

PH (02) 4344 2100  
FAX (02) 4344 3289  
MOBILE (0418) 647 581

## DISTRIBUTION

Planning Proposal for a Low Density Residential rezoning at  
Part of No 165 (Lot 51 DP 11995704) Louisiana Road  
Wadalba

| COPIES | RECIPIENT                                                      | COPIES | RECIPIENT                                                                                              |
|--------|----------------------------------------------------------------|--------|--------------------------------------------------------------------------------------------------------|
| 1      | <b>Wyong Shire Council</b><br>Hely Street<br>Wyong<br>NSW 2259 | 1      | <b>Threshold Developments Pty Ltd</b><br>C/- Mr Terry Moran<br>P O Box 433<br>Paradise Point, Qld 4216 |

Prepared by  
**Optima Developments Pty Ltd**  
Town Planning and Development Consultants  
P O Box 3136  
Umina Beach  
NSW 2257



12 January 2016

Chris Oliver  
Director/Principal Consultant  
MPIA CPP 7762

# **LOW DENSITY RESIDENTIAL PLANNING PROPOSAL**

**FOR PART OF PRECINCT 3A NORTH WYONG SHIRE STRUCTURE PLAN**

**AT**

**Part of No 165 (LOT 51 DP 1195704) LOUISIANA ROAD,  
WADALBA**

**FOR**

**OWNER: Threshold Development Pty Ltd**

Prepared by  
Optima Developments Pty Ltd  
Town Planning & Development Consultants  
11 Alfred Street  
Umina Beach, NSW 2257  
P.O. Box 3136  
Umina Beach, NSW 2257  
Ph (02) 4344 2100  
Mobile 0418 647581  
Email: [optimapl@bigpond.net.au](mailto:optimapl@bigpond.net.au)



***Part Two of Three***

## Planning Proposal

Part of No 165 (Lot 51 DP 1185704) Louisiana Road Wadalba

### Contents

#### Part One

|                  |                                                                                                                                             |           |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>Section 1</b> | <b>Objectives and Intended Outcomes</b>                                                                                                     | <b>1</b>  |
|                  | 1.1 Introduction                                                                                                                            | 1         |
|                  | 1.2 Planning History and Background                                                                                                         | 3         |
|                  | 1.3 Site Location                                                                                                                           | 4         |
|                  | 1.4 Physical Characteristic                                                                                                                 | 4         |
| <b>Section 2</b> | <b>Explanation of Provisions</b>                                                                                                            | <b>5</b>  |
| <b>Section 3</b> | <b>Justification</b>                                                                                                                        | <b>5</b>  |
|                  | 3.1 Need for the Planning Proposal                                                                                                          | 5         |
|                  | 3.2 Relationship to Strategic Planning Framework                                                                                            | 12        |
|                  | 3.3 Environmental, Social and Economic Impact                                                                                               | 17        |
|                  | 3.4 State and Commonwealth Interest                                                                                                         | 26        |
| <b>Section 4</b> | <b>Conclusion and Recommendation</b>                                                                                                        | <b>27</b> |
| <b>Section 5</b> | <b>Attachments and Supporting Documentation</b>                                                                                             | <b>28</b> |
|                  | 1 Plans                                                                                                                                     | 29        |
|                  | 2 Assessment Against Centres and Housing Actions of CCRS                                                                                    | 39        |
|                  | 3 Assessment on CCRS Sustainability Criteria for New Land Release                                                                           | 46        |
|                  | 4 Assessment of Actions of the CCRS dealing with the Environment, Heritage, Recreation and Natural Resources and Natural Hazard components. | 50        |
|                  | 5 Assessment of Goals of draft Central Coast Regional Plan                                                                                  | 57        |
|                  | 6 Assessment of Section 117 Directions.                                                                                                     | 64        |

#### Part Two

#### Section 5 Attachments and Supporting Documentation

- 7 Ecological Assessment

#### Part Three

#### Section 5 Attachments and Supporting Documentation

- 8 Archaeological Assessment
- 9 Bushfire Assessment
- 10 Traffic Impact Assessment
- 11 Development Contributions report

## Section 5 Attachments and Supporting Documentation

The following documentation is provided in support of this Planning Proposal.

| Document No<br>Part One   | Title Reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Page No                                                  | Attached |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|----------|
| 1                         | Plans <ul style="list-style-type: none"> <li>a. Proposed Draft WLEP 2013 Zoning and Lot Size Maps</li> <li>b. Extract from original WELOG Study Area and draft Zoning map</li> <li>c. Existing WLEP 2013 Zoning map</li> <li>d. Wadalba Wildlife Corridor plans</li> <li>e. Draft Development Subdivision plan</li> <li>f. Extract of approved dwelling DA/1040/1013</li> <li>g. Locality aerial photograph</li> <li>h. Ecological survey locations and results</li> <li>i. plan of Bushfire Protection Measures</li> </ul> | 29<br>30<br>31<br>32<br>33<br>34<br>35<br>36<br>37<br>38 | √        |
| 2                         | Assessment against Centres And Housing Actions of CCRS                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 39                                                       | √        |
| 3                         | Assessment on CCRS Sustainability Criteria for New Land Release                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 46                                                       | √        |
| 4                         | Assessment of Actions of the CCRS dealing with the Environment, Heritage, Recreation and Natural Resources and Natural Hazard components.                                                                                                                                                                                                                                                                                                                                                                                   | 50                                                       | √        |
| 5                         | Assessment of Goals of Draft CCRP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 57                                                       | √        |
| 6                         | Assessment of Section 117 Directions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 64                                                       | √        |
| Document No<br>Part Two   | Title Reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                          | Attached |
| 7                         | Ecological Assessment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                          | √        |
| Document No<br>Part Three | Title Reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                          | Attached |
| 8                         | Aboriginal Heritage Assessment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                          | √        |
| 9                         | Bushfire Assessment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          | √        |
| 10                        | Traffic Impact assessment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                          | √        |
| 11                        | Development Contributions Report                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                          | √        |

## ATTACHMENT 7

### ECOLOGICAL ASSESSMENT

# Ecological Assessment

For

Proposed Rezoning of

Part Lot 51 DP 1195704  
165 Louisiana Road, Wadalba NSW

By

**EverittEcology**

| Job Details            |                                           |                                |                                                      |                                   |
|------------------------|-------------------------------------------|--------------------------------|------------------------------------------------------|-----------------------------------|
| Client                 | Threshold Developments Pty Ltd            |                                |                                                      |                                   |
| Author                 | Nicholas Everitt - Everitt Ecology        |                                |                                                      |                                   |
| Contributors           | Garon Staines - Future Ecology            | Anna McConville - Echo Ecology | Rickie Eggleton - Everitt Ecology (Fauna Technician) |                                   |
| Type of Contribution   | Flora Surveys (Quadrats + random meander) | Micro-bat Identification       | Call                                                 | Assistance with stagwatch surveys |
| Report Versions        |                                           |                                |                                                      |                                   |
| Version Type           | Job Number                                | Date                           | Reviewer                                             | Notes                             |
| Draft                  | 141516                                    | 08/12/2015                     | Nicholas Everitt                                     |                                   |
| Final                  | 141516                                    | 05/01/2016                     | Nicholas Everitt                                     |                                   |
| © Everitt Ecology 2016 |                                           |                                |                                                      |                                   |

## EXECUTIVE SUMMARY

Everitt Ecology has been engaged by Threshold Developments Pty Ltd to prepare an Ecological Assessment for the proposed rezoning of Part Lot 51 DP 1195704, 165 Louisiana Road, Wadalba NSW within the Wyong LGA.

In regard to the EPBC Act, no matters of national environmental significance have been recorded by surveys or are considered likely to be impacted either directly or indirectly by the proposed action. The proposed action is unlikely to have a significant impact on any matters of national environmental significance, therefore no referral is required to be submitted to the Australian Government Environment Minister for approval; and

In regard to assessments under the EPA Act, TSC Act and FM Act, it is considered that the proposal is unlikely to have a significant impact on any threatened species, populations or endangered ecological communities. Therefore it is considered that a Species Impact Statement is not required.

A summary of the results and conclusions of the assessment are provided below:

### Vegetation and Condition

- The subject site contains a partially cleared and disturbed area of Tall Open Forest vegetation dominated by *Corymbia maculata* (Spotted Gum) and *Eucalyptus siderophloia* (Grey Ironbark) consistent with 'Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30)' (Bell, 2002). The area of the proposed rezoning is considered to be in low condition due to the presence of weeds, clearing and underscrubbing activities and previous landuse;

### Local and Regional Significance

- The proposal will remove approximately 1.75ha of disturbed 'Narrabeen Dooralong Spotted Gum-Ironbark Forest', while approximately 0.96ha of similar less disturbed habitat will be retained as part of a E2 zoned area along western side of the subject site;
- Approximately 92ha of habitats similar to those within the subject site occur within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east (Refer to Figures 1 & 4). Approximately 40ha of these similar habitats are secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of similar habitats secured within the immediate local area;

- In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002);

#### Flora and Ecological Communities

- The vegetation community identified within the subject site is not consistent with any endangered ecological community listed under the TSC Act and/or EPBC Act;
- No threatened flora species listed under either the TSC Act or the EPBC Act were recorded within the subject site;

#### Fauna

- A total of ten (10) hollow-bearing trees, containing a mixture of mostly small (<10cm) to medium (10-20cm) sized hollows are likely to be impacted by the proposal (Refer to Figure 3 & 5; section 4.4.1);
- Five (5) threatened fauna species listed as Vulnerable under the TSC Act, including *Calyptrorhynchus lathamii* (Glossy Black-cockatoo), *Miniopterus australis* (Little Bentwing-bat), *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat), *Mormopterus norfolkensis* (Eastern Freetail-bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat) were recorded within or in close proximity to the subject site during surveys;
- *Calyptrorhynchus lathamii* (Glossy Black-cockatoo) was observed to the south of the subject site within the Wadalba Wildlife Corridor and foraging evidence (chewed cones of *Allocasuarina torulosa*) were recorded in two (2) locations, one being just within the southern boundary of the subject site (Refer to Figure 3). Two (2) additional fruiting specimens of *Allocasuarina torulosa* were observed within the subject site, neither of which contained any evidence of foraging. Two (2) potential nesting hollows (within HT4 & HT6; refer to Table 7 & Figure 3) were recorded within the subject site, both of which were inhabited by other common species and are unlikely to be utilised by Glossy Black-cockatoo;
- In regard to threatened micro-bat species recorded, no roosting locations were located. The hollow-bearing trees located within the subject site are unlikely to provide seasonal roosting sites, however they are likely to provide potential temporary roosting locations (Refer to Figure 3 & Table 7);
- No potential nesting hollows for threatened Owl species, Powerful Owl and Masked Owl, were recorded within the subject site. No Owl roosting evidence was observed during detailed searches conducted in August, 2015. The E2 zoned area is considered to provide potential roosting habitat for these Owl species, however the disturbed, open and underscrubbed areas of the proposed

- rezoning area are unlikely to provide potential roosting habitat. General fauna surveys also indicated a low abundance of preferred prey species within the proposed rezoning area;
- Three (3) regionally significant fauna species, *Petaurus breviceps* (Sugar Glider), *Vespadelus pumulis* (Eastern Forest Bat) and *Lewinia pectoralis* (Lewins Rail) were recorded within the proposed rezoning area, with an additional two (2) regionally significant species, *Tachyglossus aculeatus* (Short-beaked Echidna) and *Tyto alba* (Barn Owl), recorded within the E2 zoned area and to the west of the subject site respectively. No nest or roost locations of these species, apart from Sugar Glider, were recorded within the proposed rezoning area;
  - Sugar Gliders were observed utilising HT10. It is considered that the small branch hollow in HT10 is an established nest site for Sugar Gliders and is likely to be used intermittently along with other hollows most likely within the E2 zoned area (Refer to Figure 3 & Table 7). Given that recommendations are implemented, in particular the installation of compensatory natural nest boxes, it is considered that the proposal is unlikely to have a significant impact upon this local population of Sugar Gliders;
  - No critical habitat listed under the critical habitat register or as defined under the NSW TSC Act occurs within or in close proximity to the subject site;

#### Corridors

- Overall the greatest impact of the proposal on corridors will be a reduction in wider sections of the 'local conservation link' to patch 1 in the north, by the creation of a 55m wide corridor, being the E2 zoned area (Refer to Figure 4). This will reduce the total area of the corridor, creating a longer narrow section, which will naturally increase this area's vulnerability to disturbance through edge effects and predation. The proposal will however secure a 175m long unbroken section with the narrowest width being 55m (approximately 25m wider than parts of the 'local conservation link' to the north), and therefore will not cause a reduction in the narrowest width of this link (Refer to section 4.4.1);
- It is considered that the proposal is unlikely to cause a significant reduction in the functionality or utilisation of the Wadalba Wildlife Corridor and associated local conservation links. Recommendation regarding the future management and improvement of corridors is provided in section 7.2;

#### Biodiversity Offsets

- It is recommended that fifteen (15) natural nesting boxes be installed within the adjoining area of Wadalba Wildlife Corridor and E2 zoned area (drainage corridor) at least 3 months prior to the

commencement of clearing works (Refer to section 7.2), to offset the removal of ten (10) hollow-bearing trees.

- In review of the 'Office of Environment and Heritage principles for the use of biodiversity offsets in NSW' (OEH, 2015a), it is considered that no further offsetting is required.

Recommendations have been made to minimise and mitigate likely or potential impacts of the proposal. These are provided in section 7.2.

## Table of Contents

|                                                                           |    |
|---------------------------------------------------------------------------|----|
| Executive Summary.....                                                    | ii |
| 1 Introduction .....                                                      | 12 |
| 1.1 Licensing and Qualifications .....                                    | 12 |
| 1.2 Site Description .....                                                | 12 |
| 1.3 Development Proposal.....                                             | 14 |
| 1.4 Aims and Objectives.....                                              | 17 |
| 2 Statutory Requirements .....                                            | 18 |
| 2.1 Commonwealth Legislation .....                                        | 18 |
| 2.1.1 Environment Protection and Biodiversity Conservation Act 1999 ..... | 18 |
| 2.2 NSW State Legislation .....                                           | 19 |
| 2.2.1 Environmental Planning and Assessment Act 1979 .....                | 19 |
| 2.2.2 Threatened Species Conservation Act 1995.....                       | 20 |
| 2.2.3 Fisheries Management Act 1994.....                                  | 20 |
| 2.2.4 Native Vegetation Act 2003.....                                     | 20 |
| 3 Methodology.....                                                        | 22 |
| 3.1 Database Review .....                                                 | 22 |
| 3.2 Flora and Fauna Survey .....                                          | 22 |
| 3.2.1 General Flora Survey .....                                          | 29 |
| 3.2.2 Orchid Survey.....                                                  | 29 |
| 3.2.3 Fauna Survey.....                                                   | 30 |
| 3.2.4 Compliance .....                                                    | 33 |
| 3.2.5 Survey Limitations.....                                             | 44 |
| 3.2.6 Nomenclature .....                                                  | 45 |
| 4 Results and Discussion .....                                            | 46 |

|       |                                                                                               |    |
|-------|-----------------------------------------------------------------------------------------------|----|
| 4.1   | Database Review .....                                                                         | 46 |
| 4.2   | Document and Planning Review .....                                                            | 47 |
| 4.2.1 | State Environmental Planning Policy (SEPP) .....                                              | 47 |
| 4.2.2 | Local Plans .....                                                                             | 47 |
| 4.2.3 | Previous Studies .....                                                                        | 49 |
| 4.2.4 | Vegetation Mapping .....                                                                      | 50 |
| 4.3   | Flora and Fauna Surveys.....                                                                  | 51 |
| 4.3.1 | Flora .....                                                                                   | 51 |
| 4.3.2 | Vegetation Communities .....                                                                  | 53 |
| 4.3.3 | Fauna .....                                                                                   | 56 |
| 4.4   | Habitat & Connectivity.....                                                                   | 62 |
| 4.4.1 | General Habitat Assessment .....                                                              | 62 |
| 4.4.1 | Corridor Assessment .....                                                                     | 65 |
| 4.4.2 | Squirrel Glider Habitat Assessment.....                                                       | 71 |
| 4.4.3 | Koala Habitat Assessment .....                                                                | 74 |
| 5     | Threatened Species, Populations or Endangered Ecological Communities .....                    | 76 |
| 5.1.1 | Threatened Entities Recorded .....                                                            | 76 |
| 5.1.2 | Threatened Entities Assessed in 7-part Test 'Assessment of Significance' .....                | 76 |
| 6     | Assessment of impacts .....                                                                   | 78 |
| 6.1   | Environmental Protection and Biodiversity Conservation Act 1999.....                          | 78 |
| 6.2   | Threatened Species Conservation Act 1995 & Environmental Planning & Assessment Act 1979 ..... | 78 |
| 6.3   | Direct Impacts .....                                                                          | 79 |
| 6.4   | Indirect Impacts .....                                                                        | 79 |
| 7     | Conclusion and Recommendations .....                                                          | 82 |
| 7.1   | Conclusion .....                                                                              | 82 |
| 7.2   | Recommendations .....                                                                         | 86 |

|   |                 |    |
|---|-----------------|----|
| 8 | References..... | 89 |
|---|-----------------|----|

## Figures

- Figure 1 – Location of Subject Site (pg. 15)
- Figure 2 – Proposed Rezoning with Proposed Subdivision Overlayed (pg. 16)
- Figure 3 – Survey locations and result (pg. 23)
- Figure 4 – Corridor Assessment (pg. 69)
- Figure 5 – Direct Impacts and Ecological Constraints (pg. 81)

## Tables

- Table 1 – Site Details (pg. 12)
- Table 2 – Summary of survey time & effort (pg. 24)
- Table 3 – Flora Survey compliance with WSC Flora and Fauna Survey Guidelines 2014 (pg. 33)
- Table 4 – Fauna Survey compliance with WSC Flora and Fauna Survey Guidelines 2014 (pg. 34)
- Table 5 – Summary of database searches (pg. 46)
- Table 6 – Micro-bats recorded & their known roosting habitats (pg. 58)
- Table 7 - Hollow-bearing Trees (pg. 63)
- Table 8 – Patches of natural vegetation connected to the subject site (pg.70)
- Table 9 – Threatened Species & Populations for Consideration (Appendix 1)
- Table 10 – Ecological Communities for Consideration (Appendix 2)
- Table 11 – Flora Species List (Appendix 5)
- Table 12 – Fauna Species List (Appendix 5)

## **Appendices**

Appendix 1 – Threatened Species & Populations

Appendix 2 – Ecological Communities

Appendix 3 – Protected Matters Report

Appendix 4 – 7-part test 'Assessment of Significance'

Appendix 5 – Flora and Fauna Species Lists

Appendix 6 – Squirrel Glider Habitat Assessment

Appendix 7 – Micro-bat Call Identification Report

Appendix 8 – Photographs

Appendix 9 – Weather Conditions

## Abbreviations

This report may use the following abbreviations:

- APZ - Asset Protection Zone;
- CAMBA - China-Australia Migratory Bird Agreement;
- DECC - Department of Environment & Climate Change NSW (name changed to OEH);
- EP&A Act - Environmental Planning and Assessment Act 1979;
- EPBC Act - Environment Protection and Biodiversity Conservation Act 1999;
- EEC - Endangered Ecological Community;
- EIA - Environmental Impact Assessment;
- FM Act - Fisheries Management Act 1994;
- ha - hectares;
- JAMBA - Japan-Australia Migratory Bird Agreement;
- LEP - Local environmental plan;
- LES - Local Environmental Study;
- LGA - Local Government Area;
- LHCCREMS - Lower Hunter Central Coast Regional Environmental Management Strategy;
- NPWS - National Parks and Wildlife Service;
- NPW Act - National Parks and Wildlife Act 1974;
- NSW - New South Wales;
- OEH - Office of Environment & Heritage (NSW);
- PoM - Plan of management;
- PVP - Property Vegetation Plans;
- RFS - Rural Fire Service;
- ROKAMBA - Republic of Korea-Australia Migratory Bird Agreement;

- SEE - Statement of environmental effects;
- SEPP 14 - State Environmental Planning Policy No. 14–Coastal Wetlands;
- SEPP 19 - State Environmental Planning Policy No. 19– Bushland in Urban Areas;
- SEPP 26 - State Environmental Planning Policy No. 26–Littoral Rainforest;
- SEPP 44 - State Environmental Planning Policy No. 44– Koala Habitat Protection;
- SEPP 71 - State Environmental Planning Policy No. 71 - Coastal Protection;
- SIS - Species impact statement;
- TSC Act - Threatened Species Conservation Act 1995;
- WWC - Wadalba Wildlife Corridor; and
- WSC - Wyong Shire Council.

# 1 INTRODUCTION

Everitt Ecology has been engaged by Threshold Developments Pty Ltd to prepare an Ecological Assessment for the proposed rezoning of Part Lot 51 DP 1195704, 165 Louisiana Road, Wadalba NSW.

## 1.1 Licensing and Qualifications

This work has been undertaken under the following licenses:

- National Parks & Wildlife Act Section 132c Scientific Licence: SL101494; and
- Animal Research Authority - Department of Primary Industries.

The qualifications and experience of personnel involved in this assessment include:

- Nicholas Everitt – Bachelor of Environmental Science – 10 years experience;
- Garon Staines – Bachelor in Applied Science (Coastal Management) – Over 20 years experience;
- Rickie Eggleton – Bachelor of Education – Over 20 years experience in wildlife observations for recreation. Only 6 months experience in ecological surveys; &
- Anna McConville – refer to Appendix 7 for micro-bat call identification report.

## 1.2 Site Description

The subject site is located in Wadalba NSW near the north-eastern corner of the Wadalba Wildlife Corridor. It contains a partially cleared and disturbed area of Narrabeen Dooralong Spotted Gum – Ironbark Forest' (Map Unit 30 - Bell, 2002b) and has a drainage line along the western side. The following Table 1 provides a summary of the site details. The location of the subject site is displayed in Figure 1.

**Table 1 – Site Details**

| Site Details            |                                      |
|-------------------------|--------------------------------------|
| Street Address          | 165 Louisiana Road, Wadalba NSW 2259 |
| Lot and Deposited Plans | Lot 51<br>DP 1195704                 |

| Site Details          |                                                                                                                                                                                                     |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Site Coordinates      | E. 357621 N.6317994                                                                                                                                                                                 |
| Local Government Area | Wyong                                                                                                                                                                                               |
| Determining Authority | Wyong Shire Council                                                                                                                                                                                 |
| Existing Land Use     | None. Currently approved for a single dwelling.                                                                                                                                                     |
| Current Zoning        | RU6 (Transitional Zone) & E2. Refer to Figure 2.                                                                                                                                                    |
| Elevation             | Approximately 30-45m above sea level                                                                                                                                                                |
| Aspect                | The majority of the subject site has a north/north-western aspect, with lower areas in the south-eastern corner and western side of the proposed rezoning area draining east and west respectively. |
| Soils & Geology       | Woodburys Bridge Soil Landscape - Narrabeen Group - Clifton Subgroup - Patonga Claystone                                                                                                            |
| Vegetation            | 'Narrabeen Dooralong Spotted Gum - Ironbark Forest' (Map Unit 30) as described by Bell (2002b)                                                                                                      |

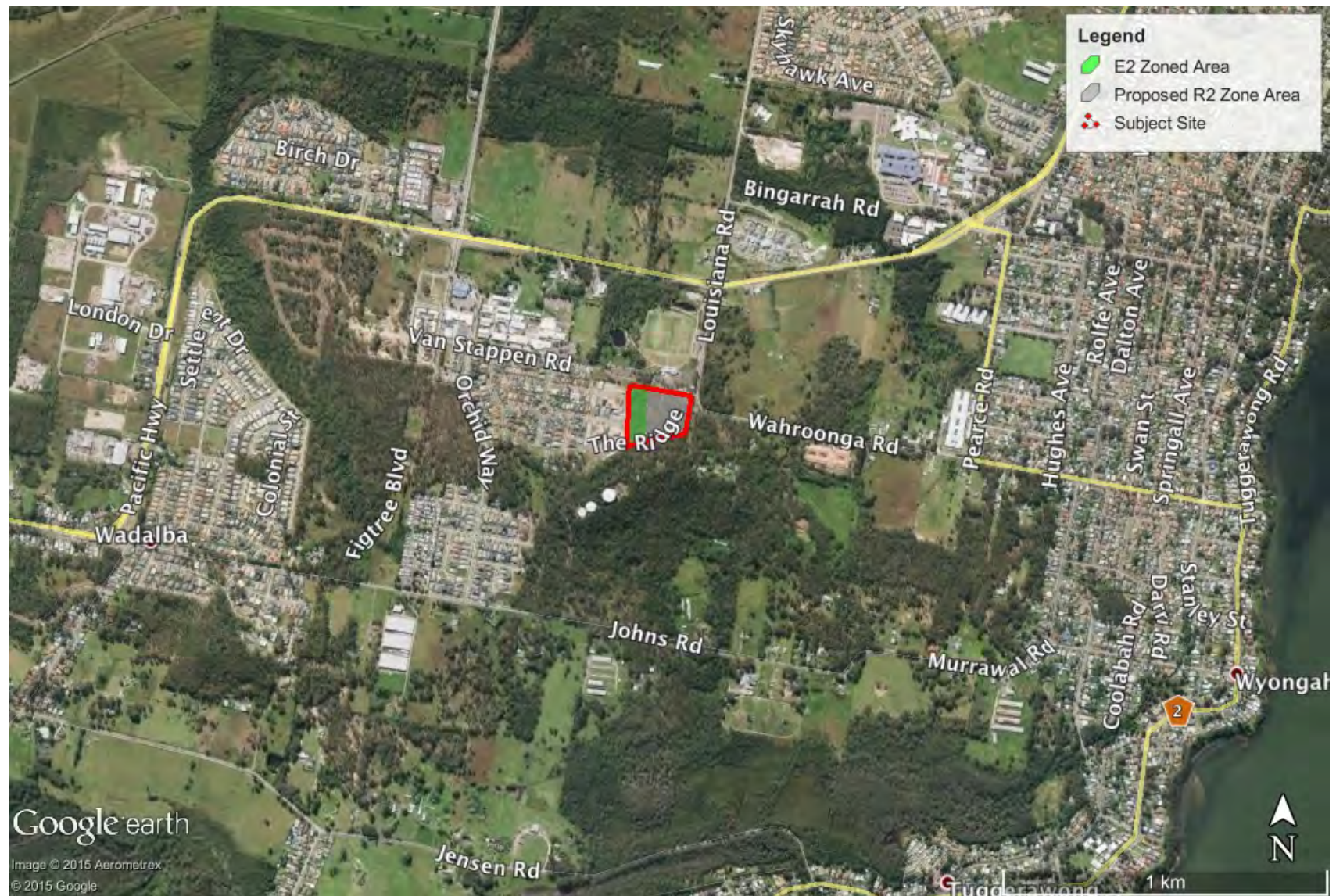


**Photograph – Overview of subject site looking north.**

### **1.3 Development Proposal**

It is proposed to rezone part of Lot 51 DP1195704 from RU6 (Transitional Zone) to R2 (Low Density Residential), retaining an area of existing E2 zoning along the western side.

Ensueing approval of this rezoning application, the area of R2 (Low Density Residential) is proposed to be subdivided into twenty (20) residential lots. A proposed subdivision design is displayed in Figure 2.



**Figure 1 – Location of Subject Site**



Figure 2 - Proposed Rezoning with Proposed Subdivision Overlaid

## 1.4 Aims and Objectives

The aims and objectives of this ecological assessment are to:

- Undertake flora surveys to identify and describe vegetation communities and their condition;
- Undertake fauna surveys to determine species presence and habitat utilisation;
- Undertake habitat assessments to determine the likelihood of occurrence of species, populations and ecological communities;
- Undertake target surveys for threatened species, populations and ecological communities;
- Identify areas or features of both low and high biodiversity value to assist with development planning or future landuse planning;
- Undertake an impact assessment in accordance with the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the *Environmental Planning and Assessment Act 1979*, the *Threatened Species Conservation Act 1995* (TSC Act), the *Fisheries Management Act 1994* (FM Act) as well as local, state and national guidelines; and
- Make recommendations to avoid, minimise or mitigate the likely impacts of the proposal.

## 2 STATUTORY REQUIREMENTS

This ecological assessment has been undertaken in accordance with the requirements of both Commonwealth and State legislation as outlined below.

### 2.1 Commonwealth Legislation

#### 2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act has several broad objectives. The primary objective relevant to this assessment is to 'provide for the protection of the environment, especially matters of national environmental significance' (CoA, 2015). Under the EPBC Act an action will require approval from the minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance (CoA, 2013a).

For the purpose of this assessment, any matters of national environmental significance which are recorded by surveys or considered likely to be impacted either directly or indirectly by the proposed action will be address by specific 'significant impact criteria' outlined by the Significant Impact Guidelines 1.1 (CoA, 2013a). If it is determined that the proposed action is likely to have a significant impact on a matter of national environmental significance, then a referral will be submitted to the Australian Government Environment Minister for approval.

The nine matters of national environmental significance (MNES) are (CoA, 2015):

- world heritage properties;
- national heritage places;
- wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed);
- nationally threatened species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;

- nuclear actions (including uranium mining); &
- a water resource, in relation to coal seam gas development and large coal mining development.

## 2.2 NSW State Legislation

### 2.2.1 Environmental Planning and Assessment Act 1979

The Environmental Planning and Assessment Act (EPA Act) is the principal legislation regulating land use in NSW. Part 1 Section 5A of the EPA Act addresses 'Significant effect on threatened species, populations or ecological communities, or their habitats (NSW Gov, 2015).

(1) For the purposes of this Act and, in particular, in the administration of sections 78A, 79B, 79C, 111 and 112, the following must be taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats (NSW Gov, 2015):

- (a) each of the factors listed in subsection (2), being the 7-part test 'Assessment of Significance';
- (b) any assessment guidelines - issued and in force under section 94A of the *Threatened Species Conservation Act 1995* or, subject to section 5C, section 220ZZA of the *Fisheries Management Act 1994*..

Proposed landuse changes or rezonings, projects, activities and DAs must address the requirements of the EP&A Act 1979 with respect to the direct and indirect impacts of the proposed development on flora and fauna (WSC, 2014).

If a proposal has the potential to impact upon threatened species, populations, ecological communities or their habitats, then a seven-part test, in accordance with section 5A of the EPA Act must be submitted with the application.

If Council determines, after reviewing the seven-part test, that the proposed development may have a significant impact upon threatened species, populations, ecological communities or their habitat pursuant to section 78A(8) of the EPA Act, a Species Impact Statement is required.

### **2.2.2 Threatened Species Conservation Act 1995**

The Threatened Species Conservation Act provides a framework for the conservation of threatened species, populations and ecological communities of flora and fauna in NSW. The Act also forms the Scientific Committee, whose function is to identify and classifying species, populations and ecological communities as well as determine key threatening processes which may threaten their survival. Species, populations, ecological communities and key threatening processes are listed in the Schedules of the Act.

The Act also provides for the declaration and mapping of habitats of 'critical habitat', habitat determined to be critical to the survival of those identified threatened species, populations and ecological communities.

The TSC Act requires the same 7-part test 'assessment of significance' as required by the EPA Act (Refer to Section 2.2.1 above). If a proposal is considered likely to have a significant affect on threatened species, populations or ecological communities, a species impact statement (SIS) must be completed as outlined in Section 110 of the Threatened Species Conservation Act 1995 (TSC Act).

### **2.2.3 Fisheries Management Act 1994**

The overall objective of this Act is to conserve, develop and share the fishery resources of the State for the benefit of present and future generations (NSW Gov, 2015). More specifically it aims to conserve threatened species, populations and ecological communities of fish and marine vegetation (NSW Gov, 2015). This Act operates in a similar way to the TSC Act, however it is administered by the Department of Primary Industries.

No fish or marine habitat will be impacts by this proposal.

### **2.2.4 Native Vegetation Act 2003**

The Native Vegetation Act 2003 provides a framework for management of native vegetation in NSW by preventing broadscale clearing unless it improves or maintains environmental outcomes (OEH, 2015a).

Under the Act landholders can (OEH, 2015a):

- clear and manage native vegetation without approval if the clearing is permitted such as clearing for a routine agricultural management activities (RAMAs), activities classified as excluded clearing or carried out on land excluded from the operation of the Act; &
- submit property vegetation plans (PVPs) for approval by their Local Land Services (LLS) that can describe how native vegetation will be managed on the property.

The Act regulates the clearing of native vegetation on all land in NSW except for land listed in Schedule 1 of the Act (OEH, 2015a). Excluded land falls into the following categories (OEH, 2015a):

- national parks and other conservation areas;
- state forests and reserves; &
- urban areas.

Native vegetation is classified as any species of vegetation that existed in NSW before pastoral settlement, including trees, saplings, shrubs, scrub, understorey, groundcover or wetland plants (OEH, 2015a).

Mangroves, seagrasses and other marine vegetation are managed under the Fisheries Management Act 1994 as addressed above (OEH, 2015a).

## 3 METHODOLOGY

### 3.1 Database Review

A list of migratory and threatened species, populations and ecological communities was obtained from the following database searches:

- A 10 km search of the Bionet Atlas of NSW Wildlife database accessed on October 27<sup>th</sup>, 2015 from <http://www.bionet.nsw.gov.au>
- A 10km search with the Protected Matters Search Tool accessed on October 28, 2015 from <http://www.environment.gov.au/webgis-framework/apps/pmst/pmst-coordinate.jsf>
- A 10km search of the PlantNet Database accessed on November 30<sup>th</sup>, 2015 from <http://plantnet.rbgsyd.nsw.gov.au/search/spatial.htm>

A list of species, populations and endangered ecological communities considered to have at least a moderate likelihood of occurring within the study area was compiled and presented in Tables 9 and 10 of Appendix 1 and 2.

The critical habitat register on the OEH website ([www.environment.nsw.gov.au](http://www.environment.nsw.gov.au)) was checked for listings of critical habitat located within close proximity to the subject site.

### 3.2 Flora and Fauna Survey

The flora and fauna survey methodology has been designed to meet the requirements of the Wyong Shire Council Flora and Fauna Survey Guidelines 2014, unless otherwise justified (referred to as WSC Guidelines).

The 'subject site' is defined as the area of Lot 51 DP 1195704 and the broader 'study area' has been defined to encompass areas of the Wadalba Wildlife Corridor in order to assist with the assessment of the proposal, in particular with regard to corridors and survey for targeted threatened fauna species (Refer to Figure 3).

A summary of survey effort is displayed in Table 2, and the survey locations and results are displayed in Figure 3 below. Tables 3 and 4 provide details of survey compliance with the WSC Guidelines.

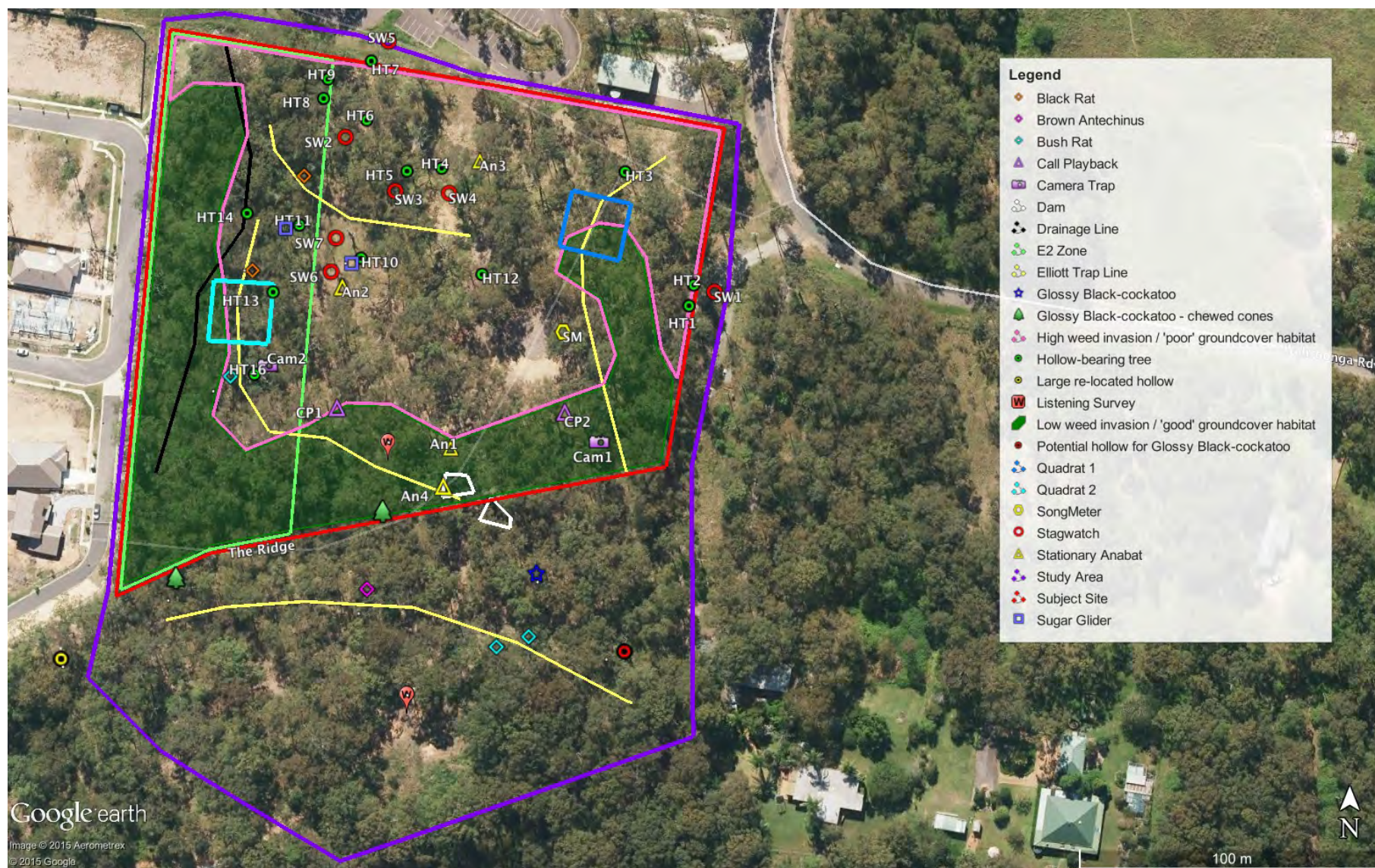


Figure 3 – Survey locations and results

**Table 2 – Summary of survey time & effort**

| <b>DATE</b>       | <b>Survey</b>                                                                                                                       | <b>Weather Conditions</b>          | <b>Times</b>                           | <b>Hours or person hours</b> |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------------------|------------------------------|
| 30/08/2015        | Diurnal bird survey / Opportunistic surveys.                                                                                        | 0/8 cloud, 15°C, 5-10kph SW wind.  | 8:30 – 9:00                            | 0.5                          |
| 30/08/2015        | Owl roost & pellet searches concentrating in areas of dense shrublayer & mid-canopy vegetation.                                     | 0/8 cloud, 15°C, 5-10kph SW wind.  | 9:00 – 10:00                           | 1                            |
| 31/08/2015        | Diurnal bird survey / Opportunistic surveys.                                                                                        | 0/8 cloud, 14°C, 5-10kph NW wind.  | 8:00 – 8:30                            | 0.5                          |
| 31/08/2015        | Owl roost & pellet searches concentrating in areas of dense shrublayer & mid-canopy vegetation.                                     | 2/8 cloud, 15°C, 10-15kph SE wind. | 8:00 – 9:00                            | 1                            |
| 31/08/2015        | Quiet listening survey.                                                                                                             | 3/8 cloud, 14°C, 5-10kph SE wind.  | 17:00 – 18:30                          | 1.5                          |
| 04/09/2015        | Quiet listening survey.                                                                                                             | 4/8 cloud, 14°C, 10-15kph S wind.  | 17:00 – 18:30                          | 1.5                          |
| 30/09/2015        | Targeted orchid survey / Opportunistic surveys.                                                                                     | 4/8 cloud, 20°C, no wind.          | 15:30 – 17:00                          | 1.5                          |
| 02/10/2015        | Targeted orchid survey / Opportunistic surveys.                                                                                     | 0/8 cloud, 22°C, no wind.          | 16:30 – 17:45                          | 1.25                         |
| 07-<br>15/10/2015 | SongMeter set in centre of subject site on edge of small clearing – continuous recording from ½hr before dusk till ½ hr after dawn. | See BOM weather conditions.        | 8 days – approximately 12 hours / day. | 96                           |
| 07-<br>21/10/2015 | Set Infrared Camera Trap PC900 Hyperfire Professional IR (Camera 1) in SE corner.                                                   | See BOM weather conditions.        | 14 days – 24 hours / day.              | 336                          |
| 07-               | Set Infrared Camera Trap PC90 Covert Professional IR                                                                                | See BOM weather conditions.        | 14 days – 24 hours /                   | 336                          |

| DATE          | Survey                                                                         | Weather Conditions                         | Times                        | Hours or person hours |
|---------------|--------------------------------------------------------------------------------|--------------------------------------------|------------------------------|-----------------------|
| 21/10/2015    | (Camera 2) in E2 zoned area SW corner.                                         |                                            | day.                         |                       |
| 12/10/2015    | Set Elliott traps / Opportunistic surveys                                      | 2/8 cloud, 26°C, 10-15kph E wind.          | 14:00 – 19:00                | 5                     |
| 13/10/2015    | Checking traps / Opportunistic surveys                                         | 2/8 cloud, 20°C, 5-10kph SE wind.          | 6:30 – 9:30                  | 3                     |
| 13/10/2015    | Diurnal reptile & amphibian searches in E2 zoned area.                         | 2/8 cloud, 20°C, 5-10kph SE wind.          | 9:30 – 10:00                 | 0.5                   |
| 14/10/2015    | Checking traps / Opportunistic surveys                                         | 2/8 cloud, 20°C, 10-15kph NE wind.         | 6:30 – 9:30                  | 3                     |
| 14/10/2015    | Diurnal Bird Survey                                                            | 3/8 cloud, 21°C, 10-15kph E wind.          | 17:45 – 19:00                | 1.25                  |
| 14/10/2015    | Anabat – handheld during spotlighting & other surveys.                         | 4/8 cloud, 19°C, 10-15kph E wind.          | 19:00 – 21:00                | 2                     |
| 14/10/2015    | Spotlighting throughout study area (incl. adjoining Wadalba Wildlife Corridor. | 6/8 cloud, 19°C, 10-15kph E wind, no moon. | 19:30 – 21:00                | 1.5                   |
| 14/10/2015    | Call playback for Squirrel Glider.                                             | 0/8 cloud, 23°C, 10-15kph NE wind.         | 19:45 – 20:15                | 0.5                   |
| 14-15/10/2015 | Anabat – Stationary north side of dams - continuous recording                  | 4/8 cloud, 18°C, 10-15kph E wind.          | 21:00 (14/10) – 6:30 (15/10) | 9.5                   |
| 15/10/2015    | Checking traps / Opportunistic surveys                                         | 3/8 cloud, 19°C, 5-10kph NE wind.          | 6:30 – 9:30                  | 3                     |
| 15/10/2015    | Diurnal reptile & amphibian searches in E2 zoned area.                         | 1/8 cloud, 22°C, 5-10kph NE wind.          | 18:00 – 18:30                | 0.5                   |
| 15/10/2015    | Diurnal Bird Survey.                                                           | 1/8 cloud, 22°C, 5-10kph NE wind.          | 18:30 – 19:00                | 2.25                  |

| DATE          | Survey                                                                               | Weather Conditions                 | Times                        | Hours or person hours |
|---------------|--------------------------------------------------------------------------------------|------------------------------------|------------------------------|-----------------------|
| 15-16/10/2015 | Anabat – Stationary at south-west corner adjacent to E2 zoned area.                  | 3/8 cloud, 20°C, no wind, ¼ moon.  | 19:00 (15/10) – 6:30 (16/10) | 11.5                  |
| 15/10/2015    | Call playback for Squirrel Glider .                                                  | 3/8 cloud, 20°C, no wind, ¼ moon.  | 19:45 – 20:15                | 0.5                   |
| 15/10/2015    | Spotlighting throughout study area (incl. adjoining Wadalba Wildlife Corridor.       | 3/8 cloud, 20°C, no wind, ¼ moon.  | 19:30 – 21:00                | 1.5                   |
| 16/10/2015    | Check & collecting traps / Opportunistic surveys.                                    | 2/8 cloud, 25°C, 5-10kph NE wind.  | 6:30 – 9:30                  | 3                     |
| 21/10/2015    | Collect SongMeter & Camera Traps / Opportunistic surveys.                            | 4/8 cloud, 26°C, 0-5kph NW wind.   | 10:30-11:30                  | 1                     |
| 21/10/2015    | Flora survey & opportunistic surveys.                                                | 4/8 cloud, 28°C, 0-5kph NW wind.   | 11:30 – 13:30                | 3                     |
| 22/10/2015    | Diurnal Bird Survey.                                                                 | 8/8 cloud, 19°C, no wind.          | 8:30 – 9:30                  | 1                     |
| 22/10/2015    | Flora survey & opportunistic surveys.                                                | 8/8 cloud, 19°C, no wind.          | 9:30 – 11:00                 | 1.5                   |
| 25/10/2015    | Diurnal reptile & amphibian searches of dams.                                        | 3/8 cloud, 23°C, 10-15kph NW wind. | 17:30 – 18:00                | 0.5                   |
| 25/10/2015    | Habitat tree survey plus Koala searches, reptile searches and opportunistic surveys. | 3/8 cloud, 23°C, 10-15kph NW wind. | 18:00 – 19:15                | 2 x 1.25 = 2.5        |
| 25/10/2015    | Stagwatching HT 1 & 2.                                                               | 2/8 cloud, 20°C, no wind, ¾ moon.  | 19:15 – 20:45                | 1.5                   |
| 25/10/2015    | Anabat - handheld while stagwatching HT 1 & 2.                                       | 2/8 cloud, 20°C, no wind, ¾ moon.  | 19:00 – 20:45                | 1.75                  |

| DATE              | Survey                                                                               | Weather Conditions                         | Times                        | Hours or person hours |
|-------------------|--------------------------------------------------------------------------------------|--------------------------------------------|------------------------------|-----------------------|
| 25/10/2015        | Stagwatching HT 6.                                                                   | 2/8 cloud, 20°C, no wind, ¾ moon.          | 19:15 – 20:45                | 1.5                   |
| 25/10/2015        | Anabat handheld while stagwatching HT 6.                                             | 2/8 cloud, 20°C, no wind, ¾ moon.          | 19:15 – 20:45                | 1.5                   |
| 25-<br>26/10/2015 | Anabat - Stationary Anabat in middle of subject site on continuous recording.        | 2/8 cloud, 20°C, no wind, ¾ moon.          | 20:45 (25/10) – 6:30 (26/10) | 9.75                  |
| 29/10/2015        | Diurnal reptile & amphibian searches of dams.                                        | 0/8 cloud, 17°C, 5-10kph NE wind.          | 17:45 – 18:15                | 0.5                   |
| 29/10/2015        | Habitat tree survey plus Koala searches, reptile searches and opportunistic surveys. | 0/8 cloud, 17°C, 5-10kph NE wind.          | 18:15 – 19:15                | 1                     |
| 29/10/2015        | Stagwatching HT 4.                                                                   | 0/8 cloud, 18°C, 5-10kph NE wind, no moon. | 19:15 – 20:45                | 1.5                   |
| 29/10/2015        | Anabat – handheld while stagwatching HT 4.                                           | 0/8 cloud, 18°C, 5-10kph NE wind, no moon. | 19:15 – 20:45                | 1.5                   |
| 29/10/2015        | Stagwatching HT 5.                                                                   | 0/8 cloud, 18°C, 5-10kph NE wind, no moon. | 19:15 – 20:45                | 1.5                   |
| 29/10/2015        | Anabat – handheld while stagwatching HT 5.                                           | 0/8 cloud, 18°C, 5-10kph NE wind, no moon. | 19:15 – 20:45                | 1.5                   |
| 29-<br>30/10/2015 | Anabat - Stationary Anabat at Dam on continuous recording (WP382)                    | 0/8 cloud, 18°C, 5-10kph NE wind, no moon. | 20:45 (29/10) – 6:30 (30/10) | 9.75                  |
| 4/11/2015         | Flora surveys plus opportunistic surveys with Garon Staines.                         | 6/8 cloud, 26°C, no wind.                  | 08:00 – 11:00                | 3                     |
| 19/11/2015        | Stagwatching of HT10 & HT7                                                           | 0/8 cloud, 26°C, no wind, ½ moon           | 19:00 – 20:30                | 2 x 1.5 = 3           |

| DATE       | Survey                             | Weather Conditions               | Times         | Hours or person hours |
|------------|------------------------------------|----------------------------------|---------------|-----------------------|
| 19/11/2015 | Spotlighting following stagwatches | 0/8 cloud, 26°C, no wind, ½ moon | 20:30 – 21:00 | 2 x 0.5 = 1           |
| 30/11/2015 | Stagwatch of HT10 with 2 people    | 2/8 cloud, 22°C, no wind.        | 19:30 – 21:00 | 2 x 1.5 = 3           |

### 3.2.1 General Flora Survey

Two ecologists conducted flora and vegetation community surveys via the random meander and quadrat plot techniques on November 4<sup>th</sup>, 2015 for approximately 3 hours from 8am to 11am. All observed vascular flora species were identified to species level wherever possible. Vegetation communities were described after Specht et al (1974).

Two (2) 20m X 20m (400m<sup>2</sup>) quadrat surveys were undertaken, Quadrat 1 within the middle of the proposed rezoning area and Quadrat 2 within the E2 zoned area (drainage corridor) (Refer to Figure 3, Tables 11 in Appendix 5 & Photo 1 of Appendix 8) and surveyed as follows:

- All vascular flora species within the quadrat were identified to species level wherever possible and their cover abundance allocated to one of seven classes in accordance with a modified Braun-Blanquet scheme (WSC, 2014).
- The native species identified within the quadrat were then compared to the 'Narrabeen Dooralong Spotted Gum – Ironbark Forest' (Map Unit 30) as described by Bell (2002b).

Flora survey using the 'random meander' technique (Cropper 1993) were also carried out on the rest of study area. The random meanders specifically searched for additional species not observed within the quadrat as well as specifically targeting any threatened and rare flora species and populations identified in the initial desktop assessment together with any declared noxious weeds for the Wyong LGA (DPI 2015).

### 3.2.2 Orchid Survey

Orchid survey methodology was adopted from 'Survey Guidelines for Australia's Threatened Orchids' (CoA, 2013b) with some guidance from WSC Guidelines and the 'Interim Survey Guidelines for Ground Orchids which are Listed on the Threatened Species Conservation Act, 1995 in Wyong Shire'.

Three (3) threatened orchid species considered to have the potential to occur within the subject site were targeted during surveys. These include (Refer to Table 9 in Appendix 1):

- *Caladenia tessellata* (Thick Lip Spider Orchid) – flowering September and November;
- *Rhizanthella slateri* (Eastern Australian Underground Orchid) – flowering September to November;  
&
- *Thelymitra adorata* (Wyong Sun Orchid) – flowering September to October.

The exact flowering period of *T.adorata* for the 2015 season was clarified by several visits to the known population located off Pollock Avenue, Wadalba. These visits were also beneficial in strengthening familiarity with the species immediately prior to conducting the surveys within the subject site.

Surveys included transects separated by 5m to 8m, undertaken throughout the entire subject site for a total of 3 person hours on September 30<sup>th</sup> and October 2<sup>nd</sup>, 2015. Weather conditions during the surveys were favourable for flowering of *T.adorata*, with temperatures of 20-22°C and periods of both no cloud and scattered cloud (Refer to Appendix 9).

### **3.2.3 Fauna Survey**

The location of fauna surveys are displayed in Figure 3 above.

#### **Owl Surveys**

Surveys for owls are guided by procedures outlines in WSC Guidelines by owl expert John Young (WSC, 2014).

Quite listening surveys were conducted on August 31<sup>st</sup> and September 4<sup>th</sup> for 1.5hours from at least 20mins prior to dusk till at least 1 hour in total darkness (Refer to Table 3 & section 3.2.5 - Survey Limitations)

No call playback surveys were undertaken. The presence of Owl species has been established by previous surveys and is likely to unnecessarily disturb owl activity (on advice from WSC September 2015).

#### **Spotlighting**

A 2200 lumen torch and a 900 lumen LED Lenser headtorch were used to spotlight tree canopies, mid-storey, shrubs and ground covers looking for eyeshine or any movement. Spotlighting was combined with short intermittent periods of listen to detect any calls or activity. Binoculars were used to assist with identification once specimens were located.

#### **Stagwatching**

Hollows were observed for 30 mins prior to sunset until 60 mins after sunset. Positions in relation to the targeted hollows were chosen to allow vision of silhouettes of specimens exiting hollows. A 2200 lumen torch and a 900 lumen LED Lenser headtorch were used for spotlighting with the aid of binoculars once a specimen was observed. An Anabat was use during stagwatches to identify micro-bats exiting the targeted hollow.

#### **Elliott Trapping**

Seventeen (17) arboreal (tree mounted) type B Elliott traps, Twenty-five (25) terrestrial (place on ground) type A Elliott traps and three (3) terrestrial type B Elliott traps were set in four (4) lines throughout the study area

(Refer to Figure 3 & Photo 2 of Appendix 8). All traps were set for four (4) nights from October 12<sup>th</sup> till October 16<sup>th</sup>, 2015. The trapping effort can be summarised as follows:

- Seventeen (17) arboreal type B traps set for four (4) nights ( $17 \times 4$ ) = 68 arboreal trap nights;
- Twenty-five (25) terrestrial type A traps set for four (4) nights ( $25 \times 4$ ) = 100 terrestrial type A trap nights; &
- Three (3) terrestrial type B traps set for four (4) nights ( $3 \times 4$ ) = 12 terrestrial type B trap nights.

Elliott traps were baited with a mixture of peanut butter, oats and honey as well as smaller amounts of molasses, fish oil, vanilla & almond essence and truffle oil. A mixture of honey, molasses, fish oil, vanilla and almond essence and truffle oil were sprayed on the trunks of trees above tree mounted traps and near the entrance of terrestrial traps. Traps were checked less than 1.5 hours after sunrise, re-baited and resprayed each morning. The trapping period was selected to avoid any extreme weather conditions. In wet weather, trap covers would be used or in hot weather traps would be closed during the day or until normal weather conditions resumed. No extreme weather occurred during the trapping period.

Trapping equipment was supplied by Bernview Environmental of Padstow NSW.

### **Call Playback**

Call playback surveys were conducted for Squirrel Glider on October 14<sup>th</sup> and 15<sup>th</sup>, 2015. A 5-minute call sequence was followed by a period of quiet listening and spotlighting, then repeated three times over half an hour. Following the listening period of the last call sequence, spotlighting surveys were resumed. A 2200 lumen torch and a 900 lumen LED Lenser headtorch were used. Calls of the above species were broadcast via an Apple iPod coupled to a Toa 15W megaphone. Calls used were supplied by NatureSound.

### **Micro-bat Surveys**

Microbat surveys were carried out using Anabat ultrasonic call detection units (Titley Electronics, QLD Australia) and a dual channel acoustic & ultrasonic recording SongMeter SM2+Bat device (Wildlife Acoustics, Maynard MA, USA). The Anabats were placed on the ground at an angle of 45° during stationary surveys and then carried at approximately 45° during spotlighting surveys (Refer to Photo 3 of Appendix 8). If bats were detected during handheld surveys, then they were followed to maximise the duration and quality of calls recorded. Stationary positions were varied to include forested edges, beneath canopies, as well as over water bodies to maximise the variety of species recorded.

The Songmeter was attached to a tree about 3.5m off the ground in the centre of the subject site on the edge of a small clearing (Refer to Photo 4 of Appendix 8). The SongMeter was programmed to record from half an

hour before dusk till half an hour after dawn. Recorded calls were then downloaded from each device and sent to microbat call experts for analysis and identification (Refer to Appendix 7).

### **Camera Traps**

Two (2) motion-activated wildlife cameras (Camera Traps) (Reconyx PC90 & PC900 models – Holmen Wisconsin USA) were deployed on site to target terrestrial and arboreal mammals. They were pointed at a perforated PVC bait chamber filled with a sponge soaked in molasses, fish oil, vanilla and almond essence and truffle oil. The area around each bait station was also sprayed with a similar mixture. Camera 1 (PC900) was placed in the sparse understorey in the south-eastern corner of the subject site and Camera 2 (PC90) was placed within dense understorey within the E2 zoned area (drainage corridor) (Refer to Figure 3 & Photo 5 & 6 of Appendix 8).

### **Reptile and Amphibian Searches**

Areas of dense leaf litter, logs, loose rocks, banks and edges of water bodies were searched by lifting of any loose objects, and any specimens were caught and/or identified. Searches were focused in areas of suitable habitat, such as the areas of low weed invasion (Refer to Figure 3), edges of the two small dams, and within and around the drainage line in the western side of the subject site (Refer to Photo 7 & 8 of Appendix 8). Amphibian calls were identified and recorded for reference. No amphibians were handled unless it was considered necessary for identification.

Opportunistic recordings were made during other surveys.

### **Bird Surveys**

Bird surveys were conducted either in the early morning or late afternoon. Due to the small size of the subject site, the entire site was able to be covered by each point census survey. Any unknown calls were recorded and/or compared to Pizzey & Knight Birds of Australia – Digital Edition, to assist with identification.

Opportunistic surveys were also undertaken during other field surveys.

### **Inspection of Hollows by Inspection Camera**

Hollows safely accessible from the ground and /or a ladder were inspected using a Explorer Premium (Model no. 8802AL) Inspection Camera attached to a 6m extension pole.

### 3.2.4 Compliance

Table 3 – Flora Survey compliance with WSC Flora and Fauna Survey Guidelines 2014

| Area of Land with Remnant Vegetation | Activity                                                                                             | Minimum Survey Effort                                             | Survey Work Undertaken and Comments                                                                                                                                                                                                                                                       |
|--------------------------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>General Flora Survey</b>          |                                                                                                      |                                                                   |                                                                                                                                                                                                                                                                                           |
| 2.7ha                                | Flora Survey - Simple Floristic Structure                                                            | 1-2 walking transects, 1 quadrat / community                      | Area of community (and subject site) is <5ha, therefore only requires 1 quadrat. A total of 2 quadrat surveys were undertaken 1 quadrat over the drainage line plus 1 quadrat on representative area of mid-slope.                                                                        |
| <b>Target Surveys for Orchids</b>    |                                                                                                      |                                                                   |                                                                                                                                                                                                                                                                                           |
| 2.7ha                                | Targeted surveys for orchid species in early October (depending on which species is being targeted). | Refer to the Interim Survey Guidelines for Ground Orchids (2000). | 2 hours of 5-8m separated transects throughout site conducted on 30-31/8/2015 in conjunction with Owl pellet searches and 2.75 hours on 30/9/2015 & 2/10/2015 during flowering period of <i>Thelymitra adorata</i> (confirmed by visits to known population off Pollock Avenue, Wadalba). |

**Table 4 – Fauna Survey compliance with WSC Flora and Fauna Survey Guidelines 2014**

| <b>Fauna Group</b>   | <b>Survey Technique</b>                           | <b>Survey Period</b>                              | <b>Minimum Survey &lt;100ha</b>                                                                                                                                                                                                                                     | <b>Survey Work Undertaken and Comments</b>                                                                                                                                                                                                                                  |
|----------------------|---------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Overall Fauna Survey | Fauna Survey                                      | -                                                 | 1 survey site per vegetation community <5ha.                                                                                                                                                                                                                        | See below.                                                                                                                                                                                                                                                                  |
| <b>Birds</b>         |                                                   |                                                   |                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                             |
| Diurnal Birds        | Formal Census                                     | Winter.                                           | 1 ha sample plot (20mins)                                                                                                                                                                                                                                           | 2 x 0.5hour surveys were conducted on August 30 <sup>th</sup> and 31 <sup>st</sup> . An additional 2 hours of opportunistic surveys were also undertaken in August during other surveys.                                                                                    |
| Diurnal Birds        | Formal Census                                     | Summer.                                           | 1 ha sample plot (20mins)                                                                                                                                                                                                                                           | A total of 2.75 hours of Spring surveys, incl. 1.25hours on October 14 <sup>th</sup> , 0.5hour on October 15 <sup>th</sup> & 1hour on October 22 <sup>nd</sup> . An additional 29.25 hours of opportunistic surveys were also undertaken during October and early November. |
| Nocturnal Birds      | Quiet Listening on a ridge near suitable habitat. | Late February to mid August depending on species. | 3 consecutive nights of quiet listening, from 20min prior to dusk & for at least 1hour in total darkness (Note: this specific minimum requirement was updated after the listening surveys were completed). Prior to the update 'the recommended number of visits to | 2 x 1.5hour quiet listening surveys on August 31 <sup>st</sup> & September 4 <sup>th</sup> .                                                                                                                                                                                |

| Fauna Group     | Survey Technique                   | Survey Period                                                                                                                                                                              | Minimum Survey <100ha                                                                                                                                                                                                          | Survey Work Undertaken and Comments                                                                                                                                                     |
|-----------------|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 |                                    |                                                                                                                                                                                            | determine the presence or absence of threatened large forest owls, with 90% confidence is seven for Powerful Owl, eight for Sooty Owl, and nine for Masked Owl (Debus 1995 in WSC, 2014). Refer to 3.2.5 - Survey Limitations. |                                                                                                                                                                                         |
| Nocturnal Birds | Formal Census - Call Playback.     | Preferred to be outside of breeding season (between October & January, depending on species) or if there is no response to 2 consecutive nights of quiet listening during breeding season. | One point census / km <sup>2</sup> x minimum of 3 visits on non-consecutive nights.                                                                                                                                            | The presence of Owl species has been established by previous surveys and is considered to be unnecessary (on advice from WSC).                                                          |
| Nocturnal Birds | Pellet/ roost/ nest tree searches. | August. Best in breeding season as pellets decompose.                                                                                                                                      | Searches of potential roost and nest trees. No time specified.                                                                                                                                                                 | A total of 2 hours of searches were undertaken on August 30 <sup>th</sup> & 31 <sup>st</sup> within proposed rezoning area & in denser understorey vegetation within the E2 zoned area. |

| Fauna Group     | Survey Technique                                  | Survey Period                       | Minimum Survey <100ha                                                                                    | Survey Work Undertaken and Comments                                                                                                                                                                                                                                                                                   |
|-----------------|---------------------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nocturnal Birds | Stagwatch potential roost/ nest trees.            | Best undertaken in breeding season. | 30mins prior to sunset, 60mins following sunset. 3-4 nights.                                             | No potential owl nesting trees have been observed within the subject site. 6 stagwatches were undertaken throughout the subject site (Refer to stagwatching for arboreal mammals).                                                                                                                                    |
| <b>Mammals</b>  |                                                   |                                     |                                                                                                          |                                                                                                                                                                                                                                                                                                                       |
| All mammals.    | Spotlighting                                      | Any time of year.                   | 2 x 30min on 2 separate nights at walking rate of 1km/hour.                                              | A total of 3hours including, 1.5 hours on October 14 <sup>th</sup> & 1.5hours on October 15 <sup>th</sup> . In addition, approximately 15-30mins (x 2 people) of spotlighting surveys were also undertaken after each stagwatch survey on October 25 <sup>th</sup> , 29 <sup>th</sup> and November 19 <sup>th</sup> . |
| All mammals.    | Faecal pellet counts & predator scats.            | Any time of year.                   | Opportunistic – during all site activities.                                                              | Opportunistic searches during other activities.                                                                                                                                                                                                                                                                       |
| All mammals.    | Stagwatch potential roost trees / foraging areas. | Any time of year.                   | Observing potential roost hollows / foraging areas for 30mins prior to sunset & 60mins following sunset. | 4 x 1.5hours (or 4 nights) on October 25 <sup>th</sup> , 29 <sup>th</sup> & November 4 <sup>th</sup> & 30 <sup>th</sup> with 2 people, given a total of 8 stagwatches.                                                                                                                                                |
| All mammals.    | Remote Camera (preferred over trapping).          | Any time of year.                   | 2 per vegetation community or habitat type for 14 consecutive nights.                                    | 2 x Cameras were set for 14 days from October 7 <sup>th</sup> till October 21 <sup>st</sup> . One camera was                                                                                                                                                                                                          |

| Fauna Group                                      | Survey Technique                                                                                     | Survey Period     | Minimum Survey <100ha                                                                             | Survey Work Undertaken and Comments                                                                                                                    |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                  |                                                                                                      |                   |                                                                                                   | set in the south-east corner of the proposed rezoning area & a second camera was set within the southern end of the E2 zoned area (drainage corridor). |
| Terrestrial mammals.                             | Small mammal / A Elliott traps.                                                                      | Any time of year. | 100 trap nights over 4 consecutive nights per vegetation community.                               | 25 Elliott type A traps set over 4 nights from October 12 <sup>th</sup> till October 16 <sup>th</sup> .                                                |
| Terrestrial mammals.                             | Cage / B Elliott traps.                                                                              | Any time of year. | 12 trap nights over 4 consecutive nights per vegetation community.                                | 3 Elliott type B traps were set over 4 nights from October 12 <sup>th</sup> till October 16 <sup>th</sup> .                                            |
| Arboreal mammals.                                | Call playback (if potential habitat for Koala, Squirrel Glider or Yellow-bellied Glider is present). |                   | 2 locations on separate nights per site or may be done in conjunction with nocturnal bird census. | Call playback surveys for Squirrel Glider were undertaken on October 14 <sup>th</sup> & 15 <sup>th</sup> .                                             |
| All mammals. <b>Optional.</b>                    | Hair tubes                                                                                           | Any time of year. | 10 small & 10 large hair tubes per vegetation community for 5-10 consecutive nights.              | Not proposed.                                                                                                                                          |
| Terrestrial mammals & reptiles. <b>Optional.</b> | Sand plots.                                                                                          | Any time of year. | 6 plots per site for 4 consecutive nights.                                                        | Not proposed.                                                                                                                                          |
| Terrestrial mammals. <b>Optional.</b>            | Pitfall trapping.                                                                                    | Any time of year. | 4 consecutive nights per site.                                                                    | Not proposed.                                                                                                                                          |

| Fauna Group                           | Survey Technique                                  | Survey Period     | Minimum Survey <100ha                                                                                                                                                                                | Survey Work Undertaken and Comments                                                                                                                                                                                                           |
|---------------------------------------|---------------------------------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arboreal mammals.                     | B Elliott traps.                                  | Any time of year. | Trapping grid of 1ha sampling per vegetation type, with 10 traps for 3 consecutive nights. Trapping grid samples each suitable vegetation community.                                                 | 17 Elliott type B traps set in 4 traplines over 4 consecutive nights from October 12 <sup>th</sup> till October 16 <sup>th</sup> . No gliders were trapped during the surveys, as such the surveys were continued over 4 nights instead of 3. |
| Arboreal mammals.                     | Stagwatching.                                     | Any time of year. | Observing hollow for 30 mins prior to sunset until 60 mins after sunset for 3-4 nights and / or mornings.                                                                                            | 4 x 1.5hours (or 4 nights) on October 25 <sup>th</sup> , 29 <sup>th</sup> & November 4 <sup>th</sup> & 30 <sup>th</sup> with 2 people, given a total of 8 stagwatches.                                                                        |
| Koalas                                | Koala quadrats (if potential habitat is present). | Any time of year. | Follow relevant guidelines in App 6 of Port Stephens CKPoM 2001 & Australian Koala Foundation (AKF) guidelines.                                                                                      | Searches for pock marks & scats were undertaken as part of hollow-bearing tree & reptile searches on October 25 <sup>th</sup> & 29 <sup>th</sup> for a total of 4.5 person hours.                                                             |
| Arboreal mammals.<br><b>Optional.</b> | Hair tubes.                                       | Any time of year. | 10 large & 10 small hair tubes in trees per vegetation community for 5-10 consecutive nights.                                                                                                        | Not proposed.                                                                                                                                                                                                                                 |
| Microchiropteran bats.                | Harp traps.                                       | October – May.    | 2 harp trap nights per site, over 2 consecutive nights in target habitat ( <i>if high quality roosting habitat is present for a threatened species that is known to be captured by harp traps</i> ). | Not proposed.                                                                                                                                                                                                                                 |

| Fauna Group                                       | Survey Technique                       | Survey Period                                                                                         | Minimum Survey <100ha                                                                                                                                                                                                                                                                                         | Survey Work Undertaken and Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------|----------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Microchiropteran bats.                            | Echolocation call.                     | Any time of year (in suitable conditions). October - May preferred due to reduced activity in winter. | 4 separate nights continuous recording from dusk per site (min 4 hours) for stationary detectors. 3 separate nights for 1-2 hours after dusk for detectors handheld in target habitats ( <i>if high quality habitat is present for a threatened species that is known to be identified by echolocation</i> ). | A SongMeter was set in the middle of the proposed rezoning area on continuous recording from 0.5hour prior to dusk till 0.5hour after dawn for 8 nights including October 7 <sup>th</sup> till October 15 <sup>th</sup> . 4 nights of Anabat stationary on continuous recording on October 14-15 <sup>th</sup> , 15-16 <sup>th</sup> , 25-26 <sup>th</sup> & 29-30 <sup>th</sup> . 1 night of handheld for 2hours during spotlighting surveys on October 14 <sup>th</sup> plus handheld during 3 x 1.5hour stagwatch surveys. |
| Microchiropteran bats                             | Stagwatching and diurnal roost search. | October - May.                                                                                        | Potential threatened species roost sites that may be impacted by proposal should be targeted and investigated for stagwatching. Observe roost entrance from 30min prior to sunset until 60min after sunset - cameras may also be used for this purpose if they can be positioned in a suitable location.      | 4 x 1.5hours (or 4 nights) on October 25 <sup>th</sup> , 29 <sup>th</sup> & November 4 <sup>th</sup> & 30 <sup>th</sup> with 2 people, given a total of 8 stagwatches.                                                                                                                                                                                                                                                                                                                                                        |
| Tree hollow roosting fauna.<br><b>Optional. #</b> | Installing and monitoring nest boxes.  | All year.                                                                                             | Nest boxes may be installed and monitored at a site, allowing for detection of more cryptic species, such as                                                                                                                                                                                                  | Not proposed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

| Fauna Group                                                    | Survey Technique    | Survey Period      | Minimum Survey <100ha                                                                                                                      | Survey Work Undertaken and Comments                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------|---------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                |                     |                    | Eastern Pygmy-possum. Nest boxes would need to be in place for months. A minimum of 5 nest boxes per hectare is recommended.               |                                                                                                                                                                                                                                                                                                                  |
| <b>Optional</b> - not recommended unless considered necessary. | Triplining.         | October - May.     | Duration of 2 hours from dusk for 2 nights.                                                                                                | Not proposed.                                                                                                                                                                                                                                                                                                    |
| <b>Optional</b> - not recommended unless considered necessary. | Mistnetting.        | October - May.     | Duration of 2 hours from dusk for 2 nights.                                                                                                | Not proposed.                                                                                                                                                                                                                                                                                                    |
| <b>Reptiles</b>                                                |                     |                    |                                                                                                                                            |                                                                                                                                                                                                                                                                                                                  |
| Diurnal searches.                                              | Habitat searches.   | September - April. | 1 ha search for 30min on 2 separate days per vegetation community or habitat type.                                                         | 0.5hour search in E2 zoned area (described as understorey variant 2) on 15 <sup>th</sup> October. 3.5hours of searches throughout whole subject site during Koala scats searches and habitat tree surveys on October 25 <sup>th</sup> & 29 <sup>th</sup> . Opportunistic surveys during all other field surveys. |
| Nocturnal searches.                                            | Spotlight searches. | September - April. | 2 x 30min searches on 2 separate nights at walking rate of 1km/hr per site. This may be done in conjunction with spotlighting for mammals. | A total of 3hours including, 1.5 hours on October 14 <sup>th</sup> & 1.5hours on October 15 <sup>th</sup> . In addition, approximately 15-30mins (x 2 people) of spotlighting surveys were also                                                                                                                  |

| Fauna Group                           | Survey Technique                        | Survey Period      | Minimum Survey <100ha                                                                  | Survey Work Undertaken and Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------|-----------------------------------------|--------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                       |                                         |                    |                                                                                        | undertaken after each stagwatch survey on October 25 <sup>th</sup> , 29 <sup>th</sup> and November 19 <sup>th</sup> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Specific habitats (targeted surveys). | Diurnal + nocturnal searches.           | September – April. | 1 ha diurnal search for 30min on 2 separate days + 30min spotlight search on 2 nights. | The two small dams & safely accessible areas of the drainage line were searched during spotlighting survey on October 14 <sup>th</sup> & 15 <sup>th</sup> . In addition, these areas were also inspected during stagwatching surveys on October 25 <sup>th</sup> , 29 <sup>th</sup> & November 19 <sup>th</sup> . Any call heard were recorded & identified. 0.5hour diurnal searches of dams were undertaken on October 25 <sup>th</sup> & 26 <sup>th</sup> . 0.5 diurnal searches of the E2 zoned area (described as understorey variant 2) were undertaken on October 13 <sup>th</sup> & 15 <sup>th</sup> . |
| <b>Optional.</b>                      | Pitfall trapping &/ or funnel trapping. | September – April. | 6 traps for minimum 4 consecutive nights per site.                                     | Not proposed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Amphibians</b>                     |                                         |                    |                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Nocturnal searches +                  | Spotlighting searches.                  | September – March. | 1 ha search for 30 mins on 2 separate days per vegetation community or habitat type.   | A total of 3hours including, 1.5 hours on October 14 <sup>th</sup> & 1.5hours on October 15 <sup>th</sup> . In addition, approximately 15-30mins (x 2 people) of spotlighting surveys were also                                                                                                                                                                                                                                                                                                                                                                                                                |

| Fauna Group          | Survey Technique                | Survey Period      | Minimum Survey <100ha                                                                                                    | Survey Work Undertaken and Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|---------------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      |                                 |                    |                                                                                                                          | undertaken after each stagwatch survey on October 25 <sup>th</sup> , 29 <sup>th</sup> and November 19 <sup>th</sup> & 30 <sup>th</sup> .                                                                                                                                                                                                                                                                                                                                                                        |
| Nocturnal searches + | Call playback / call recording. | September – March. | Once per night for 2 nights per site, where suitable habitat is present. Preferably within the first 2 hours after dark. | The two small dams & safely accessible areas of the drainage line were searched during spotlighting surveys on October 14 <sup>th</sup> & 15 <sup>th</sup> . In addition, these areas were also inspected during stagwatching surveys on October 25 <sup>th</sup> , 29 <sup>th</sup> & November 19 <sup>th</sup> & 30 <sup>th</sup> . Any call heard were recorded & identified. No call playback is required for targeted species.                                                                             |
| Nocturnal searches + | Specific habitat searches.      | September – March. | 2 hours per 200m of water body edge.                                                                                     | Small areas of water body edges occur around small dams. Despite the absence of suitable habitat, particular attention was made towards the presence of <i>Crinia tinnula</i> , particularly in north-western corner within and adjacent to the drainage line. The two small dams & safely accessible areas of the drainage line were searched during spotlighting surveys on October 14 <sup>th</sup> & 15 <sup>th</sup> . In addition, these areas were also inspected during stagwatching surveys on October |

| Fauna Group        | Survey Technique              | Survey Period                                     | Minimum Survey <100ha                                                                                                      | Survey Work Undertaken and Comments                                                                                                                                                                                                               |
|--------------------|-------------------------------|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                    |                               |                                                   |                                                                                                                            | 25 <sup>th</sup> , 29 <sup>th</sup> & November 19 <sup>th</sup> & 30 <sup>th</sup> . Any call heard were recorded & identified.                                                                                                                   |
| Diurnal searches + | Opportunistic search.         | September – March.                                | Opportunistic searches should take place if frogs are heard calling during the day, until identified.                      | 0.5hour diurnal searches of dams were undertaken on October 25 <sup>th</sup> & 26 <sup>th</sup> . 0.5 diurnal searches of the E2 zoned area (described as understorey variant 2) were undertaken on October 13 <sup>th</sup> & 15 <sup>th</sup> . |
| <b>Optional.</b>   | Tadpole and egg mass surveys. | Anytime of year (refer to specific species info). | 1 trap for each water body & / or 1 dip net survey per water body.                                                         | Due to favourable weather conditions and an abundance of amphibian activity during the survey period, dip net surveys were not required. No tadpoles were observed within temporary shallow pooling within the drainage line.                     |
| <b>Optional.</b>   | Systematic diurnal searches.  | September – March.                                | 1 ha search for 1 person hour per site (may be done in conjunction with systematic reptile survey if in suitable habitat). | Not proposed.                                                                                                                                                                                                                                     |
| <b>Optional.</b>   | Pitfall trapping.             | September – March.                                | 6 traps for minimum 4 consecutive nights per site.                                                                         | Not proposed.                                                                                                                                                                                                                                     |

# - Optional only if there are other acceptable methods of detection used; + - Note: Wallum Froglet should be surveyed May to November when adequate water present

### 3.2.5 Survey Limitations

#### Owl Surveys

WSC (2014) states that 'the recommended number of visits to determine the presence or absence of threatened large forest owls, with 90% confidence is seven for Powerful Owl, eight for Sooty Owl, and nine for Masked Owl' (Debus 1995 in WSC, 2014). This was later updated to a recommended minimum of 3 consecutive nights of quiet listening, from 20min prior to dusk & for at least 1 hour in total darkness (Note: this specific minimum requirement was updated after listening surveys were completed for this assessment).

Two nights of quiet listening survey were conducted on August 31<sup>st</sup> and September 4<sup>th</sup>, 2015.

Detailed roosting and pellet searches were conducted on August 30<sup>th</sup> and 31<sup>st</sup>, 2015. No roost evidence was found. It is considered that the very sparse understorey and mid-canopy of the proposed rezoning area is unlikely to provide potential roosting habitat for Owls. The denser areas of vegetation within the E2 zoned area along the drainage corridor may provide potential roosting habitat, particularly within denser areas in the south-western corner of the subject site. Therefore no potential roosting habitat is likely to be impacted by the proposal.

No potential nesting hollows were recorded during hollow-bearing tree surveys and therefore no potential nesting hollows will be impact by the proposal.

Given the extent of local records and known occurrence of threatened Owl species, particularly Powerful Owl and Masked Owl within the Wadalba Wildlife Corridor (BioNet, 2015; Conacher Travers, 2006), it is assumed that the subject site is likely to provide foraging habitat for these species. Determining the importance of subject site as a foraging resource has been assisted by undertaking detailed surveys to help determine the prey abundance for Owl species.

Given that no potential nesting or roosting habitat will be impact by the proposal, it is considered that the field surveys undertaken, including details surveys to determined prey abundance, are adequate for the purpose of assessing the potential impact of the proposal on threatened Owl species.

#### Stagwatching Surveys

The survey guidelines (WSC, 2014) recommend a minimum stagwatching effort for arboreal mammals as 'observing hollow for 30 mins prior to sunset until 60 mins after sunset for 3-4 nights and / or mornings'. Four (4) nights of stagwatch surveys with two people have been undertaken given a total of 8 stagwatches. All hollow-bearing trees have either been stagwatched or inspected by inspection camera. Hollow-bearing tree no. 10, where Sugar Glider was observed exiting a hollow was stagwatched on two occasions. Given the

results of stagwatching surveys (Refer to section 4.3.3 & Table 7), with consideration of the extent of fauna inhabitants recorded, it is considered that the amount of stagwatching surveys undertaken is adequate for this assessment.

### **Other Survey Limitations**

Field surveys were undertaken with the following limitations:

- Surveys were carried out from late August to late November 2015, and is therefore outside the seasonal activity or growth periods for some fauna and flora species.
- Diurnal bird surveys were undertaken from winter to late spring, however have not been undertaken in summer.

### **3.2.6 Nomenclature**

Plant and animal names used in this report are taken from the NSW Office of Environment and Heritage's Atlas of NSW Wildlife, accessed through [www.bionet.nsw.gov.au](http://www.bionet.nsw.gov.au).

Plant names are crosschecked with those contained within The Plant Information Network System of The Royal Botanic Gardens and Domain Trust, Sydney, Australia (version 2.0). This is accessed through <http://plantnet.rbgsyd.nsw.gov.au>.

All animal and plants names listed as threatened under either the NSW Threatened Species Conservation Act or the Environmental Protection & Biodiversity Conservation Act are also crosschecked with their currently profiles accessed through [www.environment.nsw.gov.au](http://www.environment.nsw.gov.au) and [www.environment.gov.au](http://www.environment.gov.au) respectively.

## 4 RESULTS AND DISCUSSION

### 4.1 Database Review

10km radius searches of BioNet Atlas of NSW Wildlife, the PlantNet and Protected Matters Search Tool databases has provided lists of threatened entities for consideration in this assessment. Table 5 below provides a summary of species lists obtained from these database searches as well as the total of threatened flora, fauna, endangered populations and ecological communities included in the '7-part test or Assessment of Significance' (Refer to Appendix 4). Tables 9 and 10 of Appendix 1 & 2 provides information on these species and the reasons for inclusion or omission from the '7-part test or Assessment of Significance'. The protected matter report obtained from searches of the commonwealth databases under the EPBC Act is provide in Appendix 3.

**Table 5 – Summary of database searches**

| Threatened Entities               | Total | Listed under TSC Act | Listed under EPBC Act | Total included in '7-part test or Assessment of Significance'. |          |
|-----------------------------------|-------|----------------------|-----------------------|----------------------------------------------------------------|----------|
|                                   |       |                      |                       | TSC Act                                                        | EPBC Act |
| Flora                             | 28    | 28                   | 25                    | 6                                                              | 6        |
| Fauna                             | 72    | 70                   | 23                    | 24                                                             | 5        |
| Endangered Populations Flora      | 1     | 1                    | 0                     | 0                                                              | 0        |
| Endangered Populations Fauna      | 0     | 0                    | 0                     | 0                                                              | 0        |
| Endangered Ecological Communities | 16    | 16                   | 4                     | 0                                                              | 0        |
| Migratory Species                 | 73    | 0                    | 73                    | 0                                                              | 0        |

Note: Marine based species have been omitted from consideration & are not included in Table 9 of Appendix 1 (with the exception of *Haliaeetus leucogaster* White-bellied Sea-Eagle).

## 4.2 Document and Planning Review

### 4.2.1 State Environmental Planning Policy (SEPP)

#### **SEPP 14 – Coastal Wetlands**

The closest SEPP 14 wetlands occur approximately 1.2km to the south of the subject site. The proposal is unlikely to impact upon any SEPP 14 wetlands.

#### **SEPP 26 – Littoral Rainforest**

The closest SEPP 26 littoral rainforest is located approximately 6km to the south-east, along the eastern edge of Tuggerah Lake. The proposal is unlikely to impact upon any SEPP 26 littoral rainforest.

#### **SEPP 44 – Koala Habitat Protection**

Refer to Section 4.4.3 – Koala Habitat Assessment for consideration of locally or regionally listed feed tree species.

#### **SEPP 71 – Coastal Protection**

The closest areas of land mapped as Coastal Protection occur approximately 470m to the south-east of the subject site. The proposal is unlikely to impact upon any lands mapped as Coastal Protection.

### 4.2.2 Local Plans

#### **Wadalba Wildlife Corridor Management Plan by Conacher Travers September 2006**

The Wadalba Wildlife Corridor (WWC) was initially acquired from areas of the Wadalba Urban Release Area (WURA) for the purpose of maintaining vegetation connectivity from Tacoma Wetlands in the south-east to Porters Creek Wetland in the north-west. The subject site was not part of the WURA. However given the subject sites proximity to the corridor, it is considered to be important that the proposal is consistent with this management plan.

This management plan has been adopted to protect the long-term ecological value of the WWC. It provides 15 broad management categories, each of which contain specific objectives and actions. In addition, Table 1

divides the WURA into 3 sections, A, B and C each with applicable management actions. If the subject site was part of WURA it would fall under Section B – Future Residential Areas Abutting Wadalba Wildlife Corridor.

The broad management categories, applicable management actions for areas of land under Section B, and the party responsible for implementation are listed within this management plan.

This document also lists ten threatened fauna species which have been recorded within the area during surveys (Conacher Travers, 2006). These species include:

- Masked Owl (*Tyto novaehollandiae*)
- Powerful Owl (*Ninox strenua*)
- Squirrel Glider (*Petaurus norfolcensis*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Little Bentwing-bat (*Mormopterus norfolkensis*)
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)
- Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)

It is considered that the proposal is consistent with the objectives and actions of this management plan.

### **Wyong Shire Council Development Control Plan 2013 – Chapter 3.4 – Conservation Areas for Northern Wyong Shire**

The subject site is situated at the southern end of the North Wyong Shire Structure Plan. The Wadalba Wildlife Corridor is mapped as 'Green Corridor' linking Tacoma Wetlands in the south-east to Porters Creek Wetland in the north-west. The area of E2 zoned land along the western side of the subject site is mapped as a 'local conservation link' connecting to an area of 'Green Corridor' on the northern side of the Pacific Highway.

## **Squirrel Glider (*Petaurus norfolcensis*) Conservation Management Plan: Wyong Shire 2002**

The purpose of the Squirrel Glider (*Petaurus norfolcensis*) Conservation Management Plan in Wyong Shire is to:

- Improve knowledge and awareness of the distribution and habitat requirements of the Squirrel Glider in Wyong Shire;
- Identify threats to Squirrel Gliders in Wyong Shire;
- Clarify the conservation status of the Squirrel Glider in WyongShire; and
- Identify recovery actions and conservation targets for sustaining a viable population of Squirrel Gliders in Wyong Shire.

This management plan is addressed in detail as part of section 4.4.2 – Squirrel Glider Habitat Assessment.

## **Draft Louisiana Road Management Plan**

This management plan is for lands to the north of the Pacific Highway.

### **4.2.3 Previous Studies**

The study area is situated adjacent to the Wadalba Wildlife Corridor and as such a variety of surveys, assessments and management plans have been previously prepared for this area. Previous studies considered to be important for this assessment are summarise below. This may be limited to those studies accessible at the time of preparing this report.

## **Wyong Ground Orchid Survey Wyong Shire – Final Version January 2003 Gunninah Environmental Consultants**

This is a detailed study of orchids concentrated within the planned northern development areas within the eastern parts of the Wyong LGA, with the purpose of establishing the conservation significance and status of species and identify the range of habitats in which orchids occur (GEC, 2003)

The specific aims of this project were (GEC, 2003):

- To undertake an initial literature review on orchid ecology and conservation issues;

- To identify vegetation communities and to describe habitat/microhabitat which are likely to provide habitat for targeted orchid species of high conservation importance identified within the Wyong LGA;
- To develop predictive criteria to identify potential habitat for orchid species of conservation importance;
- To undertake broad-based mapping of orchid species which are considered to possess conservation importance, and which are likely to occur within the Wyong Development Areas and other locations in nearby National Parks, Crown Lands and Council Reserves.

#### **Ecological Assessment of Lot 2 DP1154872 Louisiana Road, Wadalba by Enviro Ecology 2012**

No fauna surveys were conducted as part of this study. No threatened flora species, populations or endangered ecological communities were recorded by this study.

#### **Flora and Fauna Assessment Lot 3110 DP808521 Louisiana Road, Wadalba by Conacher Travers 2007**

This study recorded three (3) threatened fauna species, Squirrel Glider (*Petaurus norfolcensis*), Powerful Owl (*Ninox strenua*) and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*).

#### **4.2.4 Vegetation Mapping**

Six Maps vegetation mapping shows that subject site is mapped as 'Narrabeen Dooralong Spotted Gum – Ironbark Forest' (Map Unit 30) as described by Bell (2002b) based on 2008 revisions (OEH, 2015b).

Detailed flora surveys indicate that the vegetation community within the subject site is consistent with 'Narrabeen Dooralong Spotted Gum – Ironbark Forest' (Map Unit 30).

The most similar community described by Somerville (2009a) is 'Spotted Gum / Grey Ironbark dry open forest of the Central Coast and lower Hunter' (MU63) (Somerville, 2009a). The most similar Biometric Vegetation Type is 'Spotted Gum – Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin (ID13061) (Somerville, 2009a).

## 4.3 Flora and Fauna Surveys

The results of flora and fauna surveys are presented below.

### 4.3.1 Flora

A total of one hundred and three (103) flora species were recorded within the subject site, including sixty-six (66) native species and thirty-six (36) introduced species (Refer to Table 11 of Appendix 5).

One (1) ROTAP species, *Macrozamia flexuosa* was recorded mostly within the E2 zoned area with a few specimens also recorded in the proposed rezoning area. *M.flexuosa* is listed as 2K by ROTAP, the '2' meaning the species has a geographic range within Australia of less than 100km and K meaning that the species is poorly known (Briggs et al., 1996).

### Threatened Flora

No threatened flora species listed under the TSC Act and/or EPBC Act were recorded within the subject site. Refer to section 5 and Appendix 4 for assessment of threatened species.

### Threatened Ground Orchids

Three (3) threatened orchid species considered to have potential to occur within the subject site were targeted during surveys. These include (Refer to Table 9 of Appendix 1):

- *Caladenia tessellata* (Thick Lip Spider Orchid) – flowering September and November;
- *Rhizanthella slateri* (Eastern Australian Underground Orchid) – flowering September to November; and
- *Thelymitra adorata* (Wyong Sun Orchid) – flowering September to October.

The author visited the known population of *T.adorata* on several occasions this season to confirm the flowering period and to strengthen the familiarity with the species. The author has also recently spent time with local orchid expert, Boris Branwhite to look at specimens of *T.pauciflora* and learn the distinguishing characteristics of the locally occurring *Thelymitra* species.

Targetted surveys during favourable weather conditions for *T.adorata* were undertaken on September 30<sup>th</sup> and October 2<sup>nd</sup> of 2015. Some non-flowering stems of both *Thelymitra pauciflora* and *Calochis sp.* (Bearded Orchid species) were identified and clearly distinguished from *T.adorata* by stem diameter, being less than 2mm, colour and leaf characteristics. No specimens of *Thelymitra sp. adorata* were recorded.

No specimens of *R.slateri* or *C.tessellata* were observed during surveys.

The subject site has been stratified into areas of low and high level weed invasion. The areas with a high level of weeds with 'poor' quality groundcover habitats (Refer to Figure 3) are unlikely to provide potential habitat for these orchid species. Weeds including exotic grass species compete with orchids for light, moisture, space and nutrients (GEC, 2003; Coupar & Van Bockel, 1998). Areas of low level weed invasion, which provide potential habitat for orchids are estimated to be approximately 1.02ha out of 2.7ha (Refer to Figure 3).

## Endangered Flora Populations

Two (2) endangered flora populations which occur within the Wyong LGA include:

- Eucalyptus oblonga population at Bateau Bay, Forresters Beach and Tumby Umbi in the Wyong LGA; &
- Eucalyptus parramattensis subsp. parramattensis in Wyong and Lake Macquarie LGAs.

No specimens of these populations were observed within the subject site.

## Listed Weeds

Five (5) flora species recorded within the subject site are listed as Noxious Weeds in the Wyong LGA (DPI, 2015). These include:

- *Hypericum perforatum* (St John's Wort) and *Cortaderia selloana* (Pampas Grass) which are listed as a Class 3 Noxious Weed - '*The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed*' (DPI, 2015); &
- *Asparagus aethiopicus* (Ground Asparagus), *Asparagus asparagoides* (Bridal Creeper) and *Senecio madagascariensis* (Fireweed) are listed as a Class 4 Noxious Weeds - '*The plant must not be sold, propagated or knowingly distributed*' (DPI, 2015).

Four (4) species recorded within the subject site are listed as Weeds of National Significance. These include, *Senecio madagascariensis* (Fireweed), *Lantana camara* (Lantana), *Asparagus aethiopicus* (Ground Asparagus) and *Asparagus asparagoides* (Bridal Creeper).

Two (2) introduced species recorded, *Ligustrum sinense* (Small-leaved Privet) and *Ochna serrulata* (Mickey Mouse Plant) are listed as Noxious Weeds in other parts of NSW, but not in Wyong LGA.

### 4.3.2 Vegetation Communities

The subject site contains one (1) vegetation community, Tall Open Forest with a variation between the understorey of the proposed rezoning area (described as understorey variant 1) and the understorey of the E2 zoned area (described as understorey variant 2) (Refer to Figure 2). The descriptions of this vegetation community and understorey variants is based on both Quadrat data and random meander surveys. Quadrat 1 is located in the proposed rezoning area and Quadrat 2 in the E2 zoned area as displayed in Figure 3. The results of Quadrat surveys is displayed in Table 11 of Appendix 5.

#### **Tall Open Forest – understorey variant 1**

**Summary:** Tall Open Forest dominated by *Corymbia maculata* (Spotted Gum) and *Eucalyptus siderophloia* (Grey Ironbark) in the upper stratum with a very sparse understorey and a moderately dense to dense cover dominated by both native and introduced herbs and grasses. The understorey variant 1 of this community occurs throughout the proposed rezoning area as shown in Figure 2.

#### **Structure:**

**Upper Stratum (Trees)** (24-30m high): Dominated by *Corymbia maculata* (Spotted Gum) and *Eucalyptus siderophloia* (Grey Ironbark) with *Eucalyptus eugenioides* (Thin-leaved Stringybark) also occurring.

**Mid-stratum (Small trees)** (5-10m high): The mid-stratum of variant 1 has been previously cleared. Some specimens of *Allocasuarina torulosa* (Forest Oak), *Melaleuca nodosa* (Ball Honeymyrtle) and *Acacia falcata* (Hickory Wattle) are present.

**Lower-stratum (Shrubs)** (1-5m high): The understorey of variant 1 has been previously cleared. A very sparse layer with the occasional specimen including, *Exocarpus cupressiformis* (Native Cherry), *Pittosporum undulatum* (Sweet Pittosporum), *Acacia longifolia subsp. longifolia* (Sydney Golden Wattle), *Breynia oblongifolia* (Coffee Bush), *Daviesia ulicifolia* (Gorse Bitter Pea), *Ligustrum sinense* (Small-leaved Privet) and *Senna pendula*.

**Groundcover (incl. small shrubs)** (0-1m high): A moderately dense to dense cover dominated by a mixture of native and introduced herbs and grasses. Individual species are generally dominant in patches throughout this stratum.

Native species which are dominant in patches throughout this stratum include, *Imperata cylindrica* (Blady Grass), *Themeda triandra* (Kangaroo Grass), *Juncus usitatus*, *Lomandra longifolia* (Spiny-headed Mat-rush), *Entolasia stricta* (Wiry Panic), *Dichelachne micrantha* (Shorthair Plumegrass) and *Cymbopogon refractus*

(Barbed Wire Grass). Other commonly occurring native species include, *Dianella caerulea* var. *producta* (Blue Flax-lily), *Pratia purpurascens* (Whiteroot) and *Cheilanthes sieberi* subsp. *sieberi* (Poison Rock Fern).

Introduced species which are dominant in patches include, *Pennisetum clandestinum* (Kikuyu Grass), *Andropogon virginicus* (Whisky Grass), *Chloris gayana* (Rhodes Grass), *Paspalum urvillei* (Vasey Grass) and *Plantago lanceolata* (Lamb's Tongue). Other commonly occurring introduced species include, *Senecio madagascariensis* (Fireweed) and *Briza maxima* (Blowfly Grass).

### Listed Weeds

Noxious Weeds listed for Wyong LGA and recorded within this area include: *Hypericum perforatum* (St John's Wort), *Asparagus aethiopicus* (Ground Asparagus), *Asparagus asparagoides* (Bridal Creeper) and *Senecio madagascariensis* (Fireweed).

Weed of National Significance recorded within this area include: *Senecio madagascariensis* (Fireweed), *Lantana camara* (Lantana), *Asparagus aethiopicus* (Ground Asparagus) and *Asparagus asparagoides* (Bridal Creeper).

**Condition:** This area is considered to be in low condition due to the presence of weeds and the previous clearing and underscrubbing activities.

### Tall Open Forest – understorey variant 2

**Summary:** Tall Open Forest dominated by *Corymbia maculata* (Spotted Gum) and *Eucalyptus siderophloia* (Grey Ironbark) in the upper stratum with a moderately dense to dense understorey dominated by introduced species and a moderately dense groundcover of native and introduced herbs and grasses. The understorey variant 2 of this community occurs throughout the E2 zoned area (drainage corridor) as shown in Figure 2.

#### Structure:

**Upper Stratum (Trees)** (24-30m high): Dominated by *Corymbia maculata* (Spotted Gum) and *Eucalyptus siderophloia* (Grey Ironbark) with *Eucalyptus eugenioides* (Thin-leaved Stringybark) also occurring.

**Mid-stratum (Small trees)** (5-10m high): Moderately dense stratum including, *Allocasuarina torulosa* (Forest Oak), *Melaleuca nodosa* (Ball Honeymyrtle) and *Pittosporum undulatum* (Sweet Pittosporum). One (1) specimen of *Livistona australis* (Cabbage Tree Palm) as well as one (1) specimen of the introduced *Erythrina x sykesii* (Coral Tree) were also observed within this stratum.

**Lower-stratum (Shrubs)** (1-5m high): A moderately dense to dense layer dominated by *Pittosporum undulatum* (Sweet Pittosporum) and the introduced species, *Ligustrum sinense* (Small-leaved Privet) and *Lantana camara* (Lantana). Other shrub species represented in this stratum include, *Persoonia linearis* (Narrow-leaved Geebung), *Xanthorrhoea macronema* and the introduced *Ochna serrulata* (Mickey Mouse Plant).

**Groundcover (incl. small shrubs)** (0-2m high): A moderately dense cover dominated by *Gahnia clarkei* (Tall Saw-sedge), *Imperata cylindrica* (Blady Grass), *Oplismenus aemulus* (Australian Basket Grass), *Panicum simile* (Two-coloured Panic), *Microlaena stipoides* (Weeping Grass), *Lomandra longifolia* (Spiny-headed Mat-rush) and *Pellaea falcata* (Sickle Fern). Other species common throughout this stratum include, *Carex appressa* (Tall Sedge), *Juncus usitatus*, *Themeda triandra* (Kangaroo Grass) and the introduced species, *Andropogon virginicus* (Whisky Grass) and *Asparagus asparagoides* (Bridal Creeper).

**Climbers:** *Parsonsia straminea* (Common Silkpod) is common throughout this area with *Pandorea pandorana* (Wonga Wonga Vine) also occurring.

### Listed Weeds

Noxious Weeds in the Wyong LGA were recorded within this area include: *Asparagus asparagoides* (Bridal Creeper) and *Cortaderia selloana* (Pampas Grass).

Weed of National Significance recorded within this area include: *Lantana camara* (Lantana) and *Asparagus asparagoides* (Bridal Creeper).

Two (2) introduced species recorded within this area, *Ligustrum sinense* (Small-leaved Privet) and *Ochna serrulata* (Mickey Mouse Plant) are listed as Noxious Weeds in other parts of NSW, but not in Wyong LGA.

**Condition:** This area of vegetation is considered to be in low to moderate condition due to the dominance of weed species particularly throughout the understorey stratum. The presence of weeds species appears to be greater towards the northern end and eastern side of this area.

### Variations in the condition of ground cover

The quality of groundcover, leaf litter and fallen log habitats throughout the subject site have been stratified into areas of either 'poor' or 'good' quality habitats. The areas of 'good' and 'poor' quality groundcover habitats are displayed in Figure 3. 'Poor' quality is contains a dominance of introduced grasses and herbs with little or no leaf litter or fallen logs. 'Good' quality habitats are dominated by native grasses (including tussocks) and herbs with a natural cover of leaf litter and some small fallen logs.

## Endangered Ecological Communities

This vegetation community is not consistent with any endangered ecological community listed under the TSC Act and/or EPBC Act.

### 4.3.3 Fauna

A total of forty-nine (49) fauna species were recorded during this survey, including twenty-four (24) bird, twenty (20) mammal, three (3) amphibian and two (2) reptile species (Refer to Table 12 of Appendix 5).

Five (5) threatened fauna species, including one (1) bird species and four (4) micro-bat species were recorded within or in close proximity to the subject site during surveys. These include:

- *Calyptrorhynchus lathamii* (Glossy Black-cockatoo);
- *Miniopterus australis* (Little Bentwing-bat);
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat);
- *Mormopterus norfolkensis* (Eastern Freetail-bat); and
- *Scoteanax rueppellii* (Greater Broad-nosed Bat).

All of these species are listed as Vulnerable under the NSW TSC Act. None of these species are listed under the EPBC Act.

Threatened species are discussed below in the following fauna classes and are assessed as part a 7-part test 'Assessment of Significance' in Appendix 4.

Five (5) regionally significant fauna species, *Lewinia pectoralis* (Lewins Rail), *Tyto alba* (Barn Owl), *Petaurus breviceps* (Sugar Glider), *Tachyglossus aculeatus* (Short-beaked Echidna) and *Vespadelus pumulus* (Eastern Forest Bat) were recorded within or in close proximity to the subject site (WSC, 2014).

### Birds

One (1) threatened bird species, *Calyptrorhynchus lathamii* (Glossy Black-cockatoo), listed as Vulnerable under the NSW TSC Act was recorded on two occasions within the Wadalba Wildlife Corridor approximately 20m to the south of the subject site. This species is assessed as part of the 7-part test in Appendix 4.

Two (2) regionally significant bird species, *Lewinia pectoralis* (Lewins Rail) and *Tyto alba* (Barn Owl) were recorded during surveys. The Lewins Rail was observed foraging in the southern side of the subject site, adjacent to the Wadalba Wildlife Corridor, while calls of the Barn Owl were heard from areas offsite to the

east during nocturnal surveys. A known nest site for Barn Owl occurs in the adjoining property to the east of the subject site. Lewins Rail nests within or adjacent to swampy areas, none of which occur within the subject site. No nests of Lewins Rail were observed within proposed rezoning area.

The remaining bird species recorded are considered to be common in the local area.

Four (4) common species were observed either nesting or investigating the use of particular tree hollows within the subject site (Refer to Table 7 in section 4.4.1 for the details of hollow-bearing trees and Figure 3 & 5 for hollow-bearing tree locations). These included:

- *Chenonetta jubata* (Australian Wood Duck) – Observed investigating hollow-bearing tree no. 4;
- *Eolophus roseicapilla* (Galah) – Observed nesting in hollow-bearing tree no. 6;
- *Trichoglossus haematodus* (Rainbow Lorikeet) – Observed nesting in hollow-bearing tree no. 5; &
- *Platycercus eximius* (Eastern Rosella) – Observed nesting in hollow-bearing tree no. 6.

No other bird nests were observed within the subject site.

The diversity of bird species recorded is considered to be low, with a particular lack of species which utilise low shrub and the ground level for nesting, protection and foraging. This is likely to be result of both the absence of understorey vegetation within the proposed rezoning area and predation by introduced species, *Vulpes vulpes* (European Fox) and *Felis catus* (Domestic Cat) both recorded within the E2 zoned area (drainage corridor) along the western side of the subject site.

## **Mammals**

The twenty (20) mammal species recorded included, seven (7) terrestrial mammal species, three (3) arboreal mammal species and ten (10) micro-bat species.

### Micro-bats

A total of ten (10) micro-bat species were recorded during surveys. Of these ten, four (4) of the species recorded are threatened micro-bat species, *Miniopterus australis* (Little Bentwing-bat), *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat), *Mormopterus norfolkensis* (Eastern Freetail-bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat), all listed as Vulnerable under the NSW TSC Act.

Micro-bat call analysis identified an additional five (5) species groupings which included the possibility of an additional two (2) threatened species, *Falsistrellus tasmaniensis* (Greater Broad-nosed Bat) and *Myotis macropus* (Southern Myotis), also listed as Vulnerable under the NSW TSC Act (Refer to Table 12 of Appendix 5).

The surveys also recorded one (1) regionally significant micro-bat species, *Vespadelus pumilus* (Eastern Forest Bat) (WSC, 2014).

Table 6 provides a summary of the micro-bats recorded and there known roosting habitats. Threatened species are in bold text.

**Table 6 – Micro-bats recorded & their known roosting habitats**

| Scientific Name                                           | Common Name                      | Roosting Habitat                    |
|-----------------------------------------------------------|----------------------------------|-------------------------------------|
| <b><i>Miniopterus australis</i></b>                       | <b>Little Bentwing-bat</b>       | Caves, hollows, structures          |
| <b><i>Miniopterus schreibersii oceanensis</i></b>         | <b>Eastern Bentwing-bat</b>      | Caves, structures                   |
| <b><i>Mormopterus norfolkensis</i></b>                    | <b>Eastern Freetail-bat</b>      | Hollows, bark, structures           |
| <b><i>Scoteanax rueppellii</i></b>                        | <b>Greater Broad-nosed Bat</b>   | Hollows, bark, structures           |
| <i>Mormopterus ridei</i>                                  | Eastern Little Freetail-bat      | Hollows                             |
| <i>Tadarida australis</i>                                 | White-striped Free-tailed Bat    | Hollows                             |
| <i>Chalinolobus gouldii</i>                               | Gould's Wattled Bat              | Hollows, foliage, structures        |
| <i>Chalinolobus morio</i>                                 | Chocolate Wattled Bat            | Hollows, bark, nests, structures    |
| <i>Vespadelus pumilus</i>                                 | Eastern Forest Bat               | Hollows, structures                 |
| <i>Vespadelus vulturinus</i>                              | Little Forest Bat                | Hollows, structures                 |
| Additional possible species included in Species Groupings |                                  |                                     |
| <b><i>Falsistrellus tasmaniensis</i></b>                  | <b>Eastern False Pipistrelle</b> | Hollows, bark, structures, caves    |
| <b><i>Myotis macropus</i></b>                             | <b>Southern Myotis</b>           | Caves, hollows, structures, foliage |
| <i>Scotorepens orion</i>                                  | Eastern Broad-nosed Bat          | Hollows, structures                 |
| <i>Vespadelus darlingtoni</i>                             | Large Forest Bat                 | Hollows, structures                 |
| <i>Vespadelus regulus</i>                                 | Southern Forest Bat              | Hollows, structures                 |
| <i>Nyctophilus geoffroyi</i>                              | Lesser Long-eared Bat            | Hollows, bark, structures           |
| <i>Nyctophilus gouldi</i>                                 | Gould's Long-eared Bat           | Hollows, bark                       |

Sourced from: DECC (2007); Churchill (2008).

No caves, nests or structures were observed within the subject site, however hollow-bearing trees may provide roosting habitat. It is considered that four (4) hollow-bearing trees, HT2, HT4, HT5 and HT6 have potential to provide roosting habitat. Both of the most suitable medium sized (10-20cm) hollows in HT4, HT5 and HT6 are currently inhabited by other fauna (Refer to Table 7). The remaining six (6) hollow-bearing trees within the subject site may provide potential temporary roosts for day and night time resting. All of the ten (10) hollow-bearing trees have been either stagwatched or inspected by inspection camera. No roosting evidence or specimens have been observed either roosting or exiting hollows. Threatened bat species are assessed as part of the 7-part test in Appendix 4.

### Terrestrial Mammals

The seven (7) terrestrial mammal species included four (4) introduced species and three (3) native species. Only one (1) terrestrial mammal species, *Oryctolagus cuniculus* (Rabbit) was recorded within the proposed rezoning area, despite the application of a range of survey methods (Refer to Figure 3 & Photos 9 to 12). The remaining three (3) introduced terrestrial mammal species, *Rattus rattus* (Black Rat), *Vulpes vulpes* (European Fox) and *Felis catus* (Domestic Cat) were all recorded in the E2 zoned area (drainage corridor) along the western side of the subject site. *R.rattus* was the only species terrestrial mammal species recorded in the northern end of the E2 zoned area.

Of the native terrestrial mammal species, *Tachyglossus aculeatus* (Short-beaked Echidna) and *Rattus fuscipes* (Bush Rat) were recorded by Camera Trap and Elliott trapping respectively within the southern end of the E2 zoned area, adjoining the Wadalba Wildlife Corridor. Native species, *R.fuscipes* and *Antechinus stuartii* (Brown Antechinus) were both recorded by Elliott trapping to the south of the subject site, within the Wadalba Wildlife Corridor.

*T.aculeatus* is listed as a regionally significant species (WSC, 2014). *T.aculeatus* was recorded in the E2 zoned area, outside of the proposed rezoning area, however this species utilise a variety of habitats and is likely to utilise other areas of the subject site on occasion.

The distribution of terrestrial mammal species recorded, despite the limited data collected, indicates a greater presence of introduced species within the proposed rezoning area and the northern end of the E2 zoned area, and a greater presence of native species within the southern end of the E2 zoned area and the Wadalba Wildlife Corridor to the south. This is likely to be a result of the absence of understorey vegetation within the proposed rezoning area and a high level of disturbance, particularly within the southern end of the E2 zoned area. Predatory species, *Vulpes vulpes* (European Fox) and *Felis catus* (Domestic Cat), recorded within the E2 zoned area, are also likely to effect the abundance of native terrestrial mammals throughout both the subject site and the adjoining Wadalba Wildlife Corridor.

### Arboreal Mammals

Three (3) arboreal mammal species, *Trichosurus vulpecula* (Common Brushtail Possum), *Pseudocheirus peregrinus* (Common Ringtail Possum) and *Petaurus breviceps* (Sugar Glider) were recorded during surveys. A pair of *T.vulpecula* were observed utilising a medium (10-20cm) branch hollow within the subject site in hollow-bearing tree no. 4 (Refer to Table 7). *T.vulpecula* was also recorded within the south-eastern corner of the subject site by Camera Trap. *P.peregrinus* was recorded by Camera Trap and by observation of a drey within the southern end of the E2 zoned area and denser areas of mid-stratum vegetation further to the south within the Wadalba Wildlife Corridor (Refer to Photo 13 & 14). *P.peregrinus* was not recorded within the proposed rezoning area.

*P.breviceps* is listed as regionally significant species (WSC, 2014). Three (3) specimens of this species were observed exiting a small branch hollow (<10cm entrance diameter) in hollow-bearing tree no.10 (HT10 – refer to Table 7) during a stagwatch on November 19<sup>th</sup>, 2015. The first and largest specimens left the hollow at approximately half an hour after dark (20:05), gliding towards the E2 zoned area. This was followed shortly after by two more smaller specimens heading in the same direction.

HT10 was stagwatched again on November 30<sup>th</sup>, when no specimens of *P.breviceps* were observed exiting hollows. However two specimens were spotlighted in the edge of the E2 zoned area, approximately 20m to the west of HT10. These specimens are likely to have come from another hollow to the west within the E2 zoned area.

*P.breviceps* is similar in appearance to the threatened *Petaurus norfolcensis* (Squirrel Glider), listed as Vulnerable by the TSC Act, and also known to occur in the area. Specimens were observed from various angles and in both small branches and on lower trunks immediately after gliding. Distinguishing characteristics observed to confirm identification of *P.breviceps* included (Strahan, 1995):

- Tail length equal to or slightly less than body length;
- The tails were narrow, and clearly less than the body width at the tail base;
- A white tip was observed on the tail of 1 specimen; &
- The overall size of all specimens observed were consistent with dimension provided by Strahan, 1995.

No Sugar Gliders were observed during any other spotlighting or stagwatching surveys within the subject site. HT10 will require removal as part of a future subdivision proposal. Sugar Glider can use up to 5 hollows (over different periods) (Henry and Suckling, 1984 Table 3.3 pg.30 in Gibbons *et al*, 2002). Sugar Gliders are also versatile in their choice of nesting sites and are known to utilise nest boxes (Strahan, 1995; Gibbons *et al*, 2002). It is considered that the small branch hollow in HT10 is an established nest site for Sugar Gliders and is likely to be used intermittently along with other hollows most likely within the E2 zoned area. Given the implementation of recommendations, in particular the installation of compensatory natural nest boxes and the methods of tree removal, as well as the retaining of the E2 zoned area as a 'local conservation link', it is considered that the proposal is unlikely to have significant impact upon this local population of Sugar Gliders.

No specimens of the threatened species, *Petaurus norfolcensis* (Squirrel Glider) were recorded, despite targeted Elliott trapping and call playback surveys.

## **Amphibians**

Three (3) common amphibian species, *Litoria fallax* (Dwarf Tree Frog), *Litoria peronii* (Peron's Tree Frog) and *Litoria tyleri* (Tyler's Tree Frog) were recorded within two small dams located along the southern boundary of the subject site. It is estimated that 5 to 10 individuals of each species were present. These dams are

considered to provide suitable breeding habitat for common amphibian species, indicated by the abundance of amphibians recorded.

No threatened species of amphibians were recorded during surveys. Surveys for *Crinia tinnula* (Wallum Froglet) were conducted during suitable season and weather conditions to detect the presence of this species.

## **Reptiles**

Two (2) common reptile species, *Chelodina longicollis* (Eastern Snake-necked Turtle) and *Lampropholis guichenoti* (Pale-flecked Garden Sunskink) were recorded during surveys. *C.longicollis* was observed during spotlighting surveys approximately 15m to the south of the two dams, within the Wadalba Wildlife Corridor. *L.guichenoti* was recorded within both the subject site and the Wadalba Wildlife Corridor.

No threatened reptile species were recorded during surveys.

## **Invasive Species**

Four (4) fauna species recorded by surveys, *Oryctolagus cuniculus* (Rabbit), *Rattus rattus* (Black Rat), *Vulpes vulpes* (European Fox) and *Felis catus* (Domestic Cat) are listed as 'Invasive Species' under the EPBC Act (DSEWPC, 2015). The impact of Rabbits, European Fox and Cats are also listed as Key Threatening Processes, addressed in part (g) of the 7-part test (Refer to Appendix 4). The proposal is unlikely to exacerbate the impact of any invasive fauna species.

## 4.4 Habitat & Connectivity

### 4.4.1 General Habitat Assessment

#### Disturbance History

Some areas of the canopy have been cleared, particular along the western and northern sides with a small cleared area in the centre and along an existing vehicle access track off Louisiana Road. The proposed rezoning area has been previously underscrubbed with little to no mid-canopy or shrub layer present, apart from a small area in the south-western corner. The previous uses of the subject site include, a poultry farm from as early as the 1930s, a source of pit props as well as cattle grazing.

A significant amount of weed incursion of the ground cover has occurred particularly throughout the northern and north-western areas of the subject site (Refer to Figure 3), which is most likely a result of previous clearing of the tree canopy, previous landuse and edge effects from adjoining lands to the north.

Scattered piles of rubbish mostly throughout the southern side of the subject site, within the drainage line and in the dams indicated that the site is regularly used for illegal rubbish dumping. Four wheel drive and motorbike tracks through the site also indicated it is regularly used to gain vehicle access to the Wadalba Wildlife Corridor.

#### Habitat Assessment

Flowering trees throughout the subject site provide suitable foraging habitat for birds and arboreal mammals. In particular, *Corymbia maculata* (Spotted Gum), when flowering provides an important winter foraging resource.

A very sparse cover of flowering shrubs provides limited protective cover or foraging habitat for terrestrial and arboreal mammals and birds. Two fruiting specimens of *Allocasuarina torulosa* (Forest Oak) within the subject site provide potential foraging habitat for the threatened *Calyptrorhynchus lathamii* (Glossy Black-cockatoo).

The quality of groundcover, leaf litter and fallen log habitats throughout the subject site have been stratified into areas of either 'poor' or 'good' quality habitats. 'Good' quality groundcover habitats are displayed in Figure. These areas of varying groundcover habitats can be roughly defined as:

- 'Poor' quality - a dominance of introduced grasses and herbs with little or no leaf litter or fallen logs.

- 'Good' quality habitats - dominated by native grasses (including tussocks) and herbs with a natural cover of leaf litter and fallen logs.

Areas of 'good' quality ground cover habitats are located throughout the southern side of the subject site, including a dominance of species such as *Themeda triandra* (Kangaroo Grass) in the south-east and *Lomandra longifolia* (Spiny-headed Mat-rush) in the south-west corner. Native herbs and grasses provide some foraging habitat for terrestrial mammals and birds, while leaf litter with a very sparse cover of fallen logs provides some limited protective cover and foraging habitats for reptiles and amphibians.

The two small dams (approximately 6m x 6m each), located on the southern boundary of the subject site provide breeding habitat for common amphibian species recorded during surveys. These aquatic habitats are likely to be a breeding area for insects, which provide a foraging resources for a variety of fauna including micro-bats recorded throughout the subject site. Common duck species recorded also utilised these habitats as a refuge and foraging resource.

No caves or other potential roosting structures, suitable for roosting micro-bats were observed within the subject site.

### Hollow-bearing Trees

A total of ten (10) hollow-bearing trees are located within the proposed rezoning area (include HT7 likely to be impact by future road design), and a further six (6) hollow-bearing were recorded in areas within the E2 zoned area (drainage corridor) (Refer to Figure 3). Hollow-bearing trees within the proposed rezoning area contained a mixture of mostly small (<10cm) to medium (10-20cm) sized hollows. Hollow-bearing trees within Table 7 below are divided into those with visible entrances with or without evidence of use (coloured in yellow) and those with possible entrances and no evidence of use.

**Table 7 - Hollow-bearing Trees**

| Tree tag no.                                       | Species                  | Ht (m) | DBH (cm) | % Dead | Hollows           | Notes                                                           |
|----------------------------------------------------|--------------------------|--------|----------|--------|-------------------|-----------------------------------------------------------------|
| Hollows recorded within the proposed rezoning area |                          |        |          |        |                   |                                                                 |
| 1                                                  | <i>Corymbia maculata</i> | 22     | 100      | 40     | 2 M BT, 2 S Br    | No evidence of use.                                             |
| 2                                                  | <i>Corymbia maculata</i> | 18     | 80       | 60     | 1 M BT, 1 S Tr    | Some evidence of wear around entrance to S Tr hollow on W side. |
| 3                                                  | Stag                     | 6      | 27       | 100    | 1 M BT, 1 S Tr    | No evidence of use.                                             |
| 4                                                  | <i>Corymbia maculata</i> | 28     | 120      | 25     | 2 S Br, 4 M Br, 1 | Brushtail Possum in M Br hollow on                              |

| Tree tag no.                                            | Species                        | Ht (m) | DBH (cm) | % Dead | Hollows                | Notes                                                               |
|---------------------------------------------------------|--------------------------------|--------|----------|--------|------------------------|---------------------------------------------------------------------|
|                                                         |                                |        |          |        | M Tr                   | NE side. Wood Duck observed near hollow.                            |
| 5                                                       | <i>Corymbia maculata</i>       | 26     | 70       | 15     | 1 M Br, 1 M Sp         | Rainbow Lorikeet nesting in M Br hollow.                            |
| 6                                                       | <i>Corymbia maculata</i>       | 30     | 120      | 20     | 3 S Br, 1 M Tr, 1 L Sp | Galah nesting in L Sp hollow. Eastern Rosella observed near hollow. |
| 7                                                       | Stag                           | 12     | 70       | 100    | 2 S Br, 1 M Br         | Offsite to North. No evidence of use.                               |
| 10                                                      | Stag – Ironbark                | 18     | 90       | 100    | 2 S Br, 3 L LB         | Sugar Gliders                                                       |
| 11                                                      | <i>Eucalyptus siderophloia</i> | 18     | 50       | 40     | 1 S Br                 | No evidence of use.                                                 |
| 12                                                      | <i>Corymbia maculata</i>       | 20     | 70       | 80     | 1 M BT                 | No evidence of use.                                                 |
| Hollows recorded outside of the proposed rezoning area. |                                |        |          |        |                        |                                                                     |
| 8                                                       | <i>Corymbia maculata</i>       | 27     | 90       | 30     | 2 S Br                 | On boundary with E2 zoned area. No evidence of use.                 |
| 9                                                       | <i>Corymbia maculata</i>       | 26     | 70       | 30     | 2 S Br                 | On boundary with E2 zoned area. No evidence of use.                 |
| 13                                                      | <i>Eucalyptus siderophloia</i> | 24     | 80       | 100    | 1 S BT, 1 L LB         | No evidence of use.                                                 |
| 14                                                      | <i>Eucalyptus siderophloia</i> | 28     | 70       | 95     | 1 M BT, 1 M LB, 1 L LB | No evidence of use.                                                 |
| 15                                                      | <i>Corymbia maculata</i>       | 28     | 90       | 20     | 2 S Br, 2 M Br         | No evidence of use.                                                 |
| 16                                                      | <i>Eucalyptus siderophloia</i> | 20     | 80       | 15     | 2 S LB, 4 M LB         | No evidence of use.                                                 |

Size of hollows (estimate of diameter) : S= <10cm, M=10-20cm, L= 20-30cm, XL= 30-40cm, XXL= >40cm.

Types of hollows: BT= Broken Trunk, Br= Branch, Tr= Trunk, Sp= Split, LB= Loose Bark, N= Nest.

No critical habitat listed under the critical habitat register or as defined under the NSW TSC Act is located within or in close proximity to the subject site.

#### 4.4.1 Corridor Assessment

Landscape corridors are critical to ecological processes, enabling migration, colonisation and interbreeding of plants and animals (DEC, 2004). As vegetation patches are reduced in size and become increasingly isolated, the on-going viability of ecosystems and individual populations of species within them is severely affected, which ultimately leads to a break down in ecological processes (DEC, 2004).

The subject site is bound by the Wadalba Wildlife Corridor to the south, residential housing to the west, rural residential lands to the east and cleared land containing public sporting facilities to the north (Refer to Figures 1 & 4). An existing strip of E2 zoned land along a drainage line within the western side of the subject site, forms an important connecting corridor between the Wadalba Wildlife Corridor in the south with areas of natural vegetation along the western side of the sporting facilities, extending to the northern side of the Pacific Highway. This E2 zoned area is mapped as a 'local conservation link' in the North Wyong Shire Structure Plan (WSC, 2015). The E2 zoning was created as part of a previous allocation of lands retained for the Wadalba Wildlife Corridor and associated local conservation links and will be retained as part of this proposal.

A summary of vegetation patches adjoining the subject site and their function as corridors is provided in Table 8 below. Each of the vegetation patches referred to in this table are displayed in Figure 4.

##### Connectivity between Wadalba Wildlife Corridor & Patch 1 – Local Conservation Link

The subject site forms an integral part of a planned 'local conservation link' connecting the Wadalba Wildlife Corridor to Patch 1 on the western side of the sporting fields (WSC, 2015). Patch 1 contains approximately 3ha of Alluvial Woolly-Melaleuca Sedge Forest (MU19) (Bell, 2002).

This link is approximately 335m long, with a 30m wide section through small vegetation remnants across areas of the sporting facility and a 180m wide section formed by the subject site. Parts of the link have canopy separations up to 20m, with the greatest separation occurring outside of the subject site to the north, between the dam and the sporting ovals. The link is also dissected by a small road providing access to the sporting facility carparks, just to the north of the subject site.

The narrow section (30m wide) of the corridor is approximately 160m in length between the subject site and Patch 1, and the wide section (180m wide) is approximately 175m long through the subject site.

As mentioned above, it is proposed to retain the E2 zoned area, a 55m wide section of natural vegetation to form part of the 'local conservation link'. The remainder of the subject site is proposed to be rezoned for residential development.

The conditions of the E2 zoned area within the subject site is low to moderate, with some areas of significant weed invasion within the understorey vegetation. The vegetation to the north of the subject site appears to

be in low to moderate condition with a partially cleared and fragmented canopy, an open understorey with a moderate level of weed invasion.

The proposal will reduce the 180m wide section down to 55m wide, creating a narrower section for a distance of 175m. This will reduce the area of the corridor and also create a longer narrow section. However, the proposal will secured a 175m long unbroken section with the narrowest width being 55m and will therefore not cause a reduction in the narrowest width of the link.

All flora and fauna species are considered to benefit from vegetation corridors. It is particularly important that connections are maintained for arboreal fauna movement. Smith (2002) specifies a comfortable glide distance for Squirrel Gliders in a typical woodland habitat (15m height) on the Wyong Coastal plain is likely to be about 20 m. This minimum gliding distance is likely to be less for Sugar Gliders, particularly dispersing juveniles. It is recommended that any future road design to the north of the subject site allow for a maximum of 15m between 15m high trees (Refer to summary below).

Terrestrial fauna movement for species recorded, such as Short-beak Echidna and Bush Rat will be maintained by the proposal provide that understorey island refuges are created in any future road designs to the north of the subject site (Refer to summary below & Section 7.2 – Recommendations).

Reducing the width of a corridor is likely to cause an increase in weed invasion through an increase in the edge to area ratio. Small-leaved Privet and Lantana are already dominant throughout parts of the E2 zoned area. It is important that a reductions in the corridor width is combined with management actions to reduce the level of weeds and increase the quality of habitat.

#### Connectivity between Wadalba Wildlife Corridor & Patch 2

Patch 2 is located to the north-east of the subject site on the north-eastern side of the corner of Louisiana Road and Wahroonga Road. It contains approximately 1.37ha of Narrabeen Dooralong Spotted-Gum Ironbark Forest (MU30) (Bell, 2002). This land is mapped as a proposed residential area by the North Wyong Shire Structure Plan (WSC, 2015).

The subject site forms a 100m wide connection to patch 2 across a large road. The proposal will remove approximately 30m of this connection leaving 70m of this connection to patch 2 via the adjoining property to the east. However the proposal will also remove a 60m wide connection with Patch 3 to the east, which will also impact upon connectivity to Patch 2.

It is possible that future eastern stages of the Wadalba Wildlife Corridor may maintain connectivity to Patch 2 via a local conservation link planned between vegetation on the south and north side of Wahroonga Road, approximately 350m to the east of the subject site.

The proposal will reduce connectivity to Patch 2, however this is considered to be of low importance given it's small size and future landuse plans as shown by the North Wyong Shire Structure Plan (WSC, 2015).

#### The Wadalba Wildlife Corridor & Patch 3

The subject site is located to the north-east of the Wadalba Wildlife Corridor (WWC). The proposal will effect a 60m connection between the WWC and areas of partially cleared vegetation along the southern side of Wahroonga Road. This connection may currently contribute to the local conservation link mapped approximately 350m east of the subject site, as referred to above. However a very wide connection between the WWC and remnant vegetation to the east, including connections north, are currently present to the south of the subject site. These large remnants to the east are also likely to form part of future stages of the WWC, which will further contribute to connectivity north.

The proposal is unlikely to impact on any other vegetation connectivity associated with the WWC.

#### Summary

Overall the greatest impact of the proposal on corridors will be a reduction in wider sections of the 'local conservation link' to patch 1 in the north, by the creation of a 55m wide corridor, being the E2 zoned area. This will reduce the total area of the corridor, creating a longer narrow section, which will naturally increase this areas vulnerability to disturbance through edge effects and predation. The proposal will however secured a 175m long unbroken section with the narrowest width being 55m, and therefore will not cause a reduction in the narrowest width of this link.

It is considered that the proposal is unlikely to cause a significant reduction in the functionality or utilisation of the Wadalba Wildlife Corridor and associated local conservation links. Recommendations regarding the future management and improvement of corridors include:

- Landscaping using locally endemic species along the edges of proposed rezoning area adjoining the E2 zoned area;
- Construction of an effective barrier to inhibit vehicle access and demarcate the 'local conservation link', to be constructed along the edge of the proposed rezoning area adjoining the E2 zoned area;  
&
- Fencing at the rear boundary of properties adjoining the Wadalba Wildlife Corridor to create a physical barrier to the spread of weeds and decrease edge effects consistent with B1 – Action 5 of the Wadalba Wildlife Corridor Management Plan 2006 (Conacher Travers 2006).

Additional recommendations (not required for this assessment) regarding future road designs and corridor management for maintaining and improving the 'local conservation link' to the north include:

- Establishment of a 55m wide wildlife crossing with a maximum of 15m separation between trees in any future road design at the north end of E2 zoned area; &
- Establishment of native understorey refuges in any future road design at the north end of E2 zoned area; &
- Placement of road signs at the road crossing to the north of the subject site, consistent with Action B3 ii Road Crossing Signage of the WWC Management Plan (Conacher Travers, 2006); &
- Weed removal and bush regeneration works for improvement of habitat value, to be undertaken throughout the length of the 'local conservation link'.

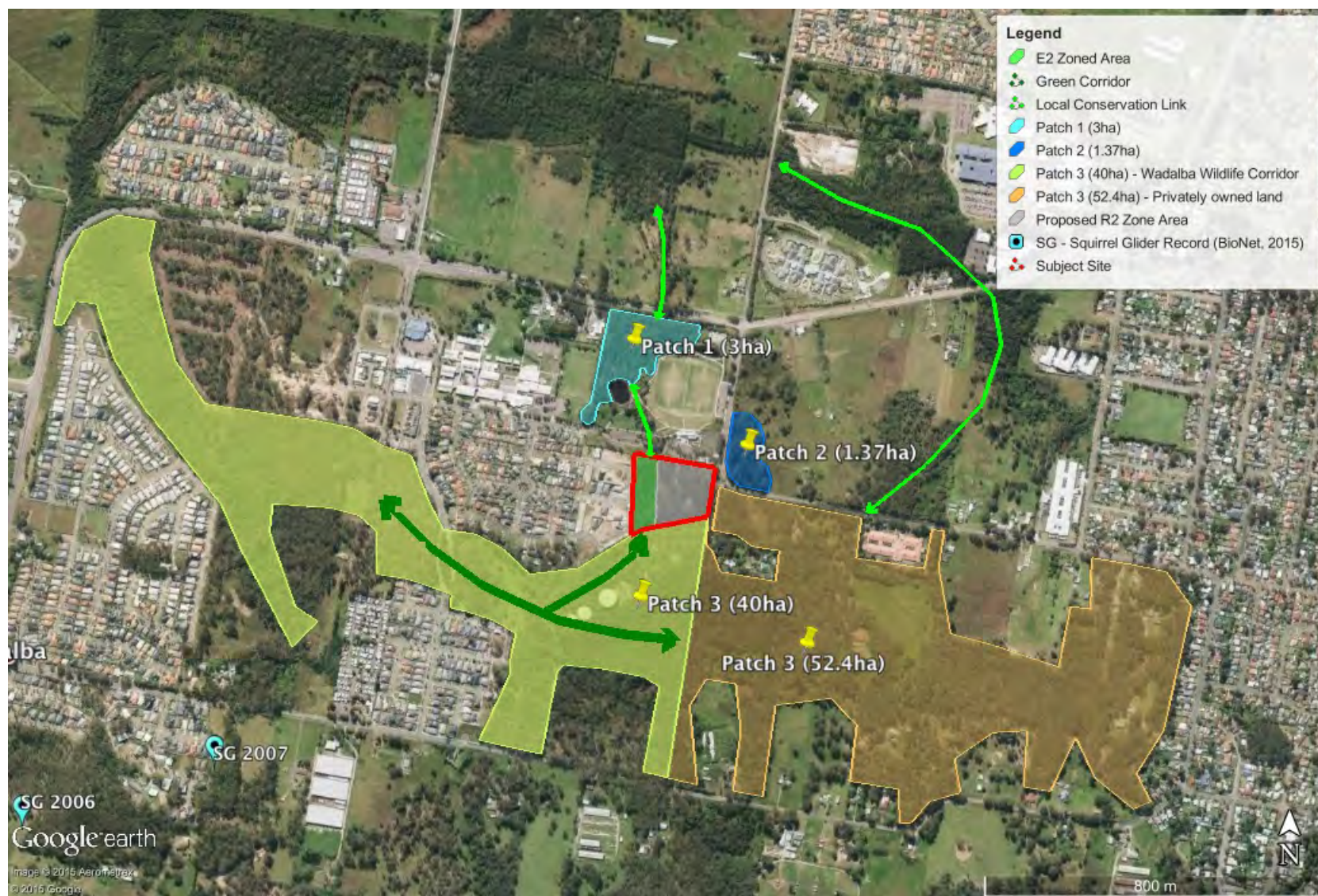


Figure 4 – Corridor Assessment

**Table 8 – Patches of natural vegetation connected to the subject site**

| Name    | Location from site | Size                   | Dominant Vegetation Type                               | Isolation Class (Smith, 2002).                                                                | North Wyong Shire Structure Plan                                                            | Continuation beyond adjoining patch                                                                        | Impact of Proposal                                                                              |
|---------|--------------------|------------------------|--------------------------------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Patch 1 | North              | 3ha                    | Alluvial Woolly-Melaleuca Sedge Forest (MU19)          | Class 3 (Connection: 30m x 170m of scattered trees & exotic grassland, broken by minor road). | Local conservation link.                                                                    | Yes.                                                                                                       | Maintained. Potential edge effects on narrow corridor (Refer to section 7.2 - Recommendations). |
| Patch 2 | North-east         | 1.37ha                 | Narrabeen Dooralong Spotted-Gum Ironbark Forest (MU30) | Class 3 (Connection: 100m wide across large road, including adjoining land to the east).      | Proposed Residential Areas.                                                                 | No.                                                                                                        | Connection from subject site severed, 70m through adjoining land to East will remain.           |
| Patch 3 | South, West & East | 40ha + 52.4ha = 92.4ha | Narrabeen Dooralong Spotted-Gum Ironbark Forest (MU30) | Class 1 (Connection: 200m wide)                                                               | Wadalba Wildlife Corridor to the south & west. Existing Rural Residential land to the east. | Includes part of Wadalba Wildlife Corridor Stage 2. Connects to local conservation link to the north-east. | Loss of 30m wide section through fragmented vegetation to the east.                             |

#### 4.4.2 Squirrel Glider Habitat Assessment

##### Habitat Quality

The subject site contains a Tall Open Forest vegetation community dominated by *Corymbia maculata* (Spotted Gum) and *Eucalyptus siderophloia* (Grey Ironbark) in the upper stratum with areas of both very sparse and moderately dense understorey of introduced and native species with a moderately dense to dense ground cover dominated by both native and introduced herbs and grasses. A detailed description of vegetation throughout the subject site is contained in section 4.3.2 and quadrat data is displayed in Table 11 of Appendix 5 (Refer to Figure 3). A summary of Squirrel Glider habitat suitability as outlined by Smith (2002) is provided in Appendix 6.

Spotted Gum-Ironbark Forest provides an important winter food resource for Squirrel Gliders throughout the coastal plains of the Wyong Shire. This vegetation assemblage type is categorised as 'less optimal' relative to other preferred vegetation types (Smith, 2002). According to Smith (2002) approximately 50% of this vegetation type was located in proposed conservation areas within the Wyong Shire.

The vegetation within the subject site has a significantly disturbed understorey, which has been previously removed from the proposed rezoning area. 'Removal of understorey food plants (Banksias and Acacias) by frequent (fuel reduction) burning, grazing or slashing (underscrubbing) is a potentially significant threat to Squirrel Glider habitat in Wyong Shire' (Smith, 2002). Areas of denser understorey within the E2 zoned area are dominated by introduced shrubs such as *Lantana camara* (Lantana) and (*Ligustrum sinence*) Small-leaved Privet. Given the presence of introduced shrubs and low numbers of food plants within the understorey, the Spotted Gum / Ironbark Forest within the subject site is considered to contain low to moderate quality habitat.

##### Remnant Patch Size

The total area of Spotted Gum – Ironbark Forest within the subject site is approximately 2.5ha. The subject site is part of a larger remnant of natural vegetation, including the Wadalba Wildlife Corridor and adjoining rural lands to the south, west and east, estimated to be approximately 90ha. The size of the subject site is small, however the ability of the site to sustain a Squirrel Glider population is increase by its connection to the larger remnant. The extent of suitable Squirrel Glider habitat within the larger remnant will also effect its importance to the subject site, however this has not been quantified. General observations indicated that the adjoining areas of the Wadalba Wildlife Corridor contain some areas of suitable Squirrel Glider habitat and some significantly disturbed areas considered to be of low suitability.

### Density of Hollow-bearing Trees

A total of sixteen (16) hollow-bearing trees were recorded within the subject site, providing a density of approximately 5.9 habitat trees per hectare (16/2.7ha). Hollow-bearing trees were divided into those with visible entrances, with or without evidence of use (coloured in yellow), and those with possible entrances and no evidence of use (Refer to Table 7 in Section 4.4.1 – General Habitat Assessment). A total of seven (7) hollow-bearing trees with visible entrances, with or without evidence of use were recorded within the subject site.

'There is a strong correlation between the numbers of all possums and gliders in forests and woodlands of the Wyong coastal plain and the number of den trees' (Smith, 2002). According to Smith (2002), possum and glider abundance is highest in forests with 18 or more habitat trees per hectare.

### Food Plants for Squirrel Glider

Two (2) flora quadrat surveys were undertaken. One quadrat was placed within the centre of the proposed rezoning area and a second within the E2 zoned area (drainage corridor), the results of which are displayed in Table 11 of Appendix 5. The abundance of specific Squirrel Glider food plant species for each quadrat as described by Smith (2002) is displayed in Appendix 6.

Based on the quadrat data it is estimated that the proposed rezoning area contains 25 *Eucalyptus siderophloia* (Grey Ironbark) per hectare and 50 *Corymbia maculata* (Spotted Gum) per hectare which provide a variety of sap, nectar and pollen for Squirrel Gliders in the canopy. No other food plant species were recorded in this quadrat, however some specimens of *Acacia longifolia* (Sydney Golden Wattle) and one specimen of *Acacia falcata* (Hickory Wattle), providing a limited supply of seeds and gum were observed within the proposed rezoning area.

Quadrat 2 estimated that the E2 zoned area contains 25 *Eucalyptus siderophloia* (Grey Ironbark) per hectare, 25 *Corymbia maculata* (Spotted Gum) per hectare and 75 *Melaleuca nodosa* (Ball Honeymyrtle), providing a variety of sap, nectar and pollen in the canopy and nectar and insect bark food in the mid-storey. Several specimens of *Xanthorrhoea macronema* were also observed throughout the southern end of the E2 zoned area, which provides nectar and potential gum resources in the ground cover.

## **Habitat Vulnerability**

The subject site is approximately 2.7ha or 27,000m<sup>2</sup> in size and is roughly square shaped. The western side, the northern side and part of the eastern side contain existing and future development areas. The subject site is therefore exposed to edge effects totaling approximately 405m of the perimeter. Given that adjoining vegetation to the south is secured in the Wadalba Wildlife Corridor, this perimeter can be excluded from the calculation of edge to area ratio. The edge to area ratio is therefore 0.015 (405 / 27000).

Approximately 80% of subject site has been underscrubbed and approximately 65% contains significant disturbance by weed invasion (Refer to Figure 3). The high level of weeds invasion throughout the northern side of the subject site is a result of edge effects as well as previous clearing and landuse (Refer to section 4.4.1).

## **Resident Breeding Squirrel Gliders**

No Squirrel Gliders were recorded within the study area during surveys.

Squirrel Gliders were targeted by Elliott trapping and call playback surveys.

A total of forty-five (45) Elliott traps were set for four (4) nights, including seventeen (17) type B mounted in trees, three (3) type B set on the ground, and a further twenty-five (25) type A set on the ground. This trapping programme provided a total of sixty-eight (68) traps nights (17x4) targeting Squirrel Glider. Refer to section 3.2.3 for Elliott trapping methodology.

A total of nineteen (19) records of Squirrel Glider occur within 2km of the subject site, seventeen (17) of which are prior to 2005 (BioNet, 2015). The two most recent records are approximately 1.7km and 1.24km to the west south-west in 2006 and 2007 (displayed in Figure 4), from patches of vegetation between Johns Road and Jensen Road (BioNet, 2015). These areas are connected to the Wadalba Wildlife Corridor by isolation class 3 links.

It is possible that resident breeding Squirrel Gliders occur within the Wadalba Wildlife Corridor, despite the lack of recent records. However, based on current surveys and the assessment of habitat, it is considered that no resident breeding Squirrel Gliders are present within the subject site.

Given the low number of feed species present, the absent of recent records and the results of surveys, despite the presence of hollows, it is considered that the subject site provides low-moderate quality habitat for Squirrel Gliders. According to Smith (2002), the proposal is a class 4 impact, given that the proposed rezoning area is less than 20ha without resident breeding Squirrel Gliders.

A plan showing the location of the subject site and adjoining vegetation patches is displayed in Figure 4. A summary of vegetation patches adjacent to the subject site is provided in Table 8.

Recommendations are provided in section 7.2.

#### 4.4.3 Koala Habitat Assessment

The Koala (*Phascolarctos cinereus*) is listed as a Vulnerable species under the Threatened Species Conservation Act 1995 (TSC Act). The combined populations of Koala in Qld, NSW and ACT is listed as vulnerable under the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The Koala inhabits eucalypt forests containing preferred feed trees (Strahan, 1995pg.197). The easiest method of identifying the presence of Koala apart from an observation is the presence of scats. Koala scats are relatively hard, long, oval or cylindrical and with a slightly ridged surface (Triggs, 1996 pg.165). Koalas can also be identified by marks on trees. They generally use the sharp tips of their claws to hold their weight and therefore leave characteristic 'pock-marks' on smooth barked trees (Triggs, 1996 pg.212).

Survey methodologies and guidelines for habitat assessment are taken from Appendix 6 and 8 of the Comprehensive Koala Plan of Management (CKPoM) for the Port Stephens LGA with the use of local feed tree species listed under the Central Coast Koala Management Area (Port Stephens Council, 2002; WSC, 2014; DECC, 2008).

The Spot Assessment Technique (SAT) (Phillips and Callaghan, 1995) is a methodology created by the Australian Koala Foundation (AKF) to identify Koala tree species preferences and Koala activity. The criteria for selection of sites or trees to begin this survey include, the presence of Koala scats, the presence of Koalas or a tree considered likely to be important for Koalas in a particular area.

##### Preliminary Assessment

No feed tree species listed under schedule 2 of SEPP 44 were observed within the subject site.

*Corymbia maculata* (Spotted Gum) present within the subject site is listed in Appendix 8 of the Port Stephens CKPoM, which includes tree species that may be utilised by Koalas based on anecdotal evidence in the Port Stephens LGA (PSC, 2002).

More recent information on local feed trees is provided in the NSW Recovery plan for Koala which identifies seven management areas (KMAs), with lists of primary, secondary and supplementary for each KMA (DECC, 2008). One (1) supplementary food tree species, *Eucalyptus eugenioides* listed for the Central Coast Koala Management Area occurs within the subject site. No primary or supplementary feed tree species occur within or in close proximity to the subject site.

Detailed surveys including searches for specimens, scats and pock marks were conducted throughout the study area, however no evidence of Koala was observed. It is considered that SAT surveys or further assessment for Koala is not required.

## 5 THREATENED SPECIES, POPULATIONS OR ENDANGERED ECOLOGICAL COMMUNITIES

### 5.1.1 Threatened Entities Recorded

Five (5) threatened fauna species, including one (1) bird species and four (4) micro-bat species were recorded within or in close proximity to the subject site during surveys. These include:

- *Calyptorhynchus lathami* (Glossy Black-cockatoo);
- *Miniopterus australis* (Little Bentwing-bat);
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat);
- *Mormopterus norfolkensis* (Eastern Freetail-bat); and
- *Scoteanax rueppellii* (Greater Broad-nosed Bat).

All of these species are listed as Vulnerable under the NSW TSC Act.

The micro-bat call analysis identified five (5) species groupings which included the possibility of an additional two (2) threatened species, *Falsistrellus tasmaniensis* (Greater Broad-nosed Bat) and *Myotis macropus* (Southern Myotis), also listed as Vulnerable under the NSW TSC Act.

### 5.1.2 Threatened Entities Assessed in 7-part Test 'Assessment of Significance'

A list of species, populations and endangered ecological communities considered to have at least a moderate likelihood of occurring within the study area has been compiled. Considerations include the results of database searches, previous studies, a detailed habitat assessment and field surveys. Tables 9 and 10 of Appendix 1 and 2 provides the reasons for their inclusion or omission.

A total of thirty (30) threatened species including, ten (10) birds, twelve (12) mammals, one (1) reptile, one (1) amphibian and six (6) threatened flora species were either recorded or considered at least moderately likely to occur within the study area. These threatened entities have been assessed by 7-part test or 'Assessment of Significance' under Section 5a of the EPA Act included in Appendix 4. Assessed species include:

- |                                  |                       |
|----------------------------------|-----------------------|
| • <i>Hieraetus morphnoides</i>   | Little Eagle          |
| • <i>Calyptorhynchus lathami</i> | Glossy Black-Cockatoo |
| • <i>Glossopsitta pusilla</i>    | Little Lorikeet       |

|                                                 |                                       |
|-------------------------------------------------|---------------------------------------|
| • <i>Lathamus discolour</i>                     | Swift Parrot                          |
| • <i>Ninox connivens</i>                        | Barking Owl                           |
| • <i>Ninox strenua</i>                          | Powerful Owl                          |
| • <i>Tyto novaehollandiae</i>                   | Masked Owl                            |
| • <i>Chthonicola sagittata</i>                  | Speckled Warbler                      |
| • <i>Anthochaera phrygia</i>                    | Regent Honeyeater                     |
| • <i>Daphoenositta chrysoptera</i>              | Varied Sittella                       |
| • <i>Dasyurus maculatus</i>                     | Spotted-tailed Quoll                  |
| • <i>Pteropus policephalus</i>                  | Grey-headed Flying-fox                |
| • <i>Petaurus norfolcensis</i>                  | Squirrel Glider                       |
| • <i>Saccolaimus flaviventris</i>               | Yellow-bellied Sheath-tail-bat        |
| • <i>Mormopterus norfolkensis</i>               | Eastern Freetail-bat                  |
| • <i>Chalinolobus dwyeri</i>                    | Large-eared Pied Bat                  |
| • <i>Falsistrellus tasmaniensis</i>             | Eastern False Pipistrelle             |
| • <i>Kerivoula papuensis</i>                    | Golden-tipped Bat                     |
| • <i>Miniopterus australis</i>                  | Little Bentwing-bat                   |
| • <i>Miniopterus schreibersii oceanensis</i>    | Eastern Bentwing-bat                  |
| • <i>Scoteanax rueppellii</i>                   | Greater Broad-nosed Bat               |
| • <i>Myotis macropus</i>                        | Southern Myotis                       |
| • <i>Hoplocephalus stephensii</i>               | Stephen's Banded Snake                |
| • <i>Crinia tinnula</i>                         | Wallum Froglet                        |
| • <i>Melaleuca biconvexa</i>                    | Biconvexa Paperbark                   |
| • <i>Caladenia tessellata</i>                   | Thick Lip Spider Orchid               |
| • <i>Rhizanthella slateri</i>                   | Eastern Australian Underground Orchid |
| • <i>Thelymitra sp. adorata</i>                 | Wyong Sun Orchid                      |
| • <i>Rutidosis heterogama</i>                   |                                       |
| • <i>Grevillea parviflora subsp. parviflora</i> | Small-flowered Grevillea              |

## 6 ASSESSMENT OF IMPACTS

### 6.1 Environmental Protection and Biodiversity Conservation Act 1999

No threatened species, populations or ecological communities listed under the EPBC Act were recorded during surveys. Six (6) flora species and five (5) fauna species listed under the EPBC Act were considered at least moderately likely to occur within the study area. These species are also listed under the TSC Act and have been assessed as part of a '7-part' or 'Assessment of Significance' in Appendix 4.

No matters of national environmental significance have been recorded by surveys or are considered likely to be impact either directly or indirectly by the proposed action. It is considered that the proposed action is unlikely to have a significant impact on any matters of national environmental significance, therefore no referral is required to be submitted to the Australian Government Environment Minister for approval.

### 6.2 Threatened Species Conservation Act 1995 & Environmental Planning & Assessment Act 1979

Five (5) threatened fauna species, including one (1) bird species and four (4) micro-bat species listed as Vulnerable under the TSC Act were recorded within or in close proximity to the subject site during surveys. These include:

- *Calyptorhynchus lathami* (Glossy Black-cockatoo);
- *Miniopterus australis* (Little Bentwing-bat);
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat);
- *Mormopterus norfolkensis* (Eastern Freetail-bat); and
- *Scoteanax rueppellii* (Greater Broad-nosed Bat).

The micro-bat call analysis identified five (5) species groupings which included the possibility of an additional two (2) threatened species, *Falsistrellus tasmaniensis* (Greater Broad-nosed Bat) and *Myotis macropus* (Southern Myotis), also listed as Vulnerable under the NSW TSC Act.

No threatened flora species, endangered populations or endangered ecological communities listed under the TSC Act have been recorded within or in close proximity to the subject site during surveys.

Six (6) threatened flora species and a further eighteen (18) threatened fauna species (in addition to the 5 definite identifications listed above) were considered at least moderately likely to occur within the study

area, providing a total of thirty (30) threatened species listed under the TSC Act to be assessed by '7-part test' or 'Assessment of Significance' provided in Appendix 4.

Recommendations have been made in section 7.2. It is considered that the proposal is unlikely that a significant impact any threatened species, population or endangered ecological community. Therefore it is considered that a Species Impact Statement is not required.

### 6.3 Direct Impacts

The subject site is approximately 2.75ha. The proposal will remove approximately 1.75ha partially cleared and disturbed vegetation which is consistent with 'Narrabeen Dooralong Spotted Gum – Ironbark Forest (MU30) as described by Bell (2002). Approximately 0.96ha of the subject site will retained as part of a E2 zoned area along western side of the subject site (Refer to Figure 2). In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of similar habitat secured within the immediate local area.

Ten (10) hollow-bearing trees recorded within the proposed rezoning area are likely to require removal as part of this proposal (Refer to Table 7). Hollow-bearing tree number 7 (HT7) is located offsite to the north, but is still likely to be impact by the future road designs.

Also two small dams providing habitat for common amphibian species are likely to require removal as part of this proposal.

The direct impacts of the proposal and ecological constraints are displayed in Figure 5.

### 6.4 Indirect Impacts

Potential indirect impacts as a result of residential development may include (Burgmann & Lindenmayer, 2005):

- soil erosion during construction phase;
- fragmentation of habitat;
- increase in urban runoff;

- invasion by weeds from gardens;
- introduction of pathogens such as *Phytophthora* fungus;
- impacts of uncontrolled domestic pets preying on native animals and the potential for pets to escape and becoming feral;
- incursion of exotic animals;
- planned and *ad hoc* mowing programs;
- removal of dead and dying trees;
- trampling by walkers, bicycles & horses;
- disruption of animal foraging or nesting behaviour due to noise, light and movement;
- dumping of household waste;
- dumping of soils and garden cuttings;
- picking of flowers, fruit and foliage;
- malicious damage to trees and wildlife;
- alteration to groundwater and surface waterflows;
- alteration of fire regimes;
- chemical pollution of the air and water;
- drift of pesticides and herbicides; &
- leaching of fertilisers from lawns and gardens.

Any indirect impacts which are likely to impact upon the retained E2 zoned area, along the western side of the subject site, require particular consideration in order to minimise the impact of this proposal. The E2 zoned area forms part of a 'local conservation link' as displayed in the North Wyong Shire Structure Plan (WSC, 2015) and discussed in section 4.4.1 of this assessment.

The likely impacts of the initial clearing and construction works can be minimised through the implementation of recommendations, in particular the use of erosion and sediment controls. Recommendations have been provided to avoid, minimise or mitigate the likely direct and indirect impacts of the proposal (Refer to section 7.2).

The potential indirect impacts of the proposal on adjoining areas of the WWC to the south, will most likely include, invasion of weeds from gardens as a result of its proximity, dumping of garden waste as well as an increase in trampling and recreational activity. It is recommended that fencing be erected at the rear boundary of properties adjoining the Wadalba Wildlife Corridor to create a physical barrier to the spread of weeds and decrease edge effects consistent with B1 – Action 5 of the Wadalba Wildlife Corridor Management Plan 2006 (Conacher Travers 2006) (Refer to section 7.2 – Recommendations).

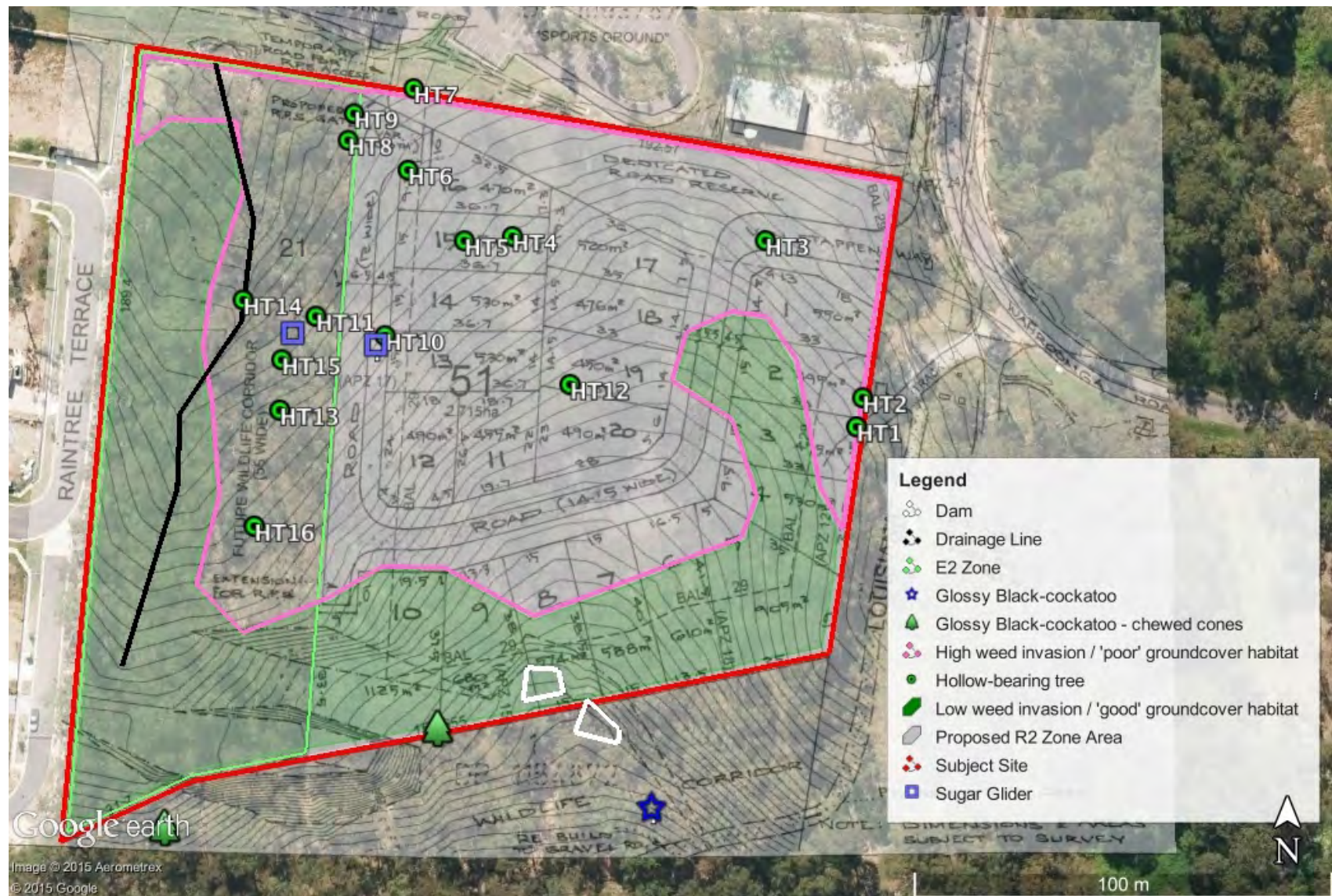


Figure 5 - Direct Impacts and Ecological Constraints

## 7 CONCLUSION AND RECOMMENDATIONS

### 7.1 Conclusion

An ecological assessment of the proposal has been undertaken and the following conclusions have been made:

#### Vegetation and Condition

- The subject site contains a partially cleared and disturbed area of Tall Open Forest vegetation dominated by *Corymbia maculata* (Spotted Gum) and *Eucalyptus siderophloia* (Grey Ironbark) consistent with 'Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30)' (Bell, 2002). The area of the proposed rezoning is considered to be in low condition due to the presence of weeds, clearing and underscrubbing activities and previous landuse;

#### Local and Regional Significance

- The proposal will remove approximately 1.75ha of disturbed 'Narrabeen Dooralong Spotted Gum-Ironbark Forest', while approximately 0.96ha of similar less disturbed habitat will be retained as part of a E2 zoned area along western side of the subject site;
- Approximately 92ha of habitats similar to those within the subject site occur within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east (Refer to Figures 1 & 4). Approximately 40ha of these similar habitats are secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of similar habitats secured within the immediate local area;
- In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002);

#### Flora and Ecological Communities

- The vegetation community identified within the subject site is not consistent with any endangered ecological community listed under the TSC Act and/or EPBC Act;
- No threatened flora species listed under either the TSC Act or the EPBC Act were recorded within the subject site;

## Fauna

- A total of ten (10) hollow-bearing trees, containing a mixture of mostly small (<10cm) to medium (10-20cm) sized hollows are likely to be impacted by the proposal (Refer to Figure 3 & 5; section 4.4.1);
- Five (5) threatened fauna species listed as Vulnerable under the TSC Act, including *Calyptorhynchus lathamii* (Glossy Black-cockatoo), *Miniopterus australis* (Little Bentwing-bat), *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat), *Mormopterus norfolkensis* (Eastern Freetail-bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat) were recorded within or in close proximity to the subject site during surveys;
- *Calyptorhynchus lathamii* (Glossy Black-cockatoo) was observed to the south of the subject site within the Wadalba Wildlife Corridor and foraging evidence (chewed cones of *Allocasuarina torulosa*) were recorded in two (2) locations, one being just within the southern boundary of the subject site (Refer to Figure 3). Two (2) additional fruiting specimens of *Allocasuarina torulosa* were observed within the subject site, neither of which contained any evidence of foraging. Two (2) potential nesting hollows (within HT4 & HT6; refer to Table 7 & Figure 3) were recorded within the subject site, both of which were inhabited by other common species and are unlikely to be utilised by Glossy Black-cockatoo;
- In regard to threatened micro-bat species recorded, no roosting locations were located. The hollow-bearing trees located within the subject site are unlikely to provide seasonal roosting sites, however they are likely to provide potential temporary roosting locations (Refer to Figure 3 & Table 7);
- No potential nesting hollows for threatened Owl species, Powerful Owl and Masked Owl, were recorded within the subject site. No Owl roosting evidence was observed during detailed searches conducted in August, 2015. The E2 zoned area is considered to provide potential roosting habitat for these Owl species, however the disturbed, open and underscrubbed areas of the proposed rezoning area are unlikely to provide potential roosting habitat. General fauna surveys also indicated a low abundance of preferred prey species within the proposed rezoning area;
- Three (3) regionally significant fauna species, *Petaurus breviceps* (Sugar Glider), *Vespadelus pumulis* (Eastern Forest Bat) and *Lewinia pectoralis* (Lewins Rail) were recorded within the proposed rezoning area, with an additional two (2) regionally significant species, *Tachyglossus aculeatus* (Short-beaked Echidna) and *Tyto alba* (Barn Owl), recorded within the E2 zoned area and to the west of the subject site respectively. No nest or roost locations of these species, apart from Sugar Glider, were recorded within the proposed rezoning area;
- Sugar Gliders were observed utilising HT10. It is considered that the small branch hollow in HT10 is an established nest site for Sugar Gliders and is likely to be used intermittently along with other

hollows most likely within the E2 zoned area (Refer to Figure 3 & Table 7). Given that recommendations are implemented, in particular the installation of compensatory natural nest boxes, it is considered that the proposal is unlikely to have a significant impact upon this local population of Sugar Gliders;

- No critical habitat listed under the critical habitat register or as defined under the NSW TSC Act occurs within or in close proximity to the subject site;

#### Corridors

- Overall the greatest impact of the proposal on corridors will be a reduction in wider sections of the 'local conservation link' to patch 1 in the north, by the creation of a 55m wide corridor, being the E2 zoned area (Refer to Figure 4). This will reduce the total area of the corridor, creating a longer narrow section, which will naturally increase this area's vulnerability to disturbance through edge effects and predation. The proposal will however secure a 175m long unbroken section with the narrowest width being 55m (approximately 25m wider than parts of the 'local conservation link' to the north), and therefore will not cause a reduction in the narrowest width of this link (Refer to section 4.4.1);
- It is considered that the proposal is unlikely to cause a significant reduction in the functionality or utilisation of the Wadalba Wildlife Corridor and associated local conservation links. Recommendation regarding the future management and improvement of corridors is provided in section 7.2;

#### Biodiversity Offsets

- It is recommended that fifteen (15) natural nesting boxes be installed within the adjoining area of Wadalba Wildlife Corridor and E2 zoned area (drainage corridor) at least 3 months prior to the commencement of clearing works (Refer to section 7.2), to offset the removal of ten (10) hollow-bearing trees.
- In review of the 'Office of Environment and Heritage principles for the use of biodiversity offsets in NSW' (OEH, 2015a), it is considered that no further offsetting is required.

#### Summary

- In regard to the EPBC Act, no matters of national environmental significance have been recorded by surveys or are considered likely to be impacted either directly or indirectly by the proposed action. It is considered that the proposed action is unlikely to have a significant impact on any matters of national environmental significance, therefore no referral is required to be submitted to the Australian Government Environment Minister for approval; and

- In regard to assessments under the EPA Act, TSC Act and FM Act, it is considered that the proposal is unlikely to have a significant impact on any threatened species, populations or endangered ecological communities. Therefore it is considered that a Species Impact Statement is not required.

## 7.2 Recommendations

The following recommendations have been made to minimise and mitigate likely or potential impacts of the proposal. General recommendations are provided first, followed by specific recommendations regarding hollow-bearing trees, wildlife corridors as well as the management of weeds and pathogens. General recommendations include:

- Implementation of appropriate erosion and sediment control measures prior to any clearing or construction works to minimise indirect impacts to the retained E2 zoned area as well as offsite areas;
- The extent of areas to be cleared are clearly marked onsite prior to the commencement of vegetation clearing, to ensure that only the minimum vegetation clearing required is undertaken;
- Hollow-bearing trees within the proposed rezoning area need to be clearly marked in the field prior to any clear works;
- All contractors working within the proposed rezoning area need to be notified of all ecological issues by onsite induction;
- Supervision of clearing works by an ecologist to ensure that, only the nominated trees are removed, the removal of hollow-bearing trees is managed appropriately as per hollow-bearing tree recommendations below, and no adjoining vegetation is damaged;
- Re-location of amphibian specimens located within the two small dams along the southern boundary of the subject site, prior to construction works. Specimens should be re-located to similar dam habitats located within the Wadalba Wildlife Corridor; &
- The installation of fifteen (15) natural nesting boxes within the adjoining area of Wadalba Wildlife Corridor and E2 zoned area (drainage corridor) at least 3 months prior to the commencement of clearing works.

### **Hollow-bearing trees**

All hollows are to be inspected for inhabitants by an Ecologist with the aid of a tree climber immediately prior to removal if safe to do so. In the event that hollow/s are inhabited by fauna, then the following options are available depending on the sensitivity of the species and/or its breeding cycle:

- If the fauna species is breeding, then tree felling is delayed until the species completes its breeding cycle, after which time the hollow would need to be inspected again immediately prior to felling;

- The hollow entrances are blocked with towels and the tree is sectionally dismantled and hollows are carefully lowered to the ground. The blocks will be released after dark and occupying specimens are re-located to suitable adjoining bushland areas; or
- If the fauna is a prevalent denswapping species or the hollow appears to be a temporary roost, the hollow is to be removed when unoccupied, confirmed by inspection, allowing the tree to be felled.

### **Wildlife Corridors**

It is considered that the proposal is unlikely to cause a significant reduction in the functionality or utilisation of the Wadalba Wildlife Corridor and associated local conservation links. Recommendations regarding the future management and improvement of corridors include:

- Landscaping using locally endemic species along the edges of proposed rezoning area adjoining the E2 zoned area;
- Construction of an effective barrier to inhibit vehicle access and demarcate the 'local conservation link', to be constructed along the edge of the proposed rezoning area adjoining the E2 zoned area; &
- Fencing at the rear boundary of properties adjoining the Wadalba Wildlife Corridor to create a physical barrier to the spread of weeds and decrease edge effects consistent with B1 – Action 5 of the Wadalba Wildlife Corridor Management Plan 2006 (Conacher Travers 2006).

Additional recommendations (not required for this assessment) regarding future road designs and corridor management for maintaining and improving the 'local conservation link' to the north include:

- Establishment of a 55m wide wildlife crossing with a maximum of 15m separation between trees in any future road design at the north end of E2 zoned area; &
- Establishment of native understorey refuges in any future road design at the north end of E2 zoned area; &
- Placement of road signs at the road crossing to the north of the subject site, consistent with Action B3 ii Road Crossing Signage of the WWC Management Plan (Conacher Travers, 2006); &
- Weed removal and bush regeneration works for improvement of habitat value, to be undertaken throughout the length of the 'local conservation link'.

## **Weed and Pathogen Management**

Five (5) flora species recorded within the subject site are listed as Noxious Weeds in the Wyong LGA (DPI, 2015). These include:

- *Hypericum perforatum* (St John's Wort) and *Cortaderia selloana* (Pampas Grass) which are listed as a Class 3 Noxious Weed - '*The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed*' (DPI, 2015); &
- *Asparagus aethiopicus* (Ground Asparagus), *Asparagus asparagoides* (Bridal Creeper) and *Senecio madagascariensis* (Fireweed) are listed as a Class 4 Noxious Weeds - '*The plant must not be sold, propagated or knowingly distributed*' (DPI, 2015).

Four (4) species recorded within the subject site are listed as Weeds of National Significance. These include, *Senecio madagascariensis* (Fireweed), *Lantana camara* (Lantana), *Asparagus aethiopicus* (Ground Asparagus) and *Asparagus asparagoides* (Bridal Creeper).

Two (2) introduced species recorded, *Ligustrum sinense* (Small-leaved Privet) and *Ochna serrulata* (Mickey Mouse Plant) are listed as Noxious Weeds in other parts of NSW, but not in Wyong LGA.

The movement of machinery and personnel can facilitate the spread of weeds and fungal pathogens such as Chytrid, Phytophthora and Myrtle Rust. Chytrid fungus has caused the decline of many amphibian species (DECC 2008b) while Phytophthora and Myrtle Rust can cause severe damage to native vegetation (Suddaby *et al*, 2008; DEH, 2004; DPI 2011).

Provided that the following hygiene, pathogen and weed control procedures are implemented, the proposal is unlikely to introduce additional weeds to the subject site, spread existing weed species or introduce pathogens. Recommended procedures include:

- NSW Frog Hygiene Protocol (DECC 2008);
- Best Practice Management Guidelines for *Phytophthora cinnamomi* within the Sydney Metropolitan Catchment Management Authority Area (Suddaby *et al*, 2008);
- Myrtle Rust: Everyday Management (Department of Primary Industries 2011) (<http://www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust>).

It is recommended that all personnel, machinery and materials are cleaned prior to entering the work site each day. This includes the cleaning and disinfecting of tyres, boots, floor pans and clothing.

## 8 REFERENCES

- Bell, S.A.J., 2002a, The natural vegetation of Wyong Local Government Area, Central Coast, New South Wales: Technical Report. Unpublished report to Wyong Shire Council, East Coast Flora Survey, Kotara Fair NSW.
- Bell, S.A.J., 2002b, The natural vegetation of Wyong Local Government Area, Central Coast, New South Wales: Vegetation Community Profiles. Unpublished report to Wyong Shire Council, 2002. East Coast Flora Survey, Kotara Fair NSW.
- Branwhite, B (2015). Personal communications with Boris Branwhite during *Thelymitra* sp. surveys in Woongarah on October 28<sup>th</sup>, 2015.
- Briggs, J.D. & Leigh, J.H., 1996, Rare or Threatened Australian Plants. 1995 Revised Edition, CSIRO Publishing Collingwood, Victoria, Australia.
- Beruldsen, G (2003). *Australian Birds their Nests and Eggs*. G. Beruldsen 47 Broadmoor Street, Kenmore Hills, Qld 4069
- Burgmann & Lindenmayer 2005, *Practical Conservation Biology (Chapter 9 – Vegetation Loss and Degradation)*, CSIRO Publishing.
- Churchill, S. (2008). *Australian Bats – Second Edition*. Jacana Books, an imprint of Allen & Unwin Crows Nest NSW.
- Commonwealth of Australia (CoA) (2013a), *Matters of National Environmental Significance – Significant Impact Guidelines 1.1*. Department of the Environment.
- Commonwealth of Australia (CoA) (2013b), *Survey Guidelines for Australia's Threatened Orchids – Guidelines for Detecting Orchids Listed as 'Threatened' Under the Environmental Protection and Biodiversity Conservation Act 1999*. Department of the Environment.
- Commonwealth of Australia (CoA) (2015), *Australian Government – Department of the Environment. About the EPBC Act*. Accessed at <https://www.environment.gov.au/epbc/about>
- Conacher Travers (2006). *Wadalba Wildlife Corridor Management Plan September 2006*. Mt Penang Parklands Kariang NSW.
- Conacher Travers (2007). *Flora and Fauna Assessment Lot 3110 DP808521 Louisiana Road, Wadalba*.
- Department of Environment & Climate Change (DECC) (2008). *Recovery Plan for the Koala (Phascolarctos cinereus) – November 2008*, DECC Sydney NSW.
- Department of Environment & Conservation NSW (DEC), 2004, *Wildlife Corridors North East NSW – Natural Resource Management Advisory Series Note 15*. August 2004. Coffs Harbour NSW.
- Department of Environment & Conservation NSW (DEC), 2006, NSW Recovery Plan for the Bush Stone-curlew *Burhinus grallarius* - Final. NSW Department of Environment & Conservation, Sydney, NSW. February 2006.

- Department of the Environment (DE) (2015). Species Profile and Threats Database (SPRAT), Department of the Environment, Canberra. Available from: <http://www.environment.gov.au/sprat>.
- Department of Environment & Conservation NSW, (DEC) 2006, NSW Recovery Plan for the Large Forest Owls: Powerful Owl *Ninox strenua*, Sooty Owl *Tyto tenebricosa* and Masked Owl *Tyto novaehollandiae*. Approved Plan New South Wales Department of Environment and Conservation (DEC). Hurstville, NSW.
- Department of the Environment & Heritage (DEH), 2004, Phytophthora root rot, online brochure from the Australian Government, Canberra at <http://www.environment.gov.au/biodiversity/invasive/publications/p-root-rot/pubs/p-root-rot.pdf>
- Duncan, M. 2010. National Recovery Plan for the Thick-lip Spider-orchid *Caladenia tessellata*. Department of Sustainability and Environment, Melbourne.
- Department of Environment and Climate Change NSW (DECC) (2007), *Private Native Forestry – Advisory Note 7 – Bat Roosts*. DECC August 2007.
- Department of Environment, Climate Change and Water NSW. 2009. Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*. Prepared by Dr Peggy Eby. Department of Environment, Climate Change and Water NSW, Sydney.
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008b). *Threat abatement plan for predation by the European red fox*, DEWHA, Canberra.
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (Australian Government), 2010. *Survey guidelines for Australia's threatened bats*. Commonwealth of Australia 2010.
- Department of Primary Industries (DPI) 2015, Information obtained from:  
<http://www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust> accessed in 2015.
- NSW Department of Primary Industries (DPI) (2011) Myrtle Rust Everyday Management Factsheet, Primefact 1104, April 2011, accessed online at <http://www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust/management>
- Department of Sustainability, Environment, Water, Populations and Communities. (DSEWPC) 2015, Protected Matters Search Tool, 'EPBC Act Protected Matters Report: Coordinates', online auto-generated report, sourced online September 2015 at: <http://www.environment.gov.au/epbc/pmst/index.html>
- Enviro Ecology (2012), *Ecological Assessment of Lot 2 DP1154872 Louisiana Road, Wadalba*.
- Everitt, N (2005) Observations of Powerful Owl roosting in *Melaleuca nodosa* in areas of bushland adjacent to the Wadalba Wildlife Corridor.
- Gibbons, P & Lindenmayer, D (2002), *Tree Hollows and Wildlife Conservation in Australia*. CSIRO Publishing Victoria.
- Gunninah Environmental Consultants (GEC) (2003), *Wyong Ground Orchid Survey Wyong Shire – Final Version January 2003*. Crows Nest NSW.
- Menkhorst, P., Schedvin, N., & Geering, D., (1999), *Regent Honeyeater Recovery Plan 1999-2003*, Department of Natural Resources and Environment, Melbourne Victoria.

- NSW Government (NSW Gov) (2015), *NSW Legislation*. Accessed at [www.legislation.nsw.gov.au](http://www.legislation.nsw.gov.au). Sydney NSW.
- NSW National Parks & Wildlife Service (NPWS), 2003a, Draft Recovery Plan for the Barking Owl. New South Wales National Parks and Wildlife Service, Hurstville, NSW.
- NSW National Parks and Wildlife Service 2003b, Recovery Plan for the Yellow-bellied Glider (*Petaurus australis*). NSW National Parks and Wildlife Service, Hurstville.
- NSW Scientific Committee (2008) Glossy Black-Cockatoo *Calyptorhynchus lathami*. Review of current information in NSW. September 2008. Unpublished report arising from the Review of the Schedules of the Threatened Species Conservation Act 1995. NSW Scientific Committee, Hurstville.
- NSW Scientific Committee 2001a, Clearing of native vegetation - key threatening process listing, NSW Scientific Committee - final determination. NSW Scientific Committee, Sydney, Australia. 21 September 2001.
- OEH 2011, *NSW Threat abatement plan for predation by the red fox (Vulpes vulpes)*, Office of Environment and Heritage NSW, Sydney.
- Office of Environment and Heritage (OEH) 2015a. Office of Environment and Heritage (OEH). Website: <http://www.environment.nsw.gov.au/>
- Office of Environment and Heritage (OEH) 2015b. Vegetation Type Maps, Vegetation Information Systems Team, Office of Environment and Heritage Department of Premier and Cabinet Hurstville NSW 2220. [www.maps.six.nsw.gov.au](http://www.maps.six.nsw.gov.au) (accessed November 18<sup>th</sup>, 2015).
- Office of Environment and Heritage (OEH) 2015c, Atlas Search, BioNet the website for the Atlas of NSW Wildlife, viewed August 2015, [http://www.environment.nsw.gov.au/atlaspublicapp/UI\\_Modules/ATLAS\\_/AtlasSearch.aspx](http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx)
- Payne, R. (2002) *Wildlife Corridors Strategy- Field Evaluation of Linkages*. Prepared for Wyong Shire Council November 2002.
- Phillips, S & Callaghan J. (1995) The Spot Assessment Technique for Determining the Significance of Habitat Utilisation by Koalas. Australian Koala Foundation, Brisbane.
- Pizzey, G & Knight, F 1997, *A Field Guide to the Birds of Australia*, Angus & Robertson.
- PlantNet (2015), The NSW Plant Information Network System. Royal Botanic Gardens and Domain Trust, Sydney. <http://plantnet.rbgsyd.nsw.gov.au>.
- Port Stephens Council (PSC) (2002). *Port Stephens Council Comprehensive Koala Plan of Management (CKPoM)* - June 2002. Prepared by Port Stephens Council with the Australian Koala Foundation.
- Robinson, L., 1997, *Field Guide to the Native Plants of Sydney*. Revised 2<sup>nd</sup> Edition Kangaroo Press, East Roseville.
- NSW Scientific Committee (2008) *Thelymitra adorata* - Critically Endangered species determination - final. Viewed 19 November 2015. Available on the Internet at: <http://www.environment.nsw.gov.au>
- Saunders, D.L. and Tzaros, C.L. 2011. *National Recovery Plan for the Swift Parrot Lathamus discolor*, Birds Australia, Melbourne.

- Smith A. P., (2002) Squirrel Glider (*Petaurus norfolcensis*) Conservation Management Plan: Wyong Shire. Wyong Shire Council, Wyong.
- Somerville, M (2009a) *Hunter, Central & Lower North Coast Vegetation Classification & Mapping Project Volume 2: Vegetation Community Profiles*, report prepared by HCCREMS/Hunter Councils Environment Division for Hunter-Central Rivers Catchment Management Authority, Tocal, NSW.
- Somerville, M (2009b) *Hunter, Central & Lower North Coast Vegetation Classification & Mapping Project Volume 1: Vegetation Classification technical report*, report prepared by HCCREMS/Hunter Councils Environment Division for Hunter-Central Rivers Catchment Management Authority, Tocal, NSW.
- Strahan, R. (1995) *The Mammals of Australia* The Australian Museum.
- Suddaby, T. & Liew, E., 2008, Best Practice Management Guidelines for *Phytophthora cinnamomi* within the Sydney Metropolitan Catchment Management Authority Area. Report prepared for the Sydney Metropolitan Catchment Management Authority by Botanic Gardens Trust Sydney, Sydney, June 2008.
- Threatened Species Scientific Committee (TSSC) 2014. *Conservation Advice - Thelymitra adorata - Wyong Sun Orchid*. Approved on 30 June 2014, effective from 19 July 2014
- Tozer, MG, Turner K, Keith DA, Tindall D, Pennay C, Simpson C, Mackenzie B, Beukers P & Cox S, 2010, Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands, *Cunninghamia* (2010) 11(3):359-406
- Triggs, B. (1996) *Tracks, Scats & Other Traces: A Field Guide to Australian Mammals*, Oxford University Press, Melbourne.
- Wyong Shire Council (WSC) (2014), *Flora and Fauna Survey Guidelines Version 2.2*, Wyong Shire Council PO Box 20 Wyong NSW 2259 27 April 2014.
- Wyong Shire Council (WSC) (2015), *Wyong Development Control Plan 2013*, Effective 6 May 2015. Wyong Shire Council PO Box 20 Wyong NSW 2259

## Appendix 1 – Threatened Species & Populations

Table 9 – Threatened Species & Populations for Consideration

| Scientific Name                   | Common Name             | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                            | Records within 10km | Likelihood of occurrence                                                                  |
|-----------------------------------|-------------------------|------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------|
| <b>Birds</b>                      |                         |            |              |                                                                                                                                                                                                                                                                |                     |                                                                                           |
| <i>Ptilinopus regina</i>          | Rose-crowned Fruit-Dove | V          | -            | Occurs mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful (OEH, 2015a).                                                                                                            | 1                   | Low. No suitable habitat occurs within the subject site.                                  |
| <i>Ptilinopus superbus</i>        | Superb Fruit-Dove       | V          | -            | Inhabits rainforest and similar closed forest where it forages high in the canopy, eating fruits of many tree species such as figs and palms (OEH, 2015a). It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees (OEH, 2015a). | 3                   | Low. The subject site lacks habitat types preferred by this species.                      |
| <i>Ephippiorhynchus asiaticus</i> | Black-necked Stork      | E1         | -            | Occur in swamps, billabongs, watercourses and dams of floodplain wetlands along major coastal rivers within NSW (OEH, 2015a). Secondary habitats include minor floodplains, coastal sandplain wetlands and estuaries (OEH, 2015a).                             | 34                  | Low. The subject site is situated on a mid-slope, outside of coastal floodplain habitats. |
| <i>Botaurus poiciloptilus</i>     | Australasian Bittern    | E1         | E            | Inhabits permanent freshwater wetlands with tall, dense vegetation, particularly bulrushes ( <i>Typha</i> spp.) and spikerushes ( <i>Eleocharis</i> spp.) (OEH, 2015a).                                                                                        | 6                   | Low. No suitable aquatic habitats occur within or in close proximity to the subject site. |
| <i>Ixobrychus flavicollis</i>     | Black Bittern           | V          | -            | Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation (OEH, 2015a).                                                                                                                                     | 22                  | Low. No suitable aquatic habitats occur within or                                         |

| Scientific Name               | Common Name              | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                          | Records within 10km      | Likelihood of occurrence                                                                                                                |
|-------------------------------|--------------------------|------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
|                               |                          |            |              |                                                                                                                                                                                                                                                                                                                              |                          | in close proximity to the subject site.                                                                                                 |
| <i>Rosratula australis</i>    | Australian Painted Snipe | E1         | E            | In NSW, most records are from the Murray Darling Basin (OEH, 2015a). It has also known to occur in the Hawkesbury River and Clarence and lower Hunter Valley (OEH, 2015a). Occurs in swamp fringes, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (OEH, 2015a).           | PMR                      | Low. No suitable aquatic habitats occur within or in close proximity to the subject site.                                               |
| <i>Hieraaetus morphnoides</i> | Little Eagle             | V          | -            | Occupies open eucalypt forest, woodland or open woodland as well as Sheoak or <i>Acacia</i> woodlands and riparian woodlands of interior NSW (OEH, 2015a). Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter (OEH, 2015a).                                                   | 8                        | Moderate. The subject site provides potential habitat for this species. No stick nest were observed.                                    |
| <i>Pandion cristatus</i>      | Eastern Osprey           | V          | -            | Inhabits coastal areas, especially mouths of large rivers, lagoons and lakes, feeding on fish over clear, open water (OEH, 2015a). Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea (OEH, 2015a).                                                               |                          | Low. Tuggerah Lake is the closest foraging resource, approximately 1.8km to the east of the subject site. No stick nests were observed. |
| <i>Haliaeetus leucogaster</i> | White-bellied Sea-Eagle  | -          | M            | Inhabits coastal habitats, especially those close to the sea shore (DoE, 2015). This species feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion and offal (DoE, 2015). A known nesting location of this species is located approximately 350m south of the subject site. | Nest located 350m south. | Low-moderate. This species was not observed during surveys. Specimens of this species are most often observed flying                    |

| Scientific Name                | Common Name         | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                               | Records within 10km | Likelihood of occurrence                                                                                                      |
|--------------------------------|---------------------|------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------|
|                                |                     |            |              |                                                                                                                                                                                                                                                                                                                   |                     | along the edges of Tuggerah Lake approximately 2km to the east.                                                               |
| <i>Falco subniger</i>          | Black Falcon        | V          | -            | Sparsley distributed in New South Wales, mostly occurring in inland regions (OEH, 2015a). Inhabits woodland, shrubland and grassland in the arid and semi-arid zones, especially wooded watercourses and agricultural land with scattered remnant trees (OEH, 2015a).                                             | 1                   | Low. The subject site is situated near the coast, outside of preferred habitat for this species. No stick nest were observed. |
| <i>Burhinus grallarius</i>     | Bush Stone-curlew   | E1         | -            | Inhabits lowland open forests and woodlands with a sparse grassy groundlayer and fallen timber (OEH, 2015a; DEC 2006). In coastal areas, structurally similar elements of tidal and estuarine communities provide suitable habitat (DEC, 2006). Nests on the ground in a scrape or small bare patch (OEH, 2015a). | 7                   | Low-moderate. The subject site occurs on a ridge and slopes outside of this species preferred lowland habitats.               |
| <i>Haematopus fuliginosus</i>  | Sooty Oystercatcher | V          | -            | Inhabits rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries (OEH, 2015a).                                                                                                                                                                                                 | 14                  | Low. The closest estuarine habitat is located approximately 1.8km to the east of the subject site.                            |
| <i>Haematopus longirostris</i> | Pied Oystercatcher  | E1         | -            | Inhabits intertidal flats of inlets and bays, open beaches and sandbanks (OEH, 2015a).                                                                                                                                                                                                                            | 47                  | Low. The closest estuarine habitat is located approximately                                                                   |

| Scientific Name                 | Common Name         | NSW status | Comm. status | Habitat Description                                                                                                                                                                                   | Records within 10km | Likelihood of occurrence                                                                           |
|---------------------------------|---------------------|------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------|
|                                 |                     |            |              |                                                                                                                                                                                                       |                     | 1.8km to the east of the subject site.                                                             |
| <i>Charadrius leschenaultia</i> | Greater Sand-plover | V          | C, J, K      | Occurs on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks (OEH, 2015a).                                                                             | 1                   | Low. The closest estuarine habitat is located approximately 1.8km to the east of the subject site. |
| <i>Charadrius mongolus</i>      | Lesser Sand-plover  | V          | C, J, K      | Prefers beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats, but occasionally occurs on sandy beaches, coral reefs and rock platforms (OEH, 2015a).         | 6                   | Low. The closest estuarine habitat is located approximately 1.8km to the east of the subject site. |
| <i>Irediparra gallinacea</i>    | Comb-crested Jacana | V          | -            | Inhabits permanent freshwater wetlands, either still or slow-flowing, with a good surface cover of floating vegetation, especially water-lilies, or fringing and aquatic vegetation (OEH, 2015a).     | 3                   | Low. No freshwater wetlands occur within or in close proximity to the subject site.                |
| <i>Calidris alba</i>            | Sanderling          | V          | C, J, K      | Occurs in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons (OEH, 2015a). Rarely recorded near coastal wetlands (OEH, 2015a).      | 2                   | Low. The closest estuarine habitat is located approximately 1.8km to the east of the subject site. |
| <i>Calidris ferruginea</i>      | Curlew Sandpiper    | E1         | CE, C, J, K  | Inhabits littoral and estuarine habitats including intertidal mudflats of sheltered coasts in NSW (OEH, 2015a). Also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. | 32                  | Low. No estuarine habitats, swamps, lakes or lagoons occur within                                  |

| Scientific Name              | Common Name            | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                           | Records within 10km | Likelihood of occurrence                                                                                              |
|------------------------------|------------------------|------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------|
|                              |                        |            |              |                                                                                                                                                                                                                                                               |                     | or in close proximity to the subject site.                                                                            |
| <i>Calidris tenuirostris</i> | Great Knot             | V          | C, J, K      | Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons (OEH, 2015a).                                                                                           | 12                  | Low. No estuarine habitats, swamps, lakes or lagoons occur within or in close proximity to the subject site.          |
| <i>Limicola falcinellus</i>  | Broad-billed Sandpiper | V          | C, J, K      | Prefers sheltered parts of the coast such as estuarine mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat (OEH, 2015a).                                                                                           | 4                   | Low. No estuarine habitats occur within or in close proximity to the subject site.                                    |
| <i>Limosa limosa</i>         | Black-tailed Godwit    | V          | C, J, K      | Primarily found on the coast, inhabiting sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats (OEH, 2015a). It can also be found inland on mudflats and in water less than 10cm deep around muddy lakes and swamps (OEH, 2015a). | 2                   | Low. No estuarine habitats or swamps or lakes occur within or in close proximity to the subject site.                 |
| <i>Xenus cinereus</i>        | Terek Sandpiper        | V          | C, J, K      | Occurs on coastal mudflats, lagoons, creeks and estuaries (OEH, 2015a). Prefers mudbanks and sandbanks located near mangroves, but may also be observed on rock pools and reefs, and occasionally up to 10km inland around brackish pools (OEH, 2015a).       | 6                   | Low. No estuarine habitats or other suitable aquatic habitats occur within or in close proximity to the subject site. |
| <i>Sternula albifrons</i>    | Little Tern            | E1         | C, J, K      | A coastal species, preferring sheltered environments, nesting in small, scattered colonies in low dunes or on sandy beaches just                                                                                                                              | 41                  | Low. No coastal habitats or other suitable aquatic                                                                    |

| Scientific Name                 | Common Name           | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                            | Records within 10km | Likelihood of occurrence                                                                                                                                                                                          |
|---------------------------------|-----------------------|------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 |                       |            |              | above the high tide mark near estuary mouths or adjacent to coastal lakes and islands (OEH, 2015a). May occurs several kilometres from the sea in harbours, inlets and rivers (OEH, 2015a).                                                                                                                                                                                                                    |                     | habitats occur within or in close proximity to the subject site.                                                                                                                                                  |
| <i>Callocephalon fimbriatum</i> | Gang-gang Cockatoo    | V          | -            | Inhabit tall mountain forests and woodlands in spring and summer with a preference for heavily timbered and mature wet sclerophyll forests (OEH, 2015a). Moves to lower altitudes in autumn and winter, occurring in drier more open eucalypt forest and woodlands, particularly box-gum and box-ironbark assemblages or in dry forest in coastal areas (OEH, 2015a). Often found in urban areas (OEH, 2015a). | 1                   | Low-moderate. The subject site does not provide preferred winter foraging habitat.                                                                                                                                |
| <i>Calyptorhynchus lathami</i>  | Glossy Black-Cockatoo | V          | -            | Inhabits open forest and woodlands of the coast and the Great Dividing Range, feeding almost exclusively on the seeds of several species of she-oak ( <i>Casuarina</i> and <i>Allocasuarina</i> species), shredding the cones with its massive bill (OEH, 2015a). Utilises large hollow-bearing eucalypts for nest sites, laying a single egg between March and May (OEH, 2015a).                              | 37                  | High. This species was observed within the Wadalba Wildlife Corridor to the south of the subject site. Some specimens of <i>Allocasuarina torulosa</i> & potential nesting hollows occur within the subject site. |
| <i>Glossopsitta pusilla</i>     | Little Lorikeet       | V          | -            | Forages primarily in open eucalypt forest and woodland, utilising riparian habitats due to higher soil fertility and resulting higher productivity (OEH, 2015a). Feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe and rarely in orchards (OEH, 2015a). Nests in hollows, selecting limb or trunk hollows of                                                                  | 22                  | Moderate. The subject site may provide potential foraging and nesting habitat for this species.                                                                                                                   |

| Scientific Name          | Common Name  | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Records within 10km | Likelihood of occurrence                                                                                                                   |
|--------------------------|--------------|------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
|                          |              |            |              | smooth-barked eucalypts with small (3cm) entrances and usually high above the ground (2-15m) (OEH, 2015a).                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                                                                                                                                            |
| <i>Lathamus discolor</i> | Swift Parrot | E1         | E            | Breeds in Tasmania from September to January, migrating to the south-eastern mainland in March and October (OEH, 2015a). Preferred winter-flowering feed trees include <i>Eucalyptus robusta</i> , <i>Corymbia maculata</i> , <i>C. gummifera</i> , <i>E. sideroxylon</i> and <i>E. albens</i> (OEH, 2015a).                                                                                                                                                                                                                                                                            | 69                  | Moderate-high. The subject site is dominated by the preferred winter-flowering tree species <i>Corymbia maculata</i> .                     |
| <i>Ninox connivens</i>   | Barking Owl  | V          | -            | Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland (OEH, 2015a). Roosts in shaded areas of the tree canopy, including tall mid-storey trees with dense foliage such as <i>Acacia</i> and <i>Casuarina</i> species (OEH, 2015a). The male perches in a nearby tree overlooking the hollow entrance during the breeding season (OEH, 2015a). Nests in hollows of large old trees, preferring living eucalypts (OEH, 2015a). Nest-hollow entrances are 2-35 m above the ground with a diameter of 20-46 cm and depth of 20-300 cm (NPWS, 2003a). | 3                   | Moderate. The subject site may provide potential foraging habitat for this species. No suitable nesting hollows were observed.             |
| <i>Ninox strenua</i>     | Powerful Owl | V          | -            | Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest (OEH, 2015a). Roosts by day in dense vegetation and nests in large tree hollows, >45cm diameter, >100cm deep and commonly >20m high (or at least >6m) (DEC, 2006). Hollows >0.5m deep according to OEH (2015a). Breeding occurs from late autumn to mid-winter during which time Males roosts nearby (10-200m) (OEH, 2015a).                                                                                                                                     | 39                  | High. The subject site provides some foraging habitat for this species. No suitable nesting hollows were observed within the subject site. |

| Scientific Name              | Common Name       | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Records within 10km | Likelihood of occurrence                                                                                             |
|------------------------------|-------------------|------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------|
| <i>Tyto novaehollandiae</i>  | Masked Owl        | V          | -            | A forest owl that lives in dry eucalypt forests and woodlands from sea level to 1100 m, with a large home range of 500 to 1000ha, often hunting along the edges of forests, including roadsides (OEH, 2015a). Roosts and breeds in moist eucalypt forested gullies, using large tree hollows (>40cm diameter & >100cm deep) or sometimes caves for nesting (OEH, 2015a; DEC, 2006).                                                                                                                                                         | 21                  | Moderate. The subject site may provide foraging habitat for this species. No suitable nesting hollows were observed. |
| <i>Tyto tenebricosa</i>      | Sooty Owl         | V          | -            | Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests (OEH, 2015a). Roosts by day in the hollow of a tall forest tree or in heavy vegetation (OEH, 2015a). Nests in large old eucalypts or rainforest species (>40cm diameter & >100cm deep) (DEC, 2006).                                                                                                                                                                                                            | 16                  | Low. No rainforest or wet sclerophyll forest types occur within close proximity to the subject site.                 |
| <i>Chthonicola sagittata</i> | Speckled Warbler  | V          | -            | Inhabits a wide range of <i>Eucalyptus</i> dominated communities that have a grassy understorey, often on rocky ridges or in gullies (OEH, 2015a). Typical habitats include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy (OEH, 2015a). Builds rounded, domed nest of dry grass and bark strips in slight hollow in the ground or base of low dense plant, often amongst fallen branches and other litter, with a side entrance allowing the bird to walk directly inside (OEH, 2015a). | 1                   | Moderate. The subject site may provide habitat for this species. No nests were observed.                             |
| <i>Anthochaera phrygia</i>   | Regent Honeyeater | E4A        | CE           | Inhabits dry open forest and woodland, particularly box-ironbark woodland and riparian forests of river she-oak, often with an abundance of mistletoe (OEH, 2015a). Non-breeding flocks have been recorded foraging in flowering Swamp Mahogany & Spotted Gum, particularly on the Central Coast (OEH, 2015a). Key foraging eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red                                                                                                                                              | 13                  | Moderate. The subject site may provide potential foraging habitat for this species.                                  |

| Scientific Name                  | Common Name        | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Records within 10km | Likelihood of occurrence                                                                                                    |
|----------------------------------|--------------------|------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------|
|                                  |                    |            |              | Gum, White Box and Swamp Mahogany (OEH, 2015a). Also utilises <i>Eucalyptus microcarpa</i> , <i>E.punctata</i> , <i>E.polyanthemos</i> , <i>E.moluccana</i> , <i>Corymbia robusta</i> , <i>E.crebra</i> , <i>E.caleyi</i> , <i>C.maculata</i> , <i>E.mckieana</i> , <i>E.macrorhyncha</i> , <i>E.laevopinea</i> and <i>Angophora floribunda</i> (OEH, 2015a). Also utilise nectar and fruit of Mistletoes <i>Amyema miquelii</i> , <i>A.pendula</i> and <i>A.cambagei</i> as well as lerp and honeydew when nectar is scarce (OEH, 2015a). |                     |                                                                                                                             |
| <i>Epthianura albifrons</i>      | White-fronted Chat | V          | -            | A gregarious species, usually found foraging on bare or grassy ground in wetlands areas, feeding mainly on flies and beetles caught from or close to the ground (OEH, 2015a). Breed from late July to early March, building an open cup nest in low vegetation, usually about 23cm above the ground, but also as high as 2.5m (OEH, 2015a).                                                                                                                                                                                                | 2                   | Low. No preferred wetland habitat occurs within or in close proximity to the subject site.                                  |
| <i>Grantiella picta</i>          | Painted Honeyeater | V          | V            | The greatest concentration of this species including almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland (OEH, 2015a). Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests, feeding on mostly fruits of mistletoes of the genus <i>Amyema</i> (OEH, 2015a). Breeds from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches (OEH, 2015a).                      | 3                   | Low. The subject site contains non-preferred habitat and is outside of the known concentrated distribution of this species. |
| <i>Daphoenositta chrysoptera</i> | Varied Sittella    | V          | -            | Inhabits eucalypt forests and woodlands, especially those with rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland (OEH, 2015a). Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high                                                                                                                                                                                                                                                                           | 31                  | Moderate. The subject site may provide potential habitat for this species. No nests were                                    |

| Scientific Name               | Common Name         | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Records within 10km | Likelihood of occurrence                                                                                                                                       |
|-------------------------------|---------------------|------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               |                     |            |              | in the living tree canopy, and often re-uses the same fork or tree in successive years (OEH, 2015a).                                                                                                                                                                                                                                                                                                                                                                                                              |                     | observed.                                                                                                                                                      |
| <i>Petroica phoenicea</i>     | Flame Robin         | V          | -            | Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes (OEH, 2015a). Prefers clearings or areas of open understoreys (OEH, 2015a). In winter, many birds move to drier more open habitats in the lowlands and to the inland slopes and plains (OEH, 2015a). Breeds in spring to late summer, building nests often near the ground in sheltered sites such as shallow cavities in trees, stumps or banks (OEH, 2015a).                                                             | 1                   | Low-moderate. The subject site may provide marginal potential habitat for this species. No nests were observed.                                                |
| <i>Stagonopleura guttata</i>  | Diamond Firetail    | V          | -            | Not commonly found in coastal districts though there are some records (OEH, 2015a). Occurs in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum <i>Eucalyptus pauciflora</i> Woodlands, often found in riparian areas (OEH, 2015a). Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities (OEH, 2015a). Builds globular nests in shrubby understorey, or higher up, especially under hawk's or raven's nests (OEH, 2015a). | 1                   | Low-moderate. The subject site may provide marginal potential habitat for this species. No nests were observed.                                                |
| <i>Dasyornis brachypterus</i> | Eastern Bristlebird | E          | E            | Known to occur in three disjunct populations: Northern NSW (at NSW/Qld border); Central (in Jervis Bay area); and Southern (at Victoria/NSW border). Central and southern populations occur in dense, low vegetation including heath and open woodland with heathy understorey (OEH, 2015a). The northern population occurs in open forest with dense tussock grass understorey with sparse mid-storey near rainforest ecotone (OEH, 2015a).                                                                      | PMR                 | Low-moderate. The subject site is located outside of the known distribution of this species. No heathy understorey preferred by the southern populations occur |

| Scientific Name                  | Common Name              | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                             | Records within 10km | Likelihood of occurrence                                                                                    |
|----------------------------------|--------------------------|------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------|
|                                  |                          |            |              |                                                                                                                                                                                                                                                                                                                                                                                 |                     | within the subject site.                                                                                    |
| <i>Numenius madagascariensis</i> | Eastern Curlew           | P          | CE           | In NSW this species occurs across the entire coast but is mainly found in estuaries such as the Hunter River, Port Stephens, Clarence River, Richmond River and ICOLLs of the south coast (OEH, 2015a). A non-breeding migrant, which occupies coastal lakes, inlets, bays and estuarine habitats, occurring mainly in intertidal mudflats and saltmarshes in NSW (OEH, 2015a). | PMR                 | Low. The estuarine habitats occur within or in close proximity to the subject site.                         |
| <b>Fish</b>                      |                          |            |              |                                                                                                                                                                                                                                                                                                                                                                                 |                     |                                                                                                             |
| <i>Prototroctes maraena</i>      | Australian Grayling      | E          | V            | A diadromous species, spending parts of its life cycle in both freshwater and coastal seas (DE, 2015a). Inhabits cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones (DE, 2015a).                                                                                                                                        | PMR                 | Low. No freshwater streams occur within or in close proximity to the subject site.                          |
| <b>Mammals</b>                   |                          |            |              |                                                                                                                                                                                                                                                                                                                                                                                 |                     |                                                                                                             |
| <i>Dasyurus maculatus</i>        | Spotted-tailed Quoll     | V          | E            | Inhabits a range of habitat types such as rainforest, open forest, woodland, coastal heath, inland riparian forest (OEH, 2015a). Occupy home ranges of 750 to 3500 ha (OEH, 2015a). Utilise hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky cliffs for den sites (OEH, 2015a).                                                          | 13                  | Moderate. The subject site may provide potential habitat for this species. No den sites were observed.      |
| <i>Isodon obesulus obesulus</i>  | Southern Brown Bandicoot | E1         | E            | It is found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River (OEH, 2015a). Generally only found in heath or open forest with a heathy understorey on sandy or friable soils (OEH, 2015a).                                                                                                                                                 | 1                   | Low. The subject site is outside of the known distribution and lacks a heathy understorey preferred by this |

| Scientific Name               | Common Name            | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                                            | Records within 10km | Likelihood of occurrence                                                                                                                                                                          |
|-------------------------------|------------------------|------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               |                        |            |              |                                                                                                                                                                                                                                                                                                                                                                                                                                |                     | species.                                                                                                                                                                                          |
| <i>Pteropus policephalus</i>  | Grey-headed Flying-fox | V          | V            | Generally found within 200km of the east coast of Australia (OEH, 2015a). Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops (OEH, 2015a). Roost camps are generally located within 20km of regular food sources and are commonly found in gullies, close to water, in vegetation with a dense canopy (OEH, 2015a). | 57                  | Moderate. The subject site provides potential foraging habitat for this species. No camps were observed.                                                                                          |
| <i>Phascolarctos cinereus</i> | Koala                  | V          | V            | Inhabit eucalypt woodlands and forest feeding on preferred feed trees, which are listed for each Koala Management Area (OEH, 2015a).                                                                                                                                                                                                                                                                                           | 11                  | Low. One (1) supplementary food tree species, <i>Eucalyptus eugenioides</i> listed for the Central Coast Koala Management Area occurs within the subject site. No evidence of Koala was observed. |
| <i>Cercartetus nanus</i>      | Eastern Pygmy-possum   | V          | -            | Occurs in a variety of habitats, but prefers woodlands and heaths (except Northern NSW its most commonly observed in rainforest) (OEH, 2015a). Feeds on nectar and pollen of banksias, eucalypts and bottlebrushes (OEH, 2015a).                                                                                                                                                                                               | 3                   | Low-moderate. The subject site does not contain suitable habitat types or foraging resources for this species.                                                                                    |

| Scientific Name                         | Common Name               | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Records within 10km | Likelihood of occurrence                                                                                                                                                                          |
|-----------------------------------------|---------------------------|------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Petaurus australis</i>               | Yellow-bellied Glider     | V          | -            | Occurs in tall mature eucalypt forest, generally in areas with high rainfall and nutrient rich soils (OEH, 2015a). Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein (OEH, 2015a). The Recovery Plan lists one (1) sap tree species, <i>Eucalyptus punctata</i> (Grey Gum) for the Central Coast region (NPWS, 2003b). They feed on favoured food trees, often leaving a distinctive V-shaped scar (OEH, 2015a). They den in hollows of large trees (OEH, 2015a). | 34                  | Low. No known sap tree species for the Central Coast region occur within the subject site. The closest record of this species is 6.7km to the west.                                               |
| <i>Petaurus norfolcensis</i>            | Squirrel Glider           | V          | -            | Inhabits Blackbutt-Bloodwood forests with heath understorey in coastal areas (OEH, 2015a). Nest in hollow-bearing trees.                                                                                                                                                                                                                                                                                                                                                                                                                         | 134                 | Moderate. The subject site provides potential habitat for this species.                                                                                                                           |
| <i>Potorous tridactylus tridactylus</i> | Long-nosed Potoroo        | V          | V            | Inhabits coastal heaths and dry and wet sclerophyll forests containing dense understorey with occasional open areas (OEH, 2015a). They forage on fruit-bodies of hypogeous (underground-fruiting) fungi as well as roots, insects and larvae and other soft bodied animals, commonly in sandy loam soil (OEH, 2015a). They dig small conical shaped holes in the soil, similar to bandicoots (OEH, 2015a).                                                                                                                                       | PMR                 | Low. No heaths or suitable dense understorey vegetation occurs within or in close proximity to the subject site. No conical diggings characteristic of either bandicoot or potoroo were observed. |
| <i>Petrogale penicillata</i>            | Brush-tailed Rock-wallaby | E1         | V            | Inhabit rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north (OEH, 2015a).                                                                                                                                                                                                                                                                                                                                                                                        | PMR                 | Low. No suitable habitat features such as rocky escarpments, outcrops and cliffs occur within or in close proximity to the                                                                        |

| Scientific Name                   | Common Name                   | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                 | Records within 10km | Likelihood of occurrence                                                                                                                   |
|-----------------------------------|-------------------------------|------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
|                                   |                               |            |              |                                                                                                                                                                                                                                                                                                                     |                     | subject site.                                                                                                                              |
| <i>Saccolaimus flaviventris</i>   | Yellow-bellied Sheathtail-bat | V          | -            | Roosts singly or in groups of up to six, in tree hollows and buildings, though in treeless areas they are known to utilise mammal burrows (OEH, 2015a). Forages in most habitats across its very wide range (OEH, 2015a).                                                                                           | 5                   | High. The subject site may provide habitat for this species. One (1) record occurs within 1km of the subject site.                         |
| <i>Mormopterus norfolkensis</i>   | Eastern Freetail-bat          | V          | -            | Occurs in dry sclerophyll forest, woodland, swamp forest and mangrove forest east of the Great Dividing Range (OEH, 2015a). Roosts usually solitary but also communally, mainly in tree hollows but also under bark or in man-made structures (OEH, 2015a).                                                         | 47                  | Recorded within the subject site during surveys. Two (2) records occurs within 1km of the subject site.                                    |
| <i>Chalinolobus dwyeri</i>        | Large-eared Pied Bat          | V          | V            | Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin. (OEH, 2015a). Occurs in low to mid-elevation dry open forest and woodland close suitable roosting habitats (OEH, 2015a).                                             | 2                   | Moderate. The subject site may provide habitat for this species. No Fairy Martin nests or other potential roosting habitats were observed. |
| <i>Falsistrellus tasmaniensis</i> | Eastern False Pipistrelle     | V          | -            | Prefers moist habitats, with trees taller than 20m where it forages on beetles, moths, weevils and flying insects above or just below the tree canopy (OEH, 2015a). Generally roosts in eucalypt hollows, but has also been found under loose bark or in buildings (OEH, 2015a). Hibernates in winter (OEH, 2015a). | 34                  | Possible identification as part of Species Grouping. The subject site may provide potential habitat for this species.                      |

| Scientific Name                            | Common Name          | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Records within 10km | Likelihood of occurrence                                                                                                                                                                                      |
|--------------------------------------------|----------------------|------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Kerivoula papuensis</i>                 | Golden-tipped Bat    | V          | -            | Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m (OEH, 2015a). Also found in tall open forest, <i>Casuarina</i> -dominated riparian forest and coastal <i>Melaleuca</i> forests (OEH, 2015a). Roosts mainly in rainforest gullies on small 1 <sup>st</sup> and 2 <sup>nd</sup> order streams, usually in hanging Yellow-throated Scrubwren and Brown Gerygone nests modified with an access hole on the underside (OEH, 2015a). May also roost under thick moss on the tree trunks, in tree hollows, dense foliage and epiphytes (OEH, 2015a). | 4                   | Moderate. The subject site may provide potential habitat for this species.                                                                                                                                    |
| <i>Miniopterus australis</i>               | Little Bentwing-bat  | V          | -            | Generally found in well-timbered areas including, moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, <i>Melaleuca</i> swamps, dense coastal forests and banksia scrub (OEH, 2015a). Roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings (OEH, 2015a). Forage beneath the canopy of densely vegetated habitats (OEH, 2015a).                                                                                                                                                | 51                  | Recorded within the subject site during surveys. The subject site also provides potential roosting habitat.                                                                                                   |
| <i>Miniopterus schreibersii oceanensis</i> | Eastern Bentwing-bat | V          | -            | Forage in forested areas, catching moths and other flying insects above the tree tops (OEH, 2015a). Roosts primarily in caves, but also uses derelict mines, storm-water tunnels, buildings and other man-made structures (OEH, 2015a). Form discrete populations centred on a maternity cave that is used annually in spring and summer for birthing and rearing of young (OEH, 2015a).                                                                                                                                                                                  | 76                  | Recorded within the subject site during survey – Identified with a 'Probable' level of confidence. The subject site provides foraging habitat for this species. No potential roosting caves or other roosting |

| Scientific Name              | Common Name             | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                          | Records within 10km | Likelihood of occurrence                                                                                                                                                         |
|------------------------------|-------------------------|------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                              |                         |            |              |                                                                                                                                                                                                                                                                                                                                              |                     | structures were observed.                                                                                                                                                        |
| <i>Scoteanax rueppellii</i>  | Greater Broad-nosed Bat | V          | -            | Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest (OEH, 2015a). Roost mainly in tree hollows, but has also been found to roost in buildings (OEH, 2015a).                                                                            | 62                  | Recorded within the subject site during surveys – Identified with a 'Probable' level of confidence. The subject site may provide roosting and foraging habitat for this species. |
| <i>Myotis macropus</i>       | Southern Myotis         | V          | -            | Generally roosts in groups of 10-15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage (OEH, 2015a). Forage over streams and pools catching insects and small fish by raking their feet across the water surface (OEH, 2015a).                                  | 36                  | Possible identification as part of Species Grouping. The subject site may provide potential habitat for this species.                                                            |
| <i>Vespadelus troughtoni</i> | Eastern Cave Bat        | V          | -            | A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs (OEH, 2015a). It has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals (OEH, 2015a). Occasionally found along cliff-lines in wet eucalypt forest and rainforest (OEH, 2015a). | 1                   | Low-moderate. No cliffs or rock overhangs were observed within or in close proximity to the subject site. The closest record of this species is 9.96km to the north.             |

| Scientific Name                  | Common Name            | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                        | Records within 10km | Likelihood of occurrence                                                                                                                                                                          |
|----------------------------------|------------------------|------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Pseudomys gracilicaudatus</i> | Eastern Chestnut Mouse | V          | -            | In NSW it is found in heathland, mostly commonly in dense, wet heath and swamps (OEH, 2015a). It has been determined that optimal habitat may be vigorously regenerating heathland burnt from 18months to 4 years previously, after which the Swamp Rat becomes dominant (OEH, 2015a).                                                     | 2                   | Low. No heaths or swamps occur within or in close proximity to the subject site.                                                                                                                  |
| <i>Pseudomys novaehollandiae</i> | New Holland Mouse      | P          | V            | Inhabits open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes (OEH, 2015a).                                                                                                                                                                                                                        | 18                  | Low. No heath or heathland understorey occurs within or in close proximity to the subject site.                                                                                                   |
| <b>Reptiles</b>                  |                        |            |              |                                                                                                                                                                                                                                                                                                                                            |                     |                                                                                                                                                                                                   |
| <i>Hoplocephalus stephensii</i>  | Stephen's Banded Snake | V          | -            | Occurs in rainforest and eucalypt forest and rock areas up to 950m in altitude (OEH, 2015a). A nocturnal snake that hunt for frogs, lizards, birds and small mammals (OEH, 2015a). During the day it shelters between loose bark and tree trunks, amongst vines, or in hollow trunks, limbs, in rock crevices or under slabs (OEH, 2015a). | 1                   | Moderate. The subject site does contain eucalypt forest, foraging resources and potential nesting habitats, however only one (1) record of this species was found approximately 6km to the north. |
| <i>Hoplocephalus bungaroides</i> | Broad-headed Snake     | V          | V            | Largely confined to Triassic and Permian sandstones, including Hawkesbury, Narrabeen and Shoalhaven groups, in the coast and ranges within 250km of Sydney (OEH, 2015a). Shelters in                                                                                                                                                       | PMR                 | Low. The subject site contains clay-based soils with no sandstone                                                                                                                                 |

| Scientific Name                 | Common Name          | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                       | Records within 10km | Likelihood of occurrence                                                                                                                                                               |
|---------------------------------|----------------------|------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 |                      |            |              | sandstone outcropping features during autumn, winter and spring, moving to hollows in large trees within 500m of escarpments in summer (OEH, 2015a).                                                                                                                                                                                                                      |                     | outcropping or escarpments observed.                                                                                                                                                   |
| <b>Amphibians</b>               |                      |            |              |                                                                                                                                                                                                                                                                                                                                                                           |                     |                                                                                                                                                                                        |
| <i>Crinia tinnula</i>           | Wallum Froglet       | V          | -            | Typically occur in sedgelands and wet heathlands but can also be found along drainage lines and disturbed areas (OEH, 2015a). Breeds in swamps with permanent water as well as shallow ephemeral pools and drainage ditches (OEH, 2015a).                                                                                                                                 | 72                  | Moderate. The drainage line along the western side of the subject site may provide marginal potential habitat for this species. This species was not recorded during targeted surveys. |
| <i>Heleioporus australiacus</i> | Giant Burrowing Frog | V          | V            | Occurs in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based (OEH, 2015a). Breeds in soaks or pools within first and second order streams, calling from open spaces, under vegetation or rocks or from within burrows in the creek bank (OEH, 2015a). Can travel up to 300m from breeding habitats (OEH, 2015a). | PMR                 | Low. The subject site contains clay-based soils, not suitable for this species.                                                                                                        |
| <i>Mixophyes balbus</i>         | Stuttering Frog      | E1         | V            | Found in rainforest and wet, tall open forest in the foothills and escarpments on the eastern side of the Great Dividing Range, breeding in streams during summer after heavy rain (OEH, 2015a).                                                                                                                                                                          | 26                  | Low. The subject site lacks wet forests preferred by this species.                                                                                                                     |
| <i>Mixophyes iteratus</i>       | Giant Barred Frog    | E1         | E            | Found along freshwater streams with permanent or semi-permanent water, generally (but not always) at lower elevation                                                                                                                                                                                                                                                      | 3                   | Low. The subject site lacks wet forests                                                                                                                                                |

| Scientific Name             | Common Name                | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                      | Records within 10km | Likelihood of occurrence                                                                                                                                                                                                                        |
|-----------------------------|----------------------------|------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             |                            |            |              | (OEH, 2015a). This species prefers rainforest or wet sclerophyll forest, but may also occur in riparian habitats in drier forest or degraded riparian remnant, and occasionally around dams (OEH, 2015a).                                                                                                                                |                     | preferred by this species. The closest records occur approximately 7.5km to the west south-west.                                                                                                                                                |
| <i>Litoria aurea</i>        | Green and Golden Bell Frog | E1         | V            | Inhabits marshes, dams and stream-sides, particularly those containing bulrushes ( <i>Typha</i> spp.) or spikerushes ( <i>Eleocharis</i> spp.) (OEH, 2015a). Prefers un-shaded water bodies with no predatory fish such as Plague Minnow ( <i>Gambusia holbrooki</i> ), available sheltering sites and grassy areas nearby (OEH, 2015a). | 13                  | Low. The two small dams along the southern boundary of the subject site are well-shaded, open water habitats with no emergent vegetation such as Bulrush or Spikerush. The drainage line contains minor pooling with no permanent water bodies. |
| <i>Litoria brevipalmata</i> | Green-thighed Frog         | V          | -            | Occurs in rainforest, moist eucalypt forest, dry eucalypt forest and health, typically where surface water gathers after rain (OEH, 2015a). Prefers wetter forests in the south of its range, but extends into drier forests in northern NSW and southern Queensland (OEH, 2015a).                                                       | 6                   | Low. The subject site contains a dry eucalypt forest type throughout, lacking the moist forest types preferred in the south of its range.                                                                                                       |

| Scientific Name            | Common Name            | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                              | Records within 10km | Likelihood of occurrence                                                                                  |
|----------------------------|------------------------|------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------|
| <i>Litoria littlejohni</i> | Littlejohn's Tree Frog | V          | V            | Breeds in the upper reaches of permanent streams and in perched swamps, after heavy rain usually in from late summer to early spring where it calls from low vegetation close to slow flowing pools (OEH, 2015a). Non-breeding habitat is heath based forest and woodlands where it shelters under leaf litter and low vegetation, hunting for invertebrate prey either in shrubs or on the ground (OEH, 2015a). | PMR                 | Low. No heath based forest or woodlands occur within or in close proximity to the subject site.           |
| <b>Insects</b>             |                        |            |              |                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                                                                                                           |
| <i>Petalura gigantea</i>   | Giant Dragonfly        | E1         | -            | Lives in permanent swamps and bogs with some free water and open vegetation, emerging as Adults in late October (OEH, 2015a).                                                                                                                                                                                                                                                                                    | 1                   | Low. No swamps or bogs occur within or in close proximity to the subject site.                            |
| <b>Flora</b>               |                        |            |              |                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                                                                                                           |
| <i>Pultenaea glabra</i>    | Smooth Bush-Pea        | V          | V            | Restricted to the higher Blue Mountains area (OEH, 2015a). Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone (OEH, 2015a).                                                                                                                                                                                                    | PMR                 | Low. The subject site contains clay-based soils and is outside of the known distribution of this species. |
| <i>Acacia bynoeana</i>     | Bynoe's Wattle         | E1         | V            | Occurs in heath or dry sclerophyll forest on sandy soils (OEH, 2015a). May prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt places (OEH, 2015a). Associated with overstorey species, Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple (OEH, 2015a).                                               | 32                  | Low. The subject site contains clay soils with none of the associated overstorey species.                 |

| Scientific Name                | Common Name          | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Records within 10km | Likelihood of occurrence                                                                                                               |
|--------------------------------|----------------------|------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <i>Maundia triglochinoides</i> |                      | V          | -            | Grows in swamps, lagoons, dams, channels, creeks or shallow freshwater (30-60cm deep) on low nutrient heavy clay (OEH, 2015a). Associated with wetland species such as <i>Triglochin procera</i> (OEH, 2015a). Flowers from November to January (OEH, 2015a).                                                                                                                                                                                                                                                      | 18                  | Low. No wetland habitats occur within or in close proximity to the subject site.                                                       |
| <i>Prostanthera askania</i>    | Tranquility Mintbush | E1         | E            | Occurs adjacent to drainage lines in moist sclerophyll forest and warm temperate rainforest communities often containing canopy species such as <i>Eucalyptus saligna</i> (Sydney Blue Gum) and <i>Syncarpia glomulifera</i> (Turpentine), though canopy species can be highly variable (OEH, 2015a).                                                                                                                                                                                                              | 5                   | Low. No moist sclerophyll forest or rainforest habitats occur within or in close proximity to the subject site.                        |
| <i>Prostanthera junonis</i>    | Somersby Mintbush    | E1         | E            | Restricted to the Somersby Plateau, this species occurs on both Somersby and Sydney Town soil landscapes on gently undulating country over weathered Hawkesbury sandstone with open forest/low woodland/ open scrub (OEH, 2015a). Dominant flowering period is October to mid-December, outside of which this species is difficult to identify (OEH, 2015a).                                                                                                                                                       | PMR                 | Low. The subject site contains clay-based soils and is outside of the known distribution for this species.                             |
| <i>Angophora inopina</i>       | Charmhaven Apple     | V          | V            | Occurs most frequently in four main vegetation communities (OEH, 2015a): <ul style="list-style-type: none"> <li><i>Eucalyptus haemastoma</i> / <i>Corymbia gummifera</i> / <i>Angophora inopina</i> Woodland/Forest;</li> <li><i>Hakea teretifolia</i> / <i>Banksia oblongifolia</i> wet heath;</li> <li><i>Eucalyptus resinifera</i> / <i>Melaleuca sieberi</i> / <i>Angophora inopina</i> sedge woodland; &amp;</li> <li><i>Eucalyptus capitellata</i> / <i>Corymbia gummifera</i> / <i>Angophora</i></li> </ul> | 2688                | Low. None of the associated vegetation communities occur within or in close proximity to the subject site. No specimens were observed. |

| Scientific Name                                                                                                           | Common Name            | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                     | Records within 10km | Likelihood of occurrence                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------|------------------------|------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------|
|                                                                                                                           |                        |            |              | <i>inopina</i> woodland/forest.                                                                                                                                                                                                                                                                                                                                                         |                     |                                                                                                                  |
| <i>Callistemon linearifolius</i>                                                                                          | Nettle Bottle Brush    | V          | -            | Grows in dry sclerophyll forest on the coast and adjacent ranges, flowering in spring to summer (OEH, 2015a). Occurs in damp places in woodland on sandstone, usually in gullies (Robinson, 1997).                                                                                                                                                                                      | 5                   | Low. The subject site contains clay soils. No specimens of the genus <i>Callistemon</i> were recorded.           |
| <i>Eucalyptus camfieldii</i>                                                                                              | Camfield's Stringybark | V          | V            | Occurs in coastal heath, mostly on exposed sandy ridges (OEH, 2015a). In shallow sandy soils overlying Hawkesbury sandstone (OEH, 2015a). Associated canopy species include, <i>Eucalyptus oblonga</i> (Narrow-leaved Stringybark), <i>E.capitellata</i> (Brown Stringybark) and <i>E.haemastoma</i> (Scribbly Gum) (OEH, 2015a).                                                       | 30                  | Low. The subject site contains clay soils with none of the associated canopy species.                            |
| <i>Eucalyptus parramattensis</i> C. Hall. Subsp. <i>parramattensis</i> in Wyong and Lake Macquarie local government areas | Parramatta Red Gum     | E2         | -            | Occurs in low moist areas alongside drainage lines and adjacent wetlands and often occurs in woodland on sandy soil (OEH, 2015a). Occurs on sandy alluvium with a floodplain community also containing, <i>Eucalyptus robusta</i> (Swamp Mahogany), <i>E.tereticornis</i> (Forest Red Gum), <i>Corymbia gummifera</i> (Red Bloodwood) as well as <i>Melaleuca</i> species (OEH, 2015a). | 111                 | Low. The subject site contains clay soils with none of the associated canopy species.                            |
| <i>Melaleuca biconvexa</i>                                                                                                | Biconvexa Paperbark    | V          | V            | Occurs in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects (OEH, 2015a).                                                                                                                                                                                                                                                         | 360                 | Moderate. The lower areas of the subject site, to the north-west may provide marginal potential habitat for this |

| Scientific Name                       | Common Name             | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                 | Records within 10km | Likelihood of occurrence                                                                                                              |
|---------------------------------------|-------------------------|------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------|
|                                       |                         |            |              |                                                                                                                                                                                                                                                                                                                                                     |                     | species. No specimens were recorded.                                                                                                  |
| <i>Syzygium paniculatum</i>           | Magenta Lilly Pilly     | E1         | V            | On the south coast this species occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest (OEH, 2015a). On the central coast this species occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities (OEH, 2015a).                      | 41                  | Low. No rainforest vegetation communities occur within or in close proximity to the subject site.                                     |
| <i>Caladenia porphyrea</i>            |                         | E1         | -            | Grows in coastal sclerophyll forest on sandy soils (OEH, 2015a).                                                                                                                                                                                                                                                                                    | PN                  | Low. The subject site contains clay based. The closest records of this species occur approximately 12km to the south-east.            |
| <i>Caladenia tessellata</i>           | Thick Lip Spider Orchid | E1         | V            | Occurs in grassy sclerophyll woodland on clay loam or sandy soils (OEH, 2015a). Flowers between September and November (OEH, 2015a). The precise habitat preferences of this species are unknown (Duncan, 2010).                                                                                                                                    | 2                   | Moderate. The subject site may provide potential habitat for this species. No specimens were recorded during targeted orchid surveys. |
| <i>Corunastylis</i> sp.<br>Charmhaven |                         | E4A        | CE           | Currently only known from the Gorokan/ Charmhaven area within the Wyong LGA (OEH, 2015a). Occur in low woodland to heathland with a shrubby understorey, in association with dominant species such as, <i>Allocasuarina littoralis</i> (Black She-oak), <i>Leptospermum juniperinum</i> (Prickly Tea-tree), <i>Melaleuca nodosa</i> (Prickly-leaved | 16                  | Low. The subject site contains a tall open forest, with no areas of heathland or low woodland within or in                            |

| Scientific Name                                                                    | Common Name            | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                                                                            | Records within 10km | Likelihood of occurrence                                                                                                                                                                                     |
|------------------------------------------------------------------------------------|------------------------|------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                    |                        |            |              | Paperbark), <i>Callistemon linearis</i> (Narrow-leaved Bottlebrush) and <i>Schoenus brevifolius</i> (Zig-zag Bog-rush) (OEH, 2015a).                                                                                                                                                                                                                                                                                                                           |                     | close proximity.                                                                                                                                                                                             |
| <i>Cryptostylis hunteriana</i>                                                     | Leafless Tongue Orchid | V          | V            | Known to occur in a range of communities including swamp-heath and woodland (OEH, 2015a). Larger populations typically occur in woodland dominated by Scribbly Gum ( <i>Eucalyptus sclerophylla</i> ), Silvertop Ash ( <i>E.sieberi</i> ), Red Bloodwood ( <i>Corymbia gummifera</i> ) and Black She-oak ( <i>Allocasuarina littoralis</i> ) (OEH, 2015a).                                                                                                     | 24                  | Low. The subject site contains a tall open forest, with no areas of swamp-heath or woodland within or in close proximity. None of the associated species of known populations occur within the subject site. |
| <i>Genoplesium insigne</i> (listed as <i>Corunastylis insignis</i> under EPBC Act) | Variable Midge Orchid  | E4A        | CE           | Occurs in patches of <i>Themeda triandra</i> (Kangaroo Grass) amongst shrubs and sedges in heathland and forest (OEH, 2015a). Associated canopy species from the Chain Valley Bay location include, <i>Eucalyptus haemastoma</i> (Scribbly Gum), <i>Corymbia gummifera</i> (Red Bloodwood), <i>Angophora costata</i> (Sydney Red Gum) and <i>Allocasuarina littoralis</i> (Black She-oak) (OEH, 2015a). Flowering period is September to October (OEH, 2015a). | 17                  | Low-moderate. None of the associated canopy species from Chain Valley Bay location occur within the subject site. No specimens were recorded during orchid surveys.                                          |
| <i>Genoplesium baueri</i>                                                          | Yellow Gnat-orchid     | E1         | E            | Grows in dry sclerophyll forest and moss gardens over sandstone, flowering from February to March (OEH, 2015a). Current likely locations include, Berowra Valley Regional Park, Royal NP and Lane Cove NP (OEH, 2015a). May also occur in Woronora, O'Hares, Metropolitan and Warragamba catchments (OEH, 2015a).                                                                                                                                              | PMR                 | Low. The subject site contains clay-based soils and is outside of the current known distribution of this                                                                                                     |

| Scientific Name                                                        | Common Name                           | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                    | Records within 10km | Likelihood of occurrence                                                                                                                              |
|------------------------------------------------------------------------|---------------------------------------|------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                        |                                       |            |              |                                                                                                                                                                                                                                                                                                                                                                        |                     | species.                                                                                                                                              |
| <i>Rhizanthella slateri</i>                                            | Eastern Australian Underground Orchid | V          | E            | Habitat requirements are poorly understood and has no specific associated vegetation type or species, however it is known to occur in sclerophyll forest (OEH, 2015a). Highly cryptic with only the flower emerging above the ground and therefore usually only located when soil is disturbed (OEH, 2015a). Flowers from September to November (OEH, 2015a).          | PMR                 | Moderate. The subject site may provide potential habitat for this species. No specimens were observed during surveys throughout the flowering period. |
| <i>Thelymitra sp. adorata</i>                                          | Wyong Sun Orchid                      | E4A        | CE           | Occurs at 10-40m a.s.l. in grassy woodland or occasionally derived grassland in well-drained clay loam or shale derived soils (OEH, 2015a). Known to occur in Spotted Gum – Ironbark Forest with a diverse grassy understorey and occasional scattered shrubs (OEH, 2015a). Peak flowering period occurs in September to October (WSC, 2014).                          | 20                  | Moderate to high. The subject site provides potential habitat for this species. No specimens were recorded during targeted orchid surveys.            |
| <i>Diuris praecox</i>                                                  | Newcastle Doubletail                  | V          | V            | Grows on hills and slopes of near-coastal districts in open forest, which have a grassy to fairly dense understorey (OEH, 2015a). Known to occur between Bateau Bay and Smiths Lake (OEH, 2015a). Exists as subterranean tubers most of the year, producing leaves and flowering stems in winter (OEH, 2015a). Flowers from July to early September (PlantNet, 2015a). | PMR                 | Moderate. No specimens of this species were recorded during targeted orchid surveys.                                                                  |
| <i>Pelargonium sp. Stiratellum</i> (listed as <i>Pelargonium sp.</i> ) | Omeo Stork's-bill                     | E1         | E            | Inhabits a narrow area just above the high water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grassland or pasture and the wetland or aquatic                                                                                                                                                                         | PMR                 | Low. No ephemeral lakes or wetlands occur within or in close                                                                                          |

| Scientific Name                                      | Common Name              | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                                                                       | Records within 10km | Likelihood of occurrence                                                                                                                          |
|------------------------------------------------------|--------------------------|------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| under TSC Act)                                       |                          |            |              | communities (OEH, 2015a).                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     | proximity to the subject site.                                                                                                                    |
| <i>Rutidosia heterogama</i>                          |                          | V          | V            | Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides (OEH, 2015a). Peak flowering period is October & November according to WSC 2014 (Guidelines) and 'chiefly autumn' according to PlantNet 2015a.                                                                                                                                                                                              | 162                 | Moderate. The subject site may provide potential habitat for this species. No specimens were recorded during detailed surveys.                    |
| <i>Tetratheca juncea</i>                             | Black-eyed Susan         | V          | V            | The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape (OEH, 2015a). Generally prefers well-drained site below 200m elevation and annual rainfall between 1000-1200mm. The preferred substrates include sandy skeletal soil on sandstone, sandy-loam soils, low nutrients and clayey soil from conglomerates, pH neutral (OEH, 2015a). Flowers mostly July to November (PlantNet, 2015a).                       | 175                 | Low. The subject site is unlikely to provide habitat for this species. No specimens were observed during surveys throughout the flowering period. |
| <i>Chamaesyce psammogeton</i>                        | Sand Spurge              | E1         | -            | Grows on fore-dunes, pebbly strandlines and exposed headlands, often with Spinifex ( <i>Spinifex sericeus</i> ) and Prickly Couch ( <i>Zoysia macrantha</i> ) (OEH, 2015a).                                                                                                                                                                                                                                                                               | 1                   | Low. No suitable habitat occurs within the subject site.                                                                                          |
| <i>Grevillea parviflora</i> subsp. <i>parviflora</i> | Small-flowered Grevillea | V          | V            | Occurs in a range of vegetation types from heath and shrubby woodland to open forest, growing in sandy or light clay soils usually over thin shales, often with lateritic ironstone gravels and nodules (OEH, 2015a). Associated understorey species include, <i>Allocasuarina littoralis</i> , <i>Daviesia ulicifolia</i> , <i>Kunzea ambigua</i> , <i>Banksia spinulosa</i> , <i>Leptospermum trinervium</i> , <i>Melaleuca nodosa</i> , <i>Pimelea</i> | 122                 | Moderate. Three (3) of the associated understorey species occur within the subject site. No specimens of this species were                        |

| Scientific Name             | Common Name      | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                                                         | Records within 10km | Likelihood of occurrence                                                                                                                 |
|-----------------------------|------------------|------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------|
|                             |                  |            |              | <i>linifolia</i> , <i>Themeda triandra</i> , <i>Entolasia stricta</i> and <i>Eragrostis brownii</i> (OEH, 2015a).                                                                                                                                                                                                                                                                                                                           |                     | recorded during surveys.                                                                                                                 |
| <i>Asterolasia elegans</i>  |                  | E1         | E            | Occurs in sheltered, wet forests on mid to lower slopes and valleys on Hawkesbury sandstone (OEH, 2015a; PlantNet, 2015a). Associated canopy species include, <i>Syncarpia glomulifera</i> subsp. <i>glomulifera</i> (Turpentine), <i>Angophora costata</i> (Sydney Red Gum), <i>Eucalyptus piperita</i> (Sydney Peppermint), <i>Allocasuarina torulosa</i> (Forest Oak) and <i>Ceratopetalum gummiferum</i> (Christmas Bush) (OEH, 2015a). | PMR                 | Low. The subject site contains a dry sclerophyll forest on clay-based soils, unsuitable for this species.                                |
| <i>Lasiopetalum joyceae</i> |                  | V          | V            | Restricted to lateritic to shaley ridgetops on the Hornsby Plateau south of the Hawkesbury River (OEH, 2015a). Grows in heath on sandstone (OEH, 2015a).                                                                                                                                                                                                                                                                                    | PN                  | Low. The subject site contains clay based soils and is outside of the known distribution of this species.                                |
| <i>Thesium australe</i>     | Austral Toadflax | V          | V            | Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast, often growing in association with <i>Themeda triandra</i> (Kangaroo Grass) (OEH, 2015a).                                                                                                                                                                                                                                                     | PMR                 | Moderate. The subject site may provide potential habitat for this species. The associated Kangaroo Grass occurs within the subject site. |

**Legend:**

V - species or ecological community listed as Vulnerable under the NSW Threatened Species Conservation Act (TSC Act) 1995 and/or Environment Protection & Biodiversity Conservation (EPBC Act) Act 1999

E1 or E - species or ecological community listed as Endangered under the TSC Act and/or EPBC Act

E2 – endangered population listed under TSC Act and/or EPBC Act

E4A or CE - species or ecological community listed as Critically Endangered under the TSC Act and/or EPBC Act

Ex - species listed as extinct under the TSC Act and/or EPBC Act

C – China-Australia Migratory Bird Agreement (CAMBA) listed by EPBC Act

J – Japan-Australia Migratory Bird Agreement (JAMBA) listed by EPBC Act

K – Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) listed by EPBC Act

Bonn – Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) listed by EPBC Act

PN – Unknown number of records from Plantnet database – 10km Search

PMR – Unknown number of records from EPBC Protected Matters Report – 10km Search

M – Marine species under EPBC Act

## Appendix 2 – Ecological Communities

Table 10 – Ecological Communities for Consideration

| Community Name                                                                                                   | NSW status | Comm. status | Habitat Description                                                                                                                                                                                                                                                                                                                                                                                                                          | Records | Likelihood of occurrence                                                                          |
|------------------------------------------------------------------------------------------------------------------|------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------------------------------------------------------------------------------------------------|
| Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions                        | E3         | CE           | Represents a complex of rainforest and coastal vine thickets on the east coast of Australia (DE, 2015a). Typically occurs within 2km of the coast or adjacent to a large salt water body, such as an estuary, thus influence by the sea (DE, 2015a).                                                                                                                                                                                         | P       | Low. No rainforest vegetation communities occur within or in close proximity to the subject site. |
| Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions (TSC Act)                | E3         | V            | Occurs in the intertidal zone on the shores of estuaries and lagoons that are permanently or intermittently open to the sea (OEH, 2015a)                                                                                                                                                                                                                                                                                                     | K       | Low. No intertidal zones occur within or in close proximity to the subject site.                  |
| Coastal Upland Swamp in the Sydney Basin Bioregion                                                               | E3         | E            | Includes open graminoid heath, sedgeland and tall scrub associated with periodically waterlogged soils on the Hawkesbury sandstone plateaux (OEH, 2015a).                                                                                                                                                                                                                                                                                    | K       | Low. The subject site contains clay-based soils.                                                  |
| Freshwater Wetlands on Coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions | E3         | -            | Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years (OEH, 2015a). Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes (OEH, 2015a). May also occur in backbarrier landforms where floodplains adjoin coastal sandplains (OEH, 2015a). | K       | Low. No wetlands occur within or in close proximity to the subject site.                          |
| Hunter Lowland Red Gum Forest in the Sydney Basin and NSW North Coast Bioregions                                 | E3         | -            | An open forest where the most common canopy species are <i>Eucalyptus tereticornis</i> (Forest Red Gum) and <i>E.punctata</i> (OEH, 2015a). It has been recorded from the Maitland, Cessnock,                                                                                                                                                                                                                                                | K       | Low. Neither of the common canopy species occur within the subject site.                          |

|                                                                        |     |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |                                                                                                                     |
|------------------------------------------------------------------------|-----|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------------------------------------------------------------------------------------------------------------------|
|                                                                        |     |    | Port Stephens, Muswellbrook and Singleton LGAs, but may occur elsewhere in these bioregions (OEH, 2015a).                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                                                                                                                     |
| Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion            | E4B | -  | An open forest with a tree canopy dominated by some combination of <i>Eucalyptus racemosa</i> (Scribbly Gum), <i>Angophora costata</i> (Smooth-barked Apple), <i>Corymbia gummifera</i> (Red Bloodwood), <i>Syncarpia glomulifera</i> (Turpentine) and <i>Eucalyptus piperita</i> (Sydney Peppermint) (OEH, 2015a).                                                                                                                                                                                                                                                          | K | Low. None of the dominant canopy species occur within the subject site.                                             |
| Low woodland with heathland on indurated sand at Norah Head            | E3  | -  | A low woodland or heathland with a very open cover of trees up to 3 metres high including, <i>Melaleuca quinquenervia</i> (Broad-leaved Paperbark), <i>Melaleuca sieberi</i> , <i>Corymbia gummifera</i> (Red Bloodwood) and the Endangered <i>Eucalyptus camfieldii</i> (Camfield's Stringybark) (OEH, 2015a). The dense shrub layer includes <i>Banksia oblongifolia</i> (Fern-leaved Banksia), <i>Hakea dactyloides</i> (Finger Hakea), <i>Melaleuca nodosa</i> (Prickly-leaved Paperbark) and <i>Allocasuarina distyla</i> (OEH, 2015a).                                 | K | Low. The subject site contains a tall open forest with none of the canopy species characteristic of this community. |
| Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion | E3  |    | Dominated by Spotted Gum ( <i>Corymbia maculata</i> ) and Broad-leaved Ironbark ( <i>Eucalyptus fibrosa</i> ), while Grey Gum ( <i>E. punctata</i> ) and Grey Ironbark <i>E. crebra</i> occur occasionally (OEH, 2015a). Restricted to a range of approximately 65 km by 35 km centred on the Cessnock - Beresfield area in the Central and Lower Hunter Valley (OEH, 2015a). Remnants occur within the Local Government Areas of Cessnock, Maitland, Singleton, Lake Macquarie, Newcastle and Port Stephens but may also occur elsewhere within the bioregion (OEH, 2015a). | K | Low. The subject site is outside of the central or lower Hunter Valley distribution of this community.              |
| Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions  | E3  | CE | An ecological community of subtropical rainforest and some related, structurally complex forms of dry rainforest (OEH, 2015a).                                                                                                                                                                                                                                                                                                                                                                                                                                               | K | Low. No rainforest vegetation communities occur within or in close                                                  |

|                                                                                                                         |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------|----|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                         |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   | proximity to the subject site.                                                                                                      |
| Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion                                                        | E3 | - | A low shrubby woodland with the overstorey dominated by <i>Eucalyptus racemosa</i> (Scribbly Gum) with other tree species including <i>E. piperita</i> (Sydney Peppermint), <i>E. resinifera</i> (Red Mahogany), <i>Angophora costata</i> (Smooth-barked Apple) and <i>E. punctata</i> (Grey Gum) (OEH, 2015a).                                                                                                                                                                                                                                                                           | K | Low. None of the dominant canopy species occur within the subject site.                                                             |
| River-flat Eucalypt Forest of Coastal Floodplains of the NSW North Coast, Sydney Basin and South East corner Bioregions | E3 | - | Occurs on the river flats of the coastal floodplains with the most widespread and abundant dominant trees including, <i>Eucalyptus tereticornis</i> (forest red gum), <i>E. amplifolia</i> (cabbage gum), <i>Angophora floribunda</i> (rough-barked apple) and <i>A. subvelutina</i> (broad-leaved apple) (OEH, 2015a).                                                                                                                                                                                                                                                                   | K | Low. The subject site is located on a mid-slope and has none of the dominant canopy species characteristic of this community.       |
| Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East corner Bioregions                       | E3 | - | Occurs on the coastal floodplains of NSW, containing a dense to sparse tree layer dominated by <i>Casuarina glauca</i> (swamp oak) northwards from Bermagui (OEH, 2015a).                                                                                                                                                                                                                                                                                                                                                                                                                 | K | Low. The subject site is located on a mid-slope, outside of floodplain habitats with no <i>Casuarina glauca</i> observed.           |
| Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East corner Bioregions   | E3 | - | A swamp community dominant by <i>Eucalyptus robusta</i> (swamp mahogany), <i>Melaleuca quinquenervia</i> (paperbark) and, south from Sydney, <i>Eucalyptus botryoides</i> (bangalay) and <i>Eucalyptus longifolia</i> (woollybutt) (OEH, 2015a). Other trees which may occur at low abundance include, <i>Callistemon salignus</i> (sweet willow bottlebrush), <i>Casuarina glauca</i> (swamp oak) and <i>Eucalyptus resinifera</i> subsp. <i>hemilampra</i> (red mahogany), <i>Livistona australis</i> (cabbage palm) and <i>Lophostemon suaveolens</i> (swamp turpentine) (OEH, 2015a). | K | Low. The subject site is located on a mid-slope, outside of swamp habitats. None of the dominant tree canopy species were observed. |
| <i>Sydney Freshwater Wetlands in the Sydney Basin Bioregion</i>                                                         | E3 | - | A complex of vegetation types largely restricted to freshwater swamps in coastal areas, occurs on sand dunes and low-                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | K | Low. The subject site is located on a mid-slope,                                                                                    |

|                                                                                                                            |    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------|----|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----------------------------------------------------------------------------------------------------------------------|
|                                                                                                                            |    |   | nutrient sandplains (OEH, 2015a).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   | outside of swamp habitats.                                                                                           |
| Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions | E3 | - | A grassland community dominated by <i>Themeda triandra</i> (Kangaroo Grass) and occurring on seacliffs and coastal headlands (OEH, 2015a). <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> , <i>Westringia fruticosa</i> and <i>Acacia sophorae</i> occurs as an emergent shrub or as a dense cover where they have recruited over grasslands (OEH, 2015a). Smaller shrubs occur often as prostrate to dwarf forms, most frequently <i>Pimelea linifolia</i> , <i>Hibbertia vestita</i> , <i>Pultenaea maritima</i> and <i>Westringia fruticosa</i> (OEH, 2015a). | K | Low. The subject site is located on a mid-slope containing tall open forest approximately 7.5km from the coast line. |
| Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion                                                             | E3 | - | A low woodland dominated by trees of <i>Eucalyptus botryoides</i> and <i>Angophora floribunda</i> with a diverse understorey of sclerophyllous shrubs species including <i>Banksia integrifolia</i> , <i>Banksia serrata</i> , <i>Monotoca elliptica</i> , <i>Macrozamia communis</i> , <i>Acacia ulicifolia</i> , <i>Platysace lanceolata</i> , <i>Acacia suaveolens</i> and <i>Allocasuarina littoralis</i> (OEH, 2015a).                                                                                                                                              | K | Low. None of the dominant canopy species were observed within the subject site.                                      |

## Appendix 3 – Protected Matters Report



# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 28/10/15 06:18:43

[Summary](#)

[Details](#)

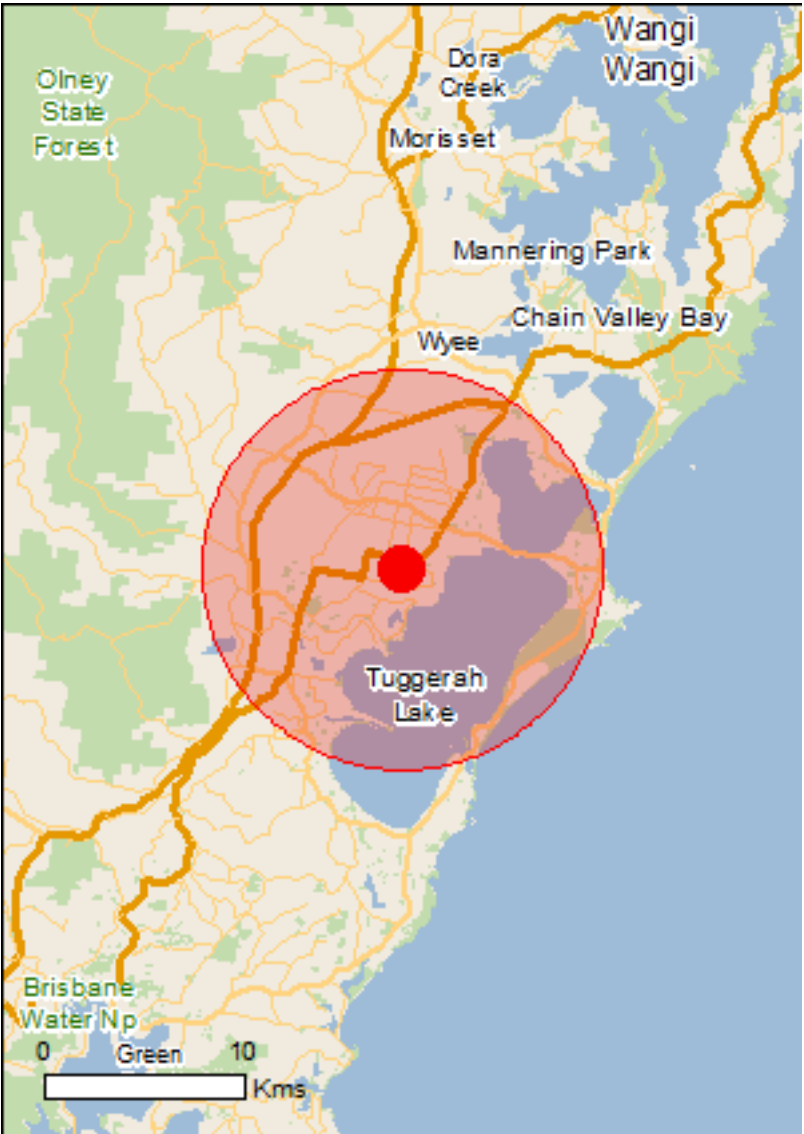
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

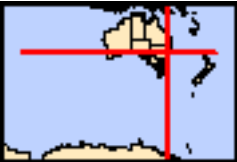
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

[Buffer: 10.0Km](#)



# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

|                                                           |      |
|-----------------------------------------------------------|------|
| <a href="#">World Heritage Properties:</a>                | None |
| <a href="#">National Heritage Places:</a>                 | None |
| <a href="#">Wetlands of International Importance:</a>     | None |
| <a href="#">Great Barrier Reef Marine Park:</a>           | None |
| <a href="#">Commonwealth Marine Area:</a>                 | None |
| <a href="#">Listed Threatened Ecological Communities:</a> | 2    |
| <a href="#">Listed Threatened Species:</a>                | 77   |
| <a href="#">Listed Migratory Species:</a>                 | 73   |

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

|                                                    |      |
|----------------------------------------------------|------|
| <a href="#">Commonwealth Land:</a>                 | 3    |
| <a href="#">Commonwealth Heritage Places:</a>      | None |
| <a href="#">Listed Marine Species:</a>             | 93   |
| <a href="#">Whales and Other Cetaceans:</a>        | 14   |
| <a href="#">Critical Habitats:</a>                 | None |
| <a href="#">Commonwealth Reserves Terrestrial:</a> | None |
| <a href="#">Commonwealth Reserves Marine:</a>      | None |

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

|                                                  |      |
|--------------------------------------------------|------|
| <a href="#">State and Territory Reserves:</a>    | 3    |
| <a href="#">Regional Forest Agreements:</a>      | 1    |
| <a href="#">Invasive Species:</a>                | 51   |
| <a href="#">Nationally Important Wetlands:</a>   | 3    |
| <a href="#">Key Ecological Features (Marine)</a> | None |

# Details

## Matters of National Environmental Significance

Listed Threatened Ecological Communities

[ Resource Information ]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

| Name                                                                               | Status                | Type of Presence                      |
|------------------------------------------------------------------------------------|-----------------------|---------------------------------------|
| <a href="#">Littoral Rainforest and Coastal Vine Thickets of Eastern Australia</a> | Critically Endangered | Community likely to occur within area |
| <a href="#">Subtropical and Temperate Coastal Saltmarsh</a>                        | Vulnerable            | Community likely to occur within area |

Listed Threatened Species

[ Resource Information ]

| Name                                                                                            | Status                | Type of Presence                                                   |
|-------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------|
| Birds                                                                                           |                       |                                                                    |
| <a href="#">Anthochaera phrygia</a><br>Regent Honeyeater [82338]                                | Critically Endangered | Species or species habitat known to occur within area              |
| <a href="#">Botaurus poiciloptilus</a><br>Australasian Bittern [1001]                           | Endangered            | Species or species habitat known to occur within area              |
| <a href="#">Calidris ferruginea</a><br>Curlew Sandpiper [856]                                   | Critically Endangered | Roosting known to occur within area                                |
| <a href="#">Dasyornis brachypterus</a><br>Eastern Bristlebird [533]                             | Endangered            | Species or species habitat likely to occur within area             |
| <a href="#">Diomedea epomophora epomophora</a><br>Southern Royal Albatross [25996]              | Vulnerable            | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Diomedea epomophora sanfordi</a><br>Northern Royal Albatross [82331]                | Endangered            | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Diomedea exulans antipodensis</a><br>Antipodean Albatross [82269]                   | Vulnerable            | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Diomedea exulans exulans</a><br>Tristan Albatross [82337]                           | Endangered            | Species or species habitat may occur within area                   |
| <a href="#">Diomedea exulans gibsoni</a><br>Gibson's Albatross [82271]                          | Vulnerable            | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Diomedea exulans (sensu lato)</a><br>Wandering Albatross [1073]                     | Vulnerable            | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Fregetta grallaria grallaria</a><br>White-bellied Storm-Petrel (Tasman Sea), White- | Vulnerable            | Species or species                                                 |

| Name                                                                                       | Status                | Type of Presence                                                   |
|--------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------|
| bellied Storm-Petrel (Australasian) [64438]                                                |                       | habitat likely to occur within area                                |
| <a href="#">Grantiella picta</a><br>Painted Honeyeater [470]                               | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Lathamus discolor</a><br>Swift Parrot [744]                                    | Endangered            | Species or species habitat likely to occur within area             |
| <a href="#">Macronectes giganteus</a><br>Southern Giant Petrel [1060]                      | Endangered            | Species or species habitat may occur within area                   |
| <a href="#">Macronectes halli</a><br>Northern Giant Petrel [1061]                          | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Numenius madagascariensis</a><br>Eastern Curlew [847]                          | Critically Endangered | Roosting known to occur within area                                |
| <a href="#">Pachyptila turtur subantarctica</a><br>Fairy Prion (southern) [64445]          | Vulnerable            | Species or species habitat known to occur within area              |
| <a href="#">Phoebetria fusca</a><br>Sooty Albatross [1075]                                 | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Pterodroma leucoptera leucoptera</a><br>Gould's Petrel [26033]                 | Endangered            | Species or species habitat may occur within area                   |
| <a href="#">Pterodroma neglecta neglecta</a><br>Kermadec Petrel (western) [64450]          | Vulnerable            | Foraging, feeding or related behaviour may occur within area       |
| <a href="#">Rostratula australis</a><br>Australian Painted Snipe [77037]                   | Endangered            | Species or species habitat may occur within area                   |
| <a href="#">Sternula nereis nereis</a><br>Australian Fairy Tern [82950]                    | Vulnerable            | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Thalassarche bulleri</a><br>Buller's Albatross, Pacific Albatross [64460]      | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche cauta cauta</a><br>Shy Albatross, Tasmanian Shy Albatross [82345] | Vulnerable            | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Thalassarche cauta salvini</a><br>Salvin's Albatross [82343]                   | Vulnerable            | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Thalassarche cauta steadi</a><br>White-capped Albatross [82344]                | Vulnerable            | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Thalassarche eremita</a><br>Chatham Albatross [64457]                          | Endangered            | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Thalassarche melanophris</a><br>Black-browed Albatross [66472]                 | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche melanophris impavida</a><br>Campbell Albatross [82449]            | Vulnerable            | Species or species habitat may occur within area                   |

| Name                                                                                                                                                                                              | Status     | Type of Presence                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------|
| Fish                                                                                                                                                                                              |            |                                                                   |
| <a href="#">Epinephelus daemeli</a><br>Black Rockcod, Black Cod, Saddled Rockcod [68449]                                                                                                          | Vulnerable | Species or species habitat likely to occur within area            |
| <a href="#">Prototroctes maraena</a><br>Australian Grayling [26179]                                                                                                                               | Vulnerable | Species or species habitat may occur within area                  |
| Frogs                                                                                                                                                                                             |            |                                                                   |
| <a href="#">Heleioporus australiacus</a><br>Giant Burrowing Frog [1973]                                                                                                                           | Vulnerable | Species or species habitat likely to occur within area            |
| <a href="#">Litoria aurea</a><br>Green and Golden Bell Frog [1870]                                                                                                                                | Vulnerable | Species or species habitat may occur within area                  |
| <a href="#">Litoria littlejohni</a><br>Littlejohn's Tree Frog, Heath Frog [64733]                                                                                                                 | Vulnerable | Species or species habitat may occur within area                  |
| <a href="#">Mixophyes balbus</a><br>Stuttering Frog, Southern Barred Frog (in Victoria) [1942]                                                                                                    | Vulnerable | Species or species habitat likely to occur within area            |
| <a href="#">Mixophyes iteratus</a><br>Giant Barred Frog, Southern Barred Frog [1944]                                                                                                              | Endangered | Species or species habitat may occur within area                  |
| Mammals                                                                                                                                                                                           |            |                                                                   |
| <a href="#">Balaenoptera musculus</a><br>Blue Whale [36]                                                                                                                                          | Endangered | Species or species habitat may occur within area                  |
| <a href="#">Chalinolobus dwyeri</a><br>Large-eared Pied Bat, Large Pied Bat [183]                                                                                                                 | Vulnerable | Species or species habitat known to occur within area             |
| <a href="#">Dasyurus maculatus maculatus (SE mainland population)</a><br>Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]                            | Endangered | Species or species habitat known to occur within area             |
| <a href="#">Eubalaena australis</a><br>Southern Right Whale [40]                                                                                                                                  | Endangered | Species or species habitat likely to occur within area            |
| <a href="#">Megaptera novaeangliae</a><br>Humpback Whale [38]                                                                                                                                     | Vulnerable | Species or species habitat known to occur within area             |
| <a href="#">Petrogale penicillata</a><br>Brush-tailed Rock-wallaby [225]                                                                                                                          | Vulnerable | Species or species habitat may occur within area                  |
| <a href="#">Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)</a><br>Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104] | Vulnerable | Species or species habitat known to occur within area             |
| <a href="#">Potorous tridactylus tridactylus</a><br>Long-nosed Potoroo (SE mainland) [66645]                                                                                                      | Vulnerable | Species or species habitat likely to occur within area            |
| <a href="#">Pseudomys novaehollandiae</a><br>New Holland Mouse, Pookila [96]                                                                                                                      | Vulnerable | Species or species habitat known to occur within area             |
| <a href="#">Pteropus poliocephalus</a><br>Grey-headed Flying-fox [186]                                                                                                                            | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Plants                                                                                                                                                                                            |            |                                                                   |

| Name                                                                                           | Status                | Type of Presence                                       |
|------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------|
| <a href="#">Acacia bynoeana</a><br>Bynoe's Wattle, Tiny Wattle [8575]                          | Vulnerable            | Species or species habitat likely to occur within area |
| <a href="#">Angophora inopina</a><br>Charmhaven Apple [64832]                                  | Vulnerable            | Species or species habitat likely to occur within area |
| <a href="#">Asterolasia elegans</a><br>[56780]                                                 | Endangered            | Species or species habitat may occur within area       |
| <a href="#">Caladenia tessellata</a><br>Thick-lipped Spider-orchid, Daddy Long-legs [2119]     | Vulnerable            | Species or species habitat likely to occur within area |
| <a href="#">Corunastylis insignis</a><br>Wyong Midge Orchid 1, Variable Midge Orchid 1 [84692] | Critically Endangered | Species or species habitat known to occur within area  |
| <a href="#">Corunastylis sp. Charmhaven (NSW 896673)</a><br>Wyong Midge Orchid 2 [86263]       | Critically Endangered | Species or species habitat likely to occur within area |
| <a href="#">Cryptostylis hunteriana</a><br>Leafless Tongue-orchid [19533]                      | Vulnerable            | Species or species habitat known to occur within area  |
| <a href="#">Diuris praecox</a><br>Newcastle Doubletail [55086]                                 | Vulnerable            | Species or species habitat likely to occur within area |
| <a href="#">Eucalyptus camfieldii</a><br>Camfield's Stringybark [15460]                        | Vulnerable            | Species or species habitat likely to occur within area |
| <a href="#">Genoplesium baueri</a><br>Yellow Gnat-orchid [7528]                                | Endangered            | Species or species habitat may occur within area       |
| <a href="#">Grevillea parviflora subsp. parviflora</a><br>Small-flower Grevillea [64910]       | Vulnerable            | Species or species habitat known to occur within area  |
| <a href="#">Melaleuca biconvexa</a><br>Biconvex Paperbark [5583]                               | Vulnerable            | Species or species habitat known to occur within area  |
| <a href="#">Pelargonium sp. Striatellum (G.W.Carr 10345)</a><br>Omeo Stork's-bill [84065]      | Endangered            | Species or species habitat likely to occur within area |
| <a href="#">Prostanthera askania</a><br>Tranquillity Mintbush, Tranquillity Mintbush [64958]   | Endangered            | Species or species habitat likely to occur within area |
| <a href="#">Prostanthera junonis</a><br>Somersby Mintbush [64960]                              | Endangered            | Species or species habitat likely to occur within area |
| <a href="#">Pultenaea glabra</a><br>Smooth Bush-pea, Swamp Bush-pea [11887]                    | Vulnerable            | Species or species habitat likely to occur within area |
| <a href="#">Rhizanthella slateri</a><br>Eastern Underground Orchid [11768]                     | Endangered            | Species or species habitat may occur within area       |
| <a href="#">Rutidosis heterogama</a><br>Heath Wrinklewort [13132]                              | Vulnerable            | Species or species habitat likely to occur within area |

| Name                                                                                                                                                         | Status                | Type of Presence                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------|
| <a href="#">Syzygium paniculatum</a><br>Magenta Lilly Pilly, Magenta Cherry, Pocket-less Brush Cherry, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307] | Vulnerable            | Species or species habitat likely to occur within area |
| <a href="#">Tetratheca juncea</a><br>Black-eyed Susan [21407]                                                                                                | Vulnerable            | Species or species habitat known to occur within area  |
| <a href="#">Thelymitra adorata</a><br>Wyong Sun Orchid [84724]                                                                                               | Critically Endangered | Species or species habitat known to occur within area  |
| <a href="#">Thesium australe</a><br>Austral Toadflax, Toadflax [15202]                                                                                       | Vulnerable            | Species or species habitat may occur within area       |

| Reptiles                                                                                 |            |                                                                   |
|------------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------|
| <a href="#">Caretta caretta</a><br>Loggerhead Turtle [1763]                              | Endangered | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Chelonia mydas</a><br>Green Turtle [1765]                                    | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Dermochelys coriacea</a><br>Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Eretmochelys imbricata</a><br>Hawksbill Turtle [1766]                        | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Hoplocephalus bungaroides</a><br>Broad-headed Snake [1182]                   | Vulnerable | Species or species habitat likely to occur within area            |
| <a href="#">Natator depressus</a><br>Flatback Turtle [59257]                             | Vulnerable | Foraging, feeding or related behaviour known to occur within area |

| Sharks                                                                                                        |                       |                                                        |
|---------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------|
| <a href="#">Carcharias taurus (east coast population)</a><br>Grey Nurse Shark (east coast population) [68751] | Critically Endangered | Species or species habitat likely to occur within area |
| <a href="#">Carcharodon carcharias</a><br>Great White Shark [64470]                                           | Vulnerable            | Species or species habitat known to occur within area  |
| <a href="#">Rhincodon typus</a><br>Whale Shark [66680]                                                        | Vulnerable            | Species or species habitat may occur within area       |

| Listed Migratory Species                                                                         |             | [ <a href="#">Resource Information</a> ]                           |
|--------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------|
| * Species is listed under a different scientific name on the EPBC Act - Threatened Species list. |             |                                                                    |
| Name                                                                                             | Threatened  | Type of Presence                                                   |
| Migratory Marine Birds                                                                           |             |                                                                    |
| <a href="#">Apus pacificus</a><br>Fork-tailed Swift [678]                                        |             | Species or species habitat likely to occur within area             |
| <a href="#">Calonectris leucomelas</a><br>Streaked Shearwater [1077]                             |             | Species or species habitat may occur within area                   |
| <a href="#">Diomedea antipodensis</a><br>Antipodean Albatross [64458]                            | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |

| Name                                                                                                 | Threatened  | Type of Presence                                                   |
|------------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------|
| <a href="#">Diomedea dabbenena</a><br>Tristan Albatross [66471]                                      | Endangered* | Species or species habitat may occur within area                   |
| <a href="#">Diomedea epomophora (sensu stricto)</a><br>Southern Royal Albatross [1072]               | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Diomedea exulans (sensu lato)</a><br>Wandering Albatross [1073]                          | Vulnerable  | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Diomedea gibsoni</a><br>Gibson's Albatross [64466]                                       | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Diomedea sanfordi</a><br>Northern Royal Albatross [64456]                                | Endangered* | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Macronectes giganteus</a><br>Southern Giant Petrel [1060]                                | Endangered  | Species or species habitat may occur within area                   |
| <a href="#">Macronectes halli</a><br>Northern Giant Petrel [1061]                                    | Vulnerable  | Species or species habitat may occur within area                   |
| <a href="#">Phoebetria fusca</a><br>Sooty Albatross [1075]                                           | Vulnerable  | Species or species habitat may occur within area                   |
| <a href="#">Puffinus carneipes</a><br>Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]       |             | Species or species habitat likely to occur within area             |
| <a href="#">Sterna albifrons</a><br>Little Tern [813]                                                |             | Breeding known to occur within area                                |
| <a href="#">Thalassarche bulleri</a><br>Buller's Albatross, Pacific Albatross [64460]                | Vulnerable  | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche cauta (sensu stricto)</a><br>Shy Albatross, Tasmanian Shy Albatross [64697] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Thalassarche eremita</a><br>Chatham Albatross [64457]                                    | Endangered  | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Thalassarche impavida</a><br>Campbell Albatross, Campbell Black-browed Albatross [64459] | Vulnerable* | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche melanophris</a><br>Black-browed Albatross [66472]                           | Vulnerable  | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche salvini</a><br>Salvin's Albatross [64463]                                   | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Thalassarche steadi</a><br>White-capped Albatross [64462]                                | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Migratory Marine Species                                                                             |             |                                                                    |
| <a href="#">Balaenoptera edeni</a><br>Bryde's Whale [35]                                             |             | Species or species habitat may occur within area                   |

| Name                                                                                                                                   | Threatened | Type of Presence                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------|
| <a href="#">Balaenoptera musculus</a><br>Blue Whale [36]                                                                               | Endangered | Species or species habitat may occur within area                  |
| <a href="#">Caperea marginata</a><br>Pygmy Right Whale [39]                                                                            |            | Species or species habitat may occur within area                  |
| <a href="#">Carcharodon carcharias</a><br>Great White Shark [64470]                                                                    | Vulnerable | Species or species habitat known to occur within area             |
| <a href="#">Caretta caretta</a><br>Loggerhead Turtle [1763]                                                                            | Endangered | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Chelonia mydas</a><br>Green Turtle [1765]                                                                                  | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Dermochelys coriacea</a><br>Leatherback Turtle, Leathery Turtle, Luth [1768]                                               | Endangered | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Eretmochelys imbricata</a><br>Hawksbill Turtle [1766]                                                                      | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Eubalaena australis</a><br>Southern Right Whale [40]                                                                       | Endangered | Species or species habitat likely to occur within area            |
| <a href="#">Lagenorhynchus obscurus</a><br>Dusky Dolphin [43]                                                                          |            | Species or species habitat may occur within area                  |
| <a href="#">Lamna nasus</a><br>Porbeagle, Mackerel Shark [83288]                                                                       |            | Species or species habitat likely to occur within area            |
| <a href="#">Manta alfredi</a><br>Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994] |            | Species or species habitat may occur within area                  |
| <a href="#">Manta birostris</a><br>Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995] |            | Species or species habitat may occur within area                  |
| <a href="#">Megaptera novaeangliae</a><br>Humpback Whale [38]                                                                          | Vulnerable | Species or species habitat known to occur within area             |
| <a href="#">Natator depressus</a><br>Flatback Turtle [59257]                                                                           | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Orcinus orca</a><br>Killer Whale, Orca [46]                                                                                |            | Species or species habitat may occur within area                  |
| <a href="#">Rhincodon typus</a><br>Whale Shark [66680]                                                                                 | Vulnerable | Species or species habitat may occur within area                  |
| <a href="#">Sousa chinensis</a><br>Indo-Pacific Humpback Dolphin [50]                                                                  |            | Species or species habitat likely to occur within area            |
| Migratory Terrestrial Species                                                                                                          |            |                                                                   |
| <a href="#">Cuculus optatus</a><br>Oriental Cuckoo, Horsfield's Cuckoo [86651]                                                         |            | Species or species habitat known to occur within area             |

| Name                                                                              | Threatened            | Type of Presence                                       |
|-----------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------|
| <a href="#">Hirundapus caudacutus</a><br>White-throated Needletail [682]          |                       | Species or species habitat known to occur within area  |
| <a href="#">Merops ornatus</a><br>Rainbow Bee-eater [670]                         |                       | Species or species habitat may occur within area       |
| <a href="#">Monarcha melanopsis</a><br>Black-faced Monarch [609]                  |                       | Species or species habitat known to occur within area  |
| <a href="#">Monarcha trivirgatus</a><br>Spectacled Monarch [610]                  |                       | Species or species habitat may occur within area       |
| <a href="#">Motacilla flava</a><br>Yellow Wagtail [644]                           |                       | Species or species habitat likely to occur within area |
| <a href="#">Myiagra cyanoleuca</a><br>Satin Flycatcher [612]                      |                       | Species or species habitat known to occur within area  |
| <a href="#">Rhipidura rufifrons</a><br>Rufous Fantail [592]                       |                       | Species or species habitat known to occur within area  |
| Migratory Wetlands Species                                                        |                       |                                                        |
| <a href="#">Actitis hypoleucos</a><br>Common Sandpiper [59309]                    | Critically Endangered | Roosting known to occur within area                    |
| <a href="#">Ardea alba</a><br>Great Egret, White Egret [59541]                    |                       | Species or species habitat known to occur within area  |
| <a href="#">Ardea ibis</a><br>Cattle Egret [59542]                                |                       | Species or species habitat may occur within area       |
| <a href="#">Arenaria interpres</a><br>Ruddy Turnstone [872]                       |                       | Roosting known to occur within area                    |
| <a href="#">Calidris acuminata</a><br>Sharp-tailed Sandpiper [874]                |                       | Roosting known to occur within area                    |
| <a href="#">Calidris alba</a><br>Sanderling [875]                                 |                       | Roosting known to occur within area                    |
| <a href="#">Calidris canutus</a><br>Red Knot, Knot [855]                          |                       | Roosting known to occur within area                    |
| <a href="#">Calidris ferruginea</a><br>Curlew Sandpiper [856]                     |                       | Roosting known to occur within area                    |
| <a href="#">Calidris melanotos</a><br>Pectoral Sandpiper [858]                    |                       | Roosting known to occur within area                    |
| <a href="#">Calidris ruficollis</a><br>Red-necked Stint [860]                     |                       | Roosting known to occur within area                    |
| <a href="#">Calidris tenuirostris</a><br>Great Knot [862]                         |                       | Roosting known to occur within area                    |
| <a href="#">Charadrius bicinctus</a><br>Double-banded Plover [895]                |                       | Roosting known to occur within area                    |
| <a href="#">Charadrius mongolus</a><br>Lesser Sand Plover, Mongolian Plover [879] |                       | Roosting known to occur within area                    |
| <a href="#">Gallinago hardwickii</a><br>Latham's Snipe, Japanese Snipe [863]      |                       | Roosting known to occur                                |

| Name                                                                           | Threatened            | Type of Presence                                      |
|--------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------|
|                                                                                |                       | within area                                           |
| <a href="#">Gallinago megala</a><br>Swinhoe's Snipe [864]                      |                       | Roosting likely to occur within area                  |
| <a href="#">Gallinago stenura</a><br>Pin-tailed Snipe [841]                    |                       | Roosting likely to occur within area                  |
| <a href="#">Heteroscelus brevipes</a><br>Grey-tailed Tattler [59311]           |                       | Roosting known to occur within area                   |
| <a href="#">Limosa lapponica</a><br>Bar-tailed Godwit [844]                    |                       | Species or species habitat known to occur within area |
| <a href="#">Limosa limosa</a><br>Black-tailed Godwit [845]                     |                       | Roosting known to occur within area                   |
| <a href="#">Numenius madagascariensis</a><br>Eastern Curlew [847]              | Critically Endangered | Roosting known to occur within area                   |
| <a href="#">Numenius minutus</a><br>Little Curlew, Little Whimbrel [848]       |                       | Roosting likely to occur within area                  |
| <a href="#">Numenius phaeopus</a><br>Whimbrel [849]                            |                       | Roosting known to occur within area                   |
| <a href="#">Pandion haliaetus</a><br>Osprey [952]                              |                       | Breeding known to occur within area                   |
| <a href="#">Pluvialis fulva</a><br>Pacific Golden Plover [25545]               |                       | Roosting known to occur within area                   |
| <a href="#">Pluvialis squatarola</a><br>Grey Plover [865]                      |                       | Roosting known to occur within area                   |
| <a href="#">Tringa stagnatilis</a><br>Marsh Sandpiper, Little Greenshank [833] |                       | Roosting known to occur within area                   |
| <a href="#">Xenus cinereus</a><br>Terek Sandpiper [59300]                      |                       | Roosting known to occur within area                   |

Other Matters Protected by the EPBC Act

|                   |                                          |
|-------------------|------------------------------------------|
| Commonwealth Land | [ <a href="#">Resource Information</a> ] |
|-------------------|------------------------------------------|

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

| Name                                                         |
|--------------------------------------------------------------|
| Commonwealth Land - Australian Postal Commission             |
| Commonwealth Land - Australian Telecommunications Commission |
| Commonwealth Land - Director of War Service Homes            |

|                       |                                          |
|-----------------------|------------------------------------------|
| Listed Marine Species | [ <a href="#">Resource Information</a> ] |
|-----------------------|------------------------------------------|

\* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name                                                           | Threatened | Type of Presence                                       |
|----------------------------------------------------------------|------------|--------------------------------------------------------|
| Birds                                                          |            |                                                        |
| <a href="#">Actitis hypoleucos</a><br>Common Sandpiper [59309] |            | Roosting known to occur within area                    |
| <a href="#">Apus pacificus</a><br>Fork-tailed Swift [678]      |            | Species or species habitat likely to occur within area |
| <a href="#">Ardea alba</a><br>Great Egret, White Egret [59541] |            | Species or species habitat known to occur              |

| Name                                                                                   | Threatened            | Type of Presence                                                   |
|----------------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------|
| <a href="#">Ardea ibis</a><br>Cattle Egret [59542]                                     | Critically Endangered | within area                                                        |
| <a href="#">Arenaria interpres</a><br>Ruddy Turnstone [872]                            |                       | Species or species habitat may occur within area                   |
| <a href="#">Calidris acuminata</a><br>Sharp-tailed Sandpiper [874]                     |                       | Roosting known to occur within area                                |
| <a href="#">Calidris alba</a><br>Sanderling [875]                                      |                       | Roosting known to occur within area                                |
| <a href="#">Calidris canutus</a><br>Red Knot, Knot [855]                               |                       | Roosting known to occur within area                                |
| <a href="#">Calidris ferruginea</a><br>Curlew Sandpiper [856]                          |                       | Roosting known to occur within area                                |
| <a href="#">Calidris melanotos</a><br>Pectoral Sandpiper [858]                         |                       | Roosting known to occur within area                                |
| <a href="#">Calidris ruficollis</a><br>Red-necked Stint [860]                          |                       | Roosting known to occur within area                                |
| <a href="#">Calidris tenuirostris</a><br>Great Knot [862]                              |                       | Roosting known to occur within area                                |
| <a href="#">Calonectris leucomelas</a><br>Streaked Shearwater [1077]                   |                       | Species or species habitat may occur within area                   |
| <a href="#">Catharacta skua</a><br>Great Skua [59472]                                  | Vulnerable*           | Species or species habitat may occur within area                   |
| <a href="#">Charadrius bicinctus</a><br>Double-banded Plover [895]                     |                       | Roosting known to occur within area                                |
| <a href="#">Charadrius mongolus</a><br>Lesser Sand Plover, Mongolian Plover [879]      |                       | Roosting known to occur within area                                |
| <a href="#">Charadrius ruficapillus</a><br>Red-capped Plover [881]                     |                       | Roosting known to occur within area                                |
| <a href="#">Cuculus saturatus</a><br>Oriental Cuckoo, Himalayan Cuckoo [710]           |                       | Species or species habitat known to occur within area              |
| <a href="#">Diomedea antipodensis</a><br>Antipodean Albatross [64458]                  | Endangered*           | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Diomedea dabbenena</a><br>Tristan Albatross [66471]                        |                       | Species or species habitat may occur within area                   |
| <a href="#">Diomedea epomophora (sensu stricto)</a><br>Southern Royal Albatross [1072] | Vulnerable*           | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Diomedea exulans (sensu lato)</a><br>Wandering Albatross [1073]            | Vulnerable            | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Diomedea gibsoni</a><br>Gibson's Albatross [64466]                         | Vulnerable*           | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Diomedea sanfordi</a><br>Northern Royal Albatross [64456]                  | Endangered*           | Foraging, feeding or                                               |

| Name                                                                         | Threatened | Type of Presence                                       |
|------------------------------------------------------------------------------|------------|--------------------------------------------------------|
| <a href="#">Gallinago hardwickii</a><br>Latham's Snipe, Japanese Snipe [863] |            | related behaviour likely to occur within area          |
| <a href="#">Gallinago megala</a><br>Swinhoe's Snipe [864]                    |            | Roosting known to occur within area                    |
| <a href="#">Gallinago stenura</a><br>Pin-tailed Snipe [841]                  |            | Roosting likely to occur within area                   |
| <a href="#">Haliaeetus leucogaster</a><br>White-bellied Sea-Eagle [943]      |            | Species or species habitat known to occur within area  |
| <a href="#">Heteroscelus brevipes</a><br>Grey-tailed Tattler [59311]         |            | Roosting known to occur within area                    |
| <a href="#">Himantopus himantopus</a><br>Black-winged Stilt [870]            |            | Roosting known to occur within area                    |
| <a href="#">Hirundapus caudacutus</a><br>White-throated Needletail [682]     |            | Species or species habitat known to occur within area  |
| <a href="#">Lathamus discolor</a><br>Swift Parrot [744]                      |            | Species or species habitat likely to occur within area |
| <a href="#">Limosa lapponica</a><br>Bar-tailed Godwit [844]                  |            | Species or species habitat known to occur within area  |
| <a href="#">Limosa limosa</a><br>Black-tailed Godwit [845]                   |            | Roosting known to occur within area                    |
| <a href="#">Macronectes giganteus</a><br>Southern Giant Petrel [1060]        |            | Species or species habitat may occur within area       |
| <a href="#">Macronectes halli</a><br>Northern Giant Petrel [1061]            |            | Species or species habitat may occur within area       |
| <a href="#">Merops ornatus</a><br>Rainbow Bee-eater [670]                    |            | Species or species habitat may occur within area       |
| <a href="#">Monarcha melanopsis</a><br>Black-faced Monarch [609]             |            | Species or species habitat known to occur within area  |
| <a href="#">Monarcha trivirgatus</a><br>Spectacled Monarch [610]             |            | Species or species habitat may occur within area       |
| <a href="#">Motacilla flava</a><br>Yellow Wagtail [644]                      |            | Species or species habitat likely to occur within area |
| <a href="#">Myiagra cyanoleuca</a><br>Satin Flycatcher [612]                 |            | Species or species habitat known to occur within area  |
| <a href="#">Numenius madagascariensis</a><br>Eastern Curlew [847]            |            | Roosting known to occur within area                    |
| <a href="#">Numenius minutus</a><br>Little Curlew, Little Whimbrel [848]     |            | Roosting likely to occur within area                   |
| <a href="#">Numenius phaeopus</a><br>Whimbrel [849]                          |            | Roosting known to occur within area                    |

| Name                                                                                                 | Threatened  | Type of Presence                                                   |
|------------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------|
| <a href="#">Pachyptila turtur</a><br>Fairy Prion [1066]                                              |             | Species or species habitat known to occur within area              |
| <a href="#">Pandion haliaetus</a><br>Osprey [952]                                                    |             | Breeding known to occur within area                                |
| <a href="#">Phoebetria fusca</a><br>Sooty Albatross [1075]                                           | Vulnerable  | Species or species habitat may occur within area                   |
| <a href="#">Pluvialis fulva</a><br>Pacific Golden Plover [25545]                                     |             | Roosting known to occur within area                                |
| <a href="#">Pluvialis squatarola</a><br>Grey Plover [865]                                            |             | Roosting known to occur within area                                |
| <a href="#">Puffinus carneipes</a><br>Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]       |             | Species or species habitat likely to occur within area             |
| <a href="#">Rhipidura rufifrons</a><br>Rufous Fantail [592]                                          |             | Species or species habitat known to occur within area              |
| <a href="#">Rostratula benghalensis (sensu lato)</a><br>Painted Snipe [889]                          | Endangered* | Species or species habitat may occur within area                   |
| <a href="#">Sterna albifrons</a><br>Little Tern [813]                                                |             | Breeding known to occur within area                                |
| <a href="#">Thalassarche bulleri</a><br>Buller's Albatross, Pacific Albatross [64460]                | Vulnerable  | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche cauta (sensu stricto)</a><br>Shy Albatross, Tasmanian Shy Albatross [64697] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Thalassarche eremita</a><br>Chatham Albatross [64457]                                    | Endangered  | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Thalassarche impavida</a><br>Campbell Albatross, Campbell Black-browed Albatross [64459] | Vulnerable* | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche melanophris</a><br>Black-browed Albatross [66472]                           | Vulnerable  | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche salvini</a><br>Salvin's Albatross [64463]                                   | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Thalassarche steadi</a><br>White-capped Albatross [64462]                                | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Tringa stagnatilis</a><br>Marsh Sandpiper, Little Greenshank [833]                       |             | Roosting known to occur within area                                |
| <a href="#">Xenus cinereus</a><br>Terek Sandpiper [59300]                                            |             | Roosting known to occur within area                                |
| Fish                                                                                                 |             |                                                                    |
| <a href="#">Acentronura tentaculata</a><br>Shortpouch Pygmy Pipehorse [66187]                        |             | Species or species habitat may occur within area                   |
| <a href="#">Festucalex cinctus</a><br>Girdled Pipefish [66214]                                       |             | Species or species                                                 |

| Name                                                                                                                            | Threatened | Type of Presence                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------|------------|---------------------------------------------------------------------------------------|
| <a href="#">Filicampus tigris</a><br>Tiger Pipefish [66217]                                                                     |            | habitat may occur within area<br><br>Species or species habitat may occur within area |
| <a href="#">Heraldia nocturna</a><br>Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]   |            | Species or species habitat may occur within area                                      |
| <a href="#">Hippichthys penicillus</a><br>Beady Pipefish, Steep-nosed Pipefish [66231]                                          |            | Species or species habitat may occur within area                                      |
| <a href="#">Hippocampus abdominalis</a><br>Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233] |            | Species or species habitat may occur within area                                      |
| <a href="#">Hippocampus whitei</a><br>White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]                               |            | Species or species habitat may occur within area                                      |
| <a href="#">Histiogamphelus briggsii</a><br>Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]                |            | Species or species habitat may occur within area                                      |
| <a href="#">Lissocampus runa</a><br>Javelin Pipefish [66251]                                                                    |            | Species or species habitat may occur within area                                      |
| <a href="#">Maroubra perserrata</a><br>Sawtooth Pipefish [66252]                                                                |            | Species or species habitat may occur within area                                      |
| <a href="#">Notiocampus ruber</a><br>Red Pipefish [66265]                                                                       |            | Species or species habitat may occur within area                                      |
| <a href="#">Phyllopteryx taeniolatus</a><br>Common Seadragon, Weedy Seadragon [66268]                                           |            | Species or species habitat may occur within area                                      |
| <a href="#">Solegnathus spinosissimus</a><br>Spiny Pipehorse, Australian Spiny Pipehorse [66275]                                |            | Species or species habitat may occur within area                                      |
| <a href="#">Solenostomus cyanopterus</a><br>Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]                           |            | Species or species habitat may occur within area                                      |
| <a href="#">Solenostomus paegnius</a><br>Rough-snout Ghost Pipefish [68425]                                                     |            | Species or species habitat may occur within area                                      |
| <a href="#">Solenostomus paradoxus</a><br>Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]         |            | Species or species habitat may occur within area                                      |
| <a href="#">Stigmatopora argus</a><br>Spotted Pipefish, Gulf Pipefish [66276]                                                   |            | Species or species habitat may occur within area                                      |
| <a href="#">Stigmatopora nigra</a><br>Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]                           |            | Species or species habitat may occur within area                                      |
| <a href="#">Stigmatopora olivacea</a><br>a pipefish [74966]                                                                     |            | Species or species habitat may occur within area                                      |
| <a href="#">Syngnathoides biaculeatus</a><br>Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]           |            | Species or species habitat may occur within                                           |

| Name                                                                                                                  | Threatened | Type of Presence                                 |
|-----------------------------------------------------------------------------------------------------------------------|------------|--------------------------------------------------|
| area                                                                                                                  |            |                                                  |
| <a href="#">Trachyrhamphus bicoarctatus</a><br>Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280] |            | Species or species habitat may occur within area |
| <a href="#">Urocampus carinirostris</a><br>Hairy Pipefish [66282]                                                     |            | Species or species habitat may occur within area |
| <a href="#">Vanacampus margaritifer</a><br>Mother-of-pearl Pipefish [66283]                                           |            | Species or species habitat may occur within area |

| Mammals                                                                                       |  |                                                  |
|-----------------------------------------------------------------------------------------------|--|--------------------------------------------------|
| <a href="#">Arctocephalus forsteri</a><br>Long-nosed Fur-seal, New Zealand Fur-seal [20]      |  | Species or species habitat may occur within area |
| <a href="#">Arctocephalus pusillus</a><br>Australian Fur-seal, Australo-African Fur-seal [21] |  | Species or species habitat may occur within area |

| Reptiles                                                                                 |            |                                                                   |
|------------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------|
| <a href="#">Caretta caretta</a><br>Loggerhead Turtle [1763]                              | Endangered | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Chelonia mydas</a><br>Green Turtle [1765]                                    | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Dermochelys coriacea</a><br>Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Eretmochelys imbricata</a><br>Hawksbill Turtle [1766]                        | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Natator depressus</a><br>Flatback Turtle [59257]                             | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| <a href="#">Pelamis platurus</a><br>Yellow-bellied Seasnake [1091]                       |            | Species or species habitat may occur within area                  |

| Whales and other Cetaceans                                                           |            | [ <a href="#">Resource Information</a> ]         |
|--------------------------------------------------------------------------------------|------------|--------------------------------------------------|
| Name                                                                                 | Status     | Type of Presence                                 |
| Mammals                                                                              |            |                                                  |
| <a href="#">Balaenoptera acutorostrata</a><br>Minke Whale [33]                       |            | Species or species habitat may occur within area |
| <a href="#">Balaenoptera edeni</a><br>Bryde's Whale [35]                             |            | Species or species habitat may occur within area |
| <a href="#">Balaenoptera musculus</a><br>Blue Whale [36]                             | Endangered | Species or species habitat may occur within area |
| <a href="#">Caperea marginata</a><br>Pygmy Right Whale [39]                          |            | Species or species habitat may occur within area |
| <a href="#">Delphinus delphis</a><br>Common Dophin, Short-beaked Common Dolphin [60] |            | Species or species habitat may occur within area |

| Name                                                                                                    | Status     | Type of Presence                                       |
|---------------------------------------------------------------------------------------------------------|------------|--------------------------------------------------------|
| <a href="#">Eubalaena australis</a><br>Southern Right Whale [40]                                        | Endangered | Species or species habitat likely to occur within area |
| <a href="#">Grampus griseus</a><br>Risso's Dolphin, Grampus [64]                                        |            | Species or species habitat may occur within area       |
| <a href="#">Lagenorhynchus obscurus</a><br>Dusky Dolphin [43]                                           |            | Species or species habitat may occur within area       |
| <a href="#">Megaptera novaeangliae</a><br>Humpback Whale [38]                                           | Vulnerable | Species or species habitat known to occur within area  |
| <a href="#">Orcinus orca</a><br>Killer Whale, Orca [46]                                                 |            | Species or species habitat may occur within area       |
| <a href="#">Sousa chinensis</a><br>Indo-Pacific Humpback Dolphin [50]                                   |            | Species or species habitat likely to occur within area |
| <a href="#">Stenella attenuata</a><br>Spotted Dolphin, Pantropical Spotted Dolphin [51]                 |            | Species or species habitat may occur within area       |
| <a href="#">Tursiops aduncus</a><br>Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418] |            | Species or species habitat likely to occur within area |
| <a href="#">Tursiops truncatus s. str.</a><br>Bottlenose Dolphin [68417]                                |            | Species or species habitat may occur within area       |

Extra Information

| State and Territory Reserves | [ Resource Information ] |
|------------------------------|--------------------------|
| Name                         | State                    |
| Tuggerah                     | NSW                      |
| Tuggerah                     | NSW                      |
| Wyrrabalong                  | NSW                      |

| Regional Forest Agreements | [ Resource Information ] |
|----------------------------|--------------------------|
|----------------------------|--------------------------|

Note that all areas with completed RFAs have been included.

|                                    |                 |
|------------------------------------|-----------------|
| Name                               | State           |
| <a href="#">North East NSW RFA</a> | New South Wales |

| Invasive Species | [ Resource Information ] |
|------------------|--------------------------|
|------------------|--------------------------|

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

| Name                                                   | Status | Type of Presence                                       |
|--------------------------------------------------------|--------|--------------------------------------------------------|
| Birds                                                  |        |                                                        |
| Acridotheres tristis<br>Common Myna, Indian Myna [387] |        | Species or species habitat likely to occur within area |
| Alauda arvensis<br>Skylark [656]                       |        | Species or species                                     |

| Name                                                           | Status | Type of Presence                                       |
|----------------------------------------------------------------|--------|--------------------------------------------------------|
| habitat likely to occur within area                            |        |                                                        |
| Anas platyrhynchos<br>Mallard [974]                            |        | Species or species habitat likely to occur within area |
| Carduelis carduelis<br>European Goldfinch [403]                |        | Species or species habitat likely to occur within area |
| Columba livia<br>Rock Pigeon, Rock Dove, Domestic Pigeon [803] |        | Species or species habitat likely to occur within area |
| Lonchura punctulata<br>Nutmeg Mannikin [399]                   |        | Species or species habitat likely to occur within area |
| Passer domesticus<br>House Sparrow [405]                       |        | Species or species habitat likely to occur within area |
| Passer montanus<br>Eurasian Tree Sparrow [406]                 |        | Species or species habitat likely to occur within area |
| Pycnonotus jocosus<br>Red-whiskered Bulbul [631]               |        | Species or species habitat likely to occur within area |
| Streptopelia chinensis<br>Spotted Turtle-Dove [780]            |        | Species or species habitat likely to occur within area |
| Sturnus vulgaris<br>Common Starling [389]                      |        | Species or species habitat likely to occur within area |
| Turdus merula<br>Common Blackbird, Eurasian Blackbird [596]    |        | Species or species habitat likely to occur within area |
| Frogs                                                          |        |                                                        |
| Rhinella marina<br>Cane Toad [83218]                           |        | Species or species habitat likely to occur within area |
| Mammals                                                        |        |                                                        |
| Bos taurus<br>Domestic Cattle [16]                             |        | Species or species habitat likely to occur within area |
| Canis lupus familiaris<br>Domestic Dog [82654]                 |        | Species or species habitat likely to occur within area |
| Felis catus<br>Cat, House Cat, Domestic Cat [19]               |        | Species or species habitat likely to occur within area |
| Feral deer<br>Feral deer species in Australia [85733]          |        | Species or species habitat likely to occur within area |
| Lepus capensis<br>Brown Hare [127]                             |        | Species or species habitat likely to occur within area |
| Mus musculus<br>House Mouse [120]                              |        | Species or species habitat likely to occur within area |

| Name                                                                                                                                              | Status | Type of Presence                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------------------------------------------------|
| Oryctolagus cuniculus<br>Rabbit, European Rabbit [128]                                                                                            |        | Species or species habitat likely to occur within area |
| Rattus norvegicus<br>Brown Rat, Norway Rat [83]                                                                                                   |        | Species or species habitat likely to occur within area |
| Rattus rattus<br>Black Rat, Ship Rat [84]                                                                                                         |        | Species or species habitat likely to occur within area |
| Vulpes vulpes<br>Red Fox, Fox [18]                                                                                                                |        | Species or species habitat likely to occur within area |
| Plants                                                                                                                                            |        |                                                        |
| Alternanthera philoxeroides<br>Alligator Weed [11620]                                                                                             |        | Species or species habitat likely to occur within area |
| Anredera cordifolia<br>Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]   |        | Species or species habitat likely to occur within area |
| Asparagus aethiopicus<br>Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]                |        | Species or species habitat likely to occur within area |
| Asparagus asparagoides<br>Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]                                 |        | Species or species habitat likely to occur within area |
| Asparagus plumosus<br>Climbing Asparagus-fern [48993]                                                                                             |        | Species or species habitat likely to occur within area |
| Asparagus scandens<br>Asparagus Fern, Climbing Asparagus Fern [23255]                                                                             |        | Species or species habitat likely to occur within area |
| Cabomba caroliniana<br>Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171] |        | Species or species habitat likely to occur within area |
| Chrysanthemoides monilifera<br>Bitou Bush, Boneseed [18983]                                                                                       |        | Species or species habitat may occur within area       |
| Chrysanthemoides monilifera subsp. monilifera<br>Boneseed [16905]                                                                                 |        | Species or species habitat likely to occur within area |
| Chrysanthemoides monilifera subsp. rotundata<br>Bitou Bush [16332]                                                                                |        | Species or species habitat likely to occur within area |
| Cytisus scoparius<br>Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]                                       |        | Species or species habitat likely to occur within area |
| Dolichandra unguis-cati<br>Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]                                       |        | Species or species habitat likely to occur within area |
| Eichhornia crassipes<br>Water Hyacinth, Water Orchid, Nile Lily [13466]                                                                           |        | Species or species habitat likely to occur within area |
| Genista monspessulana<br>Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]                              |        | Species or species habitat likely to occur within area |

| Name                                                                                                                                                                                                                                                | Status | Type of Presence                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------------------------------------------------|
| Genista sp. X Genista monspessulana<br>Broom [67538]                                                                                                                                                                                                |        | Species or species habitat<br>may occur within area       |
| Lantana camara<br>Lantana, Common Lantana, Kamara Lantana, Large-<br>leaf Lantana, Pink Flowered Lantana, Red Flowered<br>Lantana, Red-Flowered Sage, White Sage, Wild Sage<br>[10892]<br>Lycium ferocissimum<br>African Boxthorn, Boxthorn [19235] |        | Species or species habitat<br>likely to occur within area |
| Nassella neesiana<br>Chilean Needle grass [67699]                                                                                                                                                                                                   |        | Species or species habitat<br>likely to occur within area |
| Opuntia spp.<br>Prickly Pears [82753]                                                                                                                                                                                                               |        | Species or species habitat<br>likely to occur within area |
| Pinus radiata<br>Radiata Pine Monterey Pine, Insignis Pine, Wilding<br>Pine [20780]                                                                                                                                                                 |        | Species or species habitat<br>may occur within area       |
| Protasparagus densiflorus<br>Asparagus Fern, Plume Asparagus [5015]                                                                                                                                                                                 |        | Species or species habitat<br>likely to occur within area |
| Protasparagus plumosus<br>Climbing Asparagus-fern, Ferny Asparagus [11747]                                                                                                                                                                          |        | Species or species habitat<br>likely to occur within area |
| Rubus fruticosus aggregate<br>Blackberry, European Blackberry [68406]                                                                                                                                                                               |        | Species or species habitat<br>likely to occur within area |
| Sagittaria platyphylla<br>Delta Arrowhead, Arrowhead, Slender Arrowhead<br>[68483]                                                                                                                                                                  |        | Species or species habitat<br>likely to occur within area |
| Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii<br>Willows except Weeping Willow, Pussy Willow and<br>Sterile Pussy Willow [68497]                                                                                                |        | Species or species habitat<br>likely to occur within area |
| Salvinia molesta<br>Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba<br>Weed [13665]                                                                                                                                                            |        | Species or species habitat<br>likely to occur within area |
| Senecio madagascariensis<br>Fireweed, Madagascar Ragwort, Madagascar<br>Groundsel [2624]                                                                                                                                                            |        | Species or species habitat<br>likely to occur within area |
| Ulex europaeus<br>Gorse, Furze [7693]                                                                                                                                                                                                               |        | Species or species habitat<br>likely to occur within area |

| Nationally Important Wetlands           |  | [ Resource Information ] |
|-----------------------------------------|--|--------------------------|
| Name                                    |  | State                    |
| <a href="#">Budgewoi Lake Sand Mass</a> |  | NSW                      |
| <a href="#">Tuggerah Lake</a>           |  | NSW                      |
| <a href="#">Wyong Racecourse Swamp</a>  |  | NSW                      |

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

# Coordinates

-33.26781 151.47132

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Parks and Wildlife Commission NT, Northern Territory Government](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

## Appendix 4 - 7-part test 'Assessment of Significance'

A total of thirty (30) threatened species including, ten (10) birds, twelve (12) mammals, one (1) reptile, one (1) amphibian and six (6) threatened flora species were either recorded or considered at least moderately likely to occur within the study area. These threatened entities are included in the following 7-part test or 'Assessment of Significance' under Section 5a of the EPA Act. Tables 9 and 10 provide reasons their inclusion or omission. The assessed species include:

- |                                     |                                |
|-------------------------------------|--------------------------------|
| • <i>Hieraaetus morphnoides</i>     | Little Eagle                   |
| • <i>Calyptorhynchus lathamii</i>   | Glossy Black-Cockatoo          |
| • <i>Glossopsitta pusilla</i>       | Little Lorikeet                |
| • <i>Lathamus discolor</i>          | Swift Parrot                   |
| • <i>Ninox connivens</i>            | Barking Owl                    |
| • <i>Ninox strenua</i>              | Powerful Owl                   |
| • <i>Tyto novaehollandiae</i>       | Masked Owl                     |
| • <i>Chthonicola sagittata</i>      | Speckled Warbler               |
| • <i>Anthochaera phrygia</i>        | Regent Honeyeater              |
| • <i>Daphoenositta chrysoptera</i>  | Varied Sittella                |
| • <i>Dasyurus maculatus</i>         | Spotted-tailed Quoll           |
| • <i>Pteropus poliocephalus</i>     | Grey-headed Flying-fox         |
| • <i>Petaurus norfolcensis</i>      | Squirrel Glider                |
| • <i>Saccolaimus flaviventris</i>   | Yellow-bellied Sheath-tail-bat |
| • <i>Mormopterus norfolkensis</i>   | Eastern Freetail-bat           |
| • <i>Chalinolobus dwyeri</i>        | Large-eared Pied Bat           |
| • <i>Falsistrellus tasmaniensis</i> | Eastern False Pipistrelle      |
| • <i>Kerivoula papuensis</i>        | Golden-tipped Bat              |
| • <i>Miniopterus australis</i>      | Little Bentwing-bat            |

- *Miniopterus schreibersii oceanensis* Eastern Bentwing-bat
- *Scoteanax rueppellii* Greater Broad-nosed Bat
- *Myotis macropus* Southern Myotis
- *Hoplocephalus stephensii* Stephen's Banded Snake
- *Crinia tinnula* Wallum Froglet
- *Melaleuca biconvexa* Biconvexa Paperbark
- *Caladenia tessellata* Thick Lip Spider Orchid
- *Rhizanthella slateri* Eastern Australian Underground Orchid
- *Thelymitra sp. adorata* Wyong Sun Orchid
- *Rutidosia heterogama*
- *Grevillea parviflora subsp. parviflora* Small-flowered Grevillea

## 7-part test

The seven factors to be considered in the Assessment of Significance are listed below, addressing each of the included threatened species, populations and endangered ecological communities.

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

### *Hieraaetus morphnoides*

### Little Eagle

Little Eagle occupies open eucalypt forest, woodland or open woodland as well as Sheoak or *Acacia* woodlands and riparian woodlands of interior NSW (OEH, 2015a). It nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter (OEH, 2015a). Nine (9) records of this species occur within 10km of the site, including one (1) recorded approximately 1.3km to the north-west in 2003. No stick nests were observed indicating that the site is not being utilised for nesting. It is considered that the subject site may provide potential foraging habitat for this species, however no specimens were observed.

The proposal will remove approximately 1.75ha of potential foraging habitat available to this species, while approximately 0.96ha of potential foraging habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar foraging habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahrenonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential foraging habitat secured within the immediate local area.

Given the extent of potential habitat to be removed relative to that secured in the local area, and the absence of nesting of this species, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be placed at risk of extinction.

### *Calyptorhynchus lathamii*

### Glossy Black-Cockatoo

Glossy Black Cockatoo inhabits open forest and woodlands of the coast and the Great Dividing Range, feeding almost exclusively on the seeds of several species of she-oak (*Casuarina* and *Allocasuarina* species), shredding the cones with its massive bill (OEH, 2015a). It utilises large hollow-bearing eucalypts for nest sites, laying a single egg between March and May (OEH, 2015a). Two (2) specimens of this species were observed on two occasions within the Wadalba Wildlife Corridor (WWC), approximately 25m to the south of the subject site (Refer to Figure 3). On both occasions the birds were flying in a easterly direction along the corridor at dusk, where they landed in an Ironbark possibly to roost for the night. Evidence of foraging, such as chew *Allocasuarina torulosa* cones was also corded in two locations. One location, to south-west of the subject site, within the WWC contained an extensive amount of chewed cones. A second location containing a small amount of chewed cones was recorded along the southern boundary of the subject site.

Approximately four (4) specimens of *Allocasuarina torulosa* occur within the subject site, two of which contained fruit. One of these specimens along the southern boundary of the subject site, as referred to above, contained a small amount of foraging evidence. The predominantly cleared understorey of the subject site does provide a small amount of foraging habitat for this species.

'The Glossy Black-Cockatoo's nest is a hollow in a eucalypt, live or dead, commonly in a dead spout in a living tree, about 26 cm wide and up to 1.4 m deep' (NSW Scientific Committee, 2008).

The subject site does contain potential nesting habitat in two (2) out of the sixteen (16) hollow-bearing trees recorded (Refer to Table 7). Hollow-bearing tree number 4 (HT4) contains one (1) medium trunk hollow, currently inhabited by Common Brushtail Possum, which may provide potential nesting habitat. Hollow-bearing tree number 6 (HT6) contains a large split in a partly dead branch which is currently being used by Galahs. Galahs are known to wear the hollow below the entrance causing the branch to die (Beruldsen, 2003). This hollow is worn significantly at the base indicating that it is periodically use by the Galahs. Galah may breed either from July to December in southern Australia or February to June in northern Australia (Pizzey et al., 1997). Glossy Black Cockatoo nests from March to May (OEH, 2015a). So it is possible that Glossy Black Cockatoo could utilise the nest, despite it currently being occupied, however this is considered to be unlikely.

A stag located at the eastern end of the WWC, approximately 55m to the south of the subject site, does contain a suitable nesting hollow for Glossy Black-cockatoo. No specimens were observed in this stag, however they were observed at dusk on two occasions within approximately 35m of the tree.

The proposal will remove approximately 1.75ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road

to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential foraging habitat secured within the immediate local area.

Given the small extent of foraging habitat to be removed relative to that secured in the local area, and the unlikelihood of nesting occurring within the subject site, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be placed at risk of extinction.

### ***Glossopsitta pusilla***

### **Little Lorikeet**

Little Lorikeet forages primarily in open eucalypt forest and woodland, utilising riparian habitats due to higher soil fertility and resulting higher productivity (OEH, 2015a). It feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe and rarely in orchards (OEH, 2015a). Nests in hollows, selecting limb or trunk hollows of smooth-barked eucalypts with small (3cm) entrances and usually high above the ground (2-15m) (OEH, 2015a). The nesting season extends from May to September (OEH, 2015a)

Hollows observed throughout the subject site may provide potential nesting habitat for this species. However no specimens were observed during the later part of the breeding season.

The proposal will remove approximately 1.75ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential habitat secured within the immediate local area.

Given the extent of potential habitat to be removed relative to that secured in the local area, and the lack of evidence of nesting of this species, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be placed at risk of extinction.

***Lathamus discolor*****Swift Parrot**

The Swift Parrot breeds in Tasmania from September to January, migrating to the south-eastern mainland in March and October (OEH, 2015a). Preferred winter-flowering feed trees include *Eucalyptus robusta*, *Corymbia maculata*, *C. gummifera*, *E. sideroxylon* and *E. albens* (OEH, 2015a). No specimens were observed during surveys. *Eucalyptus siderophloia* (Grey Ironbark) were in flower during surveys, however *Corymbia maculata* (Spotted Gum) was not in flower. The subject site contains potential winter-foraging habitat for this species.

The proposal will remove approximately 1.75ha of potential foraging habitat available to this species, while approximately 0.96ha of potential foraging habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar foraging habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahrenonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential foraging habitat secured within the immediate local area. The extent of *Eucalyptus robusta* dominated communities in the local area provide additional preferred foraging habitat for this species.

Given the extent of potential foraging habitat to be removed relative to that secured in the local area, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

***Ninox connivens*****Barking Owl**

Barking Owl inhabits woodland and open forest, including fragmented remnants and partly cleared farmland (OEH, 2015a). It roosts in shaded areas of the tree canopy, including tall mid-storey trees with dense foliage such as *Acacia* and *Casuarina* species (OEH, 2015a). The male perches in a nearby tree overlooking the hollow entrance during the breeding season (OEH, 2015a). It nests in hollows of large old trees, preferring living eucalypts (OEH, 2015a). Nest-hollow entrances are 2-35 m above the ground with a diameter of 20-46 cm and depth of 20-300 cm (NPWS, 2003a). Barking Owls breed generally during mid-winter and spring with fledging as late as November (OEH, 2015a).

No suitable for nesting hollows for Barking Owl were observed within the subject site. It is considered that very sparse shrub and mid-storey stratus throughout the proposed rezoning area of the subject site are unlikely to provide any potential roosting habitat for this species, however denser areas within the E2 zoned

area, particular with specimens of *Melaleuca nodosa* may provide some potential roosting habitat. Extensive searches for roosting evidence were undertaken throughout the entire subject site on August 30<sup>th</sup> and 31<sup>st</sup> during the breeding season, prior to pellets decomposing (Refer to Figure 3). No evidence of roosting was observed.

Survey results indicate a low to moderate abundance of preferred prey species (Refer to section 4.3.3). It is estimate that four (4) specimens of the arboreal mammal species, *Petaurus breviceps* (Sugar Glider), a preferred prey species for Barking Owl, occur within the western side of the subject site. Other possible prey species recorded within the subject site may include medium sized birds, such as Eastern Rosella and Noisy Miner as well as Rabbits (NPWS, 2003a).

The proposal will remove approximately 1.75ha of potential foraging habitat available to this species, while approximately 0.96ha of potential foraging habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar foraging habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahrenonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential foraging habitat secured within the immediate local area.

Given the extent of potential foraging habitat to be removed relative to that secured in the local area, the absence of potential nesting hollows, and the lack of roosting habitat or evidence of roosting (particularly within the proposed rezoning area), it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Ninox strenua***

### **Powerful Owl**

Powerful owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest (OEH, 2015a). It roosts by day in dense vegetation and nests in large tree hollows, greater than 45cm diameter, greater than 100cm deep and commonly greater than 20m high (or at least >6m) (DEC, 2006). It prefers hollow greater than 0.5m deep according to OEH (2015a). Breeding occurs from late autumn to mid-winter during which time Males roosts nearby (10-200m) (OEH, 2015a).

Powerful Owl is a known resident of the Wadalba area, with eleven (11) records within approximately 2km of the subject site (BioNet, 2015; Conacher Travers, 2006).

No nesting hollows suitable for Powerful Owl were observed within the subject site. It is considered that very sparse shrub and mid-storey stratus throughout the proposed rezoning area of the subject site are unlikely

to provide any potential roosting habitat for this species, however denser areas within the E2 zoned area, particular with specimens of *Melaleuca nodosa* (Everitt, 2005) may provide some potential roosting habitat. A few small specimens of *Exocarpus cupressiformis*, which also provide suitable roosting habitat occur throughout the subject site. However these are exposed in open areas and are unlikely to provide potential roosting habitat. Extensive searches for roosting evidence were undertaken throughout the entire subject site on August 30<sup>th</sup> and 31<sup>st</sup> during the breeding season, prior to pellets decomposing. No evidence of roosting was observed.

Survey results indicate a low to moderate abundance of prey species with the subject site (Refer to section 4.3.3). Two (2) arboreal mammal species, Common Brushtail Possum (2 specimens) and Sugar Glider (approximately 4 specimens), which are non-preferred prey species, were observed within and in the western side of the subject site respectively. One (1) specimen of Common Ringtail Possum, which forms 80% of Powerful Owl diet was recorded by Camera trap within the E2 zoned area (DEC, 2006). Common bird species recorded throughout the subject site may also provide potential prey. The proposed rezoning area is considered to provide a low abundance of prey species due to the lack understorey and mid-storey habitats for species such as Common Ringtail Possum. It is likely that Powerful Owl may utilise the subject site as part of its foraging range, particularly at times when the numbers of preferred prey species, such as Common Ringtail Possum, are low.

The proposal will remove approximately 1.75ha of potential foraging habitat available to this species, while approximately 0.96ha of potential foraging habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar foraging habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential foraging habitat secured within the immediate local area.

Given the extent of potential foraging habitat to be removed relative to that secured in the local area, a low abundance of preferred prey species, the absence of potential nesting hollows, and the lack of roosting habitat or evidence of roosting (particularly within the proposed rezoning area), it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

***Tyto novaehollandiae*****Masked Owl**

A forest owl that lives in dry eucalypt forests and woodlands from sea level to 1100 m, with a large home range of 500 to 1000ha, often hunting along the edges of forests, including roadsides (OEH, 2015a). It roosts and breeds in moist eucalypt forested gullies, using large tree hollows (>40cm diameter & >100cm deep) or sometimes caves for nesting (OEH, 2015; DEC, 2006). They may also use dense foliage in gullies for roosting (DEC, 2006). 'Laying (breeding) is irregular and unpredictable, occurring from late summer to spring but mostly March to July' (DEC, 2006). A typical diet of the Masked Owl includes tree-dwelling and ground mammals, especially rats (OEH, 2015a)

Masked Owl is a known resident of the Wadalba area, with seven (7) records within approximately 2km of the subject site (BioNet, 2015; Conacher Travers, 2006).

No nesting hollows suitable for Masked Owl were observed within the subject site. It is considered that very sparse shrub and mid-storey stratus throughout the proposed rezoning area of the subject site are unlikely to provide any potential roosting habitat for this species. Denser areas within the E2 zoned area may provide some marginal potential roosting habitat. Extensive searches for roosting evidence were undertaken throughout the entire subject site on August 30<sup>th</sup> and 31<sup>st</sup> during the breeding season, prior to pellets decomposing. No evidence of roosting was observed.

Survey results indicate a moderate abundance of preferred prey species within the E2 zoned area and a low abundance within the proposed rezoning area. No rats species were recorded within the proposed rezoning area, however both Black Rat and Bush Rat were recorded within the E2 zoned area. Supplementary species including Sugar Glider (approximately 4 specimens) and Common Ringtail Possum (1 specimen) within the western side of the subject site and the E2 zoned area respectively. It is likely that Masked Owl may utilise the subject site as part of its foraging range, particularly areas within the E2 zoned area where rat species were recorded.

The proposal will remove approximately 1.75ha of potential foraging habitat available to this species, while approximately 0.96ha of potential foraging habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar foraging habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will

therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential foraging habitat secured within the immediate local area.

Given the extent of potential foraging habitat to be removed relative to that secured in the local area, a low abundance of preferred prey species within the proposed rezoning area, the absence of potential nesting hollows, and the lack of roosting habitat or evidence of roosting (particularly within the proposed rezoning area), it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Chthonicola sagittata***

### **Speckled Warbler**

Speckled Warbler inhabits a wide range of *Eucalyptus* dominated communities that have a grassy understorey, often on rocky ridges or in gullies (OEH, 2015a). Typical habitats include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy (OEH, 2015a). It builds rounded, domed nest of dry grass and bark strips in slight hollow in the ground or base of low dense plant, often amongst fallen branches and other litter, with a side entrance allowing the bird to walk directly inside (OEH, 2015a).

It is considered that areas of the subject site with low level of weed invasion or 'good' quality groundcover habitats (refer to Figure 3), estimated to be approximately 1.02ha out of 2.7ha, may provide some potential nesting and foraging habitat for this species. No specimens or nests of this species were observed. Only two (2) records of this species occur within 10km of the subject site (BioNet, 2015).

In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 2.25% ( $1.02/40 \times 100$ ) of potential foraging habitat secured within the immediate local area.

Given the extent of potential foraging habitat to be removed relative to that secured in the local area, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Anthochaera phrygia***

### **Regent Honeyeater**

Regent Honeyeater inhabits dry open forest and woodland, particularly box-ironbark woodland and riparian forests of river she-oak, often with an abundance of mistletoe (OEH, 2015a). Non-breeding flocks have been recorded foraging in flowering Swamp Mahogany & Spotted Gum, particularly on the Central Coast (OEH, 2015a). Key foraging eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany (OEH, 2015a). It also utilises *Eucalyptus microcarpa*, *E.punctata*, *E.polyanthemos*, *E.moluccana*, *Corymbia robusta*, *E.crebra*, *E.caleyi*, *C.maculata*, *E.mckieana*, *E.macrorhyncha*, *E.laevopinea* and *Angophora floribunda* (OEH, 2015a). Also utilise nectar and fruit of Mistletoes *Amyema miquelii*, *A.pendula* and *A.cambagei* as well as lerp and honeydew when nectar is scarce (OEH, 2015a).

Fifteen (15) records of this species occur within approximately 10km of the subject site, however no records occur within 2km (BioNet, 2015).

The subject site is dominated by Spotted Gum (*Corymbia maculata*), which is not considered to be a key foraging resource for this species, however Regent Honeyeater has been observed foraging in Spotted Gum on the Central Coast (OEH, 2015a). It is considered that the subject site does provide potential foraging habitat for this species, particularly when Spotted Gum is in flower.

The proposal will remove approximately 1.75ha of potential foraging habitat available to this species, while approximately 0.96ha of potential foraging habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar foraging habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahrenonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential foraging habitat secured within the immediate local area.

Given the extent of potential foraging habitat to be removed relative to that secured in the local area, and the absence of key foraging resources, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

***Daphoenositta chrysoptera*****Varied Sittella**

Varied Sittella inhabits eucalypt forests and woodlands, especially those with rough-barked species and mature smooth-barked gums with dead branches, as well as mallee and Acacia woodland (OEH, 2015a). It builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years (OEH, 2015a).

Thirty-one (31) records of this species occur within approximately 10km of the subject site, however only one (1) record occurs within 2km (BioNet, 2015).

The subject site contains only a very low cover of only small fallen branches, however areas of the subject site with low level of weed invasion or 'good' quality groundcover habitats (refer to Figure 3), estimated to be approximately 1.02ha out of 2.7ha, may provide some potential foraging habitat within a natural cover of leaf litter (Refer to Figure 3). No specimens or nests of this species were observed.

In general, the proposal will remove approximately 1.75ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002).

In a more specific local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 2.25% ( $1.02/40 \times 100$ ) of potential habitat secured within the immediate local area.

Given the extent of potential habitat to be removed relative to that secured in the local area, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

***Dasyurus maculatus*****Spotted-tailed Quoll**

Spotted-tailed Quoll inhabits a range of habitat types such as rainforest, open forest, woodland, coastal heath and inland riparian forest (OEH, 2015a). It occupies home ranges of 750 to 3500 ha (OEH, 2015a). It utilise hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky cliffs for den sites (OEH, 2015).

Thirteen (13) records of this species occur within approximately 10km of the subject site, however no records occurs within 2km (BioNet, 2015).

The subject site may provide potential den and foraging habitat for this species, however no specimens or evidence of den or latrine sites were observed.

The proposal will remove approximately 1.75ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential habitat secured within the immediate local area.

Given the extent of potential habitat to be removed relative to that secured in the local area, the absence of records within 2km and the absence of any evidence of this species, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be placed at risk of extinction.

### ***Pteropus policephalus***

### **Grey-headed Flying-fox**

This species is generally found within 200km of the east coast of Australia (OEH, 2015a). It occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops (OEH, 2015a). Roost camps are generally located within 20km of regular food sources and are commonly found in gullies, close to water, in vegetation with a dense canopy (OEH, 2015a).

Fifty-seven (57) records of this species occur within approximately 10km of the subject site (BioNet, 2015). This species is known to occur within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006).

The subject site provides potential foraging habitat for this species. The areas of vegetation along the E2 zoned area may provide potential roosting or camp habitat, however no evidence of camps were observed.

The proposal will remove approximately 1.75ha of potential foraging habitat available to this species, while approximately 0.96ha of potential foraging habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar foraging

habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential foraging habitat secured within the immediate local area.

Given the extent of potential foraging habitat to be removed relative to that secured in the local area and the absence of any evidence of camps for this species, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be placed at risk of extinction.

### **Petaurus norfolcensis**

### **Squirrel Glider**

A Squirrel Habitat Assessment has been completed in the main body of this report (Refer to section 4.4.2). Spotted Gum-Ironbark Forest provides an important winter food resource for Squirrel Gliders throughout the coastal plains of the Wyong Shire, however this vegetation assemblage type is categorised as 'less optimal' relative to other preferred vegetation types (Smith, 2002). The proposed rezoning area of the subject site has been previously underscrubbed, which further lowers the suitability of habitat for Squirrel Gliders. 'Removal of understorey food plants (Banksias and Acacias) by frequent (fuel reduction) burning, grazing or slashing (underscrubbing) is a potentially significant threat to Squirrel Glider habitat in Wyong Shire' (Smith, 2002).

Two (2) flora quadrat surveys were undertaken. One quadrat was placed within the centre of the proposed rezoning area and a second within the E2 zoned area, the results of which are displayed in Table 11 of Appendix 5. The abundance of specific Squirrel Glider food plant species for each quadrat as described by Smith (2002) is displayed in Appendix 6.

Based on the quadrat data it is estimated that the proposed rezoning area contains 25 *Eucalyptus siderophloia* (Grey Ironbark) per hectare and 50 *Corymbia maculata* (Spotted Gum) per hectare which provide a variety of sap, nectar and pollen for Squirrel Gliders in the canopy. No other food plant species were recorded in this quadrat, however some specimens of *Acacia longifolia* (Sydney Golden Wattle) and one specimen of *Acacia falcata* (Hickory Wattle), providing a limited supply of seeds and gum were observed within the proposed rezoning area. Quadrat 2 estimated that the E2 zoned area contains 25 *Eucalyptus siderophloia* (Grey Ironbark) per hectare, 25 *Corymbia maculata* (Spotted Gum) per hectare and 75 *Melaleuca nodosa* (Ball Honey-myrtle), providing a variety of sap, nectar and pollen in the canopy and nectar and insect bark food in the mid-storey. *Xanthorrhoea macronema* was also observed throughout the southern end of the E2 zoned area which provides nectar and potential gum resources in the ground cover.

The proposal includes the retaining of a 55m wide E2 zoned area along the western side of the subject site. This retained vegetation will function as a corridor, connecting to a remnant patch of natural vegetation to

the north (on the western side of the sporting grounds), in line with the planned 'local conservation link' displayed in the North Wyong Shire Structure Plan (WSC, 2015).

A total of nineteen (19) records occur within 2km of the subject site, seventeen (17) of which are prior to 2005 (BioNet, 2015). The two most recent records are approximately 1.7km and 1.24km to the west south-west in 2006 and 2007, from patches of vegetation between Johns Road and Jensen Road (BioNet, 2015). These areas are connected to the Wadalba Wildlife Corridor by isolation class 3 links.

Targetted trapping as well spotlighting surveys for Squirrel Glider were undertaken, however no specimens were recorded. A total of seven (7) hollow-bearing trees with visible entrances and with or without evidence of use were recorded within the subject site. Stagwatch surveys of all hollow-bearing trees considered to provide potential nesting habitat for Squirrel Gliders were undertaken and no specimens were recorded.

It is possible that resident breeding Squirrel Gliders occur within the Wadalba Wildlife Corridor, despite the lack of recent records. However, based on current surveys and the assessment of habitat, it is considered that no resident breeding Squirrel Gliders are present within the subject site.

The proposal will remove approximately 1.75ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential foraging habitat secured within the immediate local area.

Given the low number of feed species present, the absent of recent records and the results of surveys, despite the presence of hollows, it is considered that the subject site provides low to moderate quality habitat for Squirrel Gliders.

In consideration of the extent of this potential habitat to be removed relative to that secured in the local area, the quality of habitat recorded (particularly within the proposed rezoning area), and the maintenance of vegetation connectivity, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

## **Micro-bats**

'Whilst micro-bats may use small tree hollows, they tend to select roost sites in hollows in the largest trees available' (DECC, 2007). In forests where there is a large choice of hollows most bats use several roosts regularly, while the best hollows are used while females are nursing young (Churchill, 2008). Some bats appear to be opportunistic in their choice of roost, finding a different roost each day (Churchill, 2008).

### ***Saccolaimus flaviventris***

### **Yellow-bellied Sheathtail-bat**

This species roosts singly or in groups of up to six, in tree hollows and buildings, though in treeless areas they are known to utilise mammal burrows (OEH, 2015a). According to Churchill (2008) this species roosts in large tree hollows. It forages in most habitats across its very wide range, flying fast and straight usually above the canopy, but lower over open spaces and at forest edges (OEH, 2015a; Churchill, 2008).

Five (5) records of this species occur within 10km of the subject site, with one (1) record occurring within 1km (BioNet, 2015). This species has been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006).

Ten (10) hollow-bearing trees were recorded within the proposed rezoning area. Hollow-bearing tree number 7 (HT7) is located offsite to the north, but is still likely to be impact by the future road design.

It is considered four (4) hollow-bearing trees, HT2, HT4, HT5 and HT6 have potential to provide seasonal roosting habitat, however both of the most suitable medium sized (10-20cm) hollows in HT4, HT5 and HT6 are currently inhabited by other fauna (Refer to Table 7). The remaining six (6) hollow-bearing trees within the subject site may provide potential temporary roosts for day and night time resting. All of the ten (10) hollow-bearing trees have been either stagwatched or inspected by inspection camera. No roosting evidence or specimens have been observed either roosting or exiting hollows.

This species was not recorded during surveys, however it is considered that the subject site may provide potential foraging and roosting habitat for this species.

The proposal will remove approximately 1.75ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the

equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential habitat secured within the immediate local area.

Given the extent of potential foraging habitat to be removed relative to that secured in the local area and the absence of any roosting evidence of this species, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be placed at risk of extinction.

### ***Mormopterus norfolkensis***

### **Eastern Freetail-bat**

Eastern Freetail-bat occurs in dry sclerophyll forest, woodland, swamp forest and mangrove forest east of the Great Dividing Range (OEH, 2015a). It roosts usually solitary but also communally, mainly in tree hollows but also under bark or in man-made structures (OEH, 2015a). They usually roost in hollow spouts of large mature trees and also known to roost in bat boxes with a colony in NSW using the same boxes for over 5 years (Churchill, 2008).

Forty-seven (47) records of this species occur within 10km of the subject site, with six (6) records occurring within 2km (BioNet, 2015). This species has been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006). This species was recorded during surveys within the subject site.

Ten (10) hollow-bearing trees were recorded within the proposed rezoning area. Hollow-bearing tree number 7 (HT7) is located offsite to the north, but is still likely to be impacted by the future road design.

It is considered four (4) hollow-bearing trees, HT2, HT4, HT5 and HT6 have potential to provide seasonal roosting habitat, however both of the most suitable medium sized (10-20cm) hollows in HT4, HT5 and HT6 are currently inhabited by other fauna (Refer to Table 7). The remaining six (6) hollow-bearing trees within the subject site may provide potential temporary roosts for day and night time resting. All of the ten (10) hollow-bearing trees have been either stagwatched or inspected by inspection camera. No roosting evidence or specimens have been observed either roosting or exiting hollows. However it is considered that the subject site provides potential roosting habitat for this species.

The proposal will remove approximately 1.75ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the

equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential habitat secured within the immediate local area.

Given the extent of potential foraging habitat to be removed relative to that secured in the local area and the absence of any roosting evidence of this species, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Chalinolobus dwyeri***

### **Large-eared Pied Bat**

Large-eared Pied Bat roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin. (OEH, 2015a). It occurs in low to mid-elevation dry open forest and woodland close suitable roosting habitats (OEH, 2015a).

Two (2) records of this species occur within 10km of the subject site, with no records occurring within 2km (BioNet, 2015). This species has not been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006). This species was not recorded during surveys within the subject site.

No potential roosting habitat, such as caves, cliffs, old mine workings or Fairy Martin nests were observed within the subject site. It is unlikely that any roosting habitats occur within close proximity, given the lack of records. It is considered that the subject site provides potential foraging habitat for this species.

The proposal will remove approximately 1.75ha of potential foraging habitat available to this species, while approximately 0.96ha of potential foraging habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahrenonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential foraging habitat secured within the immediate local area.

Given the extent of potential foraging habitat to be removed relative to that secured in the local area and the absence of potential roosting habitat of this species, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Falsistrellus tasmaniensis***

### **Eastern False Pipistrelle**

Eastern False Pipistrelle prefers moist habitats, with trees taller than 20m where it forages on beetles, moths, weevils and flying insects above or just below the tree canopy (OEH, 2015a). Generally roosts in eucalypt hollows, but has also been found under loose bark or in buildings (OEH, 2015a). This species hibernates in winter (OEH, 2015a).

Thirty-four (34) records of this species occur within 10km of the subject site, with one (1) record occurring within 2km (BioNet, 2015). This species has been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006). This species was recorded during surveys within the subject site as a possible identification as part of a 'species grouping' (Refer to micro-bat identification report in Appendix 7).

Ten (10) hollow-bearing trees were recorded within the proposed rezoning area. Hollow-bearing tree number 7 (HT7) is located offsite to the north, but is still likely to be impact by the future road design.

It is considered four (4) hollow-bearing trees, HT2, HT4, HT5 and HT6 have potential to provide seasonal roosting habitat, however both of the most suitable medium sized (10-20cm) hollows in HT4, HT5 and HT6 are currently inhabited by other fauna (Refer to Table 7). The remaining six (6) hollow-bearing trees within the subject site may provide potential temporary roosts for day and night time resting. All of the ten (10) hollow-bearing trees have been either stagwatched or inspected by inspection camera. No roosting evidence or specimens have been observed either roosting or exiting hollows. However it is considered that the subject site provides potential roosting habitat for this species.

The proposal will remove approximately 1.75ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahrenonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential habitat secured within the immediate local area.

Given the extent of potential habitat to be removed relative to that secured in the local area and the absence of any roosting evidence of this species, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Kerivoula papuensis***

### **Golden-tipped Bat**

Golden-tipped Bat is found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m (OEH, 2015a). It is also found in tall open forest, *Casuarina*-dominated riparian forest and coastal *Melaleuca* forests (OEH, 2015a). It roosts mainly in rainforest gullies on small 1<sup>st</sup> and 2<sup>nd</sup> order streams, usually in hanging Yellow-throated Scrubwren and Brown Gerygone nests modified with an access hole on the underside (OEH, 2015a). May also roost under thick moss on the tree trunks, in tree hollows, dense foliage and epiphytes (OEH, 2015a).

Four (4) records of this species occur within 10km of the subject site, with no records occurring within 2km (BioNet, 2015). This species has been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006). This species was not recorded during surveys.

Ten (10) hollow-bearing trees were recorded within the proposed rezoning area. Hollow-bearing tree number 7 (HT7) is located offsite to the north, but is still likely to be impact by the future road design.

It is considered four (4) hollow-bearing trees, HT2, HT4, HT5 and HT6 have potential to provide seasonal roosting habitat, however both of the most suitable medium sized (10-20cm) hollows in HT4, HT5 and HT6 are currently inhabited by other fauna (Refer to Table 7). The remaining six (6) hollow-bearing trees within the subject site may provide potential temporary roosts for day and night time resting. All of the ten (10) hollow-bearing trees have been either stagwatched or inspected by inspection camera. No Scrub-wren or Gerygone nests were observed. No roosting evidence or specimens have been observed either roosting or exiting hollows. No rainforest gullies or gullies of dense vegetation occur within close proximity. It is considered that the subject site may provide potential foraging habitat but is unlikely to provide potential preferred roosting habitat.

The proposal will remove approximately 1.75ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahrenonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential habitat secured within the immediate local area.

Given the extent of potential habitat to be removed relative to that secured in the local area and the absence of any preferred roosting habitat for this species, it is considered that the proposal is unlikely to have an

adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Miniopterus australis***

### **Little Bentwing-bat**

Little Bentwing-bat is generally found in well-timbered areas including, moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub (OEH, 2015a). This is a cave dwelling bat that congregates in the summer months into maternity colonies, then disperses in winter to go into shallow hibernation (Churchill, 2008). They have also been recorded in tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings (OEH, 2015a). It forages beneath the canopy of densely vegetated habitats (OEH, 2015a).

Fifty-one (51) records of this species occur within 10km of the subject site, with four (4) records occurring within 2km (BioNet, 2015). This species has been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006). This species was recorded during surveys within the subject site.

No potential roosting habitat, such as caves, cliffs, old mine workings or other potential roosting structures were observed within the subject site. Records of this species utilising hollows appears to be infrequently as temporary roosts as indicated by Churchill (2008). All of the ten (10) hollow-bearing trees have been either stagwatched or inspected by inspection camera. No roosting evidence or specimens have been observed either roosting or exiting hollows. It is considered that the subject site provides foraging habitat as well as possible temporary roosting sites in hollows.

The proposal will remove approximately 1.75ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahrenonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential habitat secured within the immediate local area.

Given the extent of potential foraging habitat to be removed relative to that secured in the local area and the absence of roosting evidence of this species, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

***Miniopterus schreibersii oceanensis*****Eastern Bentwing-bat**

Eastern Bentwing-bat forages in forested areas, catching moths and other flying insects above the tree tops (OEH, 2015a). It roosts primarily in caves, but also uses derelict mines, storm-water tunnels, buildings and other man-made structures (OEH, 2015a). Form discrete populations centred on a maternity cave that is used annually in spring and summer for birthing and rearing of young (OEH, 2015a).

Seventy-six (76) records of this species occur within 10km of the subject site, with eight (8) records occurring within 2km (BioNet, 2015). This species has been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006). Eastern Bentwing-bat was recorded during surveys within the subject site to a 'probable' level of confidence (Refer to Appendix 7).

No potential roosting habitat, such as caves, old mines, storm water tunnels or other potential roosting structures were observed within the subject site. It is considered that the subject site provides foraging habitat for this species.

The proposal will remove approximately 1.75ha of potential foraging habitat available to this species, while approximately 0.96ha of potential foraging habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential foraging habitat secured within the immediate local area.

Given the extent of potential foraging habitat to be removed relative to that secured in the local area and the absence of potential roosting habitat of this species, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

***Scoteanax rueppellii*****Greater Broad-nosed Bat**

Greater Broad-nosed Bat utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest (OEH, 2015a). It roosts mainly in tree hollows, but has also been found to roost in buildings (OEH, 2015a).

Sixty-two (62) records of this species occur within 10km of the subject site, with eight (8) records occurring within 2km (BioNet, 2015). This species has been previously recorded within the area of the Wadalba

Wildlife Corridor (Conacher Travers, 2006). Greater Broad-nosed Bat was recorded during surveys within the subject site to a 'probable' level of confidence (Refer to Appendix 7).

Ten (10) hollow-bearing trees were recorded within the proposed rezoning area. Hollow-bearing tree number 7 (HT7) is located offsite to the north, but is still likely to be impact by the future road design.

Hollow-bearing trees within the subject site may provide potential roosting habitat for this species. All of the ten (10) hollow-bearing trees have been either stagwatched or inspected by inspection camera. No roosting evidence or specimens have been observed either roosting or exiting hollows.

The proposal will remove approximately 1.75ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahoonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential habitat secured within the immediate local area.

Given the extent of potential habitat to be removed relative to that secured in the local area and the absence of any roosting evidence for this species, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Myotis macropus***

### **Southern Myotis**

Southern Myotis generally roosts in groups of 10-15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage (OEH, 2015a). Forage over streams and pools catching insects and small fish by raking their feet across the water surface (OEH, 2015a). They have a preference large still pools rather than flowing streams (Churchill, 2008).

Thirty-six (36) records of this species occur within 10km of the subject site, with no records occurring within 2km (BioNet, 2015). This species has not been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006).

Ten (10) hollow-bearing trees were recorded within the proposed rezoning area. Hollow-bearing tree number 7 (HT7) is located offsite to the north, but is still likely to be impact by the future road design.

Hollow-bearing trees within the subject site may provide potential roosting habitat for this species. All of the ten (10) hollow-bearing trees have been either stagwatched or inspected by inspection camera. No roosting

evidence or specimens have been observed either roosting or exiting hollows. No potential roosting caves, mine shafts, storm water channels, bridges or buildings occur within the subject site. Dense areas of vegetation in the E2 zoned area may also provide potential roosting habitat.

This species recorded during surveys within the subject site as part of a 'species grouping', however very few passes were detected despite several nights of continuous recording pointing over the dams and in close proximity (Refer to methodology in section 3.2.3 and Appendix 7). The two small dams (approximately 6x6m each) along the southern boundary of the subject site may provide marginal potential foraging habitat for this species.

Given the extent of potential habitat to be removed and the absence of any roosting evidence for this species, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Hoplocephalus stephensii***

### **Stephen's Banded Snake**

Stephen's Banded Snake occurs in rainforest and eucalypt forest and rock areas up to 950m in altitude (OEH, 2015a). It is a nocturnal snake that hunts for frogs, lizards, birds and small mammals (OEH, 2015a). During the day it shelters between loose bark and tree trunks, amongst vines, or in hollow trunks, limbs, in rock crevices or under slabs (OEH, 2015a).

One (1) records of this species occurs within 10km of the subject site, with no records occurring within 2km (BioNet, 2015). This species has not been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006).

It is considered that the subject site provides some potential sheltering and foraging habitat for this species, however no specimens were recorded during surveys.

The proposal will remove approximately 1.75ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of potential habitat secured within the immediate local area.

Given the extent of potential habitat to be removed relative to that secured in the local area and the absence of any evidence for this species, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Crinia tinnula***

### **Wallum Froglet**

Wallum Froglet typically occur in sedgeland and wet heathlands but can also be found along drainage lines and disturbed areas (OEH, 2015a). It breeds in swamps with permanent water as well as shallow ephemeral pools and drainage ditches (OEH, 2015a).

Seventy-two (72) records of this species occur within 10km of the subject site, with only one (1) record occurring within 2km (BioNet, 2015). This species has not been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006).

Areas in the northern end of the E2 zoned area may provide marginal potential habitat for this species. No specimens were recorded during targeted surveys. These marginal potential habitats will be retained as part of this proposal.

Given the absence this species, and the areas of marginal habitat to be retained, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Melaleuca biconvexa***

### **Biconvexa Paperbark**

Biconvexa Paperbark occurs in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects (OEH, 2015a).

Three-hundred and sixty (360) records of this species occur within 10km of the subject site, with only one (1) record occurring within 2km (BioNet, 2015). This species has not been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006).

Areas in the northern end of the E2 zoned area may provide marginal potential habitat for this species. No specimens were recorded during surveys. These marginal potential habitats will be retained as part of this proposal.

Given the absence this species, and the areas of marginal habitat to be retained, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Caladenia tessellata***

### **Thick Lip Spider Orchid**

Thick Lip Spider Orchid occurs in grassy sclerophyll woodland on clay loam or sandy soils (OEH, 2015a). It flowers between September and November (OEH, 2015a). The precise habitat preferences of this species are unknown (Duncan, 2010).

Two (2) records of this species occur within 10km of the subject site, with no records occurring within 2km (BioNet, 2015). This species has not been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006).

Targetted orchid surveys were undertaken throughout the subject site on August 30<sup>th</sup>, September 30<sup>th</sup> and October 2<sup>nd</sup> of 2015. No specimens of this species were recorded.

The subject site has been stratified into areas of 'good' and 'poor' quality groundcover habitats (refer to Figure 3). Areas of low level weed invasion, or 'good' quality groundcover habitats are estimated to be approximately 1.02ha out of 2.7ha. It is considered these areas may provide potential habitat for this species.

The proposal will remove approximately 1.02ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002).

In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 2.25% ( $1.02/40 \times 100$ ) of potential habitat secured within the immediate local area.

Given the extent of potential habitat to be removed relative to that secured in the local area and the absence of this species during targeted surveys, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Rhizanthella slateri***

### **Eastern Australian Underground Orchid**

The habitat requirements of this species are poorly understood and it has no specific associated vegetation type or species, however it is known to occur in sclerophyll forest (OEH, 2015a). It is highly cryptic with only the flower emerging above the ground and therefore it is usually only located when soil is disturbed (OEH, 2015a). This species flowers from September to November (OEH, 2015a).

No records of this species occur within 10km of the subject site, however this species is include the 'Protected Matters Report' search (BioNet, 2015; DSEWPC, 2015). This species has not been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006).

Targetted orchid surveys were undertaken throughout the subject site on August 30<sup>th</sup>, September 30<sup>th</sup> and October 2<sup>nd</sup> of 2015. No specimens of this species were recorded.

The subject site has been stratified into areas of 'good' and 'poor' quality groundcover habitats (refer to Figure 3). Areas of low level weed invasion, or 'good' quality groundcover habitats are estimated to be approximately 1.02ha out of 2.7ha. It is considered these areas may provide potential habitat for this species.

The proposal will remove approximately 1.02ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002).

In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahrenonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 2.25% ( $1.02/40 \times 100$ ) of potential habitat secured within the immediate local area.

Given the extent of potential habitat to be removed relative to that secured in the local area, the lack of records of this species and the absence of this species during targeted surveys, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Thelymitra sp. adorata***

### **Wyong Sun Orchid**

Wyong Sun Orchid is a hairless terrestrial herb which dies back annually to a tuberous rootstock (NSW Scientific Committee, 2008). It occurs at approximately 10 to 40m elevation above sea level in grassy woodland or occasionally derived grassland in well-drained clay loam or shale derived soils (OEH, 2015a). This species is known to occur in Spotted Gum – Ironbark Forest with a diverse grassy understorey and occasional scattered shrubs (OEH, 2015a).

It produces a single leaf around May, which dies off in late November (TSSC, 2014). The leaf is fleshy and ribbed on the back, green in colour with purple base, and is 10-40cm long and 5-20mm wide (TSSC, 2014). The flower stem is 20-60cm tall and 2-5mm or up to 10mm (B.Branwhite pers. comm. 2015) and usually

emerges in September (TSSC, 2014). 'Dark, thick, rigidly erect stems aid field recognition, as compared to other *Thelymitra* species in the area, even when flowers are closed' (NSW Scientific Committee, 2008).

Twenty (20) records of this species occur within 10km of the subject site, with no records occurring within 2km (BioNet, 2015). This species has not been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006).

The author visited the known population of *T.adorata* on several occasions this season to confirm the flower period and to strengthen the familiarity with the species. The author has also recently spent time with local orchid expert, Boris Branwhite to look at specimens of *T.pauciflora* and learn the distinguishing characteristics of the locally occurring *Thelymitra* species.

Targetted orchid surveys were undertaken throughout the subject site on September 30<sup>th</sup> and October 2<sup>nd</sup> of 2015 to coincide with the observed flowering period of a known population off Pollock Avenue, Wadalba.

Some non-flowering stems of both *Thelymitra pauciflora* and *Calochis sp.* (Bearded Orchid species) were identified and clearly distinguished from *T.adorata* by stem diameter, being less than 2mm, colour and leaf characteristics. No specimens of *Thelymitra sp. adorata* were recorded.

The subject site has been stratified into areas of 'good' and 'poor' quality groundcover habitats (refer to Figure 3). Areas of low level weed invasion, or 'good' quality groundcover habitats are estimated to be approximately 1.02ha out of 2.7ha. It is considered these areas may provide potential habitat for this species.

The proposal will remove approximately 1.02ha of potential habitat available to this species, while approximately 0.96ha of potential habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002).

In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 2.25% ( $1.02/40 \times 100$ ) of potential habitat secured within the immediate local area.

Given the extent of potential habitat to be removed relative to that secured in the local area and the absence of this species during targeted surveys, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be place at risk of extinction.

### ***Rutidosia heterogama***

This species grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides (OEH, 2015a). Its peak flowering period is October & November according to WSC 2014 (Guidelines) and 'chiefly autumn' according to PlantNet, 2015.

One-hundred and sixty-two (162) records of this species occur within 10km of the subject site, with one (1) record occurring within 2km (BioNet, 2015). This species has not been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006).

Throughout searches throughout the subject site were undertaken on August 30<sup>th</sup>, September 30<sup>th</sup> and October 2<sup>nd</sup> of 2015 as part of orchid surveys. In addition extensive random meanders surveys were undertaken with Garon Staines on November 4<sup>th</sup>, 2015. No specimens of this species were recorded.

The absence of this species is likely to be due to a dominance of clay based soils. The proposal will remove approximately 1.75ha of marginal potential habitat available to this species, while approximately 0.96ha of habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of similar habitat secured within the immediate local area.

Given the extent of potential habitat to be removed relative to that secured in the local area, the lack of preferred soils and the absence of this species during targeted surveys, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be placed at risk of extinction.

### ***Grevillea parviflora subsp. parviflora***

#### **Small-flowered Grevillea**

Small-flowered Grevillea occurs in a range of vegetation types from heath and shrubby woodland to open forest, growing in sandy or light clay soils usually over thin shales, often with lateritic ironstone gravels and nodules (OEH, 2015a). Associated understorey species include, *Allocasuarina littoralis*, *Daviesia ulicifolia*, *Kunzea ambigua*, *Banksia spinulosa*, *Leptospermum trinervium*, *Melaleuca nodosa*, *Pimelea linifolia*, *Themeda triandra*, *Entolasia stricta* and *Eragrostis brownii* (OEH, 2015a).

One-hundred and twenty-two (122) records of this species occur within 10km of the subject site, with seventeen (17) records occurring within 2km (BioNet, 2015). This species has not been previously recorded within the area of the Wadalba Wildlife Corridor (Conacher Travers, 2006).

Four (4) of the associated understorey species occur within the subject site. It is considered that the subject site may provide marginal potential habitat for this species. No specimens were recorded during survey.

The proposal will remove approximately 1.75ha of marginal potential habitat available to this species, while approximately 0.96ha of habitat will be retained as part of a E2 zoned area along western side of the subject site. In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of similar habitat secured within the immediate local area.

Given the extent of potential habitat to be removed relative to that secured in the local area, and the absence of this species despite extensive surveys, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population may be placed at risk of extinction.

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

No endangered populations are likely to occur within the subject site.

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

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

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

No endangered ecological community were identified within or in close proximity to the subject site.

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

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

The subject site is approximately 2.75ha. The proposal will remove approximately 1.75ha partially cleared and disturbed vegetation which is consistent with 'Narrabeen Dooralong Spotted Gum - Ironbark Forest (MU30) as described by Bell (2002). Approximately 0.96ha of the subject site will retained as part of a E2 zoned area along western side of the subject site (Refer to Figure 2). In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of similar habitat secured within the immediate local area.

Ten (10) hollow-bearing trees recorded within the proposed rezoning area are likely to require removal as part of this proposal (Refer to Table 7). Hollow-bearing tree number 7 (HT7) is located offsite to the north, but is still likely to be impact by the future road design.

Also two small dams providing habitat for common amphibian species are likely to be removed as part of this proposal.

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

The subject site is bound by the Wadalba Wildlife Corridor to the south, residential housing to the west, rural residential lands to the east and cleared land containing public sporting facilities to the north (Refer to Figure 1 & 4). An existing strip of E2 zoned land within the western side of the subject site, forms an important connecting corridor between the Wadalba Wildlife Corridor in the south with areas of natural vegetation along the western side of the sporting facilities, extending to the northern side of the Pacific Highway. This E2 area is mapped as a 'local conservation link' in the North Wyong Shire Structure Plan (WSC, 2015). This E2 area has been predetermined in assessment of lands retained for the Wadalba Wildlife Corridor and associated local conservation links. This area will be retained as part of this proposal.

A detailed corridor assessment has been included in section 4.4.1 of this report. A summary of connecting patches of vegetation is displayed in Table 8.

Overall the greatest impact of the proposal on corridors will be a reduction in wider sections of the 'local conservation link' to patch 1 in the north, by the creation of a 55m wide corridor, being the E2 zoned area. This will reduce the total area of the corridor, creating a longer narrow section, which will naturally increase this areas vulnerability to disturbance through edge effects and predation. The proposal will however secured a 175m long unbroken section with the narrowest width being 55m, and therefore will not cause a reduction in the narrowest width of this link.

It is considered that the proposal is unlikely to cause a significant reduction in the functionality or utilisation of the Wadalba Wildlife Corridor and associated local conservation links. Recommendations regarding the future management and improvement of corridors include:

- Landscaping using locally endemic species along the edges of proposed rezoning area adjoining the E2 zoned area;
- Construction of an effective barrier to inhibit vehicle access and demarcate the 'local conservation link', to be constructed along the edge of the proposed rezoning area adjoining the E2 zoned area;
- &
- Fencing at the rear boundary of properties adjoining the Wadalba Wildlife Corridor to create a physical barrier to the spread of weeds and decrease edge effects consistent with B1 – Action 5 of the Wadalba Wildlife Corridor Management Plan 2006 (Conacher Travers 2006).

Additional recommendations (not required for this assessment) regarding future road designs and corridor management for maintaining and improving the 'local conservation link' to the north include:

- Establishment of a 55m wide wildlife crossing with a maximum of 15m separation between trees in any future road design at the north end of E2 zoned area; &
- Establishment of native understorey refuges in any future road design at the north end of E2 zoned area; &
- Placement of road signs at the road crossing to the north of the subject site, consistent with Action B3 ii Road Crossing Signage of the WWC Management Plan (Conacher Travers, 2006); &
- Weed removal and bush regeneration works for improvement of habitat value, to be undertaken throughout the length of the 'local conservation link'.

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

The subject site is approximately 2.75ha. The proposal will remove approximately 1.75ha partially cleared and disturbed vegetation which is consistent with 'Narrabeen Dooralong Spotted Gum – Ironbark Forest (MU30) as described by Bell (2002). Approximately 0.96ha of the subject site will retained as part of a E2 zoned area along western side of the subject site (Refer to Figure 2). In 2002 approximately 2215.10ha of Narrabeen Dooralong Spotted Gum-Ironbark Forest (MU30) (identified within the subject site) was present within the Wyong Shire, including none located in conservation reserves (Bell, 2002). In a local context, approximately 92ha of similar habitat occurs within both council and privately owned land bound by the Pacific Highway to the north and west, Wahroonga Road to the north, Johns Road to the south, and Kilpa Road to the east. Approximately 40ha of this natural vegetation is secured as part of the Wadalba Wildlife Corridor. The proposal will therefore remove the equivalent of approximately 4.4% ( $1.75/40 \times 100$ ) of similar habitat secured within the immediate local area.

Ten (10) hollow-bearing trees recorded within the proposed rezoning area are likely to require removal as part of this proposal (Refer to Table 7). Hollow-bearing tree number 7 (HT7) is located offsite to the north, but is still likely to be impact by the future road design.

Also two small dams providing habitat for common amphibian species are likely to be removed as part of this proposal.

A total of thirty (30) threatened species including, ten (10) birds, twelve (12) mammals, one (1) reptile, one (1) amphibian and six (6) threatened flora species were either recorded or considered at least moderately

likely to occur within the study area. No nesting habitats of any of the assessed species have been located within the subject site.

Hollow-bearing trees within the subject site provide potential temporary roosting sites for threatened micro-bat species. No important seasonal micro-bat roosting sites have been located or are considered likely to occur within the subject site.

No threatened flora species, populations or endangered ecological communities have been recorded within the subject site.

In particular, the subject site provides or is likely to provide an area of foraging habitat for the following species either recorded during surveys or known to occur within the local area:

- |                                              |                               |
|----------------------------------------------|-------------------------------|
| • <i>Calyptorhynchus lathami</i>             | Glossy Black-Cockatoo         |
| • <i>Lathamus discolor</i>                   | Swift Parrot                  |
| • <i>Ninox strenua</i>                       | Powerful Owl                  |
| • <i>Tyto novaehollandiae</i>                | Masked Owl                    |
| • <i>Anthochaera phrygia</i>                 | Regent Honeyeater             |
| • <i>Pteropus poliocephalus</i>              | Grey-headed Flying-fox        |
| • <i>Petaurus norfolcensis</i>               | Squirrel Glider               |
| • <i>Saccolaimus flaviventris</i>            | Yellow-bellied Sheathtail-bat |
| • <i>Mormopterus norfolkensis</i>            | Eastern Freetail-bat          |
| • <i>Falsistrellus tasmaniensis</i>          | Eastern False Pipistrelle     |
| • <i>Miniopterus australis</i>               | Little Bentwing-bat           |
| • <i>Miniopterus schreibersii oceanensis</i> | Eastern Bentwing-bat          |
| • <i>Scoteanax rueppellii</i>                | Greater Broad-nosed Bat       |

In summary it is considered that habitat within the proposed rezoning area is of low importance to the long-term survival of the species, population or ecological community in the locality.

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

No declared areas of critical habitat occur within or in close proximity to the subject site.

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

*Hieraaetus morphnoides* (Little Eagle)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Landscape species management stream under the *Saving our Species* program (2015a). This action statement aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015a).

Priority sites for species are being identified by the Office of Environment and Heritage and other program partners, where feasible, cost-effective and beneficial to the species (OEH, 2015a). Currently, 0 management sites have been identified for this species (OEH, 2015a).

*Calyptorhynchus lathami* (Glossy Black-cockatoo)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Site-managed species management stream under the *Saving our Species* program (OEH, 2015a). The conservation project aims to secure the species in the wild for 100 years and maintain its conservation status under the TSC Act. (OEH, 2015a).

The Office of Environment and Heritage has established 2 management sites where conservation activities need to take place to ensure the conservation of this species (OEH, 2015a). These include, an active site in the Central West and a proposed site on the North Coast.

The study area is not located within or in close proximity to any of these management sites. The proposal is unlikely to be inconsistent with the recovery actions for this species.

*Glossopsitta pusilla* (Little Lorikeet)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Landscape species management stream under the *Saving our Species* program (OEH, 2015a).

The action statement aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015a).

OEH is currently developing a targeted approach for managing Landscape species species. In the interim, the following management actions have been identified for this species (OEH, 2015a):

- Encourage retention of old-growth and hollow-bearing trees through community engagement and

- other mechanisms including PVPs, BioBanking and EIA; &
- Avoid burning woodland with old-growth and hollow-bearing trees.

It is considered that provide recommendations (refer to section 7.2) are adopted, the proposed works are consistent with the above management actions.

#### *Lathamus discolor* (Swift Parrot)

A national recovery plan for Swift Parrot was prepared in 2011.

The overall objectives of this plan are (Saunders, 2011):

- To prevent further decline of the Swift Parrot population; &
- To achieve a demonstrable sustained improvement in the quality of Swift Parrot habitat to increase carrying capacity.

Recovery actions include (Saunders, 2011);

- Action 1 - Identify the extent and quality of habitat;
- Action 2 - Manage and protect Swift Parrot habitat at the landscape scale;
- Action 3 - Monitor and manage the impact of collision, competition and disease;
- Action 4 - Monitor population and habitat.
- Supporting actions include (Saunders, 2011):
- Action 5 - Increase community involvement in, and awareness of, the recovery program; &
- Action 6 - Coordinate, review and report on recovery process.

It is considered that the proposal is consistent with the objectives and actions of this recovery plan.

#### *Ninox connivens* (Barking Owl)

The NSW NPWS produced a draft Recovery Plan for Barking Owl in 2003 (NSW NPWS, 2003).

The aim of this recovery plan is to recover the species to a position of viability in nature in NSW (NSW NPWS, 2003). This plan includes five specific objectives, which are as follows:

- Specific Objective 1: Increase understanding of the biology, ecology and management of the Barking Owl;
- Specific Objective 2: Increase education and awareness of and involvement in the conservation of the Barking Owl and its habitat in NSW;
- Specific Objective 3: Undertake threat abatement and mitigation;

- Specific Objective 4: Gain efficiencies through links with other conservation plans and conservation groups; &
- Specific Objective 5: Provide organisational support.

It is considered that the proposed works are consistent with the objectives of the draft recovery plan.

This species is distributed across relatively large areas and is subject to threatening processes that generally act at the landscape scale (e.g. habitat loss or degradation) rather than at distinct, defineable locations (OEH, 2015a). This species has therefore been assigned to the Landscape species management stream under the *Saving our Species* program (OEH, 2015a).

The action statement aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015a).

OEH is currently developing a targeted approach for managing Landscape species species (OEH, 2015a). In the interim, the following management actions have been identified for this species (OEH, 2015a).

- Assess the size, viability and status of the Barking Owl population in NSW using existing survey data and known information on distribution, preferred habitat, home range size and population density;
- Establish a program to monitor the NSW Barking Owl population and study its demographics, including the development, trial and establishment of a protocol for high-quality surveys to monitor the Barking Owl across land tenures and habitat types in NSW;
- Investigate conservation management strategies that act to manage known threats and restore habitat;
- Support biological and ecological studies e.g. preferred diet, reproductive strategies, home range, population viability;
- Support population genetics studies particularly between the eastern and south-western populations of *Ninox connivens connivens* and within the eastern population;
- Investigate the cultural and historic significance of the Barking Owl;
- Develop and distribute the Barking Owl information package. This will contain the species profile, environment assessment guidelines and prescriptions to minimise potential impacts;
- Prepare a poster and undertake a community survey and media campaign in rural and regional NSW to raise community awareness of the Barking Owl. The importance of each individual owl, and particularly breeding sites will be stressed;
- Establish formal conservation arrangements for properties with Barking Owls, which can be used to protect wildlife habitat;
- Negotiate with individual land managers to achieve appropriate measures to protect all known Barking Owl nest sites in NSW. Protection will need to address threats such as human disturbance, collision with wires, secondary poisoning from chemicals;
- Assess forestry prescriptions and Threatened Species Licences for their effectiveness in conserving the Barking Owl in State Forests;
- Incorporate the consideration of Barking Owl habitat and potential habitat as a high priority in the assessment of property for reserve establishment;
- Research is required into the effects of agricultural poisons upon the species;

- Maintain the threatened owl working group and links with owl researchers;
- Facilitate the establishment and maintenance of links with community involved in Barking Owl conservation;
- Coordinate the implementation of the recovery plan; &
- Complete the final recovery plan for Barking Owls by 2006.

It is considered that the proposed works are consistent with the above management actions.

*Ninox strenua* (Powerful Owl) & *Tyto novaehollandiae* (Masked Owl)

A recovery plan has been prepared for Large Forest Owls, Powerful Owl, Masked Owl and Sooty Owl (DEC 2006).

The overall objective of the NSW Large Forest Owl Recovery Plan is to ensure that the three species persist in the wild in NSW in each region where they presently occur (DEC 2006). A further objective is to reassess the conservation status of the species and down list from Vulnerable to secure if appropriate (DEC 2006). Specific objectives include:

- Manage and protect habitat off reserves and State forests;
- Mitigation of development related threats;
- Model and map owl habitat and validate with surveys;
- Monitor owl population parameters;
- Audit forestry prescriptions;
- Encourage research;
- Increase community awareness and involvement in owl conservation; &
- Provide organisational support and integration (DEC 2006).

It is considered that the proposed works and supporting assessments are consistent with the objectives of this recovery plan.

This species has been assigned to the Landscape species management stream under the *Saving our Species* program (OEH, 2015a).

The action statement aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015a).

OEH is currently developing a targeted approach for managing Landscape species species. In the interim, the following management actions have been identified for this species (OEH, 2015a):

- Prepare guidelines addressing issues associated with habitat protection and management and survey and assessment on private lands;
- Encourage CMAs to invest in actions that actively manage and/or conserve large forest owl habitat

- as part of their Catchment Action Plans;
- Encourage private landholders to undertake management options to conserve and/or actively manage forest owl habitat;
  - Prepare environmental impact assessment guidelines to assist consent and determining authorities and environmental consultants to assess impacts of developments on the Powerful Owl;
  - Monitor and report on effectiveness of concurrence and licence conditions previously applied to reduce impacts of development on Powerful Owls and their habitats, by recording conditions, picking case studies and checking owl presence post development;
  - Use records of concurrence and licence conditions to develop a set of prescriptive guidelines that may be used to mitigate the impacts of developments on the Powerful Owl outside conservation reserves and State forests;
  - Update and refine existing Powerful Owl habitat models using the best available information and map the amount of modelled habitat across forested land in NSW;
  - Design a sampling strategy to test the modelled habitat for the presence of Powerful Owls and undertake field validation;
  - Estimate amount of mapped modelled habitat for Powerful Owls that is occupied (based on proportion of sample sites with owls in them). Use this to further estimate number of owl territories within different land tenures (based on home range data);
  - Develop a sampling methodology stratified across different land tenures and disturbance histories, as well as a set of standardised regional monitoring protocols;
  - Investigate and pursue the cooperative involvement of other agencies, researchers and the community in the implementation of the regional monitoring program;
  - Implement a regional monitoring program. This will be undertaken once owl habitat models have been refined, validated and sampling strategy developed;
  - Investigate the implementation of the forestry threatened species licence owl prescriptions by carrying out proactive audits targeting these prescriptions and through IFOA monitoring and reporting;
  - Carry out post harvest surveys in locations where Powerful Owls were detected prior to logging to determine if they are continuing to occupy the habitat;
  - Encourage student radio tracking projects examining the use of logged and unlogged forest by the Powerful Owl species;
  - Make an assessment of the implementation and effectiveness of forestry owl prescriptions and if necessary refine the prescriptions and negotiate changes to the forestry threatened species licences;
  - Promote awareness of the research needs of the Powerful owl among the scientific and academic community;
  - Seek an ARC Linkage Grant or other joint funding opportunity to initiate research into identified key areas of the biology and ecology of the three large forest owls;
  - Seek scholarship funds for an identified aboriginal student to investigate the cultural and historic significance of the Powerful Owl;
  - Current information on owl and habitat identification must be maintained on the threatened species website;

- Convene a threatened owl workshop with relevant experts and stakeholders to reassess the state conservation status of the Powerful owl;
- Finalise the large forest owl Multi species plan for Sooty, Masked and Powerful Owl by 2006.
- Provide up to date and accurate large forest owl and habitat information in the PVP Developer - Threatened Species Tool'; &
- Provide up to date information and data for the Biobanking assessment methodology.

It is considered that the proposed works are consistent with the above management actions.

#### *Chthonicola sagittata* (Speckled Warbler)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Landscape species management stream under the *Saving our Species* program (OEH, 2015a).

This action statement aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015a).

Priority sites for species are being identified by the Office of Environment and Heritage and other program partners, where feasible, cost-effective and beneficial to the species (OEH, 2015a). Currently, 0 management sites have been identified for this species (OEH, 2015a).

#### *Anthochaera phrygia* (Regent Honeyeater)

A recovery plan for Regent Honeyeater was prepared in 1999.

- The objectives of this recovery plan, to be achieved in two decades, include (Menkhorst *et al*, 1999):
- To ensure that the species persists in the wild;
- To achieve a down-listing from nationally endangered to vulnerable by stabilising the population decline and securing habitat extent and quality in the main areas of occupancy; &
- Achieve increasing reporting rates (5%per annum) in areas previously used regularly, eg Munghorn Gap (NSW), Bendigo, north-east Melbourne and the Eildon area (VIC).

Specific objectives of this plan include (Menkhorst, *et al*, 1999):

- OBJECTIVE 1. Effectively organise and administer the recovery effort to ensure that recovery plan objectives are met;

- OBJECTIVE 2. Maintain and enhance the value of Regent Honeyeater habitat at the key sites and throughout the former range, by active participation in land-use planning processes and by active vegetation rehabilitation at strategic sites;
- OBJECTIVE 3. Monitor trends in the Regent Honeyeater population size and dispersion across its range to allow assessment of the efficacy of management actions;
- OBJECTIVE 4. Facilitate research on strategic questions which will enhance the capacity to achieve the long-term objectives. In particular, determine the whereabouts of Regent Honeyeaters during the non-breeding season and during breeding season absences from known sites. Identify important sites and habitat requirements at these times;
- OBJECTIVE 5. Maintain and increase community awareness, understanding and involvement in the recovery effort;
- OBJECTIVE 6. Maintain the captive population of Regent Honeyeaters at a size which will provide adequate stock to: provide insurance against the demise of the wild population; continuously improve captive-breeding and husbandry techniques; provide adequate stock for trials of release strategies; and maintain 90% of the wild heterozygosity in the captive population;

It is considered that the proposal is consistent with the objectives of this recovery plan.

#### *Daphoenositta chrysoptera* (Varied Sittella)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Landscape species management stream under the *Saving our Species* program (OEH, 2015a).

This action statement aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015a).

Priority sites for species are being identified by the Office of Environment and Heritage and other program partners, where feasible, cost-effective and beneficial to the species (OEH, 2015a). Currently, 0 management sites have been identified for this species (OEH, 2015a).

#### *Dasyurus maculatus* (Spotted-tailed Quoll)

A draft recovery plan for the Spotted-tailed Quoll (Long & Nelson 2010a) is open for public comment (DoE, 2015). Specific objectives of the plan include:

- Determine the distribution and status of Spotted-tailed Quoll populations throughout the range;
- Increase knowledge of the biology and ecology of the Spotted-tailed Quoll throughout its range to refine management of the species and its habitat;
- Reduce the rate of habitat loss and fragmentation on private land;
- Evaluate and manage the risk posed by silvicultural practices;
- Determine and manage the threat posed by introduced predators, such as Foxes (*Vulpes vulpes*), Cats (*Felis catus*) and Wild Dogs (*Canis lupus familiaris*), and predator control practices on Spotted-tailed Quoll populations;
- Determine and manage the impact of fire regimes on Spotted-tailed Quoll populations;
- Reduce deliberate killings of Spotted-tailed Quolls;
- Reduce the frequency of Spotted-tailed Quoll road mortality;
- Assess the threat Cane Toads pose to Spotted-tailed Quolls and develop threat abatement actions if necessary;
- Determine the likely impact of climate change on Spotted-tailed Quoll populations;
- Increase community awareness of the Spotted-tailed Quoll and involvement in the Recovery Program;
- Link suitable habitat fragments with corridors; &
- Continue predator and competitor control (eg. The Cat Threat Abatement Plan (Environment Australia 1995b).

It is considered that the proposal is consistent with the objectives of this draft recovery plan.

#### Grey-headed Flying-fox (*Pteropus poliocephalus*)

A draft national recovery plan for this species lists 13 specific objectives, each with a number of actions and performance criteria (DECCW, 2009).

Most are not considered specific to the current project as the study area does not contain a known camp of the Grey-headed Flying-fox (GHFF).

This species has been assigned to the Landscape species management stream under the *Saving our Species* program (OEH, 2015a).

This species is distributed across relatively large areas and is subject to threatening processes that generally act at the landscape scale (e.g. habitat loss or degradation) rather than at distinct, definable locations (OEH, 2015a).

This action statement aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015a).

OEH is currently developing a targeted approach for managing Landscape species. In the interim, the following management actions have been identified for this species (OEH, 2015a):

- Set priorities for protecting foraging habitat critical to the survival of Grey-headed Flying-foxes and generate maps of priority foraging habitat;
- Protect and enhance priority foraging habitat for Grey-headed Flying-foxes, for example through management plans, local environmental plans and development assessments, and through volunteer conservation programs for privately owned land;
- Increase the extent and viability of foraging habitat for Grey-headed Flying-foxes that is productive during winter and spring (generally times of food shortage), including habitat restoration/rehabilitation works;
- Establish & maintain a range-wide database of Grey-headed Flying-fox camps, including information on location, tenure, zoning & history of use, for distribution to land management/planning authorities, researchers & interested public;
- Improve knowledge of Grey-headed Flying-fox camp locations, targeting regional areas and seasons where information is notably incomplete, such as inland areas during spring and summer;
- Protect roosting habitat critical to the survival of Grey-headed Flying-foxes, for example through management plans, local environmental plans and development assessments, and through volunteer conservation programs for privately owned land;
- Determine characteristics of roosting habitat for Grey-headed Flying-foxes, exploring the roles of floristic composition, vegetation structure, microclimate and landscape features, and assess the status of camps;
- Enhance and sustain the vegetation of camps critical to the survival of Grey-headed Flying-foxes;
- Develop and promote incentives to reduce killing of flying-foxes in commercial fruit crops;
- Identify the commercial fruit industries that are impacted by Grey-headed Flying-foxes, to provide an information base for use by the various stakeholders;
- Systematically document the levels of flying-fox damage to the horticulture industry within the range of the Grey-headed Flying-fox;
- Develop methods for rapid estimates of flying-fox damage on commercial crops, allowing the long-term monitoring of industry-wide levels and patterns of flying-fox damage;

- Develop and implement a grower-based program to monitor trends in damage to commercial fruit crops by flying-foxes, and use the results to monitor the performance of actions to reduce crop damage;
- Develop methods to monitor landscape scale nectar availability trends, to explain/potentially predict crop damage trends where crop protection is absent, & promote importance of foraging habitat productive in seasons critical to the horticulture industry;
- Describe the species, age structure & demographics of flying-foxes killed in fruit crops to improve the understanding of the impact by assessing trends in the species, sex, age & reproductive status of animals killed on crops;
- Review & evaluate camp site management activities, summarising outcomes of past experiences at controversial camps. Noise impacts on neighbours of camps to be considered. For use in managing future conflicts with humans at flying-fox camps;
- Develop guidelines to assist land managers dealing with controversial flying-fox camps;
- Develop materials for public education & provide them to land managers & local community groups working with controversial flying-fox camps, highlighting species status, reasons for being in urban areas, reasons for decline etc;
- Assess the impacts Grey-headed Flying-fox camps have on water quality, and publish results in a peer-reviewed journal;
- Provide educational resources to improve public attitudes toward Grey-headed Flying-foxes;
- Monitor public attitudes towards flying-foxes;
- Review and improve methods used to assess population size of Grey-headed Flying-foxes;
- Conduct periodic range-wide assessments of the population size of Grey-headed Flying-foxes to monitor population trends;
- Assess the impacts on Grey-headed Flying-foxes of electrocution on powerlines and entanglement in netting and barbed wire, and implement strategies to reduce these impacts;
- Investigate the differences in genetic relatedness, sex, age etc. between sedentary and transient Grey-headed Flying-foxes;
- Investigate between-year fidelity of Grey-headed Flying-fox individuals to seasonal camps;
- Investigate the genetic structure within Grey-headed Flying-fox camps, including levels of relatedness within and between members of adult groups, occupants of individual trees etc;
- Investigate the patterns of juvenile Grey-headed Flying-fox dispersal and mortality, allowing identification of the specific habitat requirements of juveniles;
- Investigate the age structure and longevity of Grey-headed Flying-foxes;
- Complete national recovery plan;

- Grey-headed Flying-fox National Recovery Team to undertake an annual review of the national recovery plan's implementation (OEH, 2014a).

It is considered that the proposal is consistent with the above management actions.

*Petaurus norfolcensis* (Squirrel Glider)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Landscape species management stream under the *Saving our Species* program (OEH, 2015a).

This action statement aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015a).

Priority sites for species are being identified by the Office of Environment and Heritage and other program partners, where feasible, cost-effective and beneficial to the species (OEH, 2015a). Currently, 0 management sites have been identified for this species (OEH, 2015a).

*Saccolaimus flaviventris* (Yellow-bellied Sheath-tail-bat)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Landscape species management stream under the *Saving our Species* program (OEH, 2015a).

This species is distributed across relatively large areas and is subject to threatening processes that generally act at the landscape scale (e.g. habitat loss or degradation) rather than at distinct, defineable locations (OEH, 2015a).

This action statement aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015a).

OEH is currently developing a targeted approach for managing Landscape species species. In the interim, the following management actions have been identified for this species (OEH, 2015a).

- Ensure the largest hollow bearing trees (including dead trees and paddock trees) are given highest priority for retention in PVP assessments and or other land assessment tools;
- Prepare EIA guidelines which address the retention of hollow bearing trees maintaining diversity of age groups, species diversity, structural diversity. Give priority to largest hollow bearing trees;
- Investigate the effectiveness of logging prescriptions;
- Undertake long-term monitoring of populations cross tenure in conjunction with other bat species to document changes;
- Identify the effects of fragmentation on the species in a range of fragmented landscapes. .
- Study the ecology, habitat requirements and susceptibility to logging and other forestry practices of this little-known species;

- Identify areas of private land that contain high densities of large, hollow-bearing trees as areas of high conservation value planning instruments and land management negotiations e.g. LEP, CAPs, PVPs;
- Promote the conservation of these HCV private land areas using measures such as incentive funding to landholders, off-setting and biobanking, acquisition for reserve establishment or other means;
- Develop and promote State-wide bat awareness programs for schools, CMAs, landholders and industry groups etc;
- Research the effectiveness of rehabilitation measures intended to increase bat populations in degraded landscapes, such as revegetating and installing bat boxes;
- Research to quantify any benefits of local bat populations to reducing the impact of insect pests on commercial crops;
- Ensure the Code of Practice for private native forestry includes adequate measures to protect large, hollow-bearing trees and viable numbers of recruit trees;
- Research the roosting ecology of tree-roosting bats. For example identifying the attributes of key roosts;
- Research the degree of long-term fidelity to roost trees and roosting areas in order to assess their importance and the effects of their removal;
- Use radio-tracking to identify important foraging range and help interpret density of records;
- Raise awareness of the effects of pesticides;
- Study the species biology such as reproductive capacity, longevity, mortality rate and life history, or thermal and energy requirements to better determine capacity to respond to changes in climate or recover from losses in the population;
- Study the susceptibility of this species to pesticide accumulation;
- Establish a community program to encourage the reporting of roost trees;
- Research the potential for long distance/seasonal movement; &
- Research the effect of different burning regimes.

It is considered that the proposal is consistent with the above management actions.

#### *Mormopterus norfolkensis* (Eastern Freetail-bat)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Data-deficient species management stream under the *Saving our Species* program as little is known about its distribution and population size (OEH, 2015a).

This action statement aims to address key knowledge gaps for this species, which once resolved, can inform effective management of this species (OEH, 2015a).

A number of state-wide conservation actions, listed below, have also been identified for this species (OEH, 2015a):

- Complete national recovery plan;

- Ensure the largest hollow bearing trees, inc. dead trees and paddock trees, are given highest priority for retention in PVP assessments. Offsets should include remnants in high productivity;
- Prepare EIA guidelines which address the retention of hollow bearing trees maintaining diversity of age groups, species diversity, structural diversity. Give priority to largest hollow bearing trees;
- Investigate the effectiveness of logging prescriptions;
- Undertake long-term monitoring of populations cross tenure in conjunction with other bat species to document changes;
- Identify the effects of fragmentation in a range of fragmented landscapes i.e. the farmland/forest interface and the urban/forest interface e.g. movement and persistence across a range of fragment sizes;
- Study the ecology, habitat requirements and susceptibility to logging and other forestry practices of this little-known species;
- Identify areas of private land that contain high densities of large hollow-bearing trees as areas of high conservation value planning instruments and land management negotiations e.g. LEP, CAPs, PVPs;
- Promote the conservation of these private land areas using measures such as incentive funding to landholders, off-setting and biobanking, acquisition for reserve establishment or other means;
- Develop and promote State-wide bat awareness programs for schools, CMAs, landholders and industry groups etc;
- Research the effectiveness of rehabilitation measures intended to increase bat populations in degraded landscapes, such as revegetating and installing bat boxes;
- Quantify any benefits of local bat populations to reducing the impact of insect pests on commercial crops;
- Ensure the Code of Practice for private native forestry includes adequate measures to protect large, hollow-bearing trees and viable numbers of recruit trees;
- Research the roosting ecology of tree-roosting bats. For example identifying the attributes of key roosts;
- Research the degree of long-term fidelity to roost trees and roosting areas in order to assess their importance and the effects of their removal;
- Identify important foraging range and key habitat components for this species;
- Identify the susceptibility of the species to pesticides;
- Better define species distribution through survey in coastal lowlands on- and off-reserve; &
- Research the effect of different burning regimes.

It is considered that the proposal is consistent with the above management actions.

*Chalinolobus dwyeri* (Large-eared Pied Bat)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Data-deficient species management stream under the *Saving our Species* program (OEH, 2015a).

This species is in the Data Deficient stream as there is little known about its distribution, general ecology or the management techniques required to secure it in the wild (OEH, 2015a).

This action statement aims to address key knowledge gaps for this species, which once resolved, can inform effective management of this species (OEH, 2015a).

The following research actions have been designed to address priority knowledge gaps in order to develop an appropriate management approach for this species (OEH, 2015a):

- Investigate the environmental features that predict occupancy;
- Investigate habitat features that influence selection of maternity roost sites; &
- Investigate fidelity of local populations to roosting cave/s.

The following state-wide conservation actions have also been identified for this species (OEH, 2015a).

- Ensure protection of caves and overhangs in area of suitable geology when undertaking PVP assessments (offsets should include nearby remnants in high productivity) or other land assessment tools;
- Prepare EIA guidelines which address the retention of hollow bearing trees maintaining diversity of age groups, species diversity, structural diversity. Give priority to largest hollow bearing trees;
- Identify the effects of fragmentation on the species in a range of fragmented landscapes such as the farmland/forest interface. For example movement and persistence across a range of fragment sizes;
- Identify and protect roost habitat artificial structures (eg culverts, old buildings and derelict mines);
- Undertake long-term monitoring of populations cross tenure in conjunction with other bat species to document changes;
- Identify the susceptibility of the species to pesticides;
- Undertake a targeted survey to determine distribution and status in parts of their range, such as the western edge of range;
- Determine location and attributes of maternity sites and restrict access where possible. (e.g. signage; bat-friendly, preferably external, gating of caves);
- Restrict access where possible to known maternity sites (e.g. signage; bat-friendly, preferably external, gating of caves);
- Measure the genetic population structure among roosts of maternity colonies to estimate dispersal and genetic isolation, and thus vulnerability of regional populations to extinction;
- Promote bats throughout the rural community as ecologically interesting and important, but sensitive to disturbance at caves/overhangs;

- Control feral goats in rock overhangs and caves in the species range;
- Identify important foraging range and key habitat components for this species;
- Study the ecology, habitat requirements and population dynamics;
- Determine suitable geology for roosting habitat for this species;
- Implement key threat abatement actions for longwall mining; &
- Research the effect of different burning regimes.

It is considered that the proposal is consistent with the above management actions.

*Falsistrellus tasmaniensis* (Eastern False Pipistrelle)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Landscape species management stream under the *Saving our Species* program (OEH, 2015a).

The primary threats to this species are at the landscape scale; loss and fragmentation of suitable habitat, loss of foraging and roosting (hollow-bearing trees) resources (OEH, 2015a).

The action statement aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015a).

OEH is currently developing a targeted approach for managing Landscape species species. In the interim, the following management actions have been identified for this species (OEH, 2015a):

- Ensure the largest hollow bearing trees (including dead trees) are given highest priority for retention in PVP assessments or other land assessment tools;
- Prepare EIA guidelines which address the retention of hollow bearing trees maintaining diversity of age groups, species diversity, structural diversity. Give priority to largest hollow bearing trees;
- Investigate the effectiveness of logging prescriptions;
- Undertake long-term monitoring of populations cross tenure in conjunction with other bat species to document changes;
- Identify the effects of fragmentation in a range of fragmented landscapes e.g. cleared Tableland landscapes. For example genetic isolation, movement and persistence across a range of fragment sizes;
- Study the ecology, habitat requirements and susceptibility to logging and other forestry practices of this little-known species;
- Identify areas of private land that contain high densities of large hollow-bearing trees as areas of high conservation value (HCV) planning instruments and land management negotiations e.g. LEP, CAPs, PVPs;
- Promote the conservation of these HCV private land areas using measures such as incentive funding to landholders, off-setting and biobanking, acquisition for reserve establishment or other means;
- Develop and promote State-wide bat awareness programs for schools, CMAs, landholders and industry groups etc;
- Research the effectiveness of rehabilitation measures intended to increase bat populations in

- degraded landscapes, such as revegetating and installing bat boxes;
- Quantify any benefits to local bat populations from reducing the impact of insect pests on commercial crops;
- Ensure the Code of Practice for private native forestry includes adequate measures to protect large, hollow-bearing trees and viable numbers of recruit trees;
- Research the roosting ecology of tree-roosting bats. For example identifying the attributes of key roosts;
- Research the degree of long-term fidelity to roost trees and roosting areas in order to assess their importance and the effects of their removal;
- Identify important foraging range and key habitat components for this species; &
- Research the effect of different burning regimes.

It is considered that the proposal is consistent with the above management actions.

#### *Kerivoula papuensis* (Golden-tipped Bat)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Landscape species management stream under the *Saving our Species* program (OEH, 2015a).

The primary threats to this species are loss, degradation and fragmentation of wet forest habitat across the landscape (OEH, 2015a).

The action statement aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015a).

OEH is currently developing a targeted approach for managing Landscape species species. In the interim, the following management actions have been identified for this species (OEH, 2015a):

- Investigate the effectiveness of logging prescriptions such as rainforest and riparian buffers;
- Prepare EIA guidelines which address retention of hollow bearing trees maintaining diversity of age groups, species diversity & structural diversity, giving priority to largest hollow bearing trees;
- Determine impacts of different fire regimes on the habitat of this species;
- Undertake long-term monitoring of populations cross tenure in conjunction with other bat species to document changes;
- Identify the effects of fragmentation on the species in a range of fragmented landscapes. For example genetic isolation, movement and persistence across a range of fragment sizes; &
- Study the ecology, habitat requirements and susceptibility to logging and other forestry practices of this little-known species.

It is considered that the proposal is consistent with the above management actions.

#### *Miniopterus australis* (Little Bentwing-bat)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Site-managed species management stream under the *Saving our Species* program (OEH, 2015a).

This species requires site-based management in order to secure it from extinction in NSW for 100 years (OEH, 2015a).

The conservation project aims to secure the species in the wild for 100 years and maintain its conservation status under the TSC Act (OEH, 2015a).

The Office of Environment and Heritage has established one (1) proposed management site, Willi Willi in the Armidale Dumaresq/ Kempsey LGA, where conservation activities need to take place to ensure the conservation of this species (OEH, 2015a).

The subject site is not located within or in close proximity to the proposed management site for this species. It is considered that the proposal is unlikely to effect the recovery actions for this species.

#### *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Site-managed species management stream under the *Saving our Species* program (OEH 2015a)

This species requires site-based management in order to secure it from extinction in NSW for 100 years (OEH, 2015a).

The conservation project aims to secure the species in the wild for 100 years and maintain its conservation status under the TSC Act (OEH, 2015a).

The Office of Environment and Heritage has established 4 management sites where conservation activities need to take place to ensure the conservation of this species (OEH, 2015a).

#### Management sites

| <u>Site name</u>            | <u>Site type</u> | <u>Status</u> | <u>Local government area (LGA)</u>                                                             |
|-----------------------------|------------------|---------------|------------------------------------------------------------------------------------------------|
| <a href="#">Willi Willi</a> | Management Site  | Proposed      | Armidale Dumaresq/ Kempsey/<br>Nambucca/ Port Macquarie-<br>Hastings <a href="#">show more</a> |
| <a href="#">Drum Cave</a>   | Management Site  | Proposed      | Goulburn Mulwaree/<br>Shoalhaven/ Upper Lachlan                                                |

| <u>Site name</u>          | <u>Site type</u> | <u>Status</u> | <u>Local government area (LGA)</u> |
|---------------------------|------------------|---------------|------------------------------------|
| <u>Church Cave</u>        | Management Site  | Proposed      | Gundagai/ Harden/ Tumut            |
| <u>Hibernacular Sites</u> | Management Site  | Proposed      |                                    |

The subject site is not located within or in close proximity to any of these management sites. The proposal is considered to be consistent with the recovery actions for this species.

*Scoteanax rueppellii* (Greater Broad-nosed Bat)

No recovery or draft recovery plan has been prepared for this species.

This species is distributed across relatively large areas and is subject to threatening processes that generally act at the landscape scale (e.g. habitat loss or degradation) rather than at distinct, defineable locations (OEH, 2015a). As such, this species has been assigned to the Landscape species management stream under the *Saving our Species* program (OEH, 2015a).

The action statement aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015a).

OEH is currently developing a targeted approach for managing Landscape species species. In the interim, the following management actions have been identified for this species (OEH, 2015a):

- Ensure largest hollow bearing trees, inc. dead trees and paddock trees are given highest priority for retention in PVP assessments (offsets should include remnants in high productivity) and/or other land assessment tools;
- Prepare EIA guidelines which address the retention of hollow bearing trees maintaining diversity of age groups, species diversity, structural diversity. Give priority to largest hollow bearing trees.
- Investigate the effectiveness of logging prescriptions;
- Undertake long-term monitoring of populations cross tenure in conjunction with other bat species to document changes;
- Identify the effects of fragmentation on the species in a range of fragmented landscapes, such as cleared coastal river valleys. For example movement and persistence across a range of fragment sizes;
- Study the ecology, habitat requirements and susceptibility to logging and other forestry practices of this little-known species;
- Identify areas of private land that contain high densities of large, hollow-bearing trees as areas of high conservation value in planning instruments and land management negotiations e.g. LEP, CAPs, PVPs;
- Promote the conservation of these HCV private land areas using measures such as incentive funding to landholders, off-setting and biobanking, acquisition for reserve establishment or other means;

- Develop and promote State-wide bat awareness programs for schools, CMAs, landholders and industry groups etc;
- Research the effectiveness of rehabilitation measures intended to increase bat populations in degraded landscapes, such as revegetating riparian zones;
- Quantify any benefits of local bat populations to reducing the impact of insect pests on commercial crops;
- Ensure the Code of Practice for private native forestry includes adequate measures to protect large, hollow-bearing trees and viable numbers of recruit trees;
- Research the roosting ecology of tree-roosting bats. For example identifying the attributes of key roosts;
- Research the degree of long-term fidelity to roost trees and roosting areas in order to assess their importance and the effects of their removal;
- Identify important foraging range and key habitat components for this species;
- Undertake a systematic survey of productive coastal river valleys to quantify the importance of private land relative to public lands;
- Raise awareness of the effects of pesticides;
- Study the susceptibility of this species to pesticide accumulation; &
- Research the effect of different burning regimes.

It is considered that the proposal is consistent with the above management actions.

#### *Myotis macropus* (Southern Myotis)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Landscape species management stream under the *Saving our Species* program (OEH, 2015a).

This action statement aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015a).

Priority sites for species are being identified by the Office of Environment and Heritage and other program partners, where feasible, cost-effective and beneficial to the species (OEH, 2015a). Currently, 0 management sites have been identified for this species (OEH, 2015a).

#### *Hoplocephalus bitorquatus* (Pale-headed Snake)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Site-managed species management stream under the *Saving our Species* program (OEH, 2015a).

The conservation project aims to secure the species in the wild for 100 years and maintain its conservation status under the TSC Act (OEH, 2015a).

The Office of Environment and Heritage has established 3 proposed management sites where conservation activities need to take place to ensure the conservation of this species (OEH, 2015a). These include, Royal National Park, Woronora Plateau and Morton National Park.

The subject site is not located within or in close proximity to any of these management sites. The proposal is considered to be consistent with the recovery actions for this species.

#### *Crinia tinnula* (Wallum Froglet)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Keep-watch species management stream under the *Saving our Species* program (OEH, 2015a).

This species is likely to be secure in NSW for the long term without targeted management, assuming adequate ongoing management of habitat within the public reserve system (OEH, 2015a). This species is therefore a lower priority for investment than other, more threatened species that have urgent management requirements (OEH, 2015a). Any change in the status of this species (e.g. decline in abundance or emergence of a significant threat) will trigger a shift to the Site-managed stream and the development of a conservation project, which will be prioritised for implementation (OEH, 2015a).

#### *Melaleuca biconvexa* (Biconvexa Paperbark)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Site-managed species management stream under the *Saving our Species* program (OEH, 2015a).

The conservation project aims to secure the species in the wild for 100 years and maintain its conservation status under the TSC Act (OEH, 2015a).

The Office of Environment and Heritage has established three (3) management sites at Porters Creek, Ourimbah and St Georges Basin, where conservation activities need to take place to ensure the conservation of this species (OEH, 2015a). The subject site is located approximately 3km to the east of the Porters Creek site.

*Caladenia tessellata* (Thick Lip Spider Orchid)

A national recovery plan was completed for this species in 2010.

The overall objective of recovery is to minimise the probability of extinction of the Thick-lip Spider- orchid in the wild and to increase the probability of populations becoming self-sustaining in the long term (Duncan, 2010). Within the duration of this Recovery Plan, the specific objectives for the recovery of the Thick-lip Spider-orchid are to (Duncan, 2010):

- Determine taxonomy, distribution, abundance and population structure
- Determine habitat requirements
- Ensure that all populations and their habitat are protected and managed appropriately
- Manage threats to populations
- Identify key biological functions
- Determine growth rates and viability of populations
- Establish a population in cultivation
- Build community support for conservation

It is considered that the proposal is consistent with the objectives of this recovery plan.

*Rhizanthella slateri* (Eastern Australian Underground Orchid)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Site-managed species management stream under the *Saving our Species* program (OEH, 2015a).

The conservation project aims to secure the species in the wild for 100 years and maintain its conservation status under the TSC Act (OEH, 2015a).

The Office of Environment and Heritage has established two (2) proposed management sites, one at Buladelah and a translocation site (location not specified), where conservation activities need to take place to ensure the conservation of this species (OEH, 2015a).

*Thelymitra sp. adorata* (Wyong Sun Orchid)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Site-managed species management stream under the *Saving our Species* program (OEH, 2015a).

The conservation project aims to secure the species in the wild for 100 years and maintain its conservation status under the TSC Act (OEH, 2015a).

The Office of Environment and Heritage has established three (3) management sites including, Warnevale, Wyong and one translocation site (location not specified), where conservation activities need to take place to ensure the conservation of this species (OEH, 2015a). The subject site is not part of an established management site for this species. No specimens of *Thelymitra sp. adorata* were recorded within the subject site.

*Rutidosia heterogama*

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Keep-watch species management stream under the *Saving our Species* program (OEH, 2015a).

Relatively large populations of this species occur within reserves (e.g. over 500 individuals recorded in Yuragir National Park and Torrington State Conservation Area) where current management is sufficient to ensure their long term security (OEH, 2015a).

*Grevillea parviflora subsp. parviflora* (Small-flowered Grevillea)

No recovery or draft recovery plan has been prepared for this species.

This species has been assigned to the Data-deficient species management stream under the *Saving our Species* program (OEH, 2015a).

This species is in the Data Deficient stream as little is known about its distribution or the management techniques required to secure it in the wild (OEH, 2015a). This action statement aims to address key knowledge gaps for this species, which once resolved, can inform effective management of this species (OEH, 2015a). Priority research actions for this species are currently under development (OEH, 2015a).

## Threat Abatement Plans

The Red Fox (*Vulpes vulpes*) was recorded within the subject site. In 2011 the OEH published the NSW Threat abatement plan for predation by the red fox (*Vulpes vulpes*). The primary action of this plan is for public-land managers (especially the DECCW Parks and Wildlife, Forests NSW and the LPMA) to undertake frequent broad-area fox control at priority sites (OEH, 2011).

This plan lists priority sites and actions which apply to priority sites. The subject site is not within or in close proximity to any listed priority sites.

No other current threat abatement plans appear to be specifically relevant to any tested threatened entities, the subject site or the proposal.

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

The proposal may potentially constitute or promote the following listed Key Threatening Processes (KTP) under the NSW TSC Act or NSW Fisheries Management Act.

#### *Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners (Manorina melanocephala) (TSC Act)*

Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners (*Manorina melanocephala*) is listed as a KEY THREATENING PROCESS by both the TSC Act and the EPBC Act.

A range of threatened woodland and forest bird species listed under the *Threatened Species Conservation Act 1995* are adversely affected by aggressive exclusion by abundant Noisy Miners including Regent Honeyeater (*Anthochaera phrygia*), Swift Parrot (*Lathamus discolor*), Speckled Warbler (*Chthonicola sagittata*), Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*), Varied Sittella (*Daphoenositta chrysoptera*), Little Lorikeet (*Glossopsitta pusilla*), Painted Honeyeater (*Grantiella picta*), Hooded Robin (south- eastern form) (*Melanodryas cucullata cucullata*), Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*), Turquoise Parrot (*Neophema pulchella*), Gilbert's Whistler (*Pachycephala inornata*), Scarlet Robin (*Petroica boodang*), Flame Robin (*P. phoenicea*), Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*), and Diamond Firetail (*Stagonopleura guttata*) (OEH, 2015a). These and other bird species are primarily impacted by their active exclusion from areas of otherwise suitable habitat, which limits feeding, breeding and dispersal opportunities and therefore ultimately population size and persistence (OEH, 2015a).

The Office of Environment and Heritage has identified 0 priority actions to help recover the Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners *Manorina melanocephala* in New South Wales (OEH, 2015a).

Noisy Miner was recorded during the surveys, so it is likely that this KTP is actively occurring. It is considered that the proposal is unlikely to increase the impact of this KTP.

#### Bushrock removal (TSC Act).

Bushrock Removal is listed as a KEY THREATENING PROCESS by the TSC Act (OEH, 2015a).

Bushrock removal is the removal of natural surface deposits of rock from rock outcrops or from areas of native vegetation (OEH, 2015a).

Bushrock serves many purposes in the natural environment (OEH, 2015a). It provides habitat for many plants and animals, some of which are threatened (OEH, 2015a). Many animals use rocks and rock environments for shelter, to hide from predators, find food, avoid extreme weather conditions and escape bushfires (OEH, 2015a). Bushrock is also known to provide egg-laying sites for reptiles (OEH, 2015a).

Threatened species which are identified as being adversely affected by Bushrock are: Fauna - Pink-tailed Worm lizard, Striped Legless lizard, Broad-headed snake, Red-crowned toadlet, Little Whip Snake and Grassland Earless Dragon; Flora - *Acacia bynoeana*, *A. gordonii*, *Boronia granitica*, *Darwinia biflora*, *Eucalyptus camfieldii*, *Kunzea rupestris*, *Melaleuca deanei*, *Micromyrtus blakelyi*, *Persoonia hirsute*, *Pimelea curviflora* var. *curviflora*, *Tetradlea glandulosa* and *Velleia perfoliate* (OEH, 2015a).

The Office of Environment and Heritage has identified 14 priority actions to help recover the Bushrock removal in New South Wales (OEH, 2015a).

A very sparse cover of small surface rocks were observed in parts of the subject site. This KTP is unlikely to be significantly increased due to the proposal.

#### Clearing of native vegetation (TSC Act).

Clearing of native vegetation is listed as a KEY THREATENING PROCESS under both the TSC Act and the EPBC Act (OEH, 2015a).

Clearing, as defined by the determination, refers to the destruction of a sufficient proportion of one or more strata (layers) within a stand or stands of native vegetation (OEH, 2015a). For the purposes of this

determination native vegetation does not include marine vegetation within the meaning of the Fisheries Management Act 1994. There are numerous impacts as a result of clearing native vegetation (OEH, 2015a), including:

- destruction of habitat causing a loss of biological diversity, and may result in total extinction of species or loss of local genotypes;
- fragmentation of populations resulting in limited gene flow between small isolated populations, reduced potential to adapt to environmental change and loss or severe modification of the interactions between species;
- riparian zone degradation, such as bank erosion leading to sedimentation that affects aquatic communities;
- disturbed habitat which may permit the establishment and spread of exotic species which may displace native species; and
- loss of leaf litter, removing habitat for a wide variety of vertebrates and invertebrates.

Clearing has been identified as a threat to a number of species, communities and populations listed under the Threatened Species Conservation Act, could cause species, populations or ecological communities that are not threatened to become threatened, but the determination applies to clearing as a process, regardless of the species, populations and ecological communities affected in a particular instance (NSW Scientific Committee 2001a).

As such this KTP applies to all of the threatened species tested in this assessment.

The Office of Environment and Heritage has identified 21 priority actions to help recover the Clearing of native vegetation in New South Wales (OEH, 2015a).

The proposal will remove approximately 1.75ha of marginal potential habitat available to this species, while approximately 0.96ha of habitat will be retained as part of a E2 zoned area along western side of the subject site.

#### *Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus* (TSC Act)*

This Key Threatening Process is listed by both the TSC Act and the EPBC Act.

Grazing and burrowing by rabbits can cause massive erosion problems, reduce recruitment and survival of native plants, and alter entire landscapes (OEH, 2015a). Rabbits also threaten the survival of a number of native animal species by altering habitat, reducing native food sources, displacing small animals from burrows and attracting introduced predators such as foxes (OEH, 2015a). In addition, rabbits may have significant impacts on Aboriginal and historic cultural heritage, for example, overgrazing by rabbits has exacerbated soil erosion in Mungo and Kinchega national parks, exposing culturally significant sites such as Aboriginal burial grounds (OEH, 2015a).

The Office of Environment and Heritage has identified 11 priority actions to help recover the Competition and grazing by the feral European Rabbit, (*Oryctolagus cuniculus*) in New South Wales (OEH, 2015a).

Rabbits were recorded within the subject site during surveys. It is unlikely that the proposal will increase the impact of this KTP.

*Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners (TSC Act).*

Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners is listed as a key threatening process by the TSC Act (OEH, 2015a).

This KTP is a form of tree canopy dieback affecting extensive areas of eucalypt forest which can be diagnosed by the presence of over-abundant populations of psyllids, and often large numbers of bell miners (OEH, 2015a).

The Office of Environment and Heritage has identified 10 priority actions to help recover the Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners in New South Wales (OEH, 2015a).

Bell Miners were recorded to the south of the subject site within the Wadalba Wildlife Corridor (WWC) during surveys. It is considered that this KTP may be active within the WWC, however high levels of dieback were not observed.

*Infection of frogs by amphibian chytrid causing the disease chytridiomycosis (TSC Act).*

Infection of frogs by amphibian chytrid causing the disease chytridiomycosis is listed as a KEY THREATENING PROCESS by both the TSC Act and the EPBC Act (OEH, 2015a).

Chytridiomycosis is a fatal disease of amphibians and is caused by the chytrid *Batrachochytrium dendrobatidis* (Longcore et al. 1999 cited in OEH, 2015a).

It is potentially fatal to all native species of amphibian and therefore all frog species that are listed under the schedules of the Act may be affected by the disease (OEH, 2015a).

The Office of Environment and Heritage has identified 24 priority actions to help the recovery this KTP in NSW (OEH, 2015a).

Three (3) common frog species were recorded within the two small dams along the southern boundary of the subject site. Some potential frog habitat also occur within the E2 zoned area (drainage corridor) however no specimens were recorded in this area. Provided that recommendations are adopted, it is considered that the

proposal is unlikely to cause any spread of this disease into areas of potential frog habitat in the E2 zoned area.

*Infection of native plants by Phytophthora cinnamomi (TSC Act)*

Infection of native plants by *Phytophthora cinnamomi* is listed as a KEY THREATENING PROCESS by both the TSC Act and the EPBC Act (OEH, 2015a).

*Phytophthora cinnamomi* is a soil borne pathogen that spreads in plant roots in warm, moist conditions. The pathogen appears to be widespread in coastal forests (Arentz 1974, Blowes 1980, Gerrettson-Cornell 1986, McDougall and Summerell pers. comm. all cited in OEH, 2015a), but may also occur at higher elevations, e.g. Barrington Tops. It infects a large range of species and susceptible species display a range of symptoms; some are killed, some are damaged but endure, and some show no apparent symptoms (OEH, 2015a). In some circumstances, *P. cinnamomi* may contribute to plant death where there are other stresses present (e.g. waterlogging, drought, and wildfire) (OEH, 2015a).

The Office of Environment and Heritage has identified 29 priority actions to help the recovery from this KTP in NSW (OEH, 2015a).

The current proposal could initiate this KTP. As such the contractor will be required to adopt hygiene controls in accordance with the Best Practice Management Guidelines for *Phytophthora cinnamomi* within the Sydney Metropolitan Catchment Management Authority Area (Suddaby & Liew 2008), to ensure that all machinery, materials and personnel are disinfected prior to entering the work site each day (or each part-day). Such action is in accordance with the priority action listed above (Refer to recommendations in section 7.2)

However with adequate controls this KTP is unlikely to be significantly increased due to the proposal or for the species tested in this assessment.

*Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae (TSC Act)*

Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae is listed as a KEY THREATENING PROCESS by the TSC Act (OEH, 2015a).

Currently many coastal parts of NSW from the Shoalhaven to the Queensland border are experiencing an outbreak of Myrtle Rust *Uredo rangelii* which can affect plants belonging to the Myrtaceae family such as

Eucalypts, Melaleuca, Callistemon etc (DPI, 2015). A number of Myrtle Rust controls are required for bushland workers in accordance with document, Myrtle Rust: Everyday Management (DPI, 2015).

The Office of Environment and Heritage has identified 11 priority actions to help the recovery of this KTP in New South Wales (OEH, 2015a).

This KTP was not observed within the subject site. Provided recommendations in section 7.2 are adopted, the proposal is unlikely to cause an increase in the impact of this KTP.

#### *Invasion and establishment of exotic vines and scramblers (TSC Act).*

Invasion and establishment of exotic vines and scramblers is listed as a KEY THREATENING PROCESS by the TSC Act (OEH, 2015a).

A large number of exotic vines and scramblers have become established in New South Wales with many now widespread and locally abundant, especially in the eastern part of the state (OEH, 2015a). Many of these were originally introduced as garden plants and have subsequently escaped into native vegetation communities (OEH, 2015a).

Exotic vines and scramblers have significant adverse effects on biodiversity including smothering native vegetation and seedlings as well as preventing recruitment, especially in riparian areas (OEH, 2015a).

The Office of Environment and Heritage has identified 4 priority actions to help the recovery of this KTP in NSW (OEH, 2015a).

Three (3) species of listed on this KTP profile (OEH, 2015a), *Asparagus aethiopicus* (Asparagus Fern), *Asparagus asparagoides* (Ground Asparagus) and *Impomoea purpurea* (Morning Glory) were recorded within the subject site.

The proposal could exacerbate this KTP if the contractor introduces such species via contaminated machinery etc. As such the contractor will be required to adopt hygiene controls to ensure that all machinery, materials and personnel are clean of any weed seed or propagules prior to entering any work site each day (or each part-day) and the contractor ensures that such material is not spread from one location to another.

However with adequate controls (refer to section 7.2 – Recommendations) this KTP is unlikely to be significantly increased due to the proposal or for the species tested in this assessment.

*Invasion, establishment and spread of Lantana (Lantana camara L. sens. lat) (TSC Act).*

Invasion, establishment and spread of Lantana is listed as a KEY THREATENING PROCESS by the TSC Act (OEH, 2015a).

Lantana is a branching shrub that grows in clumps or dense thickets 2-4 m high, but is able to grow to 15 m tall if given support and its fleshy fruits are mainly dispersed by birds (OEH, 2015a). Lantana is native to Central and tropical South America and some 29 variants are naturalised in Australia (OEH, 2015a).

It has spread rapidly along the east coast of Australia from southern NSW to Cape York and it currently occurs in about 4 million hectares of land, mainly in NSW and Queensland (OEH, 2015a).

Lantana has significant adverse effects on biodiversity including suppressing native vegetation and seedlings through shading, nutrient competition, smothering and chemical suppression (OEH, 2015a). Lantana readily invades disturbed sites and communities and often becomes a dominant understorey species (OEH, 2015a).

The Office of Environment and Heritage has identified 8 priority actions to help the recovery of this KTP in NSW (OEH, 2015a).

This species was recorded within the subject site, particularly along the western boundary within the E2 zoned area (drainage corridor). It is possible that the current proposal could exacerbate this KTP. As such the contractor will be required to adopt hygiene controls to ensure that all machinery, materials and personnel are clean of any weed seed or propagules prior to entering any work site each day (or each part-day) and the contractor ensures that such material is not spread from one location to another (Refer to section 7.2 - Recommendations).

However with adequate controls this KTP is unlikely to be significantly increased due to the proposal or for the species tested in this assessment.

*Invasion of native plant communities by exotic perennial grasses (TSC Act).*

Invasion of native plant communities by exotic perennial grasses is listed as a KEY THREATENING PROCESS by the TSC Act.

Exotic perennial grasses are those that are not native to NSW and have a life-span of more than one growing season (OEH, 2015a). More than a hundred species of exotic perennial grasses occur in New South Wales but only a relatively small number of these threaten native plant communities (OEH, 2015a).

The Office of Environment and Heritage has identified 4 priority actions to help the recovery of this KTP in NSW (OEH, 2015a).

Several exotic and invasive grass species were recorded within the study area. The current proposal could exacerbate this KTP. As such the contractor will be required to adopt hygiene controls to ensure that all machinery, materials and personnel are clean of any weed seed or propagules prior to entering any work site each day (or each part-day) and the contractor ensures that such material is not spread from one location to another (Refer to section 7.2 – Recommendations).

However with adequate controls this KTP is unlikely to be significantly increased due to the proposal or for the species tested in this assessment.

*Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants (TSC Act)*

Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants is listed as a KEY THREATENING PROCESS by both the TSC Act and the EPBC Act (OEH, 2015a).

Invasive exotic plants can impact on ecosystem structure and function, reducing native species richness, altering hydrological or fire regimes, changing soil nutrient status and modifying habitat (Cronk and Fuller 1995; Lockwood *et al.* 2007 in OEH, 2015a)

In New South Wales, introduced invasive plants have been recognized as having an adverse impact on 341 species, 14 populations and 64 ecological communities listed as threatened under the *Threatened Species Conservation Act* 1995 (Courtts-Smith and Downey 2006 in OEH, 2015a).

The Office of Environment and Heritage has identified 4 priority actions to help the recovery of this KTP in NSW (OEH, 2015a).

This KTP is not currently active due to isolation of the site from existing residential develop to the west, however it is considered that the proposal could exacerbate this KTP. It is likely that exotic garden plants will be planted within the subject site as a result of the proposal. However with careful plant selection the proposal is unlikely to further exacerbate this KTP.

*Loss of Hollow-bearing Trees*

Loss of hollow-bearing trees is listed as a KEY THREATENING PROCESS by the TSC Act (OEH, 2015a).

Tree hollows are cavities formed in the trunk or branches of a living or dead tree (OEH, 2015a). Hollows are usually more characteristic of older, mature to over mature trees (OEH, 2015a). There are approximately 303 native hollow-using species in Australia (Gibbons *et al.*, 2002).

Hollow entrances are more common in larger trunks and branches because damage is less likely to be covered by growth of external sapwood (Gibbon *et al*, 2002).

Hollows with large internal dimensions are the rarest and occur predominantly in large old trees, which are rarely less than 220 years old (OEH, 2015a). Larger, older trees also provide a greater density of hollows per tree and as such, large old hollow-bearing trees are relatively more valuable to hollow-using fauna than younger hollow-bearing trees (OEH, 2015a).

The Office of Environment and Heritage has identified 6 priority actions to help the recovery of this KTP in NSW (OEH, 2015a).

Ten (10) hollow-bearing trees were recorded within the proposed rezoning area and are likely to require removal as part of this proposal. No large hollows (>20cm diameter entrances) were recorded. The proposal will remove approximately 1.75ha of Tall Open Forest, while approximately 0.96ha of this community will be retained as part of a E2 zoned area along western side of the subject site. It is recommended that compensatory natural nest box be installed (Refer to section 7.2 – Recommendations). This proposal does constitute this KTP, however provided the recommendations are adopted, it is considered that the proposal unlikely to significant increase the impact of this KTP.

#### Predation and hybridisation by Feral Dogs, *Canis lupus familiaris* (TSC Act)

Predation and Hybridisation by Feral Dogs (*Canis lupus familiaris*) is listed as a KEY THREATENING PROCESS by the TSC Act (OEH, 2015a).

Domestic Dogs, both those that are feral and some that are associated with human habitation, can exert a high intensity of predation pressure on native fauna, especially medium to large macropods (Mitchell and Banks 2005 in OEH, 2015a). Predation pressure on native fauna by Feral Dogs threatens a number of species, including the following threatened fauna (OEH, 2015a):

- Spotted-tailed Quoll (*Dasyurus maculatus*) - Vulnerable
- Koala (*Phascolarctos cinereus*) - Vulnerable
- Southern Brown Bandicoot (*Isodon obesulus obesulus*) - Endangered
- Eastern Ground Parrot (*Pezoporus wallicus wallicus*) - Vulnerable
- Pied Oystercatcher (*Haematopus longirostris*) - Endangered
- Hooded Plover (*Thinornis rubricollis*) - Critically Endangered
- Little Penguin (*Eudyptula minor*) - Endangered Population

Potential predation on non-listed species such as Sugar Glider are of particular relevance to this site.

The Office of Environment and Heritage has identified 5 priority actions to help the recovery of this KTP in NSW (OEH, 2015a).

No Dogs were recorded within the subject site, however it is likely that this KTP process is occurring, due to the extent residential development in the area.

Given that the pet owners lawfully abide by the Companion Animals Act 1998 Act then this KTP is unlikely to be significantly increased due to the proposal or for the species tested in this assessment.

*Predation by the European Red Fox (TSC Act)*

Predation by the European Red Fox *Vulpes vulpes* (Linnaeus, 1758) was listed as a KEY THREATENING PROCESS by the TSC Act (OEH, 2015a).

Foxes are an adaptable and elusive predator common in rural and urban areas throughout southern Australia. They do not appear to favour any particular habitat and the main determinants of their population size and distribution appear to be food supply, disturbance of natural habitats and refuge availability (OEH, 2015a).

Since their introduction into Australia in the 1870s, foxes have contributed to severe declines and extinctions of a suite of native fauna, particularly among medium-sized (450-5000 g) ground-dwelling and semi-arboreal mammals, ground-nesting birds and freshwater turtles. Recent experimental studies have shown that predation by foxes continues to threaten remnant populations of many of these species. In contrast, some studies have found that fox predation has little or no impact on some populations of native prey, including some small mammal populations in dense microhabitats (OEH, 2015a).

A Red Fox Threat Abatement Plan has also been prepared for NSW (OEH, 2011).

This species was recorded within the subject site by Camera Trap 2 (refer to Figure 3).

This KTP is unlikely to be significantly increased due to the proposal or for any species tested in this assessment.

*Predation by the Feral Cat *Felis catus* (TSC Act)*

Predation by the Feral Cat *Felis catus* is listed as a KEY THREATENING PROCESS by the TSC Act and the EPBC Act (OEH, 2015a)

The Cat is a common predator that occurs in virtually all terrestrial habitats in Australia (OEH, 2015a).

The Office of Environment and Heritage has identified 11 priority actions to help the recovery of this KTP in NSW (OEH, 2015a).

In 2008 the Commonwealth government published a Threat Abatement Plan for predation by feral cats, which aims to reduce their impact on native species. The NSW National Parks and Wildlife Service are currently preparing a threat abatement plan for this KTP.

A domestic Cat was observed near the western boundary of the subject site.

Given that the pet owners lawfully abide by the Companion Animals Act 1998 Act then this KTP is unlikely to be significantly increased due to the proposal or for the species tested in this assessment.

#### Removal of dead wood and dead trees (TSC Act)

Removal of dead wood and dead trees is listed as a KEY THREATENING PROCESS by the TSC Act (OEH, 2015a).

It includes: the removal of forest and woodland waste left after timber harvesting, collecting fallen timber for firewood, burning on site, mulching on site, the removal of fallen branches and litter as general tidying up, and the removal of standing dead trees (OEH, 2015a).

Dead wood and dead trees provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems (OEH, 2015a). The removal of dead wood can have a range of environmental consequences, including the loss of habitat (as they often contain hollows used for shelter by animals), disruption of ecosystem process and soil erosion (OEH, 2015a).

The Office of Environment and Heritage has identified 10 priority actions to help the recovery of this KTP in NSW (OEH, 2015a).

The subject site does contain some dead trees but only has a limited extent of dead wood on the ground. Ten (10) hollow-bearing trees were recorded within the proposed rezoning area and are likely to require removal as part of this proposal. No large hollows (>20cm diameter entrances) were recorded. The proposal will remove approximately 1.75ha of Tall Open Forest, while approximately 0.96ha of this community will be retained as part of a E2 zoned area along western side of the subject site. It is recommended that compensatory natural nest box be installed (Refer to section 7.2 – Recommendations). This proposal does constitute this KTP, however provided the recommendations are adopted, it is considered that the proposal unlikely to significant increase the impact of this KTP.

## Appendix 5 – Flora and Fauna Species Lists

Table 11 – Flora Species List

| Life Form  | Family         | Species                                             | Common Name             | Introduced Species | Weeds of Nat. Sign. | Nox Weeds – Wyong LGA | Quadrat 1 | Quadrat 2 | E2 Zoned Area | Proposed Rezoning Area |
|------------|----------------|-----------------------------------------------------|-------------------------|--------------------|---------------------|-----------------------|-----------|-----------|---------------|------------------------|
| Tree       | Myrtaceae      | <i>Corymbia maculata</i>                            | Spotted Gum             |                    |                     |                       | 4         | 3         | x             | x                      |
| Tree       | Fabaceae       | <i>Erythrina x sykesii</i>                          | Coral Tree              | x                  |                     |                       |           |           | x             | x                      |
| Tree       | Myrtaceae      | <i>Eucalyptus eugenioides</i>                       | Thin-leaved Stringybark |                    |                     |                       |           |           | x             | x                      |
| Tree       | Myrtaceae      | <i>Eucalyptus siderophloia</i>                      | Grey Ironbark           |                    |                     |                       | 2         | 3         | x             | x                      |
| Palm Tree  | Arecaceae      | <i>Livistona australis</i>                          | Cabbage Tree Palm       |                    |                     |                       |           |           | x             |                        |
| Small Tree | Fabaceae       | <i>Acacia implexa</i>                               | Lightwood               |                    |                     |                       |           |           |               | x                      |
| Small Tree | Casuarinaceae  | <i>Allocasuarina torulosa</i>                       | Forest Oak              |                    |                     |                       |           |           | x             | x                      |
| Small Tree | Santalaceae    | <i>Exocarpus cupressiformis</i>                     | Native Cherry           |                    |                     |                       |           |           | x             | x                      |
| Small Tree | Phyllanthaceae | <i>Glochidion ferdinandi</i> var. <i>ferdinandi</i> | Cheese Tree             |                    |                     |                       |           | 1         | x             | x                      |

| Life Form  | Family         | Species                                    | Common Name                | Introduced Species | Weeds of Nat. Sign. | Nox Weeds – Wyong LGA | Quadrat 1 | Quadrat 2 | E2 Zoned Area | Proposed Rezoning Area |
|------------|----------------|--------------------------------------------|----------------------------|--------------------|---------------------|-----------------------|-----------|-----------|---------------|------------------------|
| Small Tree | Myrtaceae      | <i>Melaleuca nodosa</i>                    | Ball Honeymyrtle           |                    |                     |                       |           | 3         | x             | x                      |
| Small Tree | Pittosporaceae | <i>Pittosporum undulatum</i>               | Sweet Pittosporum          |                    |                     |                       | 1         | 3         |               | x                      |
| Shrub      | Fabaceae       | <i>Acacia falcata</i>                      | Hickory Wattle             |                    |                     |                       |           |           |               | x                      |
| Shrub      | Fabaceae       | <i>Acacia longifolia subsp. longifolia</i> | Sydney Golden Wattle       |                    |                     |                       |           |           |               | x                      |
| Shrub      | Phyllanthaceae | <i>Breynia oblongifolia</i>                | Coffee Bush                |                    |                     |                       | 1         |           | x             | x                      |
| Shrub      | Fabaceae       | <i>Daviesia ulicifolia</i>                 | Gorse Bitter Pea           |                    |                     |                       |           |           |               | x                      |
| Shrub      | Clusiaceae     | <i>Hypericum perforatum</i>                | St. Johns Wort             | x                  |                     | 3                     |           |           |               | x                      |
| Shrub      | Verbenaceae    | <i>Lantana camara</i>                      | Lantana                    | x                  |                     |                       | 1         | 3         | x             | x                      |
| Shrub      | Oleaceae       | <i>Ligustrum sinense</i>                   | Small-leaved Privet        | x                  |                     |                       | 2         | 3         | x             | x                      |
| Shrub      | Zamiaceae      | <i>Macrozamia flexuosa</i>                 |                            |                    |                     |                       |           |           | x             | x                      |
| Shrub      | Ochnaceae      | <i>Ochna serrulata</i>                     | Mickey Mouse Plant         | x                  |                     |                       |           | 1         | x             |                        |
| Shrub      | Asteraceae     | <i>Ozothamnus diosmifolius</i>             | Rice Flower, White Dogwood |                    |                     |                       |           |           |               | x                      |

| Life Form | Family           | Species                       | Common Name           | Introduced Species | Weeds of Nat. Sign. | Nox Weeds – Wyong LGA | Quadrat 1 | Quadrat 2 | E2 Zoned Area | Proposed Rezoning Area |
|-----------|------------------|-------------------------------|-----------------------|--------------------|---------------------|-----------------------|-----------|-----------|---------------|------------------------|
| Shrub     | Proteaceae       | <i>Persoonia linearis</i>     | Narrow-leaved Geebung |                    |                     |                       |           |           | x             |                        |
| Shrub     | Fabaceae         | <i>Senna pendula</i>          |                       | x                  |                     |                       |           |           |               | x                      |
| Shrub     | Xanthorrhoeaceae | <i>Xanthorrhoea macronema</i> |                       |                    |                     |                       |           |           | x             |                        |
| Sub-shrub | Asparagaceae     | <i>Asparagus aethiopicus</i>  | Ground Asparagus      | x                  |                     | 4                     | 1         |           |               | x                      |
| Sub-shrub | Rubiaceae        | <i>Pomax umbellata</i>        | Pomax                 |                    |                     |                       |           |           |               | x                      |
| Sedge     | Cyperaceae       | <i>Carex appressa</i>         | Tall Sedge            |                    |                     |                       |           | 2         | x             |                        |
| Sedge     | Cyperaceae       | <i>Cyperus eragrostis</i>     | Umbrella Sedge        | x                  |                     |                       |           |           |               | x                      |
| Sedge     | Cyperaceae       | <i>Gahnia clarkei</i>         | Tall Saw-sedge        |                    |                     |                       |           | 3         | x             |                        |
| Sedge     | Cyperaceae       | <i>Gahnia sieberiana</i>      | Red-fruit Saw-sedge   |                    |                     |                       |           |           |               | x                      |
| Sedge     | Cyperaceae       | <i>Lepidosperma laterale</i>  |                       |                    |                     |                       |           |           | x             |                        |
| Rush      | Juncaceae        | <i>Juncus usitatus</i>        |                       |                    |                     |                       | 2         | 2         | x             | x                      |
| Herb      | Asteraceae       | <i>Bidens pilosa</i>          | Cobbler's Pegs        | x                  |                     |                       |           |           |               | x                      |

| Life Form | Family         | Species                                | Common Name          | Introduced Species | Weeds of Nat. Sign. | Nox Weeds – Wyong LGA | Quadrat 1 | Quadrat 2 | E2 Zoned Area | Proposed Rezoning Area |
|-----------|----------------|----------------------------------------|----------------------|--------------------|---------------------|-----------------------|-----------|-----------|---------------|------------------------|
| Herb      | Gentianaceae   | <i>Centaurium tenuiflorum</i>          |                      | x                  |                     |                       |           |           |               | x                      |
| Herb      | Apiaceae       | <i>Centella asiatica</i>               | Indian Pennywort     |                    |                     |                       |           | 1         | x             | x                      |
| Herb      | Asteraceae     | <i>Cirsium vulgare</i>                 | Spear Thistle        | x                  |                     |                       | 1         |           | x             | x                      |
| Herb      | Commelinaceae  | <i>Commelina cyanea</i>                | Native Wandering Jew |                    |                     |                       |           |           | x             | x                      |
| Herb      |                | <i>Conyza spp.</i>                     | Fleabane             | x                  |                     |                       |           |           |               | x                      |
| Herb      | Apiaceae       | <i>Cyclospermum leptophyllum</i>       | Slender Celery       | x                  |                     |                       |           |           |               | x                      |
| Herb      | Phormiaceae    | <i>Dianella caerulea var. producta</i> | Blue Flax-lily       |                    |                     |                       | 2         | 1         | x             | x                      |
| Herb      | Convolvulaceae | <i>Dichondra repens</i>                | Kidney Weed          |                    |                     |                       | 1         | 1         | x             | x                      |
| Herb      | Asteraceae     | <i>Euchiton sphaericus</i>             | Cudweed              |                    |                     |                       |           |           |               | x                      |
| Herb      | Rubiaceae      | <i>Galium propinquum</i>               | Maori Bedstraw       |                    |                     |                       |           |           | x             |                        |
| Herb      | Asteraceae     | <i>Gamochaeta purpurea</i>             | Purple Cudweed       | x                  |                     |                       | 1         |           |               | x                      |
| Herb      | Goodeniaceae   | <i>Goodenia heterophylla</i>           |                      |                    |                     |                       |           |           | x             | x                      |

| Life Form | Family         | Species                         | Common Name            | Introduced Species | Weeds of Nat. Sign. | Nox Weeds – Wyong LGA | Quadrat 1 | Quadrat 2 | E2 Zoned Area | Proposed Rezoning Area |
|-----------|----------------|---------------------------------|------------------------|--------------------|---------------------|-----------------------|-----------|-----------|---------------|------------------------|
| Herb      |                | <i>Hydrocotyle peduncularis</i> |                        |                    |                     |                       |           |           |               | x                      |
| Herb      | Asteraceae     | <i>Hypochaeris radicata</i>     | Cats Ear or Flatweed   | x                  |                     |                       | 1         |           |               | x                      |
| Herb      | Asteraceae     | <i>Onopordum acanthium</i>      | Scotch Thistle         | x                  |                     |                       |           |           |               | x                      |
| Herb      | Plantaginaceae | <i>Plantago lanceolata</i>      | Lamb's Tongues         | x                  |                     |                       | 2         |           |               | x                      |
| Herb      |                | <i>Pratia purpurascens</i>      | Whiteroot              |                    |                     |                       | 1         | 1         | x             | x                      |
| Herb      | Polygonaceae   | <i>Rumex brownii</i>            | Swamp Dock             |                    |                     |                       |           |           |               | x                      |
| Herb      | Polygonaceae   | <i>Rumex crispus</i>            | Curled Dock            | x                  |                     |                       |           |           |               | x                      |
| Herb      | Asteraceae     | <i>Senecio madagascariensis</i> | Fireweed               | x                  | x                   | 4                     | 1         |           |               | x                      |
| Herb      |                | <i>Sida rhombifolia</i>         | Paddy's Lucerne        | x                  |                     |                       | 1         |           |               | x                      |
| Herb      | Solanaceae     | <i>Solanum nigrum</i>           | Black-berry Nightshade | x                  |                     |                       |           |           |               | x                      |
| Herb      | Asteraceae     | <i>Sonchus oleraceus</i>        | Common Sowthistle      | x                  |                     |                       |           |           |               | x                      |
| Herb      | Asteraceae     | <i>Tagetes minuta</i>           | Stinking Roger         | x                  |                     |                       |           |           |               | x                      |

| Life Form | Family          | Species                          | Common Name                 | Introduced Species | Weeds of Nat. Sign. | Nox Weeds – Wyong LGA | Quadrat 1 | Quadrat 2 | E2 Zoned Area | Proposed Rezoning Area |
|-----------|-----------------|----------------------------------|-----------------------------|--------------------|---------------------|-----------------------|-----------|-----------|---------------|------------------------|
| Herb      | Caryophyllaceae | <i>Vaccaria hispanica</i>        | Bladder Soapwort            | x                  |                     |                       |           |           |               | x                      |
| Herb      | Verbenaceae     | <i>Verbena incompta</i>          | Purpletop                   | x                  |                     |                       |           |           |               | x                      |
| Herb      | Asteraceae      | <i>Vernonia cinerea</i>          |                             |                    |                     |                       |           |           |               | x                      |
| Herb      | Fabaceae        | <i>Vicia sativa subsp. nigra</i> | Narrow-leaved Vetch         | x                  |                     |                       |           |           |               | x                      |
| Grass     | Poaceae         | <i>Andropogon virginicus</i>     | Whisky Grass                | x                  |                     |                       | 3         | 2         | x             | x                      |
| Grass     | Poaceae         | <i>Aristida vagans</i>           | Three-awned Speargrass      |                    |                     |                       |           | 1         | x             |                        |
| Grass     | Poaceae         | <i>Briza maxima</i>              | Blowfly Grass               | x                  |                     |                       | 1         |           |               | x                      |
| Grass     | Poaceae         | <i>Chloris gayana</i>            | Rhodes Grass                | x                  |                     |                       | 2         |           |               | x                      |
| Grass     | Poaceae         | <i>Cortaderia selloana</i>       | Pampas Grass                | x                  |                     | 3                     |           |           | x             |                        |
| Grass     | Poaceae         | <i>Cymbopogon refractus</i>      | Barbed Wire Grass           |                    |                     |                       | 3         |           |               | x                      |
| Grass     | Poaceae         | <i>Dichelachne micrantha</i>     | Shorthair Plumegrass        |                    |                     |                       | 4         |           |               | x                      |
| Grass     | Poaceae         | <i>Digitaria parviflora</i>      | Small-flowered Finger Grass |                    |                     |                       |           |           | x             |                        |

| Life Form | Family  | Species                        | Common Name             | Introduced Species | Weeds of Nat. Sign. | Nox Weeds – Wyong LGA | Quadrat 1 | Quadrat 2 | E2 Zoned Area | Proposed Rezoning Area |
|-----------|---------|--------------------------------|-------------------------|--------------------|---------------------|-----------------------|-----------|-----------|---------------|------------------------|
| Grass     | Poaceae | <i>Echinopogon caespitosus</i> | Tufted Hedgehog Grass   |                    |                     |                       |           |           |               | x                      |
| Grass     | Poaceae | <i>Entolasia marginata</i>     | Bordered Panic          |                    |                     |                       |           | 1         | x             | x                      |
| Grass     | Poaceae | <i>Entolasia stricta</i>       | Wiry Panic              |                    |                     |                       | 2         | 1         | x             | x                      |
| Grass     | Poaceae | <i>Imperata cylindrica</i>     | Blady Grass             |                    |                     |                       |           | 3         | x             | x                      |
| Grass     | Poaceae | <i>Lachnagrostis aemula</i>    | Blowngrass              |                    |                     |                       | 1         |           |               | x                      |
| Grass     | Poaceae | <i>Microlaena stipoides</i>    | Weeping Grass           |                    |                     |                       |           |           | x             | x                      |
| Grass     | Poaceae | <i>Oplismenus aemulus</i>      | Australian Basket Grass |                    |                     |                       |           | 3         | x             | x                      |
| Grass     | Poaceae | <i>Panicum simile</i>          | Two-colour Panic        |                    |                     |                       |           | 3         | x             | x                      |
| Grass     | Poaceae | <i>Paspalum urvillei</i>       | Vasey Grass             | x                  |                     |                       |           |           |               | x                      |
| Grass     | Poaceae | <i>Pennisetum clandestinum</i> | Kikuyu Grass            | x                  |                     |                       |           |           |               | x                      |
| Grass     | Poaceae | <i>Rytidosperma monticola</i>  | Wallaby Grass           |                    |                     |                       | 1         |           |               | x                      |
| Grass     | Poaceae | <i>Sporobolus africanus</i>    | Parramatta Grass        | x                  |                     |                       |           |           |               | x                      |

| Life Form | Family         | Species                                      | Common Name              | Introduced Species | Weeds of Nat. Sign. | Nox Weeds – Wyong LGA | Quadrat 1 | Quadrat 2 | E2 Zoned Area | Proposed Rezoning Area |
|-----------|----------------|----------------------------------------------|--------------------------|--------------------|---------------------|-----------------------|-----------|-----------|---------------|------------------------|
| Grass     | Poaceae        | <i>Sporobolus elongatus</i>                  | Slender Rat's Tail Grass |                    |                     |                       | 1         |           |               | x                      |
| Grass     | Poaceae        | <i>Themeda triandra</i>                      | Kangaroo Grass           |                    |                     |                       |           | 2         | x             | x                      |
| Graminoid | Lomandraceae   | <i>Lomandra longifolia</i>                   | Spiny-headed Mat-rush    |                    |                     |                       |           | 3         | x             | x                      |
| Graminoid | Lomandraceae   | <i>Lomandra multiflora subsp. multiflora</i> | Many-flowered Mat-rush   |                    |                     |                       |           | 1         | x             | x                      |
| Fern      | Pteridaceae    | <i>Adiantum aethiopicum</i>                  | Common Maidenhair        |                    |                     |                       |           |           |               | x                      |
| Fern      | Pteridaceae    | <i>Cheilanthes sieberi subsp. sieberi</i>    | Poison Rock Fern         |                    |                     |                       |           | 1         | x             | x                      |
| Fern      | Pteridaceae    | <i>Pellaea falcata</i>                       | Sickle Fern              |                    |                     |                       |           | 3         | x             | x                      |
| Fern      | Pteridaceae    | <i>Pellaea viridis</i>                       | Green Cliff Brake        | x                  |                     |                       |           |           |               | x                      |
| Fern      | Gleicheniaceae | <i>Sticherus flabellatus</i>                 | Umbrella Fern            |                    |                     |                       |           | 1         | x             |                        |
| Climber   | Asparagaceae   | <i>Asparagus asparagoides</i>                | Bridal Creeper           | x                  |                     | 1                     | 2         | 2         | x             | x                      |
| Climber   | Ranunculaceae  | <i>Clematis glycinoides</i>                  | Headache Vine            |                    |                     |                       |           |           |               | x                      |
| Climber   | Fabaceae       | <i>Desmodium varians</i>                     | Slender Tick-trefoil     |                    |                     |                       |           |           |               | x                      |

| Life Form | Family         | Species                      | Common Name            | Introduced Species | Weeds of Nat. Sign. | Nox Weeds – Wyong LGA | Quadrat 1 | Quadrat 2 | E2 Zoned Area | Proposed Rezoning Area |
|-----------|----------------|------------------------------|------------------------|--------------------|---------------------|-----------------------|-----------|-----------|---------------|------------------------|
| Climber   | Fabaceae       | <i>Glycine clandestina</i>   |                        |                    |                     |                       |           |           | x             | x                      |
| Climber   | Fabaceae       | <i>Hardenbergia violacea</i> | False Sarsparilla      |                    |                     |                       | 1         |           |               | x                      |
| Climber   | Convolvulaceae | <i>Ipomoea purpurea</i>      | Common Morning Glory   | x                  |                     |                       |           |           |               | x                      |
| Climber   | Bignoniaceae   | <i>Pandorea pandorana</i>    | Wonga Wonga Vine       |                    |                     |                       |           |           | x             |                        |
| Climber   | Apocynaceae    | <i>Parsonsia straminea</i>   | Common Silkpod         |                    |                     |                       |           | 4         | x             |                        |
| Orchid    | Orchidaceae    | <i>Caladenia catenata</i>    | White Caladenia        |                    |                     |                       |           |           | x             | x                      |
| Orchid    | Orchidaceae    | <i>Calochilus sp.</i>        | Bearded Orchid species |                    |                     |                       |           |           |               | x                      |
| Orchid    | Orchidaceae    | <i>Pterostylis bicolor</i>   | Black-tip Greenhood    |                    |                     |                       | 1         |           |               | x                      |
| Orchid    | Orchidaceae    | <i>Thelymitra pauciflora</i> | Slender Sun Orchid     |                    |                     |                       |           |           |               | x                      |
| Aquatic   | Salviniaceae   | <i>Azolla sp.</i>            | Free floating fern     |                    |                     |                       |           |           |               | x                      |

Table 12 – Fauna Species List

| Life Form   | Species                               | Common Name                  | Observation Type | Identification Confidence | Location | Nesting or foraging locations | Estimate of numbers |
|-------------|---------------------------------------|------------------------------|------------------|---------------------------|----------|-------------------------------|---------------------|
| Bird        | <i>Anas superciliosa</i>              | Pacific Black Duck           | O                | D                         | I        |                               | 2                   |
| Bird        | <i>Chenonetta jubata</i>              | Australian Wood Duck         | O                | D                         | I        | HT4                           | 2                   |
| Bird        | <i>Cracticus nigrogularis</i>         | Pied Butcherbird             | OW               | D                         | I        |                               | 2                   |
| Bird        | <i>Cracticus tibicen</i>              | Australian Magpie            | OW               | D                         | I        |                               | 3                   |
| Bird        | <i>Cracticus torquatus</i>            | Grey Butcherbird             | OW Q             | D                         | I E      | E2 area - Cam 2               | 2                   |
| Bird        | <i>Strepera graculina</i>             | Pied Currawong               | OW               | D                         | S        |                               | 2                   |
| Bird        | <i>Cacatua galerita</i>               | Sulphur-crested Cockatoo     | OW               | D                         | I S      |                               | 6                   |
| Bird        | <i>Cacatua sanguinea</i>              | Little Corella               | OW E             | D                         | E        | Edge of road to east          | 3                   |
| <b>Bird</b> | <b><i>Calyptorhynchus lathami</i></b> | <b>Glossy Black-cockatoo</b> | <b>OW G</b>      | <b>D</b>                  | <b>S</b> |                               | <b>2</b>            |
| Bird        | <i>Eolophus roseicapilla</i>          | Galah                        | O E              | D                         | I        | HT6                           | 3                   |
| Bird        | <i>Eurostopodus mystacalis</i>        | White-throated Nightjar      | W                | D                         | NE       |                               | 2                   |
| Bird        | <i>Eurystomus orientalis</i>          | Dollarbird                   | OW               | D                         | I        |                               | 2                   |
| Bird        | <i>Eudynamys orientalis</i>           | Eastern Koel                 | W                | D                         | E        |                               | 1                   |
| Bird        | <i>Scythrops novaehollandiae</i>      | Channel-billed Cuckoo        | OW               | D                         | I        |                               | 2                   |
| Bird        | <i>Dacelo novaeguineae</i>            | Laughing Kookaburra          | OW               | D                         | E S      |                               | 2                   |
| Bird        | <i>Manorina melanocephala</i>         | Noisy Miner                  | OW               | D                         | I S      |                               | >15                 |

| Life Form | Species                         | Common Name             | Observation Type | Identification Confidence | Location | Nesting or foraging locations | Estimate of numbers |
|-----------|---------------------------------|-------------------------|------------------|---------------------------|----------|-------------------------------|---------------------|
| Bird      | <i>Manorina melanophrys</i>     | Bell Miner              | W                | D                         | S        |                               | >15                 |
| Bird      | <i>Podargus strigoides</i>      | Tawny Frogmouth         | O                | D                         | E        |                               | 2                   |
| Bird      | <i>Alisterus scapularis</i>     | Australian King Parrot  | OW               | D                         | W I      |                               | 4                   |
| Bird      | <i>Trichoglossus haematodus</i> | Rainbow Lorikeet        | OW E             | D                         | I        | HT5                           | 6                   |
| Bird      | <i>Platycercus eximius</i>      | Eastern Rosella         | OW E             | D                         | I        | HT6                           | 2                   |
| Bird      | <i>Lewinia pectoralis</i>       | Lewin's Rail            | O                | D                         | I        |                               | 1                   |
| Bird      | <i>Ninox novaehollandiae</i>    | Southern Boobook Owl    | W                | D                         | E S      |                               | 1                   |
| Bird      | <i>Tyto alba</i>                | Barn Owl                | W                | D                         | E        |                               | 1                   |
| Mammal    | <i>Vulpes vulpes</i>            | European Fox            | Q                | D                         | E        | Cam 2                         | 1                   |
| Mammal    | <i>Felis catus</i>              | Domestic Cat            | O                | D                         |          |                               |                     |
| Mammal    | <i>Antechinus stuartii</i>      | Brown Antechinus        | T                | D                         | S        |                               | 1                   |
| Mammal    | <i>Oryctolagus cuniculus</i>    | Rabbit                  | O P              | D                         | I        |                               | 6                   |
| Mammal    | <i>Rattus fuscipes</i>          | Bush Rat                | T Q              | D                         | E S      |                               | >2                  |
| Mammal    | <i>Rattus rattus</i>            | Black Rat               | T Q              | D                         | E        |                               | >2                  |
| Mammal    | <i>Petaurus breviceps</i>       | Sugar Glider            | O                | D                         | I W      | HT10                          | 4                   |
| Mammal    | <i>Trichosurus vulpecula</i>    | Common Brushtail Possum | O E Q            | D                         | I        | HT4 - Cam 1                   | 2                   |
| Mammal    | <i>Pseudocheirus peregrinus</i> | Common Ringtail Possum  | E Q              | D                         | S        | SW cnr - drey, Cam 2          | 2                   |
| Mammal    | <i>Tachyglossus aculeatus</i>   | Short-beaked Echidna    | Q                | D                         | E        | E2 area - Cam 2               | 1                   |

| Life Form | Species                                                                                           | Common Name                   | Observation Type | Identification Confidence | Location | Nesting or foraging locations | Estimate of numbers |
|-----------|---------------------------------------------------------------------------------------------------|-------------------------------|------------------|---------------------------|----------|-------------------------------|---------------------|
| Mammal    | <i>Miniopterus australis</i>                                                                      | Little Bentwing-bat           | U                | D                         | I        |                               |                     |
| Mammal    | <i>Miniopterus schreibersii oceanensis</i>                                                        | Eastern Bentwing-bat          | U                | Pr                        | I        |                               |                     |
| Mammal    | <i>Mormopterus norfolkensis</i>                                                                   | Eastern Freetail-bat          | U                | D                         | I        |                               |                     |
| Mammal    | <i>Mormopterus ridei</i>                                                                          | Eastern Little Freetail-bat   | U                | D                         | I        |                               |                     |
| Mammal    | <i>Tadarida australis</i>                                                                         | White-striped Free-tailed Bat | U                | D                         | I        |                               |                     |
| Mammal    | <i>Chalinolobus gouldii</i>                                                                       | Gould's Wattled Bat           | U                | D                         | I        |                               |                     |
| Mammal    | <i>Chalinolobus morio</i>                                                                         | Chocolate Wattled Bat         | U                | D                         | I        |                               |                     |
| Mammal    | <i>Scoteanax rueppellii</i>                                                                       | Greater Broad-nosed Bat       | U                | Pr                        | I        |                               |                     |
| Mammal    | <i>Vespadelus pumilus</i>                                                                         | Eastern Forest Bat            | U                | D                         | I        |                               |                     |
| Mammal    | <i>Vespadelus vulturnus</i>                                                                       | Little Forest Bat             | U                | D                         | I        |                               |                     |
| Mammal    | <i>Falsistrellus tasmaniensis</i> /<br><i>Scotorepens orion</i>                                   | Species Grouping              | U                | -                         | I        |                               |                     |
| Mammal    | <i>Falsistrellus tasmaniensis</i> /<br><i>Scotorepens orion</i> / <i>Scoteanax rueppellii</i>     | Species Grouping              | U                | -                         | I        |                               |                     |
| Mammal    | <i>Miniopterus schreibersii oceanensis</i> /<br><i>Vespadelus darlingtoni</i> / <i>Vespadelus</i> | Species Grouping              | U                | -                         | I        |                               |                     |

| Life Form | Species                                                                                  | Common Name                  | Observation Type | Identification Confidence | Location | Nesting or foraging locations | Estimate of numbers |
|-----------|------------------------------------------------------------------------------------------|------------------------------|------------------|---------------------------|----------|-------------------------------|---------------------|
|           | <i>regulus</i>                                                                           |                              |                  |                           |          |                               |                     |
| Mammal    | <b><i>Myotis macropus</i></b> / <i>Nyctophilus geoffroyi</i> / <i>Nyctophilus gouldi</i> | Species Grouping             | U                | -                         | I        |                               |                     |
| Mammal    | <i>Nyctophilus geoffroyi</i> / <i>Nyctophilus gouldi</i>                                 | Species Grouping             | U                | -                         | I        |                               |                     |
| Frog      | <i>Litoria fallax</i>                                                                    | Dwarf Tree Frog              | OW T             | D                         | I        |                               | >10                 |
| Frog      | <i>Litoria peronii</i>                                                                   | Peron's Tree Frog            | OW T             | D                         | I        |                               | >10                 |
| Frog      | <i>Litoria tyleri</i>                                                                    | Tyler's Tree Frog            | OW               | D                         | I        |                               | >10                 |
| Reptile   | <i>Chelodina longicollis</i>                                                             | Eastern Snake-necked Turtle  | O                | D                         | I S      |                               | 2                   |
| Reptile   | <i>Lampropholis guichenoti</i>                                                           | Pale-flecked Garden Sunskink | O                | D                         | S        |                               | 2                   |

Observation Type Codes (Atlas of NSW Wildlife Database): AR – Acoustic recording; C – Cat kill; D – Dog kill; E – Nest/ Roost; F – Tracks scratchings; FB – Burrow; G – Crushed cones; H – Hair, feathers or skin; K – Dead; O – Seen; OW – Seen & heard; P – Scat; Q – Camera; R – Road Kill; T – Trapped or netted; V – Fox kill; W – Heard call; X – In scat; Y – Bone, teeth, shell; & Z – In raptor/owl pellet.

Identification confidence: D – Definite; Pr – Probable; & Po – Possible.

Location: I – In subject site; N, NE, E, SE, S, SW & W refer to outside of the subject site to the north, north-east, east, south-east, south, south-west & west respectively.

## APPENDIX 6 – SQUIRREL GLIDER HABITAT ASSESSMENT

## 1.1 *Habitat Suitability*

### a **Habitat Quality**

Assess relative predominance of optimum Squirrel Glider microhabitat types according to vegetation assemblage type:

|                                                                             | Habitat Area | % Habitat Type Within Patch |                                                                                                                      |
|-----------------------------------------------------------------------------|--------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------|
| 1 Stringybark/Gum with Acacia/Melaleuca/Grass understorey                   |              |                             | Less optimum<br><br>More optimum |
| 2 Spotted Gum/Ironbark/Gum                                                  | 2.5 ha       | 100                         |                                                                                                                      |
| 3 Stringybark with Banksia/Allocasuarina/Melaleuca understorey              |              |                             |                                                                                                                      |
| 4 Sydney Red Gum/Scribbly Gum with Allocasuarina/Melaleuca understorey      |              |                             |                                                                                                                      |
| 5 Sydney Red Gum/Scribbly Gum with Banksia understorey                      |              |                             |                                                                                                                      |
| 6 If plant assemblage type does not fit well with the above describe below: |              |                             |                                                                                                                      |
| .....                                                                       |              |                             |                                                                                                                      |
| .....                                                                       |              |                             |                                                                                                                      |

## **b      Remnant Patch Size**

Assess patch size on site according to the scale outlined below:

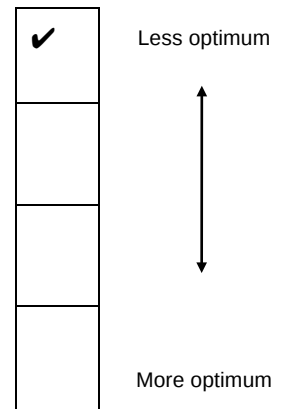
Patch < 5 hectares in size

Patch > 5 hectares but less than 10 hectares in size

Patch > 10 hectares but less than 30 hectares in size

Patch > 30 hectares but less than 90 hectares in size

|   |              |
|---|--------------|
| ✓ | Less optimum |
|   |              |
|   |              |
|   | More optimum |

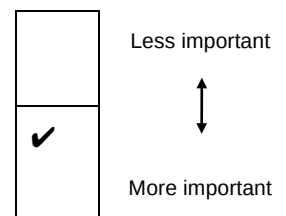


## **c      Density Habitat Trees**

Average number of trees with hollows per hectare < 2 habitat trees / hectare

Average number of trees with hollows per hectare > 2 habitat trees / hectare

|   |                |
|---|----------------|
|   | Less important |
| ✓ | More important |



**d (i) Abundance of Food Plants of Squirrel Glider – Quadrat 1**

Quantitatively assess using plot based data, the proportion of Squirrel Glider food plants which occur on the site and show plot locations on map. Field survey effort for measuring food plant abundance should be applied as per Council's Flora and Fauna Guidelines for Development (see section on survey effort for vegetation plots). A summary of locally occurring food resources for Squirrel Gliders is provided below:

| Local Food Plants<br>in Study Area |                     | Food Item                 | Average No<br>of Plants/<br>Hectare | % of<br>Vegetation<br>Assemblage |
|------------------------------------|---------------------|---------------------------|-------------------------------------|----------------------------------|
| <i>Angophora/</i>                  | <i>costata</i>      | sap, nectar & pollen      | 0                                   |                                  |
|                                    | <i>haemastoma</i>   | sap, nectar & pollen      | 0                                   |                                  |
| <i>Eucalyptus</i>                  | <i>racemosa</i>     | sap, nectar & pollen      | 0                                   |                                  |
|                                    | <i>robusta</i>      | sap, nectar & pollen      | 0                                   |                                  |
|                                    | <i>siderophloia</i> | sap, nectar & pollen      | 25                                  | 65                               |
|                                    | <i>paniculata</i>   | sap, nectar & pollen      | 0                                   |                                  |
|                                    | <i>fibrosa</i>      | sap, nectar & pollen      | 0                                   |                                  |
|                                    | <i>gummifera</i>    | sap, nectar & pollen      | 0                                   |                                  |
|                                    | <i>maculata</i>     | nectar & pollen           | 50                                  | 65                               |
| <i>Melaleuca</i>                   | <i>linariifolia</i> | nectar & insect bark food | 0                                   |                                  |
|                                    | <i>nodosa</i>       | nectar & insect bark food | 0                                   |                                  |
|                                    | <i>quingueneria</i> | nectar & insect bark food | 0                                   |                                  |
|                                    | <i>sieberi</i>      | nectar & insect bark food | 0                                   |                                  |
| <i>Acacia</i>                      | <i>spp.</i>         | seeds & gum               | 0                                   |                                  |
| <i>Banksia</i>                     | <i>spimbosa</i>     | nectar & pollen           | 0                                   |                                  |

|                     |                     |                        |   |  |
|---------------------|---------------------|------------------------|---|--|
|                     | <i>serrata</i>      | nectar & pollen        | 0 |  |
|                     | <i>integrifolia</i> | nectar & pollen        | 0 |  |
|                     | <i>oblongifolia</i> | nectar & pollen        | 0 |  |
| <i>Xanthorrhoea</i> | <i>spp.</i>         | nectar & potential gum | 0 |  |

\* Council staff will have regard to the availability of food resources and continuity of flowering times of different plant species in making any assessment.

#### d (ii) Abundance of Food Plants of Squirrel Glider – Quadrat 2

Quantitatively assess using plot based data, the proportion of Squirrel Glider food plants which occur on the site and show plot locations on map. Field survey effort for measuring food plant abundance should be applied as per Council's Flora and Fauna Guidelines for Development (see section on survey effort for vegetation plots). A summary of locally occurring food resources for Squirrel Gliders is provided below:

| Local Food Plants<br>in Study Area |                     | Food Item            | Average No<br>of Plants/<br>Hectare | % of<br>Vegetation<br>Assemblage |
|------------------------------------|---------------------|----------------------|-------------------------------------|----------------------------------|
| <i>Angophora/</i>                  | <i>costata</i>      | sap, nectar & pollen | 0                                   |                                  |
| <i>Eucalyptus</i>                  | <i>haemastoma</i>   | sap, nectar & pollen | 0                                   |                                  |
|                                    | <i>racemosa</i>     | sap, nectar & pollen | 0                                   |                                  |
|                                    | <i>robusta</i>      | sap, nectar & pollen | 0                                   |                                  |
|                                    | <i>siderophloia</i> | sap, nectar & pollen | 50                                  | 35                               |
|                                    | <i>paniculata</i>   | sap, nectar & pollen | 0                                   |                                  |
|                                    | <i>fibrosa</i>      | sap, nectar & pollen | 0                                   |                                  |
|                                    | <i>gummifera</i>    | sap, nectar & pollen | 0                                   |                                  |

|                     |                     |                           |    |    |
|---------------------|---------------------|---------------------------|----|----|
|                     | <i>maculata</i>     | nectar & pollen           | 50 | 35 |
| <i>Melaleuca</i>    | <i>linariifolia</i> | nectar & insect bark food | 0  |    |
|                     | <i>nodosa</i>       | nectar & insect bark food | 75 | 35 |
|                     | <i>quingueneria</i> | nectar & insect bark food | 0  |    |
|                     | <i>sieberi</i>      | nectar & insect bark food | 0  |    |
| <i>Acacia</i>       | <i>spp.</i>         | seeds & gum               | 0  |    |
| <i>Banksia</i>      | <i>spimbosa</i>     | nectar & pollen           | 0  |    |
|                     | <i>serrata</i>      | nectar & pollen           | 0  |    |
|                     | <i>integrifolia</i> | nectar & pollen           | 0  |    |
|                     | <i>oblongifolia</i> | nectar & pollen           | 0  |    |
| <i>Xanthorrhoea</i> | <i>spp.</i>         | nectar & potential gum    | 0  |    |

\* Council staff will have regard to the availability of food resources and continuity of flowering times of different plant species in making any assessment.

## 1.2 *Habitat Vulnerability*

Factors to be assessed include area, edge/area ratio of the habitat, presence of disturbed or weed invaded vegetation within remnant patch, presence of threatening processes and impact of surrounding land use proposals. Assessment criteria are outlined below.

### a **Edge to Width Ratio**

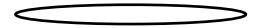
Which shape is the patch size most similar to?



Round ✓



Oval Shaped



Narrow Linear Fragment

### b **Habitat Disturbance**

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

Approximately 80% of subject site has been underscrubbed. Approximately 65% of the subject site has significant weed incursion.

.....

### c **Proximity to Existing or Future Residential Development**

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

Yes ✓

No

### **2.3     *Resident Breeding Squirrel Gliders***

Presence / absence of resident breeding Squirrel Gliders in patch?

Yes

No ✓

Applicants must supply details from trapping programme.

## Appendix 7 – Micro-bat Call Identification Report



**ECHO  
ECOLOGY**

## **Bat Call Identification**

**Louisiana Road,  
Wadalba, NSW**

**Prepared for**  
Everitt Ecology  
PO Box 198,  
Wyong, NSW, 2259

**Job Reference BC\_NE1 - November 2015**

This report has been prepared to document the analysis of digital ultrasonic bat echolocation calls received from a third party. The data was not collected by the author and as such no responsibility is taken for the quality of data collection or for the suitability of its subsequent use.

This report was authored by

A handwritten signature in black ink, appearing to read 'Anna McConville', followed by a period.

**Dr Anna McConville**

PhD, B.Env.Sc.

## Contents

|            |                                                     |    |
|------------|-----------------------------------------------------|----|
| <b>1.0</b> | Introduction .....                                  | 2  |
| <b>2.0</b> | Methods .....                                       | 2  |
| <b>2.1</b> | Characteristics Used to Differentiate Species ..... | 3  |
| <b>3.0</b> | Results .....                                       | 3  |
| <b>4.0</b> | Sample Calls .....                                  | 9  |
| <b>5.0</b> | References .....                                    | 12 |

## List of Tables

|                                                                                     |   |
|-------------------------------------------------------------------------------------|---|
| Table 3-1: Results of bat call analysis (number of passes per site per night) ..... | 5 |
|-------------------------------------------------------------------------------------|---|

## List of Figures

|                                                                            |    |
|----------------------------------------------------------------------------|----|
| Figure 4-1: <i>Chalinolobus gouldii</i> definite call .....                | 9  |
| Figure 4-2: <i>Chalinolobus morio</i> definite call .....                  | 9  |
| Figure 4-3: <i>Miniopterus australis</i> definite call .....               | 9  |
| Figure 4-4: <i>Miniopterus schreibersii oceanensis</i> probable call ..... | 10 |
| Figure 4-5: <i>Mormopterus norfolkensis</i> definite call .....            | 10 |
| Figure 4-6: <i>Mormopterus (Ozimops) ridei</i> definite call .....         | 10 |
| Figure 4-7: <i>Nyctophilus</i> sp. species group .....                     | 10 |
| Figure 4-8: <i>Scoteanax rueppellii</i> probable call .....                | 11 |
| Figure 4-9: <i>Vespadelus pumilus</i> definite call .....                  | 11 |
| Figure 4-10: <i>Vespadelus vulturnus</i> definite call .....               | 11 |
| Figure 4-11: <i>Tadarida australis</i> definite call .....                 | 11 |

## 1.0 INTRODUCTION

This report has been commissioned by Everitt Ecology to analyse bat echolocation call data (Anabat - Titley Electronics; Song Meter - Wildlife Acoustics) collected from Louisiana Road, Wadalba, NSW. Data was provided electronically to the author. This report documents the methods involved in analysing bat call data and the results obtained only.

## 2.0 METHODS

The identification of bat echolocation calls recorded during surveys was undertaken using AnalookW software (Version 4.1t, Chris Corben). Song Meter calls were first converted to zero crossings format. The identification of calls was undertaken with reference to Pennay *et al.* (2004) and through the comparison of recorded reference calls from the Sydney Basin. Reference calls were obtained from the NSW database and from the authors personal collection.

Each call sequence ('pass') was assigned to one of five categories, according to the confidence with which an identification could be made, being:

- Definite - Pass identified to species level and could not be confused with another species
- Probable - Pass identified to species level and there is a low chance of confusion with another species
- Possible - Pass identified to species level but short duration or poor quality of the pass increases the chance of confusion with another species
- Species group - Pass could not be identified to species level and could belong to one of two or more species. Occurs more frequently when passes are short or of poor quality
- Unknown - Either background 'noise' files or passes by bats which are too short and/or of poor quality to confidently identify.

Call sequences that were less than three pulses in length were not analysed and were assigned to 'Unknown' and only search phase calls were analysed. Furthermore, some species are difficult to differentiate using bat call analysis due to overlapping call frequencies and similar shape of plotted calls and in these cases calls were assigned to species groups.

The total number of passes (call sequences) per unit per night was tallied to give an index of activity.

It should be noted that the activity levels recorded at different sites may not be readily able to be compared. Such comparisons are dependent on many variables which need to be carefully controlled during data collection and statistically analysed. Influential variables include wind, rain, temperature, duration of recording, season, detector and microphone sensitivity, detector placement, weather protection devices etc.

## 2.1 Characteristics Used to Differentiate Species

*Miniopterus australis* was differentiated from *Vespadelus pumilus*, by characteristic frequency or the presence of a down-sweeping tail on pulses. Call sequences which had a majority of pulses containing an up-sweeping tail were assigned to *Vespadelus pumilus*.

*Miniopterus schreibersii oceanensis* was differentiated by *Vespadelus* sp. by a combination of uneven consecutive pulses and the presence of a down-sweeping tail.

Calls from *Mormopterus* sp. were differentiated by the presence of mainly flat pulses. *Mormopterus (Micronomus) norfolkensis* was differentiated from *Mormopterus (Ozimops) ridei* in long call sequences where pulses alternated, often with a downward sloping tail.

*Chalinolobus gouldii* was differentiated from other species by the presence of curved, alternating call pulses. *Scoteanax rueppellii* was differentiated from *Falsistrellus tasmaniensis* and *Scotorepens orion* only at lower frequencies. It was differentiated from *Chalinolobus gouldii* (to a probable confidence) in long call sequences by high knee frequency, long characteristic section and no pulse alternation.

*Scotorepens orion*, *Scoteanax rueppellii* and *Falsistrellus tasmaniensis* were unable to be differentiated from one another.

*Chalinolobus morio* calls were differentiated from those of *Vespadelus* sp. by the presence of a down-sweeping tail on the majority of pulses.

*Tadarida australis* were differentiated from other bat species on the basis of characteristic frequency.

## 3.0 RESULTS

A total of 2,368 call sequences were recorded, of which 1,824 call sequences were able to be analysed (ie were not 'noise' files or bat calls of short length). Of the bat calls, 872 call sequences (48 %) were able to be confidently identified (those classified as either definite or probable identifications) to species level (Table 3-1). Species recorded confidently within the site include:

- *Chalinolobus gouldii* (Gould's wattled bat)
- *Chalinolobus morio* (Chocolate wattled bat)
- *Miniopterus australis* (Little bentwing bat)
- *Miniopterus schreibersii oceanensis* (Eastern bentwing bat)
- *Mormopterus (Micronomus) norfolkensis* (East coast free-tailed bat)
- *Mormopterus (Ozimops) ridei* (Eastern free-tailed bat)
- *Scoteanax rueppellii* (Greater broad-nosed bat)
- *Tadarida australis* (White-striped free-tailed bat)
- *Vespadelus pumilus* (Eastern forest bat)
- *Vespadelus vulturnus* (Little forest bat)

Additionally, the following bat species potentially occurred within the site, but could not be confidently identified (those calls classified as possible or as a species group):

- *Falsistrellus tasmaniensis* (Eastern falsistrelle)
- *Myotis macropus* (Large-footed myotis)
- *Nyctophilus geoffroyi* (Lesser long-eared bat)
- *Nyctophilus gouldi* (Gould's long-eared bat)
- *Scotorepens orion* (Eastern broad-nosed bat)
- *Vespadelus darlingtoni* (Large forest bat)
- *Vespadelus regulus* (Southern forest bat)

It should be noted that additional bat species may be present within the site but were not recorded by the detectors and habitat assessment should be used in conjunction with these results to determine the likelihood of occurrence of other bat species.

Table 3-1 below summarises the results of the bat call analysis.

**Table 3-1: Results of bat call analysis (number of passes per site per night)**

| IDENTIFICATION                               | Anabat<br>14/10/2015 | Anabat<br>15/10/2015 | Anabat<br>25/10/2015 | Anabat<br>29/10/2015 | Song Meter<br>7/10/2015 | Song Meter<br>8/10/2015 | Song Meter<br>9/10/2015 | Song Meter<br>10/10/2015 | Song Meter<br>11/10/2015 | Song Meter<br>12/10/2015 | Song Meter<br>13/10/2015 | Song Meter<br>14/10/2015 | Song Meter<br>15/10/2015 |
|----------------------------------------------|----------------------|----------------------|----------------------|----------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <b>DEFINITE</b>                              |                      |                      |                      |                      |                         |                         |                         |                          |                          |                          |                          |                          |                          |
| <i>Chalinolobus gouldii</i>                  | 23                   | 5                    | 9                    | 27                   | 33                      | 30                      | 24                      | 21                       | 34                       | 28                       | 18                       | 26                       | 65                       |
| <i>Chalinolobus morio</i>                    | -                    | -                    | 2                    | -                    | 13                      | 5                       | 4                       | 1                        | 2                        | 1                        | 1                        | -                        | -                        |
| <i>Miniopterus australis</i>                 | 1                    | -                    | -                    | -                    | 5                       | 6                       | 1                       | 3                        | -                        | 1                        | 1                        | 4                        | 1                        |
| <i>Mormopterus (Micronomus) norfolkensis</i> | 17                   | 1                    | 2                    | 1                    | 10                      | 65                      | 3                       | 1                        | 1                        | -                        | 11                       | 10                       | -                        |
| <i>Mormopterus (Ozimops) ridei</i>           | -                    | -                    | -                    | -                    | -                       | -                       | 36                      | 4                        | 27                       | 1                        | 1                        | 2                        | -                        |
| <i>Tadarida australis</i>                    | -                    | -                    | -                    | -                    | 2                       | 1                       | -                       | -                        | -                        | -                        | -                        | -                        | -                        |
| <i>Vespadelus pumilus</i>                    | -                    | -                    | -                    | 1                    | -                       | -                       | -                       | -                        | -                        | -                        | 1                        | 1                        | 1                        |
| <i>Vespadelus vulturnus</i>                  | 1                    | -                    | -                    | -                    | -                       | -                       | -                       | -                        | -                        | -                        | -                        | -                        | -                        |
| <b>PROBABLE</b>                              |                      |                      |                      |                      |                         |                         |                         |                          |                          |                          |                          |                          |                          |
| <i>Chalinolobus gouldii</i>                  | 14                   | 3                    | 15                   | 7                    | 2                       | 4                       | 7                       | 7                        | 10                       | 20                       | 11                       | 8                        | 3                        |
| <i>Chalinolobus morio</i>                    | -                    | -                    | -                    | -                    | 11                      | 8                       | 1                       | 2                        | -                        | -                        | -                        | -                        | -                        |
| <i>Miniopterus australis</i>                 | 1                    | 1                    | -                    | 1                    | 1                       | -                       | 1                       | -                        | -                        | 1                        | 1                        | 2                        | -                        |

| IDENTIFICATION                               | Anabat<br>14/10/2015 | Anabat<br>15/10/2015 | Anabat<br>25/10/2015 | Anabat<br>29/10/2015 | Song Meter<br>7/10/2015 | Song Meter<br>8/10/2015 | Song Meter<br>9/10/2015 | Song Meter<br>10/10/2015 | Song Meter<br>11/10/2015 | Song Meter<br>12/10/2015 | Song Meter<br>13/10/2015 | Song Meter<br>14/10/2015 | Song Meter<br>15/10/2015 |
|----------------------------------------------|----------------------|----------------------|----------------------|----------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <i>Miniopterus schreibersii oceanensis</i>   | -                    | 1                    | 2                    | -                    | 2                       | 1                       | -                       | -                        | -                        | -                        | 1                        | 1                        | -                        |
| <i>Mormopterus (Micronomus) norfolkensis</i> | 7                    | -                    | -                    | 4                    | 6                       | 6                       | 4                       | -                        | 1                        | -                        | 3                        | 9                        | 1                        |
| <i>Mormopterus (Ozimops) ridei</i>           | -                    | -                    | -                    | -                    | -                       | 1                       | 25                      | -                        | 14                       | 4                        | 1                        | 1                        | -                        |
| <i>Scoteanax rueppellii</i>                  | -                    | -                    | -                    | -                    | -                       | 5                       | -                       | 4                        | -                        | 7                        | 1                        | -                        | -                        |
| <i>Vespadelus vulturnus</i>                  | 3                    | -                    | 5                    | -                    | 6                       | -                       | -                       | -                        | -                        | -                        | -                        | 7                        | 1                        |
| POSSIBLE                                     |                      |                      |                      |                      |                         |                         |                         |                          |                          |                          |                          |                          |                          |
| <i>Chalinolobus gouldii</i>                  | -                    | 2                    | 1                    | -                    | -                       | -                       | -                       | -                        | -                        | -                        | 1                        | -                        | -                        |
| <i>Chalinolobus morio</i>                    | -                    | -                    | -                    | -                    | -                       | -                       | 1                       | -                        | -                        | -                        | -                        | 1                        | -                        |
| <i>Miniopterus australis</i>                 | 2                    | -                    | -                    | 1                    | -                       | -                       | -                       | -                        | -                        | -                        | -                        | -                        | -                        |
| <i>Mormopterus (Micronomus) norfolkensis</i> | 2                    | -                    | -                    | 1                    | 1                       | -                       | -                       | -                        | -                        | -                        | -                        | -                        | -                        |
| <i>Mormopterus (Ozimops) ridei</i>           | -                    | -                    | -                    | -                    | -                       | -                       | -                       | -                        | 1                        | -                        | -                        | -                        | -                        |
| <i>Scoteanax rueppellii</i>                  | -                    | -                    | -                    | -                    | -                       | -                       | -                       | -                        | -                        | -                        | -                        | -                        | 1                        |
| <i>Tadarida australis</i>                    | -                    | -                    | -                    | -                    | -                       | -                       | -                       | 1                        | -                        | -                        | -                        | -                        | -                        |
| <i>Vespadelus pumilus</i>                    | -                    | -                    | -                    | 1                    | -                       | -                       | -                       | -                        | -                        | -                        | -                        | -                        | -                        |

| IDENTIFICATION                                                                                                  | Anabat<br>14/10/2015 | Anabat<br>15/10/2015 | Anabat<br>25/10/2015 | Anabat<br>29/10/2015 | Song Meter<br>7/10/2015 | Song Meter<br>8/10/2015 | Song Meter<br>9/10/2015 | Song Meter<br>10/10/2015 | Song Meter<br>11/10/2015 | Song Meter<br>12/10/2015 | Song Meter<br>13/10/2015 | Song Meter<br>14/10/2015 | Song Meter<br>15/10/2015 |
|-----------------------------------------------------------------------------------------------------------------|----------------------|----------------------|----------------------|----------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <i>Vespadelus vulturnus</i>                                                                                     | -                    | -                    | -                    | -                    | 3                       | -                       | -                       | -                        | -                        | -                        | -                        | -                        | -                        |
| <b>SPECIES GROUPS</b>                                                                                           |                      |                      |                      |                      |                         |                         |                         |                          |                          |                          |                          |                          |                          |
| <i>Chalinolobus gouldii</i> / <i>Mormopterus (Micronomus) norfolkensis</i> / <i>Mormopterus (Ozimops) ridei</i> | 2                    | -                    | 5                    | -                    | 11                      | 24                      | 6                       | 5                        | 6                        | 14                       | 6                        | 5                        | 3                        |
| <i>Chalinolobus gouldii</i> / <i>Mormopterus (Ozimops) ridei</i>                                                | -                    | 1                    | 6                    | 2                    | 9                       | 5                       | 4                       | 2                        | 1                        | 7                        | 2                        | 10                       | 3                        |
| <i>Chalinolobus morio</i> / <i>Vespadelus pumilus</i> / <i>Vespadelus vulturnus</i>                             | -                    | -                    | -                    | 5                    | 172                     | 18                      | 9                       | 9                        | 2                        | 12                       | 4                        | 46                       | 17                       |
| <i>Chalinolobus morio</i> / <i>Vespadelus vulturnus</i>                                                         | 12                   | 4                    | 1                    | -                    | 2                       | -                       | -                       | -                        | -                        | -                        | -                        | 1                        | -                        |
| <i>Falsistrellus tasmaniensis</i> / <i>Scotorepens orion</i>                                                    | -                    | 3                    | -                    | 1                    | -                       | -                       | -                       | -                        | 1                        | 4                        | 1                        | -                        | 1                        |
| <i>Falsistrellus tasmaniensis</i> / <i>Scotorepens orion</i> / <i>Scoteanax rueppellii</i>                      | 13                   | 2                    | 1                    | 21                   | -                       | 3                       | 1                       | 5                        | 15                       | 31                       | 14                       | 6                        | 16                       |
| <i>Miniopterus australis</i> / <i>Vespadelus pumilus</i>                                                        | -                    | -                    | -                    | 3                    | 3                       | 1                       | -                       | 1                        | -                        | 5                        | 2                        | 4                        | 4                        |
| <i>Miniopterus schreibersii oceanensis</i> / <i>Vespadelus darlingtoni</i> / <i>Vespadelus regulus</i>          | 7                    | 1                    | 2                    | -                    | 17                      | 24                      | 18                      | 9                        | 3                        | 2                        | 20                       | 18                       | 3                        |
| <i>Mormopterus (Micronomus) norfolkensis</i> / <i>Mormopterus (Ozimops) ridei</i>                               | 4                    | 1                    | 1                    | 6                    | 8                       | 31                      | 38                      | 3                        | 23                       | 4                        | 13                       | 12                       | 2                        |
| <i>Myotis macropus</i> / <i>Nyctophilus geoffroyi</i> / <i>Nyctophilus gouldi</i>                               | 1                    | 1                    | -                    | -                    | 1                       | 3                       | -                       | 3                        | -                        | 2                        | 3                        | -                        | -                        |
| <i>Nyctophilus geoffroyi</i> / <i>Nyctophilus gouldi</i>                                                        | -                    | 1                    | -                    | -                    | -                       | -                       | -                       | -                        | -                        | -                        | -                        | -                        | -                        |
| <i>Vespadelus pumilus</i> / <i>Vespadelus vulturnus</i>                                                         | -                    | -                    | -                    | 1                    | 19                      | -                       | -                       | -                        | -                        | 2                        | -                        | 10                       | -                        |

| IDENTIFICATION | Anabat<br>14/10/2015 | Anabat<br>15/10/2015 | Anabat<br>25/10/2015 | Anabat<br>29/10/2015 | Song Meter<br>7/10/2015 | Song Meter<br>8/10/2015 | Song Meter<br>9/10/2015 | Song Meter<br>10/10/2015 | Song Meter<br>11/10/2015 | Song Meter<br>12/10/2015 | Song Meter<br>13/10/2015 | Song Meter<br>14/10/2015 | Song Meter<br>15/10/2015 |
|----------------|----------------------|----------------------|----------------------|----------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| UNKNOWN        |                      |                      |                      |                      |                         |                         |                         |                          |                          |                          |                          |                          |                          |
| 'Noise' files  | 22                   | 16                   | 6                    | 8                    | 7                       | 12                      | 27                      | 12                       | 19                       | 52                       | 20                       | 30                       | 10                       |
| Unknown        | 19                   | 7                    | 7                    | 8                    | 54                      | 27                      | 24                      | 18                       | 20                       | 30                       | 33                       | 47                       | 9                        |
| <b>TOTAL</b>   | <b>151</b>           | <b>50</b>            | <b>65</b>            | <b>99</b>            | <b>398</b>              | <b>280</b>              | <b>234</b>              | <b>111</b>               | <b>180</b>               | <b>228</b>               | <b>170</b>               | <b>261</b>               | <b>141</b>               |

## 4.0 SAMPLE CALLS

A sample of the calls actually identified from the site for each species is given below.

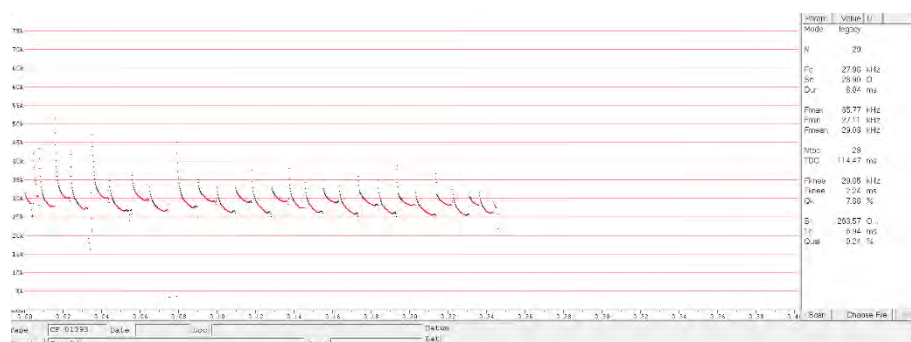


Figure 4-1: *Chalinolobus gouldii* definite call



Figure 4-2: *Chalinolobus morio* definite call



Figure 4-3: *Miniapterus australis* definite call



Figure 4-4: *Miniopertus schreibersii oceanensis* probable call

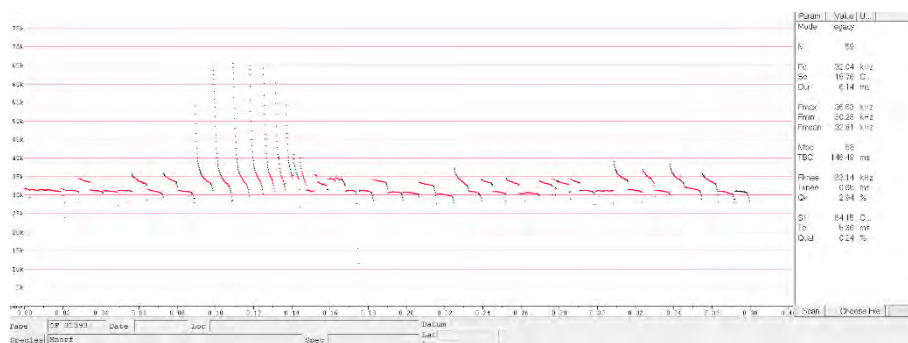


Figure 4-5: *Mormopterus norfolkensis* definite call

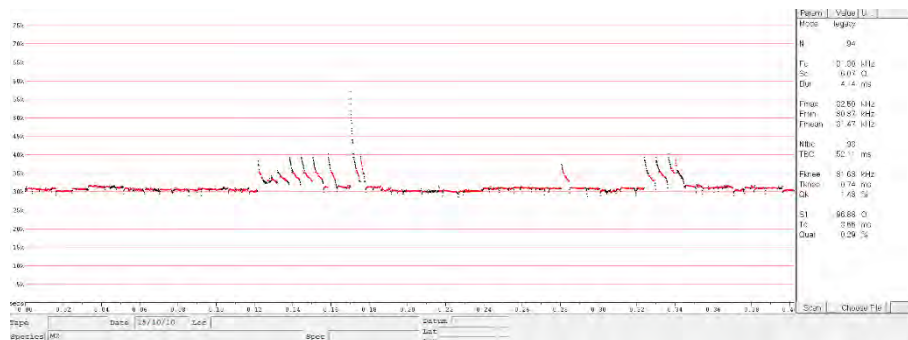


Figure 4-6: *Mormopterus (Ozimops) ridei* definite call



Figure 4-7: *Nyctophilus* sp. species group



Figure 4-8: *Scoteanax rueppellii* probable call



Figure 4-9: *Vespadelus pumilus* definite call

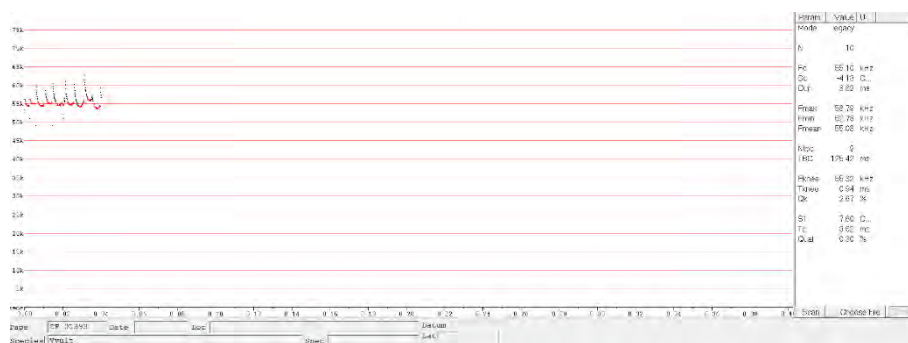


Figure 4-10: *Vespadelus vulturnus* definite call



Figure 4-11: *Tadarida australis* definite call

## 5.0 REFERENCES

Adams, M., Reardon, T.R., Baverstock, P.R. and Watts, C.H.S. (1988). Electrophoretic resolution of species boundaries in Australian Microchiroptera. IV. The Molossidae (Chiroptera). *Australian Journal of Biological Sciences* 41: 315-326.

Australasian Bat Society Incorporated (undated) *Standards for reporting bat detector surveys*, [http://batcall.csu.edu.au/abs/issues/ABS\\_Anabat\\_survey\\_standards.pdf](http://batcall.csu.edu.au/abs/issues/ABS_Anabat_survey_standards.pdf)

Churchill, S. (2008). *Australian Bats*. Second Edition Allen & Unwin; Crows Nest, NSW.

Hoye, G.A, Law, B.S. and Lumsden, L.F. (2008). Eastern Free-tailed Bat *Mormopterus* sp. Pp. 493-495 in *The Mammals of Australia*: Third Edition (S. van Dyck and R. Strahan, Eds.); New Holland; Sydney.

Law, B.S., Turbill, C. and Parnaby, H. (2008). Eastern Forest Bat *Vespadelus pumilus*. Pp. 567-568 in *The Mammals of Australia*: Third Edition (S. van Dyck & R. Strahan; Eds.); New Holland; Sydney.

Law, B.S., Reinhold, L. and Pennay, M. (2002). Geographic variation in the echolocation calls of *Vespadelus* spp. (Vespertilionidae) from New South Wales and Queensland, Australia. *Acta Chiropterologica* 4: 201-215.

Pennay, M., Law, B. and Reinhold, L. (2004). *Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats*. NSW Department of Environment and Conservation, Hurstville.

Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001a). *Key to the bat calls of south-east Queensland and north-east New South Wales*. Queensland Department of Natural Resources and Mines, State Forests of New South Wales, University of Southern Queensland, and New South Wales National Parks and Wildlife Service, Australia.

Reinhold, L., Herr, A., Lumsden, L., Reardon, T., Corben, C., Law, B., Prevett, P., Ford, G., Conole, L., Kutt, A., Milne, D. and Hoye, G. (2001b). Geographic variation in the echolocation calls of Gould's wattled bat *Chalinolobus gouldii*. *Australian Zoologist* 31: 618-624.

Richards, G.C., Ford, G.I. and Pennay, M. (2008). Inland Free-tailed Bat *Mormopterus* sp. Pp. 494-495 in *The Mammals of Australia*: Third Edition (S. van Dyck and R. Strahan, Eds.); New Holland; Sydney.

Thomas, D.W., Bell, G.P. and Fenton, M.B. (1987). Variation in echolocation call frequencies recorded from North American vespertilionid bats: a cautionary note. *Journal of Mammalogy* 68: 842-847.

Van Dyck, S. and Strahan, R. (Eds.) (2008). *The Mammals of Australia: Third Edition*. New Holland; Sydney.

## Appendix 8 – Photographs



**Photo 1 - Looking East at Quadrat 1**



**Photo 2 – Arboreal Elliott Trap.**



**Photo 3 – Stationary Anabat.**



**Photo 4 – SongMeter**



**Photo 5 – Camera 1**



**Photo 6 – Camera 2**



**Photo 7 – South-eastern Small Dam**



**Photo 8 – Drainage Line in E2 Zoned Area**



Photo 9 – Black Rat (*Rattus rattus*) at Camera 2



Photo 10 - Short-beaked Echidna (*Tachyglossus aculeatus*) at Camera 2



Photo 11 - Bush Rat (*Rattus fuscipes*) at Camera 2



Photo 12 - European Fox (*Vulpes vulpes*) at Camera 2



Photo 13 - Common Brushtail Possum (*Trichosurus vulpecula*) at Camera 1



Photo 14 - Common Ringtail Possum (*Pseudocheirus peregrinus*) at Camera 2

## Appendix 9 – WEATHER CONDITIONS

Table 13 – Weather Conditions from the Bureau of Meteorology for August 2015 - Norah Head Weather Station no. 061366 ([www.bom.gov.au](http://www.bom.gov.au))

| Date | Day | Temps |      | Rain | Evap | Sun | Max wind gust |     |       | 9 am |    |                 |      |     |        | 3 pm |    |                 |      |     |        |
|------|-----|-------|------|------|------|-----|---------------|-----|-------|------|----|-----------------|------|-----|--------|------|----|-----------------|------|-----|--------|
|      |     | Min   | Max  |      |      |     | Dir           | Spd | Time  | Temp | RH | Cld             | Dir  | Spd | MSLP   | Temp | RH | Cld             | Dir  | Spd | MSLP   |
|      |     | °C    | °C   |      |      |     | km/h          |     | local | °C   | %  | 8 <sup>th</sup> | km/h |     | hPa    | °C   | %  | 8 <sup>th</sup> | km/h |     | hPa    |
| 1    | Sa  | 10.2  | 22.9 | 0    |      |     | WNW           | 35  | 15:59 | 15.8 | 61 |                 | NNW  | 20  | 1019.6 | 21.8 | 34 |                 | NW   | 13  | 1016.1 |
| 2    | Su  | 14.3  | 27.8 | 0    |      |     | NW            | 43  | 13:09 | 19.4 | 49 |                 | N    | 9   | 1015.6 | 24.1 | 36 |                 | WNW  | 9   | 1010.4 |
| 3    | Mo  | 10.7  | 19.3 | 0    |      |     | WNW           | 33  | 14:53 | 13.2 | 49 |                 | WNW  | 15  | 1015.4 | 18.8 | 34 |                 | WNW  | 11  | 1013.5 |
| 4    | Tu  | 8.7   | 13.6 | 0    |      |     | SW            | 24  | 05:45 | 9.5  | 70 |                 | WSW  | 11  | 1022.7 | 12.4 | 65 |                 | S    | 9   | 1019.2 |
| 5    | We  | 4.6   | 14.0 | 0    |      |     | NW            | 31  | 14:10 | 9.5  | 52 |                 | NW   | 9   | 1015.0 | 13.8 | 48 |                 | WNW  | 11  | 1010.8 |
| 6    | Th  | 6.8   | 15.8 | 0    |      |     | SSW           | 30  | 12:18 | 11.1 | 60 |                 | W    | 6   | 1016.5 | 14.9 | 49 |                 | S    | 19  | 1016.6 |
| 7    | Fr  | 6.8   | 16.3 | 0    |      |     | SSE           | 26  | 18:18 | 11.2 | 61 |                 | W    | 7   | 1023.6 | 15.3 | 54 |                 | S    | 20  | 1020.9 |
| 8    | Sa  | 8.6   | 15.6 | 0    |      |     | SSW           | 37  | 14:16 | 11.9 | 68 |                 | WSW  | 13  | 1023.9 | 14.9 | 66 |                 | S    | 28  | 1021.9 |
| 9    | Su  | 8.1   | 17.8 | 0    |      |     | W             | 26  | 07:11 | 11.5 | 74 |                 | W    | 13  | 1024.0 | 16.5 | 61 |                 | SE   | 11  | 1019.6 |
| 10   | Mo  | 9.3   | 20.6 | 0    |      |     | N             | 31  | 23:37 | 14.5 | 64 |                 | NW   | 7   | 1018.3 | 19.8 | 40 |                 | NW   | 13  | 1013.3 |
| 11   | Tu  | 10.4  | 20.9 | 0    |      |     | N             | 31  | 00:25 | 16.5 | 56 |                 | NW   | 9   | 1014.7 | 18.4 | 51 |                 | SE   | 22  | 1011.0 |
| 12   | We  | 8.4   | 17.8 | 0    |      |     | N             | 43  | 10:26 | 14.7 | 56 |                 | N    | 22  | 1007.7 | 17.3 | 44 |                 | W    | 11  | 1004.4 |
| 13   | Th  | 9.0   | 19.2 | 0    |      |     | WNW           | 31  | 05:49 | 13.1 | 53 |                 | W    | 11  | 1015.1 | 18.8 | 31 |                 | SW   | 9   | 1014.7 |

| Date | Day | Temps |      | Rain | Evap | Sun | Max wind gust |     |       | 9 am |     |       |     |     |                 | 3 pm |     |     |     |     |                 |
|------|-----|-------|------|------|------|-----|---------------|-----|-------|------|-----|-------|-----|-----|-----------------|------|-----|-----|-----|-----|-----------------|
|      |     | Min   | Max  |      |      |     | Dir           | Spd | Time  | Temp | RH  | Cld   | Dir | Spd | MSLP            | Temp | RH  | Cld | Dir | Spd | MSLP            |
|      |     | °C    | °C   |      |      |     | mm            | mm  | hours | km/h |     | local | °C  | %   | 8 <sup>th</sup> | km/h |     | hPa | °C  | %   | 8 <sup>th</sup> |
| 14   | Fr  | 7.9   | 17.9 | 0    |      |     | SSE           | 19  | 12:14 | 13.1 | 57  |       | W   | 7   | 1025.3          | 16.5 | 50  |     | E   | 6   | 1023.6          |
| 15   | Sa  | 9.3   | 16.7 | 0    |      |     | S             | 39  | 15:31 | 11.1 | 77  |       | W   | 13  | 1029.9          | 15.7 | 81  |     | S   | 24  | 1028.4          |
| 16   | Su  | 10.7  | 20.2 | 0    |      |     | NNE           | 37  | 18:39 | 14.4 | 81  |       | W   | 11  | 1027.3          | 18.0 | 70  |     | NE  | 20  | 1021.7          |
| 17   | Mo  | 10.1  | 20.8 | 0    |      |     | SSE           | 26  | 15:26 | 13.9 | 59  |       | WNW | 9   | 1017.8          | 19.2 | 46  |     | SE  | 15  | 1013.5          |
| 18   | Tu  | 9.8   | 15.2 | 0    |      |     | SSE           | 33  | 15:41 | 12.9 | 53  |       | SW  | 15  | 1020.5          | 14.7 | 61  |     | S   | 22  | 1020.7          |
| 19   | We  | 9.5   | 19.2 | 0    |      |     | NE            | 24  | 20:17 | 13.8 | 70  |       | SW  | 6   | 1026.4          | 17.3 | 58  |     | ENE | 13  | 1024.8          |
| 20   | Th  | 11.4  | 20.1 | 0    |      |     | NNE           | 39  | 19:50 | 15.7 | 73  |       | NW  | 9   | 1028.2          | 19.5 | 69  |     | NE  | 19  | 1024.9          |
| 21   | Fr  | 11.3  | 22.6 | 0    |      |     | NE            | 35  | 14:22 | 15.7 | 83  |       | N   | 6   | 1025.8          | 18.5 | 78  |     | NE  | 28  | 1021.4          |
| 22   | Sa  | 14.4  | 25.2 | 0    |      |     | NNE           | 41  | 17:02 | 18.8 | 75  |       | NNW | 7   | 1021.8          | 23.4 | 55  |     | N   | 20  | 1017.3          |
| 23   | Su  | 15.0  | 16.8 | 7.4  |      |     | SSW           | 37  | 06:01 | 15.3 | 96  |       | W   | 4   | 1022.3          | 16.4 | 95  |     | NNW | 11  | 1018.2          |
| 24   | Mo  | 15.0  | 17.9 | 7.6  |      |     | N             | 37  | 21:25 | 15.5 | 100 |       | WSW | 9   | 1017.7          | 15.7 | 100 |     | WNW | 7   | 1016.0          |
| 25   | Tu  | 13.9  | 20.8 |      |      |     | NW            | 39  | 19:09 | 15.6 | 89  |       | NW  | 6   | 1014.9          | 16.4 | 88  |     | W   | 9   | 1013.7          |
| 26   | We  | 13.2  | 18.1 |      |      |     | NNW           | 31  | 00:38 | 14.0 | 86  |       | W   | 9   | 1017.9          | 18.0 | 81  |     | S   | 13  | 1017.7          |

| Date                       | Day | Temps |      | Rain | Evap | Sun | Max wind gust |     |       | 9 am |     |                 |      |     |        | 3 pm |     |                 |      |     |        |
|----------------------------|-----|-------|------|------|------|-----|---------------|-----|-------|------|-----|-----------------|------|-----|--------|------|-----|-----------------|------|-----|--------|
|                            |     | Min   | Max  |      |      |     | Dir           | Spd | Time  | Temp | RH  | Cld             | Dir  | Spd | MSLP   | Temp | RH  | Cld             | Dir  | Spd | MSLP   |
|                            |     | °C    | °C   |      |      |     | km/h          |     | local | °C   | %   | 8 <sup>th</sup> | km/h |     | hPa    | °C   | %   | 8 <sup>th</sup> | km/h |     | hPa    |
| 27                         | Th  | 12.6  | 19.4 |      |      |     | NW            | 28  | 09:56 | 15.9 | 87  |                 | NW   | 7   | 1019.9 | 18.6 | 61  |                 | WNW  | 9   | 1016.2 |
| 28                         | Fr  | 11.1  | 19.0 | 2.8  |      |     | WNW           | 30  | 09:09 | 14.9 | 56  |                 | WNW  | 11  | 1020.0 | 17.5 | 54  |                 | S    | 13  | 1019.2 |
| 29                         | Sa  | 9.6   | 19.5 | 0    |      |     | SSE           | 24  | 14:39 | 14.4 | 64  |                 | WNW  | 4   | 1022.8 | 17.5 | 63  |                 | SE   | 17  | 1018.1 |
| 30                         | Su  | 8.7   | 16.6 | 0    |      |     | S             | 37  | 16:02 | 13.3 | 58  |                 | SW   | 13  | 1019.8 | 16.1 | 62  |                 | S    | 24  | 1017.3 |
| 31                         | Mo  | 10.4  | 17.4 | 1.4  |      |     | SSE           | 31  | 15:22 | 14.6 | 66  |                 | SSW  | 17  | 1017.1 | 15.7 | 65  |                 | SSE  | 22  | 1013.7 |
| Statistics for August 2015 |     |       |      |      |      |     |               |     |       |      |     |                 |      |     |        |      |     |                 |      |     |        |
| Mean                       |     | 10.3  | 18.9 |      |      |     |               |     |       | 14.0 | 67  |                 |      | 10  | 1020.2 | 17.5 | 59  |                 |      | 15  | 1017.4 |
| Lowest                     |     | 4.6   | 13.6 | 0    |      |     |               |     |       | 9.5  | 49  |                 | #    | 4   | 1007.7 | 12.4 | 31  |                 | E    | 6   | 1004.4 |
| Highest                    |     | 15.0  | 27.8 | 7.6  |      |     | #             | 43  |       | 19.4 | 100 |                 | N    | 22  | 1029.9 | 24.1 | 100 |                 | #    | 28  | 1028.4 |
| Total                      |     |       |      | 19.2 |      |     |               |     |       |      |     |                 |      |     |        |      |     |                 |      |     |        |

Table 14 – Weather Conditions from the Bureau of Meteorology for September 2015 - Norah Head Weather Station no. 061366 ([www.bom.gov.au](http://www.bom.gov.au))

| Date | Day | Temps |      | Rain | Evap | Sun | Max wind gust |     |       | 9 am |    |                 |      |     |        | 3 pm |    |                 |      |     |        |
|------|-----|-------|------|------|------|-----|---------------|-----|-------|------|----|-----------------|------|-----|--------|------|----|-----------------|------|-----|--------|
|      |     | Min   | Max  |      |      |     | Dir           | Spd | Time  | Temp | RH | Cld             | Dir  | Spd | MSLP   | Temp | RH | Cld             | Dir  | Spd | MSLP   |
|      |     | °C    | °C   |      |      |     | km/h          |     | local | °C   | %  | 8 <sup>th</sup> | km/h |     | hPa    | °C   | %  | 8 <sup>th</sup> | km/h |     | hPa    |
| 1    | Tu  | 9.3   | 18.1 |      |      |     | S             | 24  | 13:32 | 13.1 | 58 |                 | W    | 6   | 1015.9 | 16.8 | 54 |                 | SSE  | 17  | 1013.4 |
| 2    | We  | 9.3   | 20.3 |      |      |     | NNE           | 41  | 20:07 | 16.1 | 55 |                 | NNW  | 9   | 1018.1 | 18.1 | 54 |                 | NNE  | 26  | 1012.2 |
| 3    | Th  | 12.7  | 19.5 |      |      |     | SW            | 43  | 23:30 | 17.4 | 70 |                 | WNW  | 13  | 1005.8 | 19.3 | 49 |                 | WNW  | 9   | 1005.8 |
| 4    | Fr  | 12.8  | 17.0 |      |      |     | SSW           | 54  | 00:25 | 14.0 | 98 |                 | SW   | 15  | 1021.1 | 16.7 | 76 |                 | S    | 24  | 1020.3 |
| 5    | Sa  | 12.3  | 20.2 |      |      |     | SE            | 43  | 18:52 | 16.4 | 77 |                 | WNW  | 6   | 1022.1 | 18.4 | 57 |                 | SSE  | 17  | 1019.3 |
| 6    | Su  | 13.5  | 19.2 |      |      |     | NNE           | 41  | 19:34 | 14.2 | 94 |                 | W    | 2   | 1024.8 | 16.8 | 80 |                 | ESE  | 6   | 1021.8 |
| 7    | Mo  | 11.5  | 24.4 |      |      |     | N             | 43  | 14:04 | 19.1 | 72 |                 | NNW  | 7   | 1018.9 | 22.8 | 40 |                 | NNW  | 11  | 1014.1 |
| 8    | Tu  | 9.1   | 19.5 |      |      |     | W             | 33  | 00:39 | 13.4 | 46 |                 | WNW  | 11  | 1019.6 | 17.9 | 37 |                 | SSW  | 13  | 1015.8 |
| 9    | We  | 9.7   | 17.8 |      |      |     | S             | 37  | 15:25 | 15.1 | 54 |                 | WSW  | 6   | 1022.7 | 17.1 | 62 |                 | S    | 28  | 1021.5 |
| 10   | Th  | 12.2  | 17.7 |      |      |     | S             | 39  | 12:46 | 13.7 | 82 |                 | SW   | 13  | 1030.5 | 17.3 | 65 |                 | S    | 19  | 1029.6 |
| 11   | Fr  | 13.4  | 22.3 |      |      |     | N             | 46  | 20:17 | 16.5 | 72 |                 | WSW  | 2   | 1032.2 | 19.1 | 57 |                 | NE   | 24  | 1028.2 |
| 12   | Sa  | 11.5  | 21.5 |      |      |     | ESE           | 20  | 14:38 | 18.2 | 67 |                 | N    | 4   | 1028.2 | 20.1 | 69 |                 | ESE  | 15  | 1024.8 |
| 13   | Su  | 14.0  | 21.5 | 0    |      |     | NNE           | 39  | 18:58 | 19.8 | 78 |                 | Calm |     | 1028.4 | 20.8 | 76 |                 | ENE  | 19  | 1025.1 |

| Date | Day | Temps |      | Rain | Evap | Sun | Max wind gust |     |       | 9 am |    |                 |      |     |        | 3 pm |    |                 |      |     |        |
|------|-----|-------|------|------|------|-----|---------------|-----|-------|------|----|-----------------|------|-----|--------|------|----|-----------------|------|-----|--------|
|      |     | Min   | Max  |      |      |     | Dir           | Spd | Time  | Temp | RH | Cld             | Dir  | Spd | MSLP   | Temp | RH | Cld             | Dir  | Spd | MSLP   |
|      |     | °C    | °C   |      |      |     | km/h          |     | local | °C   | %  | 8 <sup>th</sup> | km/h |     | hPa    | °C   | %  | 8 <sup>th</sup> | km/h |     | hPa    |
| 14   | Mo  | 13.6  | 21.9 | 0    |      |     | NNE           | 46  | 18:03 | 18.3 | 72 |                 | N    | 9   | 1026.1 | 19.9 | 78 |                 | NE   | 31  | 1020.8 |
| 15   | Tu  | 15.2  | 27.9 | 0    |      |     |               |     |       | 21.1 | 64 |                 | N    | 22  | 1016.0 | 27.4 | 36 |                 | NW   | 15  | 1011.7 |
| 16   | We  |       |      |      |      |     |               |     |       |      |    |                 |      |     |        | 18.5 | 61 |                 | SE   | 13  | 1014.7 |
| 17   | Th  | 13.5  | 17.8 |      |      |     | SSE           | 57  | 23:18 | 15.8 | 80 |                 | SSW  | 19  | 1017.4 | 15.2 | 87 |                 | SE   | 15  | 1017.7 |
| 18   | Fr  | 13.6  | 19.6 | 7.4  |      |     | SSE           | 61  | 00:48 | 17.4 | 62 |                 | S    | 31  | 1025.4 | 17.6 | 65 |                 | S    | 37  | 1024.6 |
| 19   | Sa  | 13.1  | 19.5 | 1.2  |      |     | SE            | 39  | 12:00 | 19.2 | 70 |                 | SE   | 19  | 1025.7 | 15.9 | 87 |                 | SSE  | 26  | 1023.6 |
| 20   | Su  | 13.8  | 18.5 | 11.8 |      |     | NNE           | 41  | 20:19 | 14.3 | 99 |                 | WSW  | 6   | 1024.4 | 17.9 | 85 |                 | S    | 13  | 1021.2 |
| 21   | Mo  | 12.4  | 23.6 | 5.6  |      |     | N             | 39  | 15:01 | 17.8 | 79 |                 | N    | 9   | 1019.9 | 19.4 | 81 |                 | NNE  | 26  | 1015.6 |
| 22   | Tu  | 14.4  | 19.4 | 0.2  |      |     | S             | 74  | 20:04 | 17.8 | 61 |                 | SW   | 11  | 1016.2 | 17.2 | 69 |                 | S    | 44  | 1016.5 |
| 23   | We  | 8.6   | 14.7 | 14.2 |      |     | S             | 87  | 13:12 | 10.5 | 80 |                 | SW   | 20  | 1024.7 | 13.9 | 76 |                 | SSW  | 50  | 1023.9 |
| 24   | Th  | 8.3   | 15.9 | 16.0 |      |     | S             | 80  | 23:05 | 11.2 | 83 |                 | SW   | 19  | 1024.7 | 14.2 | 74 |                 | SSW  | 39  | 1023.5 |
| 25   | Fr  | 10.7  | 17.6 | 23.0 |      |     | S             | 78  | 00:03 | 14.3 | 89 |                 | SSW  | 24  | 1028.1 | 15.3 | 82 |                 | S    | 52  | 1026.1 |
| 26   | Sa  | 11.6  | 18.8 | 2.8  |      |     | SSE           | 54  | 00:55 | 15.0 | 82 |                 | WSW  | 7   | 1028.0 | 16.3 | 69 |                 | S    | 24  | 1024.8 |

| Date                          | Day | Temps |      | Rain | Evap | Sun | Max wind gust |     |       | 9 am |    |                 |      |     |        | 3 pm |    |                 |      |     |        |
|-------------------------------|-----|-------|------|------|------|-----|---------------|-----|-------|------|----|-----------------|------|-----|--------|------|----|-----------------|------|-----|--------|
|                               |     | Min   | Max  |      |      |     | Dir           | Spd | Time  | Temp | RH | Cld             | Dir  | Spd | MSLP   | Temp | RH | Cld             | Dir  | Spd | MSLP   |
|                               |     | °C    | °C   |      |      |     | km/h          |     | local | °C   | %  | 8 <sup>th</sup> | km/h |     | hPa    | °C   | %  | 8 <sup>th</sup> | km/h |     | hPa    |
| 27                            | Su  | 12.4  | 17.1 | 8.4  |      |     | S             | 54  | 13:11 | 13.0 | 98 |                 | SW   | 15  | 1023.8 | 16.6 | 72 |                 | S    | 30  | 1020.6 |
| 28                            | Mo  | 10.5  | 20.7 | 2.2  |      |     | SE            | 24  | 15:39 | 16.5 | 62 |                 | WSW  | 9   | 1020.9 | 19.2 | 49 |                 | SE   | 17  | 1017.7 |
| 29                            | Tu  | 12.5  | 23.5 | 0    |      |     | NE            | 30  | 15:51 | 19.1 | 72 |                 | N    | 11  | 1019.4 | 20.9 | 69 |                 | ENE  | 22  | 1016.2 |
| 30                            | We  | 14.6  | 21.5 | 0    |      |     | ESE           | 59  | 20:37 | 19.7 | 79 |                 | S    | 26  | 1021.6 | 19.7 | 74 |                 | SE   | 26  | 1020.9 |
| Statistics for September 2015 |     |       |      |      |      |     |               |     |       |      |    |                 |      |     |        |      |    |                 |      |     |        |
| Mean                          |     | 12.1  | 19.9 |      |      |     |               |     |       | 16.1 | 74 |                 | 12   |     | 1022.4 | 18.2 | 66 |                 | 23   |     | 1019.7 |
| Lowest                        |     | 8.3   | 14.7 | 0    |      |     |               |     |       | 10.5 | 46 |                 | Calm |     | 1005.8 | 13.9 | 36 |                 | ESE  | 6   | 1005.8 |
| Highest                       |     | 15.2  | 27.9 | 23.0 |      |     | S             | 87  |       | 21.1 | 99 |                 | S    | 31  | 1032.2 | 27.4 | 87 |                 | S    | 52  | 1029.6 |
| Total                         |     |       |      | 92.8 |      |     |               |     |       |      |    |                 |      |     |        |      |    |                 |      |     |        |

Table 15 – Weather Conditions from the Bureau of Meteorology for October 2015 - Norah Head Weather Station no. 061366 ([www.bom.gov.au](http://www.bom.gov.au))

| Date | Day | Temps |      | Rain | Evap | Sun | Max wind gust |     |       | 9 am |    |       |     |     |                 | 3 pm |    |     |     |     |                 |
|------|-----|-------|------|------|------|-----|---------------|-----|-------|------|----|-------|-----|-----|-----------------|------|----|-----|-----|-----|-----------------|
|      |     | Min   | Max  |      |      |     | Dir           | Spd | Time  | Temp | RH | Cld   | Dir | Spd | MSLP            | Temp | RH | Cld | Dir | Spd | MSLP            |
|      |     | °C    | °C   |      |      |     | mm            | mm  | hours | km/h |    | local | °C  | %   | 8 <sup>th</sup> | km/h |    | hPa | °C  | %   | 8 <sup>th</sup> |
| 1    | Th  | 15.6  | 25.6 | 1.4  |      |     | NE            | 30  | 15:55 | 21.0 | 76 |       | NNW | 2   | 1026.4          | 21.1 | 79 |     | NE  | 24  | 1023.1          |
| 2    | Fr  | 17.3  | 23.6 | 0    |      |     | SSW           | 48  | 02:38 | 22.3 | 69 |       | SE  | 11  | 1033.6          | 20.7 | 66 |     | ESE | 13  | 1032.5          |
| 3    | Sa  | 14.2  | 27.4 | 0    |      |     | NE            | 33  | 15:37 | 21.3 | 80 |       | N   | 13  | 1030.8          | 21.4 | 86 |     | NE  | 26  | 1025.1          |
| 4    | Su  | 17.7  | 34.2 | 0    |      |     | WSW           | 33  | 14:56 | 22.4 | 69 |       | NE  | 6   | 1024.5          | 30.6 | 25 |     | S   | 4   | 1021.9          |
| 5    | Mo  | 16.9  | 29.9 | 0    |      |     | N             | 26  | 18:47 | 21.8 | 74 |       | N   | 9   | 1023.9          | 28.9 | 41 |     | N   | 6   | 1021.5          |
| 6    | Tu  | 16.9  | 28.4 | 0    |      |     | NNE           | 39  | 18:32 | 23.4 | 58 |       | NNW | 4   | 1023.1          | 23.9 | 72 |     | NNE | 33  | 1019.6          |
| 7    | We  | 19.0  | 19.7 | 0    |      |     | SSW           | 78  | 05:47 | 19.5 | 81 |       | S   | 56  | 1028.0          | 17.9 | 77 |     | S   | 44  | 1032.5          |
| 8    | Th  | 17.0  | 20.5 | 0    |      |     | SSE           | 41  | 04:07 | 18.8 | 68 |       | ESE | 22  | 1038.3          | 19.8 | 67 |     | ENE | 22  | 1035.6          |
| 9    | Fr  | 17.2  | 24.7 | 0    |      |     | NE            | 41  | 15:41 | 19.5 | 61 |       | NNE | 28  | 1034.2          | 22.1 | 68 |     | NE  | 31  | 1029.8          |
| 10   | Sa  | 15.2  | 25.8 | 0    |      |     | E             | 22  | 16:07 | 20.2 | 79 |       | ENE | 4   | 1028.6          | 22.9 | 72 |     | ENE | 15  | 1025.7          |
| 11   | Su  | 14.9  | 26.8 | 0    |      |     | W             | 39  | 17:36 | 19.8 | 84 |       | N   | 6   | 1022.7          | 22.0 | 79 |     | ENE | 24  | 1018.2          |
| 12   | Mo  | 16.1  | 26.0 | 6.6  |      |     | SE            | 43  | 16:04 | 21.6 | 82 |       | N   | 2   | 1017.0          | 24.3 | 79 |     | NE  | 26  | 1012.2          |
| 13   | Tu  | 19.3  | 23.1 | 0.4  |      |     | S             | 44  | 04:51 | 20.2 | 85 |       | SSE | 26  | 1021.2          | 21.1 | 80 |     | ESE | 20  | 1021.6          |

| Date | Day | Temps |      | Rain | Evap | Sun | Max wind gust |     |       | 9 am |    |                 |      |     |        | 3 pm |    |                 |      |     |        |
|------|-----|-------|------|------|------|-----|---------------|-----|-------|------|----|-----------------|------|-----|--------|------|----|-----------------|------|-----|--------|
|      |     | Min   | Max  |      |      |     | Dir           | Spd | Time  | Temp | RH | Cld             | Dir  | Spd | MSLP   | Temp | RH | Cld             | Dir  | Spd | MSLP   |
|      |     | °C    | °C   |      |      |     | km/h          |     | local | °C   | %  | 8 <sup>th</sup> | km/h |     | hPa    | °C   | %  | 8 <sup>th</sup> | km/h |     | hPa    |
| 14   | We  | 18.8  | 26.3 | 0.8  |      |     | NE            | 43  | 21:44 | 21.4 | 77 |                 | NE   | 19  | 1026.5 | 24.2 | 68 |                 | ENE  | 24  | 1025.3 |
| 15   | Th  | 16.7  | 24.4 | 0.2  |      |     | NE            | 44  | 19:16 | 21.1 | 81 |                 | NNE  | 7   | 1026.3 | 22.4 | 80 |                 | NE   | 30  | 1022.3 |
| 16   | Fr  | 17.2  | 23.0 | 0    |      |     | NE            | 35  | 16:05 | 20.6 | 85 |                 | NNE  | 7   | 1022.2 | 22.0 | 85 |                 | NE   | 26  | 1019.1 |
| 17   | Sa  | 18.3  | 24.2 | 0.2  |      |     | S             | 37  | 22:54 | 20.1 | 97 |                 | SSW  | 20  | 1022.5 | 23.3 | 80 |                 | S    | 13  | 1021.3 |
| 18   | Su  | 19.3  | 21.8 | 0.2  |      |     | SSE           | 37  | 08:35 | 20.7 | 79 |                 | SSE  | 30  | 1028.0 | 21.0 | 77 |                 | S    | 19  | 1027.6 |
| 19   | Mo  | 18.6  | 25.9 | 2.8  |      |     | NE            | 44  | 18:28 | 21.1 | 92 |                 | ENE  | 2   | 1026.4 | 24.0 | 73 |                 | NE   | 26  | 1022.6 |
| 20   | Tu  | 17.6  | 25.8 | 0    |      |     | NNE           | 44  | 14:47 | 20.7 | 80 |                 | NNE  | 11  | 1020.8 | 22.0 | 83 |                 | NE   | 28  | 1016.4 |
| 21   | We  | 18.5  | 29.0 | 0    |      |     | NNE           | 48  | 18:21 | 22.1 | 84 |                 | S    | 4   | 1014.2 | 22.3 | 82 |                 | NNE  | 7   | 1011.1 |
| 22   | Th  | 17.7  | 24.6 | 4.0  |      |     | S             | 78  | 19:25 | 19.3 | 92 |                 | NNW  | 9   | 1011.5 | 18.4 | 95 |                 | SSW  | 35  | 1009.5 |
| 23   | Fr  | 14.5  | 19.8 | 18.4 |      |     | SSW           | 67  | 23:46 | 16.6 | 84 |                 | S    | 22  | 1021.2 | 19.4 | 57 |                 | S    | 26  | 1021.0 |
| 24   | Sa  | 13.7  | 24.2 | 0.2  |      |     | NNE           | 44  | 19:31 | 18.7 | 74 |                 | NW   | 4   | 1024.3 | 22.3 | 66 |                 | NE   | 26  | 1021.2 |
| 25   | Su  | 15.0  | 25.5 | 0    |      |     | NNE           | 44  | 16:46 | 19.6 | 74 |                 | NNE  | 4   | 1022.1 | 22.1 | 77 |                 | NE   | 30  | 1017.9 |
| 26   | Mo  | 17.7  | 30.5 | 0    |      |     | WSW           | 63  | 14:10 | 21.6 | 83 |                 | NE   | 15  | 1015.1 | 21.3 | 77 |                 | W    | 11  | 1014.8 |

| Date                                             | Day | Temps |      | Rain | Evap | Sun | Max wind gust |     |       | 9 am |    |                 |      |     |        | 3 pm |    |                 |      |     |        |
|--------------------------------------------------|-----|-------|------|------|------|-----|---------------|-----|-------|------|----|-----------------|------|-----|--------|------|----|-----------------|------|-----|--------|
|                                                  |     | Min   | Max  |      |      |     | Dir           | Spd | Time  | Temp | RH | Cld             | Dir  | Spd | MSLP   | Temp | RH | Cld             | Dir  | Spd | MSLP   |
|                                                  |     | °C    | °C   |      |      |     | km/h          |     | local | °C   | %  | 8 <sup>th</sup> | km/h |     | hPa    | °C   | %  | 8 <sup>th</sup> | km/h |     | hPa    |
| 27                                               | Tu  | 16.1  | 18.6 | 36.0 |      |     | S             | 70  | 02:30 | 17.5 | 82 |                 | S    | 44  | 1024.1 | 18.3 | 66 |                 | S    | 43  | 1024.7 |
| 28                                               | We  | 14.4  | 21.2 | 0    |      |     | SE            | 39  | 01:16 | 17.8 | 75 |                 | SW   | 4   | 1025.0 | 20.0 | 49 |                 | E    | 15  | 1022.5 |
| 29                                               | Th  | 14.4  | 24.0 | 0    |      |     | NE            | 30  | 21:26 | 20.0 | 60 |                 | SE   | 15  | 1023.2 | 20.9 | 56 |                 | E    | 20  | 1022.2 |
| 30                                               | Fr  | 14.9  | 25.0 | 0    |      |     | NNE           | 44  | 20:29 | 19.5 | 76 |                 | SSW  | 6   | 1023.6 | 21.8 | 60 |                 | NE   | 26  | 1021.1 |
| 31                                               | Sa  | 17.7  |      | 0    |      |     |               |     |       | 20.3 | 76 |                 | NNE  | 22  | 1021.5 |      |    |                 |      |     |        |
| Statistics for the first 31 days of October 2015 |     |       |      |      |      |     |               |     |       |      |    |                 |      |     |        |      |    |                 |      |     |        |
| Mean                                             |     | 16.7  | 25.0 |      |      |     |               |     |       | 20.3 | 77 |                 |      | 14  | 1024.2 | 22.1 | 70 |                 |      | 23  | 1022.0 |
| Lowest                                           |     | 13.7  | 18.6 | 0    |      |     |               |     |       | 16.6 | 58 |                 | #    | 2   | 1011.5 | 17.9 | 25 |                 | S    | 4   | 1009.5 |
| Highest                                          |     | 19.3  | 34.2 | 36.0 |      |     | #             | 78  |       | 23.4 | 97 |                 | S    | 56  | 1038.3 | 30.6 | 95 |                 | S    | 44  | 1035.6 |
| Total                                            |     |       |      | 71.2 |      |     |               |     |       |      |    |                 |      |     |        |      |    |                 |      |     |        |

Table 16 – Weather Conditions from the Bureau of Meteorology for November 2015 - Norah Head Weather Station no. 061366 ([www.bom.gov.au](http://www.bom.gov.au))

| Date | Day | Temps |      | Rain | Evap | Sun | Max wind gust |     |       | 9 am |     |                 |      |     |        | 3 pm |     |                 |      |     |        |
|------|-----|-------|------|------|------|-----|---------------|-----|-------|------|-----|-----------------|------|-----|--------|------|-----|-----------------|------|-----|--------|
|      |     | Min   | Max  |      |      |     | Dir           | Spd | Time  | Temp | RH  | Cl<br>d         | Dir  | Spd | MSLP   | Temp | RH  | Cl<br>d         | Dir  | Spd | MSLP   |
|      |     | °C    | °C   |      |      |     | km/h          |     | local | °C   | %   | 8 <sup>th</sup> | km/h |     | hPa    | °C   | %   | 8 <sup>th</sup> | km/h |     | hPa    |
| 1    | Su  | 17.0  | 23.4 | 0    |      |     | NE            | 50  | 15:19 | 20.2 | 86  |                 | NNE  | 17  | 1015.7 | 22.2 | 82  |                 | NE   | 35  | 1010.9 |
| 2    | Mo  | 18.9  | 26.9 | 3.0  |      |     | ENE           | 37  | 15:18 | 23.3 | 81  |                 | NW   | 7   | 1011.4 | 23.1 | 85  |                 | ESE  | 17  | 1009.2 |
| 3    | Tu  | 19.0  | 19.6 | 6.2  |      |     | SSW           | 43  | 14:19 | 19.1 | 100 |                 | SSW  | 28  | 1016.0 | 19.0 | 100 |                 | S    | 30  | 1015.4 |
| 4    | We  | 17.9  | 20.2 | 20.6 |      |     | ESE           | 70  | 12:28 | 18.9 | 100 |                 | SSW  | 17  | 1016.7 | 17.9 | 99  |                 | E    | 50  | 1015.4 |
| 5    | Th  | 17.1  | 22.6 | 5.8  |      |     | NNE           | 57  | 15:02 | 17.9 | 100 |                 | NNE  | 26  | 1015.9 | 20.0 | 95  |                 | NE   | 43  | 1010.2 |
| 6    | Fr  | 17.7  | 25.1 | 2.0  |      |     | SW            | 57  | 11:50 | 22.2 | 99  |                 | NNW  | 2   | 1007.8 | 20.7 | 100 |                 | ENE  | 9   | 1005.8 |
| 7    | Sa  | 18.1  | 23.5 | 15.4 |      |     | S             | 52  | 21:59 | 20.9 | 96  |                 | SSW  | 15  | 1012.1 | 22.7 | 84  |                 | ESE  | 17  | 1011.7 |
| 8    | Su  | 15.7  | 20.3 | 5.6  |      |     | S             | 54  | 02:15 | 16.0 | 96  |                 | WSW  | 13  | 1019.9 | 18.3 | 84  |                 | S    | 24  | 1019.6 |
| 9    | Mo  | 14.8  | 22.8 | 1.6  |      |     | S             | 31  | 23:02 | 19.0 | 69  |                 | SSW  | 11  | 1021.0 | 21.1 | 64  |                 | ESE  | 17  | 1017.8 |
| 10   | Tu  | 15.6  | 25.8 | 0    |      |     | NE            | 28  | 15:18 | 20.8 | 78  |                 | NE   | 2   | 1016.2 | 24.6 | 71  |                 | ENE  | 19  | 1013.8 |
| 11   | We  | 18.3  | 24.7 | 0    |      |     | NNE           | 31  | 22:30 | 21.8 | 86  |                 | S    | 9   | 1020.3 | 22.7 | 73  |                 | ESE  | 7   | 1020.2 |
| 12   | Th  | 19.0  | 23.9 | 0    |      |     | NE            | 46  | 14:40 | 20.6 | 81  |                 | NNE  | 24  | 1020.3 | 22.3 | 76  |                 | NE   | 33  | 1017.1 |
| 13   | Fr  | 18.2  | 27.4 | 3.8  |      |     | S             | 50  | 15:37 | 21.9 | 88  |                 | N    | 9   | 1013.1 | 26.1 | 70  |                 | NE   | 19  | 1009.4 |
| 14   | Sa  | 16.6  | 22.2 | 27.2 |      |     | SSE           | 46  | 22:18 | 17.6 | 100 |                 | ESE  | 19  | 1013.9 | 18.9 | 85  |                 | S    | 22  | 1012.2 |
| 15   | Su  | 16.2  | 20.2 | 9.2  |      |     | SSE           | 63  | 07:05 | 16.8 | 98  |                 | SSE  | 39  | 1016.8 | 16.4 | 93  |                 | S    | 20  | 1017.2 |
| 16   | Mo  | 14.7  | 21.5 | 9.8  |      |     | SSW           | 31  | 08:34 | 18.1 | 82  |                 | SSW  | 15  | 1019.6 | 21.1 | 67  |                 | SSE  | 20  | 1018.1 |
| 17   | Tu  | 15.0  | 26.3 | 0    |      |     | NE            | 44  | 17:34 | 19.9 | 68  |                 | NNE  | 6   | 1019.6 | 21.7 | 68  |                 | NE   | 30  | 1016.6 |
| 18   | We  | 16.7  | 35.8 | 0    |      |     | SSW           | 50  | 20:48 | 26.2 | 63  |                 | NNW  | 7   | 1014.3 | 34.8 | 24  |                 | WNW  | 9   | 1010.4 |
| 19   | Th  | 18.8  | 27.4 | 0    |      |     | SSW           | 44  | 23:05 | 22.6 | 76  |                 | SSW  | 4   | 1015.1 | 22.8 | 89  |                 | NNE  | 13  | 1012.7 |
| 20   | Fr  | 20.3  | 40.3 | 0    |      |     | SSW           | 50  | 21:18 | 23.2 | 96  |                 | S    | 11  | 1012.9 | 40.2 | 16  |                 | W    | 11  | 1007.2 |
| 21   | Sa  | 20.1  | 22.0 | 0    |      |     | SSW           | 50  | 00:18 | 22.0 | 73  |                 | SE   | 20  | 1015.2 | 20.2 | 73  |                 | SSE  | 37  | 1016.6 |
| 22   | Su  | 17.8  | 23.0 | 0.2  |      |     | NNE           | 30  | 21:42 | 20.8 | 64  |                 | ENE  | 19  | 1019.4 | 21.7 | 69  |                 | NE   | 20  | 1016.5 |
| 23   | Mo  | 16.7  | 26.1 | 0    |      |     | S             | 43  | 15:35 | 22.4 | 75  |                 | NNE  | 7   | 1012.0 | 22.5 | 81  |                 | S    | 31  | 1010.4 |
| 24   | Tu  | 19.5  | 27.4 | 0    |      |     | NNE           | 50  | 20:00 | 24.7 | 69  |                 | ENE  | 9   | 1017.5 | 23.3 | 71  |                 | NE   | 28  | 1014.6 |
| 25   | We  | 17.5  | 30.9 | 0    |      |     | NNE           | 44  | 17:47 | 23.2 | 78  |                 | NE   | 6   | 1013.5 | 23.9 | 81  |                 | NE   | 31  | 1007.8 |

| Date                         | Day | Temps |      | Rain  | Evap | Sun | Max wind gust |     |       | 9 am |     |                 |      |     |        | 3 pm |     |                 |      |     |        |
|------------------------------|-----|-------|------|-------|------|-----|---------------|-----|-------|------|-----|-----------------|------|-----|--------|------|-----|-----------------|------|-----|--------|
|                              |     | Min   | Max  |       |      |     | Dir           | Spd | Time  | Temp | RH  | Cl<br>d         | Dir  | Spd | MSLP   | Temp | RH  | Cl<br>d         | Dir  | Spd | MSLP   |
|                              |     | °C    | °C   |       |      |     | km/h          |     | local | °C   | %   | 8 <sup>th</sup> | km/h |     | hPa    | °C   | %   | 8 <sup>th</sup> | km/h |     | hPa    |
| 26                           | Th  | 20.8  | 39.3 | 0     |      |     | SSE           | 70  | 17:14 | 30.8 | 49  |                 | NNW  | 30  | 1000.9 | 39.1 | 12  |                 | WNW  | 9   | 999.2  |
| 27                           | Fr  | 18.4  | 24.1 | 0     |      |     | SSE           | 44  | 23:35 | 20.4 | 68  |                 | ENE  | 17  | 1015.9 | 21.0 | 64  |                 | NE   | 24  | 1013.9 |
| 28                           | Sa  | 19.2  | 23.0 | 0     |      |     | ENE           | 41  | 17:31 | 20.6 | 86  |                 | ENE  | 24  | 1016.2 | 21.9 | 72  |                 | ENE  | 26  | 1016.0 |
| 29                           | Su  | 19.7  | 25.1 | 0     |      |     | NE            | 41  | 17:33 | 20.2 | 96  |                 | NE   | 15  | 1013.5 | 22.4 | 87  |                 | NE   | 31  | 1009.6 |
| 30                           | Mo  | 18.4  | 24.1 | 0     |      |     | SSW           | 39  | 03:00 | 21.0 | 85  |                 | SSW  | 9   | 1012.4 | 22.4 | 84  |                 | E    | 19  | 1009.0 |
| Statistics for November 2015 |     |       |      |       |      |     |               |     |       |      |     |                 |      |     |        |      |     |                 |      |     |        |
| Mean                         |     | 17.8  | 25.5 |       |      |     |               |     |       | 21.1 | 82  |                 |      | 14  | 1015.2 | 23.2 | 73  |                 |      | 23  | 1012.8 |
| Lowest                       |     | 14.7  | 19.6 | 0     |      |     |               |     |       | 16.0 | 49  |                 | #    | 2   | 1000.9 | 16.4 | 12  |                 | ESE  | 7   | 999.2  |
| Highest                      |     | 20.8  | 40.3 | 27.2  |      |     | #             | 70  |       | 30.8 | 100 |                 | SSE  | 39  | 1021.0 | 40.2 | 100 |                 | E    | 50  | 1020.2 |
| Total                        |     |       |      | 110.4 |      |     |               |     |       |      |     |                 |      |     |        |      |     |                 |      |     |        |