation of plans of management before development consent can be granted in relation to areas of *Core Koala Habitat*;
b) by encouraging the identification of areas of *Core Koala Habitat*; and
c) by encouraging the inclusion of areas of *Core Koala Habitat* in environment protection zones.

This report has been prepared for CMF Australia Ltd. and details the results of a koala habitat assessment for a land unit described as Lot 2 DP1100181, Bundeena Road, Glenning Valley in the Wyong Shire Local Government Area (WSLGA) on the central coast of New South Wales. The WSLGA is listed in Schedule 1 of SEPP 44 as lands to which the policy applies. The site in question (see below) has an area of more than one hectare and is thus potentially subject to Part 2 of the Policy (Development Control of Koala Habitats).

Free-ranging koala populations are threatened by a variety of processes including:

- destruction of *Core Koala Habitat* by inappropriate clearing for urban development, roadworks, agricultural and mining activities,
- fragmentation of both *Potential* and *Core Koala Habitat* such that barriers to movement are created that isolate individuals and populations, hence altering population dynamics, impeding gene flow and the ability to maintain effective recruitment levels,
- unsustainable mortalities caused by dog attacks and road fatalities,
- mortalities caused by stochastic events such as fire, and
- degradation of habitat by logging of preferred food trees.

Previous surveys targeting koalas detected faecal pellets, subsequently identified as koala scats, in Blackbutt forest in the north east of the study area. The purpose of this report is to augment preliminary flora and fauna investigations currently being

undertaken by other consultants by specifically focusing on koalas, their habitat and other issues associated with SEPP 44.

Methods

Study area

The site (Figure 1) is approximately 40ha in size and located in the south east of the Wyong Shire LGA, approximately 6km south of Wyong town centre. The site is bordered partially in the north by a new industrial development, to the east and south by residential development and its western boundary is contiguous with a large area of native vegetation which extends southwest from the study area.

Vegetation of the study area

With the exception of a small clearing in the south and a number of informal tracks, the majority of the study area is vegetated and in a relatively undisturbed state. The site supports two main vegetation communities broadly described by other consultants as Blackbutt Open Forest and Swamp Mahogany Woodland. A dense mid-stratum of *Leptospermum* and other shrub species is present throughout much of the study area. A change in vegetation towards the south of the study area reflects a higher level of disturbance and a slight elevation in topography with a structurally simple, mixed species forest and a greater proportion of introduced species present.

Survey methodology

A. Historical Records

Records from the NSW National Parks and Wildlife Service's Wildlife Atlas database for an area of 100km^2 centrally located over the site (centre point 151°25'23.259"E, -33°20'8.253"S) were obtained for the purposes of identifying historical and contemporary koala records of relevance to the study area.

B. Field survey

In order to ensure a uniform and unbiased distribution of sampling effort throughout the study area, a 125m by 125m regularised grid was overlain on a digital image of the study area, the resulting grid-cell intersections at 250m selected as primary sampling points where they intersected remnant patches of native vegetation (Figure 1), the remainder serving as defaults to be sampled in the event that koala activity was recorded and an increase in sampling intensity was required. UTM coordinates for each grid-cell intersection were then determined and programmed into a 12

parallel-channel GPS receiver navigating on the GDA datum to assist their location in the field. Once located, each point was sampled using the Spot Assessment Technique (SAT) of Phillips and Callaghan (Appendix I). Amongst other things, this methodology categorises koala activity for the purposes of SEPP 44, with activity levels greater than 22.52 (23)% being indicative of the presence of *Core Koala Habitat* (refer Appendix 1, Table 2). Regularised Grid-based SAT (RGB-SAT) sampling has proved successful in both capturing koala activity even at low densities, and delineating koala metapopulation boundaries generally; the technique widely used throughout NSW and recently adopted by DECC as a key tool in koala recovery efforts in south-eastern NSW. Figure 2 (below) illustrates the results that can be obtained when koalas are present in an area.

In addition to the formal survey component, field work also included examination of known koala food trees such as Swamp Mahogany *E. robusta* for koalas or signs thereof as such trees were encountered while traversing between sites. Cursory inspections were also undertaken within other parts of the study site.

Bundeena Road koala habitat assessment

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Figure 1. Study area and location of SAT sampling points

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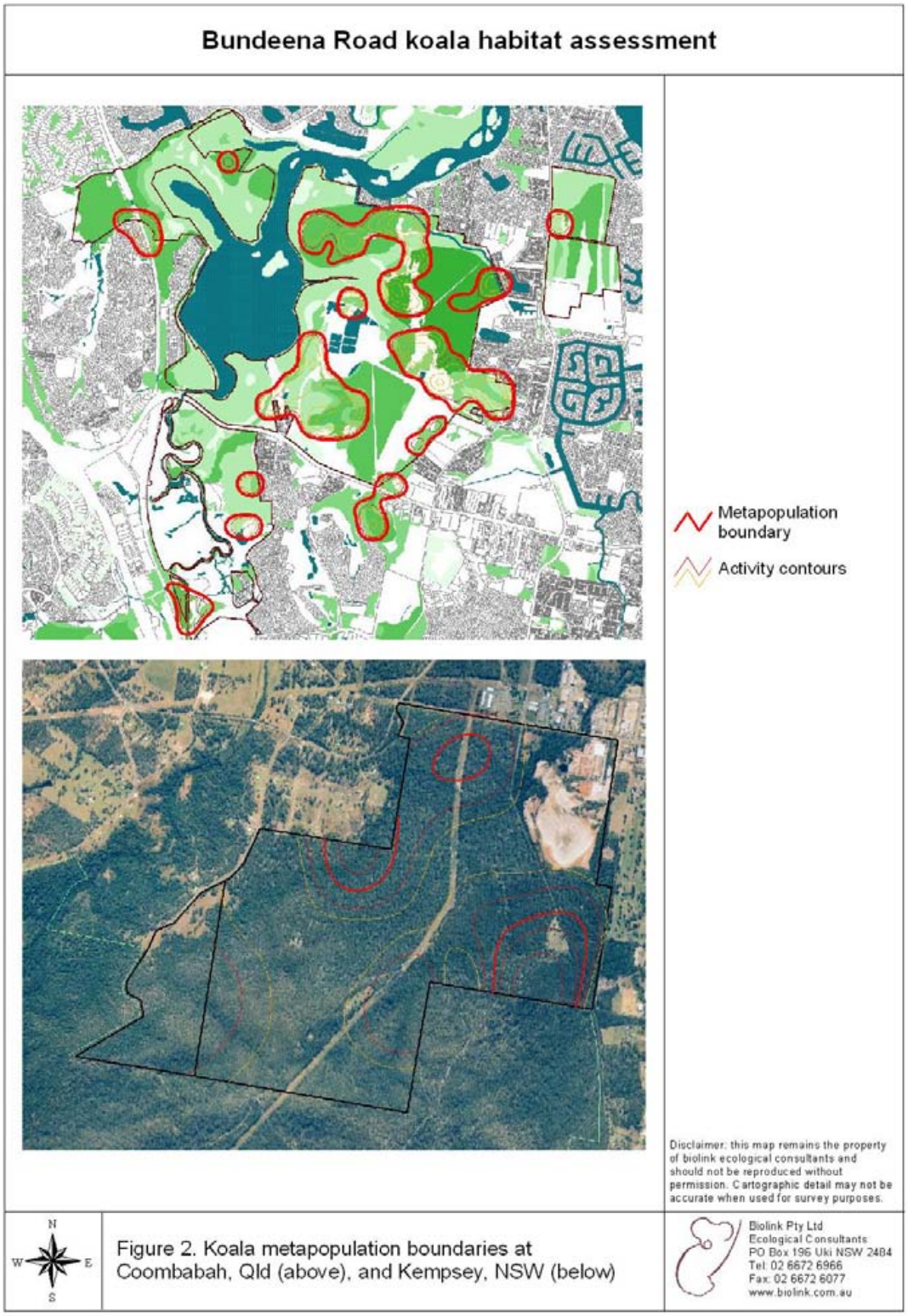
Bundeena Road koala habitat assessment
Metapopulation boundary
Activity contours
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N
W
E
S
Figure 2. Koala metapopulation boundaries at Coombabah, Qld (above), and Kempsey, NSW (below)
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Results

A. Historical records

Our search of the NSW NPWS Wildlife Atlas returned one record of a koala from within the site and an additional seven records within a five kilometre radius from the centre of the site. These records date from 1968 to 2007, with that from 2007 located within the site and another in 2006 approximately 1km to the south. Other records from the surrounding area include scattered historical and recent records to the south in and around Gosford and to the north at Wyong. The location of the known record for the site is illustrated in Figure 3.

B. Field Survey

Field survey was undertaken over the period 29th – 30th October 2008 during which time seven SAT sites were assessed. Collectively, a total of 178 trees were sampled, comprising 4 species from the Genus *Eucalyptus* and at least 13 species of non-eucalypt. Table 1 details the tree species sampled during the course of the field survey.

No koala activity was detected on the site.

Table 1. Number of each tree species sampled for koala faecal pellets during field sampling and number of sites in which the species was recorded.

Species	Common name	Trees sampled	Sites
Eucalypts			
Eucalyptus patentinervis	Swamp Mahogany x Forest Red Gum hybrid	2	1
Eucalyptus pilularis	Blackbutt	17	5
Eucalyptus resinifera	Red Mahogany	2	1
Eucalyptus robusta	Swamp Mahogany	37	2
Non-eucalypts			
Acacia sp	Wattle	5	2
Angophora floribunda	Rough-barked Apple	18	2
Allocasuarina torulosa	Forest Oak	26	4
Corymbia gummifera	Red Bloodwood	20	4
Corymbia maculata	Spotted Gum	2	1
Callistemon salignus	Willow Bottlebrush	1	1
Leptospermum sp	Tea Tree	2	1
Melaleuca linariifolia	Flax-leaved Paperbark	7	2
Melaleuca sp	Paperbark	8	3
Pinus sp	Pine	1	1
Persoonia levis	Broad-leaved Geebung	1	1
Syncarpia glomulifera	Turpentine	28	6
Ceratopetalum gummiferum	Christmas Bush	1	1
Total		**178**	

Bundeena Road koala habitat assessment

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Figure 3. Location of 2007 koala record (from Travers environmental (2008))

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General discussion

Swamp Mahogany *Eucalyptus robusta* is known to be an important primary food tree for koalas throughout the east coast of NSW (Phillips et al 2000) and is listed as a feed tree species on Schedule 2 of SEPP44. Despite the presence of a large area of Swamp Mahogany forest within the study area, which would otherwise be regarded as high-quality koala habitat, no koala activity was recorded in this area or elsewhere within the study area during this survey.

We consider that the 2007 koala record from the site likely represents the sighting of either a dispersing animal from a local resident population or a reflection of occasional transient use of the site. The location of the single faecal pellet recorded prior to this survey from within an area of limited importance to koalas (i.e. Blackbutt forest containing no preferred food tree species) also supports this assertion, and may have originated from the animal referred to above. It is also possible that the pellet was misidentified as Brushtail and Ringtail Possum scats were common throughout this area and can be mistaken for koala scats in some cases.

Conclusion

Core Koala Habitat is a dynamic rather than static phenomenon, the boundaries of which can be expected to change over the course of successive koala “generations”, the measure of which has been estimated to be 5.6 – 7.8 years (Phillips 2000). The direction of such change (i.e. expansion or contraction) is dependent upon several factors including:

- the level of historical disturbance prior to assessment,
- the size and proximity of any other resident population(s),
- the availability of suitable habitat in proximity to that currently being occupied by resident koala populations,
- habitat linkages to assist processes of emigration and recruitment, and
- extant threatening processes.

At this point in time we find no evidence to suggest that *Core Koala Habitat* exists within the study area, and hence there is no need for a Koala Plan of Management to be prepared. That proportion of the study area containing Swamp Mahogany qualifies as *Potential Koala Habitat* and as such we recommend, as a minimum, the maintenance of this portion of the study area in its current state in order to provide for continued availability of the habitat for future expansion and movement of koala populations in the local area.

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Phillips, S. 2000. Population trends and the koala conservation debate. *Conservation Biology* 14(3):650-659

Phillips, S. and Callaghan, J. The Spot Assessment Technique: a tool for determining levels of localized habitat use by Koalas (*Phascolarctos cinereus*). Submitted to *Ecological Management & Restoration*.

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Appendix I

The Spot Assessment Technique

The *Spot Assessment Technique*: a tool for determining levels of localised habitat use by Koalas *Phascolarctos cinereus*.

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Summary

In order to more effectively conserve koalas, the National Koala Conservation Strategy promotes development of reliable approaches to the assessment of koala habitat. This paper describes a localised, tree-based sampling methodology that utilises the presence/absence of koala faecal pellets within a prescribed search area around the base of trees in order to derive a measure of koala activity. Confidence intervals associated with koala activity data from 405 randomly selected field plots within which koala faecal pellets were recorded have been utilised to assign threshold values for three population density/habitat biomes in eastern Australia. Subject to the need for a precautionary approach to data interpretation in areas that support naturally occurring, low-density koala populations, the approach is expected to assist field-based assessments by researchers, land managers and others interested in clarifying aspects of habitat utilisation by free-ranging koalas, especially where identification of important areas for protection and management is required.

Key-words. Spot Assessment Technique, Koala, *Phascolarctos cinereus*, SEPP 44, habitat assessment, survey techniques.

Introduction

The primary aim of the National Koala Conservation Strategy (NKCS) is to conserve Koalas (*Phascolarctos cinereus*) by retaining viable populations throughout their natural range (Australian and New Zealand Environment and Conservation Council (ANZECC) 1998). In order to develop a better understanding of the conservation biology of koalas, Objective three of the NKCS promotes the need for development of consistent and repeatable approaches to assessment of koala populations, in addition to the need for survey work to establish correlates of habitat quality at both broad geographic scales and the individual-tree scale within preferred habitats (ANZECC 1998).

The primary responsibility for conservation of free-ranging koalas and their habitat rests with State, Territory and Local Government authorities. In this regard State Government authorities in New South Wales and Queensland have enacted specific planning policies and/or strategic planning measures to assist koala conservation. However, the ability of these strategies to achieve their stated conservation objectives is hindered in part by the lack of standardised and reproducible methodologies that can be applied to the task of habitat assessment in the first instance.

In this paper we present a technique that we believe contributes to the need for a reliable approach to objectively assessing koala habitat use. An unreviewed progenitor to this work (Phillips and Callaghan 1995) was originally circulated to a limited audience following the Australian Koala Foundation's 1995 conference on the status of Koalas, its purpose at that time to promulgate an approach that could potentially assist field-based assessments by ecological consultants, land managers and others interested in quantifying aspects of habitat utilisation by free-ranging koalas. Much has happened since then such that the purpose of this work is to further refine the initial approach in the light of additional field studies and in so doing, formally supersede the earlier work.

Background to the approach

Traditionally, knowledge relating to habitat utilisation by free-ranging koalas has been reliant on opportunistic observations or radio-tracking data (Robbins and Russell 1978; Martin 1985; Hindell *et al*. 1985; Hindell and Lee 1987; 1988; White and Kunst 1990; Reed *et al*. 1990; Hasegawa 1995; Melzer and Lamb 1996; Pieters and Woodhall 1996). In other instances, emphasis has been placed on benign indicators such as accumulated faecal pellet counts (Moon 1990; Munks *et al*. 1996; Pahl 1996). However, both of the preceding approaches can be problematic. Firstly, existing models for determining tree preferences by free-ranging Koalas (Hindell *et al*. 1985) require a number of assumptions to be met which do not appear to hold in heterogeneous forest communities (Phillips 1999;

Ellis *et al.* 2002). Secondly, while accumulated faecal pellet counts can elucidate issues of koala abundance (Sullivan *et al*. 2002, 2004), they have proved of limited value when used to infer the importance of various tree species, (Munks *et al*. 1996; Pahl 1996). The ability to census and interpret faecal pellet deposits can also be influenced by other variables including visibility, tree morphometrics and insect activity (Achurch 1989; Melzer *et al*. 1994; Pahl 1996; Ellis *et al*. 1998; Sullivan *et al.* 2003). Scratch marks on trees are also an unreliable indicator of habitat use – they cannot be detected on some species whereas others retain them for long periods of time, nor is it always possible to confidently distinguish Koala scratches from those of other arboreal animals.

Studies of free-ranging koalas have established that those in stable breeding aggregations arrange themselves in a matrix of overlapping home range areas (Lee and Martin 1988; Faulks 1990; Mitchell 1990). Home range areas vary in size depending upon the quality of the habitat (measurable in terms of the density of preferentially utilised food tree species) and the sex of the animal (males tend to have larger home range areas than females). Long-term fidelity to the home range area is generally maintained by adult koalas in a stable population (Mitchell 1990; Phillips 1999, Kavanagh *et al*. 2007). An additional feature of home range use is the repeated use of certain trees, some of which may also be utilised by other koalas in the population (Faulks 1990; Mitchell 1990; Phillips 1999; Ellis *et al*. 2002).

Given the preceding considerations, it follows that areas being utilised by resident koala populations must also be characterised by a higher rate of faecal pellet deposition (see Lunney *et al.* 1998). For the purposes of this paper, we propose the term "areas of major activity" to describe such localities, regarding them as synonymous with the term “*Core Koala Habitat*” as defined by the NSW Government’s *State Environmental Planning Policy No. 44 (Koala Habitat Protection)*, in addition to being a fundamental element of “Koala Habitat Areas” as defined by the Nature Conservation (Koala) Conservation Plan 2006 and

Management Program 2006 – 2016 (Environment Protection Agency/Queensland National Parks and Wildlife Service 2006).

The Spot Assessment Technique

The Spot Assessment Technique (SAT) is an abbreviated form of a methodology developed by the Australian Koala Foundation for purposes of the Koala Habitat Atlas project (Sharp and Phillips 1997; Phillips *et al*. 2000; Phillips and Callaghan 2000). This approach is probability-based and utilises a binary variable (presence/absence of faecal pellets within a prescribed search area around the base of trees) to determine tree species preferences, along with a commensurate measure of koala "activity" (number of trees with faecal pellets present divided by total number of trees in the plot) within a 40m x 40m (1600m^2) plot. Given that the selection of Atlas field plots is based on replication and stratification by soil landscape and vegetation associations in the first instance, the data presented for the purposes of this paper reflects a random selection of field sites within which koala faecal pellets were recorded. The SAT approach arose from observations of consistency within the four smaller (20m x 20m) sub-quadrats that otherwise comprise Atlas field plots and the consequent realisation that a smaller plot size would essentially provide the same empirical outcomes in terms of both tree species/faecal pellet associations and koala activity. However, the number of trees sampled in a smaller site is critical to any meaningful estimate of activity hence we have adopted the latter as the more important variable for the purposes of this technique.

Table 1 details results from Atlas plots that have been undertaken across a variety of habitat types and landscapes utilised by koalas in eastern Australia. To this end, while significant differences between mean activity levels from low and medium - high density Koala populations of the eastern seaboard are believed to reflect real differences in habitat quality and thus koala density (Table 1 - Southeast Forests/Campbelltown *vs* Port Stephens/Noosa: Levene's test: $F = 0.086$, $P > 0.05$; $t = -7.877$, $P < 0.001$), we submit that similar differences

between medium - high density populations of the eastern seaboard and those from more western areas (areas generally receiving less than 600mm of rainfall annually) (Port Stephens/Noosa vs Pilliga/Walgett – Levene's test: $F = 0.925$, $P > 0.05$; $t = -4.743$, $P < 0.001$), more likely reflect differences in faecal pellet longevity as a consequence of aridity than they do habitat quality *per se*.

The SAT involves an assessment of koala "activity" within the immediate area surrounding a tree of any species that is known to have been utilised by a koala, or otherwise considered to be of some importance for koala conservation and/or habitat assessment purposes. In order of decreasing priority, selection of the centre tree for a SAT site should be based on one or more of the following criteria:-

1. a tree of <u>any species</u> beneath which one or more koala faecal pellets have been observed; and/or
2. a tree in which a koala has been observed; and/or
3. any other tree known or considered to be potentially important for koalas, or of interest for other assessment purposes.

In order to establish a meaningful confidence interval for the activity level of a given SAT site, a <u>minimum</u> of thirty (30) trees must be sampled. For assessment purposes, a tree is defined as "*a live woody stem of any plant species (excepting palms, cycads, tree ferns and grass trees) which has a diameter at breast height (dbh) of 100mm or greater*" (Phillips *et al*. 2000). In the case of multi-stemmed trees, at least one of the live stems must have a diameter at breast height over bark (dbhob) of 100 millimetres or greater.

Applying the SAT

1. Locate and uniquely mark with flagging tape a tree (the centre tree) that meets one or more of the abovementioned selection criteria;
2. differentially mark the 29 nearest trees to that identified in Step 1,

3. undertake a search for koala faecal pellets beneath each of the marked trees based on a cursory inspection of the undisturbed ground surface within 100 centimetres[1] from the base of each tree, followed (if no faecal pellets are initially detected) by a more thorough inspection involving disturbance of the leaf litter and ground cover within the prescribed search area.

An average of approximately two person minutes/tree should be dedicated to the faecal pellet search. In practice, more time will be spent searching beneath larger trees than smaller trees. For assessment purposes, the search should be concluded once a single koala faecal pellet has been detected or when the maximum search time has expired, whichever happens first. This process should be repeated until each of the 30 trees in the site has been assessed. Where the location of faecal pellets falls within overlapping search areas brought about by two or more trees growing in close proximity to each other, both should be positively scored for pellet(s). For more detailed reporting purposes, information relating to the site's location (UTM co-ordinates or Lat/Long), selection criteria, tree species assessed (and their dbh), and the radial area searched should also be recorded. Faecal pellets should not be removed from the site unless some verification (i.e. that they are in fact koala faecal pellets) is necessary.

Calculation and interpretation of Koala activity levels

The activity level for a SAT site is simply expressed as the percentage equivalent of the proportion of surveyed trees within the site that had a koala faecal pellet recorded within the prescribed search area. For example, given a sample of 30 trees, 12 of which had one or more faecal pellets recorded within the prescribed search area – the resulting activity level would be determined as 12/30 = 0.4 = 40 per cent.

[1] The minimum distance within which (on average) 50% of the total number of koala faecal pellets beneath the canopy of a given tree will be located (Jones 1994).

From the data sets presented in Table 1, we propose use of mean activity levels ± 99 per cent confidence intervals to define the limits of “normal” koala activity. Based on the threshold values that result we can then recognise three categories of koala activity as detailed in Table 2. Subject to qualifications regarding the need for a precautionary approach to low activity levels in some instances (see below), where the results of a SAT site returns an activity level within the range prescribed for low use, we suggest that the current level of use by koalas is likely to be transitory. Conversely, where a given SAT site returns an activity level within the prescribed range for medium (normal) to high use - the level of use is indicative of more sedentary ranging patterns and is thus within an area of major koala activity.

A precautionary approach to activity levels in low use areas.

Ideally, SAT site activity levels should only be interpreted in the context of location-specific habitat utilisation data (e.g. Lunney *et al*. 1998; Phillips *et al.* 2000; Phillips and Callaghan 2000). Low activity levels recorded in what might otherwise be considered important koala habitat may be a result of contemporary koala population dynamics and/or historical disturbances including logging, mining, fire frequency, agricultural activities and urban development. Such considerations should not necessarily detract from the potential importance of such habitat for longer-term koala conservation, particularly if koala food trees are present and koalas are known to occur in the general area. Application of a "Koala Habitat Atlas" type methodology over the larger area in conjunction with an understanding of ecological history (e.g. Knott *et al.* 1998) would be useful to clarify such issues.

Low activity levels can also be associated with low-density koala populations. Stable, low-density koala populations occur naturally in some areas (Melzer and Lamb 1994; Jurskis and Potter 1997; Phillips and Callaghan 2000; Ellis *et al*. 2002; Sullivan *et al.* 2006). Koala density in such areas generally reflects the absence of “primary” food tree species and reliance by the population on

"secondary" food tree species only (Phillips and Callaghan 2000; Phillips 2000). While secondary food tree species will return significantly higher levels of utilisation when compared to other *Eucalyptus* spp. in the area, their level of use (as determined by field survey) will generally tend to be both size-class and/or density dependent when compared to a primary food tree species (size-class and/or density independent) (Phillips *et al.* 2000; Phillips and Callaghan 2000; Phillips 2000). Because the autecology of koalas occupying habitat areas that do not naturally support one or more "primary" food tree species remains poorly understood at this point in time, we propose a precautionary approach whereby the presence of any activity in areas occupied by naturally occurring, low density populations should be regarded as ecologically meaningful for conservation and management purposes.

Recommended Applications

The SAT can be used in conjunction with land-use planning activities and/or policies that require koalas and their habitat to be assessed, especially where identification of important areas for protection and management is required. The technique is also suitable for monitoring purposes. However, the design and detail of sampling protocols that could be developed using the SAT approach are beyond the scope of this paper. Further information and advice regarding application and use of the SAT, interpretation of activity levels, and its application to the task of determining broad-scale tree species preferences, can be supplied if required. The authors would also be thankful for any feedback regarding application of SAT methodology for any of the purposes indicated in this paper.

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We are indebted to the many individuals and organisations that have generously given their time, energy and support to Koala Habitat Atlas field projects over the years. We also appreciate the constructive criticism provided by colleagues who have reviewed various drafts of this paper; the final work has benefited greatly as a result.

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Table 1. Mean activity levels and related measures of central tendency (expressed as percentage equivalents) associated with habitat utilisation by Koalas from six areas in eastern Australia. Data relates to sites within which koala faecal pellets were recorded and has been pooled to reflect three major categories of Koala activity which correspond to low and med-high density Koala populations of the tablelands and areas east of the Great Dividing Range, and those of more western areas respectively. Koala densities for the east coast, low density category are arbitrarily defined at ≤ 0.01 Koalas/ha. (Data sources: [1]South-east Forests Conservation Council, unpub. data; [2]Phillips and Callaghan 1997; [3]Phillips and Callaghan 2000; [4]Phillips *et al*. 1996; [5]Phillips *et al*. 2000; [6]AKF, unpub.data; [7]Phillips 1999; [8]AKF unpub. data; [9]AKF unpub. data).

Area	Pop. Density	No. sites	No. trees	A/level	SD	SE	99% CL
East Coast							
S/E Forests[1]	Low	111	2979	11.85	6.84	0.65	1.70
Campbelltown[2, 3]	Low	20	1194	6.52	4.72	1.06	3.02
Pooled		**131**	**4173**	**11.03**	**6.82**	**0.60**	**1.56**
East Coast							
Port Stephens[4, 5]	Med - high	76	3847	23.65	23.63	2.71	7.16
Noosa[6]	Med - high	63	1647	32.55	22.05	2.78	7.38
Pooled		**139**	**5494**	**27.68**	**23.27**	**1.97**	**5.16**
Western Plains							
Pilliga[7, 8]	Med - high	98	3656	42.52	22.78	2.30	6.05
Walgett[9]	Med - high	37	990	38.01	27.66	4.55	12.37
Pooled		**135**	**4646**	**41.28**	**24.19**	**2.08**	**5.44**

Table 2. Segregation of Koala activity into Low, Medium (normal) and High use categories based on use of mean activity level ± 99 per cent confidence intervals (nearest percentage equivalents) from each of the three area/population density categories indicated in Table 1.

Activity category	Low use	Medium (normal) use	High use
Area (density)			
East Coast (low)	< 9.47%	≥ 9.47% but ≤ 12.59%	> 12.59%
East Coast (med – high)	< 22.52%	≥ 22.52% but ≤ 32.84%	> 32.84%
Western Plains (med – high)	< 35.84%	≥ 35.84% but ≤ 46.72%	> 46.72%

APPENDIX 2

Target Survey for Powerful Owl and White-bellied Sea Eagle at Berkeley Vale

John Young Wildlife

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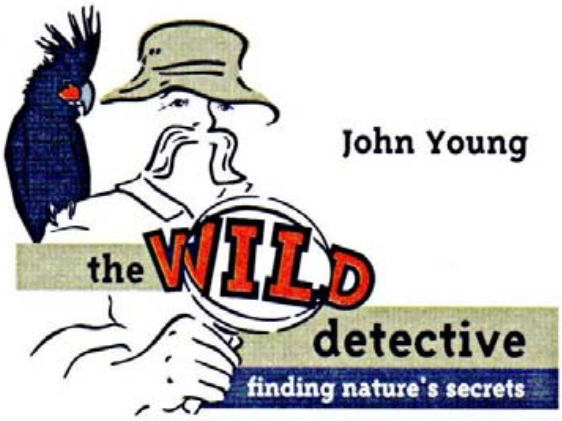

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Target Survey for Powerful Owl and White-bellied Sea Eagle at Berkeley Vale
Report compiled by – John Young

Background

I am aware that the subject site includes lands totalling approximately 53.38ha and bound within Bundeena Road, Bottlebrush Drive, Torrellia Way, Enterprise Drive and Berkeley Road, Berkeley Vale.

I am also aware that Travers bushfire & ecology has undertaken fauna surveys across the entire subject site and Powerful Owl was recorded responding to call-playback on the 16th March 2009. White-bellied Sea Eagle was also recorded on most days during more recent surveys during May and June 2010.

Whitewash considered to be consistent with both species was recorded at a number of locations within the subject site during survey however no nesting locations were located for either bird.

I was contacted to assist in undertaking supplementary target survey for the Powerful Owl and White-bellied Sea Eagle to determine the level of site utilisation and importance. A

raptor nest was also located; as the resident species was unknown assistance was required in identification.

Supplementary Target Survey

A site inspection and supplementary survey was undertaken from the 10th – 13th August 2010.

The sites habitat features were inspected. All white wash locations were also inspected. The following species specific inspections were made:

Powerful Owl

- Presence and potential for use of the subject site.
- Nocturnal survey after dusk on the 11th & 12 August 2010.
- Trees identified by Travers bushfire & ecology as containing hollows potentially suitable for Powerful Owl nesting.
- Suitable roosting habitat locations within the subject site.
- Suitability of connective habitats to the south-west towards and within Pleasant Valley, Fountaindale.

White-bellied Sea Eagle

- Search for nesting location.
- Use of locality based on nest location, available habitat, flight observations and perch locations.

Other Avarian species

- Raptor nest species survey using raptor call-playback of potential residing species and morning observations.
- Other threatened or protected bird species not previously recorded within the site.

Findings

Powerful Owl

- The site is not currently being utilised by Powerful Owl for nesting purposes.
- The site has potential for use for foraging and roosting however whitewash recorded within the site during the recent breeding period is not from this species. Higher quality nesting and roosting habitat is located on the other side of Berkeley Road to the south-west. A male was heard calling emerging from roosting on the night of the 18th August 2010 within Pleasant Valley, Fountaindale located approximately 1.4km to the south-west of the subject site.
- The owl recorded by Travers bushfire & ecology responding to call-playback in March 2009 was likely called off a nearby mountain to the south-west. Although the response time was short it would only take this species about 30 seconds to travel a distance of 1km.
- Travers bushfire & ecology were precautionary in their selection of suitable nesting trees within the subject site. A number of these trees are considered by me to be unsuitable. Of the majority of these trees I observed, habitat trees #29, #73 & #89 are suitable for Powerful Owl. There is evidence of previous logging within the site which is likely the cause of a very low density of suitable large hollows.

White-bellied Sea Eagle

- The White-bellied Sea Eagle's nest was located in a small rise of Blackbutt forest on the western edge of the paperbark wetland area. This nest is located within a large Red Bloodwood (*Corymbia gummifera*) approximately 87m to the north of the subject site boundary and is adequately buffered.
- The large areas of whitewash identified within the site belong to this species.

Other Species

- The raptor nest observed belongs to Brown Goshawk (*Accipiter fasciatus*). This species is not threatened or of national significance.
- No other threatened or protected bird species were recorded within the subject site.
- The Varied Sittella (*Daphoenositta chrysoptera*) was recorded on the ridge to the other side of Berkeley Road. Behaviour indicated nesting nearby.
- The Yellow-bellied Glider (*Petaurus australis*) was recorded emerging from a tree also located on this ridge during nocturnal survey. Diurnal inspections revealed chew marks on the den tree. This ridge contained numerous large hollow-bearing trees as well as other habitat features to warrant high conservation values. Yellow-tailed Black Cockatoo and Sulphur-crested Cockatoo were also observed nesting in hollows present along this ridge.

Recommendations

The whitewash located below a large Turpentine along trap-line 12 is a regularly used roosting location for the White-bellied Sea Eagle. A 15 metre buffer should be provided around this large Turpentine (main Sea Eagle Roost tree) connected to a 25 metre protected corridor of Blackbutt Forest (as per Figure 4) which borders the edge of the existing wetland – encompassing the White Breasted Sea Eagles nest.

Habitat tree #43 is of an exceptional size to be utilised as an outlook perch by Sea Eagle. This tree has been previously observed to be utilised by the species and should be retained with a small protected area of maybe 5 metres around its base so heavy machinery does not damage the root system.

The Blackbutt Open Forest that fringes the eastern edge of the paperbark wetland area provides high perching potential for White-bellied Sea Eagle and should be conserved at a minimum width of 25 metres (as per Figure 4).

A corridor along the northern boundary of the eastern portions of the site (fringing the industrial area off Enterprise Drive to the north) should be at least 60m in width to facilitate White-bellied Sea Eagle roosting perches on nearby upper-slopes and encourage continued use of this naturally vegetated flyway into the nesting location.

Conclusion

Between the 10th to 13th of August 2010 – an extensive search of the above development site was undertaken by myself in the company of Corey Mead from *Travers bushfire & ecology* to search for the White Breasted Sea-Eagles nest and more so – to clarify if indeed a pair of Powerful Owls (Ninox Strenua) occurred on or were utilizing the site.

After analizing the Sea-Eagles' movement and seeing one of the adults fly into the wetland twice during this period – Corey Mead discovered the nest – I believe with eggs or small young – at the listed location.

Regarding the Powerful Owl that was drawn to the south eastern section of the site by call playback many months earlier – I believe that this individual was drawn in from maybe more than 1 and a half kilometres to the west from a ridge top as it was patrolling the eastern border of its territory which we now know is in another valley well away from the development site.

It is my opinion after working with this species for more than 40 years that this development site will have No impact on the owls what so ever – as their territory centre is maybe 1 kilometre west of the western boundary of the development site.

After examining the site – thoroughly looking at all hollow-bearing trees that Corey had already discovered – I am totally confident that the few hollows on the site are of poor quality – except for 1 - and would only be used by Boobook Owls.

Sincerely

John Young

John Young
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27th August 2010