JAMES WARREN & Associates Pty Ltd

ENVIRONMENTAL CONSULTANTS

# RESPONSE TO THE DIRECTOR GENERAL'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

## COBAKI LAKES

# VOLUME 1 - ECOLOGICAL ASSESSMENT

AS AMENDED
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A REPORT TO LEDA MANORSTEAD PTY LTD

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# 1. INTRODUCTION

## 1.1 Background

James Warren and Associates (JWA) have been engaged by LEDA Manorstead Pty Ltd to complete an Ecological Assessment for land at Cobaki Lakes, Cobaki. The Minister for Planning authorised a Concept Plan for the proposed residential community at Cobaki Lakes on the 24th January 2007. Subsequently, the Director General's Environmental Assessment Requirements (DGEAR's) were issued to LEDA Manorstead Pty Ltd on the 21st August 2007.

The Ecological Assessment (Volume 1) and associated documents (i.e. Volumes 2 – 8) have been prepared in response to the DGEAR's. The Draft reports (i.e. Volumes 1 – 8) were reviewed by the Department of Planning (DoP) and a Test of Adequacy Response was provided in August 2008. The current Volumes 1 – 8 have been amended in consideration of the DoP review comments.

## 1.2 Locality

### *1.2.1 Introduction*

The Locality is defined as the area within a 10km radius of the Subject site. The Locality therefore extends from North Tumbulgum in the south to Burleigh Heads in the north and from Currumbin Valley in the west to Tweed Heads in the east (**FIGURE 1**).

Prominent features in the locality include the townships of Coolangatta, Palm Beach and Banora Point and the villages of Tallebudgera, Pigabeen and Bilambil Heights. Prominent water bodies in the locality include the Cobaki Broadwater, Currumbin Creek, Cobaki Creek, Terranora Broadwater and the Coral Sea.

Dominant habitat types are eucalypt forest, swamp sclerophyll forest, heathlands, sedgelands, rushlands, subtropical rainforest, littoral rainforest and intertidal communities. Land uses within the locality include residential, forestry, conservation, tourism, commercial, fishing, grazing and agriculture.

### *1.2.2 Conservation Reserves/Ecologically significant areas in the locality*

There are three (3) dedicated conservation reserves in the locality:

- Tweed Estuary Nature Reserve, an area of 59 hectares occurs 2.5km to the east of the Subject site;
- Ukerabagh Nature Reserve, an area of 150 hectares occurs 5.2km to the east of the Subject site; and
- Stotts Island Nature Reserve, an area of 142 hectares occurs 8.3km to the south of the Subject site.

State Environmental Planning Policy (SEPP) 14 - Wetlands numbers 1 - 30 occur within 10km of the locality, and are shown in **FIGURE 2**. A large area of SEPP 14 wetland no. 1

is located immediately east of the subject site adjacent to Cobaki Broadwater and Cobaki Creek **FIGURE 3**.

SEPP 26 Littoral Rainforests numbers 2A, 2B, and 2C occur within the locality and are shown in **FIGURE 4**.

Cobaki Creek (tidal) occurs adjacent to part of the eastern boundary of the site. Cobaki Broadwater and a large area of wetland occur alongside the north-eastern boundary.

### *1.2.3 The Study Area*

The Study area is defined as the Subject site together with any proximate areas that may be affected by the proposed development. The site is surrounded by a narrow belt of forested land adjacent to the northern and western boundaries of the site. This belt of vegetation occurs within the Crown Reserve separating Queensland from New South Wales. Private large landholdings occur adjacent to the southern site boundary. Piggabeen Road separates these landholdings from the Cobaki Lakes site.

## 1.3 The Subject Site

### *1.3.1 Description*

The Subject site consists of land described as Lot 1 DP 570076, Lot 2 DP 566529, Lot 1 DP 562222, Lot 1 DP 570077, Lot 1 823679, Lots 46, 54, 55, 199, 200, 201, 202, 205, 206, 209, 228 & 305 DP 755740, Cobaki Lakes, off Pigabeen Road, Tweed Heads (**FIGURE 5**). The site covers an area of approximately 598 hectares.

The site comprises a large portion of land cleared for agricultural purposes (i.e. grazing) throughout which a number of native vegetation communities occur. Extensive clearing and subsequent slashing over the drainage basin has resulted in the recruitment of a combination of native and introduced grass species in place of the original mature native plant communities. **FIGURE 6** shows a recent aerial photograph of the site. Currently eighteen (18) broad vegetation associations comprising twenty-four (24) vegetation communities occur on the site.

### *1.3.2 Landuse Zones*

The Environmental zoning process on the Cobaki Lakes site has been in progress for over 15 years. A large number of environmental assessments over this period of time have informed the environmental zoning process.

The Subject site currently contains the following landuse zones:

- 2(c) Urban Expansion
- 2(e) Residential Tourist Zone
- Recreation (Special Purposes)
- Environmental Protection (Scenic Escarpment)
- Environmental Protection (Habitat)

The current zoning plan is shown in **FIGURE 7.** It is worth noting that the Concept Plan proposes amendments to the current zoning of the site based on the results of the numerous environmental assessments completed over the site. These amendments fall into five categories as follows:

1. Amendments in accordance with Clause 52 of the Tweed LEP 2000;
2. Amendments to zonings contemplated by existing Development Consents;
3. Other proposed additions to the 2(c) Urban Expansion zone;
4. Proposed additions to the 7(l) Environmental Protection (Habitat) zone; and
5. Proposed additions to the 6(b) Recreation zone.

The proposed amended zoning plan is shown in **FIGURE 8.**

### *1.3.3 Soils and Geology*

The Subject site occupies the lower or eastern end of the Cobaki – Pigabeen Valley system**.** The site topography is considered as two (2) separate systems:

- The Sub-coastal foothills and outcrops of the eastern end of the McPherson Range, which comprises the western and northern part of the site and covers an area of approximately 280 hectares, or 42% of the site, and corresponding to a broad north/south line of hills. The terrain of these hills is rolling/hilly to hilly in a series of ridges and spurs with slopes of 10% to 25% and some 16% of the site having slopes in excess of 25%.
- The foothills enclose a coastal plain drainage basin comprising a composite of river/estuarine floodplain and sand-plain formed by sandbanks, beach or rolled and flattened dune systems.

The McPherson range foothills and elevated portions of the site derive from bedrock of deeply weathered argillites (greywackes, siltstones and shales) of the Neranleigh – Fernvale Group (metasediments) overlain in parts by basalt fragments of the tertiary volcanics. More recent alluvial and estuarine deposits comprise the coastal plains on the site (Woodward-Clyde 1997).

### *1.3.4 Topography and Drainage*

Elevations of the poorly drained, or low lying coastal plains, range from Cobaki Broadwater level to approximately four (4) metres AHD. The elevations of the foothills extend to a maximum of approximately one-hundred (100) metres at the north-west extremity of the site, and around ninety-five (95) metres near Mt. Woodgee in the northern extremity of the site (Woodward-Clyde 1997).

A series of drains run through the site (**FIGURE 6**). Dunn's Drain is the main drain, traversing the site in a south-east to north-west direction. A floodgate located at its junction with Cobaki Creek, in the south-east portion of the site, inhibits tidal flows. Tides at the higher levels enter the low-lying land in the south of the site by over-topping the bund wall adjacent to Cobaki Creek.

## 1.4 Structure of this Assessment

The Ecological Assessment (**VOLUME 1**) and associated documents have been prepared in response to the DGEAR's.

Accompanying Volumes of this assessment are as follows:

**VOLUME 2** – Appendices to the Ecological Assessment;
**VOLUME 3** – Saltmarsh Rehabilitation Plan;
**VOLUME 4** – Scribbly Gum Management Plan;
**VOLUME 5** – Site Regeneration and Rehabilitation Plan;
**VOLUME 6** – Vegetation Management Plan;
**VOLUME 7** – Fauna Management Plan; and
**VOLUME 8** – Freshwater Wetland Rehabilitation Plan.

# 2. PROPOSED DEVELOPMENT

## 2.1 Concept plan

The site covers an area of approximately five hundred and ninety-eight (598) hectares and is proposed to be developed into a master planned residential community. A concept plan for the development is shown as **FIGURE 8**. The proposed development will include the following:

- Town centre (17.4 hectares);
- Residential (282.7 hectares);
- Education/Community facilities/Utilities (7.2 hectares);
- Open space (166.7 hectares)
- Environmental protection areas (84.3 hectares); and
- Constructed lakes (15.6 hectares).

## 2.2 Existing Approvals

It is worth noting that a number of development and earthworks approvals currently exist over the site. These are shown in **FIGURES 10 & 11** respectively.

An existing development consent over a portion of land in the north-western portion of the site known as the 'Northern Hillside' is to be preserved and implemented. The approved development layout in this portion of the site is shown in **FIGURE 12.** Conditions of consent regulate the management of significant ecological matters which occur in the approved 'Northern Hillside' precinct. Consideration has however been given to ecological matters (i.e. Threatened species and EEC's) in all areas of the site during this assessment.

## 2.3 'Restriction on Use' area

A parcel of land in the eastern portion of the subject site covering an area of approximately 16.375 hectares has been dedicated to Tweed Shire Council under Section 88b of the Conveyancing Act (1919) (**FIGURE 6**). This area has been fenced and remediated by Council as works in compensation for the impact of development by Council elsewhere in the Shire.

The terms of the Restriction on Use are:

> *"That no structure shall be erected, no native fauna or flora shall be damaged in any way and no domestic animal shall be permitted on the land".*

This portion of the subject site will, therefore, not be further considered in this assessment.

## 2.4 Existing use rights

The property has been grazed by cattle since the early 1900's. Landuse activities which have been a long term and constant feature of this site are defined in Section 106 of the EP&A Act 1979. Existing use rights occur over the subject site for routine agricultural activities including the construction and maintenance of drains, fencing and firebreaks as well as pasture improvement activities.

# 3. LITERATURE REVIEW

## 3.1 Introduction

A number of Flora and Fauna Reports and other sources of information have been reviewed prior to the completion of the current assessment. These include:

- Cameron McNamara (1983), Cobaki Village Environmental Study (Report Prepared for the Bradshaw Group);
- WBM (1990), Evaluation of Terrestrial Fauna – Cobaki Community Project;
- WBM (1991a), Greater Gliders of the Cobaki Lakes Project Property, Cobaki, NSW;
- WBM (1991b), Flora and Fauna Studies, Proposed Boyd Street Extension to Cobaki;
- Warren (1992), Fauna Impact Assessment of the Proposed Boyd Street Access;
- Warren (1993), Flora and Fauna survey of proposed cut/fill areas at Cobaki Lakes development (Unpublished Report);
- Warren (1994), Flora and Fauna survey of the Cobaki Lakes development site (Unpublished Report);
- Debus (1994), Bird Survey of the Cobaki Community Project Site;
- Woodward-Clyde (1997), A Flora and Fauna Assessment of Parcels 7, 8, 9 and 10 of the "Cobaki Lakes Residential Development";
- Woodward-Clyde (1997), Species Impact Statement - AGC Woodward-Clyde Pty Ltd;
- Parker (1999), A Species Impact Statement for the Cobaki Lakes Project; and
- EcoPro Pty Ltd (2004), Tugun Bypass: Species Impact Statement (SIS). A report prepared for the Queensland Department of Main Roads.

A summary of findings is provided below. A detailed literature review is provided in **VOLUME 2 (APPENDIX 1)**.

## 3.2 Summary

The literature review has revealed the presence (historically) of twelve (12) Threatened fauna species on the subject site with an additional nineteen (19) Threatened species recorded during surveys on adjacent land (**TABLE 1**).

The literature review has also revealed the presence (historically) of four (4) Threatened flora species and three (3) Rare or Threatened Australian Plants (ROTAP) (Briggs & Leigh 1996) listed flora species on the subject site, with an additional eight (8) Threatened flora species and two (2) ROTAP flora species recorded during surveys on adjacent land (**TABLE 2**).

Species status is listed below in accordance with the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act 1999), NSW *Threatened Species Conservation Act 1995* (TSC Act 1995) and ROTAP (Briggs & Leigh 1996).

**TABLE 1**
**THREATENED FAUNA SPECIES RECORDED ON OR ADJACENT TO THE SUBJECT SITE**

| Common name | Scientific name | Status | Source |
|---|---|---|---|
| Wallum froglet | *Crinia tinnula* | Vulnerable (TSC Act 1995) | McNamara 1983, WBM 1990, Warren 1992, 1993, Woodward-Clyde 1997, EcoPro 2004 |
| Wallum sedge-frog* | *Litoria olongburensis* | Vulnerable (TSC Act 1995) & Endangered (EPBC Act 1999) | Warren 1992, Woodward-Clyde 1997, EcoPro 2004 |
| Bush hen* | *Amaurornis olivaceus* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Glossy black-cockatoo* | *Calyptorhynchus lathami* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Brolga* | *Grus rubicunda* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Black bittern*[U] | *Ixobrychus flavicollis* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Mangrove honeyeater* | *Lichenostomus fasciogularis* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| White-eared monarch* | *Monarcha leucotis* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Powerful owl | *Ninox strenua* | Vulnerable (TSC Act 1995) | Warren 1993, 1994, Woodward-Clyde 1997 |
| Osprey | *Pandion haliaetus* | Vulnerable (TSC Act 1995) | McNamara 1983, WBM 1990, Warren 1992, 1993, Woodward-Clyde 1997, EcoPro 2004 |
| Wompoo fruit-dove* | *Ptilinopus magnificus* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Rose-crowned fruit-dove* | *Ptilinopus regina* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Superb fruit-dove*[U] | *Ptilinopus superbus* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Collared kingfisher* | *Todiramphus chloris* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Eastern grass owl* | *Tyto capensis* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Masked owl | *Tyto novaehollandiae* | Vulnerable (TSC Act 1995) | Debus 1994, Woodward-Clyde 1997, EcoPro 2004 |
| Black neck-stork | *Xenorhynchus asiaticus* | Endangered (TSC Act 1995) | WBM 1990, Warren 1993, Woodward-Clyde 1997, EcoPro 2004 |
| Little bent-wing bat | *Miniopterus australis* | Vulnerable (TSC Act 1995) | Warren 1994, Woodward-Clyde 1997, EcoPro 2004 |

| Common name | Scientific name | Status | Source |
|---|---|---|---|
| Common bent-wing bat | *Miniopterus schreibersii* | Vulnerable (TSC Act 1995) | Warren 1994, Woodward-Clyde 1997 |
| Eastern free-tail bat | *Mormopterus norfolkensis* | Vulnerable (TSC Act 1995) | Warren 1994, Woodward-Clyde 1997 |
| Large-footed myotis* | *Myotis adversus* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Eastern long-eared bat* | *Nyctophilus bifax* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Squirrel glider* | *Petaurus norfolkensis* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Koala | *Phascolarctos cinereus* | Vulnerable (TSC Act 1995) | Woodward-Clyde 1997 |
| Common planigale* | *Planigale maculata* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Long-nosed potoroo* | *Potorous tridactylus* | Vulnerable (TSC Act 1995) | Warren 1992, Woodward-Clyde 1997, EcoPro 2004 |
| Black flying-fox* | *Pteropus alecto* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Grey-headed flying-fox | *Pteropus poliocephelus* | Vulnerable (EPBC Act) | Woodward-Clyde 1997, EcoPro 2004 |
| Yellow-bellied sheathtail bat | *Saccolaimus flaviventris* | Vulnerable (TSC Act 1995) | Warren 1994, Woodward-Clyde 1997 |
| Greater broad-nosed bat | *Scoteanax rueppellii* | Vulnerable (TSC Act 1995) | Warren 1994 |
| Common blossom bat* | *Syconycteris australis* | Vulnerable (TSC Act 1995) | EcoPro 2004 |

* Historically recorded adjacent to the subject site only
[U] Unconfirmed sighting

**TABLE 2**
**THREATENED FLORA SPECIES RECORDED ON OR ADJACENT TO THE SUBJECT SITE**

| Common name | Scientific name | Status | Source |
|---|---|---|---|
| Marblewood | *Acacia bakeri* | Vulnerable (TSC Act 1995) | Woodward-Clyde 1997, Parker 1999 |
| White lace flower* | *Archidendron hendersonii* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Veiny lace flower | *Archidendron muellerianum* | ROTAP LISTED | Woodward-Clyde 1997, EcoPro 2004 |
| Brush cassia | *Cassia brewsteri* var. *marksiana* | Endangered (TSC Act 1995) | Woodward-Clyde 1997, Parker 1999 |

| Common name | Scientific name | Status | Source |
|---|---|---|---|
| Coastal cordyline | *Cordyline congesta* | ROTAP LISTED | Parker 1999, EcoPro 2004 |
| Stinking cryptocarya* | *Cryptocarya foetida* | Vulnerable (TSC Act 1995 & EPBC Act 1999) | EcoPro 2004 |
| Long-leaved tuckeroo* | *Cupaniopsis newmanii* | ROTAP LISTED | EcoPro 2004 |
| Black walnut* | *Endiandra globosa* | ROTAP LISTED | EcoPro 2004 |
| Green-leaved rose-walnut* | *Endiandra muelleri* subsp. *bracteata* | Endangered (TSC Act 1995) | EcoPro 2004 |
| Pink nodding orchid* | *Geodorum densiflorum* | Endangered (TSC Act 1995) | EcoPro 2004 |
| White yiel yiel* | *Grevillea hilliana* | Endangered (TSC Act 1995) | EcoPro 2004 |
| Fine-leaved tuckeroo* | *Lepiderema pulchella* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Rough-shelled bush-nut* | *Macadamia tetraphylla* | Vulnerable (TSC Act 1995 & EPBC Act 1999) | EcoPro 2004 |
| Swamp orchid* | *Phaius australis* | Endangered (TSC Act 1995 & EPBC Act 1999) | EcoPro 2004 |
| Spiny gardenia | *Randia moorei* | Endangered (TSC Act 1995 & EPBC Act 1999) | Woodward-Clyde 1997 |
| Smooth scrub turpentine | *Rhodamnia maideniana* | ROTAP LISTED | Warren 1994, Woodward-Clyde 1997, Parker 1999, EcoPro 2004 |
| Coolamon | *Syzygium moorei* | Vulnerable (TSC Act 1995) | Woodward-Clyde 1997, EcoPro 2004 |

* Historically recorded adjacent to the subject site only

The potential impacts on all Threatened species recorded on and adjacent to the subject site, as well as proposed mitigation measures and offsets, are discussed in detail in Section 4 of this assessment. Plans showing the locations of these species in relation to the proposed development are also included.

# 4. DIRECTOR GENERAL'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

## 4.1 Background

A concept plan for the proposed residential community at Cobaki Lakes was authorised on the 24th of January 2007. Subsequently, the Director-general's Environmental Assessment Requirements (DGEAR's) have been outlined in a letter from the NSW Governments Department of Planning dated 21st August 2007.

This section of the report aims to address the flora and fauna requirements for the Concept Plan Application which are listed in Section 4 of Attachment 1 of the Department of Planning letter.

The seven (7) flora and fauna requirements that the Director-general has listed for environmental assessment are as follows:

1. Demonstrate that the development footprint will not adversely impact on existing native flora and fauna. This should include consideration of the impact of the proposal on wildlife corridors, any remnant bushland, Koala habitat in accordance with SEPP 44 and consultation with Council and threatened species and their habitats in accordance with draft *Guidelines for Threatened Species Assessment (*July 2005).
2. Provide a description of the proposed treatment of any ecological buffers, including interaction with the proposed land uses, asset protection zones, stormwater structures, extent of proposed environmental restoration and enhancement works.
3. Assess proposed native vegetation clearing with consideration of potential impacts and if applicable, provide details of any offset strategy or other suitable mitigation measures to ensure that there is no net loss of native vegetation values.
4. Consideration of the provision, management and ongoing maintenance of general public open space.
5. Provide an assessment against SEPP 14 – Coastal Wetlands.
6. Address the requirements of Councils DCP 25 – Biting Midge and Mosquito Control.
7. Consideration of impacts, if any, on matters of national environmental significance under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999.*

Each of these requirements will be addressed in the following sections of this report.

## 4.2 DoP Test of Adequacy Response

The Ecological Assessment (Volume 1) and associated documents (i.e. Volumes 2 – 8) have been prepared in response to the DGEAR's. The Draft reports (i.e. Volumes 1 – 8) were reviewed by the Department of Planning (DoP) and a Test of Adequacy Response was provided in August 2008. The following comments were provided:

1. The EA has failed to adequately identify the extent of native and threatened flora to be removed or impacted by the proposal;
2. The EA has failed to demonstrate that the development footprint will not adversely impact on threatened flora and fauna and in particular has failed to give full consideration to the mitigation of those impacts; and
3. The EA has failed to adequately document the Aboriginal Cultural Heritage Assessment process and findings.

The current Volumes 1 – 8 have been amended in consideration of the DoP review comments with the exception of point 3 above which will be subject to a separate assessment.

## 4.3 Compliance with Relevant Legislation

The NSW *Threatened Species Conservation Act 1995* (TSC Act 1995) requires that the planning and development approval process for development and other activities have regard to the potential for adverse impacts on Threatened flora and fauna species and their habitats.

The Minister for Planning has determined that the proposed development is a 'Major Project' under section 3A of the *Environmental Planning & Assessment Act 1979* (EPA Act 1979). In July 2005 the NSW Department of Environment and Conservation (DEC) and NSW Department of Primary Industries (DPI) drafted Guidelines for Threatened Species Assessment. These guidelines indentify factors that must be considered when assessing potential impacts on Threatened species, populations, or ecological communities, or their habitats for development applications assessed under part 3A of the EPA Act 1979.

This assessment has been completed in accordance with the DEC & DPI (2005) Draft guidelines. APPENDIX 1 of the guidelines includes recommendations for the structure and content of the threatened species assessment. A summary of compliance with the guidelines is contained in **TABLE 3** below.

**TABLE 3**
**COMPLIANCE WITH THE GUIDELINES FOR THREATENED SPECIES ASSESSMENT**

| Section | Purpose | Compliance |
|---|---|---|
| Introduction | Sets the scene of the study | • The author of the study and who it was commissioned by is included in **SECTION 1.1.**<br>• The regional context, location, geology, soils, landforms, disturbance history and other relevant information relating to stratification requirements is provided in **SECTION 1.2.**<br>• A detailed description of the proposal is in included in **SECTION 2.** |
| Methods | Details the desktop and field survey methods employed. The technical information should be sufficiently detailed to enable the field survey to be replicated. The choice of field methods and extent of survey should be justified, and any constraints noted. | • The methods utilised in this assessment are contained in **VOLUME 2.**<br>• Descriptions of vegetation types in terms of structure and floristics, and a list of the dominant plant species in each growth stratum (trees, midstorey and groundcover) is included in **VOLUME 2.**<br>• An assessment of the suitability of the site as habitat for species, populations and ecological communities of conservation significance has been completed in **VOLUME 2.**<br>• Descriptions of survey techniques utilised during the flora assessment are contained in **VOLUME 2**, and during the fauna assessment in **VOLUME 2.**<br>• The type and number of traps, a description and map of their layout, details of the bait used, and the number of survey nights for each technique in included in **VOLUME 2.** |

| Section | Purpose | Compliance |
|---|---|---|
| Results | Displays the findings of the study | • A list of all flora species recorded from the subject site is contained in **VOLUME 2.**<br>• A list of all fauna species recorded is contained in **VOLUME 2.**<br>• A list of all Threatened species, populations, and ecological communities recorded or known to occur in the locality is provided in **SECTION 4.3.2.**<br>• Maps of survey method locations are included in **VOLUME 2.**<br>• Maps of environmental features, vegetation types and habitat types are provided (**FIGURES 2 – 4, 13, 17 & 20**).<br>• Maps showing the location of Threatened species records and the extent of Endangered Ecological communities are provided (**FIGURES 23 – 26 & 29 - 32**). |
| Impact Evaluation | Describe context and intensity of impacts | • The potential impacts of the proposed development on the following ecological characteristics has been discussed:<br>o Wildlife corridors (**SECTION 4.3.3.3**);<br>o Remnant bushland (**SECTION 4.3.4.2**);<br>o Koala habitat (**SECTION 4.3.5.3**);<br>o Threatened flora species & their habitats (**SECTION 4.3.6.3**);<br>o Endangered Ecological Communities (**SECTION 4.3.6.5**);<br>o Threatened fauna species and their habitats (**SECTION 4.3.6.7**); and<br>o Native vegetation communities (**SECTION 4.5.2**). |

| Section | Purpose | Compliance |
|---|---|---|
| Mitigation | Discuss measures to minimise impacts | • Amelioration measures to minimise potential impacts of the proposed development on the following ecological characteristics has been discussed:<br>o Wildlife corridors (**SECTION 4.3.3.4**);<br>o Remnant bushland (**SECTION 4.3.4.3**);<br>o Koala habitat (**SECTION 4.3.5.4**);<br>o Threatened flora species & their habitats (**SECTION 4.3.6.4**);<br>o Endangered Ecological Communities (**SECTION 4.3.6.6**);<br>o Threatened fauna species and their habitats (**SECTION 4.3.6.7**); and<br>o Native vegetation communities (**SECTION 4.5.4**).<br>• Specific offset strategies to ensure no net loss has been discussed for the following ecological characteristics:<br>o Remnant bushland (**SECTION 4.3.4.3**);<br>o Threatened flora species & their habitats (**SECTION 4.3.6.3**);<br>o Endangered Ecological Communities (**SECTION 4.3.6.5**);<br>o Threatened fauna species and their habitats (**SECTION 4.3.6.7**); and<br>o Native vegetation communities (**SECTION 4.5.2**). |
| Conclusion | Discuss the results | Statements on the likely presence/absence of threatened biodiversity, and the general habitat value of the study area is provided in **SECTION 4.** This section also includes statements as to the likely impacts on key population thresholds. Potential impacts on threatened biodiversity and the proposed mitigation measures and offsets are summarised in **SECTION 5**. |
| References | Cites publications used in the report | A list of references is provided on **Page 126.** |
| Appendices | Collates detailed information in the back of the report and allows the main body of the report to be concise | Appendices and supporting documentation to the main report are included in **VOLUMES 2 - 8.** |

## 4.4 Demonstrate that the development footprint will not adversely impact on existing native flora and fauna

### *4.4.1 Introduction*

This section will include a consideration of the impact of the proposal on wildlife corridors, remnant bushland, Koala habitat in accordance with SEPP 44 and consultation with Tweed Shire Council, and any threatened species or EEC's and their habitats in accordance with draft *Guidelines for Threatened Species Assessment (*July 2005).

### *4.4.2 Summary of existing flora and fauna values*

A detailed flora assessment which discusses the methods used in the vegetation assessment and provides a description of the location, composition and extent of the vegetation communities on the Subject site is provided within **VOLUME 2 (APPENDIX 2).** The flora assessment recorded eighteen (18) broad vegetation associations comprising twenty-four (24) vegetation communities (**FIGURE 13**). In total, four hundred and forty-nine (449) flora species have been recorded at the subject site. This list is a compilation of all plant species recorded from the site by JWA as well as during previous flora assessments (i.e. WBM 1990 & 1991b; Woodward-Clyde 1997 & Parker 1999).

A total of eight (8) threatened flora species have been recorded on the subject site to date. These include:

- White yiel yiel (*Grevillea hilliana*) Endangered (TSC Act 1995);
- Scented acronychia (*Acronychia littoralis*) - Endangered (TSC Act 1995 & EPBC Act 1999);
- Fine-leaved tuckeroo (*Lepiderema pulchella*) - Vulnerable (TSC Act 1995,
- Spiny gardenia (*Randia moorei)* - Endangered (TSC Act 1995 & EPBC Act 1999);
- Marblewood (*Acacia bakeri*) - Vulnerable (TSC Act 1995);
- Brush cassia (*Cassia brewsteri* var. *marksiana*) - Endangered (TSC Act 1995);
- Coolamon (*Syzygium moorei*) - Vulnerable (TSC Act 1995, EPBCA 1999); and
- Green-leaved rose walnut (*Endiandra muelleri* subsp. *bracteata)* Endangered (TSC Act 1995).

An additional five (5) Threatened flora species have been recorded to date during surveys on adjacent land (EcoPro 2004), including:

- White lace flower (*Archidendron hendersonii*) – Vulnerable (TSC Act 1995);
- Stinking cryptocarya (*Cryptocarya foetida*) – Vulnerable (TSC Act 1995 & EPBC Act 1999);
- Pink nodding orchid (*Geodorum densiflorum*) - Endangered (TSC Act 1995);
- Rough-shelled bush-nut (*Macadamia tetraphylla*) – Vulnerable (TSC Act 1995 & EPBC Act 1999); and
- Swamp orchid (*Phaius australis*) – Endangered (TSC Act 1995 & EPBC Act 1999).

A detailed fauna assessment which includes a description of the methods used in determining which fauna species use, or are likely to use, the Study area and a discussion of the results of fauna surveys completed on the subject site is also provided within **VOLUME 2 (APPENDIX 3)**. Fauna surveys on the subject site have revealed the presence of thirteen (13) amphibian species, ten (10) reptile species, one hundred and thirty-eight (138) bird species and thirty-three (33) mammal species.

A total of twelve (12) Threatened fauna species have been recorded from the subject site to date, including:

- Wallum froglet (*Crinia tinnula*) – Vulnerable (TSC Act 1995);
- Black-necked stork (*Xenorhynchus asiaticus*) – Endangered (TSC Act 1995);
- Powerful owl (*Ninox strenua*) – Vulnerable (TSC Act 1995);
- Masked owl – (*Tyto novaehollandiae*) - Vulnerable (TSC Act 1995);
- Osprey (*Pandion haliaetus*) - Vulnerable (TSC Act 1995);
- Koala (*Phascolarctos cinereus*) - Vulnerable (TSC Act 1995);
- Grey-headed flying-fox (*Pteropus poliocephelus*) - Vulnerable (EPBC Act 1999);
- Little bent-wing bat (*Miniopterus australis*) - Vulnerable (TSC Act 1995);
- Common bent-wing bat (*Miniopterus schreibersii*) - Vulnerable (TSC Act 1995);
- Eastern free-tail bat (*Mormopterus norfolkensis*) - Vulnerable (TSC Act 1995);
- Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) - Vulnerable (TSC Act 1995); and
- Greater broad-nosed bat (*Scoteanax rueppellii*) - Vulnerable (TSC Act 1995).

An additional nineteen (19) Threatened fauna species have been recorded to date during surveys on adjacent land (EcoPro 2004), including:

- Wallum sedge-frog (*Litoria olongburensis*) - Vulnerable (TSC Act 1995) & Endangered (EPBC Act 1999);
- Bush hen (*Amaurornis olivaceus*) - Vulnerable (TSC Act 1995);
- Glossy black-cockatoo (*Calyptorhynchus lathami*) - Vulnerable (TSC Act 1995);
- Brolga (*Grus rubicunda*) - Vulnerable (TSC Act 1995);
- Black bittern (*Ixobrychus flavicollis*) - Vulnerable (TSC Act 1995);
- Mangrove honeyeater (*Lichenostomus fasciogularis*) - Vulnerable (TSC Act 1995);
- White-eared monarch (*Monarcha leucotis*) - Vulnerable (TSC Act 1995);
- Wompoo fruit-dove (*Ptilinopus magnificus*) - Vulnerable (TSC Act 1995);
- Rose-crowned fruit-dove (*Ptilinopus regina*) - Vulnerable (TSC Act 1995);
- Superb fruit-dove (*Ptilinopus superbus*) - Vulnerable (TSC Act 1995);
- Collared kingfisher (*Todiramphus chloris*) - Vulnerable (TSC Act 1995);
- Eastern grass owl (*Tyto capensis*) - Vulnerable (TSC Act 1995);
- Large-footed myotis (*Myotis adversus*) - Vulnerable (TSC Act 1995);
- Eastern long-eared bat (*Nyctophilus bifax*) - Vulnerable (TSC Act 1995);
- Squirrel glider (*Petaurus norfolkensis*) - Vulnerable (TSC Act 1995);
- Common planigale (*Planigale maculata*) - Vulnerable (TSC Act 1995);
- Long-nosed potoroo (*Potorous tridactylus*) - Vulnerable (TSC Act 1995);
- Black flying-fox (*Pteropus alecto*) - Vulnerable (TSC Act 1995); and
- Common blossom bat (*Syconycteris australis*) - Vulnerable (TSC Act 1995).

### *4.4.3 Wildlife corridors*

4.4.3.1 Applicability to the subject site

The National Parks & Wildlife Service (NPWS) Key Habitats and Corridors database shows a number of regional and sub-regional habitat corridors within the locality of the site (**FIGURE 14**).

The NPWS Key Habitats and Corridors database maps the Cobaki-Terranora Regional Corridor as traversing a large area of the eastern portion of the Subject site. The corridor is a link between Cobaki Wetlands and Terranora Broadwater.

Three (3) Sub-regional corridors which branch off this Regional corridor occur on the subject site:

- The Pigabeen corridor – traverses the central portion of the site in a generally east-west direction, linking Pigabeen with Cobaki Wetlands;
- The McPherson corridor - traverses the northern portion of the site, forking off to the north and west, and forming a link between the Cobaki Wetlands and Mt Tomewin; and
- The Cobaki corridor - branches off the Cobaki-Terranora Regional Corridor across a small portion of the far-eastern edge of the Subject site, linking Cobaki Wetlands with Cobaki Broadwater.

Details on all fauna assemblages within corridors in the vicinity of the site are shown in **VOLUME 2 (APPENDIX 4).**

In addition, key habitat has been identified as occurring within the northern, western and southern portions of the site (**FIGURE 14**). As described by NPWS (2007), key habitats are areas of predicted high conservation value for fauna assemblages, endemic forest vertebrates or endemic invertebrates; depicted spatially as a merging of mapped assemblage hubs, assemblage hot spots and centres of endemism.

The forested Crown lands which form the boundary of NSW and QLD occur between the Cobaki Lakes northern and western boundaries and the border. This elevated forest community creates a link near the north-eastern boundary of the site to 'Wallum' habitats surrounding the Cobaki Broadwater. This link, which extends to Mt. Cougal in the north-west, is considered to be of high importance by NPWS. These issues have been addressed in a previous approval for the Boyd Street access (Warren *et al.* 1994).

4.4.3.2 Accuracy of NPWS mapping

Site assessments have revealed that the NPWS Corridor mapping in inaccurate over the subject site. Large areas of the site that are included in the mapping have been cleared of vegetation in accordance with various development approvals. An overlay of the NPWS Corridor mapping on a recent aerial photograph of the site is included as **FIGURE 15**. Inaccuracies within the NPWS Corridor mapping are as follows:

- Cobaki-Terranora Regional Corridor – the majority of this mapped "Regional Corridor" on the subject site is comprised of cleared land (**FIGURE 15**);

- The Pigabeen corridor – the majority of this mapped corridor on the subject site is comprised of cleared lands (**FIGURE 15**). A small portion of the mapped corridor contains remnant vegetation associated with the central ridgeline and additionally an area of regrowth in the western portion of the site is included;
- The McPherson corridor - a large portion of this mapped corridor is comprised of cleared land. The rainforests associated with Mt. Woodgee are included within this corridor as well as mature forests in the north-eastern and north-western portions of the site (**FIGURE 15**);
- The Cobaki corridor – this mapped corridor is comprised of saltmarsh communities in the low-lying eastern portion of the subject site (**FIGURE 15**); and
- Key habitats – areas of Key Habitat are mapped by NPWS across the subject site, the largest of which occurring in the western and north-eastern portions of the site. The majority of these areas across the site are comprised of cleared land (**FIGURE 15**).

#### 4.4.3.3 Potential impacts

The Proposed development has the potential to reduce the overall effectiveness of the site as a corridor due to habitat loss and fragmentation. Edge effects may also further impact on retained vegetation and corridor habitat. An overlay of the proposed development on the NPWS corridors is shown in **FIGURE 16.** Specific impacts on the NPWS corridors on the subject site are as follows:

- Cobaki-Terranora Regional Corridor – The entire mapped area on the subject site occurs within areas of the subject site with existing development approvals or which are proposed to be developed (**FIGURE 16**).
- The Pigabeen corridor – large portions of this mapped corridor occur in areas with existing development approvals or which are proposed to be developed (**FIGURE 16**). Some vegetation retention will occur within this mapped corridor as well as regeneration/revegetation works.
- The McPherson corridor - large portions of this mapped corridor occur in areas with existing development approvals or which are proposed to be developed (**FIGURE 16**). Some vegetation retention will occur within this mapped corridor as well as regeneration/revegetation works.
- The Cobaki corridor – the proposed development will not impact on the extent of vegetation in this mapped corridor.
- Key habitats – large areas mapped as Key Habitats occur in areas with existing development approvals or which are proposed to be developed (**FIGURE 16**). Some vegetation retention will occur within these mapped areas as well as regeneration/revegetation works.

#### 4.4.3.4 Proposed amelioration measures

The proposed development has been designed to utilise existing cleared areas where possible. A network of existing vegetated corridors will be retained on the site the most significant of which include the forested escarpment in the western portion of the site and Mt. Woodgee and associated rainforest habitats in the northern portion of the site. Additionally, smaller interlinking corridors will be provided on the subject site through regeneration and revegetation works.

A Site Regeneration and Revegetation Plan has been prepared for the subject site (**VOLUME 5**) and will result in approximately 59.5ha of revegetation/regeneration to provide vegetated links across the site and ensure that the remaining wildlife corridors will be embellished utilising revegetation and natural regeneration principles. An overlay of the areas to be regenerated and rehabilitated with the current NPWS corridors is shown in **FIGURE 16.** Amelioration measures for the NPWS corridors on the subject site are as follows:

- Cobaki-Terranora Regional Corridor – the retention and rehabilitation of all intertidal communities occurring east of the Cobaki Parkway will ensure that movement opportunities for fauna species along this regional corridor will continue.
- The Pigabeen corridor – Some rehabilitation works will occur within this mapped corridor. Additional corridors will be revegetated/regenerated to the north and south of the mapped location of this corridor to increase current movement opportunities for fauna across the site. These corridors will provide links from the western portion of the subject to the central Open Space area.
- The McPherson corridor - Some rehabilitation works will occur within this mapped corridor. The scattered clumps of vegetation in this area will be replaced by a number of smaller corridors which link the Border reserve with the central Open Space area on the site. The rainforests associated with Mt. Woodgee and mature forests in the north-eastern and north-western portions of the site which occur within this mapped corridor will be retained and rehabilitated.
- The Cobaki corridor - the proposed development will not impact on the extent of vegetation in this mapped corridor. Saltmarsh communities in this portion of the site will be retained and rehabilitated.
- Key habitats – Whilst development will occur within areas of the subject site identified as Key Habitat, no vegetation within these areas will be removed. All retained vegetation identified as Key Habitats will be retained, buffered and rehabilitated.

### *4.4.4 Remnant Bushland*

#### 4.4.4.1 Applicability to the subject site

NPWS (2003) describe remnant vegetation as those patches of native trees, shrubs and grasses remaining following clearing operations. The NSW *Native Vegetation Act* (2003) (NV Act 2003) defines remnant native vegetation as any native vegetation other than

regrowth. For the purposes of NV Act 2003, regrowth refers to any native vegetation that has regrown since 1st January 1990.

Remnant vegetation:

- can be of any shape or size;
- can include all types of native vegetation communities, including forest woodland, native grasslands, mallee, coastal heathland or rainforest.

Numerous vegetation surveys have been completed on the subject site by JWA between 2000 and the present and have included detailed mapping of vegetation communities as well as searches for Threatened flora species. A detailed Flora Assessment of the subject site is included in **VOLUME 2 (APPENDIX 2)** of this report which details the results of vegetation surveys on the site**.** A plan showing the location of the remnant bushland occurring on the Subject site is included in **FIGURE 17**.

#### 4.4.4.2 Impacts on Remnant Bushland

The potential impacts on remnant bushland from the proposed development are shown in **FIGURE 18.** A summary of the potential loss of remnant bushland and respective areas are shown in **TABLE 4**.

In total 22.28 hectares of remnant bushland will be lost from the subject site (24.62% of the total area of remnant bushland). The majority of remnant bushland to be removed occurs within portions of the site with existing development approval (i.e. 22.08 hectares) whilst a small area of remnant bushland will be removed from areas without current development approvals (i.e. 0.2 hectares).

**TABLE 4**
**POTENTIAL LOSS OF REMNANT BUSHLAND FROM THE PROPOSED DEVELOPMENT**

| Community | TOTAL AREA (ha) | Existing Approved Areas | | | | Non-Approved Areas | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Retained Areas | | | | Retained Areas | | | |
| | | | Breakdown of Retained Areas | | | | Breakdown of Retained Areas | | |
| | | Retained - TOTAL (ha) | Open Space (ha) | Environmental Protection (ha) | Loss - TOTAL (ha) | Retained - TOTAL (ha) | Open Space (ha) | Environmental Protection (ha) | Loss - TOTAL (ha) |
| 1a | 33.10 | 28.35 | 3.14 | 25.20 | 4.75 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1b | 4.66 | 4.11 | 0.00 | 4.11 | 0.55 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1c | 12.87 | 8.23 | 0.03 | 8.20 | 2.91 | 1.54 | 1.51 | 0.03 | 0.20 |
| 1d | 2.37 | 1.68 | 1.68 | 0.00 | 0.69 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2a | 9.10 | 0.69 | 0.00 | 0.69 | 0.28 | 8.13 | 0.46 | 7.67 | 0.00 |
| 2b | 0.35 | 0.00 | 0.00 | 0.00 | 0.02 | 0.32 | 0.32 | 0.00 | 0.00 |
| 2c | 0.35 | 0.00 | 0.00 | 0.00 | 0.35 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2d | 1.43 | 1.07 | 1.07 | 0.00 | 0.17 | 0.19 | 0.19 | 0.00 | 0.00 |
| 3 | 2.20 | 1.93 | 0.73 | 1.20 | 0.19 | 0.07 | 0.07 | 0.00 | 0.00 |
| 4 | 2.13 | 0.00 | 0.00 | 0.00 | 2.12 | 0.02 | 0.00 | 0.02 | 0.00 |
| 5 | 2.48 | 0.00 | 0.00 | 0.00 | 0.00 | 2.48 | 0.28 | 2.21 | 0.00 |
| 6 | 1.91 | 0.18 | 0.14 | 0.04 | 1.60 | 0.14 | 0.00 | 0.14 | 0.00 |
| 7 | 3.80 | 0.00 | 0.00 | 0.00 | 3.80 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | 5.13 | 0.00 | 0.00 | 0.00 | 4.52 | 0.60 | 0.55 | 0.06 | 0.00 |
| 9 | 0.23 | 0.18 | 0.18 | 0.00 | 0.00 | 0.09 | 0.09 | 0.00 | 0.00 |
| 11 | 2.72 | 2.59 | 0.00 | 2.59 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 |
| 15 | 5.66 | 0.00 | 0.00 | 0.00 | 0.00 | 5.66 | 0.25 | 5.41 | 0.00 |
| **TOTAL** | **90.49** | **49.01** | **6.97** | **42.03** | **22.08** | **19.24** | **3.72** | **15.54** | **0.20** |

4.4.4.3 Proposed amelioration measures

The majority of existing remnant bushland on the subject site will be retained. A total of 49.01 hectares is proposed to be retained within areas of the site with current development approvals, and a further 19.24 hectares within areas of the site without current development approvals. This will result in the retention of a total of 68.25 hectares (75.38%) of the remnant bushland on the subject site. A summary of the proposed retention of remnant bushland on the subject site is shown in **TABLE 4.** This bushland will be retained within Environmental Protection Areas as well as Open Space areas throughout the development envelope.

The Site Regeneration and Revegetation Plan (**VOLUME 5**) outlines the various measures to ensure that the retained remnant vegetation is adequately managed. Approximately 59.5ha of revegetation/regeneration will be completed in accordance with this plan to offset any loss of remnant bushland and to provide vegetated links across the site. Additional amelioration measures for the remnant vegetation will include:

- Weed control will primarily be completed by a qualified Bush regenerator;
- All weed control will be completed using the recommended methods (ARBA approved);
- Weed control will be undertaken on a progressive basis over a three (3) – five (5) year period;
- Embellishment plantings are to be used to consolidate each of the areas of remnant vegetation;
- All areas of remnant vegetation will be fenced to exclude pedestrian traffic and cattle grazing;
- Formal pathways are to be provided through areas of remnant vegetation to prevent the creation of numerous informal tracks;
- All of the rehabilitation works are to be completed by qualified bush regenerators;
- A monitoring and maintenance program for areas of remnant vegetation will be included in the Vegetation Rehabilitation and Management Plan.

### *4.4.5 Koala Habitat*

4.4.5.1 Council consultation - Tweed Coast Koala Atlas (TCKA)

In April, 1993 Council resolved to contribute $10,000 to the Australian Koala Foundation (AKF) to assist them in the preparation of a Tweed Coast Koala Atlas for the eastern section of the Shire. The 37,608 hectare study area comprises approximately 29 percent of Tweed Shire.

The Tweed coast Koala atlas maps parts of the site as Secondary Habitat (**FIGURE 19**). However, clearing activities on the subject site have occurred subsequent to the preparation of the Koala habitat mapping. This has resulted in the removal of vegetation within large areas of the mapped secondary habitat which now consists of open grassland and is not considered to represent Koala habitat. Recent vegetation assessments of the site has recorded grasslands with scattered trees occurring over

much of the Secondary habitat mapped in the Tweed Koala Atlas (A detailed vegetation assessment for the site is included as **APPENDIX 2**).

JWA are of the opinion that the large area of mapped Secondary habitat located on the elevated plateau in the western portion of the site, does not represent secondary Koala habitat as described in the Summary of Tweed Coast Koala Atlas.

It should be noted that in the absence of a shire-wide Koala Plan of Management (KPoM), State Environmental Planning Policy No. 44 (SEPP 44) applies.

#### 4.4.5.2 State Environmental Planning Policy No. 44 – Koala Habitat Protection

In response to the state-wide decline of Koala populations the Department of Planning has enacted SEPP - 44 Koala Habitat Protection. The Policy aims to "encourage the proper conservation and management of area of natural vegetation that provide habitat for Koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline."

A number of criteria in the SEPP are to be addressed:

***1. Does the policy apply?***

*Does the subject land occur in an LGA identified in Schedule 1?*

The Subject site occurs in the Tweed LGA, which is listed under Schedule 1.

*Is the landholding to which the DA applies greater than 1 hectare in area?*

Yes.

***2. Is the land potential Koala habitat?***

*Does the site contain areas of native vegetation where the trees of types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component?*

The majority of scattered trees within Community 7 in the eastern portion of the site are Swamp mahogany (*Eucalyptus robusta*), which is listed as a Primary Koala food tree under Schedule 2 of SEPP 44. This community covers a total area of approximately 3.80 hectares and Swamp mahogany in this area constitutes 95% of the total number of trees in the upper strata.

The majority of scattered trees within Community 8 in the eastern portion of the site are Scribbly gum (*Eucalyptus racemosa*), which is listed as a Primary Koala food tree under Schedule 2 of SEPP 44. This community covers a total area of approximately 5.13 hectares and Scribbly gum in this area constitutes 95% of the total number of trees in the upper strata.

At least 15% of the total number of trees in the upper strata of Community 1a (Blackbutt – Tallowwood association), are Tallowwood (*E. microcorys*), which is also

listed under Schedule 2 of SEPP 44. This community covers a total area of approximately 33.10 hectares and Tallowwoods constitute at least 15% of the total number of trees in the upper strata, whilst the lower strata comprises a sparse midstorey of dry Sclerophyll species including Crinkle bush (*Lomatia silaifolia*), Geebung, Grass trees, various *Acacia* species (*A. melanoxylon*, *A. orites*), Dogwood, Forest oak, Tree heath, Red ash, Wild may (*Leptospermum flavescens*), Lantana and regenerating *Eucalyptus* species.

At least 15% of the total numbers of trees in the upper strata of Community 1d (Tall open sclerophyll forest) are Forest red gum (*E. tereticornis*), a species listed under Schedule 2 of SEPP 44. This community covers a total area of approximately 2.37 hectares. Forest red gums are scattered throughout this community, and constitute at least 15% of the total number of trees in the upper strata. Around the edges of this community the lower strata is sparse, comprised of species including Camphor laurel, Sweet pittosporum, Umbrella cheese tree, Blunt-leaf bitter-pea, Geebung, various *Acacia* species, Tree heath, Red ash, Lantana and regenerating *Eucalyptus* species.

Tallowwoods, Swamp mahogany and Forest red gums over the remainder of the site are estimated to constitute less than 15% of the total number of trees in the upper and lower strata.

The NPWS online database was consulted for recent sightings and historical records of Koalas in the locality. The NPWS database contained sixty-six (66) records of this species within 10 kilometres of the site.

The NPWS online database contained two hundred and ninety-nine (299) sightings of this species in the Tweed LGA, the nearest of which was within 1km of the Subject site. Warren (1994) completed a detailed assessment of Koala habitat usage on the subject site. Approximately 483 trees in the Scribbly gum/ Swamp mahogany community and the Blackbutt community were assessed for Koala activity. Most of the trees inspected were restricted to Grey gum, Tallowwood and Forest red gum as these are known to be preferentially browsed by Koalas in the region. The analysis was based on scratch density on trees as well as the occurrence of faecal pellets around the base of the tree. Each tree was allocated a rating of 0-5 depending on the density of pellets or scratch marks. 0 indicated absence of Koala activity whilst 5 indicated a level of high activity. Only a very small number of trees showed any indication of activity and none of the trees showed an activity level greater than 2. In some cases it was difficult to ascribe the scratches to Koalas as there were no faecal pellets and it is known that Common Brushtail Possums and Lace monitors occur on the site.

More recently (December 2007), areas of the site containing preferred Koala food trees (i.e. Swamp mahogany, Forest red gum, Tallowwood, Grey gum, Scribbly gum) were searched for evidence of Koala activity (i.e. scats, scratches). Two (2) scientists spent approximately twelve (12) hours on this component of the assessment. A nocturnal survey was also completed including spotlighting and call playback techniques. Approximately eight (8) hours was spent on this component of the assessment. No conclusive evidence of Koala activity (scats) was recorded on the site. Whilst a number of trees contained scratch marks this is not considered a conclusive method of identifying Koala activity when not accompanied by scats as they may be attributed to other more common arboreal species. One (1) male Koala was heard calling approximately 200-300m north of the south-western corner of the subject site.

No records of a resident population, evidenced by attributes such as breeding females, exist for the Subject site. It is considered that Koalas may occasionally disperse across the site whilst moving through the locality. It is considered that the site does not support core Koala habitat.

It is worth noting that whilst a number of areas of the site contain Primary Koala food trees as discussed above, these comprise less than 1% of the total number of trees on the subject site. No further assessment under SEPP 44 is therefore required.

#### 4.4.5.3 Impacts on Koala Habitat

As discussed within Section 4.3.5.2 above, JWA consider that vegetation communities 1a, 1d, 7 and 8 provide suitable habitat for the Koala due to the presence of preferred food tree species (**FIGURE 20**). Surveys for the Koala on the subject site have revealed that a resident population is not present. However it is considered that this species may occasionally utilise habitat on the subject site as it disperses through the area. The potential impacts on Koala habitat from the proposed development are shown in **FIGURE 21.**

It is worth noting that suitable Koala habitat to be removed from the subject site occurs within existing 2(c) zoned land (i.e. Urban Expansion), land proposed to be rezoned as 2(c), or land that may otherwise be cleared in accordance with existing use rights. A summary of the potential loss of suitable Koala habitats is shown in **TABLE 5**.

In total 9.24 hectares of suitable Koala habitat (20.8% of the total available habitat) may potentially be lost from the subject site the majority of which may be lost from community 1a. It is worth noting that all potential Koala habitat to be removed occurs within portions of the site with existing development approval.

It is also worth noting that the most recent Koala survey (December 2007) failed to record recent Koala activity on the subject site. The Swamp mahogany and Scribbly gum communities (communities 7 & 8) on the subject site occur as isolated stands of trees which are likely to be relatively inaccessible to Koalas residing in the locality.

**TABLE 5**
**POTENTIAL LOSS OF KOALA HABITAT**
**RESULTING FROM THE PROPOSED DEVELOPMENT**

| | | Existing Approved Areas | | | | Non-Approved Areas | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Retained Areas | | | | Retained Areas | | | |
| | | | Breakdown of Retained Areas | | | | Breakdown of Retained Areas | | |
| **Community** | **TOTAL AREA (ha)** | **Retained - TOTAL (ha)** | Open Space (ha) | Environmental Protection (ha) | **Loss - TOTAL (ha)** | **Retained - TOTAL (ha)** | Open Space (ha) | Environmental Protection (ha) | **Loss - TOTAL (ha)** |
| 1A # | 33.10 | 28.35 | 3.14 | 25.20 | 4.75 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1D | 2.37 | 1.68 | 1.68 | 0.00 | 0.69 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | 3.80 | 0.00 | 0.00 | 0.00 | 3.80 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | 5.13 | 4.53* | 0.00 | 0.00 | 0.00 | 0.61 | 0.55 | 0.06 | 0.00 |
| **TOTAL** | **44.40** | **34.56** | **4.82** | **25.2** | **9.24** | **0.61** | **0.55** | **0.06** | **0.00** |

Note: # Portions of these communities occur within proposed Landscape Areas and additional areas may be lost as a result of landscaping and recreational facilities located within these areas.

* Specific trees within the Scribbly gum community (Community 8) will be retained and protected within the development footprint (in accordance with the Scribbly Gum Management Plan – **VOLUME 4**).

#### 4.4.5.4 Proposed Amelioration Measures

The majority of potential Koala habitat on the subject site will be retained. A total of 35.17 hectares of suitable Koala habitat (79.2% of available habitat) is proposed to be retained. A summary of the proposed retention of remnant bushland on the subject site is shown in **TABLE 4.** This bushland will be retained within Environmental Protection Areas as well as Open Space areas throughout the development envelope.

Specific trees within the Scribbly gum community (Community 8) will be retained within the development envelope and protected (in accordance with the Scribbly Gum Management Plan – **VOLUME 4**).

Additionally, 59.5ha of proposed revegetation and regeneration works on the subject site (**FIGURE 22**) will increase the area of available habitat in the long-term and provide vegetated linkages through the landscape.

### *4.4.6 Threatened species and their habitats*

#### 4.4.6.1 Introduction

Several species of flora and fauna listed as threatened species under the *Threatened Species Conservation Act* (1995), as well as several Endangered Ecological Communities, occur on the Cobaki lakes site or are considered possible or likely occurrences. Loss of habitat for Threatened species and losses of EEC's have been calculated as the possible maximum loss based on the concept plan. However, there may be opportunities to retain Threatened species and/or their habitat, and EEC's within the proposed development footprint and this will be the subject of a detailed assessment at the Development Application stage. Seven (7) part tests will also be completed at the Development Application stage for all Threatened flora and fauna species as well as Endangered Ecological Communities in accordance with the *Threatened Species Conservation Amendment Act 2002*.

#### 4.4.6.2 Threatened flora

Eight (8) listed flora species have been recorded on the subject site in the most recent vegetation survey (**VOLUME 2 [APPENDIX 2]**)**.** Threatened flora recorded includes the following species:

- White yiel yiel (*Grevillea hilliana*) Endangered (TSC Act 1995);
- Scented acronychia (*Acronychia littoralis*) - Endangered (TSC Act 1995 & EPBC Act 1999);
- Fine-leaved tuckeroo (*Lepiderema pulchella*) - Vulnerable (TSC Act 1995,
- Spiny gardenia (*Randia moorei)* - Endangered (TSC Act 1995 & EPBC Act 1999);
- Marblewood (*Acacia bakeri*) - Vulnerable (TSC Act 1995);
- Brush cassia (*Cassia brewsteri* var. *marksiana*) - Endangered (TSC Act 1995);
- Coolamon (*Syzygium moorei*) - Vulnerable (TSC Act 1995, EPBCA 1999); and

- Green-leaved rose walnut (*Endiandra muelleri* subsp. *bracteata)* Endangered (TSC Act 1995).

The locations of these species are shown in **FIGURES 23, 23a & 23b.**

An additional five (5) Threatened species have been recorded during surveys on adjacent land, including:

- White lace flower (*Archidendron hendersonii*) – Vulnerable (TSC Act 1995);
- Stinking cryptocarya (*Cryptocarya foetida*) – Vulnerable (TSC Act 1995 & EPBC Act 1999);
- Pink nodding orchid (*Geodorum densiflorum*) - Endangered (TSC Act 1995);
- Rough-shelled bush-nut (*Macadamia tetraphylla*) – Vulnerable (TSC Act 1995 & EPBC Act 1999); and
- Swamp orchid (*Phaius australis*) – Endangered (TSC Act 1995 & EPBC Act 1999).

The known locations of Threatened flora species adjacent to the subject site are shown in **FIGURE 24.**

It is worth noting that suitable habitat for Threatened flora to be removed from the subject site occurs within existing 2(c) zoned land (i.e. Urban Expansion), land proposed to be rezoned as 2(c), or land that may otherwise be cleared in accordance with existing use rights.

A summary of impacts for each species recorded on and adjacent to the subject site is provided in **TABLE 6.**

**TABLE 6**
**POTENTIAL LOSS OF THREATENED FLORA HABITAT FROM THE PROPOSED DEVELOPMENT**

| Species | Existing habitat (ha) | Existing Approved Areas | | | | Non-Approved Areas | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Retained Areas | | | Habitat Loss (ha) | Retained Areas | | | Habitat Loss (ha) |
| | | Habitat Retained (ha) | Breakdown of Retained Areas | | | Habitat Retained (ha) | Breakdown of Retained Areas | | |
| | | | Open Space (ha) | Environmental Protection (ha) | | | Open Space (ha) | Environmental Protection (ha) | |
| White yiel yiel | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Scented acronychia | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Fine-leaved tuckeroo | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Spiny gardenia | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Marblewood | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Brush cassia | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Coolamon | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Green-leaved rose-walnut | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| White lace flower | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Stinking cryptocarya | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Pink nodding orchid | 3.80 | 0.00 | 0.00 | 0.00 | 3.80 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rough-shelled bush-nut | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Swamp orchid | 3.80 | 0.00 | 0.00 | 0.00 | 3.80 | 0.00 | 0.00 | 0.00 | 0.00 |

4.4.6.3 Impacts on Threatened Flora

A plan showing the locations of Threatened flora on the subject site in relation to the proposed development is shown in **FIGURES 25, 25a & 25b** and a summary of impacts for each species is provided below:

**White yiel yiel**

The NPWS database (October 2008) contains two (2) records of this species within 10 km of the Subject site. Seven (7) records occur within the Tweed LGA. A total of two (2) stems of White yiel yiel have been recorded on the subject site (**FIGURES 23 & 23a**) both of which occur within the rainforest communities associated with Mt. Woodgee in the northern portion of the subject site. Two (2) additional stems of this species have been recorded within the border reserve to the north of the subject site. This species has also been recorded in adjacent habitat to the east of the subject site (EcoPro 2004) (**FIGURE 24**).

One (1) White yiel yiel occurs within an area of the proposed development footprint with existing approvals (**FIGURE 25a**).

The proposed development will result in the removal or modification of a total of 0.82 hectares (7.3%) of rainforest communities that are considered to represent potential habitat for this species, all of which will occur from areas of the site with existing development approvals.

The potential removal of a single stem of this species, and a small area of potential habitat, from the subject site is not considered to represent a significant impact in relation to the regional distribution of habitat for this species. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Scented acronychia**

The NPWS database (October 2008) contains one (1) record of this species within 10 km of the Subject site. Thirty (30) records occur within the Tweed LGA. A total of one (1) stem of Scented acronychia has been recorded from within a small isolated clump of vegetation in the central northern portion of the subject site **FIGURES 23 & 23a**). This species has not previously been recorded from the subject site or adjacent areas.

This small patch of vegetation, including the single stem of Scented acronychia, occurs within an area of the proposed development footprint with existing approvals (**FIGURE 25a**).

The proposed development will result in the removal or modification of a total of 0.82 hectares (7.3%) of rainforest communities that are considered to represent potential habitat for this species, all of which will occur from areas of the site with existing development approvals.

The potential removal of a single stem of this species, and a small area of potential habitat, from the subject site is not considered to represent a significant impact in relation to the regional distribution of habitat for this species. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Fine-leaved tuckeroo**

The NPWS database (October 2008) contains twenty (20) records of this species within 10 km of the Subject site. Ninety (90) records occur within the Tweed LGA. A total of thirty-nine (39) stems of Fine-leaved tuckeroo have been recorded on the subject site (**FIGURES 23, 23a & 23b**) the majority of which occur within the rainforest communities associated with Mt. Woodgee in the northern portion of the subject site. One (1) stem occurs within a small isolated patch of rainforest in the central southern portion of the subject site (i.e. Community 2b). This species has also been recorded in adjacent habitat to the east of the subject site (EcoPro 2004) (**FIGURE 24**).

Six (6) stems of Fine-leaved tuckeroo occur within areas of the proposed development footprint with existing approvals (**FIGURE 25a & 25b**).

The proposed development will result in the removal or modification of a total of 0.82 hectares (7.3%) of rainforest communities that are considered to represent potential habitat for this species, all of which occurs in areas of the site which have existing development approvals. It is worth noting that this species is particularly common within the locality with several hundred having been recorded by JWA at Terranora and Bilambil.

The potential removal of a six (6) stems stem of this species, and a small area of potential habitat, from the subject site is not considered to represent a significant impact in relation to the regional distribution of habitat for this species. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Spiny gardenia**

The NPWS database (October 2008) contains eight (8) records of this species within 10 km of the Subject site. Fifty-six (56) records occur within the Tweed LGA. A total of fourteen (14) stems of Spiny gardenia have been recorded on the subject site (**FIGURES 23 & 23a**) the majority of which occur within the rainforest communities associated with Mt. Woodgee and in a small riparian community (near Mt. Woodgee) in the northern portion of the subject site. Six (6) additional stems of this species have been recorded within the border reserve to the north of the subject site.

One (1) Spiny gardenia occurs within an area of the proposed development footprint with existing approvals (**FIGURE 25a**).

The proposed development will result in the removal or modification of a total of 0.82 hectares (7.3%) of rainforest communities that are considered to represent potential habitat for this species, all of which occurs in areas of the site which have existing development approvals.

The potential removal of a single stem of this species, and a small area of potential habitat, from the subject site is not considered to represent a significant impact in relation to the regional distribution of habitat for this species. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Marblewood**

The NPWS database (October 2008) contains fourteen (14) records of this species within 10 km of the Subject site. Seventy-six (76) records occur within the Tweed LGA. A total of nine (9) stems of Marblewood have been recorded on the subject site (**FIGURES 23, 23a & 23b**) from within the rainforest communities associated with Mt. Woodgee in the northern portion of the subject site, and within small isolated patches of vegetation in the central northern portion of the site. A number of specimens are also located within the steep-sided gullies near the dam on the western boundary of the subject site. Fourteen (14) additional stems of this species have been recorded adjacent to the western boundary and three (3) additional stems within the border reserve to the north.

Four (4) stems of Marblewood occur within areas of the proposed development footprint with existing approvals (**FIGURE 25a & 25b**).

The proposed development will result in the removal or modification of a total of 0.82 hectares (7.3%) of rainforest communities that provide potential habitat for this species, all of which occurs in areas of the site which have existing development approvals.

The removal of four (4) stems of this species, and a small area of potential habitat, from the subject site is not considered to represent a significant impact in relation to the regional distribution of habitat for this species. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Brush cassia**

The NPWS database (October 2008) contains eleven (11) records of this species within 10 km of the Subject site. One hundred (100) records occur within the Tweed LGA. A total of two (2) stems of Brush cassia have been recorded on the subject site (**FIGURES 23, 23a & 23b**) from within small isolated patches of vegetation and riparian areas in the central northern portion of the site.

Both stems of the Brush cassia on the subject site occur within areas designated as Open Space (**FIGURE 25a & 25b**).

The proposed development will result in the removal or modification of a total of 0.82 hectares (7.3%) of potential habitat for this species, all of which occurs in areas of the site which have existing development approvals.

The removal of a small area of potential habitat from the subject site is not considered to represent a significant impact in relation to the regional distribution of habitat for this species. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Coolamon**

The NPWS database (October 2008) contains two (2) records of this species within 10 km of the Subject site. One hundred and thirty-seven (137) records occur within the Tweed LGA. No specimens of Coolamon have been recorded on the subject site,

however two (2) Coolamon have been recorded within the border reserve to the north of the subject site (**FIGURES 23 & 23a**).

The proposed development is considered unlikely to impact on the Coolamon which occur adjacent to the subject site (**FIGURE 25a**).

The proposed development will result in the removal or modification of a total of 0.82 hectares (7.3%) of rainforest communities considered to represent potential habitat for this species, all of which occurs in areas of the site which have existing development approvals.

The removal of a small area of potential habitat from the subject site is not considered to represent a significant impact in relation to the regional distribution of habitat for this species. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Green-leaved rose walnut**

The NPWS database (October 2008) contains two (2) records of this species within 10 km of the Subject site. Twenty-nine (29) records occur within the Tweed LGA. A total of five (5) stems of Green-leaved rose-walnut have been recorded on the subject site (**FIGURES 23 & 23b**) from within the steep-sided gullies near the dam on the western boundary of the subject site. This species has also been recorded in adjacent habitat to the east of the subject site (EcoPro 2004) (**FIGURE 24**).

None of the five (5) stems of Green-leaved rose-walnut recorded on the site occur within the proposed development footprint (**FIGURE 25b**).

The proposed development will result in the removal or modification of a total of 0.82 hectares (7.3%) of rainforest communities considered to represent potential habitat for this species, all of which occurs in areas of the site which have existing development approvals.

The removal of a small area of potential habitat from the subject site is not considered to represent a significant impact in relation to the regional distribution of habitat for this species. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**White lace flower**

The NPWS database (October 2008) contains three (3) records of this species within 10 km of the Subject site. Eleven (11) records occur within the Tweed LGA. This species has been recorded from rainforest communities adjacent to the subject site (EcoPro 2004) (**FIGURE 24**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

Suitable habitat for the White lace flower is considered to be comprised of undisturbed riverine and lowland subtropical rainforest communities on and adjacent to the subject site. The proposed development will result in the removal or modification a total of 0.82 hectares (7.3%) of potential habitat for this species, all of which occurs in areas of the site which have existing development approvals.

The removal of a small area of potential habitat from the subject site is not considered to represent a significant impact in relation to the regional distribution of habitat for this species. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Stinking cryptocarya**

The NPWS database (October 2008) contains thirteen (13) records of this species within 10 km of the Subject site. Fifty-nine (59) records occur within the Tweed LGA. This species has been recorded from rainforest communities adjacent to the subject site (EcoPro 2004) (**FIGURE 24**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

Suitable habitat for this species is considered to be comprised of undisturbed riverine and lowland subtropical rainforest communities on and adjacent to the subject site. The proposed development will result in the removal or modification a total of 0.82 hectares (7.3%) of potential habitat for this species, all of which occurs in areas of the site which have existing development approvals.

The removal of a small area of potential habitat from the subject site is not considered to represent a significant impact in relation to the regional distribution of habitat for this species. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Pink nodding orchid**

The NPWS database (October 2008) contains no records of this species within 10 km of the Subject site. Nine (9) records occur within the Tweed LGA. This species has been recorded from Swamp forest adjacent to the subject site (EcoPro 2004) (**FIGURE 24**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

Suitable habitat for this species is considered to be comprised of undisturbed dry eucalypt forest and coastal swamp forest at lower altitudes on and adjacent to the subject site. The proposed development will result in the removal or modification a total of 3.8 hectares of potential habitat for this species, all of which occurs in areas of the site which have existing development approvals.

The removal of a small area of potential habitat from the subject site is not considered to represent a significant impact in relation to the regional distribution of habitat for this species. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Rough-shelled bush-nut**

The NPWS database (October 2008) contains eight (8) records of this species within 10 km of the Subject site. Eighty-three (83) records occur within the Tweed LGA. This species has been recorded from rainforest communities adjacent to the subject site (EcoPro 2004) (**FIGURE 24**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

Suitable habitat for this species is considered to be comprised of undisturbed subtropical rainforest communities on and adjacent to the subject site. The proposed development will result in the removal or modification a total of 0.82 hectares (7.3%) of potential habitat for this species, all of which occurs in areas of the site which have existing development approvals.

The removal of a small area of potential habitat from the subject site is not considered to represent a significant impact in relation to the regional distribution of habitat for this species. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Swamp orchid**

The NPWS database (October 2008) contains two (2) records of this species within 10 km of the Subject site. Four (4) records occur within the Tweed LGA. This species has been recorded from Swamp forest adjacent to the subject site (EcoPro 2004) (**FIGURE 24**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

Suitable habitat for the Swamp orchid is considered to be comprised of undisturbed swamp sclerophyll forest communities on and adjacent to the subject site. The proposed development will result in the removal or modification a total of 3.8 hectares of potential habitat for this species, all of which occurs in areas of the site which have existing development approvals.

The removal of a small area of potential habitat from the subject site is not considered to represent a significant impact in relation to the regional distribution of habitat for this species. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

#### 4.4.6.4 Amelioration for Threatened flora

The major amelioration strategy for Threatened flora species on the subject site is the retention and long-term protection of suitable habitat within Environmental Protection Areas.

All of the Threatened plants recorded on and adjacent to the subject site, with the exception of the Swamp orchid and the Pink nodding orchid, are typical of lowland rainforest. Approximately 10.32 hectares (91.9%) of lowland rainforest communities occurring on the subject site will be retained with an additional 14.66 hectares of land proposed to be rehabilitated as lowland rainforest in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**). These areas will ensure protection for retained Threatened flora species and also provide additional habitat for Threatened flora species occurring on and adjacent to the subject site. Rehabilitation of lowland rainforest communities is discussed further in Section 4.3.6.6.

The Swamp orchid and the Pink nodding orchid have been recorded from adjacent to the subject site and are typical of swamp sclerophyll forest communities. The entire area of existing Swamp sclerophyll forest on coastal floodplain will be lost from the subject site. It is worth noting that the conservation significance of this community has

been severely compromised by past land-use activities including cattle grazing and periodic slashing which has resulted in the removal of the midstorey and the prevalence of introduced grasses and common agricultural weeds in the groundcover layer.

In total, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site to offset the loss of 3.8 hectares. Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas will ensure protection for retained Threatened flora species and also provide additional habitat for Threatened flora species occurring on and adjacent to the subject site. Rehabilitation of lowland rainforest communities is discussed further in Section 4.3.6.6.

It is also recommended that propagation of Threatened flora species be undertaken as part of the rehabilitation works on the subject site in an attempt to bolster local populations. The rationale and methodology of Threatened plant propagation will be detailed within individual regeneration and revegetation plans to be completed for each of the rehabilitation precincts (in accordance with the Site Regeneration and Revegetation Plan - **VOLUME 5**) at the Operational Works stage.

As a minimum, every retained Threatened plant on the subject site will be provided with a 5m vegetated buffer.

#### 4.4.6.5 Impacts on Endangered Ecological Communities

Six (6) Endangered Ecological Communities (EECs) are considered to occur on the site, including:

- Swamp sclerophyll forest on coastal floodplain - which occurs as an isolated clump of scattered Swamp mahogany in the central eastern of the Subject site;
- Lowland rainforest on floodplain - occurring at various locations generally in association with drainage lines and depressions;
- Lowland rainforest - occurring on Mt. Woodgee and on lower slopes in the northern portion of the subject site;
- Freshwater wetlands - occurring in the central and eastern portions of the site;
- Swamp oak floodplain forest – occurring in association with drainage lines in the south-east of the site; and
- Coastal saltmarsh in the NSW North Coast bioregion - occurring in the south-east of the site.

The locations of these EEC's are shown in **FIGURE 26.** The potential impacts of the proposed development on EEC's recorded on the site are discussed briefly below. A plan showing the locations of EEC's in relation to the proposed development is shown in **FIGURE 27**. A summary of the impacts on EEC's is provided in **TABLE 7.**

**TABLE 7**
**POTENTIAL LOSS OF ENDANGERED ECOLOGICAL COMMUNITIES FROM THE PROPOSED DEVELOPMENT**

| Existing EEC | TOTAL AREA (ha) | Existing Approved Areas | | | | Non-Approved Areas | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Retained Areas | | | | Retained Areas | | | |
| | | | Breakdown of Retained Areas | | | | Breakdown of Retained Areas | | |
| | | Retained - TOTAL (ha) | Open Space (ha) | Environmental Protection (ha) | Loss - TOTAL (ha) | Retained - TOTAL (ha) | Open Space (ha) | Environmental Protection (ha) | Loss - TOTAL (ha) |
| Swamp Sclerophyll Forest on Floodplain | 3.80 | 0.00 | 0.00 | 0.00 | 3.80 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lowland Rainforest on Floodplain | 1.78 | 1.07 | 1.07 | 0.00 | 0.19 | 0.51 | 0.51 | 0.00 | 0.00 |
| Lowland Rainforest | 9.45 | 0.69 | 0.00 | 0.69 | 0.63 | 8.13 | 0.46 | 7.67 | 0.00 |
| Freshwater Wetland | 37.64 | 0.08 | 0.08 | 0.00 | 0.99 | 30.73 | 30.73 | 0.00 | 5.83 |
| Swamp oak floodplain forest | 4.24 | 0.00 | 0.00 | 0.00 | 0.00 | 3.87 | 3.85 | 0.01 | 0.37 |
| Saltmarsh | 53.95 | 0.13 | 0.13 | 0.00 | 0.42 | 49.04 | 48.20 | 0.83 | 4.36 |

**Swamp sclerophyll forest on coastal floodplain**

This EEC occurs in the central eastern potion of the subject site and is comprised of approximately 3.80 hectares of Mid-high open woodland (*Eucalyptus robusta*) (**FIGURE 26**).

The entire area of existing Swamp sclerophyll forest on coastal floodplain will be lost from the subject site (**FIGURE 27**). It is worth noting that the conservation significance of this community has been severely compromised by past land-use activities including cattle grazing and periodic slashing which has resulted in the removal of the midstorey and the prevalence of introduced grasses and common agricultural weeds in the groundcover layer. The Mid-high open woodland (*E. robusta*) community on the subject site is therefore generally comprised of scattered trees within a slashed/grazed grassland environment.

It is also worth noting that the removal of this vegetation community will occur from an area of the site which has an existing development approval. The removal of this small area of degraded Swamp sclerophyll forest on coastal floodplain from the subject site is not considered to represent a significant impact in relation to the regional distribution of this community. Offsets to ensure no net loss are discussed in Section 4.3.6.6.

**Lowland rainforest on floodplain**

This EEC occurs as several isolated patches of forest in the southern and northern portions of the subject site generally in association with drainage lines and depressions (i.e. riparian forest) (**FIGURE 26**). Lowland rainforest on floodplain covers a total area of approximately 1.78 hectares on the subject site.

In total 0.19 hectares of Lowland rainforest on floodplain (10.7%) will be lost from the subject site (**FIGURE 27**), all of which occurs within portions of the site with existing development approvals.

It is worth noting that the conservation significance of these communities has been compromised by historical clearing activities which have resulted in the fragmentation of rainforest communities. The removal of this small area of degraded Lowland rainforest on floodplain from the subject site is not considered to represent a significant impact in relation to the regional distribution of this community. Offsets to ensure no net loss are discussed in Section 4.3.6.6.

**Lowland rainforest**

This EEC occurs on Mt. Woodgee and associated slopes in the northern portion of the subject site (**FIGURE 26**) and covers a total area of approximately 9.45 hectares. Vegetation on Mt. Woodgee (i.e. Community 2a) is relatively intact and is considered to represent one of the most ecologically significant vegetation communities on the subject site, particularly in terms of habitat value for Threatened flora species.

Approximately 0.63 hectares of this EEC (6.7%) will be lost from the subject site (**FIGURE 27**), all of which occurs within portions of the site with existing development approvals. The removal of this small area of Lowland rainforest from the subject site is

not considered to represent a significant impact in relation to the regional distribution of this community. Offsets to ensure no net loss are discussed in Section 4.3.6.6.

**Freshwater wetlands**

This EEC is comprised of areas of Tall closed grassland/fernland/Sedgeland (i.e. Community 10) and Rushland/Sedgeland/Grassland (i.e. Community 14) on the subject site covering a total area of approximately 37.64 hectares (**FIGURE 26**). The area of Freshwater wetland in the eastern portion of the site (i.e. Community 10) has been impacted by adjacent earthworks for the formation of Cobaki Parkway. It is worth noting that the location of the road reserve is fixed by Tweed Council planning as a future four lane arterial road funded by the Section 94 Development Contribution Scheme. Additionally, the large area of Freshwater wetland in the central portion of the site (i.e. Community 14) has been heavily degraded by past and existing land use including drain construction and maintenance, grazing and slashing.

In total 6.82 hectares of Freshwater wetland (18.1%) will be lost from the subject site (**FIGURE 27**). The loss of this EEC is comprised of 0.99 hectares from areas of the site with existing development approvals, and 5.83 hectares from areas of the site without existing development approvals. The removal of this area of degraded Freshwater wetland from the subject site is not considered to represent a significant impact in relation to the regional distribution of this community. Offsets to ensure no net loss are discussed in Section 4.3.6.6.

**Swamp oak floodplain forest**

This EEC occurs in the south-eastern potion of the subject site in association with drainage lines and covers an area of approximately 4.24 hectares (**FIGURE 26**). This community occurs in an area that is currently subject to tidal inundation via the main constructed drain in this portion of the site (i.e. Dunn's drain) and also through a breach in the constructed levy bank adjacent to the creek. It is worth noting that this community occurs as linear stands of trees along the edges of constructed drains. Additionally, this area is currently actively grazed by cattle under existing use rights (i.e. routine agricultural activities) which has resulted in the prevalence of introduced grasses and common agricultural weeds in some areas.

In total 0.37 hectares of Swamp oak floodplain (8.73%) will be lost from the subject site (**FIGURE 27**). The loss of this will occur within an area of the site without existing development approval. The removal of this small area of Swamp oak floodplain forest from the subject site is not considered to represent a significant impact in relation to the regional distribution of this community. Offsets to ensure no net loss are discussed in Section 4.3.6.6.

**Coastal saltmarsh in the NSW North Coast bioregion**

This EEC occurs in the south-eastern potion of the subject site adjacent to Cobaki Creek and covers an area of approximately 53.95 hectares (**FIGURE 26**). This area is currently subject to tidal inundation via the main constructed drain in this portion of the site (i.e. Dunn's drain) and also through a breach in the constructed levy bank

adjacent to the creek. It is worth noting that this area is currently actively grazed by cattle, and slashed in some areas, under existing use rights (i.e. routine agricultural activities). This has resulted in the prevalence of introduced grasses and common agricultural weeds in some areas.

In total 4.78 hectares of Coastal saltmarsh (8.9%) will be lost from the subject site (**FIGURE 27**). The loss of this EEC is comprised of 0.42 hectares from areas of the site with existing development approvals, and 4.36 hectares for the construction of a school within an area of the site without existing development approval (**FIGURE 27**). The proposed school will occur in an area comprised of Saltmarsh which is currently zoned for Recreation. This proposed location of the school is allowable under the present LEP subject to consent (in accordance with Clause 8.2).

The removal of this small area of degraded Coastal saltmarsh from the subject site is not considered to represent a significant impact in relation to the regional distribution of this community. Offsets to ensure no net loss are discussed in Section 4.3.6.6.

#### 4.4.6.6 Amelioration for Endangered Ecological Communities

The major amelioration strategy for EEC's on the subject site is the retention and long-term protection of these vegetation communities within Environmental Protection Areas.

The Site Regeneration and Revegetation Plan (**VOLUME 5**) outlines the various measures to ensure that the retained EEC's are adequately managed. Revegetation/regeneration will be completed in accordance with this plan to offset any loss of EEC's. A summary of proposed EEC offsets is provided in **TABLE 8** and the location and extent of proposed offsets are shown in **FIGURE 28**.

**TABLE 8**
**PROPOSED EEC OFFSETS IN ACCORDANCE WITH THE SITE REGENERATION AND REVEGETATION PLAN**

| EEC Offset Areas | Loss - TOTAL (ha) | Revegetation Areas (ha) | Natural Regeneration Areas (ha) | Total Area (ha) |
|---|---|---|---|---|
| Swamp Sclerophyll on Floodplain | 3.80 | 15.82 | 2.36 | 18.18 |
| Lowland Rainforest on Floodplain | 0.19 | 4.81 | 0 | 4.81 |
| Lowland Rainforest | 0.63 | 7.62 | 2.23 | 9.85 |
| Freshwater Wetland | 6.82 | 2.73 | 3.09 | 5.82 |
| Saltmarsh | 4.78 | 7.7# | 0 | 7.7 |
| Swamp oak Floodplain Forest | 0.37 | 7.7# | 0 | 7.7 |
| Freshwater Wetland / Swamp Sclerophyll Forest on Floodplain (Landscape Area*) | - | - | - | 35.21 |

* Note: The total area of Freshwater Wetland / Swamp Sclerophyll Forest on Floodplain EEC revegetated within Landscape Areas will be dependent on the location of landscaping and recreational facilities within these areas.

\# The revegetation of Saltmarsh and Swamp oak floodplain forest will occur in combination over the same area.

**Swamp sclerophyll forest on coastal floodplain**

Amelioration for the removal of the degraded Swamp sclerophyll forest on coastal floodplain will be provided through revegetation works on the subject site. A Site Regeneration and Revegetation Plan has been prepared for the subject site and includes measures to offset the loss of this EEC from the subject site (**VOLUME 5**). Additional compensation will be provided through regeneration and revegetation works in accordance with the Freshwater Wetland Rehabilitation Plan (**VOLUME 8**).

In total, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site (**FIGURE 28**) to offset the loss of 3.8 hectares. Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.

Both the Site Regeneration and Revegetation Plan and the Freshwater Wetland Rehabilitation Plan include specific performance criteria as well as detailed maintenance and monitoring programs and it is therefore considered that the compensatory Swamp sclerophyll forest on coastal floodplain will be more likely to persist in the long-term compared to the existing communities.

**Lowland rainforest on floodplain**

Amelioration for any removal of the isolated patches of Lowland rainforest on floodplain will be provided through revegetation works on the subject site. A Site Regeneration and Revegetation Plan has been prepared for the subject site and includes measures to offset any loss of this EEC from the subject site (**VOLUME 5**). Furthermore, retained patches of this EEC will be buffered from the proposed development and embellished to increase the overall extent of isolated patches and reduce existing anthropogenic impacts. The Site Regeneration and Revegetation Plan includes specific performance criteria as well as a detailed maintenance and monitoring program to ensure the persistence of this EEC in the long-term.

In total, 4.81 hectares of Lowland rainforest will be regenerated/revegetated on the subject site (**FIGURE 28**) to offset the loss of 0.19 hectares. As a minimum, retained Lowland rainforest on floodplain on the subject site will be provided with a 10m vegetated buffer.

**Lowland rainforest**

Amelioration for the removal of any of the isolated patches of Lowland rainforest will be provided through revegetation works on the subject site. A Site Regeneration and Revegetation Plan has been prepared for the subject site and includes measures to offset any loss of this EEC from the subject site (**VOLUME 5**). Furthermore, retained patches of this EEC will be buffered from the proposed development and embellished to increase the overall extent of isolated patches and reduce existing anthropogenic impacts. The Site Regeneration and Revegetation Plan includes specific performance criteria as well as a detailed maintenance and monitoring program to ensure the persistence of this EEC in the long-term.

In total, 9.85 hectares of Lowland rainforest on floodplain will be regenerated/revegetated on the subject site (**FIGURE 28**) to offset the loss of 0.63 hectares. As a minimum, retained Lowland rainforest on the subject site will be provided with a 10m vegetated buffer.

**Freshwater wetlands**

A Freshwater Wetland Rehabilitation Plan has been prepared for the subject site and includes measures to provide a more intact wetland community on the subject site (**VOLUME 8**). This plan aims to rehabilitate an area of the subject site that is considered to have formally been comprised of freshwater wetland communities.

In total, 5.82 hectares of Freshwater wetlands will be regenerated/revegetated on the subject site (**FIGURE 28**) to offset the loss of 6.82 hectares. Additionally, 17.22 hectares of wetlands will be constructed for stormwater management comprised of 14.1ha of lakes/open water zones and 3.12ha of shallow/macrophyte zones. Stormwater treatment devices are discussed in further detail in Section 4.4.2.4.

As a minimum, retained Freshwater wetlands on the subject site will be provided with a 10m vegetated buffer.

The Freshwater Wetland Rehabilitation Plan include specific performance criteria as well as a detailed maintenance and monitoring program and it is therefore considered that the rehabilitated Freshwater wetland will be more likely to persist in the long-term compared to the existing community.

**Swamp oak floodplain forest**

The removal of approximately 0.37 hectares of the Swamp oak floodplain forest community from the subject site will be ameliorated by regenerating and revegetating compensatory Swamp oak communities on the subject site. Areas within and adjacent to the existing Saltmarsh communities on the subject site are currently comprised of a mixture of exotic grasses and will be restored to Saltmarsh and Swamp oak communities in accordance with the Saltmarsh Restoration Plan (**VOLUME 3**). Removal of cattle from the area and subsequent relinquishment of existing use rights is considered an integral component of the rehabilitation process.

In total, 7.7 hectares of Swamp oak floodplain forest will be regenerated/revegetated on the subject site (**FIGURE 28**) to offset the loss of 0.37 hectares. As a minimum, retained Swamp oak floodplain forest on the subject site will be provided with a 10m vegetated buffer.

**Coastal saltmarsh in the NSW North Coast bioregion**

The removal of approximately 4.78 hectares of Saltmarsh communities from the subject site will be ameliorated by regenerating and revegetating compensatory Saltmarsh communities on the subject site. Large areas adjacent to the existing Saltmarsh communities are currently comprised of a mixture of exotic grasses and will be restored to Saltmarsh communities in accordance with the Saltmarsh Restoration Plan (**VOLUME**

**3**). Removal of cattle from the area and subsequent relinquishment of existing use rights is considered an integral component of the rehabilitation process.

In total, 7.7 hectares of Coastal saltmarsh will be regenerated/revegetated on the subject site (**FIGURE 28**) to offset the loss of 4.78 hectares. As a minimum, retained Coastal saltmarsh on the subject site will be provided with a 10m vegetated buffer.

#### 4.4.6.7 Impacts & Amelioration for Threatened Fauna and their habitat

Details of all fauna surveys completed (1983-2007) on the Cobaki Lakes site are contained in **VOLUME 2 (APPENDIX 3)**. Twelve (12) Threatened fauna species have been recorded from the subject site during this time period, including:

- Wallum froglet (*Crinia tinnula*) – Vulnerable (TSC Act 1995);
- Black-necked stork (*Xenorhynchus asiaticus*) – Endangered (TSC Act 1995);
- Powerful owl (*Ninox strenua*) – Vulnerable (TSC Act 1995);
- Masked owl – (*Tyto novaehollandiae*) - Vulnerable (TSC Act 1995);
- Osprey (*Pandion haliaetus*) - Vulnerable (TSC Act 1995);
- Koala (*Phascolarctos cinereus*) - Vulnerable (TSC Act 1995);
- Grey-headed flying-fox (*Pteropus poliocephelus*) - Vulnerable (EPBC Act 1999);
- Little bent-wing bat (*Miniopterus australis*) - Vulnerable (TSC Act 1995);
- Common bent-wing bat (*Miniopterus schreibersii*) - Vulnerable (TSC Act 1995);
- Eastern free-tail bat (*Mormopterus norfolkensis*) - Vulnerable (TSC Act 1995);
- Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) - Vulnerable (TSC Act 1995); and
- Greater broad-nosed bat (*Scoteanax rueppellii*) - Vulnerable (TSC Act 1995).

The known locations of Threatened fauna sightings on the subject site are shown in **FIGURE 29.**

An additional nineteen (19) Threatened species have been recorded during surveys on adjacent land, including:

- Wallum sedge-frog (*Litoria olongburensis*) - Vulnerable (TSC Act 1995) & Endangered (EPBC Act 1999);
- Bush hen (*Amaurornis olivaceus*) - Vulnerable (TSC Act 1995);
- Glossy black-cockatoo (*Calyptorhynchus lathami*) - Vulnerable (TSC Act 1995);
- Brolga (*Grus rubicunda*) - Vulnerable (TSC Act 1995);
- Black bittern (*Ixobrychus flavicollis*) - Vulnerable (TSC Act 1995);
- Mangrove honeyeater (*Lichenostomus fasciogularis*) - Vulnerable (TSC Act 1995);
- White-eared monarch (*Monarcha leucotis*) - Vulnerable (TSC Act 1995);
- Wompoo fruit-dove (*Ptilinopus magnificus*) - Vulnerable (TSC Act 1995);
- Rose-crowned fruit-dove (*Ptilinopus regina*) - Vulnerable (TSC Act 1995);
- Superb fruit-dove (*Ptilinopus superbus*) - Vulnerable (TSC Act 1995);
- Collared kingfisher (*Todiramphus chloris*) - Vulnerable (TSC Act 1995);
- Eastern grass owl (*Tyto capensis*) - Vulnerable (TSC Act 1995);
- Large-footed myotis (*Myotis adversus*) - Vulnerable (TSC Act 1995);

- Eastern long-eared bat (*Nyctophilus bifax*) - Vulnerable (TSC Act 1995);
- Squirrel glider (*Petaurus norfolkensis*) - Vulnerable (TSC Act 1995);
- Common planigale (*Planigale maculata*) - Vulnerable (TSC Act 1995);
- Long-nosed potoroo (*Potorous tridactylus*) - Vulnerable (TSC Act 1995);
- Black flying-fox (*Pteropus alecto*) - Vulnerable (TSC Act 1995); and
- Common blossom bat (*Syconycteris australis*) - Vulnerable (TSC Act 1995).

The known locations of Threatened fauna sightings adjacent to the subject site are shown in **FIGURE 30.**

It is worth noting that suitable habitat for Threatened fauna to be removed from the subject site occurs within existing 2(c) zoned land (i.e. Urban Expansion), land proposed to be rezoned as 2(c), or land that may otherwise be cleared in accordance with existing use rights.

A summary of impacts for each species recorded on and adjacent to the subject site is provided in **TABLE 9.**

**TABLE 9**
**POTENTIAL LOSS OF THREATENED FAUNA HABITAT FROM THE PROPOSED DEVELOPMENT**

| Species | Existing habitat (ha) | Existing Approved Areas | | | | Non-Approved Areas | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Retained Areas | | | Habitat Loss (ha) | Retained Areas | | | Habitat Loss (ha) |
| | | Habitat Retained (ha) | Breakdown of Retained Areas | | | Habitat Retained (ha) | Breakdown of Retained Areas | | |
| | | | Open Space (ha) | Environmental Protection (ha) | | | Open Space (ha) | Environmental Protection (ha) | |
| Wallum froglet | 82.86 | 0.08 | 0.08 | 0.00 | 37.05 | 39.07 | 36.86 | 2.22 | 6.65 |
| Black-necked stork | 142.47 | 0.21 | 0.21 | 0.00 | 37.47 | 93.77 | 85.31 | 8.46 | 11.01 |
| Powerful owl | 64.36 | 44.48 | 5.76 | 38.71 | 17.41 | 2.30 | 2.21 | 0.09 | 0.20 |
| Osprey* | - | - | - | - | - | - | - | - | - |
| Koala | 39.27 | 30.03 | 4.82 | 25.2 | 9.24 | 0.00 | 0.00 | 0.00 | 0.00 |
| Grey-headed flying-fox | 82.11 | 46.42 | 6.97 | 39.44 | 21.95 | 13.58 | 3.47 | 10.13 | 0.20 |
| Little bent-wing bat[1] | 74.42 | 45.73 | 6.97 | 38.75 | 21.32 | 6.84 | 6.58 | 0.26 | 0.57 |
| Common bent-wing bat[1] | 74.42 | 45.73 | 6.97 | 38.75 | 21.32 | 6.84 | 6.58 | 0.26 | 0.57 |
| Eastern little mastiff bat[1] | 74.42 | 45.73 | 6.97 | 38.75 | 21.32 | 6.84 | 6.58 | 0.26 | 0.57 |
| Yellow-bellied sheathtail bat[1] | 74.42 | 45.73 | 6.97 | 38.75 | 21.32 | 6.84 | 6.58 | 0.26 | 0.57 |
| Greater broad-nosed bat[1] | 74.42 | 45.73 | 6.97 | 38.75 | 21.32 | 6.84 | 6.58 | 0.26 | 0.57 |
| Wallum sedge frog | 40.12 | 0.08 | 0.08 | 0.00 | 0.99 | 33.21 | 31.00 | 2.21 | 5.83 |
| Bush hen | 1.78 | 1.07 | 1.07 | 0.00 | 0.19 | 0.51 | 0.51 | 0.00 | 0.00 |
| Glossy black-cockatoo | 53.00 | 42.37 | 4.85 | 37.51 | 8.90 | 1.54 | 1.51 | 0.03 | 0.20 |
| Brolga | 142.47 | 0.21 | 0.21 | 0.00 | 37.47 | 93.77 | 85.31 | 8.46 | 11.01 |
| Black bittern | 11.01 | 0.2 | 0 | 0.2 | 2.01 | 8.58 | 0.97 | 7.62 | 0.22 |

| Species | Existing habitat (ha) | Existing Approved Areas | | | | Non-Approved Areas | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Retained Areas | | | | Retained Areas | | | |
| | | Habitat Retained (ha) | Breakdown of Retained Areas | | Habitat Loss (ha) | Habitat Retained (ha) | Breakdown of Retained Areas | | Habitat Loss (ha) |
| | | | Open Space (ha) | Environmental Protection (ha) | | | Open Space (ha) | Environmental Protection (ha) | |
| Mangrove honeyeater | 5.66 | 0.00 | 0.00 | 0.00 | 0.00 | 5.66 | 0.25 | 5.41 | 0.00 |
| White-eared monarch | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Wompoo fruit-dove | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Rose-crowned fruit-dove | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Superb fruit-dove | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Collared kingfisher | 5.66 | 0.00 | 0.00 | 0.00 | 0.00 | 5.66 | 0.25 | 5.41 | 0.00 |
| Eastern grass owl | 2.48 | 0.00 | 0.00 | 0.00 | 0.00 | 2.48 | 0.28 | 2.21 | 0.00 |
| Large-footed myotis | | | | | | | | | |
| Eastern long-eared bat | 11.23 | 1.76 | 1.07 | 0.69 | 0.82 | 8.64 | 0.97 | 7.67 | 0.00 |
| Squirrel glider | 66.08 | 46.06 | 6.65 | 39.4 | 9.89 | 9.93 | 2.23 | 7.7 | 0.2 |
| Common planigale | 77.31 | 47.82 | 7.72 | 40.09 | 10.71 | 18.57 | 3.2 | 15.37 | 0.2 |
| Long-nosed potoroo[#] | - | - | - | - | - | - | - | - | - |
| Black flying-fox | 82.11 | 46.42 | 6.97 | 39.44 | 21.95 | 13.58 | 3.47 | 10.13 | 0.20 |
| Common blossom bat | 3.80 | 0.00 | 0.00 | 0.00 | 3.80 | 0.00 | 0.00 | 0.00 | 0.00 |

***** Nesting habitat only

[#] Habitat adjacent to the subject site only

[1] Forage habitat for these species has been calculated based on more suitable habitat (i.e. forested areas). Other areas of the site (i.e. open areas) may also be utilised for foraging purposes on occasions but have not been included in this calculation.

A discussion of amelioration measures to reduce potential impacts on Threatened fauna species is included below.

**Wallum froglet**

The NPWS database (October 2008) contains eleven (11) records of this species within 10 km of the Subject site. One hundred and seventy-eight (178) records occur within the Tweed LGA. Wallum froglets have been recorded within Paperbark areas, sedgelands and in the main drainage channel and adjacent sedgeland in the east of the property (**FIGURE 31**). This species has also been recorded in a numerous locations adjacent to the subject site (EcoPro 2004) and is very widespread. The local population is estimated to comprise approximately 10,000 individuals (Hero *et al.* 2001).

Core habitat for this species is considered to be comprised of undisturbed wet heathland and wetland communities on and adjacent to the subject site whilst remaining habitats (i.e. adjoining areas of grassland and slashed areas) are considered to provide forage habitat when inundated during wet periods (**FIGURE 31**). It is estimated that approximately 82.86 hectares of forage habitat occurs on the subject site during suitable conditions (i.e. localised flooding after periods of heavy rainfall).

The proposed development may result in direct mortality to individuals of this species during construction due to habitat loss and/or being run over by machinery. However, the loss of some individuals and habitat of this widespread species during construction is unlikely to significant impact upon the local population of Wallum froglets. The proposed development will not remove or modify any area considered to provide core habitat for the Wallum froglet (i.e. breeding habitat, refuge habitat).

Approximately 43.7 hectares (52.7%) of potential forage habitat will be removed from the subject site. This loss of forage habitat is comprised of 37.05 hectares from areas of the site with existing development approvals, and 6.65 hectares from areas of the site without existing development approval.

Additional impacts may include:

- Alteration of water quality in drainage lines due to soil runoff from the construction site.
- Alteration of hydrology of the drainage lines due to construction.
- Contamination or reduction of water quality in drainage lines due to runoff from chemicals or debris (fertilisers, etc).
- Introduction of weed species into core habitat areas.
- Increased competition from disturbance-adapted native, domestic and introduced fauna (such as Cane toads, Noisy miners, foxes, dogs, cats, rats, etc.).

An area in the central portion of the subject site will be rehabilitated in accordance with a Freshwater Wetland Rehabilitation Plan (**VOLUME 8**). This area will be designed to provide approximately 5.82 hectares of additional habitat for the Wallum froglet on the subject site. Furthermore, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site (**FIGURE 28**) in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and these areas are likely to provide

suitable forage habitat for this species and offset any loss of forage habitat. Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.

A detailed Stormwater Management Plan has been prepared for the subject site (Gilbert & Sutherland 2008) utilising current best-practice management techniques which will ensure no adverse impacts on the hydrology of the current core habitat and the proposed rehabilitated freshwater wetland. Furthermore any stormwater treatment devices and sedimentation ponds will be designed so that they provide limited opportunities for the introduced Mosquito fish (*Gambusia* sp.) to breed and hence provide better habitat for native frogs.

It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Black-necked Stork**

The NPWS database (October 2008) contains thirty-two (32) records of this species within 10 km of the Subject site. Eighty-five (85) records occur within the Tweed LGA. This species has been recorded foraging within the low-lying eastern and south-eastern portions of the subject site (**FIGURE 29**). The proposed development will not result in significant disturbance to or the removal of habitat for this species within the wetland area located in the south-eastern portion of the site. It is estimated that approximately 142.47 hectares of forage habitat occurs on the subject site during suitable conditions (i.e. localised flooding after periods of heavy rainfall).

Approximately 48.48 hectares (34%) of potential forage habitat will be removed from the subject site. This loss of forage habitat is comprised of 37.47 hectares from areas of the site with existing development approvals, and 11.01 hectares from areas of the site without existing development approval. Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species.

An area in the central portion of the subject site will be rehabilitated in accordance with a Freshwater Wetland Rehabilitation Plan (**VOLUME 8**). This area will provide approximately 5.82 hectares of additional habitat for the Black-necked stork on the subject site. Furthermore, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site (**FIGURE 28**) in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas are likely to provide suitable forage habitat for this species and offset any loss of forage habitat.

Additionally, 93.3 hectares of vegetation within the south-eastern portion of the subject site will be retained and rehabilitated in accordance with the Saltmarsh Rehabilitation Plan (**VOLUME 3**). This area currently provides suitable forage habitat for the Black-necked stork and will continue to do so in the long term. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Powerful Owl**

The NPWS database (October 2008) contains no records of this species within 10 km of the Subject site. Seventeen (85) records occur within the Tweed LGA. The Powerful owl was recorded in the north-eastern portion of the subject site (**FIGURE 29**) in 1994 (Warren 1994). A survey completed by Debus (1994) did not confirm the presence of this species. However, Debus indicated that this absence following the breeding season is consistent with the seasonal shift in the use of different parts of the species' large home range.

These owls were again recorded during November 1997 in the Blackbutt Open Forest in the north-eastern portion of the site (Woodward-Clyde 1997). Further spotlighting and call playback surveys of the subject site (JWA 2000 – 2007) have failed to record this species.

The primary threat to this species and its habitat is the loss and modification of forest and old growth elements, especially trees supporting large nest hollows and areas supporting high densities of prey populations (Debus and Chafer 1994).

This species may potentially forage over the majority of the subject site however it is estimated that approximately 64.36 hectares of better quality forage habitat (i.e. more mature forest and woodland communities) occurs on the subject site. The development will result in the loss of approximately 17.61 hectares of potential habitat for the Powerful owl (approximately 27.36% of available habitat). This loss relates to the clearing of 17.41 hectares from areas of the site with existing development approvals, and 0.20 hectares from areas of the site without existing development approval.

Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species. This species is able to live in disturbed coastal forest (Debus 1994). Loss of Sclerophyll forest and woodland may reduce the availability of arboreal and terrestrial mammalian prey for this species however loss of vegetation from the subject site will approximate to only 2-3% of the estimated home range of a Powerful owl.

The proposed retention of large areas of intact forest is likely to result in the continued foraging of this species on the subject site. Furthermore, approximately 59.5ha of revegetation/regeneration will be completed in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) to offset any loss of remnant bushland and to provide vegetated links across the site. Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas are all likely to provide suitable forage habitat for the Powerful owl in the long-term.

Retention of old growth trees will also provide continued nesting opportunities for this species. Additionally, the installation of nest boxes of a suitable size for owls within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will improve the habitat values of the site for this species and encourage the use of site habitats for nesting purposes. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Masked Owl**

The NPWS database (October 2008) contains two (2) records of this species within 10 km of the Subject site. Five (5) records occur within the Tweed LGA. The Masked owl was recorded in the north-eastern portion of the subject site (**FIGURE 29**) in 1994 (Debus 1994). Further spotlighting and call playback surveys of the subject site (JWA 2000 – 2007) have failed to record this species. A number of unconfirmed records of this species occurred during survey of adjacent lands to the east (EcoPro 2004). This species is typically recorded in dry sclerophyll forest and woodland, but also occasionally forages over open or partly cleared country.

This species may potentially forage over the majority of the subject site however, it is estimated that approximately 64.36 hectares of better quality forage habitat occurs on the subject site comprised of mature dry sclerophyll forests and woodlands. It is noted that this species will also forage over open areas (i.e. grasslands etc.) however these areas are not considered to form a significant component of the habitat for this species.

The development will result in the loss of approximately 17.61 hectares of potential forage habitat for the Masked owl (approximately 27.36% of available habitat). This loss relates to the clearing of 17.41 hectares from areas of the site with existing development approvals, and 0.20 hectares from areas of the site without existing development approval. This species may also be susceptible to road-strike, as birds often forage along roadsides or use roads to move between foraging sites (Debus and Rose 1994).

Loss of Sclerophyll forest may reduce the availability of arboreal and terrestrial mammalian prey for this species however loss of vegetation from the subject site will approximate to only 2%-3% of the estimated home range of a Masked owl.

This species roosts and breeds primarily in wet sclerophyll forested gullies, favouring large roomy hollows for nesting. Nests have been located in both live and dead eucalypts. Roost sites are also typical in mature eucalypts bearing large hollows. It is considered that the proposed development will not remove any suitable nesting or roosting habitat.

Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species. As with the Powerful owl this species is able to live in disturbed coastal forest (Debus 1994). The owls appear to favour a complex local mosaic of dense and sparse tree and ground cover and a high density of old hollow trees. This species will persist in disturbed environments as long as existing and potential nest trees are retained, and suitable areas of forested or woodland areas are conserved so as to conserve prey species (Woodward-Clyde 1997).

The proposed retention of large areas of intact forest is likely to result in the continued foraging of this species on the subject site. Furthermore, approximately 59.5ha of revegetation/regeneration will be completed in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) to offset any loss of remnant bushland and to provide vegetated links across the site. Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll

forest species. These areas are all likely to provide suitable forage habitat for the Masked owl in the long-term.

Retention of old growth trees will also provide nesting opportunities for this species. Additionally, the installation of nest boxes of a suitable size for owls within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will improve the habitat values of the site for this species and encourage the use of site habitats for nesting purposes. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Osprey**

The NPWS database (October 2008) contains one hundred and seventy-six (176) records of this species within 10 km of the Subject site. Four hundred (400) records occur within the Tweed LGA.

It is expected that impacts of the proposed development will be restricted to human disturbance near any nest site. A nest site on a power pole was discovered in the south – east of the site (JWA 2006) away from any future development areas (**FIGURE 32**). Two (2) Ospreys have subsequently been observed in the nest on several separate occasions (2006 – 2008). A 100m buffer area has been designated around this nest (**FIGURE 32**) and it is considered that the proposed development will have little impact on this nest site. It is considered however, that this nest site will not be suitable for use in the long-term. The developer is therefore committed to erecting at least two (2) artificial nesting platforms on the site (**FIGURE 32**). It is well known that these platforms are highly successful.

It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Koala**

The NPWS database (October 2008) contains twenty-six (26) records of this species within 10 km of the Subject site. Five hundred and thirty-three (533) records occur within the Tweed LGA.

The site contains a number of tree species listed under Schedule 2 of the TSC Act (1995) as Koala feed tree species. These include:

- Tallowwood;
- Swamp mahogany;
- Blackbutt;
- Forest red gum; and
- Scribbly gum.

Warren (1994) completed a targeted search on the Subject site for evidence of Koala activity (i.e. scratches and scats). A small number of faecal pellets were recorded and a low density of scratches on Grey gums and Tallowwoods were observed throughout the site.

More recently (December 2007), areas of the site containing preferred Koala food trees (i.e. Swamp mahogany, Forest red gum, Tallowwood, Grey gum) were searched for evidence of Koala activity. Two (2) scientists spent approximately twelve (12) hours on this component of the assessment. A nocturnal survey was also completed including spotlighting and call playback techniques. Approximately eight (8) hours was spent on this component of the assessment. No conclusive evidence of Koala activity (scats) was recorded from the site. Whilst a number of trees contained scratch marks, this is not considered a conclusive method of identifying Koala activity when not accompanied by scats and may be attributable to other more common arboreal species (i.e. Common brushtail possum). One (1) male Koala was heard calling approximately 200-300m north of the south-western corner of the subject site (**FIGURE 29**).

It is considered that Koalas may utilise the site occasionally as they disperse throughout the locality, however large areas of more suitable habitat is considered to occur throughout the locality (particularly within intact forested areas to the west) and are likely to be preferred by the local population of Koalas.

It is estimated that approximately 39.27 hectares of potential Koala habitat occurs on the subject site. Approximately 9.24 hectares (23.5%) of potential forage habitat will be removed from the subject site all of which will be removed from areas of the site with existing development approvals.

Additional impacts of the proposed development on Koalas include:

- Increased risk of death or injury from vehicle strike;
- Risk of harassment, death or injury from straying dogs;
- Risk of drowning in swimming pools; and
- Opportunities for Koala movement over the site may be restricted.

The majority of vegetation communities which provide suitable habitat for the Koala on the subject site will be retained (**FIGURE 21**). Furthermore, approximately 59.5ha of revegetation/regeneration will be completed in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) to offset any loss of remnant bushland and to provide vegetated links across the site. Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas are all likely to provide suitable forage habitat for the Koala in the long-term and provide vegetated linkages through the landscape (**FIGURE 22**). It is also worth noting that habitat for the Koala will be retained in perpetuity within the adjacent border reserve.

The following amelioration measures should also be considered:

- Traffic movement controls on local roads and awareness signage are to be incorporated into detailed site design.
- Where feasible, box culverts are to be included in road design where they intersect the areas designated as Open Space. These are drainage structures that can function as fauna movement corridors beneath roads.
- Speed on the majority of roads within the development site will be limited to 50 kilometres per hour. Pedestrian crossings planned for these roads will further reduce actual speed. This should significantly reduce Koala road casualties.

- Landowners will be required to control dogs in accordance with relevant Tweed Shire Council by-laws; and
- Swimming pools should be fenced in a manner to restrict access by Koalas.

It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Grey-headed flying-fox**

The NPWS database (October 2008) contains three (3) records of this species within 10 km of the Subject site. One hundred and eighty-four (184) records occur within the Tweed LGA. The Grey-headed flying-fox has been recorded foraging in various locations on and adjacent to the subject site (**FIGURES 29 & 30**). This species is known to roost in rainforest and swamp forest communities. A day-roost site for a small group (15 to 20 individuals) of this species has been recorded from Hidden Valley, to the north-east of the subject site.

The Grey-headed flying-fox forages in rainforests, wet and dry sclerophyll forest, mangroves, fruit orchids and fruiting trees in parks and urban areas. The proposed development has the potential to result in the loss of foraging habitat for this species and reduce the foraging efficiency of any individuals foraging in the Study area.

It is estimated that approximately 82.11 hectares of forage habitat occurs on the subject site for this species. Approximately 22.15 hectares (26.9%) of potential forage habitat will be removed from the subject site. This loss relates to the clearing of 21.95 hectares from areas of the site with existing development approvals, and 0.20 hectares from areas of the site without existing development approval.

Suitable roosting habitat for this species may occur in the rainforest community located on Mt. Woodgee which will be retained. Given the high mobility of this species, the loss of 22.15 hectares of known and potential foraging habitat is not considered significant in relation to the regional distribution of potential foraging habitat for this species. The Grey-headed flying-fox is considered likely to continue foraging within retained areas of vegetation on the site.

Furthermore, 18.18 hectares of Swamp sclerophyll forest will be regenerated/ revegetated on the subject site (**FIGURE 28**) in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas are likely to provide suitable forage habitat for this species and offset the loss of 22.15ha. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Little bent-wing bat & Common bent-wing bat**

The NPWS database (October 2008) contains ten (10) records of the Little bent-wing bat within 10 km of the Subject site. Thirty-six (36) records occur within the Tweed LGA. The NPWS database (October 2008) contains no records of the Common bent-wing bat within 10 km of the Subject site or within the Tweed LGA.

The Little bent-wing bat and Common bent-wing bat forage on insects in forested habitats, and roost in caves, tunnels or similar structures located nearby. The proposed development will result in the loss of some foraging habitat for these species in the open woodland environments of the site, and reduce the foraging efficiency of any individuals foraging in the Study area.

It is estimated that approximately 74.42 hectares of forage habitat occurs on the subject site for these species. Approximately 21.89 hectares (29.4%) of potential forage habitat will be removed from the subject site. This loss relates to the clearing of 21.32 hectares from areas of the site with existing development approvals, and 0.57 hectares from areas of the site without existing development approval.

Given the high mobility of these species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species. No roost habitat will be affected by the proposed development and it is considered that this species will continue to forage over the retained vegetation on the subject site.

Furthermore, approximately 59.5ha of revegetation/regeneration will be completed in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) to offset any loss of remnant bushland and to provide vegetated links across the site. Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas are all likely to provide suitable forage habitat for these species in the long-term. It is considered that the proposed development is highly unlikely to result in the local extinction of these species.

**Eastern little mastiff bat, Yellow-bellied sheathtail bat & Greater broad-nosed bat**

The NPWS database (October 2008) contains no records of the Eastern little mastiff bat within 10 km of the Subject site or within the Tweed LGA.

The NPWS database (October 2008) contains one (1) record of the Yellow-bellied sheathtail bat within 10 km of the Subject site. Three (3) records occur within the Tweed LGA.

The NPWS database (October 2008) contains no records of the Greater broad-nosed bat within 10 km of the Subject site. Two (2) records occur within the Tweed LGA.

It is estimated that approximately 74.42 hectares of forage habitat occurs on the subject site for these species. Approximately 21.89 hectares (29.4%) of potential forage habitat will be removed from the subject site. This loss relates to the clearing of 21.32 hectares from areas of the site with existing development approvals, and 0.57 hectares from areas of the site without existing development approval.

Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species. There will be a minor loss of potential roost sites (i.e. hollow-bearing trees) for these species however the installation of bat boxes within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will increase roosting opportunities for these species. It is considered that these species will continue to utilise retained vegetation for foraging and retained habitat trees for roosting.

Furthermore, approximately 59.5ha of revegetation/regeneration will be completed in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) to offset any loss of remnant bushland and to provide vegetated links across the site. Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas are all likely to provide suitable forage habitat for these species in the long-term. It is considered that the proposed development is highly unlikely to result in the local extinction of these species.

**Wallum sedge-frog**

The NPWS database (October 2008) contains no records of this species within 10 km of the Subject site. Four (4) records occur within the Tweed LGA. This species has been recorded from swamp forest communities adjacent to the subject site on a number of occasions (Warren 1992, Woodward-Clyde 1997, EcoPro 2004) (**FIGURE 30**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

The Wallum sedge frog is dependent on low-nutrient wetlands with acidic waters, and often occurs in swamp forests dominated by Broad-leaved paperbark. It is also found along creeks or in marshy or swampy lowlands with emergent vegetation and reeds. The Wallum sedge frog is one of several species that breeds in water of low pH (3.4 to 4.5). Core habitat for this species is considered to be comprised of undisturbed wet heathland and wetland communities on and adjacent to the subject. The proposed development will not remove or modify any area considered to provide core habitat for the Wallum sedge frog.

It is estimated that approximately 40.12 hectares of potential forage habitat may occur on the subject site during suitable conditions (i.e. localised flooding after periods of heavy rainfall). Approximately 6.82 hectares (16.9%) of this potential forage habitat will be removed from the subject site. This loss of forage habitat is comprised of 0.99 hectares from areas of the site with existing development approvals, and 5.83 hectares from areas of the site without existing development approval.

Proposed rehabilitation works in accordance with a Freshwater Wetland Rehabilitation Plan (**VOLUME 8**) may result in additional habitat for the Wallum sedge frog on the subject site. Furthermore, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site (**FIGURE 28**) in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas may also provide suitable habitat for this species.

A detailed Stormwater Management Plan has been prepared for the subject site (Gilbert & Sutherland 2008) utilising current best-practice management techniques which will ensure no adverse impacts on the hydrology of the current core habitat and the proposed rehabilitated freshwater wetland. Furthermore any stormwater treatment devices and sedimentation ponds will be designed so that they provide limited opportunities for the introduced Mosquito fish (*Gambusia* sp.) to breed and hence provide better habitat for native frogs.

It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Bush hen**

The NPWS database (October 2008) contains three (3) records of this species within 10 km of the Subject site. Twenty-five (25) records occur within the Tweed LGA. This species has been recorded within Swamp mahogany forest at the northern end of the Cobaki Broadwater (EcoPro 2004) (**FIGURE 30**). Critical habitat features for this species appear to be dense vegetation and proximity to water, although it has been recorded some distance from permanent streams on occasions. Extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

Potential habitat for this species is considered to be comprised of lowland rainforest and swamp forest communities with a dense midstorey/groundcover and standing water. It is estimated that approximately 1.78 hectares of potential habitat occurs on the subject site for this species, comprised of isolated patches of lowland rainforest.

The proposed development will result in the removal or modification a total of 0.19 hectares (10.7%) of potential habitat for this species, all of which occurs within portions of the site with existing development approvals. Due to their crepuscular and nocturnal nature, this species is most likely to be active around dusk or during the night. This may place any birds at risk of disturbance by street lighting and night-time traffic. Other impacts may include predation by domestic cats.

Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and Freshwater Wetland Rehabilitation Plan (**VOLUME 8**) will result in the regeneration/revegetation of 18.18 hectares of Swamp sclerophyll forest, 4.81 hectares of Lowland rainforest on floodplain, 9.85 hectares of Lowland rainforest and 5.82 hectares of Freshwater wetland. Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas may also provide suitable habitat for this species and offset any loss of habitat.

The following additional amelioration measures should be considered:

- Traffic movement controls on local roads and awareness signage are to be incorporated into detailed site design
- Landowners should control cats. All animals should reside within fenced enclosures and be on a leash when outside of the enclosure.
- Street lights adjacent to retained habitat areas should be capped. Vegetated buffers and/or dense planted screens will also reduce the impacts of lighting.

It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Glossy black-cockatoo**

The NPWS database (October 2008) contains one (1) record of this species within 10 km of the Subject site. Forty-nine (49) records occur within the Tweed LGA. This species has been recorded from suitable habitat adjacent to the subject site (EcoPro 2004)

(**FIGURE 30**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

Suitable habitat for this species is considered to be comprised of dry and moist sclerophyll forests with an abundance of *Allocasuarina* species. It is estimated that approximately 53.00 hectares of potential forage habitat occurs on the subject site for this species.

The proposed development will result in the removal or modification a total of 9.10 hectares (17.2%) of potential habitat for this species. This loss of potential habitat is comprised of 8.90 hectares from areas of the site with existing development approvals, and 0.20 hectares from areas of the site without existing development approval. Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species.

The proposed development will retain large areas of intact forest that will provide continued foraging resources for this species on the subject site. Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) will result in the regeneration/revegetation of approximately 59.5ha to offset any loss of vegetation and to provide vegetated links across the site. These works will utilise *Allocasuarina* species where possible to provide suitable forage resources for this species.

Additionally, the installation of nest boxes of a suitable size for cockatoos within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will improve the habitat values of the site for this species and encourage the use of site habitats for nesting purposes. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Brolga**

The NPWS database (October 2008) contains no record of this species within 10 km of the Subject site or within the Tweed LGA. This species has been recorded from wetlands adjacent to the subject site (EcoPro 2004) (**FIGURE 30**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

Potential habitat for this species occurs within the low-lying eastern and south-eastern portions of the subject site. The proposed development will not result in disturbance to or the removal of potential habitat for this species within the wetland area located in the south-eastern portion of the site. It is estimated that approximately 142.47 hectares of forage habitat occurs on the subject site during suitable conditions (i.e. localised flooding after periods of heavy rainfall).

Approximately 48.48 hectares (34%) of potential forage habitat will be removed from the subject site. This loss of forage habitat is comprised of 37.47 hectares from areas of the site with existing development approvals, and 11.01 hectares from areas of the site without existing development approval. Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species.

An area in the central portion of the subject site will be rehabilitated in accordance with a Freshwater Wetland Rehabilitation Plan (**VOLUME 8**). This area will provide approximately 5.82 hectares of additional suitable habitat for the Brolga on the subject site. Furthermore, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site (**FIGURE 28**) in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas may provide suitable habitat for this species and offset any loss of habitat.

Additionally, 93.3 hectares of vegetation within the south-eastern portion of the subject site will be retained and rehabilitated in accordance with the Saltmarsh Rehabilitation Plan (**VOLUME 3**). This area currently provides suitable forage habitat for the Brolga and will continue to do so in the long term. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Black bittern**

The NPWS database (October 2008) contains no record of this species within 10 km of the Subject site. Eight (8) records occur within the Tweed LGA. An unconfirmed sighting of this species occurred near the Cobaki Broadwater adjacent to the subject site (EcoPro 2004) (**FIGURE 30**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

Potential habitat for this species occurs within the low-lying eastern and south-eastern portions of the subject site, particularly in association with the Cobaki Broadwater. The proposed development will not result in disturbance to or the removal of potential habitat for this species within the wetland area located in the south-eastern portion of the site.

It is estimated that approximately 11.01 hectares of potential habitat occurs on the subject site for this species. Approximately 2.23 hectares (20.25%) of potential forage habitat will be removed from the subject site. This loss of forage habitat is comprised of 2.01 hectares from areas of the site with existing development approvals, and 0.22 hectares from areas of the site without existing development approval. Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species.

An area in the central portion of the subject site will be rehabilitated in accordance with a Freshwater Wetland Rehabilitation Plan (**VOLUME 8**). This area will provide approximately 5.82 hectares of additional suitable habitat for the Black bittern on the subject site. Furthermore, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site (**FIGURE 28**) in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas may provide suitable habitat for this species and offset any loss of habitat.

It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Mangrove honeyeater**

The NPWS database (October 2008) contains thirteen (13) records of this species within 10 km of the Subject site. Twenty-two (22) records occur within the Tweed LGA. This species has been recorded from mangrove and swamp forest communities adjacent to the subject site (EcoPro 2004) (**FIGURE 30**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

Suitable habitat for this species is considered to be comprised of undisturbed mangrove and wetland communities on and adjacent to the subject site. Potential habitat for this species occurs within the low-lying eastern and south-eastern portions of the subject site, particularly in association with the Cobaki Broadwater. It is estimated that approximately 5.66 hectares of potential habitat for this species occurs on the subject site. The proposed development will not result in disturbance to or the removal of potential habitat for this species. Overall, impacts on this species are considered to be relatively low.

Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) will result in the regeneration/revegetation of 18.18 hectares of Swamp sclerophyll forest. Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas may also provide suitable habitat for this species.

Additionally, 93.3 hectares of vegetation within the south-eastern portion of the subject site will be retained and rehabilitated in accordance with the Saltmarsh Rehabilitation Plan (**VOLUME 3**). This area currently provides stands of mangrove vegetation suitable as forage habitat for the Mangrove honeyeater and will continue to do so in the long term. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**White-eared monarch**

The NPWS database (October 2008) contains two (2) records of this species within 10 km of the Subject site. Forty-eight (48) records occur within the Tweed LGA. This species has been recorded from rainforest communities adjacent to the subject site (EcoPro 2004) (**FIGURE 30**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

Suitable habitat for this species is considered to be comprised of undisturbed rainforest communities associated with Mt Woodgee on and adjacent to the subject site. It is estimated that approximately 11.23 hectares of potential forage habitat occurs on the subject site for the White-eared monarch. Approximately 0.82 hectares (7.3%) of potential forage habitat will be removed from the subject site all of which will be removed from areas of the site with existing development approvals. Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species.

Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) will result in the regeneration/revegetation of 4.81 hectares of Lowland rainforest on floodplain and 9.85 hectares of Lowland rainforest. These areas may provide suitable habitat for this species and offset any loss of habitat. It is considered

that the proposed development is highly unlikely to result in the local extinction of this species.

**Wompoo fruit-dove, Rose-crowned fruit-dove & Superb fruit-dove**

The NPWS database (October 2008) contains no records of the Wompoo fruit-dove within 10 km of the Subject site. Sixty-six (66) records occur within the Tweed LGA.

The NPWS database (October 2008) contains two (2) records of the Rose-crowned fruit-dove within 10 km of the Subject site. Twenty-eight (28) records occur within the Tweed LGA.

The NPWS database (October 2008) contains no records of the Superb fruit-dove within 10 km of the Subject site. Two (2) records occur within the Tweed LGA.

The Wompoo fruit-dove and Rose-crowned fruit-dove have been recorded from rainforest and swamp forest communities adjacent to the subject site, and an unconfirmed sighting of the Superb fruit-dove also occurred (EcoPro 2004) (**FIGURE 30**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record these species.

Suitable habitat for the fruit-doves is considered to be comprised of undisturbed rainforest communities associated with Mt Woodgee on and adjacent to the subject site. It is estimated that approximately 11.23 hectares of potential forage habitat occurs on the subject site for these species. Approximately 0.82 hectares (7.3%) of potential forage habitat will be removed from the subject site all of which will be removed from areas of the site with existing development approvals. Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species.

Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) will result in the regeneration/revegetation of 4.81 hectares of Lowland rainforest on floodplain, 9.85 hectares of Lowland rainforest and 18.18 hectares of Swamp sclerophyll forest. Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas may provide additional suitable habitat for these species and offset any loss of habitat.

It is considered that the proposed development is highly unlikely to result in the local extinction of these species.

**Collared kingfisher**

The NPWS database (October 2008) contains ten (10) records of the Rose-crowned fruit-dove within 10 km of the Subject site. Fifty-eight (58) records occur within the Tweed LGA. This species has been recorded from the Cobaki Broadwater adjacent to the subject site (EcoPro 2004) (**FIGURE 30**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

Suitable habitat for this species is considered to be comprised of undisturbed mangrove communities on and adjacent to the subject site. Potential habitat for this species

occurs within the low-lying eastern and south-eastern portions of the subject site, particularly in association with the Cobaki Broadwater. It is estimated that approximately 5.66 hectares of potential habitat for this species occurs on the subject site. The proposed development will not result in disturbance to or the removal of potential habitat for this species. Overall, impacts on this species are considered to be relatively low and it is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Eastern grass owl**

The NPWS database (October 2008) contains one (1) record of this species within 10 km of the Subject site. Twenty-four (24) records occur within the Tweed LGA. An individual Eastern grass owl was recorded in sedgeland at the southern end of the airport runway, adjacent to the subject site (EcoPro 2004) (**FIGURE 30**). However, extensive searches on the subject site (JWA 2000 – 2007) have failed to record this species.

This species has been recorded inhabiting coastal and inland grasslands, coastal heath, agricultural crops and swamp margins (NSW State Forests 1995; Shields 1995). Primary breeding habitat appears to be dense, secluded grass tussock swards, sometimes near water (NSW State Forests 1995). It hunts nocturnally, feeding mainly on rodents. However birds, insects, frogs and reptiles are also consumed (Shields 1995). Nesting occurs in trodden-down grass under bushes or tussocks.

This species may forage over the low-lying eastern portions of the subject site. Potential nesting/roost habitat for this species also occurs within the low-lying eastern and south-eastern portions of the subject site. It is estimated that approximately 2.48 hectares of potential nesting/roost habitat for this species occurs on the subject site. The proposed development will not result in disturbance to or the removal of potential nesting/roost habitat for this species.

Given the high mobility of this species, the loss of potential foraging habitat on the subject site is not considered significant in relation to the regional distribution of potential foraging habitat for this species.

Increased vehicular traffic on the subject site may result in the increased risk of vehicular strike. In the vicinity of Ballina in northern NSW birds are often recorded as road kills along the edge of the Pacific Highway, suggesting that they may use the road verge for foraging (Maciejewski 1996).

Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) will result in the regeneration/revegetation of 18.18 hectares of Swamp sclerophyll forest. These areas may also provide suitable habitat for this species and offset any loss of habitat.

It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Large-footed myotis**

The NPWS database (October 2008) contains one (1) record of this species within 10 km of the Subject site. Thirteen (13) records occur within the Tweed LGA. This species has been recorded during surveys adjacent to the subject site (EcoPro 2004) (**FIGURE 30**). However, numerous surveys on the subject site (JWA 2000 – 2007) have failed to record this species.

Large-footed myotis generally roost close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage. They forage over streams and pools catching insects and small fish. Potential forage habitat for this species is generally restricted to the adjacent Cobaki Broadwater and the large farm dam in the south-western portion of the site. The proposed development will not result in disturbance to or the removal of potential habitat for this species. Overall, impacts on this species are considered to be relatively low.

The proposed construction of a number of large lakes covering a total area of approximately 14.1ha is likely to provide suitable forage habitat for this species. The retention of large areas of intact forest communities, including a number of old growth trees, will continue to provide potential roost sites. Additionally, the installation of bat boxes within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will improve the habitat values of the site for this species and encourage the use of site habitats for roosting purposes. It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

**Eastern long-eared bat**

The NPWS database (October 2008) contains three (3) records of this species within 10 km of the Subject site. Sixteen (16) records occur within the Tweed LGA. This species has been recorded from rainforest communities adjacent to the subject site (EcoPro 2004) (**FIGURE 30**). However, numerous surveys on the subject site (JWA 2000 – 2007) have failed to record this species.

Suitable habitat for the Eastern long-eared bat is considered to be comprised of lowland subtropical rainforest and swamp sclerophyll forest. This species roosts in hollows in trees and also in the hanging foliage of palms, in dense clumps of foliage of rainforest trees and under bark. It forages within structurally complex forests. It is estimated that approximately 11.23 hectares of potential forage habitat occurs on the subject site for this species, comprised of the intact rainforest community associated with Mt Woodgee, and smaller isolated rainforest patches.

Approximately 0.82 hectares (7.3%) of potential forage habitat will be removed from the subject site, all of which will be removed from areas of the site with existing development approvals. Given the high mobility of this species, the loss of a small area of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species. The retention of large areas of intact forest communities, including a number of old growth trees, will continue to provide potential roost sites.

Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) will result in the regeneration/revegetation of 4.81 hectares of Lowland rainforest on floodplain, 9.85 hectares of Lowland rainforest and 18.18 hectares of Swamp sclerophyll forest. Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas may provide additional suitable habitat for this species and offset any loss of habitat.

The installation of bat boxes within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) may also improve the habitat values of the site for this species and encourage the use of site habitats for roosting purposes. It is considered that the proposed development is highly unlikely to result in the local extinction of these species.

**Squirrel glider**

The NPWS database (October 2008) contains no records of this species within 10 km of the Subject site. Three (3) records occur within the Tweed LGA. This species has been recorded from forest communities adjacent to the subject site (EcoPro 2004) (**FIGURE 30**). However, numerous surveys on the subject site (JWA 2000 – 2007) have failed to record this species.

Suitable habitat for the Squirrel glider is considered to be comprised of mature dry sclerophyll and wet sclerophyll forests with abundant hollows for refuge and den sites. It is estimated that approximately 66.08 hectares of potential forage habitat occurs on the subject site for this species.

In total 10.09 hectares (15.3%) of potential habitat (i.e. remnant bushland with hollow-bearing trees) will be lost from the subject site. The majority of habitat to be removed occurs within portions of the site with existing development approval (i.e. 9.89 hectares) whilst a small area will be removed from areas without current development approvals (i.e. 0.2 hectares). The loss of potential habitat on the subject site is not considered significant in relation to the regional distribution of habitat for this species.

The Site Regeneration and Revegetation Plan (**VOLUME 5**) outlines the various measures to ensure that the retained remnant vegetation is adequately managed. Approximately 59.5ha of revegetation/regeneration will be completed in accordance with this plan to offset any loss of remnant bushland and to provide vegetated links across the site.

The retention of large areas of intact forest communities, including a number of old growth trees, will continue to provide potential roost sites. Additionally, the installation of nest boxes within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will improve the habitat values of the site for this species and encourage the use of site habitats for denning purposes.

It is considered that the proposed development is highly unlikely to result in the local extinction of these species.

**Common planigale**

The NPWS database (October 2008) contains four (4) records of this species within 10 km of the Subject site. Twenty-six (26) records occur within the Tweed LGA. This species has been recorded from a very small area (i.e. about 1 hectare) consisting of Swamp Mahogany-Brushbox Forest and adjacent habitats adjacent to the subject site (EcoPro 2004) (**FIGURE 30**). However, numerous surveys on the subject site (JWA 2000 – 2007) have failed to record this species.

Suitable habitat for the Common planigale is considered to be comprised of mature rainforest, eucalypt forest and heathland on and adjacent to the subject site. It is estimated that approximately 77.31 hectares of potential forage habitat occurs on the subject site for these species.

In total 10.91 hectares (14.1%) of potential habitat will be lost from the subject site. The majority of habitat to be removed occurs from portions of the site with existing development approval (i.e. 10.71 hectares) whilst a small area will be removed from areas without current development approvals (i.e. 0.2 hectares). The loss of potential habitat is not considered significant in relation to the regional distribution of habitat for this species.

This species would be particularly susceptible to predation by cats and dogs.

The Site Regeneration and Revegetation Plan (**VOLUME 5**) outlines the various measures to ensure that the retained remnant vegetation is adequately managed. Approximately 59.5ha of revegetation/regeneration will be completed in accordance with this plan to offset any loss of vegetation and to provide vegetated links across the site.

The retention of large areas of intact forest communities, including a number of old growth trees, will continue to provide potential habitat for this species. Additionally, the installation of nest boxes within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will improve the habitat values of the site for this species and encourage the use of site habitats for denning purposes.

Landowners will be required to control cats and dogs in accordance with relevant Tweed Shire Council by-laws.

It is considered that the proposed development is highly unlikely to result in the local extinction of these species.

**Long-nosed potoroo**

The NPWS database (October 2008) contains three (3) records of this species within 10 km of the Subject site. Eight (8) records occur within the Tweed LGA. It is also worth noting that the Long-nosed potoroo population adjacent to the subject site has been listed as an Endangered Population.

A small disjunct population of Long-nosed potoroos has been recorded adjacent to the north-eastern corner of the subject site (Warren 1992, Woodward-Clyde 1997, EcoPro 2004) (**FIGURE 30**). However, numerous surveys on the subject site (Warren 1992,

1993, Woodward-Clyde 1997, Parker 1999, JWA 2000 – 2007) and within the border reserve to the north and north-west of the subject site (JWA 2000 – 2007), have failed to record this species.

Suitable habitat for the Long-nosed potoroo is considered to be comprised of heathland and dry and wet sclerophyll forests with a dense understorey adjacent to the north-eastern boundary of the subject site. A sandy loam soil is also a common feature. The proposed development will not result in disturbance to or the removal of potential habitat for this species. This species has historically been recorded from the north and south of the existing site access road, which has essentially formed two small sub-populations. Without mitigation, road kills may significantly affect these populations. Predation by domestic cats and dogs is also a potential impact of the development.

The Site Regeneration and Revegetation Plan (**VOLUME 5**) outlines the various measures to ensure that the retained remnant vegetation is adequately managed. Approximately 59.5ha of revegetation/regeneration will be completed in accordance with this plan to offset any loss of vegetation and to provide vegetated links across the site.

It is recommended that the construction of the main access road into the Cobaki Lakes development incorporates a number of underpasses/culverts to encourage movements of potoroos between the two identified sub-populations. Landowners will be required to control cats and dogs in accordance with relevant Tweed Shire Council by-laws. Predator control fencing along the interface of the development site and potoroo habitat is also recommended. With the adoption of these amelioration measures, it is unlikely that the proposed development will result in the extinction of this Endangered Population.

**Black flying-fox**

The NPWS database (October 2008) contains no records of this species within 10 km of the Subject site or within the Tweed LGA. This species has been recorded from rainforest and swamp forest communities adjacent to the subject site (EcoPro 2004) (**FIGURE 30**). The proposed development has the potential to result in the loss of foraging habitat for this species and reduce the foraging efficiency of any individuals foraging in the Study area.

It is estimated that approximately 82.11 hectares of forage habitat occurs on the subject site for this species. Approximately 22.15 hectares (26.9%) of potential forage habitat will be removed from the subject site. This loss relates to the clearing of 21.95 hectares from areas of the site with existing development approvals, and 0.20 hectares from areas of the site without existing development approval.

Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species. Suitable roosting habitat for this species may occur in the rainforest community located on Mt. Woodgee which will be retained. The Black flying-fox is considered likely to continue foraging within retained areas of vegetation on the site.

Furthermore, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site (**FIGURE 28**) in accordance with the Site

Regeneration and Revegetation Plan (**VOLUME 5**) and 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas are likely to provide suitable forage habitat for this species and offset any loss of habitat.

It is considered that the proposed development is highly unlikely to result in the local extinction of these species.

**Common blossom bat**

The NPWS database (October 2008) contains no records of this species within 10 km of the Subject site. Twenty-three (23) records occur within the Tweed LGA. This species has been recorded during surveys of land adjacent to the subject site (EcoPro 2004) (**FIGURE 30**). However, numerous surveys on the subject site (JWA 2000 – 2007) have failed to record this species.

Common blossom-bats often roost in littoral rainforest and feed on flowers in adjacent heathland and paperbark swamps. Potential forage habitat for this species occurs in the low-lying eastern portion of the subject site. The proposed development will result in the removal or modification a total of 3.8 hectares of Swamp sclerophyll forest on floodplain. Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species.

Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) will result in the regeneration/revegetation of 18.18 hectares of Swamp sclerophyll forest. Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas may provide additional suitable forage habitat for this species and offset any loss of habitat.

It is considered that the proposed development is highly unlikely to result in the local extinction of these species.

# 4.5 Provide a description of the proposed treatment of any ecological buffers

### *4.5.1 Introduction*

This section will describe the various treatments of ecological buffers on the subject site and will include details on the interactions of ecological buffers with the following:

1. Threatened flora species;
2. Endangered Ecological Communities;
3. Retained remnant bushland areas;
4. Stormwater treatment areas;
5. Asset Protection Zones; and
6. Environmental restoration and enhancement works.

### *4.5.2 Proposed buffers*

4.5.2.1 Buffers to Threatened flora

The locations of Threatened flora species on the subject site are shown in **FIGURES 23, 23a & 23b** and have been described within Section 4.2.5.2 of this report. A large proportion of Threatened species on the subject site occur within the rainforest communities associated with Mt. Woodgee in the northern portion of the subject site, or in areas of the subject site otherwise designated for retention (**FIGURES 25, 25a & 25b**).

A Vegetation Management Plan has been prepared for the subject site (**VOLUME 6**) and discusses measures to be implemented to protect Threatened flora species during the construction phase. The Mt. Woodgee remnant will be conserved and buffered by a minimum of 10 metres of planted vegetation to ameliorate the potential impacts of adjacent development (in accordance with the Site Regeneration and Revegetation Plan – **VOLUME 5**). The Site Regeneration and Revegetation Plan will also ensure that a minimum five (5) metre revegetated buffer is marked for all known specimens of Threatened flora to be retained, and the cleared parts of these areas are revegetated with locally endemic flora species.

An indicative cross-section of the interface between development and the locations of retained Threatened flora is shown in **FIGURES 33A & 33B**. These areas will be maintained in their natural condition with minimal disturbance, except where the development is sensitive to and consistent with the conservation values of these areas, and undertaken in accordance with an approved management plan.

Allowable uses: No uses will be allowed within this area.

Landscape and Built Form: Maintenance of existing significant vegetation is the primary aim within this area. Management of these areas may also include the replanting of appropriate native species in accordance with an approved Management Plan.

Lot Reconfiguration: No lot reconfiguration is envisaged within this precinct.

#### 4.5.2.2 Buffers to Endangered Ecological Communities

The concept plan has been designed to retain the majority of EEC's on the subject site (**FIGURE 27**). Retained EEC's on the subject site will be buffered by a minimum of 10 metres of vegetation where possible to ameliorate potential impacts of adjacent development (in accordance with the Site Regeneration and Revegetation Plan – **VOLUME 5**). Where sufficient area is not available to provide a 10m buffer (i.e. particularly steep land adjacent to land zoned for development & Cobaki Parkway) a dense screen of vegetation will be planted to minimise edge effects and the interface of the remnant bushland and development will be monitored for weed infestations (in accordance with the Site Regeneration and Revegetation Plan – **VOLUME 5**). A Vegetation Management Plan has been prepared for the subject site (**VOLUME 6**) and discusses measures to be implemented to protect EEC's during the construction phase.

An indicative cross-section of the interface between development and retained EEC's is shown in **FIGURES 33A & 33B**. These areas will be maintained in their natural condition with minimal disturbance, except where the development is sensitive to and consistent with the conservation values of these areas, and undertaken in accordance with an approved management plan.

Allowable uses: No uses will be allowed within this area.

Landscape and Built Form: Maintenance of existing significant vegetation is the primary aim within this area. Management of these areas may also include the replanting of appropriate native species in accordance with an approved Management Plan.

Lot Reconfiguration: No lot reconfiguration is envisaged within this precinct.

#### 4.5.2.3 Buffers to Remnant Bushland

The concept plan has been designed to retain the majority of remnant bushland on the subject site (**FIGURE 18**). These areas will be buffered where possible by a minimum of 10 metres of planted vegetation to ameliorate potential impacts of adjacent development (in accordance with the Site Regeneration and Revegetation Plan – **VOLUME 5**). Where sufficient area is not available to provide a 10m buffer (i.e. particularly steep land adjacent to land zoned for development) a dense screen of vegetation will be planted to minimise edge effects and the interface of the remnant bushland and development will be monitored for weed infestations (in accordance with the Site Regeneration and Revegetation Plan – **VOLUME 5**). A Vegetation Management Plan has been prepared for the subject site (**VOLUME 6**) and discusses measures to be implemented to protect retained vegetation during the construction phase.

In some instances an Asset Protection Zone (APZ) will be required on the interface between retained Remnant Bushland and the development. The treatment of this interface is discussed in Section 4.4.2.5.

An indicative cross-section of the interface between development and retained remnant bushland is shown in **FIGURES 33A & 33B**. These areas will be maintained in their natural condition with minimal disturbance, except where the development is sensitive to and consistent with the conservation values of these areas, and undertaken in accordance with an approved management plan.

Allowable uses: No uses will be allowed within this area.

Landscape and Built Form: Maintenance of existing significant vegetation is the primary aim within this area. Management of these areas may also include the replanting of appropriate native species in accordance with an approved Management Plan.

Lot Reconfiguration: No lot reconfiguration is envisaged within this precinct.

#### 4.5.2.4 Stormwater treatment areas

A detailed Stormwater Management Plan has been prepared for the subject site (Gilbert & Sutherland 2008). The conceptual planning of the urban development proposed for Leda Manorstead's land at Cobaki has followed a constraints-based approach, which recognises:

a) The sensitivity of the receiving environment within the Cobaki Broadwater;
b) The large mosquito breeding areas currently on site; and
c) The major opportunity that the careful rehabilitation of the southern areas could provide by way of an ongoing fisheries habitat contribution to the Broadwater.

Starting from the watershed of each sub-catchment, the stormwater treatment train involves the following measures:

a) Compliance with BASIX;
b) Bioretention devices within constructed swales on slopes <5% and Gross Pollutant traps (GPTs);
c) Sedimentation basins;
d) Constructed wetlands with a minimum 30% soft-edge treatment;
e) Diffuse low-flow discharge ($<Q_{3month}$) and stormwater treatment within the rehabilitation areas;
f) High-flow bypass channels to protect the rehabilitation areas; and
g) Discharge of fully treated water to the Cobaki Broadwater.

North of Sandy Lane would form a predominantly freshwater environment, south, a salt-water regime would prevail. Engineering structures have been designed to maintain drainage, provide flood protection and allow for the effects of climate change.

The locations of Stormwater treatment areas are shown in **FIGURE 34.** All stormwater treatment areas occur within land designated as Open Space and have been designed to provide wetland habitat. These devices and surrounding areas will be revegetated

through a combination of landscaping works and rehabilitation (in accordance with the Site Regeneration and Revegetation Plan - **VOLUME 5**).

#### 4.5.2.5 Asset Protection Zones

The NSW Rural Fire Services guidelines "Planning for Bushfire Protection 2006" list six (6) key Bushfire Protection Measures which in combination must be addressed in a development assessment context. In relation to Asset Protection Zones (APZ's), Table A2.3 in the guidelines classifies the Tweed local council area as having a Forest Danger Index rating of 80 assumed as a 1:50 year event.

Table A2.5 of the guidelines sets the minimum width of APZ's for residential development based on the adjacent forest type. These minimum APZ widths range from 20m (for situations where the slope towards the vegetation ranges from uphill, to a maximum of $5^{o}$ downhill) to 45m (for situations where the adjacent forested slope is up to $18^{o}$ downhill). Requirements for APZ's on the Cobaki Lakes site are shown in **FIGURE 35**.

Asset Protection Zones (APZs) will generally be accommodated within already cleared land unless further clearing is required within existing 2(c) zoned land (i.e. Urban Expansion), land proposed to be rezoned as 2(c), or land that may otherwise be cleared in accordance with existing use rights.

The interface between retained vegetation areas and APZ's will be planted with a dense screen of fire-resistant vegetation to minimise edge effects and will be monitored for weed infestations (in accordance with the Site Regeneration and Revegetation Plan – **VOLUME 5**). There may also be opportunities for revegetation within APZ's with fire-resistant plant species. An indicative cross-section showing the interaction of APZ's with retained vegetation is shown in **FIGURES 33A & 33B.**

#### 4.5.2.6 Environmental restoration and enhancement works

A detailed Site Regeneration and Revegetation Plan has been completed to accompany this Ecological Assessment (**VOLUME 5**). The Site Regeneration and Revegetation Plan outlines the restoration works which are to be completed in the areas of vegetation that will be retained and rehabilitated, including buffer areas (**FIGURE 22**).

The basic principles of the Site Regeneration and Revegetation Plan include:

- Weed control will occur within the Environmental protection areas, open space and any ecological buffers;
- All weed control will be completed using the recommended methods, including poisoning of Camphor laurel, cut and paint of woody weeds and selective spot spraying of any weedy annuals and grasses.
- All herbicide applications will be completed by suitably qualified persons;
- Weed control will be undertaken on a progressive basis over a three (3) – five (5) year period;
- Embellishment plantings are to be used to consolidate each of the Environmental Protection Areas (EPA's). Planting efforts will be divided into moderate planting zones and high density planting zones.

- All revegetation areas will fenced to exclude cattle and reduce native fauna grazing;
- All revegetation will include the planting of native species that are representative of the species composition of the community concerned;
- All of the rehabilitation work is to be completed by qualified bush regenerators;
- A detailed maintenance program for each area will be included which outlines the maintenance to be completed over the next three (3) – five (5) years.
- A detailed monitoring program will be completed by a qualified ecologist. Reports on the progress of the rehabilitation are to be issued to Tweed Shire Council on a quarterly basis.

## 4.6 Assess proposed native vegetation clearing with consideration of potential impacts

### *4.6.1 Introduction*

This section details the extent of native vegetation clearing as a result of the proposed development. The possible direct and indirect impacts of the proposal are outlined, along with proposed offset strategies to ensure that there is no net loss of native vegetation values. The potential impacts on significant vegetation (i.e. remnant bushland, Threatened flora species, EEC's etc.) has been discussed in previous sections of this report.

It is worth noting that the majority of vegetation to be removed will be in accordance with existing DA's and construction certificates.

### *4.6.2 Potential Impacts on Native Vegetation*

The proposed development concept will result in the loss of vegetation for the construction of a town centre, residential dwellings, educational buildings, a business park, access roads, driveways and associated infrastructure. It is worth noting that vegetation to be removed from the subject site occurs within existing 2(c) zoned land (i.e. Urban Expansion), land proposed to be rezoned as 2(c), or land that may otherwise be cleared in accordance with existing use rights. The impact of the proposed development on vegetation communities on the site is shown in **FIGURE 36**.

A summary of vegetation that may be removed and their respective areas is shown in **TABLE 10**. It should be noted that portions of the subject site that have been cleared in accordance with existing development and earthworks approvals (covering 150.22 hectares) have not been included in the following table and calculations.

In total, 197.64 hectares of vegetation occurs within the proposed development footprint the majority of which is comprised of grassland communities. Of this vegetation, 178.88 hectares occur in areas of the site with existing development approvals. The remaining 18.76 hectares occur in areas of the site without existing approvals. As previously mentioned, existing use rights over the subject site would allow for the continued maintenance of drainage lines, fence lines and firebreaks as well as pasture improvement activities throughout the subject site.

The Scribbly gum community (community 8) on the subject site occurs as an isolated stand of trees within the central portion of the subject site (**FIGURE 13**). Specific trees in this community will be retained and protected (in accordance with the Scribbly Gum Management Plan – **VOLUME 4**).

It is also worth noting that the maximum area of vegetation to be lost has been calculated based on the concept plan. There may be opportunities to retain areas of native vegetation within the proposed development footprint and this will be the subject of a detailed assessment at the Development Application stage.

**TABLE 10**
**POTENTIAL VEGETATION LOSS AS A RESULT OF THE PROPOSED DEVELOPMENT**

| Community | TOTAL AREA (ha) | Existing Approved Areas | | | | Non-Approved Areas | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Retained Areas | | | | Retained Areas | | | |
| | | Retained - TOTAL (ha) | Breakdown of Retained Areas | | Loss - TOTAL (ha) | Retained - TOTAL (ha) | Breakdown of Retained Areas | | Loss - TOTAL (ha) |
| | | | Open Space (ha) | Environmental Protection (ha) | | | Open Space (ha) | Environmental Protection (ha) | |
| 1A # | 33.10 | 28.35 | 3.14 | 25.20 | 4.75 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1B | 4.66 | 4.11 | 0.00 | 4.11 | 0.55 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1C | 12.87 | 8.23 | 0.03 | 8.20 | 2.91 | 1.54 | 1.51 | 0.03 | 0.20 |
| 1D | 2.37 | 1.68 | 1.68 | 0.00 | 0.69 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2A | 9.10 | 0.69 | 0.00 | 0.69 | 0.28 | 8.13 | 0.46 | 7.67 | 0.00 |
| 2B | 0.35 | 0.00 | 0.00 | 0.00 | 0.02 | 0.32 | 0.32 | 0.00 | 0.00 |
| 2C | 0.35 | 0.00 | 0.00 | 0.00 | 0.35 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2D # | 1.43 | 1.07 | 1.07 | 0.00 | 0.17 | 0.19 | 0.19 | 0.00 | 0.00 |
| 3 | 2.20 | 1.93 | 0.73 | 1.20 | 0.19 | 0.07 | 0.07 | 0.00 | 0.00 |
| 4 | 2.13 | 0.00 | 0.00 | 0.00 | 2.12 | 0.02 | 0.00 | 0.02 | 0.00 |
| 5 | 2.48 | 0.00 | 0.00 | 0.00 | 0.00 | 2.48 | 0.28 | 2.21 | 0.00 |
| 6 # | 1.91 | 0.18 | 0.14 | 0.04 | 1.60 | 0.14 | 0.00 | 0.14 | 0.00 |
| 7 | 3.80 | 0.00 | 0.00 | 0.00 | 3.80 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | 5.13 | 0.00 | 0.00 | 0.00 | 4.52 | 0.60 | 0.55 | 0.06 | 0.00 |
| 9 | 0.23 | 0.18 | 0.18 | 0.00 | 0.00 | 0.09 | 0.09 | 0.00 | 0.00 |
| 10 | 0.68 | 0.00 | 0.00 | 0.00 | 0.68 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11 | 2.72 | 2.59 | 0.00 | 2.59 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 |
| 12 # | 188.14 | 20.36 | 12.28 | 8.07 | 118.01 | 42.82 | 42.00 | 0.82 | 6.96 |
| 13 # | 53.95 | 0.13 | 0.13 | 0.00 | 0.42 | 49.04 | 48.20 | 0.83 | 4.36 |

| Community | TOTAL AREA (ha) | Existing Approved Areas | | | | Non-Approved Areas | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Retained Areas | | | | Retained Areas | | | |
| | | | Breakdown of Retained Areas | | | | Breakdown of Retained Areas | | |
| | | Retained - TOTAL (ha) | Open Space (ha) | Environmental Protection (ha) | Loss - TOTAL (ha) | Retained - TOTAL (ha) | Open Space (ha) | Environmental Protection (ha) | Loss - TOTAL (ha) |
| 14 # | 36.96 | 0.08 | 0.08 | 0.00 | 0.31 | 30.73 | 30.73 | 0.00 | 5.83 |
| 15 | 5.66 | 0.00 | 0.00 | 0.00 | 0.00 | 5.66 | 0.25 | 5.41 | 0.00 |
| 16 | 2.19 | 0.20 | 0.00 | 0.20 | 1.33 | 0.44 | 0.44 | 0.00 | 0.22 |
| 17 | 4.24 | 0.00 | 0.00 | 0.00 | 0.00 | 3.87 | 3.85 | 0.01 | 0.37 |
| 18 # | 42.74 | 0.00 | 0.00 | 0.00 | 36.06 | 5.86 | 5.85 | 0.01 | 0.82 |
| **TOTAL** | **419.39** | **69.78** | **19.47** | **50.31** | **178.88** | **152.02** | **134.80** | **17.22** | **18.76** |

# Note: Portions of these communities occur within proposed Landscape Areas and additional areas may be lost as a result of landscaping and recreational facilities located within these areas.

Additional impacts on vegetation communities include:

- Clearance of areas of the Subject site represents a loss of habitat available for dispersal for plants and will reduce visits by pollination and dispersal vectors;
- Disturbance to the Subject site creates opportunities for weeds to colonise. Weeds may be introduced to the Study site in construction materials or by vehicles. Occupation of the Subject site creates opportunities for weeds to become established. Landscape species may escape to retained areas of vegetation;
- The removal of vegetation from the Subject site represents the loss of organic material from the site;
- Residents may create walking tracks through bushland areas. This may result in direct loss of vegetation, change in vegetation structure and increased opportunities for weeds and disturbance-adapted animal species; and
- Occupation of the site may increase the risk of fire release into the surrounding bushland.

### *4.6.3 Impacts on Threatened flora*

The potential impacts on Threatened flora species on the subject site have been discussed in Section 4.3.6.3. Seven (7) part tests will completed at the Development Application stage in accordance with the *Threatened Species Conservation Amendment Act 2002*.

### *4.6.4 Proposed Offset strategy to ensure that there is no net loss of native vegetation values.*

The proposed development may result in the loss of native vegetation as discussed within Section 4.4.2. Vegetation communities occurring within the Environmental protection areas will be retained (**FIGURE 9**). Additionally, numerous areas of the site will be revegetated or regenerated (**FIGURE 22**) in accordance with a detailed Site Regeneration and Revegetation Plan (**VOLUME 5**). The Site Regeneration and Revegetation Plan outlines the restoration works which are to be completed in the areas of vegetation that will be retained and rehabilitated.

The basic principles of the Vegetation and Management Plan include:

- Weed control will primarily consist of minor weed control within the Environmental protection areas, open space and any ecological buffers, the SEPP 14 wetland;
- All weed control will be completed using the recommended methods, including poisoning of Camphor laurel, cut and paint of woody weeds and selective spot spraying of any weedy annuals and grasses.
- All herbicide use will be completed by a qualified Bush regenerator;
- Weed control will be undertaken on a progressive basis over a three (3) – five (5) year period;

- Embellishments planting are to be used to consolidate each of the Environmental protection areas (EPA's). Planting efforts will be divided into moderate planting zones and high density planting zones.
- All revegetation areas will fenced to exclude cattle and reduce native fauna grazing;
- All revegetation will included the planting of native species that are representative of the species composition of the community concerned;
- All of the rehabilitation work is to be completed by qualified bush regenerators;
- A detailed maintenance program for each area will be included which outlines the maintenance to be completed over the next three (3) – five (5) years.
- A detailed monitoring program will be completed by a qualified ecologist. Reports on the progress of the rehabilitation are to be issued to Tweed Shire Council on a quarterly basis.

As previously discussed, approximately 223.65 hectares of vegetation occurs within the proposed development envelope, the majority of which is comprised of Low closed grassland.

In terms of remnant vegetation, 7.82 hectares occurs within the proposed development envelope (10.74% of the total area of remnant bushland). The Site Regeneration and Revegetation Plan will ensure that rehabilitation works to be completed will adequately offset any vegetation loss, through rehabilitation works and the provision of detailed monitoring and maintenance programs and specific performance objectives.

It is also worth noting that the following management plans have also been prepared to offset any removal of vegetation and/or to protect and enhance specific vegetation communities on the subject site:

- Saltmarsh Restoration Plan (**VOLUME 3**);
- Scribbly gum Management Plan (**VOLUME 4**); and
- Freshwater Wetland Rehabilitation Plan (**VOLUME 8**).

## 4.7 Consideration of the provision, management and ongoing maintenance of general public open space

### *4.7.1 Introduction*

This section will discuss the location of proposed Environmental Protection Areas within the open space network on the subject site and also address the management and maintenance of these Environmental Protection Areas. The management intent of the remaining active and passive open space areas is detailed within the Landscape Concept Plan (Place 2008).

### *4.7.2 Description of Environmental Protection Areas*

The concept plan for the proposed development of the Cobaki lakes site includes approximately 84.3 ha of Environmental Protection Areas (**FIGURE 9**). Consideration is also to be given to the rezoning of the Saltmarsh Rehabilitation Area to Environmental Protection (in accordance wit the Saltmarsh Rehabilitation Plan – **VOLUME 3**). The Environmental Protection Areas have been designated primarily for conservation uses and retention of habitat linkages from the vegetated ridgelines adjacent to and within the western portion of the subject site to the central Active Open Space area.

The key ecological values of the Environmental Protection Areas will be retained through the following measures:

- No development except for tracks for pedestrian access or for essential environmental management purposes.
- Pedestrian access is to be limited to designated tracks.
- Vehicular access, apart from for essential environmental management purposes, will be precluded.

### *4.7.3 Management of Environmental Protection Areas*

An Environmental Protection Area Management Plan (EPAMP) will be completed for the proposed residential development at Cobaki lakes at the Development Application stage. The EPAMP will provide details on the specific uses and management for the Environmental Protection Areas, including the following:

- A description of the existing features;
- An outline of the rehabilitation or revegetation to be completed, including a detailed description of which species are to be planted;
- A detailed maintenance and monitoring program, including performance indicators, deadlines for completion, reporting and reviewing and any corrective action that may be required.

### *4.7.4 Maintenance*

The maintenance of the Environmental Protection Areas will be described in detail in the EPAMP. The EPAMP will detail a 5 year maintenance program and it is intended that maintenance would become public responsibility after this time period.

## 4.8 Provide an assessment against SEPP 14 – Coastal Wetlands

### *4.8.1 Introduction*

In response to the state-wide degradation of coastal wetlands, the Department of Planning enacted SEPP – 14 Coastal Wetlands in 1985. The policy aims to "ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the State".

This section provides an assessment of the potential impacts and the planned amelioration measures to reduce impacts associated with the proposed development.

### *4.8.2 Impacts on SEPP 14 wetland No.1*

4.8.2.1 Background

SEPP 14 - Coastal Wetland No.1 occurs adjacent to the Subject site as shown in **FIGURE 3.** This wetland area is protected by State Environmental Planning Policy No. 14 – Coastal wetlands. The portion of the wetland that occurs on the subject site occurs almost entirely within the area dedicated to council (under Section 88b of the Conveyancing Act 1919) and the approved alignment of the Cobaki Parkway (i.e. a major arterial road to be constructed through the subject site).

It is therefore considered that the proposed residential development of the Subject site is unlikely to have any significant direct impacts on the ecology of the wetland area. However, there is potential for the wetland area to be affected indirectly by changes in water quality, alteration of the local hydrological regime, sedimentation or a combination of these factors.

Stormwater runoff from the subject site has the potential to impact on the hydrological regime of the adjacent area of wetland. Amelioration measures are discussed in detail within the Stormwater Management Plan (Gilbert & Sutherland 2008).

4.8.2.2 General Impacts

The proposed development has the potential to result in impacts on the SEPP 14 wetland related to:

- Alterations of hydrology within SEPP 14 wetlands;
- Change to the hydrological regime may alter the current distribution of vegetation communities;
- Increased sediment loads from construction activities;
- Impacts on water quality and hydrology as a result of stormwater runoff from the proposed development;
- Increased visitation, with potential for trampling of intertidal vegetation, dumping of rubbish or refuse in creek habitats (particularly discarded fishing line, bait bags etc.), disturbance of fauna; and
- Disturbance to the Subject site creates opportunities for weeds to colonise. Weeds may be introduced to the Study site in construction materials or by

vehicles. Occupation of the Subject site creates opportunities for weeds to become established.

#### 4.8.2.3 Erosion

The subject site shows some evidence of soil erosion. A number of factors contribute to the level of erosion evident on the site. These factors include:

- The nature of the alluvial soil structure,
- The high rainfall and climatic conditions of the Subject site, and
- Land management practices.

Earthworks will increase the potential for soil erosion.

#### 4.8.2.4 Stormwater Impacts

Due to the steep slope in parts of the Subject site and the periods of high rainfall, stormwater runoff may potentially impact on the Subject site and Study area in a number of ways.

Impacts may include:

- Increased soil erosion,
- Increased soil dispersal,
- Alteration of habitat microclimate conditions for flora and fauna, and
- Alteration of water quality of aquatic habitats downstream from the Subject site.

### *4.8.3 Amelioration measures*

The entire development footprint occurs to the west of the approved alignment of the Cobaki Parkway (i.e. a major arterial road to be constructed through the subject site). Areas of retained vegetation will assist in sedimentation deposition and nutrient uptake for any stormwater runoff from the development area. These vegetated areas also provide habitat and movement opportunities for fauna in the Study area (including Threatened fauna).

A Stormwater Management Plan has been prepared for the subject site (Gilbert & Sutherland 2008) which incorporates current best-practise measures to ensure that untreated stormwater does not flow directly into the SEPP 14 wetland. The locations of Stormwater treatment areas are shown in **FIGURE 34.** All stormwater treatment areas occur within land designated as Open Space and have been designed to provide wetland habitat.

Stormwater management will involve the creation and use of suitable planted buffer zones where necessary, in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**).

## 4.9 Address the requirements of Councils DCP 25 – Biting Midge and Mosquito Control

### *4.9.1 Introduction*

This section addresses the requirements of Tweed Shire Council's DCP 25 – Biting Midge and Mosquito Control. A Development Control Plan (DCP 25) relating to biting insects problems in the Tweed Shire was adopted by Tweed Shire Council in 1993. The DCP outlines the nuisance of biting insects, suggests ways to avoid biting insect problems, and includes maps of biting insect breeding areas. DCP 25 can be used in the planning stages of development, alleviating the nuisance and health risks associated with biting insects for residents and visitors.

### *4.9.2 Literature review*

A Mosquito Management Report was compiled by Anthony E. Wright in 2001. The report addressed a number of strategies for the effective prevention of the vast majority of mosquito breeding at Cobaki Lakes, which may have the potential to "significantly constrain or prevent the successful development of the Cobaki lakes site". This report will be utilised in the assessment of mosquito nuisance at the Cobaki Lakes development site due to the localized nature of the report.

### *4.9.3 Mosquito control*

The existing site at Cobaki Lakes frequently breeds large populations of mosquitoes, in particular the saltmarsh mosquito *Aedes vigilax* (Wright 2001). This species, and several others, create both an intolerable level of nuisance and health risks from mosquito borne viruses including Ross River (RR) and Barmah Forest (BF). Wright (2001) suggests three options for the effective prevention of the vast majority of mosquito breeding at Cobaki Lakes, including:

- "Cobaki Lakes Wetland Habitat Restoration" (Tweed Shire);
- Solid fill, laser levelling and freshwater lagoon; and
- Liquid fill and freshwater lagoon.

A Biting Midge and Mosquito Control Plan for the Cobaki Lakes site has been prepared by Mosquito Consulting Services Pty Ltd (McGinn 2008). This plan has been developed in consultation with JWA and Gilbert & Sutherland. Furthermore, the Stormwater Management Plan (Gilbert & Sutherland 2008) provides for the diffuse discharge of treated stormwater to both the freshwater and saltwater habitats through the construction of under-drained swales with level-spreader devices. By controlling, repairing and improving the surface water management within the rehabilitated areas, it is anticipated that the mosquito and biting midge problem will be reduced.

This Biting Midge and Mosquito Control Plan (McGinn 2008), in association with the Stormwater Management Plan (Gilbert & Sutherland 2008), is considered to adequately address the requirements of Tweed Shire Council DCP 25.

## 4.10 Consideration of impacts on matters of national environmental significance (EPBC Act 1999)

### *4.10.1 Introduction*

The *Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act 1999)* was passed by Commonwealth Parliament in June 1999 and came into force on 16 July, 2000. A person must not, without an approval under the Act, take an action that has or will have, or is likely to have, a significant impact on a matter of National Environmental Significance (NES). A Commonwealth Assessment will be required for proposed activities on the subject site if they affect a matter of NES.

A detailed assessment of the Environment Protection & Biodiversity Conservation (EPBC) Act (1999) is included within **VOLUME 2 (APPENDIX 5).** A summary of this assessment is provided below.

### *4.10.2 Summary*

**Flora**

Six (6) Commonwealth Threatened flora species have been recorded on and/or adjacent to the Subject site:

- Coolamon
- Spiny gardenia
- Scented acronychia
- Stinking cryptocarya
- Rough-shelled bush-nut
- Swamp orchid

Potential impacts on these species and amelioration measures to retain/enhance habitat on the subject site have been discussed in section 4.2.

**Fauna**

One (1) Commonwealth Threatened fauna species, the Grey-headed flying-fox, was recorded on the Subject site. The Long-nosed potoroo and the Wallum sedgefrog were recorded on land adjacent to the Subject site, in the SEPP 14 wetlands to the east and in Crown land to the south-east, respectively. Mitchell's rainforest snail is considered a possible occurrence at the site.

It is considered that the Subject site does not support an important population of any species listed in the *EPBC Act (1999)* and a significant impact on these species will not be incurred.

***Listed Migratory Species***

It is considered that although two (2) listed migratory species, the Osprey and Black-tailed godwit, are known or likely to occur occasionally in the Study area, no area of important habitat occurs in the Study area for listed migratory species.

### *4.10.3 Requirement for Commonwealth Assessment*

**On the basis of the above assessment, it is concluded that Commonwealth Assessment is not required for the Proposed development of the subject site.**

# 5. SUMMARY OF IMPACTS, MITIGATION & OFFSETS

The environmental zoning process on the subject site over 15 years has ensured that areas of ecological significance have been included in environmental protection zones. These areas have therefore been avoided in the development planning process. Ecologically significant plants or areas occurring within residentially zoned land will either be avoided or replaced in non-developed portions of the site. The emphasis will be to avoid the loss of these plants or EEC's in the Development Application phase.

A summary of impacts on wildlife corridors, remnant bushland, Koala habitat in accordance with SEPP 44 and Tweed Shire Council, and any threatened species and their habitats is provided in **TABLE 11** below. Also addressed are the mitigation and offset measures proposed to ensure minimal impacts on ecologically significant areas and species.

**TABLE 11**
**SUMMARY OF IMPACTS, MITIGATION AND OFFSETS**

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| **Wildlife corridors** | | | | |
| | • A reduction in the overall effectiveness of the site as a corridor due to habitat loss and fragmentation.<br>• Edge effects may impact on retained corridor habitat. | • The proposed development utilises existing cleared areas.<br>• A network of existing vegetated corridors will be retained on the site.<br>• Additionally, smaller interlinking corridors will be provided on the subject site through regeneration and revegetation works.<br>• Rehabilitation works on the subject site will include buffers to retained vegetation corridors as well as weed maintenance along edges. | • A Site Regeneration and Revegetation Plan has been prepared for the subject site (**VOLUME 5**) to provide vegetated links across the site and ensure that the remaining wildlife corridors will be embellished utilising revegetation and natural regeneration principles. | • A net gain of approximately 59.5ha of vegetation providing suitable corridor habitat will occur as a result of the proposed development. |
| **Remnant bushland** | | | | |
| | • 22.28 hectares (24.62%) of remnant bushland will be lost.<br>• Edge effects may impact on retained remnant bushland. | • A total of 68.25 hectares (75.38%) of remnant bushland will be retained on the subject site.<br>• Weed control will be completed on the interface of remnant bushland by a qualified Bush regenerator;<br>• Weed control will be undertaken on a progressive basis over a three (3) – five (5) year period;<br>• Embellishment plantings are to be used to consolidate each of the areas of remnant vegetation; | • The Site Regeneration and Revegetation Plan (**VOLUME 5**) includes 59.5ha of revegetation/ regeneration works to offset the loss of 22.28ha of remnant bushland and outlines the various measures to ensure that the retained remnant vegetation is adequately managed. | • Revegetation on the subject site will result in a long-term net gain of approximately 37.22ha of remnant bushland. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | | • All areas of remnant vegetation will be fenced to exclude pedestrian traffic and cattle grazing;<br>• Formal pathways are to be provided through areas of remnant vegetation to prevent the creation of numerous informal tracks;<br>• A monitoring and maintenance program for areas of remnant vegetation is included in the Site Regeneration and Revegetation Plan (**VOLUME 5**). | | |
| **Koala habitat** | | | | |
| | • 9.24 hectares (20.8%) of suitable Koala habitat may potentially be lost.<br>• It is worth noting that all potential Koala habitat to be removed occurs within portions of the site with existing development approval. | • A total of 35.17 hectares (79.2%) of suitable Koala habitat is proposed to be retained within Environmental Protection Areas & Open Space areas.<br>• Specific trees within the Scribbly gum community (Community 8) will be retained within the development envelope and protected (in accordance with the Scribbly Gum Management Plan – **VOLUME 4**). | • Proposed revegetation and regeneration works on the subject site (**FIGURE 22**) will increase the area of available Koala habitat in the long-term and provide vegetated linkages through the landscape.<br>• 59.5ha of revegetation works will be completed to offset the loss of 9.24ha of suitable Koala habitat. | • Revegetation on the subject site, including planted Koala food tree species, will result in a long-term net gain of approximately 50.26ha of vegetation suitable as Koala forage and/or corridor habitat. |
| **Threatened flora** | | | | |
| • White yiel yiel (*Grevillea hilliana*) | • One (1) White yiel yiel occurs within an area of the proposed development footprint | • Approximately 10.32 hectares (91.9%) of suitable habitat for these species will be retained. | • Rehabilitation of approximately 14.66ha of lowland rainforest in accordance with the Site | • The local populations of these species will be bolstered through propagation and replanting |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | with existing approvals (**FIGURE 25a**). | • Rehabilitation of lowland rainforest communities will be completed.<br>• Retained patches of rainforest will be buffered from the proposed development and embellished to increase the overall extent of isolated patches and reduce existing anthropogenic impacts.<br>• It is also recommended that propagation of Threatened flora species be undertaken as part of the rehabilitation works on the subject site in an attempt to bolster local populations.<br>• As a minimum, every retained Threatened plant on the subject site will be provided with a 5m vegetated buffer.<br>• Weed control will be completed on the interface of remnant bushland by a qualified Bush regenerator;<br>• Weed control will be undertaken on a progressive basis over a three (3) – five (5) year period;<br>• All areas of remnant vegetation will be fenced to exclude pedestrian traffic and cattle grazing;<br>• Formal pathways are to be provided through areas of remnant vegetation to prevent the creation of numerous informal tracks; | Regeneration and Revegetation Plan (**VOLUME 5**) to offset the loss of 0.82 ha and will ensure protection for retained Threatened flora species. | of this species.<br>• Revegetation on the subject site will result in a long-term net gain of approximately 13.84ha of suitable habitat for these species. |
| • Scented acronychia (*Acronychia littoralis*) | • One (1) stem of Scented acronychia has been recorded from within a small isolated clump of vegetation in the central northern portion of the subject site **FIGURES 23 & 23a**). | | | |
| • Fine-leaved tuckeroo (*Lepiderema pulchella*) | • Six (6) stems of Fine-leaved tuckeroo occur within areas of the proposed development footprint with existing approvals (**FIGURE 25a & 25b**). | | | |
| • Spiny gardenia (*Randia moorei)* | • One (1) Spiny gardenia occurs within an area of the proposed development footprint with existing approvals (**FIGURE 25a**). | | | |
| • Marblewood (*Acacia bakeri*) | • Four (4) stems of Marblewood occur within areas of the proposed development footprint with existing approvals (**FIGURE 25a & 25b**). | | | |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| • Brush cassia (*Cassia brewsteri* var. *marksiana*) | • Two (2) stems of the Brush cassia occur on the subject site within areas designated as Open Space (**FIGURE 25a & 25b**). | • A monitoring and maintenance program for areas of remnant vegetation is included in the Site Regeneration and Revegetation Plan (**VOLUME 5**). | | |
| • Coolamon (*Syzygium moorei*) | • The proposed development is considered unlikely to impact on the Coolamon which occur adjacent to the subject site (**FIGURE 25a**). | | | |
| • Green-leaved rose walnut (*Endiandra muelleri* subsp. *bracteata)* | • None of the five (5) stems of Green-leaved rose-walnut recorded on the site occur within the proposed development footprint (**FIGURE 25b**). | | | |
| • White lace flower (*Archidendron hendersonii*) | • This species has not been recorded from the subject site. | | | |
| • Stinking cryptocarya (*Cryptocarya foetida*) | • This species has not been recorded from the subject site. | | | |
| • Rough-shelled bush-nut | • This species has not been recorded from the | | | |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| (*Macadamia tetraphylla*) | subject site.<br><br>• The proposed development will remove 0.82 hectares (7.3%) of potential habitat for these species, all of which will occur from areas of the site with existing development approvals. | | | |
| • Pink nodding orchid (*Geodorum densiflorum*)<br><br>• Swamp orchid (*Phaius australis*) | • This species has not been recorded from the subject site.<br><br>• This species has not been recorded from the subject site.<br><br>• The proposed development will result in the removal or modification a total of 3.8 hectares of potential habitat for this species, all of which occurs in areas of the site which have existing development approvals.<br>• Edge effects may impact on retained habitat. | • Rehabilitation of Swamp sclerophyll forest communities will be completed.<br>• Additionally, landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• It is also recommended that propagation of Threatened flora species be undertaken as part of the rehabilitation works on the subject site in an attempt to bolster local populations.<br>• As a minimum, every retained Threatened plant on the subject site will be provided with a 5m vegetated buffer.<br>• Weed control will be completed on the interface of EEC's by a qualified Bush regenerator;<br>• Weed control will be undertaken | • In total, 18.18 hectares of Swamp sclerophyll forest will be regenerated/ revegetated on the subject site to offset the loss of 3.8 hectares.<br>• Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas will ensure protection for retained Threatened flora species and also provide additional habitat for Threatened flora species occurring on and adjacent to the subject site. | • The local populations of these species will be bolstered through propagation and replanting of this species.<br>• Revegetation and landscaping works on the subject site will result in a long-term net gain of approximately 49.59ha of suitable habitat for these species. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | | on a progressive basis over a three (3) – five (5) year period;<br>• Embellishment plantings are to be used to consolidate each of the areas of EEC;<br>• All areas of EEC will be fenced to exclude pedestrian traffic and cattle grazing;<br>• A monitoring and maintenance program for areas of remnant vegetation is included in the Site Regeneration and Revegetation Plan (**VOLUME 5**). | | |
| **Endangered Ecological Communities** | | | | |
| • Swamp sclerophyll forest on coastal floodplain | • The entire area (3.8ha) of existing Swamp sclerophyll forest on coastal floodplain will be lost (**FIGURE 27**).<br>• It is worth noting that the conservation significance of this community has been severely compromised by past land-use activities including cattle grazing and periodic slashing which has resulted in the removal of the midstorey and the prevalence of introduced grasses and | • Amelioration for the removal of the degraded Swamp sclerophyll forest on coastal floodplain will be provided through revegetation works on the subject site.<br>• A Site Regeneration and Revegetation Plan has been prepared for the subject site and includes measures to offset the loss of this EEC from the subject site (**VOLUME 5**).<br>• Additional compensation will be provided through regeneration and revegetation works in accordance with the Freshwater Wetland Rehabilitation Plan (**VOLUME 8**).<br>• Both the Site Regeneration and | • In total, 18.18 hectares of Swamp sclerophyll forest will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 3.8 hectares.<br>• Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. | • Revegetation and landscaping works on the subject site will result in a long-term net gain of approximately 49.59ha of Swamp sclerophyll forest on coastal floodplain. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | common agricultural weeds in the groundcover layer.<br>• Edge effects may impact on retained EEC's. | Revegetation Plan and the Freshwater Wetland Rehabilitation Plan include specific performance criteria as well as detailed maintenance and monitoring programs and it is therefore considered that the compensatory Swamp sclerophyll forest on coastal floodplain will be more likely to persist in the long-term compared to the existing communities.<br>• Weed control will be completed on the interface of EEC's by a qualified Bush regenerator;<br>• Weed control will be undertaken on a progressive basis over a three (3) – five (5) year period;<br>• Embellishment plantings are to be used to consolidate each of the areas of EEC;<br>• All areas of EEC will be fenced to exclude pedestrian traffic and cattle grazing;<br>• A monitoring and maintenance program for areas of remnant vegetation is included in the Site Regeneration and Revegetation Plan (**VOLUME 5**). | | |
| • Lowland rainforest on floodplain | • In total 0.19 hectares (10.7%) of Lowland rainforest on floodplain will be lost (**FIGURE 27**), | • Amelioration for any removal of the isolated patches of Lowland rainforest on floodplain will be provided through revegetation | • In total, 4.81 hectares of Lowland rainforest will be regenerated/ revegetated on the subject site | • Revegetation works on the subject site will result in a long-term net gain of approximately 4.62ha of |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | all of which occurs within portions of the site with existing development approvals.<br>• Edge effects may impact on retained EEC's. | works on the subject site.<br>• A Site Regeneration and Revegetation Plan has been prepared for the subject site and includes measures to offset any loss of this EEC from the subject site (**VOLUME 5**).<br>• Furthermore, retained patches of this EEC will be buffered from the proposed development and embellished to increase the overall extent of isolated patches and reduce existing anthropogenic impacts.<br>• As a minimum, retained Lowland rainforest on floodplain on the subject site will be provided with a 10m vegetated buffer.<br>• The Site Regeneration and Revegetation Plan includes specific performance criteria as well as a detailed maintenance and monitoring program to ensure the persistence of this EEC in the long-term.<br>• Weed control will be completed on the interface of EEC's by a qualified Bush regenerator;<br>• Weed control will be undertaken on a progressive basis over a three (3) – five (5) year period;<br>• Embellishment plantings are to be used to consolidate each of the | (**FIGURE 28**) to offset the loss of 0.19 hectares. | Lowland rainforest on floodplain. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | | areas of EEC;<br>• All areas of EEC will be fenced to exclude pedestrian traffic and cattle grazing;<br>• A monitoring and maintenance program for areas of remnant vegetation is included in the Site Regeneration and Revegetation Plan (**VOLUME 5**). | | |
| • Lowland rainforest | • Approximately 0.63 hectares (6.7%) of Lowland rainforest will be lost (**FIGURE 27**), all of which occurs within portions of the site with existing development approvals.<br>• Edge effects may impact on retained EEC's. | • Amelioration for the removal of any of the isolated patches of Lowland rainforest will be provided through revegetation works on the subject site.<br>• A Site Regeneration and Revegetation Plan has been prepared for the subject site and includes measures to offset any loss of this EEC from the subject site (**VOLUME 5**).<br>• Furthermore, retained patches of this EEC will be buffered from the proposed development and embellished to increase the overall extent of isolated patches and reduce existing anthropogenic impacts.<br>• As a minimum, retained Lowland rainforest on the subject site will be provided with a 10m vegetated buffer.<br>• The Site Regeneration and Revegetation Plan includes | • In total, 9.85 hectares of Lowland rainforest on floodplain will be regenerated/revegetated on the subject site (**FIGURE 28**) to offset the loss of 0.63 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 9.22ha of Lowland rainforest. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | | specific performance criteria as well as a detailed maintenance and monitoring program to ensure the persistence of this EEC in the long-term.<br>• Weed control will be completed on the interface of EEC's by a qualified Bush regenerator;<br>• Weed control will be undertaken on a progressive basis over a three (3) – five (5) year period;<br>• Embellishment plantings are to be used to consolidate each of the areas of EEC;<br>• All areas of EEC will be fenced to exclude pedestrian traffic and cattle grazing;<br>• A monitoring and maintenance program for areas of remnant vegetation is included in the Site Regeneration and Revegetation Plan (**VOLUME 5**). | | |
| • Freshwater wetlands | • In total 6.82 hectares (18.1%) of Freshwater wetland will be lost (**FIGURE 27**). The loss of this EEC is comprised of 0.99 hectares from areas of the site with existing development approvals, and 5.83 hectares from areas of the site without existing development | • A Freshwater Wetland Rehabilitation Plan has been prepared for the subject site and includes measures to provide a more intact wetland community on the subject site (**VOLUME 8**). This plan aims to rehabilitate an area of the subject site that is considered to have formally been comprised of freshwater wetland communities. | • In total, 5.82 hectares of Freshwater wetlands will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 6.82 hectares.<br>• Additionally, 17.22 hectares of wetlands will be constructed for stormwater management comprised of 14.1ha of | • Revegetation works and stormwater treatment devices on the subject site will result in a long-term net gain of approximately 16.22 ha of Freshwater wetlands. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | approvals.<br>• Edge effects may impact on retained EEC's. | • As a minimum, retained Freshwater wetlands on the subject site will be provided with a 10m vegetated buffer.<br>• The Freshwater Wetland Rehabilitation Plan include specific performance criteria as well as a detailed maintenance and monitoring program and it is therefore considered that the rehabilitated Freshwater wetland will be more likely to persist in the long-term compared to the existing community.<br>• Weed control will be completed on the interface of EEC's by a qualified Bush regenerator;<br>• Weed control will be undertaken on a progressive basis over a three (3) – five (5) year period;<br>• Embellishment plantings are to be used to consolidate each of the areas of EEC;<br>• All areas of EEC will be fenced to exclude pedestrian traffic and cattle grazing;<br>• A monitoring and maintenance program for areas of remnant vegetation is included in the Site Regeneration and Revegetation Plan (**VOLUME 5**). | lakes/open water zones and 3.12ha of shallow/macrophyte zones. | |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| • Swamp oak floodplain forest | • In total 0.37 hectares (8.73%) of Swamp oak floodplain will be lost (**FIGURE 27**). The loss of this will occur within an area of the site without existing development approval (**FIGURE 27**).<br>• Edge effects may impact on retained EEC's. | • The removal of approximately 0.37 hectares of the Swamp oak floodplain forest community from the subject site will be ameliorated by regenerating and revegetating compensatory Swamp oak communities on the subject site.<br>• Areas within and adjacent to the existing Saltmarsh communities on the subject site are currently comprised of a mixture of exotic grasses and will be restored to Saltmarsh and Swamp oak communities in accordance with the Saltmarsh Restoration Plan (**VOLUME 3**).<br>• Removal of cattle from the area and subsequent relinquishment of existing use rights is considered an integral component of the rehabilitation process.<br>• As a minimum, retained Swamp oak floodplain forest on the subject site will be provided with a 10m vegetated buffer.<br>• Weed control will be completed on the interface of EEC's by a qualified Bush regenerator;<br>• Weed control will be undertaken on a progressive basis over a three (3) – five (5) year period;<br>• Embellishment plantings are to be | • In total, 7.7 hectares of Swamp oak floodplain forest will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 0.37 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 7.33ha of Swamp oak floodplain forest. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | | used to consolidate each of the areas of EEC;<br>• All areas of EEC will be fenced to exclude pedestrian traffic and cattle grazing;<br>• A monitoring and maintenance program for areas of remnant vegetation is included in the Site Regeneration and Revegetation Plan (**VOLUME 5**). | | |
| • Coastal saltmarsh | • In total 4.78 hectares (8.9%) of Coastal saltmarsh will be lost (**FIGURE 27**). The loss of this EEC is comprised of 0.42 hectares from areas of the site with existing development approvals, and 4.36 hectares for the construction of a school within an area of the site without existing development approval (**FIGURE 27**).<br>• Edge effects may impact on retained EEC's. | • The removal of approximately 4.78 hectares of Saltmarsh communities from the subject site will be ameliorated by regenerating and revegetating compensatory Saltmarsh communities on the subject site.<br>• Large areas adjacent to the existing Saltmarsh communities are currently comprised of a mixture of exotic grasses and will be restored to Saltmarsh communities in accordance with the Saltmarsh Restoration Plan (**VOLUME 3**).<br>• Removal of cattle from the area and subsequent relinquishment of existing use rights is considered an integral component of the rehabilitation process.<br>• As a minimum, retained Coastal saltmarsh on the subject site will be provided with a 10m vegetated | • In total, 7.7 hectares of Coastal saltmarsh will be regenerated/revegetated on the subject site (**FIGURE 28**) to offset the loss of 4.78 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 2.92ha of Coastal saltmarsh. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | | buffer.<br>• Weed control will be completed on the interface of EEC's by a qualified Bush regenerator;<br>• Weed control will be undertaken on a progressive basis over a three (3) – five (5) year period;<br>• Embellishment plantings are to be used to consolidate each of the areas of EEC;<br>• All areas of EEC will be fenced to exclude pedestrian traffic and cattle grazing;<br>• A monitoring and maintenance program for areas of remnant vegetation is included in the Site Regeneration and Revegetation Plan (**VOLUME 5**). | | |
| **Threatened fauna** | | | | |
| • Wallum froglet (*Crinia tinnula*) | • The proposed development may result in direct mortality to individuals of this species during construction.<br>• The proposed development will not remove or modify any areas of core habitat.<br>• Approximately 43.7 hectares (52.7%) of potential forage habitat will be removed. This loss | • An area in the central portion of the subject site will be rehabilitated in accordance with a Freshwater Wetland Rehabilitation Plan (**VOLUME 8**). This area will be designed to provide approximately 5.82 hectares of additional habitat for the Wallum froglet on the subject site.<br>• Furthermore, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site (**FIGURE 28**) in accordance with the Site | • No core habitat will be removed.<br>• In total, 59.21 hectares of vegetation likely to provide suitable forage habitat will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 43.7 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 15.51ha of suitable forage habitat, and may also provide areas of core habitat. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | of forage habitat is comprised of 37.05 hectares from areas of the site with existing development approvals, and 6.65 hectares from areas of the site without existing development approval.<br>• Alteration of water quality in drainage lines due to soil runoff from the construction site.<br>• Alteration of hydrology of the drainage lines due to construction.<br>• Contamination or reduction of water quality in drainage lines due to runoff from chemicals or debris (fertilisers, etc).<br>• Introduction of weed species into core habitat areas.<br>• Increased competition from disturbance-adapted native, domestic and introduced fauna (such as Cane toads, Noisy miners, foxes, dogs, cats, rats, etc.). | Regeneration and Revegetation Plan (**VOLUME 5**) and these areas are likely to provide suitable forage habitat for this species and offset any loss of forage habitat.<br>• Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• A detailed Stormwater Management Plan has been prepared for the subject site (Gilbert & Sutherland 2008) utilising current best-practice management techniques which will ensure no adverse impacts on the hydrology of the current core habitat and the proposed rehabilitated freshwater wetland.<br>• Furthermore any stormwater treatment devices and sedimentation ponds will be designed so that they provide limited opportunities for the introduced Mosquito fish (*Gambusia* sp.) to breed and hence provide better habitat for native frogs.<br>• Weed control will be completed on the interface of retained habitat by a qualified Bush regenerator;<br>• Weed control will be undertaken | | |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | | on a progressive basis over a three (3) – five (5) year period;<br>• A monitoring and maintenance program for areas of retained habitat is included in the Site Regeneration and Revegetation Plan (**VOLUME 5**). | | |
| • Black-necked stork (*Xenorhynchus asiaticus*) | • Approximately 48.48 hectares (34%) of potential forage habitat will be removed from the subject site. This loss of forage habitat is comprised of 37.47 hectares from areas of the site with existing development approvals, and 11.01 hectares from areas of the site without existing development approval.<br>• Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species. | • An area in the central portion of the subject site will be rehabilitated in accordance with a Freshwater Wetland Rehabilitation Plan (**VOLUME 8**). This area will provide approximately 5.82 hectares of additional habitat for the Black-necked stork on the subject site.<br>• Furthermore, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site (**FIGURE 28**) in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas are likely to provide suitable forage habitat for this species and offset any loss of forage habitat.<br>• Additionally, 93.3 hectares of | • In total, 59.21 hectares of vegetation likely to provide suitable forage habitat will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 48.48 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 10.73ha of suitable forage habitat for the Black-necked stork. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | | vegetation within the south-eastern portion of the subject site will be retained and rehabilitated in accordance with the Saltmarsh Rehabilitation Plan (**VOLUME 3**). This area currently provides suitable forage habitat for the Black-necked stork and will continue to do so in the long term. | | |
| • Powerful owl (*Ninox strenua*) | • The primary threat to this species and its habitat is the loss and modification of forest and old growth elements, especially trees supporting large nest hollows and areas supporting high densities of prey populations (Debus and Chafer 1994).<br>• This species may potentially forage over the majority of the subject site however it is estimated that the development will result in the loss of approximately 17.61 (27.36%) hectares of better quality habitat.<br>• This loss relates to the | • The proposed retention of large areas of intact forest is likely to result in the continued foraging of this species on the subject site.<br>• Furthermore, approximately 59.5ha of revegetation/regeneration will be completed in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) to offset the loss of 17.61ha of forage habitat.<br>• Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas are all likely to provide suitable forage habitat for the Powerful owl in the long-term.<br>• Retention of old growth trees will also provide continued nesting | • In total, 94.71 hectares of vegetation likely to provide suitable forage habitat for the Powerful owl will be regenerated/revegetated on the subject site (**FIGURE 28**) to offset the loss of 17.61 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 77.1ha of suitable forage habitat for the Powerful owl. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
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| | clearing of 17.41 hectares from areas of the site with existing development approvals, and 0.20 hectares from areas of the site without existing development approval.<br>• Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species.<br>• Loss of vegetation from the subject site will approximate to only 2-3% of the estimated home range of a Powerful owl. | opportunities for this species.<br>• Additionally, the installation of nest boxes of a suitable size for owls within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will improve the habitat values of the site for this species and encourage the use of site habitats for nesting purposes. | | |
| • Masked owl – (*Tyto novaehollandiae*) | • This species may potentially forage over the majority of the subject site however, it is estimated that approximately 17.61 hectares (27.36%) of better quality forage habitat for the Masked owl will be removed.<br>• This loss relates to the clearing of 17.41 | • The proposed retention of large areas of intact forest is likely to result in the continued foraging of this species on the subject site.<br>• Furthermore, approximately 59.5ha of revegetation/ regeneration will be completed in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) to offset the loss of 17.61ha of forage habitat.<br>• Additionally, 35.21 hectares of | • In total, 94.71 hectares of vegetation likely to provide suitable forage habitat for the Masked owl will be regenerated/revegetated on the subject site (**FIGURE 28**) to offset the loss of 17.61 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 77.1ha of suitable forage habitat for the Masked owl. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | hectares from areas of the site with existing development approvals, and 0.20 hectares from areas of the site without existing development approval.<br>• This species may also be susceptible to road-strike, as birds often forage along roadsides or use roads to move between foraging sites (Debus and Rose 1994).<br>• Loss of Sclerophyll forest may reduce the availability of arboreal and terrestrial mammalian prey for this species however loss of vegetation from the subject site will approximate to only 2%-3% of the estimated home range of a Masked owl.<br>• Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species. | landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas are all likely to provide suitable forage habitat for the Masked owl in the long-term.<br>• Retention of old growth trees will also provide nesting opportunities for this species.<br>• Additionally, the installation of nest boxes of a suitable size for owls within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will improve the habitat values of the site for this species and encourage the use of site habitats for nesting purposes. | | |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| • Osprey (*Pandion haliaetus*) | • It is expected that impacts of the proposed development will be restricted to human disturbance near any nest site.<br>• A nest site on a power pole was discovered in the south – east of the site (JWA 2006) away from any future development areas (**FIGURE 32**). Two (2) Ospreys have subsequently been observed in the nest on several separate occasions (2006 – 2008). | • A 100m buffer area has been designated around the nest (**FIGURE 32**) and it is considered that the proposed development will have little impact on this nest site.<br>• It is considered however, that this nest site will not be suitable for use in the long-term. The developer is therefore committed to erecting at least two (2) artificial nesting platforms on the site (**FIGURE 32**). It is well known that these platforms are highly successful. | No forage habitat will be removed from the subject site. | N/A |
| • Koala (*Phascolarctos cinereus*) | • Approximately 9.24 hectares (23.5%) of potential forage habitat will be removed from the subject site all of which will be removed from areas of the site with existing development approvals.<br>• Increased risk of death or injury from vehicle strike;<br>• Risk of harassment, death or injury from straying dogs; | • The majority of vegetation communities which provide suitable habitat for the Koala on the subject site will be retained (**FIGURE 21**).<br>• Furthermore, approximately 59.5ha of revegetation/ regeneration will be completed in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) to offset any loss of remnant bushland and to provide vegetated links across the site.<br>• Additionally, 35.21 hectares of | • In total, 94.71 hectares of vegetation likely to provide suitable forage habitat and/or movement opportunities for the Koala will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 9.24 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 85.47ha of suitable forage and/or corridor habitat for the Koala. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | • Risk of drowning in swimming pools; and<br>• Opportunities for Koala movement over the site may be restricted. | landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas are all likely to provide suitable forage habitat for the Koala in the long-term and provide vegetated linkages through the landscape (**FIGURE 22**).<br>• It is also worth noting that habitat for the Koala will be retained in perpetuity within the adjacent border reserve.<br>• Traffic movement controls on local roads and awareness signage are to be incorporated into detailed site design.<br>• Where feasible, box culverts are to be included in road design where they intersect the areas designated as Open Space. These are drainage structures that can function as fauna movement corridors beneath roads.<br>• Speed on the majority of roads within the development site will be limited to 50 kilometres per hour. Pedestrian crossings planned for these roads will further reduce actual speed. This should significantly reduce Koala road casualties.<br>• Landowners will be required to | | |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
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| | | control dogs in accordance with relevant Tweed Shire Council by-laws.<br>• Swimming pools should be fenced in a manner to restrict access by Koalas. | | |
| • Grey-headed flying-fox (*Pteropus poliocephelus*) | • Approximately 22.15 hectares (26.9%) of potential forage habitat will be removed from the subject site.<br>• This loss relates to the clearing of 21.95 hectares from areas of the site with existing development approvals, and 0.20 hectares without existing development approval.<br>• Suitable roosting habitat will be retained on Mt. Woodgee.<br>• Given the high mobility of this species, the loss of 22.15 hectares of known and potential foraging habitat is not considered significant in relation to the regional distribution of potential foraging habitat for this species. | • The Grey-headed flying-fox is considered likely to continue foraging within retained areas of vegetation on the site.<br>• Furthermore, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site (**FIGURE 28**) in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas are likely to provide suitable forage habitat for this species and offset the loss of 22.15ha. | • In total, 53.39 hectares of vegetation likely to provide suitable forage habitat for the Grey-headed flying-fox will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 22.15 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 31.24ha of suitable forage and/or corridor habitat for the Grey-headed flying-fox. |
| • Little bent-wing | • Approximately 21.89 | • Approximately 59.5ha of revegetation/regeneration will be | • In total, 94.71 hectares of vegetation likely to provide | • Revegetation works on the subject site will result in a |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| bat *Miniopterus australis*) & Common bent-wing bat (*Miniopterus schreibersii*) | hectares (29.4%) of potential forage habitat will be removed from the subject site.<br>• This loss relates to the clearing of 21.32 hectares from areas of the site with existing development approvals, and 0.57 hectares from areas of the site without existing development approval.<br>• Given the high mobility of these species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species.<br>• No roost habitat will be affected by the proposed development and it is considered that this species will continue to forage over the retained vegetation on the subject site. | completed in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) to offset any loss of remnant bushland and to provide vegetated links across the site.<br>• Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas are all likely to provide suitable forage habitat for these species in the long-term. | suitable forage habitat for these species will be regenerated/revegetated on the subject site (**FIGURE 28**) to offset the loss of 21.32 hectares. | long-term net gain of approximately 73.39ha of suitable forage habitat for these species. |
| • Eastern free-tail bat | • Approximately 21.89 hectares (29.4%) of | • It is considered that these species will continue to utilise retained | • In total, 94.71 hectares of vegetation likely to provide | • Revegetation works on the subject site will result in a |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| (*Mormopterus norfolkensis*), Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) & Greater broad-nosed bat (*Scoteanax rueppellii*) | potential forage habitat will be removed from the subject site.<br>• This loss relates to the clearing of 21.32 hectares from areas of the site with existing development approvals, and 0.57 hectares from areas of the site without existing development approval.<br>• Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species.<br>• There will be a minor loss of potential roost sites (i.e. hollow-bearing trees) for these species. | vegetation for foraging and retained habitat trees for roosting.<br>• Furthermore, approximately 59.5ha of revegetation/regeneration will be completed in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) to offset any loss of remnant bushland and to provide vegetated links across the site.<br>• Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas are all likely to provide suitable forage habitat for these species in the long-term.<br>• The installation of bat boxes within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will increase roosting opportunities for these species. | suitable forage habitat for these species will be regenerated/revegetated on the subject site (**FIGURE 28**) to offset the loss of 21.89 hectares. | long-term net gain of approximately 72.82ha of suitable forage habitat for these species.<br>• Installation of bat boxes within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will increase roosting opportunities for these species and offset the loss of any hollow-bearing trees. |
| • Wallum sedge-frog (*Litoria olongburensis*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• The proposed development will not remove or modify any area considered to | • 5.82ha of proposed rehabilitation works in accordance with a Freshwater Wetland Rehabilitation Plan (**VOLUME 8**) may result in additional habitat for the Wallum sedge frog on the subject site.<br>• Furthermore, 18.18 hectares of Swamp sclerophyll forest will be | • No core habitat will be removed.<br>• In total, 59.21 hectares of vegetation likely to provide suitable forage habitat will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset | • Revegetation works on the subject site will result in a long-term net gain of approximately 52.391ha of suitable forage habitat, and may also provide areas of core habitat. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
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| | provide core habitat for the Wallum sedge frog.<br>• Approximately 6.82 hectares (16.9%) of this potential forage habitat will be removed from the subject site.<br>• This loss of forage habitat is comprised of 0.99 hectares from areas of the site with existing development approvals, and 5.83 hectares from areas of the site without existing development approval.<br>• Alteration of water quality in drainage lines due to soil runoff from the construction site.<br>• Alteration of hydrology of the drainage lines due to construction.<br>• Contamination or reduction of water quality in drainage lines due to runoff from chemicals or debris (fertilisers, etc).<br>• Introduction of weed species into core habitat areas.<br>• Increased competition | regenerated/revegetated on the subject site (**FIGURE 28**) in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas may also provide suitable habitat for this species.<br>• A detailed Stormwater Management Plan has been prepared for the subject site (Gilbert & Sutherland 2008) utilising current best-practice management techniques which will ensure no adverse impacts on the hydrology of the current core habitat and the proposed rehabilitated freshwater wetland.<br>• Any stormwater treatment devices and sedimentation ponds will be designed so that they provide limited opportunities for the introduced Mosquito fish (*Gambusia* sp.) to breed and hence provide better habitat for native frogs.<br>• Weed control will be completed on the interface of retained habitat by a qualified Bush regenerator;<br>• Weed control will be undertaken | the loss of 6.82 hectares. | |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
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| | from disturbance-adapted native, domestic and introduced fauna (such as Cane toads, Noisy miners, foxes, dogs, cats, rats, etc.). | on a progressive basis over a three (3) – five (5) year period;<br>• A monitoring and maintenance program for areas of retained habitat is included in the Site Regeneration and Revegetation Plan (**VOLUME 5**). | | |
| • Bush hen (*Amaurornis olivaceus*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• The proposed development will result in the removal or modification a total of 0.19 hectares (10.7%) of potential habitat for this species, all of which occurs within portions of the site with existing development approvals.<br>• Due to their crepuscular and nocturnal nature, this species is most likely to be active around dusk or during the night. This may place any birds at risk of disturbance by street lighting and night-time traffic.<br>• Other impacts may include predation by domestic cats. | • Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and Freshwater Wetland Rehabilitation Plan (**VOLUME 8**) will result in the regeneration/revegetation of 18.18 hectares of Swamp sclerophyll forest, 4.81 hectares of Lowland rainforest on floodplain, 9.85 hectares of Lowland rainforest and 5.82 hectares of Freshwater wetland.<br>• Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas may also provide suitable habitat for this species and offset the loss of 0.19ha of habitat.<br>• Traffic movement controls on local roads and awareness signage are to be incorporated into detailed site design<br>• Landowners should control cats. | • In total, 73.87 hectares of vegetation that may provide suitable forage habitat for this species in the long-term will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 0.19 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 73.681ha of potential forage habitat for the Bush hen. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
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| | | All animals should reside within fenced enclosures and be on a leash when outside of the enclosure.<br>• Street lights adjacent to retained habitat areas should be capped. Vegetated buffers and/or dense planted screens will also reduce the impacts of lighting. | | |
| • Glossy black-cockatoo (*Calyptorhynchus lathami*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• The proposed development will result in the removal or modification a total of 9.10 hectares (17.2%) of potential habitat for this species.<br>• This loss of potential habitat is comprised of 8.90 hectares from areas of the site with existing development approvals, and 0.20 hectares from areas of the site without existing development approval.<br>• Given the high mobility of this species, the loss of potential foraging habitat is not considered | • The proposed development will retain large areas of intact forest that will provide continued foraging resources for this species on the subject site.<br>• Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) will result in the regeneration/ revegetation of approximately 59.5ha to offset any loss of vegetation and to provide vegetated links across the site. These works will utilise *Allocasuarina* species where possible to provide suitable forage resources for this species.<br>• Additionally, the installation of nest boxes of a suitable size for cockatoos within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will improve the habitat values of the site for this | • In total, 59.5ha of vegetation that may provide suitable forage habitat for this species in the long-term will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 9.10 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 50.41ha of forage habitat for the Glossy black-cockatoo. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
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| | significant in relation to the regional distribution of habitat for this species. | species and encourage the use of site habitats for nesting purposes. | | |
| • Brolga (*Grus rubicunda*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• Approximately 48.48 hectares (34%) of potential forage habitat will be removed from the subject site.<br>• This loss of forage habitat is comprised of 37.47 hectares from areas of the site with existing development approvals, and 11.01 hectares from areas of the site without existing development approval.<br>• Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species. | • An area in the central portion of the subject site will be rehabilitated in accordance with a Freshwater Wetland Rehabilitation Plan (**VOLUME 8**). This area will provide approximately 5.82 hectares of additional suitable habitat for the Brolga on the subject site.<br>• Furthermore, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site (**FIGURE 28**) in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas may provide suitable habitat for this species and offset any loss of habitat.<br>• Additionally, 93.3 hectares of vegetation within the south-eastern portion of the subject site will be retained and rehabilitated in accordance with the Saltmarsh Rehabilitation Plan (**VOLUME 3**). | • In total, 59.21ha of vegetation that may provide suitable forage habitat for this species in the long-term will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 48.48 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 10.73ha of potential forage habitat for the Brolga. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
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| | | This area currently provides suitable forage habitat for the Brolga and will continue to do so in the long term. | | |
| • Black bittern (*Ixobrychus flavicollis*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• Approximately 2.23 hectares (20.25%) of potential forage habitat will be removed from the subject site.<br>• This loss of forage habitat is comprised of 2.01 hectares from areas of the site with existing development approvals, and 0.22 hectares from areas of the site without existing development approval.<br>• Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species. | • An area in the central portion of the subject site will be rehabilitated in accordance with a Freshwater Wetland Rehabilitation Plan (**VOLUME 8**). This area will provide approximately 5.82 hectares of additional suitable habitat for the Black bittern on the subject site.<br>• Furthermore, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site (**FIGURE 28**) in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas may provide suitable habitat for this species and offset any loss of habitat. | • In total, 59.21ha of vegetation that may provide suitable forage habitat for this species in the long-term will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 2.23 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 56.98ha of potential forage habitat for the Black bittern. |
| • Mangrove honeyeater | • This species has not been recorded from the | • Rehabilitation works in accordance with the Site Regeneration and | • The proposed development will not result in | N/A |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
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| (*Lichenostomus fasciogularis*) | subject site, however potential habitat occurs.<br>• The proposed development will not result in disturbance to or the removal of potential habitat for this species.<br>• Overall, impacts on this species are considered to be relatively low. | Revegetation Plan (**VOLUME 5**) will result in the regeneration/revegetation of 18.18 hectares of Swamp sclerophyll forest.<br>• Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species. These areas may also provide suitable habitat for this species.<br>• Furthermore, 93.3 hectares of vegetation within the south-eastern portion of the subject site will be retained and rehabilitated in accordance with the Saltmarsh Rehabilitation Plan (**VOLUME 3**). This area currently provides stands of mangrove vegetation suitable as forage habitat for the Mangrove honeyeater and will continue to do so in the long term. | disturbance to or the removal of potential habitat for this species.<br>• In total, 53.39ha of vegetation that may provide suitable forage habitat for this species in the long-term will be regenerated/ revegetated on the subject site (**FIGURE 28**). | |
| • White-eared monarch (*Monarcha leucotis*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• Approximately 0.82 hectares (7.3%) of potential forage habitat will be removed from the subject site all of which will be removed from | • Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) will result in the regeneration/ revegetation of 4.81 hectares of Lowland rainforest on floodplain and 9.85 hectares of Lowland rainforest.<br>• These areas may provide suitable habitat for this species and offset | • In total, 14.66ha of vegetation that may provide suitable forage habitat for this species in the long-term will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 0.82 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 13.84ha of potential forage habitat for the White-eared monarch. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
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| | areas of the site with existing development approvals.<br>• Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species. | the loss of 0.82ha of potential habitat. | | |
| • Wompoo fruit-dove (*Ptilinopus magnificus*), Rose-crowned fruit-dove (*Ptilinopus regina*) & Superb fruit-dove (*Ptilinopus superbus*) | • These species have not been recorded from the subject site, however potential habitat occurs.<br>• Approximately 0.82 hectares (7.3%) of potential forage habitat will be removed from the subject site all of which will be removed from areas of the site with existing development approvals.<br>• Given the high mobility of these species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat. | • Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) will result in the regeneration/ revegetation of 4.81 hectares of Lowland rainforest on floodplain and 9.85 hectares of Lowland rainforest.<br>• These areas may provide suitable habitat for the fruit-doves and offset the loss of 0.82ha of potential habitat. | • In total, 14.66ha of vegetation that may provide suitable forage habitat for these species in the long-term will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 0.82 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 13.84ha of potential forage habitat for the fruit-doves. |
| • Collared | • This species has not been | • 93.3 hectares of vegetation within | No forage habitat will be | N/A |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| kingfisher (*Todiramphus chloris*) | recorded from the subject site, however potential habitat occurs.<br>• The proposed development will not result in disturbance to or the removal of potential habitat for this species.<br>• Overall, impacts on this species are considered to be relatively low. | the south-eastern portion of the subject site will be retained and rehabilitated in accordance with the Saltmarsh Rehabilitation Plan (**VOLUME 3**). This area currently provides stands of mangrove vegetation suitable as forage habitat for the Mangrove honeyeater and will continue to do so in the long term. | removed from the subject site. | |
| • Eastern grass owl (*Tyto capensis*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• The proposed development will not result in disturbance to or the removal of potential nesting/roost habitat for this species.<br>• Given the high mobility of this species, the loss of potential foraging habitat on the subject site is not considered significant in relation to the regional distribution of potential foraging habitat for this species.<br>• Increased vehicular | • Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) will result in the regeneration/ revegetation of 18.18 hectares of Swamp sclerophyll forest. These areas may also provide suitable habitat for this species and offset any loss of habitat. | No nesting/roost habitat will be removed from the subject site. | N/A |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
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| | traffic on the subject site may result in the increased risk of vehicular strike. | | | |
| • Large-footed myotis (*Myotis adversus*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• The proposed development will not result in disturbance to or the removal of potential habitat for this species.<br>• Overall, impacts on this species are considered to be relatively low. | • The proposed construction of a number of large lakes covering a total area of approximately 14.1ha is likely to provide suitable forage habitat for this species.<br>• The retention of large areas of intact forest communities, including a number of old growth trees, will continue to provide potential roost sites.<br>• Additionally, the installation of bat boxes within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will improve the habitat values of the site for this species and encourage the use of site habitats for roosting purposes. | No forage habitat will be removed from the subject site. | N/A |
| • Eastern long-eared bat (*Nyctophilus bifax*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• Approximately 0.82 hectares (7.3%) of potential forage habitat will be removed from the subject site, all of which will be removed from areas of the site with | • Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) will result in the regeneration/ revegetation of 4.81 hectares of Lowland rainforest on floodplain, 9.85 hectares of Lowland rainforest and 18.18 hectares of Swamp sclerophyll forest.<br>• Additionally, 35.21 hectares of landscaping will be completed | • In total, 68.05ha of vegetation that may provide suitable forage habitat for this species in the long-term will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 0.82 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 67.23ha of potential forage habitat for the Eastern long-eared bat. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | existing development approvals.<br>• Given the high mobility of this species, the loss of a small area of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species.<br>• The retention of large areas of intact forest communities, including a number of old growth trees, will continue to provide potential roost sites. | within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas may provide additional suitable habitat for this species and offset any loss of habitat.<br>• The installation of bat boxes within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) may also improve the habitat values of the site for this species and encourage the use of site habitats for roosting purposes. | | |
| • Squirrel glider (*Petaurus norfolkensis*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• In total 10.09 hectares (15.3%) of potential habitat (i.e. remnant bushland with hollow-bearing trees) will be lost from the subject site.<br>• The majority of habitat to be removed occurs within portions of the site with existing development approval (i.e. 9.89 hectares) whilst | • Approximately 59.5ha of revegetation/regeneration will be completed in accordance with Site Regeneration and Revegetation Plan (**VOLUME 5**) to offset any loss of remnant bushland and to provide vegetated links across the site.<br>• The retention of large areas of intact forest communities, including a number of old growth trees, will continue to provide potential roost sites.<br>• Additionally, the installation of nest boxes within retained vegetation (in accordance with the | • In total, 59.5ha of vegetation that may provide suitable forage habitat for this species in the long-term will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 10.09 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 49.41ha of potential forage habitat for the Squirrel glider. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | a small area will be removed from areas without current development approvals (i.e. 0.2 hectares).<br>• The loss of potential habitat on the subject site is not considered significant in relation to the regional distribution of habitat for this species. | Vegetation & Fauna Management Plan – **VOLUME 7**) will improve the habitat values of the site for this species and encourage the use of site habitats for denning purposes. | | |
| • Common planigale (*Planigale maculata*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• In total 10.91 hectares (14.1%) of potential habitat will be lost from the subject site.<br>• The majority of habitat to be removed occurs from portions of the site with existing development approval (i.e. 10.71 hectares) whilst a small area will be removed from areas without current development approvals (i.e. 0.2 hectares).<br>• The loss of potential habitat is not considered | • Approximately 59.5ha of revegetation/regeneration will be completed in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) to offset any loss of vegetation and to provide vegetated links across the site.<br>• The retention of large areas of intact forest communities, including a number of old growth trees, will continue to provide potential habitat for this species.<br>• Additionally, the installation of nest boxes within retained vegetation (in accordance with the Vegetation & Fauna Management Plan – **VOLUME 7**) will improve the habitat values of the site for this species and encourage the use of site habitats for denning purposes. | • In total, 59.5ha of vegetation that may provide suitable forage habitat for this species in the long-term will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 10.91 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 48.59ha of potential forage habitat for the Common planigale. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | significant in relation to the regional distribution of habitat for this species.<br>• This species would be particularly susceptible to predation by cats and dogs. | • Landowners will be required to control cats and dogs in accordance with relevant Tweed Shire Council by-laws. | | |
| • Long-nosed potoroo (*Potorous tridactylus*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• The proposed development will not result in disturbance to or the removal of potential habitat for this species.<br>• This species has historically been recorded from the north and south of the existing site access road, which has essentially formed two small sub-populations. Without mitigation, road kills may significantly affect these populations.<br>• Predation by domestic cats and dogs is also a potential impact of the development. | • Approximately 59.5ha of revegetation/regeneration will be completed in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) to offset any loss of vegetation and to provide vegetated links across the site.<br>• It is recommended that the construction of the main access road into the Cobaki Lakes development incorporates a number of underpasses/culverts to encourage movements of potoroos between the two identified sub-populations.<br>• Landowners will be required to control cats and dogs in accordance with relevant Tweed Shire Council by-laws.<br>• Predator control fencing along the interface of the development site and potoroo habitat is also recommended.<br>• With the adoption of these | No known habitat will be removed from the subject site. | N/A |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | | amelioration measures, it is unlikely that the proposed development will result in the extinction of this Endangered Population. | | |
| • Black flying-fox (*Pteropus alecto*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• Approximately 22.15 hectares (26.9%) of potential forage habitat will be removed from the subject site.<br>• This loss relates to the clearing of 21.95 hectares from areas of the site with existing development approvals, and 0.20 hectares from areas of the site without existing development approval.<br>• Suitable roosting habitat for this species may occur in the rainforest community located on Mt. Woodgee which will be retained.<br>• Given the high mobility of this species, the loss of 22.15 hectares of known and potential foraging | • The Grey-headed flying-fox is considered likely to continue foraging within retained areas of vegetation on the site.<br>• Furthermore, 18.18 hectares of Swamp sclerophyll forest will be regenerated/revegetated on the subject site (**FIGURE 28**) in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) and 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas are likely to provide suitable forage habitat for this species and offset the loss of 22.15ha. | • In total, 53.39 hectares of vegetation likely to provide suitable forage habitat for the Black flying-fox will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 22.15 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 31.24ha of suitable forage and/or corridor habitat for the Koala. |

| | Potential impacts | Mitigation measures | Proposed offset | Net loss/gain |
|---|---|---|---|---|
| | habitat is not considered significant in relation to the regional distribution of potential foraging habitat for this species. | | | |
| • Common blossom bat (*Syconycteris australis*) | • This species has not been recorded from the subject site, however potential habitat occurs.<br>• The proposed development will result in the removal or modification a total of 3.8 hectares of Swamp sclerophyll forest on floodplain.<br>• Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species. | • Rehabilitation works in accordance with the Site Regeneration and Revegetation Plan (**VOLUME 5**) will result in the regeneration/revegetation of 18.18 hectares of Swamp sclerophyll forest.<br>• Additionally, 35.21 hectares of landscaping will be completed within Open Space areas of the site and will utilise Swamp sclerophyll forest species.<br>• These areas may provide additional suitable forage habitat for this species and offset any loss of habitat. | • In total, 53.39 hectares of vegetation likely to provide suitable forage habitat for the Black flying-fox will be regenerated/ revegetated on the subject site (**FIGURE 28**) to offset the loss of 3.8 hectares. | • Revegetation works on the subject site will result in a long-term net gain of approximately 49.59ha of suitable forage and/or corridor habitat for the Common blossom bat. |

# REFERENCES

Barry D.H. (1981) A preliminary survey of the terrestrial vertebrates of the Proposed Cobaki Village Shire, Tweed Shire, NSW.

Briggs J.D. and Leigh, J.H. (1995) Rare or Threatened Australian Plants. CSIRO Division of Plant Industry.

CSIRO - Division of Wildlife and Ecology (1995). Murwillumbah Management Area-Fauna Survey.

Debus, S.J.S. (1993) The mainland Masked Owl *Tyto novaehollandiae*. A Review. Aust. Bird Watcher 15, 168-191.

Debus S.J.S and Rose A.B. (1994) The Masked Owl *Tyto novaehollandiae* in New South Wales, *Australian Birds*, **8**: 40-65.

Debus S.J.S. & Chafer C.J. (1994) The Powerful Owl *Ninox strenua* in NSW. Aust Birds, 28: 40-64.

Department of Environment & Conservation (2005). Draft Recovery Plan for the Large Forest Owls. DEC, Sydney.

Frith, H.J. (1952) Notes on the pigeons of the Richmond River, NSW. Emu, 52: 88-99.

Hero J-M, Phillips S. and Shoo L. (2001) Survey for Reptiles, Amphibians and Mammals Inhabiting the Northern Section of the Proposed Tugun Bypass, prepared for PPK Environment & Infrastructure, Brisbane.

Kavanagh, R.P. and Murray, M. (1996). Home range, Habitat and Behaviour of the Masked Owl *Tyto novaehollandiae* near Newcastle, New South Wales. Emu, 96. Pp250-257.

Lindsey, R.L. (1992) Encyclopaedia of Australian Animals: Birds The Australian Museum, Sydney.

Maciejewski S.E. (1996) The Grass Owl *Tyto Capensis* in North-eastern New South Wales, pp 54-70, in: *Australian Raptor Studies II, Birds Australia Monograph 3*, (Eds) Szechura and Debus S., Birds Australia, Melbourne.

Marchant, S & Higgins, P.J. (coordinators) (1990) Handbook of Australian, New Zealand and Antarctic Birds. Vol. 1 Ratites to Ducks. Oxford University Press, Melbourne.

Marchant, S & Higgins, P. J. (eds) (1993) Handbook of Australian, New Zealand and Antarctic Birds. Vol. 2. Raptors to Lapwings. Oxford University Press, Melbourne.

National Parks and Wildlife (2003) Voluntary Conservation on Private and Public Land – Protecting Remnant Bush. Note 11 – 2003 located at nationalparks.nsw.gov.au/PDFs/Factsheet11_Protecting_remnants.pdf

NSW State Forests (1995) Dorrigo Management Area. Proposed Forestry Operations, Interim (3 years) Environmental Impact Statement: Volume C - Fauna Species Profiles, State Forests of NSW, Sydney.

Recher H.F. and Date E.M. (1988) Distribution and abundance of rainforest pigeons in NSW. Report to the NSW NPWS.

Shields J.M. (1995) Wildlife Management Prescriptions for Logging in Even-aged and Multi-aged Regrowth Forests, North of Narooma Management Area, unpublished report by State Forests of NSW and NSW National Parks and Wildlife Service.

Sherringham and Westaway (1995). Significant vascular plants of northern NSW. A report to the NSW NPWS and Northern Region Audit Council.

State Forests of NSW. (1995) Coffs Harbour Urunga Management Area - Environmental Impact Statement. Vol C, Proposed forestry operations - Schedule 12 Fauna. SFNSW, Northern Region.

Warren J, Holloway G & Scotts D (1994) "Draft Management Plan for the Long-nosed Potoroo (*Potorous tridactylus*)". Report prepared for Cobaki Lakes (Calsonic Management Services Pty Ltd).

White, A.W., (1995). Frog Survey of Taree and Coopernook Management Areas and Marsh State Forest. Unpublished Report. State Forests of New South Wales.

Wright A.E. (2001) "Cobaki Lakes Development, Anglican School: Mosquito Management Options". Report prepared for Cobaki Lakes (Leda Development Pty Ltd).

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ENVIRONMENTAL CONSULTANTS

RESPONSE TO THE DIRECTOR GENERAL'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

# COBAKI LAKES

# VOLUME 2 - APPENDICES TO THE ECOLOGICAL ASSESSMENT

AS AMENDED
NOVEMBER 2008

A REPORT TO LEDA MANORSTEAD PTY LTD

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# Appendix 1 – Literature Review

## 1.1 Introduction

A number of Flora and Fauna Reports and other sources of information have been prepared for the subject site and surrounding areas. These include:

- Cameron McNamara (1983), Cobaki Village Environmental Study (Report Prepared for the Bradshaw Group).
- WBM (1990), Evaluation of Terrestrial Fauna – Cobaki Community Project.
- WBM (1991a), Greater Gliders of the Cobaki Lakes Project Property, Cobaki, NSW.
- WBM (1991b), Flora and Fauna Studies, Proposed Boyd Street Extension to Cobaki.
- Warren (1992), Fauna Impact Assessment of the Proposed Boyd Street Access.
- Warren (1993), Flora and Fauna survey of proposed cut/fill areas at Cobaki Lakes development (Unpublished Report).
- Warren (1994), Flora and Fauna survey of the Cobaki Lakes development site (Unpublished report).
- Debus (1994), Bird Survey of the Cobaki Community Project Site.
- Woodward-Clyde (1997), A Flora and Fauna Assessment of Parcels 7, 8, 9 and 10 of the "Cobaki Lakes Residential Development"
- Woodward-Clyde (1997), Species Impact Statement - AGC Woodward-Clyde Pty Ltd.
- Parker (1999), A Species Impact Statement for the Cobaki Lakes Project.
- EcoPro Pty Ltd (2004), Tugun Bypass: Species Impact Statement. A report prepared for the Queensland Department of Main Roads.

These documents were reviewed as part of this Ecological Assessment and a summary of findings is provided below.

## 1.2 Results

### *1.2.1 Cameron McNamara (1983), Cobaki Village Environmental Study (Report Prepared for the Bradshaw Group)*

The fauna survey component of this study was carried out by Barry (1981). This survey was mainly restricted to less elevated portions of the site. Barry set a number of trap lines and one drift fence with pits.

Eight (8) reptiles and ten (10) amphibians, including the Wallum froglet (*Crinia tinnula*), were noted as occurring. The Wallum froglet is contained on Schedule 2 – Vulnerable, of the Threatened Species Conservation Act (1995). It is unclear from Barry's report as to where the Wallum froglet was recorded. Barry's report included a comprehensive bird species list (78 birds). Five (5) native mammal species were also recorded.

Threatened fauna recorded during this survey were the Wallum froglet (*Crinia tinnula*) and Osprey (*Pandion haliaetus*).

### *1.2.2 WBM (1990), Evaluation of Terrestrial Fauna – Cobaki Community Project*

The survey was carried out in January and February 1990 and consisted of daylight observations for mammals, birds, reptiles and amphibians and spotlight observations at night for nocturnal birds and larger mammals. All major habitat types were surveyed.

A representative live-trapping survey was designed in order to evaluate the current status of small mammals recorded by Barry (1981) at his trapping Site E. The actual location used by Barry had been cleared during 1982-1985 necessitating the setting of the trap line in representative, nearby vegetation.

Eighty-two (82) species of birds, nine (9) species of mammals (including two (2) introduced species), three (3) species of reptile and three (3) amphibians (including one (1) introduced species) were recorded on the site.

All bird species observed were coastal species commonly occurring throughout the region, with the exception of two (2) Threatened species - the Osprey and Black-necked Stork. The most significant mammal species recorded was the Greater Glider, observed in the Open Forest community of the upper ridges in the western corner of the Cobaki property.

Freycinet's frog (*Litoria freycineti*) and the Wallum froglet (*Crinia tinnula*) were heard in a drainage line near to the small mammal trapping area.

### *1.2.3 WBM (1991a), Greater Gliders of the Cobaki Lakes Project Property, Cobaki, NSW*

A population of Greater Gliders was recorded in the Blackbutt forest on the Cobaki site. A report was prepared by WBM which related to an evaluation of the ecological requirements and conservation strategies required for this species. The recommendations within this report were aimed at ameliorating any potential impacts of development on this species and to provide guidelines for long term management of Glider habitat on the site.

### *1.2.4 WBM (1991b), Flora and Fauna Studies, Proposed Boyd Street Extension to Cobaki*

The survey (carried out in October and November 1991) centred on the fauna existing in the Crown Reserve area between the QLD – NSW border and the Cobaki property boundary. The survey included day and night observations for large mammals, small mammal trapping (cage and Elliot), pitfall trapping and bird survey.

No Threatened species were recorded during this survey. It was concluded that a fire that burnt through much of the area of the Crown Reserve two (2) months prior to this survey could have led to an underestimation of the species diversity in the area.

The vegetation study was completed to assess any changes in vegetation structure that may have occurred since the previously survey by the McNamara (1983). WBM (1990b) identified eight (8) plant communities on the site. No threatened flora species were recorded. However it is noted that the Coolamon (*Syzygium moorei*) is a possible occurrence if an intensive survey was completed.

### *1.2.5 Warren (1992), Fauna Impact Assessment of the Proposed Boyd Street Access*

Further survey work was carried out within the Crown reserve in the area of the proposed Boyd Street Extension. This survey targeted a number of Threatened fauna species and consisted of Elliott & cage trapping, frog surveys and harp net surveys. A frog survey of Barry's Site E and the SEPP 14 Wetlands No. 1 was carried out after rain on the night of 9 September 1992.

Two (2) Threatened frog species were recorded in the SEPP 14 Wetlands - the Wallum froglet and the Wallum sedge-frog. Both species are listed as Threatened fauna under Schedule 2 of the Threatened Species Conservation Act (1995), and the Wallum sedge-frog is also listed as Vulnerable within schedules of the EPBC Act (1999).

A survey in Crown Land south-east of the proposed Boyd Street access road also recorded the presence of the Threatened Long-nosed Potoroo (*Potorous tridactylus*). A management plan was subsequently prepared (Warren *et al*. 1994) to ensure the conservation and viability of this population.

### *1.2.6 Warren (1993), Flora and Fauna survey of proposed cut/fill areas at Cobaki Lakes development (Unpublished Report)*

The area subject of the bulk earthworks (cut and fill) was the subject of an intensive fauna survey in April and May 1993 and again in October and November 1994. Most of the areas surveyed contained a much depleted understorey which meant that very few terrestrial mammal, reptile and bird species would be expected to occur.

The surveys centred on the identification of Threatened fauna given that numerous studies had already been carried out on the site. Observations on the site recorded the presence of Black-necked storks (male & female) foraging on the low lying land in the south-eastern portion of the site. The survey also recorded the presence of an Osprey nest in Blackbutt Open Forest. This nest was additional to the existing active nest recorded for a number of years near the Broadwater. At the time of the survey there were two (2) birds actively tending the nest and feeding on nearby branches.

Spotlighting surveys also confirmed the presence of Greater Gliders in Blackbutt forest in the northern portion of the site. WBM made one sighting of this species in this location in October 1991.

### *1.2.7 Warren (1994), Flora and Fauna survey of the Cobaki Lakes development site (Unpublished report)*

Supplementary work in the proposed cut/fill areas (C5, F8-11) was carried out in September and October 1994. Again this survey work was designed to record Threatened fauna species. The survey consisted of Elliott trapping and hair tube sampling. Bat echo-location survey, spotlighting and the plotting of possible habitat trees was also carried out. This plotting survey included all trees with obvious hollows.

Survey work involving habitat tree identification, bird census and Microchiropteran bat analysis was extended from the cut/fill areas to include the most of the remainder of the site. Approximately sixty-one (61) possible habitat trees were located and plotted. Many of these trees were located outside of the Phase 1 development area.

Approximately 483 trees in the Scribbly gum/ Swamp mahogany community, and the Blackbutt community in the Stages 7-10 and SIS Study site were assessed for Koala activity. Most of the trees inspected were restricted to Grey gum, Tallowwood and Forest red gum as these are known to be preferentially browsed by Koalas in the region. The analysis was based on scratch density on trees as well as the occurrence of faecal pellets around the base of the tree. Each tree was allocated a rating of 0-5 depending on the density of pellets or scratch marks. 0 indicated absence of Koala activity whilst 5 indicated a level of high activity. Only a very small number of trees showed any indication of activity and none of the trees showed an activity level greater than 2. In some cases it was difficult to ascribe the scratches to Koalas as there were no faecal pellets and it is known that Common brushtail possums and Lace monitors occur on the site.

A Microchiropteran bat survey was carried out in ten (10) separate locations on the Cobaki site. The site was split up into these areas to allow a more accurate analysis of bat occurrence. Five (5) Threatened species were recorded as follows:

- Eastern free-tail bat (*Mormopterus norfolkensis*);
- Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*);
- Common bent-wing bat (*Miniopterus schreibersii*);
- Little bent-wing bat (*Miniopterus australis*); and
- Greater broad-nosed bat (*Scoteanax rueppellii*).

A Broad-nosed bat recorded at Sites E and J was an un-described species at the time that appeared to be restricted to the North Coast of New South Wales and southern coastal Queensland.

The call of two Powerful owls was recorded during the Microchiropteran bat survey. These owls were recorded during November 1994 in the Blackbutt Open Forest in the north-east portion of the site (near the Osprey nest).

### *1.2.8 Debus (1994), Bird Survey of the Cobaki Community Project Site*

Debus (1994) carried out a survey of the bird fauna on the site in November 1994. The aim of this survey was to confirm the presence of the Powerful owl and also to target other Threatened bird species. This survey was restricted to the dune in the eastern

portion of the site (Scribbly gum community) and the extensive elevated ridge in the western portion of the site dominated by Blackbutt Open Forest.

One Threatened fauna species was recorded during this survey, the Masked Owl (*Tyto novaehollandiae*). During the bird survey three (3) Greater Gliders (*Petauroides volans*) were observed in a similar location to those observed by WBM (1991a), i.e. in the elevated ridge-line Blackbutt Open Forest in the western portion of the site.

### *1.2.9 Woodward-Clyde (1997), A Flora and Fauna Assessment of Parcels 7, 8, 9 and 10 of the "Cobaki Lakes Residential Development"*

Woodward-Clyde (1997) carried out a fauna survey in May and July 1997 on the Subject site. A report was prepared for Leda Developments, this report outlines the Part 5A of the EPA Act factors to be considered in deciding whether there is a likely to be a significant effect on Threatened species, populations or ecological communities.

An assessment was completed for eleven (11) threatened species recorded on the subject site. Part 5A of the Environmental Planning and Assessment Act (1979) it is concluded that there is unlikely to be a significant effect on any threatened species populations or ecological community. Therefore there is no requirement to submit a SIS with the DA for the proposed development.

### *1.2.10 Woodward-Clyde (1997), Species Impact Statement - AGC Woodward-Clyde Pty Ltd*

A detail botanical survey was undertaken between April and June 1997 and twelve (12) vegetation communities have been mapped. Several of the significant species were recorded as ROTAP (Briggs & Leigh 1996) are now currently listed as threatened species under the *Threatened Species Conservation Act 1979,* including:

- Spiny gardenia (*Randia moorei*);
- Veiny lace flower (*Archidendron muellerianum*);
- Brush cassia (*Cassia brewsteri* var. *marksiana*);
- Marblewood (*Acacia bakeri*); and
- Coolamon (*Syzygium moorei*).

The fauna section of the SIS relies on the comprehensive fauna study effort which has been previously completed on the site. A complete fauna list from the previous sixteen (16) years of surveys includes the following threatened species:

- Koala (*Phascolarctos cinereus*);
- Eastern free-tail bat (*Mormopterus norfolkensis*);
- Yellow-bellied sheathtail bat (*Saccolaimus flaviventris);*
- Common bent-winged bat *(Miniopterus schreibersii);*
- Little bent-winged bat *(Miniopterus australis)*
- Wallum froglet(*Crinia tinnula*);
- Osprey (*Pandion haliaetus*);
- The Wallum Tree-frog;

- The Long-nosed Potoroo (*Potorous tridactylus*);
- Black-neck stork
- Masked owl (*Tyto novaehollandiae*); and
- Powerful owl (*Ninox strenua*).

Since this report has been published several of the recorded fauna species have been listed under the *Threatened Species Conservation Act 1979.* The Grey headed flying fox (*Pteropus poliocephalus*) was recorded on the site and has recently been gazetted as vulnerable.

### *1.2.11 Parker (1999), A Species Impact Statement for the Cobaki Lakes Project*

Parker used the vegetation descriptions from WBM (1990a) as a basis of the vegetation assessment. Parker recorded nine (9) plant communities and several significant flora species including:

- *Cordyline congesta;*
- Smooth scrub turpentine;
- Brush cassia; and
- Marblewood.

The fauna section of the SIS relies on the comprehensive fauna study effort which has been previously completed on the site. A complete fauna list from the previous sixteen (16) years of surveys includes the following threatened species recorded on site:

- Koala (*Phascolarctos cinereus*);
- Eastern free-tail bat (*Mormopterus norfolkensis*);
- Yellow-bellied sheathtail bat (*Saccolaimus flaviventris);*
- Common bent-winged bat *(Miniopterus schreibersii);*
- Little bent-winged bat *(Miniopterus australis)*
- Wallum froglet(*Crinia tinnula*);
- Osprey (*Pandion haliaetus*);
- Black-neck stork
- Masked owl (*Tyto novaehollandiae*); and
- Powerful owl (*Ninox strenua*).

### *1.2.12 EcoPro Pty Ltd (2004), Tugun Bypass: Species Impact Statement.*

EcoPro Pty Ltd were engaged by the Queensland Department of Main Roads to comleted a Species Impact Statement (SIS) for the Tugun Bypass. The Tugun Bypass is a recently constructed motorway between Currumbin in Queensland and Tweed Heads in NSW. The northern limit of the bypass joins the Pacific Motorway at Stewart Road, Currumbin. The route then follows an alignment to the east of the Cobaki Lakes site and to the west of the Gold Coast Airport main runway, joining the Pacific Highway on the Tweed Heads Bypass just north of Kennedy Drive, Tweed Heads in NSW.

The vegetation assessment relied on data collected by Mike Olsen (Land Assessment Management and Rehabilitation Pty Ltd) and Andrew Benwell (Flora Consultant) in 2000 and 2001.

Olsen & Benwell recorded a total of nine (9) Threatened flora species along the Tugun Bypass alignment:

- White lace flower (*Archidendron hendersonii*)
- Stinking cryptocarya (*Cryptocarya foetida*)
- Green-leaved rose-walnut (*Endiandra muelleri* subsp. *Bracteata*)
- Pink nodding orchid (*Geodorum densiflorum*)
- White yiel yiel (*Grevillea hilliana*)
- Fine-leaved tuckeroo (*Lepiderema pulchella*)
- Rough-shelled bush-nut (*Macadamia tetraphylla*)
- Swamp orchid (*Phaius australis*)
- Coolamon (*Syzygium moorei*)

Five (5) ROTAP species were also recorded:

- Veiny lace flower (*Archidendron muellerianum*)
- Coastal cordyline (*Cordyline congesta*)
- Long-leaved tuckeroo (*Cupaniopsis newmanii*)
- Black walnut (*Endiandra globosa*)
- Smooth scrub turpentine (*Rhodamnia maideniana*)

Terrestrial vertebrate fauna reports commissioned as part of the Tugun Bypass SIS included:

1. Survey for Reptiles, Amphibians and Mammals Inhabiting Coastal Lowland Areas Associated with the Proposed Tugun Bypass (Hero et al. 2000);
2. Survey for Reptiles, Amphibians and Mammals Inhabiting the Northern Section of the Proposed Tugun Bypass (Hero et al. 2001);
3. Supplementary Surveys of Planigales, Eastern Long-eared Bat and Wallum Sedge Frogs within the Proposed Tugun Bypass (Hero et al. 2001);
4. Amelioration and Monitoring Measures for the Conservation of Herpetofauna along the Proposed Tugun Bypass (Hero et al. 2001);
5. Assessment of the Impact of the Proposed Tugun Bypass: Terrestrial and Estuarine Birds (Sandpiper Ecological Surveys 2001);
6. Tugun Bypass Assessment of Impacts on Birds: Boyd Street Interchange to Stewart Road (Sandpiper Ecological Surveys 2001);
7. The Status and Distribution of the Cobaki Long-nosed Potoroo Population (Bali et al. 2003); and
8. Systematic Surveys for the Coastal Planigale (Planigale maculata) on Crown lands and a Detailed Habitat Appraisal of the Tugun/Cobaki Locality (Lewis 2004).

In total, twenty-five (25) Threatened fauna species were recorded along the Tugun Bypass alignment:

- Wallum sedge-frog (*Litoria olongburensis*)
- Bush hen (*Amaurornis olivaceus*)
- Glossy black-cockatoo (*Calyptorhynchus lathami*)
- Brolga (*Grus rubicunda*)
- Black bittern (*Ixobrychus flavicollis*) – Unconfirmed sighting
- Mangrove honeyeater (*Lichenostomus fasciogularis*)
- Wallum froglet (*Crinia tinnula*)
- White-eared monarch (*Monarcha leucotis*)
- Osprey (*Pandion haliaetus*)
- Wompoo fruit-dove (*Ptilinopus magnificus*)
- Rose-crowned fruit-dove (*Ptilinopus regina*)
- Superb fruit-dove (*Ptilinopus superbus*) - Unconfirmed sighting
- Collared kingfisher (*Todiramphus chloris*)
- Eastern grass owl (*Tyto capensis*)
- Masked owl (*Tyto novaehollandiae*)
- Black-necked stork (*Xenorhynchus asiaticus*)
- Little bent-wing bat (*Miniopterus australis*)
- Large-footed myotis (*Myotis adversus*)
- Eastern long-eared bat (*Nyctophilus bifax*)
- Squirrel glider (*Petaurus norfolcensis*)
- Common planigale (*Planigale maculata*)
- Long-nosed potoroo (*Potorous tridactylus*)
- Black flying-fox (*Pteropus alecto*)
- Grey-headed flying-fox (*Pteropus poliocephelus*)
- Common blossom bat (*Syconycteris australis*).

## 1.3 Summary

The literature review has revealed the presence (historically) of twelve (12) Threatened fauna species (**TABLE 1**), four (4) Threatened flora species (**TABLE 2**) and three (3) Rare or Threatened Australian Plants (ROTAP) (Briggs & Leigh 1996) listed flora species (**TABLE 2**).

Species status is listed below in accordance with the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act 1999), NSW *Threatened Species Conservation Act 1995* (TSC Act 1995) and ROTAP (Briggs & Leigh 1996).
The literature review has revealed the presence (historically) of twelve (12) Threatened fauna species on the subject site with an additional nineteen (19) Threatened species recorded during surveys on adjacent land (**TABLE 1**).

The literature review has also revealed the presence (historically) of four (4) Threatened flora species and three (3) Rare or Threatened Australian Plants (ROTAP) (Briggs & Leigh 1996) listed flora species on the subject site, with an additional eight (8) Threatened flora species and two (2) ROTAP flora species recorded during surveys on adjacent land (**TABLE 2**).

Species status is listed below in accordance with the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act 1999), NSW *Threatened Species Conservation Act 1995* (TSC Act 1995) and ROTAP (Briggs & Leigh, 1996).

**TABLE 1**
**THREATENED FAUNA SPECIES RECORDED ON OR ADJACENT TO THE SUBJECT SITE**

| Common name | Scientific name | Status | Source |
|---|---|---|---|
| Wallum froglet | *Crinia tinnula* | Vulnerable (TSC Act 1995) | McNmarra 1983, WBM 1990, Warren 1992, 1993, Woodward-Clyde 1997, EcoPro 2004 |
| Wallum sedge-frog* | *Litoria olongburensis* | Vulnerable (TSC Act 1995) & Endangered (EPBC Act 1999) | Warren 1992, Woodward-Clyde 1997, EcoPro 2004 |
| Bush hen* | *Amaurornis olivaceus* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Glossy black-cockatoo* | *Calyptorhynchus lathami* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Brolga* | *Grus rubicunda* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Black bittern*[U] | *Ixobrychus flavicollis* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Mangrove honeyeater* | *Lichenostomus fasciogularis* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| White-eared monarch* | *Monarcha leucotis* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Powerful owl | *Ninox strenua* | Vulnerable (TSC Act 1995) | Warren 1993, 1994, Woodward-Clyde 1997 |
| Osprey | *Pandion haliaetus* | Vulnerable (TSC Act 1995) | McNmarra 1983, WBM 1990, Warren 1992, 1993, Woodward-Clyde 1997, EcoPro 2004 |
| Wompoo fruit-dove* | *Ptilinopus magnificus* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Rose-crowned fruit-dove* | *Ptilinopus regina* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Superb fruit-dove*[U] | *Ptilinopus superbus* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Collared kingfisher* | *Todiramphus chloris* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Eastern grass owl* | *Tyto capensis* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Masked owl | *Tyto novaehollandiae* | Vulnerable (TSC Act 1995) | Debus 1994, Woodward-Clyde 1997, EcoPro 2004 |

| Common name | Scientific name | Status | Source |
|---|---|---|---|
| Black neck-stork | *Xenorhynchus asiaticus* | Endangered (TSC Act 1995) | WBM 1990, Warren 1993, Woodward-Clyde 1997, EcoPro 2004 |
| Little bent-wing bat | *Miniopterus australis* | Vulnerable (TSC Act 1995) | Warren 1994, Woodward-Clyde 1997, EcoPro 2004 |
| Common bent-wing bat | *Miniopterus schreibersii* | Vulnerable (TSC Act 1995) | Warren 1994, Woodward-Clyde 1997 |
| Eastern free-tail bat | *Mormopterus norfolkensis* | Vulnerable (TSC Act 1995) | Warren 1994, Woodward-Clyde 1997 |
| Large-footed myotis* | *Myotis adversus* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Eastern long-eared bat* | *Nyctophilus bifax* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Squirrel glider* | *Petaurus norfolkensis* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Koala | *Phascolarctos cinereus* | Vulnerable (TSC Act 1995) | Woodward-Clyde 1997 |
| Common planigale* | *Planigale maculata* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Long-nosed potoroo* | *Potorous tridactylus* | Vulnerable (TSC Act 1995) | Warren 1992, Woodward-Clyde 1997, EcoPro 2004 |
| Black flying-fox* | *Pteropus alecto* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Grey-headed flying-fox | *Pteropus poliocephelus* | Vulnerable (EPBC Act) | Woodward-Clyde 1997, EcoPro 2004 |
| Yellow-bellied sheathtail bat | *Saccolaimus flaviventris* | Vulnerable (TSC Act 1995) | Warren 1994, Woodward-Clyde 1997 |
| Greater broad-nosed bat | *Scoteanax rueppellii* | Vulnerable (TSC Act 1995) | Warren 1994 |
| Common blossom bat* | *Syconycteris australis* | Vulnerable (TSC Act 1995) | EcoPro 2004 |

* Historically recorded adjacent to the subject site only
[U] Unconfirmed sighting

**TABLE 2**
**THREATANED FLORA SPECIES RECORDED ON OR ADJACENT TO THE SUBJECT SITE**

| Common name | Scientific name | Status | Source |
|---|---|---|---|
| Marblewood | *Acacia bakeri* | Vulnerable (TSC Act 1995) | Woodward-Clyde 1997, Parker 1999 |
| White lace flower* | *Archidendron hendersonii* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Veiny lace flower | *Archidendron muellerianum* | ROTAP LISTED | Woodward-Clyde 1997, EcoPro 2004 |
| Brush cassia | *Cassia brewsteri* var. *marksiana* | Endangered (TSC Act 1995) | Woodward-Clyde 1997, Parker 1999 |
| Coastal cordyline | *Cordyline congesta* | ROTAP LISTED | Parker 1999, EcoPro 2004 |
| Stinking cryptocarya* | *Cryptocarya foetida* | Vulnerable (TSC Act 1995 & EPBC Act 1999) | EcoPro 2004 |
| Long-leaved tuckeroo* | *Cupaniopsis newmanii* | ROTAP LISTED | EcoPro 2004 |
| Black walnut* | *Endiandra globosa* | ROTAP LISTED | EcoPro 2004 |
| Green-leaved rose-walnut* | *Endiandra muelleri* subsp. *bracteata* | Endangered (TSC Act 1995) | EcoPro 2004 |
| Pink nodding orchid* | *Geodorum densiflorum* | Endangered (TSC Act 1995) | EcoPro 2004 |
| White yiel yiel* | *Grevillea hilliana* | Endangered (TSC Act 1995) | EcoPro 2004 |
| Fine-leaved tuckeroo* | *Lepiderema pulchella* | Vulnerable (TSC Act 1995) | EcoPro 2004 |
| Rough-shelled bush-nut* | *Macadamia tetraphylla* | Vulnerable (TSC Act 1995 & EPBC Act 1999) | EcoPro 2004 |
| Swamp orchid* | *Phaius australis* | Endangered (TSC Act 1995 & EPBC Act 1999) | EcoPro 2004 |
| Spiny gardenia | *Randia moorei* | Endangered (TSC Act 1995 & EPBC Act 1999) | Woodward-Clyde 1997 |
| Smooth scrub turpentine | *Rhodamnia maideniana* | ROTAP LISTED | Parker 1999, EcoPro 2004 |
| Coolamon | *Syzygium moorei* | Vulnerable (TSC Act 1995) | Woodward-Clyde 1997, EcoPro 2004 |

* Historically recorded adjacent to the subject site only

# Appendix 2 - Flora Assessment

## 1.1 Introduction

This section of the report discusses the methods used in the vegetation assessment and provides a description of the location, composition and extent of the vegetation communities on the Subject site.

## 1.2 Methodology

### *1.2.1 Database searches*

Searches of the NPWS database were completed to find records of National and NSW Threatened flora, known to occur within 10km of the Subject site.

### *1.2.2 Literature review*

A number of Flora and Fauna Reports and other sources of information have been prepared for the subject site and surrounding areas. These documents were reviewed as part of this Ecological Assessment and a detailed Literature Review is provided as **ANNEXURE 1**.

### *1.2.3 Vegetation Assessment*

A broad-scale vegetation survey was completed by two (2) scientists on the 8th, 10th and 11th July 2005 over a total period of twelve (12) hours. Vegetation communities were assessed and mapped to ascertain their ecological value and levels of disturbance.

A detailed vegetation assessment was completed by three (3) scientists on the 9th and 10th of July 2007 and two (2) scientists on the 11th of July 2007 over a total period of twenty (20) hours.

All vegetation was traversed during the site assessment and vegetation communities were described with referenced to the Walker & Hopkins vegetation classification system (Walker & Hopkins 1990).

All vegetation was assessed with particular attention to the areas of high diversity and structural complexity.

Rare and Threatened flora targeted during the site assessment include flora listed as Vulnerable or Endangered under the *Threatened Species Conservation Act 1995* (TSCA 1995) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); flora listed in Rare or Threatened Australian Plants (ROTAP) (Briggs & Leigh 1995); and significant flora described by Sheringham & Westaway (1995).

Endangered Ecological Communities (EEC's) were identified by JWA (2007) with reference to the EEC's listed for the North Coast Bio-region and the final determination from the NSW Scientific Committee (NSW NPWS website 2007).

In addition, the conservation status of vegetation communities is discussed with reference to the Regional Forestry Agreement (RFA), the occurrence of significant vegetation such as EEC's, Threatened or ROTAP flora, the presence of Camphor laurel, and the size and connectivity of remnant vegetation.

Conservation values for the site are summarised in **TABLE 1**.

**TABLE 1**
**CONSERVATION VALUES FOR THE SITE**

| Conservation value | Criteria |
|---|---|
| Low | Generally pasture grassland, highly disturbed/exotic vegetation, crops |
| Low - Moderate | Scattered native trees within grassland, disturbed/exotic vegetation |
| Moderate | Disturbed/fragmented native vegetation with a moderate – high presence of Camphor laurel |
| Moderate - High | Native vegetation with a lower occurrence of Camphor laurel, tending to be larger and less disturbed, containing ROTAP or Threatened flora species |
| High | Larger areas of native vegetation with little Camphor laurel, containing Threatened species, indicative of Endangered Ecological Communities (EEC's). |

## 1.3 Results

### *1.3.1 Results of Database Searches*

A search of the NPWS Database revealed twenty-six (26) Threatened Flora species within 10km of the Subject site. These species are shown in **TABLE 2**.

**TABLE 2**
**NPWS DATABASE RECORDS OF THREATENED FLORA SPECIES WITHIN 10 KM OF THE SUBJECT SITE**

| Common name | Botanical name |
|---|---|
| Baker's wattle | *Acacia bakeri* |
| Scented acronychia | *Acronychia littoralis* |
| Rusty plum | *Amorphospermum whitei* |
| Sweet myrtle | *Austromyrtus fragrantissima* |
| Yellow satinheart | *Bosistoa transversa* |
| Brush cassia | *Cassia brewsteri var.* |

| Common name | Botanical name |
|---|---|
| | *marksiana* |
| Stinking cryptocarya | *Cryptocarya foetida* |
| Corokia | *Corokia whiteana* |
| Smooth Davidson's Plum | *Davidsonia johnsonii* |
| Red-fruited ebony | *Diospyros mabacea* |
| Small-leaved tamarind | *Diploglottis campbellii* |
| Crystal Creek Walnut | *Endiandra floydii* |
| Rusty rose walnut | *Endiandra hayesii* |
| Green-leaved rose walnut | *Endiandra muelleri* subsp. *bracteata* |
| Pink nodding orchid | *Geodorum densiflorum* |
| Axe-breaker | *Geijera paniculata* |
| Sweet myrtle | *Gossia fragrantissima* |
| White Yiel Yiel | *Grevillea hilliana* |
| Fine-leaved tuckeroo | *Lepiderema pulchella* |
| Rough-shelled bush nut | *Macadamia tetraphylla* |
| Southern swamp orchid | *Phaius australis* |
| Spiny gardenia | *Randia moorei* |
| Small-leaved hazelwood | *Symplocos baeuerlenii* |
| Red lilly pilly | *Syzygium hodgkinsoniae* |
| Coolamon | *Syzygium moorei* |
| Queensland Xylosma | *Xylosma terrae-reginae* |

### *1.3.2 Results of Literature Review*

A number of Vegetation Studies and Flora and Fauna Surveys have been carried out on the Cobaki Lakes site over the past thirty-four (34) years. Results of a detailed Literature Review are included in **APPENDIX 1.**

Based on previous surveys within the locality, the following Threatened and significant flora species have been recorded, were considered as possible occurrences on the site:

- Fine-leaved tuckeroo (*Lepiderema pulchella*) - Vulnerable (TSC Act 1995, EPBC Act 1999);
- Spiny gardenia (*Randia moorei)* - Endangered (TSC Act 1995);
- Marblewood (*Acacia bakeri*) - Vulnerable (TSC Act 1995); and
- Brush cassia (*Cassia brewsteri* var. *marksiana*) - Endangered (TSC Act 1995).

Significant species (ROTAP) include:

- Coast cordyline (*Cordyline congesta);*
- Veiny laceflower (*Archidendron muellerianum*);
- Long-leaved tuckeroo (*Cupaniopsis newmanii*);
- Black walnut (*Endiandra globosa*); and
- Smooth scrub turpentine (*Rhodamnia maideniana*).

### *1.3.3 Results of Vegetation Assessment*

Due to extensive earth works and clearing activities that are currently being undertaken several patches of vegetation are being modified. These construction works may result in changes to the extent and/or structure of vegetation communities recorded and mapped during this assessment.

Eighteen (18) broad vegetation associations comprising twenty-four (24) vegetation communities were identified on the Subject site. These communities are described in Section 1.3.4 and are shown in **VOLUME 1**.

In total, four hundred and forty-nine (449) flora species have been recorded at the Subject site and are listed in **ANNEXURE 1**. This list is a compilation of all plant species recorded from the site by JWA as well as during previous flora assessment (i.e. WBM, 1990, 1991b; Woodward-Clyde, 1997 & Parker, 1999).

Eight (8) threatened species were recorded. These include:

- White yiel yiel (*Grevillea hilliana*) Endangered (TSC Act 1995);
- Scented acronychia (*Acronychia littoralis*) - Endangered (TSC Act 1995 & EPBC Act 1999);
- Fine-leaved tuckeroo (*Lepiderema pulchella*) - Vulnerable (TSC Act 1995,
- Spiny gardenia (*Randia moorei)* - Endangered (TSC Act 1995 & EPBC Act 1999);
- Marblewood (*Acacia bakeri*) - Vulnerable (TSC Act 1995);
- Brush cassia (*Cassia brewsteri* var. *marksiana*) - Endangered (TSC Act 1995);
- Coolamon (*Syzygium moorei*) - Vulnerable (TSC Act 1995, EPBCA 1999); and
- Green-leaved rose walnut (*Endiandra muelleri* subsp. *bracteata)* Endangered (TSC Act 1995).

The locations of these species are shown in **VOLUME 1**.

Five (5) ROTAP (Briggs & Leigh 1996) species were recorded. These include:

- Veiny laceflower (*Archidendron muellerianum*);
- Coast cordyline (*Cordyline congesta);*
- Black walnut (*Endiandra globosa*);
- Smooth Scrub turpentine (*Rhodamnia maideniana*); and
- Long-leaved tuckeroo (*Cupaniopsis newmanii*).

Ten (10) regionally significant species (Sheringham & Westaway 1995) were recorded. These include:

- Umbrella cheese tree (*Glochidion sumatranum*);
- Pink euodia (*Melicope elleryana*);
- Bennett's ash (*Flindersia bennettiana*);
- Pink ash (*Alphitonia petrei*);
- Teak (*Flindersia australis*);
- Smooth wilkiea (*Wilkiea austroqueenslandica*);
- Red-fruited laurel (*Cryptocarya laevigata*);

- Large-leaved wilkiea (*Wilkiea macrophylla*);
- Smooth wilkiea (*Wilkiea austroqueenslandica*); and
- Yellowwood (*Flindersia xanthoxyla*).

A full list of species recorded at the site is included in **ANNEXURE 1**.

### *1.3.4 Community descriptions*

#### 1.3.4.1 Introduction

The vegetation communities are shown in **TABLE 3**. The conservation status of these communities is discussed below with reference to:

- The Comprehensive Regional Assessment completed for NSW Forest and Non-forest ecosystems as part of the Regional Forestry Agreement (RFA) process (CRA Unit 1999). The RFA establishes the framework for the management of the forests of upper north-east and lower north-east regions. The RFA document sets out percentage reservation status of forest and non-forest Ecosystems in the CAR Reserve System based on vegetation modelling to establish the pre-1750 extent of forest ecosystems in the region.

- Threatened Species Conservation Act (1995). This Act provides protection for the listed "Endangered Ecological Communities". Each EEC recorded for the Subject site is described in **ANNEXURE 2.**

**TABLE 3**
**VEGETATION COMMUNITIES PRESENT ON THE SUBJECT SITE**

| | |
|---|---|
| **1** | **Dry Sclerophyll Communities** |
| 1a | Very Tall Open/Closed Sclerophyll Forest (*Eucalyptus pilularis +/- E. microcorys +/- E. propinqua +/- Corymbia intermedia)* |
| 1b | Tall Open/Closed Sclerophyll Forest (*E. propinqua*) |
| 1c | Tall Open Sclerophyll Woodland (*E. pilularis)* |
| 1d | Tall Open Sclerophyll Forest (*E. pilularis +/- E. siderophloia +/- E. tereticornis)* |
| **2** | **Rainforest Communities** |
| 2a | Tall Closed Forest (*Lophostemon confertus +/- Araucaria cunninghamii*) |
| 2b | Tall Open Forest (*Archontophoenix cunninghamiana*) |
| 2c | Very Tall Closed Forest (*Araucaria cunninghamii*) |
| 2d | Mid-high Open/Closed Forest (Riparian species +/- Mixed species) |
| | **Other Communities** |
| 3 | Tall/Very Tall Open/Closed Forest (*Lophostemon confertus* +/- Mixed rainforest species) |
| 4 | Tall Open Woodland (*Araucaria cunninghamii* +/- Mixed species) |

| | |
|---|---|
| 5 | Closed Scrub (*Banksia aemula, E. racemosa* +\- *Leptospermum* spp.) |
| 6 | Mid-high Open Woodland (Mixed rainforest species) |
| 7 | Mid-high Open Woodland (*Eucalyptus robusta*) |
| 8 | Mid-high Open Woodland (*Eucalyptus racemosa*) |
| 9 | Mid-high Open Woodland (*Eucalyptus siderophloia*) |
| 10 | Tall Closed Grassland/Fernland/Sedgeland (Mixed Species) |
| 11 | Low Closed Forest (Re-vegetation areas +\- Mixed *Eucalyptus* species) |
| 12 | Low Closed Grassland with Scattered Trees (Pastoral grasses +/- Mixed species) |
| 13 | Low Closed Grassland (*Sporobolus virginicus, Triglochin striata* + /- *Casuarina glauca*) |
| 14 | Rushland/Sedgeland/Grassland (Mixed aquatic species) |
| 15 | Low to Mid-high Open Mangrove Forest (*Avicennia marina* var. *australasica* / *Aegiceras corniculatum* +/- *Casuarina glauca*) |
| 16 | Dam & Drainage Lines (Mixed aquatic species) |
| 17 | Low open forest/woodland (*Casuarina glauca* +/- Mixed species) |
| 18 | Slashed Grassland/Heath land/Sedgeland (Mixed species) |

### 1.3.4.2 Community 1 - Dry Sclerophyll Communities

1a - Very Tall Open/Closed Sclerophyll forest (*Eucalyptus pilularis +/- E. microcorys +/- E. propinqua +/- Corymbia intermedia)*

*Location and area*
This community occurs in the western portion of the subject site and covers an area of approximately 33.10 hectares.

*Description*
The canopy of this community is dominated by mature Blackbutt standing approximately 25 - 35 metres in height. Other species commonly occurring in the canopy include Tallowwood, Grey gum, Brushbox, Northern grey ironbark, White mahogany and Pink bloodwood.

The midstorey of this community the midstorey vegetation is generally quite sparse and comprised of dry Sclerophyll species including Crinkle bush, Geebung, Grass trees, various *Acacia* species, Dogwood, Forest oak, Tree heath, Red ash, Wild may, Lantana and regenerating *Eucalyptus* species.

The ground cover in these drier areas of the site is comprised of Blady grass, Whisky grass, Nut grass, Leaf litter and bark, twigs, and various Mat rushes. Kangaroo grass and various sedges are also common.

Large patches of this community in the north-west of the Subject site occur adjacent to a creek-line and display a complex structure of midstorey vegetation associated with riparian zones. The midstorey in these areas is dominated by various Palm lilys, Water

gum, Crab apple, Hodgkinsonia, Blue tongue, Weeping lilly pilly and Blue lilly pilly. Spiny Mat rush and regenerating Bangalow palms are also common. Other less common species include Plum myrtle, Hard quandong, Prickly alyxia and Coffee bush. Climbers include Prickly smilax, Morinda, Smooth smilax, Whip vine, Water vine, Silk pod and Cockspur.

The groundcover in these wetter portions of the site is comprised of Mat rushes, various sedges, Bracken fern, Binung, Harsh Ground fern, Gristle fern, Tall sedge, Prickly rasp fern and Broad-leaved paspalum, amongst rocks and decaying leaf litter.

Three (3) threatened species were recorded within this community, including:

- Marblewood (*Acacia bakeri*) - Vulnerable (TSC Act 1995);
- Fine-leaved tuckeroo (*Lepiderema pulchella*) - Vulnerable (TSC Act 1995); and
- Green-leaved rose walnut (*Endiandra muelleri* subsp. *bracteata)* Endangered (TSC Act 1995).

*Conservation status*
The most appropriate CRA classification for this community is Forest Ecosystem 34 – (Dry grassy Blackbutt - Tallowwood), with elements of FE 72 (Low Relief Coastal Blackbutt) also occurring.

The Regional Forestry Agreement provides the following data on FE 34 – (Dry grassy Blackbutt - Tallowwood):

- 6,052 hectares of this ecosystem type remains within the upper north east section of the NSW North Coast Bioregion. The original extent (i.e. pre-1750) was approximately 9,880 hectares;
- The ecosystem is not considered to be Vulnerable or Rare;

The Regional Forestry Agreement provides the following data on FE 72 – (Low Relief Coastal Blackbutt):

- 859 hectares of this ecosystem type remains within the upper north-east section of the NSW North Coast Bioregion. The original extent (i.e. pre-1750) was approximately 1,574 hectares;
- The ecosystem is considered to be Rare; and
- The forest ecosystem has been identified as a priority for conservation on private land.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Sclerophyll open forest on bedrock substrates – 201 Blackbutt open forest complex. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 6,875 hectares (vegetated land), which is approximately 10.02% of the vegetated land in the Shire.
- This ecosystem is considered to be iInadequately conserved over all its range.

The conservation status of this community is considered to be moderate to high due to the diverse species composition, the presence of Threatened species, and large proportion of mature native trees.

1b -Tall Open/Closed Sclerophyll Forest (*Eucalyptus propinqua*)

*Location and area*
Community 1b occurs in the north-west of the subject site and covers an area of approximately 4.66 hectares.

*Description*
The canopy of this community is dominated by Grey gum. Other species present within the canopy include Tallowwood, Brush box and Pink bloodwood.

The midstorey is of similar composition to the dry areas of Community 1a, and includes the following species: Crinkle bush, Forest oak, Geebung, Wild may, Red kamala, Bennett's ash, Grass trees, various *Acacia* species, Dogwood, Forest oak, Tree heath, Red ash and regenerating *Eucalyptus* species.

One (1) stem of the ROTAP listed Long-leaved tuckeroo (*Cupaniopsis newmanii*) occurs within the midstorey of this community.

The ground cover is similar throughout and is comprised of Blady grass, Whisky grass, Nut grass, Settlers flax, various Mat rushes and Sedges, Goodenia and Kangaroo grass, amongst leaf litter, bark and twigs.

*Conservation status*
The most appropriate CRA classification for this community is FE 52 (Foothills Grey gum – Ironbark – Spotted gum). The Regional Forestry Agreement provides the following data on FE 52:

- 46,753 hectares of this ecosystem type remains within the upper north-east section of the NSW North Coast Bioregion. The original extent (i.e. pre-1750) was approximately 59,393 hectares;
- The ecosystem is not considered to be Vulnerable or Rare.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Sclerophyll open forest on bedrock substrates – 202 Grey ironbark/White mahogany/Grey gum open forest complex. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 12,820 hectares (vegetated land), which is approximately 18.68% of the vegetated land in the Shire;
- This ecosystem is considered to be adequately reserved.

The conservation status of this community is considered to be moderate, due to diverse species composition and the presence of mature native trees.

1c-Tall Open Sclerophyll Woodland (*E. pilularis)*

*Location and area*
This community occurs in the north-east of the subject site and covers an area of approximately 12.87 hectares.

*Description*
The canopy of this community is dominated by Blackbutt. Other species occurring sporadically include Northern grey ironbark, Pink bloodwood, Brushbox and Tallowwood. Due to historical clearing activities and grazing by cattle, the midstorey in this community is absent. The ground cover is comprised of a mixture of Kangaroo grass, pasture grass species and common agricultural weeds.

*Conservation status*
The most appropriate CRA classification for this community is FE 72 – (Low Relief Coastal Blackbutt). The regional Forestry Agreement provides the following data on FE 72:

- 859 hectares of this ecosystem type remains within the upper north-east section of the NSW North Coast Bioregion. The original extent (i.e. pre-1750) was approximately 1574 hectares;
- The ecosystem is considered to be **Rare**; and
- The forest ecosystem has been identified as a priority for conservation on private land.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Sclerophyll open forest on bedrock substrates – 201 Blackbutt open forest complex which is discussed previously under Community 1a.

The conservation status of this community is lowered due to historic clearing and grazing activities which have essentially removed the midstorey and resulted in the dominance of exotic groundcovers. The conservation status of this community is considered to be low to moderate.

1d - Tall Open Sclerophyll Forest (*E. pilularis +/- E. siderophloia +/- E. tereticornis)*

*Location and area*
This community occurs in the north-east of the subject site and covers an area of approximately 2.37 hectares.

*Description*
The canopy of this community is dominated by Blackbutt standing approximately 15-20 metres in height. Other species commonly occurring in the canopy include Northern grey ironbark and Forest red gum.

The midstorey vegetation within this community is sparse and comprised of species including Camphor laurel, Sweet pittosporum, Umbrella cheese tree, Blunt-leaf bitter-pea, Geebung, various *Acacia* species, Tree heath, Red ash, Lantana and regenerating *Eucalyptus* species.

The ground cover is dominated by Molasses grass, Lantana and Bracken fern. Crofton weed, White passionfruit, Blady grass, Whisky grass, Nut grass also occur amongst leaf litter, bark and twigs.

*Conservation status*
The most appropriate CRA classification for this community is FE 72 – (Low Relief Coastal Blackbutt) as described for community 1c.
Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Sclerophyll open forest on bedrock substrates – 201 Blackbutt open forest complex which is discussed under Community 1a.

The conservation status of this community is lowered due to the occurrence of exotic species and the reduced structural complexity. The conservation status of this community is considered to be low to moderate.

### 1.3.4.3 Community 2 - Rainforest Communities

Background

Community 2 occurs as five (5) isolated rainforest patches across the subject site and covers a total area of approximately 10.37 hectares. The Rainforest communities occur as isolated remnants across the subject site and comprise various species assemblages and community structures.

2a - Tall Closed Forest (*Lophostemon confertus +/- Araucaria cunninghamii*)

*Location and area*
This community occurs in the north of the subject site and is located on the slopes and summit of Mount Woodgee. Community 2a covers an area of approximately 9.10 hectares.

*Description*
The large Rainforest community occurring in the north of the Subject site is considered to be the most structurally complex and contains the highest diversity of rainforest species on the subject site, including several Threatened species.

The canopy of this community is dominated by Brushbox with Hoop pines occurring as a common emergent throughout the canopy. Various rainforest species also occur in the canopy including Tuckeroo, Guioa, Red kamala, Red bean, Foam bark, Native tamarind, Yellowwood, Cudgerie and Scentless rosewood.

The midstorey is generally well-developed, comprising common rainforest species such as Red ash, Umbrella cheese tree, Yellow carabeen, Grey myrtle, Guioa, Bennett's ash, Common lily pilly, Smooth scrub turpentine, Palm lily, Prickly alyxia, Pepperberry, White bolly gum, Bolly gum, Red-fruited laurel, Scentless rosewood and Hairy walnut. Two species of Wilkiea commonly occur throughout the rainforest communities, including Veiny wilkiea and Smooth wilkiea.

Common climbers include Native yam, Burny vine, Cockspur thorn, Supplejack, Scrambling lily, Snake vine and Sweet sarsaparilla. The ground covers include Basket

grass, Mist flower, Bracken fern, and Rough maiden hair fern amongst decaying leaf litter.

Four (4) threatened species were recorded within this community, including:

- White yiel yiel (*Grevillea hilliana*) - Endangered (TSC Act 1995);
- Fine leaved tuckeroo (*Lepiderema pulchella*) - Vulnerable (TSC Act 1995);
- Spiny gardenia (*Randia moorei)* - Endangered (TSC Act 1995 & EPBC Act 1999); and
- Marblewood (*Acacia bakeri*) - Vulnerable (TSC Act 1995).

*Conservation status*
Under the CRA classification, this community is best described as FE 168 (Rainforest) (CRA 1999). It must be noted that CRA (1999) does not provide for more detailed categorisation of rainforest e.g. Littoral rainforest. The Regional Forestry Agreement document provides the following data on this ecosystem:

- 159,211 hectares of this ecosystem type remains within the upper north-east section of the NSW North Coast Bioregion. The original extent (i.e. pre-1750) has not been calculated;
- The extent present in the Comprehensive, Adequate and Representative (CAR) reserve system has not been determined;
- The ecosystem is considered to be **Endangered**; and
- Rainforest communities have been identified as a priority for conservation on private land.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Rainforest and riparian – 103 Dry rainforest. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 157 hectares (vegetated land), which is approximately 0.23% of the vegetated land in the Shire;
- This ecosystem is considered to be inadequately conserved over all its range; and
- Floyd (1990) also states that this community is not reserved on the North Coast.

The location of the threatened species is shown in **VOLUME 1**.

This community is representative of the Endangered Ecological Community (EEC) 'Lowland Rainforest on Floodplain', which has a high conservation value. The conservation status of this community on the subject site is considered to be high, due to this vegetation type representing an EEC, the occurrence of Threatened flora species and the relative high species diversity and composition.

2b - Tall Open Forest (*Archontophoenix cunninghamiana*)

*Location and area*
Community 2b occurs as in the south of the subject site and covers an area of approximately 0.35 hectares.

*Description*
The canopy of this community is dominated by Bangalow palms reaching a height of approximately 12–15 metres. Broad-leaved paperbark is present as a minor occurrence.

The midstorey is sparse in the north of this community, with only Bangalow palm trunks occurring. The midstorey is dense in the south of this small patch of vegetation and consists of Common lilly pilly, Whalebone tree, Umbrella cheese trees, Pink euodia, Bolwarra, Creek sandpaper fig, Fine-leaved tuckeroo, Hard quandong, Camphor laurel, Lantana and Blackwood wattle. Common climbers include Snake vine, Wisteria, Wonga vine, Common silk pod, Burny vine, Scrambling lilly and Climbing fern.

Two (2) stems of the Threatened Fine-leaved tuckeroo (*Lepiderema pulchella)* occur within this community.

The ground cover vegetation is dominated by ferns and grasses including Broad-leaved paspalum, Gristle fern, Binung and Bracken fern (*Pteridium esculentum*), amongst decomposing Bangalow palm fronds.

*Conservation status*
Under the CRA classification, this community is best described as FE 168 (Rainforest) (CRA 1999) which is discussed under Community 2a.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified Rainforest and Riparian - 104 Lowland rainforest on floodplain. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 283 hectares (vegetated land), which is approximately 0.41% of the vegetated land in the Shire;
- This ecosystem is considered to be not/poorly conserved.; and
- This community is indicative of the EEC Lowland rainforest on coastal floodplain as listed by the NSW Scientific Committee on the 13th August 1999.

This community is considered to be representative of the Endangered Ecological Community 'Lowland Rainforest on Floodplain' which has a high conservation value. The conservation value of this community is reduced on the subject site due to its small size, degradation by cattle, fragmentation and a reduced structure. The conservation status of this community is considered to be moderate. Individual Threatened species have an elevated conservation value.

2c - Very Tall Closed Forest (*Araucaria cunninghamii*)

*Location and area*
Community 2c occurs in the north-east of the subject site and covers an area of approximately 0.35 hectares.

*Description*
The canopy of this community is dominated by Hoop pine approximately 25-35 metres in height. Other canopy species also represented include Bennett's ash, Camphor

laurel, Yellow pear fruit, Umbrella cheese tree, Blue lilly pilly, Denhamia and Hard quandong.

The midstorey is sparse and includes Smooth scrub turpentine, Common lilly pilly, Prickly alyxia and regenerating Hoop pines. The ground cover is comprised of Broad-leaved paspalum, Red fruited saw-sedge and Ottochloa

*Conservation status*
Under the CRA classification, this community is best described as FE 168 (Rainforest) (CRA 1999) which is discussed under Community 2a.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Rainforest and riparian – 103 Dry rainforest which has previously been discussed under Community 2a.

This community is considered to be representative of the Endangered Ecological Community 'Lowland Rainforest on Floodplain' which has a high conservation value. The conservation value of this community is reduced on the subject site due to its small size, degradation by cattle, fragmentation and the presence of weed species. The conservation status of this community is considered to be moderate.

2d - Mid-high Open/Closed Forest (Riparian species +/- Mixed species)

*Location and area*
Community 2d occurs as four (4) isolated patches in the north and south-west of the Subject site and covers a total area of approximately 1.43 hectares.

*Description*
These rainforest communities all occur within the riparian zone, and display low species diversity and a reduced structure. The reduced complexity is associated with small rainforest patches that have been subject to anthropogenic pressures.

Commonly occurring canopy species include Bennett's ash, Umbrella cheese tree, Foambark, Macaranga, Brushbox, Swamp box, Brown kurrajong, Three-veined cryptocarya, Yellow pear fruit, Broad-leaved paperbark, Teak, Creek sandpaper fig, Hoop pine, Guioa, Red kamala, Scentless rosewood, Tuckeroo and Camphor laurel.

The midstorey is sparse, and includes Guioa, Blackwood wattle, Bangalow palm, *Cordyline* sp., Smooth scrub turpentine, Common lilly pilly, Blue lilly pilly, Red kamala and Yellowwood. Sweet Pittosporum and Camphor laurel also occur sporadically. Common climbers include Common silkpod, Lawyer vine, Scrambling lilly, Cockspur and Wisteria.

The Vulnerable (TSCA 1995) Brush cassia (*Cassia brewsteri* var. *marksiana*) has been recorded within the midstorey of this community. The Endangered (TSCA 1995, EPBCA 1999) Spiny gardenia (*Randia moorei*) also occurs within this community.

The groundcover includes Rough maidenhair fern, Basket grass and Mist flower, amongst bare rock and leaf litter.

*Conservation status*
Under the CRA classification, this community is best described as FE 168 (Rainforest) (CRA 1999) which is discussed under Community 2a.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified Rainforest and Riparian - 104 Lowland rainforest on floodplain which has been discussed under Community 2b.

This community is considered to be representative of the Endangered Ecological Community 'Lowland Rainforest on Floodplain' which has a high conservation value. The conservation value of this community is reduced on the subject site due to fragmentation, its small size, degradation by cattle and the presence of weed species. The conservation status of this community is considered to be moderate. Individual Threatened species have an elevated conservation value.

#### 1.3.4.4 Community 3 - Tall/Very Tall Open/Closed Forest (*Lophostemon confertus* +/- Mixed rainforest species)

*Location and area*
Community 3 occurs as four (4) patches in the north-west of the site, covering an area of approximately 2.2 hectares.

*Description*
The canopy is dominated by Brushbox standing approximately 15-30 metres in height. Other species occurring within the canopy include Pink bloodwood and Blackwood wattle. In the higher elevated portions of this community Blackbutts are common, signifying changes in the ecotone.

The midstorey is sparse on the upper reaches of the hill. As the elevation decreases towards drainage lines, species diversity increases. Common species include, regenerating *Acacia* spp., Red ash, Plum myrtle, Macaranga, Camphor laurel, Jackwood, Umbrella cheese trees, Sweet pittosporum, Tuckeroo and Guioa.

The ground cover is comprised of Guinea flower, Mat rushes, Basket grass, Corky passionfruit, Sedges, Bracken fern amongst bare rock, decaying leaves, and twigs. Mistflower occurs as a minor ground cover within Community 3.

*Conservation status*
The Regional Forestry Agreement provides the following data on FE 103 – (Northern Wet Brushbox):

- 16,379 hectares of this ecosystem type remains within the upper north-east section of the NSW North Coast Bioregion. The original extent (i.e. pre-1750) was approximately 25,433 hectares;
- The ecosystem is not considered to be Vulnerable or Rare.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Sclerophyll open forest on bedrock substrates – 207 Brushbox open forest.

The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 10,211 hectares (vegetated land), which is approximately 14.88% of the vegetated land in the Shire;
- This ecosystem is considered to be adequately reserved.

The conservation status of this community is considered to be moderate, due to the species diversity and the presence of mature trees.

#### 1.3.4.5 Community 4 – Tall Open Woodland (*Araucaria cunninghamii* +/- mixed species)

*Location and area*
Community 4 occurs as two (2) patches within the northern portion of the Subject site and covers a total area of approximately 2.13 hectares.

*Description*
The patch of this community in the north-east of the Subject site contains a very open canopy comprising scattered Hoop pines reaching approximately 15-25 metres in height.

Regular slashing has reduced structural complexity. Currently only trees or shrubs which are regenerating at the base of the large Hoop pines occur in the midstorey. Species occurring within the very open midstorey include Bennett's ash, Prickly alyxia, Brush cherry, Rose maraya, Crab apple, Guioa and Lantana.

One (1) intermediate stem of the White yiel yiel (*Grevillea hilliana*), which is listed as Endangered (TSCA 1995 & EPBCA 1999), occurs within the midstorey of this community.

The groundcover is comprised of a mixture of Whisky grass, Kangaroo grass, Bracken fern, various Sedges and Matrushes, *Cordyline* sp. and a number of agricultural grasses, including Broad-leaved paspalum. These all occur amongst decaying Hoop pine leaves.

The patch of this community in the west of the Subject site also contains a very open canopy comprised of scattered Hoop pines, Camphor laurel, Pink bloodwood, and Blackbutt reaching approximately fifteen 15-25 metres in height. The midstorey is sparse, and contains Willow bottle brush, Umbrella cheese tree, Tuckeroo and Common lilly pilly.

One (1) stem of the Endangered (TSAC 1995) Spiny gardenia (*Randia moorei*) occurs within the midstorey of this community.

The ground covers which occur within this patch of the community include Blady grass, Ottochloa, Nut grass, Red-fruited saw-sedge, and Harsh ground fern.

*Conservation status*
This community is not considered to be analogous with any of the Forest Ecosystems identified within the Regional Forestry Agreement (RFA) report.

The closest classification for this community under the Tweed Vegetation Management Strategy (Ecograph 2004) is Rainforest and riparian – 103 Dry rainforest. The conservation status has previously discussed under Community 2a.

The conservation status of this community on the subject site is considered to be low-moderate with individual threatened species having a raised conservation value.

#### 1.3.4.6 Community 5 – Closed Scrub (*Banksia aemula, E. racemosa* +\- *Leptospermum* spp.)

*Location and area*
Community 5 occurs in the east of the subject site and covers an area of approximately 2.48 hectares.

*Description*
The canopy of this community type is dominated by Wallum banksia, with emergent Scribbly gums present to approximately 8 metres in height.

The midstorey is very dense, comprising a diverse group of species including Midgenberry, Prickly moses, Prickly broom heath, Lemon-scented teatree, Wallum banksia, Blue berry ash, *Baeckea sterophylla, Leucopogon leptospermoides, Leptospermum trinervium, Leptospermum polygalifolium* and Bracken fern. The ground covers consist of Foxtails, Swamp saliginella, Grasstrees and *Hibbertia obtusifolia*, amongst decaying leaves, logs, sticks and Banksia seed pods.

*Conservation status*
The regional Forestry Agreement provides the following data on FE 5 – (Banksia):

- 7,561 hectares of this ecosystem type remains within the upper north-east section of the NSW North Coast Bioregion. The original extent (i.e. pre-1750) was approximately 2,046 hectares;
- The ecosystem is considered to be Rare.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Heathlands - 501 Dry heathland to Shrubland. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 72 hectares (vegetated land), which is approximately 0.11% of the vegetated land in the Shire; and
- This ecosystem is considered to be inadequately reserved over all its range.

The conservation status of this community on the subject site is considered to be moderate.

#### 1.3.4.7 Community 6 - Mid-high Open Woodland (Mixed rainforest species)

*Location and area*
Community 6 occurs as three (3) patches in the north of the subject site, covering a total area of approximately 1.91 hectares.

*Description*
The three (3) patches of this community type have a similar structure. Each of the patches has a relatively low open canopy, and the midstorey is absent due to a history of cattle grazing and slahing. The species which commonly occur within these three (3) patches include Hoop pine, Swamp box, Foambark, Brushbox, Red ash, White beech, Blackwood wattle, Bennett's ash, Guioa, Tuckeroo, and Three-veined laurel.

Several threatened species occur within this community type, including;

- Marblewood (*Acacia bakeri*) Vulnerable (TSCA 1995);
- Scented acronychia (*Acronychia littoralis*) Endangered (TSCA 1995, EPBCA 1999); and
- Fine-leaved tuckeroo (*Lepiderema pulchella*) Vulnerable (TSCA 1995).

Commonly occurring ground cover species include Broad-leaved paspalum, Whisky grass, Cotton bush, Blady grass, Barbwire grass, Sedges (*Gahnia* spp.), Prickly rasp fern, Bracken fern and seedlings of regenerating rainforest species.

*Conservation status*
Under the CRA classification, this community is best described as FE 168 (Rainforest) (CRA 1999) which is discussed previously under Community 2a.

The closest classification for this community under the Tweed Vegetation Management Strategy (Ecograph 2004) is Rainforest and riparian – 103 Dry rainforest. The conservation status has been previously discussed under Community 2a.

This community is considered to be representative of the Endangered Ecological Community 'Lowland Rainforest on Floodplain' which has a high conservation value. The conservation value of this community is reduced on the subject site due to fragmentation, the small size of each individual patch, degradation by cattle, and the presence of weed species including Camphor laurel. The conservation status of this community is considered to be moderate, with individual threatened species considered to have an elevated conservation status.

### 1.3.4.8 Community 7 – Mid-high Open Woodland (*Eucalyptus robusta*)

*Location and area*
Community 7 occurs in the east of the subject site and covers an area of approximately 3.8 hectares.

*Description*
The canopy of this community is very open and comprised entirely of Swamp mahogany. The midstorey is absent, and the ground cover is regularly slashed. The ground cover is comnprised of a mixture of Swamp saliginella, Bracken fern, Curly sedge, Foxtails, Sawsedge, Whisky grass, Nut grass, Mat rushes, Flax lily and various regenerating heath species.

*Conservation status*
The closest analogue to this community considered in the Regional Forestry Agreement (RFA) report is Forest Ecosystem 142 (Swamp mahogany). The RFA document provides the following data on this ecosystem:

- 578 hectares of this ecosystem type remains within the upper north-east section of the NSW North Coast Bioregion. The original extent (i.e. pre-1750) was approximately 695 hectares.
- The ecosystem is considered to be **Rare**.
- 39.5% of the total forest ecosystem area is within the Comprehensive, Adequate and Representative (CAR) reserve system including 25.7% in dedicated reserves and 12.3% in informal reserves. A further 1.4% is protected by tabulated prescriptions.
- Swamp mahogany communities have been identified as a priority for conservation on private land.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Sclerophyll forest/woodlands on sand substrates and alluvium – 305 Coastal Swamp mahogany open forest to woodland. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 170 hectares (vegetated land), which is approximately 0.25 % of the vegetated land in the Shire;
- This ecosystem is considered to be inadequately conserved over all its range.

This Swamp mahogany dominated community is considered to represent the Endangered Ecological Community (EEC) Swamp sclerophyll forest on coastal floodplains, which has a high conservation value.

The conservation values of this community are reduced on the subject site due to historical clearinhg and grazing activities and the current regular slashing, which has eliminated the midstorey and reduced the understorey to only common regenerating species. This community is considered to have a moderate conservation status.

### 1.3.4.9 Community 8 – Mid-high Open Woodland (*Eucalyptus racemosa*)

*Location and area*
Community 8 occurs in the south-east of the subject site and covers an area of approximately 5.13 hectares.

*Description*
The canopy of this community is very open and generally comprised of mature isiolated Scribbly gums. Additional species scattered throughout the canopy include Tallowwood, Pink bloodwood, and Swamp mahogany.

The midstorey is absent, and the ground cover is regularly slashed. At the time of this survey, large parts of the ground layer of this community had been recently burnt and were absent of vegetation cover. The ground cover which had not been burnt was very similar to the composition of Community 7.

*Conservation status*
The closest analogue to this community considered in the Regional Forestry Agreement (RFA) report is Forest Ecosystem 74 (Lowlands Scribbly Gum). The RFA document provides the following data on this ecosystem:

- 3,496 hectares of this ecosystem type remains within the upper north-east section of the NSW North Coast Bioregion. The original extent (i.e. pre-1750) was approximately 6,783 hectares.
- The ecosystem is considered to be **Vulnerable**.
- 29.7% of the total forest ecosystem area is within the Comprehensive, Adequate and Representative (CAR) reserve system including 26.4% in dedicated reserves and 1.0% in informal reserves. A further 2.3% is protected by tabulated prescriptions.
- Scribbly gum communities have been identified as a priority for conservation on Private Land.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Sclerophyll forest/woodlands on sand substrates and alluvium – 306 Coastal Scribbly gum open forest to woodland. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 131 hectares (vegetated land), which is approximately 0.21% of the vegetated land in the Shire;
- This ecosystem is considered to be inadequately conserved over all its range.

The conservation values of this community are reduced on the subject site due to historical clearinhg and grazing activities and the current regular slashing, which has eliminated the midstorey and reduced the understorey to only common regenerating species. This community is considered to have a low-moderate conservation status.

### ***Community 9*** **– Mid-high Open Woodland (*Eucalyptus siderophloia*)**

*Location and area*
Community 9 occurs in the south-east of the subject site and covers an area of approximately 0.28 hectares.

*Description*
The canopy of this community is very open and comprised entirely of Northern grey ironbark. The mid-storey is absent and the ground cover is comprised of pasture grass species and is regularly slashed.

*Conservation status*
The most appropriate analogue considered in the Regional Forestry Agreement (RFA) report is NFE 54 Grey Box-Red Gum-Grey Ironbark.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as open forests on bedrock – 202 Grey ironbark/ White mahogany/ Grey gum open forest complex. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 12,820 hectares (vegetated land), which is approximately 18.68 of the vegetated land in the Shire;
- This ecosystem is considered to be adequately conserved over a major part of its range.

### 1.3.4.10 Community 10 -Tall Closed Grassland/Fernland/Sedgeland (Mixed Species)

*Location and area*
Community 10 occurs in the east of the subject site and covers an area of approximately 0.68 hectares.
*Description*
The vegetation within this community type includes Swamp water fern, Foxtails, Frogmouth, *Cyprus* sp., Geebung, Coral fern, Smart weed, Jointed twig rush, Swamp rice grass, Swamp millet, Fireweed, Devil's twine, Batwing fern and regenerating Paperbark and Swamp box.

Several drainage lines occur across the site. Species commonly occurring within these drainage lines include Frogsmouth, Swamp water fern, Sedge, Curly sedge, Bunchy flat sedge, Spike rush, Fringe rush, Gristle fern and Tussock rush.

*Conservation status*
The conservation status of Grassland/Fernland/Sedgeland/Rushland communities has not been specifically discussed in the Regional Forestry Agreement document. The most appropriate analogue is NFE 141 Swamp. It is noted that Swamp ecosystems are Rare in the upper north-east section of the NSW North Coast Bioregion.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Sedgeland and related communities – 701 Sedgeland/Rushland. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 262 hectares (vegetated land), which is approximately 0.38% of the vegetated land in the Shire;
- This ecosystem is considered to be iInadequately conserved over a major part of its range.

This community contains species which are indicative of the Endangered Ecological Community (EEC) 'Freshwater Wetlands on Coastal Floodplain'. The conservation value of this community is considered to be low–moderate on the subject site due to the large piles of fill (top soil) which have been deposited within this community during construction of Cobaki Parkway (the location of which is fixed), and the degraded nature of the drainage lines.

### 1.3.4.11 Community 11 - Low Closed Forest (Re-vegetation areas +\- Mixed Eucalyptus species)

*Location and area*
Community 11 occurs as three (3) patches within the western portion of the Subject site, covering a total area of approximately 2.72 hectares.

*Description*
Community 11 is comprised of various regenerating Eucalypts approximately 2-3 metres in height. Species present include Blackbutt, Small-fruited grey gum, Pink bloodwood, Tallowwood, Narrow-leaved ironbark, Forest red gum, and Red mahogany. The ground cover is comprised of various grasses including Blady grass, Whisky grass, and Kangaroo grass.

*Conservation status*
This community is not considered to be analogous with any of the Forest Ecosystems identified within the Regional Forestry Agreement (RFA) report.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Highly modified/Disturbed 1005 – Native plantation. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 1,307 hectares (vegetated land), which is approximately 1.90 % of the vegetated land in the Shire.

The conservation status of this community is considered to be low-moderate.

### 1.3.4.12 Community 12 - Low Closed Grassland with Scattered Trees (Pastoral grasses +/- Mixed species)

*Location and area*
Community 12 occurs throughout the majority the subject site and covers an area of approximately 188.14 hectares.

*Description*
The grassland is dominated by a mixture of species that vary with location. The foot slopes and grassy areas adjacent to the forests and woodlands are dominated by a mixture of native species including Kangaroo grass, Blady grass, Bracken fern, and introduced grasses including Broad leaved paspalum and Setaria.

The flat areas east of Sandy Lane have been historically slashed and grazed, and are comprised of introduced pasture species including Broad-leaved carpet grass, Paspalum, Rhodes grass and African lovegrass.

Several significant trees occur within this community, including a row of old growth Forest red gums at the Piggabeen Road entrance in the southern portion of the site. Several other species of trees occur within this community, including Northern grey iron bark, Scribbly gum, Figs, Camphor laurel, Blackwood wattle, Blackbutt, Tallowwood, Pink bloodwood, Grey gum, Hoop pine, Swamp mahogany and Swamp oak.

*Conservation status*
This community is not considered to be analogous with any of the Forest Ecosystems identified within the Regional Forestry Agreement (RFA) report.

The conservation status of this community is considered to be low. Individual trees within this community have a raised conservation status. The conservation status of the significant old growth forest red gums is considered to be moderate–high.

### 1.3.4.13 Community 13 - Low Closed Grassland (*Sporobolus virginicus, Triglochin striata, +/- Casuarina glauca*)

*Location and area*
Community 13 occurs in the low-lying area in the south-east of the Subject site and covers a total area of approximately 53.95 hectares.

*Description*
This community is dominated by a mixture of salt marsh species that vary with location. These include Saltwater couch, Streaked arrow-grass, Samphire and Fimbristylis.

Stands of regenerating Swamp she-oak approximately 3-4 metres in height occur, flanking drainage lines throughout this community.

*Conservation status*
This community is best described by Forest Ecosystem 125 - Saltbush (CRA Unit 1999). The Regional Forestry Agreement document provides the following data on this ecosystem:

- The pre-1750 extent of this ecosystem type has been calculated at 17 hectares. Approximately 16 hectares remains.
- The ecosystem is considered **Rare**.
- The extent of this ecosystem type contained within the Comprehensive, Adequate & Representative (CAR) reserve system has been calculated, with 55.8% protected in dedicated reserves.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Estuarine complexes – 603 Saltmarsh. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 49 hectares (vegetated land), which is approximately 0.07% of the vegetated land in the Shire;
- This ecosystem is considered to be inadequately conserved over all its range.

This vegetation community is considered to represent the Endangered Ecological Community (EEC) 'Coastal Saltmarsh in the North Coast Bio-region' (NPWS 2004). This EEC is considered to be of high conservation value on the subject site.

### 1.3.4.14 Community 14 – Rushland/Sedgeland/Grassland (Mixed Aquatic species)

*Location and area*
Community 14 occurs in the central portion of the site, covering a total area of approximately 36.96 hectares.

*Description*
Community 14 is comprised of aquatic and semi-aquatic vegetation including Mangrove fern, *Cyperus* sp., Frogsmouth, Swamp water fern, Curly sedge, Bunchy flat sedge, Spike rush, Fringe rush, Tussock rush and Jointed twig rush.

*Conservation status*
The conservation status of Sedgeland/Rushland/Grassland communities has not been specifically discussed in the Regional Forestry Agreement document. The most appropriate analogue is NFE 141 Swamp. It is noted that Swamp ecosystems are Rare in the upper north-east section of the NSW North Coast Bioregion.

This community contains species which are indicative of the Endangered Ecological Community (EEC) 'Freshwater Wetlands on Coastal Floodplain'. The conservation value of this community is considered to have been significantly reduced however due a history of drainage construction and maintenance, grazing and slashing. The conservation status of this community on the subject site is considered to be moderate.

### 1.3.4.15 Community 15 - Low to Mid-high Open Mangrove Forest (*Avicennia marina var australasica / Aegiceras corniculatum +/- Casuarina glauca*)

*Location and area*
Community 15 occurs in the east of the subject site, and covers a total area of approximately 5.66 hectares.

*Description*
This community is dominated by Grey mangrove with River mangrove occurring. Swamp she-oak, Black mangrove and Milky mangrove also occur.

*Conservation Status*
This community is analogous with the Mangrove non-forest ecosystem (Ecosystem 77) (NPWS 1999). The Regional Forestry Agreement document provides the following data for this ecosystem:

- The extent of this ecosystem pre-1750 has not been determined. Approximately 734 hectares remain in the upper north-east section of the NSW North Coast Bioregion. The ecosystem type is considered to be **Rare**.
- The extent of the ecosystem in the Comprehensive, Adequate and Representative (CAR) reserve system has not been determined.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Estuarine complexes – 602 Mangrove low closed forest to woodland. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 474 hectares (vegetated land), which is approximately 0.69% of the vegetated land in the Shire and 0.36% of the Shire;
- Inadequately conserved over all its range.
- Note: only a limited area reserved.

The conservation status of this community is considered to be high.

### 1.3.4.16 Community 16 - Dam & Drainage lines (Mixed Aquatic species)

*Location and area*
Community 16 occurs throughout the majority of the site as low lying drainage lines, and as a constructed dam in the north-west of the Subject site. Community 15 covers an area of approximately 2.19 hectares.

*Description*
Community 16 is comprised of aquatic and semi-aquatic vegetation. The vegetation occurring in the constructed dam in the north-west of the site includes Water lilly (*Nymphaea caerulea*) and *Cyperus* sp. The edges of the dam have only recently been constructed and contain very little vegetation. Species present in low abundance include regenerating Paperbark, Prickly moses and Fireweed.

Several drainage lines occur across the site. Species which commonly occur within these drainage lines include Frogsmouth, Swamp water fern, Curly sedge, Bunchy flat sedge, Spike rush, Fringe rush, Tussock rush and Jointed twig rush.

*Conservation status*
The conservation status of Sedgeland/Rushland/Grassland communities has not been specifically discussed in the Regional Forestry Agreement document. The most appropriate analogue is NFE 141 Swamp. It is noted that Swamp ecosystems are Rare in the upper north-east section of the NSW North Coast Bioregion.

The conservation value of this community is considered to be low.

### *1.3.4.17* **Community 17 *- Low Open Forest/Woodland (Casuarina glauca +\- Mixed species)***

*Location and area*
Community 17 occurs across the southern portions of the site and is found most commonly along the low lying drainage lines. This community covers a total area of approximately 4.24 hectares.

*Description*
This community is dominated by Swamp oak and occurs in low lying swamplands, with very few associated species, the exception being Grey mangrove, Tuckeroo, Umbrella Cheese Tree, Cottonwood and some exotic species in the understorey.

*Conservation status*
Swamp She-oak communities in the study area are analogous to forest ecosystem 143 (Swamp she-oak) (NPWS 1999). This ecosystem is considered to be Rare in the upper north-east section of the NSW North Coast Bioregion. The Regional Forestry Agreement document provides the following data on this ecosystem:

- Pre-1750 there was 11165 hectares of this ecosystem type in the upper north-east section of the NSW North Coast Bioregion. 2883 hectares (25.8 %) remains;
- The ecosystem is considered to be Rare;
- 8.3% of the ecosystem type is present within the Comprehensive, Adequate and Representative (CAR) reserve system, including 7.6% in dedicated reserves and 0.2% in informal reserves. A further 0.5% is protected by tabulated prescriptions.
- Swamp she-oak communities have been identified as a priority for conservation on private land.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Melaleuca and Swamp she-oak - 402 Broad-leaved paperbark/ Swamp she-oak closed forest to woodland. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 180 ha (vegetated land), which is approximately 0.26% of the vegetated land in the shire and 0.14 % of the shire;
- Inadequately conserved over a major part of its range;
- NOTE: Poorly reserved in the Tweed Shire and elsewhere only as a small portion of its original extent. This community is indicative of the EEC Swamp sclerophyll forest on coastal floodplain as listed by the NSW Scientific Committee on the 17/12/04.
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The vegetation community is considered to represent the Endangered Ecological Community (EEC) Swamp oak floodplain forest of the NSW North Coast.

### 1.3.4.18 Community 18 – Slashed Grassland/Heathland/Sedgeland (Mixed species)

*Location and area*
Community 18 occurs in the east of the Subject site and covers an area of approximately 42.74 hectares.

*Description*
This community is regularly slashed, and only common regenerating species currently occur. At the time of this survey, large parts of the community had been recently burnt and were absent of any vegetation cover. The ground cover which had not been burnt consists of various Grass, Heath, Sedge and Fern species between ten (10) and fifty (50) centimetres in height.

Various regenerating heath species occur, including Swamp saliginella, Bracken fern, Curly sedge, Foxtails, Sawsedge, Coral fern, Mat rush and Flax lily.

Grass species are common and dominate large portions of this community including Whisky grass, Setaria, Paspalum and Nut grass.

Several drainage lines traverse this community. Within these drainage lines common aquatic species occur.

*Conservation status*
This community is not considered to be analogous with any of the Forest Ecosystems identified within the Regional Forestry Agreement (RFA) report.

Under the Tweed Vegetation Management Strategy (Ecograph 2004) this ecosystem is classified as Highly modified/ Disturbed 1001 – Mowed heathland. The Tweed Vegetation Management Strategy (Ecograph 2004) provides the following data on this ecosystem:

- This ecosystem covers an area of approximately 0.3 hectares (vegetated land), which is approximately 0.0002% of the Shire; and

The conservation status of this community is considered to be low.

## 1.4 Conclusion

Eighteen (18) broad vegetation associations comprising twenty-four (24) vegetation communities were identified on the Subject site including:

- Dry Sclerophyll forest (Blackbutt)
- Rainforest (Mixed species)
- Tall forest (Brush box)
- Mid-high Open Woodland (*Eucalyptus racemosa, E. robusta*)
- Low closed forest (Regenerating *Eucalyptus* sp.)
- Low closed grassland (pastoral grasses*)*
- Grassland/Fernland/Sedgeland (Mixed species)

The Subject site consists of mostly cleared agricultural land with some patches of Dry sclerophyll forest and Rainforest.

Five (5) Endangered Ecological Communities (EECs) are considered to occur on the site, including:

- Swamp sclerophyll forest on coastal floodplain - which occurs as an isolated clump of scattered Swamp mahogany in the central eastern of the Subject site;
- Lowland rainforest on floodplain - occurring at various locations generally in association with drainage lines and depressions;
- Lowland rainforest - occurring on Mt. Woodgee and on lower slopes in the northern portion of the subject site;
- Freshwater wetlands - occurring in the central and eastern portions of the site;
- Coastal saltmarsh in the NSW North Coast bioregion - occurring in the south-east of the site.

A search of the NPWS Database revealed twenty-six (26) Threatened Flora species within 10km of the Subject site. Eight (8) Threatened flora species, five (5) ROTAP flora species (Briggs & Leigh 1995) and Ten (10) significant flora species (Sheringham & Westaway 1995) were recorded during the assessment. The majority of significant plants were recorded in the rainforest communities.

**ANNEXURE 1 - PLANT SPECIES LIST**

| Grouping | Family | Botanical Name | Common Name |
|---|---|---|---|
| Ferns and Fern Allies | Adiantaceae | *Adiantum aethiopicum* | Common maidenhair |
| Ferns and Fern Allies | Adiantaceae | *Adiantum hispidulum* | Rough maidenhair |
| Ferns and Fern Allies | Adiantaceae | *Adiantum silvaticum* | Maidenhair |
| Ferns and Fern Allies | Adiantaceae | *Cheilanthes distans* | Bristly cloak fern |
| Ferns and Fern Allies | Aspleniaceae | *Asplenium australasicum* | Bird's nest fern |
| Ferns and Fern Allies | Azollaceae | *Azolla filiculoides* | Azolla |
| Ferns and Fern Allies | Blechnaceae | *Blechnum cartilagineum* | Gristle fern |
| Ferns and Fern Allies | Blechnaceae | *Blechnum indicum* | Swamp water fern |
| Ferns and Fern Allies | Blechnaceae | *Doodia aspera* | Prickly rasp fern |
| Ferns and Fern Allies | Cyatheaceae | *Cyathea cooperi* | Straw tree fern |
| Ferns and Fern Allies | Cyatheaceae | *Cyathea leichhardtiana* | Prickly tree-fern |
| Ferns and Fern Allies | Dennstaedtiaceae | *Hypolepis muelleri* | Harsh ground fern |
| Ferns and Fern Allies | Dennstaedtiaceae | *Hypolepis rugosula* | Ruddy ground fern |
| Ferns and Fern Allies | Dennstaedtiaceae | *Pteridium esculentum* | Bracken fern |
| Ferns and Fern Allies | Dicksoniaceae | *Calochlaena dubia* | Rainbow fern |
| Ferns and Fern Allies | Dryopteridaceae | *Lastreopsis acuminata* | Shiny shield fern |
| Ferns and Fern Allies | Dennstaedtiaceae | *Histiopteris incisa* | Bats wing fern |
| Ferns and Fern Allies | Dryopteridaceae | *Lastreopsis marginans* | Glossy shield-fern |
| Ferns and Fern Allies | Gleicheniacedae | *Gleichenia microphylla* | Scrambling coral fern |
| Ferns and Fern Allies | Polypodiaceae | *Platycerium bifurcatum* | Elkhorn fern |
| Ferns and Fern Allies | Polypodiaceae | *Platycerium superbum* | Staghorn |
| Ferns and Fern Allies | Schizaeaceae | *Lygodium japonicum* | |
| Ferns and Fern Allies | Thelypteridaceae | *Christella dentata* | Binung |

| Grouping | Family | Botanical Name | Common Name |
|---|---|---|---|
| Gymnosperms | Araucariaceae | *Araucaria cunninghamii* | Hoop pine |
| Gymnosperms | Pinaceae | *Pinus elliottii** | Slash pine |
| Gymnosperms | Podocarpaceae | *Podocarpus elatus* | Plum pine |
| Monocotyledons | Arecaceae | *Archontophoenix cunninghamiana* | Bangalow palm |
| Monocotyledons | Arecaceae | *Calamus muelleri* | Lawyer vine/ Wait-a-while |
| **Monocotyledons** | **Asteliaceae** | ***Cordyline congesta*** | **Coastal cordyline** |
| Monocotyledons | Asteliaceae | *Cordyline petiolaris* | Broad-leaved palm lily |
| Monocotyledons | Asteliaceae | *Cordyline rubra* | Red fruited palm lily |
| Monocotyledons | Commelinaceae | *Commelina cyanea* | Native wandering jew |
| Monocotyledons | Cyperaceae | *Caustis blakei subsp. blakei* | Foxtails |
| Monocotyledons | Cyperaceae | *Caustis recurvata* | |
| Monocotyledons | Cyperaceae | *Baumea articulata* | Jointed twig-rush |
| Monocotyledons | Cyperaceae | *Cyperus polystachyos var polystachyos* | Bunchy sedge |
| Monocotyledons | Cyperaceae | *Eleocharis equisetina* | Common spike-rush |
| Monocotyledons | Cyperaceae | *Fimbristylis dichotoma* | Common finger-rush |
| Monocotyledons | Cyperaceae | *Gahnia aspera* | Rough saw sedge |
| Monocotyledons | Cyperaceae | *Gahnia clarkei* | Tall saw sedge |
| Monocotyledons | Cyperaceae | *Gahnia sieberiana* | Red-fruited saw sedge |
| Monocotyledons | Cyperaceae | *Schoenoplectus mucronatus* | |
| Monocotyledons | Juncaceae | *Juncus usitatus* | Common rush |
| Monocotyledons | Juncaginaceae | *Triglochin procerum* | Water ribbons |
| Monocotyledons | Lomandraceae | *Lomandra hystrix* | Stream matrush |
| Monocotyledons | Lomandraceae | *Lomandra longifolia* | Long-leaved matrush/ Spiny-headed matrush |
| Monocotyledons | Lomandraceae | *Lomandra multiflora* | Many flowered matrush |
| Monocotyledons | Orchidaceae | *Cymbidium madidum* | Northern cymbidum |
| Monocotyledons | Orchidaceae | *Pterostylis hildae* | Rainforest greenhood |
| Monocotyledons | Philydraceae | *Philydrum lanuginosum* | Frogsmouth |
| Monocotyledons | Phormiaceae | *Dianella caerulea* | Blue flax lily |
| Monocotyledons | Poaceae | *Andropogon virginicus** | Whiskey grass |
| Monocotyledons | Poaceae | *Aristida vagans* | Threeawn speargrass |
| Monocotyledons | Poaceae | *Axonopus compressus** | Broad-leaf carpet grass |
| Monocotyledons | Poaceae | *Cenchrus echinatus* | Mossman River grass |
| Monocotyledons | Poaceae | *Chloris gayana** | Rhodes grass |
| Monocotyledons | Poaceae | *Cymbopogon refractus* | Barbed wire grass |
| Monocotyledons | Poaceae | *Cynodon dactylon** | Couch grass |
| Monocotyledons | Poaceae | *Digitaria* sp. | Summer grasses |

| Grouping | Family | Botanical Name | Common Name |
|---|---|---|---|
| Monocotyledons | Poaceae | *Entolasia stricta* | Wiry panic |
| Monocotyledons | Poaceae | *Eragrostis sp.* | Lovegrass |
| Monocotyledons | Poaceae | *Hermarthria* sp. | |
| Monocotyledons | Poaceae | *Imperata cylindrical** | Blady grass |
| Monocotyledons | Poaceae | *Melinis minutiflora** | Molasses grass |
| Monocotyledons | Poaceae | *Melinis repens** | Red natal grass |
| Monocotyledons | Poaceae | *Oplismenus aemulus* | Basket grass |
| Monocotyledons | Poaceae | *Oplismenus imbecillis* | Weak basket grass |
| Monocotyledons | Poaceae | *Ottochloa gracillima* | Shade grass |
| Monocotyledons | Poaceae | *Paspalum dilatatum** | Paspalum |
| Monocotyledons | Poaceae | *Paspalum distichum* | Water grass |
| Monocotyledons | Poaceae | *Paspalum orbiculare* | Water grass |
| Monocotyledons | Poaceae | *Paspalum wettsteinii** | Broad-leaved paspalum |
| Monocotyledons | Poaceae | *Pennisetum alopecuroides* | Swamp foxtail |
| Monocotyledons | Poaceae | *Pennisetum clandestinum** | Kikuyu grass |
| Monocotyledons | Poaceae | *Phragmites australis* | Common reed |
| Monocotyledons | Poaceae | *Setaria sphacelata** | Pigeon grass |
| Monocotyledons | Poaceae | *Sporobolus virginicus* | Saltwater couch |
| Monocotyledons | Poaceae | *Stenotaphrum secundatum** | Buffalo grass |
| Monocotyledons | Poaceae | *Themeda triandra* | Kangaroo grass |
| Monocotyledons | Restionaceae | *Balsokian tetraphyllus* | Feather plant |
| Monocotyledons | Restionaceae | *Hypolaena fastigiata* | A rush |
| Monocotyledons | Ripogonaceae | *Ripogonum discolor* | Prickly supplejack |
| Monocotyledons | Ripogonaceae | *Ripogonum elseyanum* | Hairy supplejack |
| Monocotyledons | Smilacaceae | *Smilax australis* | Prickly smilax |
| Monocotyledons | Smilacaceae | *Smilax glyciphylla* | Smooth smilax |
| Monocotyledons | Typhaceae | *Typha orientalis* | Broad-leaved cumbungi |
| Monocotyledons | Uvulariaceae | *Tripladenia cunninghamii* | Wire lily |
| Monocotyledons | Zingiberaceae | *Alpinia caerulea* | Native ginger |
| Dicotyledons | Acanthaceae | *Avicennia marina* | Grey mangrove |
| Dicotyledons | Amaranthaceae | *Chenopodium* sp. | Inkweed |
| Dicotyledons | Amaranthaceae | *Sarcocornia quinqueflora* | Samphire |
| Dicotyledons | Amaryllidaceae | *Crinum pedunculatum* | Swamp lily |
| Dicotyledons | Anacardiaceae | *Euroschinus falcata* | Ribbonwood |
| Dicotyledons | Anacardiaceae | *Mangifera indica** | Mango |
| Dicotyledons | Annonaceae | *Fissistigma stenopetala* | |
| Dicotyledons | Annonaceae | *Meiogyne stenopetala* | |
| Dicotyledons | Annonaceae | *Polyalthia nitidissima* | Polyalthia |
| Dicotyledons | Apiaceae | *Centella asiatica* | Pennywort (Gotu kola) |
| Dicotyledons | Apiaceae | *Hydrocotyle bonariensis* | |
| Dicotyledons | Apiaceae | *Platysace ericoides* | |
| Dicotyledons | Apocynaceae | *Alyxia ruscifolia* | Prickly alyxia |
| Dicotyledons | Apocynaceae | *Carissa ovata* | Currant bush |

| Grouping | Family | Botanical Name | Common Name |
|---|---|---|---|
| Dicotyledons | Apocynaceae | *Parsonsia straminea* | Common silkpod |
| Dicotyledons | Apocynaceae | *Tabernaemontana augustisepala* | Banana bush |
| Dicotyledons | Araliaceae | *Astrotricha longifolia* | Starhair bush |
| Dicotyledons | Araliaceae | *Polyscias elegans* | Celerywood |
| Dicotyledons | Araliaceae | *Polyscias murrayi* | Pencil cedar |
| Dicotyledons | Araliaceae | *Schefflera actinophylla** | Umbrella tree |
| Dicotyledons | Asclepiadaceae | *Asclepias curassavica** | Redhead cotton bush |
| Dicotyledons | Asclepiadaceae | *Asclepias fruticosa** | Milky cotton-bush |
| Dicotyledons | Asclepiadaceae | *Gomphocarpus fruticosus** | Narrow-leafed cotton bush |
| Dicotyledons | Asclepiadaceae | *Gomphocarpus physocarpus** | Balloon cotton bush |
| Dicotyledons | Asclepiadaceae | *Marsdenia rostrata* | Milk vine |
| Dicotyledons | Asteraceae | *Ageratina adenophora** | Crofton weed |
| Dicotyledons | Asteraceae | *Ageratina riparia** | Mistflower |
| Dicotyledons | Asteraceae | *Ageratum conyzoides* | Goatweed |
| Dicotyledons | Asteraceae | *Ageratum houstonianum** | Blue billygoat weed |
| Dicotyledons | Asteraceae | *Ambrosia psilostachya* | Perennial ragweed |
| Dicotyledons | Asteraceae | *Baccharis halimifolia* | Groundsel bush |
| Dicotyledons | Asteraceae | *Biddens pilosa** | Cobbler's pegs |
| Dicotyledons | Asteraceae | *Cotula australis* | Carrot weed |
| Dicotyledons | Asteraceae | *Cirsium vulgare* | Spear thistle |
| Dicotyledons | Asteraceae | *Cotula coronopifolia* | Water buttons |
| Dicotyledons | Asteraceae | *Crassocephalum crepidioides** | Thickhead |
| Dicotyledons | Asteraceae | *Conyza albida* | Tall fleabane |
| Dicotyledons | Asteraceae | *Erechtites valerianifolia** | Brazilian fire weed |
| Dicotyledons | Asteraceae | *Eupatorium* sp. | Crofton weed |
| Dicotyledons | Asteraceae | *Hypochoeris radicata** | Flatweed |
| Dicotyledons | Asteraceae | *Senecio lautus* | Fireweed |
| Dicotyledons | Asteraceae | *Senecio madagascariensis** | Fireweed |
| Dicotyledons | Asteraceae | *Soliva pterosperma** | Bindii |
| Dicotyledons | Asteraceae | *Tagetes minuta** | Stinking roger |
| Dicotyledons | Asteraceae | *Xanthium pungens* | Noogoora burr |
| Dicotyledons | Bignoniaceae | *Pandorea pandorana* | Wonga wonga vine |
| **Dicotyledons** | **Caesalpiniaceae** | ***Cassia brewsteri var. marksiana*** | **Mark's Cassia/ Brush cassia** |
| Dicotyledons | Caesalpiniaceae | *Caes decapetala** | Winter senna |
| Dicotyledons | Caesalpiniaceae | *Senna pendula var. glabrata** | Winter senna |
| Dicotyledons | Caesalpiniaceae | *Senna floribunda* | Smooth cassia |
| Dicotyledons | Capparaceae | *Capparis arborea* | Brush caper berry |
| Dicotyledons | Capparaceae | *Capparis brewsteri var. marksiana* | Brush cassia |
| Dicotyledons | Caryophyllaceae | *Moenchea erecta** | Chick weed |
| Dicotyledons | Casuarinaceae | *Allocasuarina littoralis* | Black she-oak |

| Grouping | Family | Botanical Name | Common Name |
|---|---|---|---|
| Dicotyledons | Casuarinaceae | *Allocasuarina torulosa* | Forest oak |
| Dicotyledons | Casuarinaceae | *Casuarina glauca* | Swamp she-oak |
| Dicotyledons | Celastraceae | *Denhamia celastroides* | Denhamia |
| Dicotyledons | Celastraceae | *Denhamia pittosporoides* | Orange Boxwood |
| Dicotyledons | Celastraceae | *Hedraianthera porphyropetala* | Hedraianthera |
| Dicotyledons | Convolvulaceae | *Convolvulus* sp. | |
| Dicotyledons | Convolvulaceae | *Ipomoea cairica** | Coastal morning glory |
| Dicotyledons | Convolvulaceae | *Ipomoea indica** | Morning glory |
| Dicotyledons | Cunoniaceae | *Caldcluvia paniculosa* | Soft corkwood |
| Dicotyledons | Cunoniaceae | *Pseudoweinmannia lachnocarpa* | Rose marara |
| Dicotyledons | Cunoniaceae | *Schizomeria ovata* | Crab apple |
| Dicotyledons | Dilleniaceae | *Hibbertia aspera* | Golden guinea flower |
| Dicotyledons | Dilleniaceae | *Hibbertia dentata* | Twining guinea flower |
| Dicotyledons | Dilleniaceae | *Hibbertia obtusifolia* | Grey guinea flower |
| Dicotyledons | Dilleniaceae | *Hibbertia scandens* | Climbing guinea flower |
| Dicotyledons | Dioscoreaceae | *Dioscorea transversa* | Native yam |
| Dicotyledons | Droseraceae | *Drosera spatulata* | Spoon leaf sundew |
| Dicotyledons | Ebenaceae | *Diospyros fasciculosa* | Grey ebony |
| Dicotyledons | Ebenaceae | *Dlospyros kaki* | Persimmon |
| Dicotyledons | Ebenaceae | *Diospyros pentamera* | Myrtle ebony |
| Dicotyledons | Elaeocarpaceae | *Elaeocarpus obovatus* | Hard quandong |
| Dicotyledons | Elaeocarpaceae | *Elaeocarpus reticulatus* | Blueberry ash |
| Dicotyledons | Elaeocarpaceae | *Sloanea australis* | Maiden's blush |
| Dicotyledons | Elaeocarpaceae | *Sloanea woollsii* | Yellow carabeen |
| Dicotyledons | Epacridaceae | *Acrotriche aggregata* | Tree heath |
| Dicotyledons | Epacridaceae | *Leucopogon lanceolatus* subsp. *gracilis* | Beard heath |
| Dicotyledons | Epacridaceae | *Monotoca elliptica* | Broom heath |
| Dicotyledons | Epacridaceae | *Trochocarpa laurina* | Tree heath |
| Dicotyledons | Ericaceae | *Brachyloma daphnoides* | Daphne heath |
| Dicotyledons | Ericaceae | *Brachyloma scortechinii* | |
| Dicotyledons | Ericaceae | *Leucopogon ericoides* | Pink beard-heath |
| Dicotyledons | Ericaceae | *Leucopogon juniperinus* | Prickly beard heath |
| Dicotyledons | Ericaceae | *Leucopogon lanceolatus var. gracilis* | Beard heath |
| Dicotyledons | Ericaceae | *Leucopogon leptospermoides* | Beard heath |
| Dicotyledons | Ericaceae | *Leucopogon margarodes* | |
| Dicotyledons | Ericaceae | *Leucopogon microphylla* | Wire beard-Heath |
| Dicotyledons | Ericaceae | *Leucopogon muticus* | Blunt beard-Heath |
| Dicotyledons | Ericaceae | *Leucopogon pedicellatus* | Wallum beard heath |
| Dicotyledons | Ericaceae | *Monotoca scoparia* | Prickly broom heath |
| Dicotyledons | Ericaceae | *Styphelia viridis* | |

| Grouping | Family | Botanical Name | Common Name |
|---|---|---|---|
| Dicotyledons | Euphorbiaceae | *Alchornea ilicifolia* | Native holly |
| Dicotyledons | Euphorbiaceae | *Breynia oblongifolia* | Coffee bush |
| Dicotyledons | Euphorbiaceae | *Bridelia exaltata* | Brush ironbark |
| Dicotyledons | Euphorbiaceae | *Claoxylon australe* | Brittlewood |
| Dicotyledons | Euphorbiaceae | *Cleistanthus cunninghamii* | Cleistanthus |
| Dicotyledons | Euphorbiaceae | *Croton verrauxii* | Native carscarilla |
| Dicotyledons | Euphorbiaceae | *Excoecaria agallocha* | Milky mangrove |
| Dicotyledons | Euphorbiaceae | *Glochidion ferdinandi var. ferdinandi* | Cheese tree |
| Dicotyledons | Euphorbiaceae | *Glochidion sumatranum* | Umbrella cheese tree |
| Dicotyledons | Euphorbiaceae | *Macaranga tanarius* | Macaranga |
| Dicotyledons | Euphorbiaceae | *Mallotus discolor* | Yellow kamala |
| Dicotyledons | Euphorbiaceae | *Mallotus philippensis* | Red kamala |
| Dicotyledons | Euphorbiaceae | *Omalanthus populifolius* | Native Bleeding heart |
| Dicotyledons | Euphorbiaceae | *Ricinocarpos pinifolius* | Wedding bush |
| Dicotyledons | Euphorbiaceae | *Tragia novae-hollandiae* | Stinging vine |
| Dicotyledons | Eupomatiaceae | *Eupomatia laurina* | Bolwarra |
| Dicotyledons | Fabaceae | *Aotus ericoides* | Golden pea |
| Dicotyledons | Fabaceae | *Caesalpinea decapetala* | Wait-a-while |
| Dicotyledons | Fabaceae | *Crotalaria* sp. | Rattlepod |
| Dicotyledons | Fabaceae | *Daviesia arborea* | Bitter pea |
| Dicotyledons | Fabaceae | *Desmodium rhytidophyllum* | Rusty tick-trefoil |
| Dicotyledons | Fabaceae | *Dillwynia floribunda* | Snowy parrot pea |
| Dicotyledons | Fabaceae | *Glycine clandestina* | Twining glycine |
| Dicotyledons | Fabaceae | *Glycine javanica* | Glycine |
| Dicotyledons | Fabaceae | *Gompholobium virgatum* | Leafy wedge pea |
| Dicotyledons | Fabaceae | *Hardenbergia violacea* | False sarsaparilla |
| Dicotyledons | Fabaceae | *Hovea acutifolia* | Brush hovea |
| Dicotyledons | Fabaceae | *Hovea longifolia* | Purple bush pea |
| Dicotyledons | Fabaceae | *Jacksonia scorparia* | Dogwood |
| Dicotyledons | Fabaceae | *Kennedia rubicunda* | Dusky coral pea |
| Dicotyledons | Fabaceae | *Macroptilium atropurpureum** | Siratro |
| Dicotyledons | Fabaceae | *Medicago** sp. | Media |
| Dicotyledons | Fabaceae | *Melilotus indicus** | Hexham scent |
| Dicotyledons | Fabaceae | *Millettia australis* | Wistaria |
| Dicotyledons | Fabaceae | *Millettia megasperma* | Native wistaria |
| Dicotyledons | Fabaceae | *Phyllota phylicoides* | Heath phyllota |
| Dicotyledons | Fabaceae | *Pultenaea retusa* | Blunt bush pea |
| Dicotyledons | Fabaceae | *Pultenaea villosa* | Hairy bush pea |
| Dicotyledons | Fabaceae | *Vigna lanceolata* | Maloga bean |
| Dicotyledons | Flagellariaceae | *Flagellaria indica* | Whip vine |
| Dicotyledons | Goodeniaceae | *Goodenia rotundifolia* | Star goodenia |
| Dicotyledons | Haloragaceae | *Myriophyllum aquaticum* | Parrot's feather |
| Dicotyledons | Lamiaceae | *Stachys arvensis** | Stagger weed |
| Dicotyledons | Lauraceae | *Beilschmiedia elliptica* | Grey walnut |

| Grouping | Family | Botanical Name | Common Name |
|---|---|---|---|
| Dicotyledons | Lauraceae | *Cassytha filliformes* | Devil's twine |
| Dicotyledons | Lauraceae | *Cinnamomum camphora** | Camphor laurel |
| Dicotyledons | Lauraceae | *Cinnamomum oliveri* | Oliver's sassafras |
| Dicotyledons | Lauraceae | *Cinnamomum virens* | Red-barked sassafras |
| Dicotyledons | Lauraceae | *Cryptocarya erythroxylon* | Pigeonberry ash |
| Dicotyledons | Lauraceae | *Cryptocarya glaucescens* | Jackwood |
| Dicotyledons | Lauraceae | *Cryptocarya laevigata* | Glossy laurel |
| Dicotyledons | Lauraceae | *Cryptocarya obovata* | Pepperberry tree |
| Dicotyledons | Lauraceae | *Cryptocarya triplinervis var. triplinervis* | Three-veined laurel |
| Dicotyledons | Lauraceae | *Endiandra globosa* | Black walnut |
| **Dicotyledons** | **Lauraceae** | ***Endiandra hayesii*** | **Rusty rose walnut** |
| Dicotyledons | Lauraceae | *Endiandra introrsa* | Dorrigo plum |
| **Dicotyledons** | **Lauraceae** | ***Endiandra muelleri var. bracteata*** | **Green-leaved rose walnut** |
| Dicotyledons | Lauraceae | *Endiandra pubens* | Hairy walnut |
| Dicotyledons | Lauraceae | *Endiandra sieberi* | Hard corkwood |
| Dicotyledons | Lauraceae | *Litsea australis* | Brown bolly gum |
| Dicotyledons | Lauraceae | *Litsea reticulata* | Brown bolly gum |
| Dicotyledons | Lauraceae | *Neolitsea dealbata* | White bolly gum |
| Dicotyledons | Loranthaceae | *Amylotheca dictyophleba* | |
| Dicotyledons | Loranthaceae | *Amyema Conspicuum* subsp. *conspicuum* | Mistletoe |
| Dicotyledons | Lythraceae | *Lagerstroemia indica** | Crepe Myrtle |
| Dicotyledons | Malvaceae | *Hibiscus diversifolius* | Swamp hibiscus |
| Dicotyledons | Malvaceae | *Hibiscus heterophyllus* | Native rosella |
| Dicotyledons | Malvaceae | *Sida rhombifolia** | Paddy's lucerne |
| Dicotyledons | Melastomataceae | *Melastoma affine* | Native lasiandra |
| Dicotyledons | Melastomataceae | *Melastoma polyanthum* | Blue tongue |
| Dicotyledons | Meliaceae | *Dysoxylum mollissimum ssp. Molle* | Red bean |
| Dicotyledons | Meliaceae | *Melia azedarach* | White cedar |
| Dicotyledons | Meliaceae | *Synoum glandulosum* | Scentless rosewood |
| Dicotyledons | Meliaceae | *Toona ciliata* | Red cedar |
| Dicotyledons | Menispermaceae | *Stephania aculeata* | Prickly snake vine |
| Dicotyledons | Menispermaceae | *Stephania japonica* | Snake vine |
| Dicotyledons | Mimosaceae | *Acacia aulacocarpa* | Hickory wattle |
| **Dicotyledons** | **Mimosaceae** | ***Acacia bakeri*** | **Baker's wattle/ Marblewood** |
| Dicotyledons | Mimosaceae | *Acacia concurrens* | Black wattle |
| Dicotyledons | Mimosaceae | *Acacia implexa* | Hickory wattle |
| Dicotyledons | Mimosaceae | *Acacia leiocalyx* | Black wattle |
| Dicotyledons | Mimosaceae | *Acacia longissima* | Narrow leaf acacia |
| Dicotyledons | Mimosaceae | *Acacia melanoxylon* | Blackwood wattle |
| Dicotyledons | Mimosaceae | *Acacia penninervis* | Mountain hickory |
| Dicotyledons | Mimosaceae | *Acacia sopharae* | Coastal wattle |

| Grouping | Family | Botanical Name | Common Name |
|---|---|---|---|
| Dicotyledons | Mimosaceae | *Acacia suaveolens* | Sweet wattle |
| Dicotyledons | Mimosaceae | *Acacia ulicifolia* | Prickly moses |
| Dicotyledons | Mimosaceae | *Archidendron muellerianum* | Veiny lace flower |
| Dicotyledons | Monimiaceae | *Wilkiea austroqueenslandica* | Smooth wilkiea |
| Dicotyledons | Monimiaceae | *Wilkiea huegeliana* | Veiny wilkiea |
| Dicotyledons | Monimiaceae | *Wilkiea macrophylla* | Large leaved wilkiea |
| Dicotyledons | Moraceae | *Ficus coronata* | Creek sandpaper fig |
| Dicotyledons | Moraceae | *Ficus macrophylla* | Moreton Bay fig |
| Dicotyledons | Moraceae | *Ficus fraseri* | Sandpaper fig |
| Dicotyledons | Moraceae | *Ficus obliqua* | Small-leaved fig |
| Dicotyledons | Moraceae | *Ficus rubiginosa* | Port Jackson fig/Rusty fig |
| Dicotyledons | Moraceae | *Ficus watkinsiana* | Strangler fig |
| Dicotyledons | Moraceae | *Maclura cochinchinensis* | Cockspur |
| Dicotyledons | Moraceae | *Morus nigra* | Black mulberry |
| Dicotyledons | Moraceae | *Streblus brunonianus* | Whalebone tree |
| Dicotyledons | Moraceae | *Trophis scandens* | Burny vine |
| Dicotyledons | Myrsinaceae | *Aegiceras corniculatum* | River mangrove |
| Dicotyledons | Myrsinaceae | *Ardisia bakeri* | Ardisia |
| Dicotyledons | Myrsinaceae | *Embelia australiana* | Embelia |
| Dicotyledons | Myrsinaceae | *Rapanea howittiana* | Brush muttonwood |
| Dicotyledons | Myrsinaceae | *Rapanea variabilis* | Muttonwood |
| Dicotyledons | Myrtaceae | *Acmena smithii* | Lilly pilly |
| Dicotyledons | Myrtaceae | *Angophora costata* | Rusty gum |
| Dicotyledons | Myrtaceae | *Archirhodomyrtus beckleri* | Rose myrtle |
| Dicotyledons | Myrtaceae | *Austromyrtus dulcis* | Midgen berry |
| Dicotyledons | Myrtaceae | *Austromyrtus bidwillii* | Python tree |
| Dicotyledons | Myrtaceae | *Backhousia myrtifolia* | Grey myrtle |
| Dicotyledons | Myrtaceae | *Baeckea linifolia* | Weeping baeckea |
| Dicotyledons | Myrtaceae | *Callistemon salignus* | Willow bottlebrush |
| Dicotyledons | Myrtaceae | *Callistemon pachyphyllus* | Wallum bottlebrush |
| Dicotyledons | Myrtaceae | *Corymbia intermedia* | Pink bloodwood |
| Dicotyledons | Myrtaceae | *Corymbia maculate* | Spotted gum |
| Dicotyledons | Myrtaceae | *Eucalyptus acmenoides* | White mahogany |
| Dicotyledons | Myrtaceae | *Eucalyptus crebra* | Narrow-leaved ironbark |
| Dicotyledons | Myrtaceae | *Eucalyptus gummifera* | Red bloodwood |
| Dicotyledons | Myrtaceae | *Eucalyptus microcorys* | Tallowwood |
| Dicotyledons | Myrtaceae | *Eucalyptus pilularis* | Blackbutt |
| Dicotyledons | Myrtaceae | *Eucalyptus propinqua* | Small-fruited grey gum |
| Dicotyledons | Myrtaceae | *Eucalyptus racemosa* | Narrow-leaved scribbly gum |
| Dicotyledons | Myrtaceae | *Eucalyptus resinifera* | Red mahogany |
| Dicotyledons | Myrtaceae | *Eucalyptus robusta* | Swamp mahogany |

| Grouping | Family | Botanical Name | Common Name |
|---|---|---|---|
| Dicotyledons | Myrtaceae | *Eucalyptus saligna* | Sydney blue gum |
| Dicotyledons | Myrtaceae | *Eucalyptus siderophloia* | Northern grey ironbark |
| Dicotyledons | Myrtaceae | *Eucalyptus sideroxylon* | Mugga |
| Dicotyledons | Myrtaceae | *Eucalyptus tereticornis* | Forest red gum |
| Dicotyledons | Myrtaceae | *Gossia hillii* | Scaly myrtle |
| Dicotyledons | Myrtaceae | *Homoranthus virgatus* | |
| Dicotyledons | Myrtaceae | *Leptospermum flavescens* | Wild may |
| Dicotyledons | Myrtaceae | *Leptospermum liversidgei* | Swamp may |
| Dicotyledons | Myrtaceae | *Leptospermum juniperinum* | Prickly tea-tree |
| Dicotyledons | Myrtaceae | *Leptospermum polygalifolium* | Yellow tea-tree |
| Dicotyledons | Myrtaceae | *Leptospermum trinervium* | |
| Dicotyledons | Myrtaceae | *Lophostemon confertus* | Brush box |
| Dicotyledons | Myrtaceae | *Lophostemon suaveolens* | Swamp turpentine |
| Dicotyledons | Myrtaceae | *Melaleuca quinquenervia* | Broad-leaved paperbark |
| Dicotyledons | Myrtaceae | *Ochrosperma lineare* | Straggly baeckea |
| Dicotyledons | Myrtaceae | *Pilidiostigma glabrum* | Plum myrtle |
| Dicotyledons | Myrtaceae | *Psidium guajava** | Guava |
| Dicotyledons | Myrtaceae | *Rhodamnia argentea* | Malletwood |
| Dicotyledons | Myrtaceae | *Rhodamnia maideniana* | Smooth scrub turpentine |
| Dicotyledons | Myrtaceae | *Rhodamnia rubescens* | Scrub turpentine |
| Dicotyledons | Myrtaceae | *Rhodomyrtus psidioides* | Native guava |
| Dicotyledons | Myrtaceae | *Syncarpia glomulifera* | Turpentine |
| Dicotyledons | Myrtaceae | *Syzygium australe* | Brush cherry |
| | | *Syzygium francisii* | Giant water gum |
| Dicotyledons | Myrtaceae | *Syzygium luehmannii* | Riberry |
| **Dicotyledons** | **Myrtaceae** | ***Syzygium moorei*** | **Coolamon, Durobby** |
| Dicotyledons | Myrtaceae | *Syzygium oleosum* | Blue lilly pilly |
| Dicotyledons | Myrtaceae | *Syzygium smithii* | Lilly pilly |
| Dicotyledons | Myrtaceae | *Tristaniopsis laurina* | Water gum |
| Dicotyledons | Myrtaceae | *Waterhousea floribunda* | Weeping lilly pilly |
| Dicotyledons | Nymphaeaceae | *Nymphonaceae capensis** | Water lily |
| Dicotyledons | Ochnaceae | *Ochna serrulata** | Mickey mouse plant |
| Dicotyledons | Oleaceae | *Ligustrum lucidum** | Large-leaved privet |
| Dicotyledons | Oleaceae | *Ligustrum sinense** | Small-leaved privet |
| Dicotyledons | Oleaceae | *Notelaea longifolia* | Large mock-olive |
| Dicotyledons | Oxalidaceae | *Oxalis corniculata* | Yellow wood-sorrel |
| Dicotyledons | Oxalidaceae | *Oxalis exilis* | Shady wood-sorrel |
| Dicotyledons | Passifloraceae | *Passiflora edulis* | Passionfruit |
| Dicotyledons | Passifloraceae | *Passiflora herbertiana subsp. herbertiana* | Native passionfruit |
| Dicotyledons | Passifloraceae | *Passiflora suberosa** | Cork/Small passionfruit |

| Grouping | Family | Botanical Name | Common Name |
|---|---|---|---|
| Dicotyledons | Passifloraceae | *Passiflora subpeltata** | White passionflower |
| Dicotyledons | Philesiaceae | *Eustrephus latifolius* | Wombat berry |
| Dicotyledons | Pittosporaceae | *Citriobatus lancifolius* | Narrow-leaved Orange thorn |
| Dicotyledons | Pittosporaceae | *Citriobatus pauciflorus* | Orange thorn |
| Dicotyledons | Pittosporaceae | *Pittosporum multiflorum* | Orange thorn |
| Dicotyledons | Pittosporaceae | *Pittosporum oreillyanum* | Thorny pittosporum |
| Dicotyledons | Pittosporaceae | *Pittosporum revolutum* | Hairy pittosporum |
| Dicotyledons | Pittosporaceae | *Pittosporum spinescens* | Large-fruited Orang thorn |
| Dicotyledons | Pittosporaceae | *Pittosporum undulatum* | Sweet pittosporum |
| Dicotyledons | Polygonaceae | *Persicaria decipiens* | Slender knotweed |
| Dicotyledons | Proteaceae | *Banksia aemula* | Wallum banksia |
| Dicotyledons | Proteaceae | *Banksia integrifolia* | Coast banksia |
| Dicotyledons | Proteaceae | *Banksia oblongifolia* | Dwarf banksia |
| Dicotyledons | Proteaceae | *Banksia robur* | Broad-leaved banksia |
| Dicotyledons | Proteaceae | *Grevillea hilliana* | White yiel yiel |
| Dicotyledons | Proteaceae | *Hakea dactyloides* | Finger hakea |
| Dicotyledons | Proteaceae | *Lomatia silaifolia* | Crinkle bush |
| Dicotyledons | Proteaceae | *Macadamia integrifolia* | Macadamia nut |
| Dicotyledons | Proteaceae | *Persoonia adenantha* | |
| Dicotyledons | Proteaceae | *Persoonia cornifolia* | Geebung |
| Dicotyledons | Proteaceae | *Persoonia stradbrokensis* | Broad-leaved geebung |
| Dicotyledons | Proteaceae | *Persoonia virgata* | Geebung |
| Dicotyledons | Proteaceae | *Stenocarpus sinuatus* | Firewheel tree |
| Dicotyledons | Pteridaceae | *Acrostichum speciosum* | Mangrove fern |
| Dicotyledons | Ranunculaceae | *Clematis glycinoides* | Headache Vine |
| Dicotyledons | Rhamnaceae | *Alphitonia excelsa* | Red ash |
| Dicotyledons | Rhizophoraceae | *Bruguiera gymnorrhiza* | Black mangrove |
| Dicotyledons | Rhizophoraceae | *Ceriops tagal* | Smooth fruited spurred mangrove |
| Dicotyledons | Rhizophoraceae | *Rhizophora stylosa* | Small-stilited mangrove |
| Dicotyledons | Rosaceae | *Rubus ellipticus* | Yellow raspberry |
| Dicotyledons | Rosaceae | *Rubus fruticosus* | Blackberry |
| Dicotyledons | Rosaceae | *Rubus moluccanus var. trilobus* | Molucca bramble |
| Dicotyledons | Rosaceae | *Rubus moluccanus var. trilobus* | Molucca raspberry |
| Dicotyledons | Rosaceae | *Rubus parvifolius* | Native raspberry |
| Dicotyledons | Rosaceae | *Rubus rosifolius* | Rose leaf bramble |
| Dicotyledons | Rubiaceae | *Hodgkinsonia ovatiflora* | Hodgkinsonia |
| Dicotyledons | Rubiaceae | *Morinda jasminoides* | Morinda |
| Dicotyledons | Rubiaceae | *Psychotria loniceroides* | Hairy psychotria |
| Dicotyledons | Rubiaceae | *Randia chartacea** | Narrow leaved gardenia |

| Grouping | Family | Botanical Name | Common Name |
|---|---|---|---|
| **Dicotyledons** | **Rubiaceae** | ***Randia moorei*** | **Spiny gardenia** |
| **Dicotyledons** | **Rutaceae** | ***Acronychia littoralis*** | **Scented acronychia** |
| Dicotyledons | Rutaceae | *Acronychia oblongifolia* | Common acronychia |
| Dicotyledons | Rutaceae | *Acronychia pubescens* | Hairy acronychia |
| Dicotyledons | Rutaceae | *Boronia falcifolia* | Wallum boronia |
| Dicotyledons | Rutaceae | *Boronia rosmarinifolia* | Forest boronia |
| Dicotyledons | Rutaceae | *Citris limon** | Lemon bush |
| Dicotyledons | Rutaceae | *Flindersia australis* | Crows ash |
| Dicotyledons | Rutaceae | *Flindersia bennettiana* | Bennett's ash |
| Dicotyledons | Rutaceae | *Flindersia schottiana* | Cudgerie |
| Dicotyledons | Rutaceae | *Flindersia xanthoxyla* | Yellowwood |
| Dicotyledons | Rutaceae | *Melicope elleryana* | Pink-flowered doughwood |
| Dicotyledons | Rutaceae | *Pentaceras australe* | Crow's ash |
| Dicotyledons | Rutaceae | *Euodia ellervana* | Pink euodia |
| Dicotyledons | Rutaceae | *Sarcomelicope simplicifolia* | Bauerella |
| Dicotyledons | Rutaceae | *Zieria smithii* | Sandfly zieria |
| Dicotyledons | Rutaceae | *Zieria laxiflora* | Wallum zieria |
| Dicotyledons | Sambucaceae | *Sambucus australasica* | Native elderberry |
| Dicotyledons | Santalaceae | *Exocarpus latifolius* | Broad-leaved ballart |
| Dicotyledons | Santalaceae | *Exocarpus strictus* | Pale-fruit ballart |
| Dicotyledons | Sapindaceae | *Alectryon tomentosus* | Hairy alectryon |
| Dicotyledons | Sapindaceae | *Arytera distylis* | Twin-leaved coogera |
| Dicotyledons | Sapindaceae | *Cupaniopsis anacardioides* | Tuckeroo |
| Dicotyledons | Sapindaceae | *Cupaniopsis flagelliformis var. australis* | Brown tuckeroo |
| Dicotyledons | Sapindaceae | *Cupaniopsis newmanii* | Long-leaved tuckeroo |
| Dicotyledons | Sapindaceae | *Cupaniopsis parvifolia* | Small-leaved tuckeroo |
| Dicotyledons | Sapindaceae | *Diploglottis australis* | Native tamarind |
| Dicotyledons | Sapindaceae | *Dodonaea triquetra* | Hopbush |
| Dicotyledons | Sapindaceae | *Elattostachys nervosa* | Green tamarind |
| Dicotyledons | Sapindaceae | *Guioa semiglauca* | Guioa |
| Dicotyledons | Sapindaceae | *Harpullia alata* | Wing-leaved Tulip |
| Dicotyledons | Sapindaceae | *Jagera pseudorhus* | Foambark |
| **Dicotyledons** | **Sapindaceae** | ***Lepiderema pulchella*** | **Fine-leaved tuckeroo** |
| Dicotyledons | Sapindaceae | *Mischocarpus pyriformis* | Yellow pear fruit |
| Dicotyledons | Sapindaceae | *Sarcopteryx stipata* | Steelwood |
| Dicotyledons | Sapindaceae | *Toechima dasyrrhache* | Blunt-leaved steelwood |
| Dicotyledons | Sapotaceae | *Planchonella laurifolia* | Blush coondoo |
| Dicotyledons | Sapotaceae | *Planchonella queenslandica* | Blush coondoo |
| Dicotyledons | Solanaceae | *Lycium ferocissimum* | African boxthorn |
| Dicotyledons | Solanaceae | *Solanum capsicoides* | Devil's apple |

| Grouping | Family | Botanical Name | Common Name |
|---|---|---|---|
| Dicotyledons | Solanaceae | *Solanum hermanii* | Apple of Sodon |
| Dicotyledons | Solanaceae | *Solanum mauritianum** | Wild tobacco tree |
| Dicotyledons | Solanaceae | *Solanum nigrum** | Black-berry nightshade |
| Dicotyledons | Solanaceae | *Solanum seaforthianum** | Brazilian nightshade |
| Dicotyledons | Sterculiaceae | *Commersonia bartramia* | Brown kurrajong |
| Dicotyledons | Sterculiaceae | *Argyrodendrom trifoliolatum* | White booyong |
| Dicotyledons | Sterculiaceae | *Sterculia quadrifida* | Red-fruited kurrajong |
| Dicotyledons | Symplocaceae | *Symplocos stawellii* | White hazelwood |
| Dicotyledons | Thymelaeaceae | *Pimelea linifolia* | Slender rice flower |
| Dicotyledons | Thymelaeaceae | *Wikstroemia indica* | Wikstroemia |
| Dicotyledons | Ulmaceae | *Aphananthe philippinensis* | Rough–leaved elm |
| Dicotyledons | Ulmaceae | *Trema tomentosa* | Poison peach |
| Dicotyledons | Urticaceae | *Urtica* sp.* | Stinging nettle |
| Dicotyledons | Verbenaceae | *Clerodendrum floribundum* | Smooth clerodendrum |
| Dicotyledons | Verbenaceae | *Gmelina leichhardtii* | White beech |
| Dicotyledons | Verbenaceae | *Lantana camara** | Lantana |
| Dicotyledons | Verbenaceae | *Verbena bonariensis** | Purple top |
| Dicotyledons | Violaceae | *Viola hederacea subsp. Hederaceae* | Native violet |
| Dicotyledons | Visaceae | *Notothixos cornifolius* | Mistletoe |
| Dicotyledons | Vitaceae | *Cissus antarctica* | Water vine |
| Dicotyledons | Vitaceae | *Cissus hypoglauca* | Five-leaf water vine |
| Dicotyledons | Xanthorrhoeacae | *Xanthorrhoea macronema* | Bottle-brush Grass trees |

* Introduced Species

**Threatened species are shown in bold**

# Appendix 3 - Fauna Assessment

## 1.1 Introduction

This section includes a description of the methods used in determining which fauna species use, or are likely to use, the Study area and a discussion of the results of the previous Fauna assessments conducted on the Subject site. The fauna assessments involved a variety of fauna surveys (i.e. specialised bird, bat and amphibian survey, spotlighting, hair sampling and trapping).

## 1.2 Methodology

### *1.2.1 Background*

Eleven (11) fauna surveys were carried out between 1981 and 2008. These involved the following:

- The fauna survey carried out by Barry (1981) for the Cobaki Village Environmental Study (McNamara 1983) was carried out over 250 trap nights.
- The WBM (1990) survey was carried out in January and February 1990, and consisted of daylight and spotlight observations for a range of fauna assemblages throughout all major habitat types.
- The WBM (1991a) report focused on a population of Greater Gliders identified on the Subject site. Information was obtained from field studies carried out between October and December 1991.
- The WBM (1991b) survey centred on fauna existing on Crown Reserve land between the QLD-NSW border and the boundary of the Cobaki property, and was carried out in October and November 1991.
- Warren (1992) completed a survey targeting a number of Threatened fauna species in the area of the proposed Boyd Street extension. The fauna survey was completed over 173 trap nights and 10 trap days. A frog survey was carried out on the night of 9 September 1992.
- Warren (1993) involved an intensive fauna survey in April and May 1993.
- Warren (1994) carried out a survey involving habitat tree identification, bird census and Microchiropteran bat analysis in October and November 1994.
- Debus (1994) carried out an intensive bird survey on 27-28 November 1994.
- Woodward-Clyde (1997) carried out a fauna survey in May and July 1997 on the Subject site.
- JWA (unpublished data 2007) carried out a targeted Wallum froglet survey in August 2007 on the Subject site.
- JWA (unpublished data 2007) carried out a Koala and Greater glider survey in December 2007 on the Subject site.

### *1.2.2 Survey Techniques*

Detailed fauna surveys were designed to target threatened species identified as occurring in the Study area. The following survey techniques were utilised in these assessments.

**Opportunistic Sightings**
Daylight observations for mammals, birds, reptiles and amphibians were utilised by Barry (1981); WBM (1990); WBM (1991b); and Warren (1993). All incidental records of fauna utilising the study area were recorded.

**Active Searching**
Logs, sheets of tin, cardboard, bark and leaves were overturned in search of reptiles and amphibians while incidentally traversing the site. Diggings and signs of droppings were searched for. The site was actively searched for scats and bones. Active observation of bird activity was also undertaken during site visits.

**Type 'A' Elliott Box Traps and Cage Traps**
This methodology provides an insight into the size and density of populations of ground fauna which may form a component of the diet of raptors such as the Eastern grass owl and the Masked owl. It also indicates the extent of invasion by exotic species such as the Black rat and the House mouse which allows an assessment of the 'naturalness' of the area to be made.

This method was utilised by Barry (1981), WBM (1990), WBM (1991b), Warren (1992), and Warren (1993) during previous fauna assessments on the Subject site.

**Pitfall traps**
Pitfall traps were utilised in the studies completed by Barry (1981) and WBM (1991b) on the Subject site.

**Hair Tubes**
Hair tube sampling was used by Warren (1993) during survey work on the Subject site.

**Mist Netting**
This method was utilised by Woodward-Clyde (1997). Two (2) mist nets were placed adjacent to Paperbark wetland vegetation in the north-east of the site, and left in place for three (3) hours. The target of this survey was the Queensland blossom bat.

**Specialist avian survey**
Surveys were carried out to sample diurnal bird species. A census of bird occurrence was carried out to sample both diurnal and nocturnal birds. This methodology was utilised in the studies conducted by WBM (1991b); Warren (1994); Debus (1994); and Woodward-Clyde (1997).

**Call playback techniques**
Call playback was carried out by S. Debus during a supplementary bird survey over 2-3 May 1997. Target species included: Masked owl, Barking Owl, Sooty owl. Additional survey for owls (S. Debus) was conducted on the night of 28 July 1997.

**Koala survey**
Koala survey was utilised in the studies conducted by Warren (1994) during a habitat tree assessment. The analysis was based on scratch density on trees as well as the occurrence of faecal pellets around the base of the tree. Each tree was allocated a rating of 0-5 depending on the density of pellets or scratch marks i.e. 0 indicated absence of Koala activity, whilst 5 indicated a high level of activity.

The target Koala survey completed in December 2007 included two (2) nights spotlighting for a total of twelve (12) hours. Call play was also used at three (3) locations through out the site. Scat and scratch searches were also employed in this survey.

**Wallum froglet survey**
A survey of the Wallum froglets on the site was completed by JWA in August 2007 after 3-4 days of consistent rain. The site was traversed by two (2) scientists, G.P.S points were recorded for each of the locations where Wallum froglets were calling.

**Harp Netting**
This method was utilised by Warren (1992) during a survey targeting Threatened fauna species.

**Anabat Recording**
This method was utilised by Warren (1994) in ten (10) separate locations on the Cobaki site for the Microchiropteran bat survey.

**Spotlighting**
Spotlighting was undertaken by WBM (1990); WBM (1991a); WBM (1991b); and Warren (1993). Woodward-Clyde (1997) spent a total of fourteen (14) hours utilising this methodology to assess the occurrence of Koala, arboreal mammals and large forest owls.

### *1.2.3 Review of Significant Fauna Species*

A search of the NPWS database was completed to find records of Threatened fauna species within 10km of the Subject site.

### *1.2.4 Literature Review*

A comprehensive literature review was completed by Woodward-Clyde 1997 as part of a Species Impact Statement for the Cobaki Lakes site. This review used a number of sources to identify records of Threatened species occurring on the site.

### *1.2.5 Habitat Suitability Assessment for Significant Fauna*

Site habitats were assessed to determine their value for native fauna species. The assessments focused on identifying habitat features typically associated with Threatened species as well as other native fauna groups. Particular attention was paid to habitat features such as:

- The presence of mature trees with hollows, fissures and/or other suitable roosting/nesting places;
- The presence of Koala food trees;
- The presence of preferred Glossy black cockatoo feed trees (Forest oak and/or Black she-oak);
- The presence of characteristic signs of foraging (e.g. Yellow-bellied glider feeding scars);
- Condition, flow and water quality of drainage lines and bodies of water;
- Areas of dense vegetation;
- Presence of hollow logs/debris and areas of dense leaf litter;
- Presence of fruiting flora species;
- Presence of blossoming flora species, particularly winter-flowering species;
- Vegetation connectivity and proximity to neighbouring areas of intact vegetation; and
- Presence of caves and man-made structures suitable as microchiropteran bat roost sites.

Each Threatened species known from the locality was regarded as *Likely*, *Possible* or *Unlikely* to occur within the site, based on known records from the locality and provision of suitable habitat. A rating of *Likely* was given for those species where breeding or high quality habitat was found on the site; a rating of *Possible* was given for those species where suitable foraging or roosting habitat was found on the site; and a rating of *Unlikely* was given for species where no suitable habitat was found on the site.

## 1.3 Results

### *1.3.1 Review of Threatened Fauna Species*

The NPWS database search for the locality revealed that forty-five (45) species considered Endangered, Vulnerable or Rare are known within 10km of the Subject site. The results are shown in **TABLE 4**.

**TABLE 4**
**NPWS DATABASE RECORDS OF THREATENED FAUNA SPECIES**
**WITHIN 10 KM OF THE SUBJECT SITE**

| Scientific Name | Common Name |
|---|---|
| *Menura alberti* | Albert's lyrebird |
| *Arctocephalus pusillus doriferus* | Australian fur seal |
| *Ninox connivens* | Barking owl |
| *Coracina lineata* | Barred cuckoo-shrike |
| *Esacus neglectus* | Beach stone-curlew |
| *Mormopterus beccarii* | Beccari's free-tail bat |
| *Ixobrychus flavicollis* | Black bittern |
| *Pteropus alecto* | Black flying-fox |

| Scientific Name | Common Name |
|---|---|
| *Xenorhychus asiaticus* | Black-necked stork |
| *Limosa limosa* | Black-tailed godwit |
| *Gallinula olivacea* | Bush-hen |
| *Burhinus grallarius* | Bush stone-curlew |
| *Todiramphus chloris* | Collared kingfisher |
| *Irediparra gallinacea* | Comb-crested jacana |
| *Syconycteris australis* | Common blossom bat |
| *Planigale maculata* | Common planigale |
| *Nyctophilus bifax* | Eastern long-eared bat |
| *Puffinus carneipes* | Flesh-footed shearwater |
| *Calyptorhynchus lathami* | Glossy black-cockatoo |
| *Tyto capensis* | Grass owl |
| *Calidris tenuirostris* | Great knot |
| *Charadrius leschenaultii* | Greater sand-plover |
| *Chelonia mydas* | Green turtle |
| *Pteropus poliocephalus* | Grey-headed flying-fox |
| *Phascolarctos cinereus* | Koala |
| *Charadrius mongolus* | Lesser sand-plover |
| *Miniopterus australis* | Little bent-wing bat |
| *Sterna albifrons* | Little tern |
| *Caretta caretta* | Loggerhead turtle |
| *Potorous tridactylus* | Long-nosed potoroo |
| *Anseranas semipalmata* | Magpie goose |
| *Lichenostomus fasciogularis* | Mangrove honeyeater |
| *Tyto novaehollandiae* | Masked owl |
| *Thersites mitchellae* | Mitchell's rainforest snail |
| *Litoria olongburensis* | Wallum sedge frog |
| *Pandion haliaetus* | Osprey |
| *Haematopus fuliginosus* | Pied oystercatcher |
| *Ptilinopus regina* | Rose-crowned fruit dove |
| *Haematopus longirostris* | Sooty oystercatcher |
| *Lophoictinia isura* | Square-tailed kite |
| *Xenus cinereus* | Terek sandpiper |
| *Crinia tinnula* | Wallum froglet |
| *Monarcha leucotis* | White-eared monarch |
| *Ptilinopus magnificus* | Wompoo fruit-dove |
| *Saccolaimus flaviventris* | Yellow-bellied sheath-tailed bat |

### *1.3.2 Threatened Species Recorded in the Study Area*

Threatened species recorded in previous studies completed on the site are shown in **TABLE 5**.

**TABLE 5**
**THREATENED FAUNA SPECIES RECORDED IN STUDIES IN THE LOCALITY**
**(SOURCE: WOODWARD-CLYDE 1997)**

| | | | |
|---|---|---|---|
| **Birds** | Osprey | **Mammals** | Eastern free-tail bat |
| | Black-necked stork | | Yellow-bellied sheath-tail bat |
| | Powerful owl | | Common bent-wing bat |
| | Masked owl | | Little bent-wing bat |
| | | | Greater broad-nosed bat |
| | | | Eastern little mastiff bat |
| | Wallum froglet | | Koala |
| **Amphibians** | Wallum sedgefrog | | |

### *1.3.3 Habitat Suitability for Significant Fauna*

1.3.3.1 Amphibians

Amphibians occurring in the region are poikilothermic, predominantly insectivorous and generally require free water for reproduction, with the exception of two highland genera (*Assa darlingtoni* and *Philoria* spp.) The habitat requirements of most species are unlikely to be determined by forest cover or floristics, but are more strongly influenced by factors such as climate, distance to water bodies, riparian vegetation, hydrological and morphological characteristics of water bodies and the availability of suitable micro-habitat for aestivation and shelter.

The majority of species that occur within the region lay eggs in or near temporary or permanent water bodies and rely on free water for larval development and metamorphosis. Of these species, only a few are dependent on forested habitats beyond the riparian zone or beyond areas of temporary inundation. These species include the Red-eyed tree frog (*Litoria chloris*), Leseuer's frog (*Litoria leseueri*), Fletcher's frog (*Lechriodus fletcheri*) and the Barred frogs of the *Mixophyes* genus.

The Subject site is likely to provide good quality habitat for a range of frogs. While the distribution of amphibians is likely to be patchy, given the specific habitat requirements of some species (Woodward-Clyde 1997), areas of seasonal inundation including those vegetation communities described as Swampland would provide habitat for the Wallum froglet. This species, which occurs on the Subject site, may extend into the Sedgeland community during suitable periods.

Grasslands provide suitable habitat for a range of Amphibian species, particularly along drainage depressions and soaks. Species commonly encountered in grassland communities include the Common eastern froglet, Eastern sign bearing froglet, Striped marsh frog, Spotted grass frog, Eastern dwarf tree frog, Rocket frog, Whistling tree frog and Cane toad.

Species typically encountered in or adjacent to Closed Forests include the Eastern dwarf tree frog, Red-eyed tree frog, Striped marsh frog, Cane toad and Dainty green tree frog. Relatively few species occur in conjunction with Closed Forest types when permanent water is absent. Species which typically occur in low elevation Rainforest and permanent streams such as the Giant barred frog (*Mixophyes iteratus*) are unlikely to occur at the study site.

1.3.3.2 Reptiles

As reptiles are poikilothermic, and predominantly insectivorous or carnivorous, their habitat requirements are less directly determined by vegetation species composition than other taxa which feed directly on plants. Reptile distributions are strongly influenced by structural characteristics of the vegetation, climate and other factors affecting thermoregulation such as shade and availability of shelter and basking sites (Smith *et al* 1994).

In a survey of the moist forest herpetofauna of North-eastern NSW, Smith *et al* (1989) found that few species discriminated between rainforest and wet sclerophyll forest, however, most species exhibited a response to differences in elevation and the availability of microhabitat components and other substrates.
The availability of microhabitats, of varying thermal properties is particularly important for most reptile species, as behavioural thermoregulation (regulation of body heat) is important in controlling critical body functions such as digestion, foraging activity and reproduction.

Reptile diversity and abundance is often (but not always) significantly higher in drier habitat types, particularly those with a wide variety of ground substrate microhabitats. This contrasts markedly with the distribution patterns of birds, and most mammals.

The single limiting factor in terms of species diversity in coastal vegetation is the lack of shelter sites (e.g. logs, tree hollows and decorticating bark). Such habitat components characterise eucalypt forests and woodlands, where species diversity may be much higher, depending on disturbance factors.

The Subject site is considered to provide good quality habitat for reptiles due to the presence of: the combination of shelter and basking sites; rocky areas and fallen logs for shelter; rainforest areas with good canopy and leaf litter development; availability of water in drainage lines; shelter areas in rocky outcrops along the escarpment and reliable sources of prey.

1.3.3.3 Birds

The significance of near coastal environments of the N.S.W. Far North Coast and South-East Queensland as over-wintering habitat for migratory birds has been established by many observers and bird banders including Keast (1968), Robertson (1973), Gravatt (1974), Porter (1982) and Robertson and Woodall (1983). These patterns may be attributable to the relatively high winter temperatures and long growing season of this region compared with the rest of south-eastern Australia (Fitzpatrick and Nix 1973; Edwards 1979; Nix 1982; Specht *et al* 1981).

Many insectivorous birds from higher latitudes and elevation over-winter in the locality. These include species such as the Fantail cuckoo, Sacred kingfisher, Rainbow bee-eater, Noisy pitta, Tree martin, Black-faced cuckoo-shrike, Cicada bird, Golden whistler, Rufous whistler, Rose robin, Grey fantail, White-throated gerygone, Silvereye, Olive-backed oriole and Spangled drongo.

Birds such as honeyeaters and lorikeets are Blossom nomads (*ibid.*). These birds move locally in response to variation in the availability of nectar and or pollen, important

components in their diet. Porter (1982) highlights the importance of Forest red gum, Broad-leaved paperbark and Coast banksia for Scaly-breasted and Rainbow lorikeets as these species flower during the lorikeet's winter breeding period. A sequence of important nectar bearing plants in the genera Eucalyptus, Banksia, Melaleuca and Callistemon provide a continuity of food for nectarivorous birds.

Studies of bird usage in rainforest remnants by Holmes (1987), Connelly and Specht (1988) and Lott & Duigan (1993) indicate that the diversity and abundance of birds is related to the size of the Rainforest patches and their degree of isolation from major areas of native forest. Lott & Duigan (1993) and Howe *et al* (1981) also note that sites with a higher diversity of vegetation and those which are closer to water generally support a greater diversity of birds. Locally nomadic and migratory rainforest species such as the Wompoo, Rose-crowned and Superb fruit-doves, Common koel and Black-faced cuckoo-shrike are known to use scattered areas of habitat as "stepping-stones" between more intact areas of forest (Date *et al* 1992; Lott & Duigan 1993).

The variety of habitats present in the Study area is likely to result in a high diversity of resident and nomadic birds occurring on the site over the year. The site provides a high diversity and abundance of fruiting species. The Subject site and adjacent areas of vegetation represent high quality habitat for frugivorous birds, particularly within the rainforest communities.

The Subject site provides foraging resources for nectarivorous birds. Extensively cleared areas in the locality may restrict the movement of forest dwelling species (Woodward-Clyde 1997). However, species such as bitterns and rails may occur within the Swampland communities occurring on the Subject site.

There are a number of trees with hollows necessary for hollow-nesting birds. The Study area may represent important forage habitat for hollow-dependent avifauna breeding in Blackbutt and Scribbly gum forests in the locality.

#### 1.3.3.4 Mammals

Small terrestrial mammals generally occur in highest densities in association with a complex vegetation structure. A dense understorey layer, which provides shelter from predators and provides nesting opportunities, is particularly important. The impacts of grazing and slashing on the Subject site in general have removed habitat for small, ground-dwelling mammals (Woodward-Clyde 1997).

In general medium-large terrestrial mammals such as macropods select habitats which provide a dense cover for shelter and refuge and open areas for feeding. The larger species tend to occupy drier more open habitats: the smaller species, moister and more densely vegetated habitats. Grazing macropods such as Swamp wallaby may use the dense vegetation between the Subject site and the Cobaki Broadwater as daytime refugia, and move out to feed on adjacent pasture grasses during the night. It is unlikely, however, that the forested areas constitute a significant feed or refuge source for these animals, due to the sparsity of understorey development on the Subject site itself (Woodward-Clyde 1997).

All Arboreal mammals that occur in the region (with the exception of the Koala) utilise tree hollows for nesting and shelter (although the Common ringtail possum is not

dependent on hollows). Smith & Lindenmeyer (1988) consider that shortage of nest hollows is likely to limit arboreal mammal populations where density of hollow bearing trees is less than 2 to 8 trees per hectare.

Arboreal folivores (*e.g.* Common ringtail possum, Greater glider) are widespread and abundant but exhibit local variation in response to such factors as tree species composition, foliage protein and fibre levels, leaf toughness, toxins, forest structure and the availability of shelter sites. Arboreal folivores are expected to be most abundant in areas of high productivity, high soil fertility and moderate climate, in conjunction with adequate shelter and suitable foraging substrate. A significant population of Greater gliders was recorded on the Subject site from two separate locations in the Blackbutt open forest (WBM 1991a; Warren 1993; Debus 1994), and from an area in the north-east of the site (Woodward-Clyde 1997).
Arboreal nectarivore/insectivores feed on a wide variety of plant and insect exudates including the nectar of flowering eucalypts, and shrubs such as *Banksia* and *Acacia* spp. These species also feed extensively on insects, particularly under the shedding bark of eucalypts. The distribution of nectarivore/insectivores is considered to be related to the abundance of nectar and pollen producing plants, the abundance of bark shedding eucalypts which harbour insect prey, and the occurrence of sap and gum exudate producing trees (Sap feed trees) and shrubs (*e.g. Acacia* spp.). Arboreal nectarivores and insectivores are generally hollow-dependent species.

There are a number of trees with hollows necessary for hollow-dependent mammals. As with the birds, the Study area may represent important forage habitat for hollow-dependent mammals resident in Blackbutt and Scribbly gum communities in the locality. The vegetation in the Subject site is not considered to be prime habitat for koala populations (Woodward-Clyde 1997). There are relatively small numbers of preferred browse species including Grey gum, Tallowwood, Swamp mahogany and Forest red gum.

Insectivorous bats like insectivorous birds overlap considerably in diet and broad vegetation preferences (Hall 1981), but specialise in foraging in specific layers or substrates within the forest (Crome and Richards 1988). The Study area is likely to provide forage habitat for a relatively high diversity and abundance of insectivorous bats, due to the combination of open, forested and denser areas of vegetation. When in flower, Paperbark throughout the site may provide a food resource for the Common blossom bat. The site provides a relatively high diversity and abundance of fruiting species and represents high quality foraging habitat for frugivorous bats, particularly along the escarpment. The nectarivorous Common blossom bat may forage on banksias throughout the site.

Areas of rainforest, particularly along the escarpment, may provide roost sites for bat species that roost in dense vegetation, rock faces or within strangling figs. These areas represent suitable roost habitat for the Threatened Black flying-fox, Grey-headed flying fox and Common blossom bat. There are a number of old-growth trees which may provide suitable habitat for hollow-dependant bats, with a number of such bat species being recorded during previous surveys of the Subject site.

### *1.3.4 Threatened species considered possible occurrences in the Study area*

Based on the assessment of habitats in the Study area, Threatened species known from the locality were assessed for the likelihood of their occurrence in the Study area, and are shown in **TABLE 6**.

The following oceanic and coastal species are not likely to occur in the Study area and are not considered in the table:

Australian fur seal; Beach stone-curlew; Flesh-footed shearwater; Great knot; Green Turtle; Lesser sand plover; Little tern; Loggerhead turtle; Pied oystercatcher; Sooty oystercatcher; and Terek sandpiper.

**TABLE 6**
**LIKELIHOOD OF OCCURRENCE OF THREATENED FAUNA SPECIES IN THE STUDY AREA**

| Species | Likelihood of occurrence in the Study area | Notes |
|---|---|---|
| Albert's lyrebird (*Menura alberti*) | Unlikely | Restricted to south-east Queensland and far north-east New South Wales. Inhabits mixed rainforest and wet open forest, frequently dominated by Brush box. This species is confined to large remnants of upland rainforest entirely within he McPherson and nearby Ranges (TVMP 1999). |
| Barking owl (*Ninox connivens*) | Unlikely | The Barking owl is distributed thinly throughout NSW. It occurs in eucalypt woodland, open forest, swamp woodlands and timber along watercourses. Territories range from 30 to over 1000 hectares. Suitable habitat for this species does not occur on the Subject site. Understorey vegetation which provides habitat and foraging substrate for prey species is depleted, and there is only one NPWS record of this species occurring within the locality. |
| Barred Cuckoo-shrike (*Coracina lineata*) | **Possible** | The Barred cuckoo-shrike is generally uncommon and is rare in NSW. This species lives in rainforest, eucalypt forests and woodland, swamp woodlands and timber along watercourses, and wanders nomadically in search of fruit. Vegetation assemblages present on the site may provide suitable habitat for this species. |
| Beccari's Free-tail bat (*Mormopterus beccarii*) | **Possible** | This species is rare in northern NSW. The only confirmed record in NSW is a colony found in the roof of a house in Murwillumbah. It inhabits a range of vegetation types from rainforests to open forests and woodlands, usually along watercourses. The variety of habitat types required for this species are present on the Subject site, and may provide suitable habitat for this species. |

| Species | Likelihood of occurrence in the Study area | Notes |
|---|---|---|
| Black bittern (*Ixobrychus flavicollis*) | **Possible** | This species occurs in coastal and sub-coastal areas of south-western, northern and eastern Australia. It is usually found in dense vegetation fringing and in streams, swamps, tidal creeks and mudflats, particularly amongst swamp she-oaks and mangroves. The wetland areas and mangrove communities that occur throughout the site may provide suitable habitat for this species. |
| Black flying-fox (*Pteropus alecto*) | **Possible** | Black flying foxes occur in coastal and near-coastal areas across northern Australia. They are relatively uncommon in NSW. Large communal day-time camps occupy remnants of coastal subtropical rainforest or swamp forest and at night they travel up to 50km to feed on blossoms and fruits. The Mt. Woodgee community may provide roosting habitat for this species. Swamp sclerophyll forest on the Subject site may be utilised as foraging habitat. The site may also be utilised as a movement corridor between the roosting site in the Tweed Estuary and feeding areas. |
| Black-necked stork (*Ephippiorhynchus asiaticus*) | **RECORDED ON SUBJECT SITE** | This species is widespread in northern Australia and sparse in coastal eastern Australia from Qld to southern NSW. It inhabits swamps, mangroves, mudflats, dry floodplains and irrigated land. It occasionally forages in open grassy woodland. This species has been recorded during various studies completed over a number of years on the Subject site (WBM 1990, Warren 1993). The species was more recently recorded in 2004 by JWA during a vegetation assessment. |
| Black-tailed godwit (*Limosa limosa*) | **Possible** | This species is a non-breeding migrant to Australian coasts from spring to autumn. They visit tidal mudflats, sand-spits, swamps, shallow river margins and reservoirs. Individuals have also been observed in wet meadows and sewage treatment works. This species may utilise the wetland habitat, and areas of seasonal inundation, occurring throughout the Subject site. |
| Bush-hen (*Amaurornis olivaceus*) | Unlikely | The Bush-hen occurs in coastal northern Australia and through eastern Qld to the NSW north coast. It inhabits a variety of coastal wetlands from mangroves, lagoons and swamps, to river margins and creeks running through rainforest. These birds require dense rank vegetation for cover, usually near permanent fresh water. Suitable habitat for this species does not occur on the Subject site. |

| Species | Likelihood of occurrence in the Study area | Notes |
|---|---|---|
| Bush stone-curlew (*Burhinus grallarius*) | Unlikely | This species is rare east of the Great Divide except for isolated populations along the north coast. It forages and breeds in open-grassed woodlands or sparsely treed rangelands, often with a non-existent shrub layer and abundant leaf litter. In consideration of the rarity of this species and the habitat modification occurring on the Subject site, suitable habitat does not occur within the Study area. |
| Collared kingfisher (*Todiramphus chloris*) | **Possible** | The Collared kingfisher is most commonly observed in the Tweed River estuary in NSW. It is virtually restricted to mangroves and other estuarine habitats in Australia, mainly about the mouths of the larger coastal rivers. This species has been previously recorded from the Subject site. |
| Comb-crested jacana (*Irediparra gallinacea*) | Unlikely | This species is found in coastal and sub-coastal northern and eastern Australia. In NSW populations are localised and scattered. It lives amongst vegetation floating on the surface of slow-moving rivers and permanent lagoons, swamps, lakes and dams. Habitat suitable for this species does not occur on the Subject site. |
| Common blossom bat (*Syconycteris australis*) | **Possible** | Common blossom bats occur in coastal areas of north-east NSW and eastern Qld. They often roost in littoral rainforest and feed on flowers in adjacent heathland and paperbark swamps. Suitable habitat for this species may occur on the Subject site. |
| Common planigale (*Planigale maculata*) | Unlikely | This species occurs in coastal north-east NSW. It occupies a wide range of habitats from rainforest, sclerophyll forest, grasslands, marshlands, rocky areas and even some suburban areas, and usually occurs close to water. Suitable habitat for this species does not occur on the Subject site, due to low levels of understorey. |
| Eastern long-eared bat (*Nyctophilus bifax*) | **Possible** | This species occurs from Cape York through eastern Qld to the far north-east corner of NSW. It inhabits lowland subtropical rainforest and wet and swamp eucalypt forest, extending into adjacent moist eucalypt forest. Suitable habitat for this species may occur on the Subject site. |

| Species | Likelihood of occurrence in the Study area | Notes |
|---|---|---|
| Glossy black cockatoo (*Calyptorhynchus lathami*) | Unlikely | Found in coastal forests and open inland woodland in eastern Australia. Glossy black-cockatoo distribution is limited to habitat which contains sufficient seed reserves of their three favoured species of food trees: *Allocasuarina littoralis*, *A. torulosa* and *A. verticillata* (Forshaw 1981) and suitable large hollow bearing trees for nesting. A comprehensive survey conducted by Debus (1994) failed to record the presence of this species on the Subject site. Habitat suitable for this species does not occur on the Subject site. |
| Grass owl (*Tyto capensis*) | Unlikely | The Grass owl occupies coastal heath and grassland across northern Australia (Reader's Digest 1993). In NSW they are more likely to be found in the north-east. Habitat suitable for this species does not occur on the Subject site. |
| Greater sand plover (*Charadrius leschenaultia*) | Unlikely | This species is a non-breeding migrant to Australia coasts and islands between August and May. In NSW they are generally rare. They visit undisturbed wide sandy beaches and sand-spits, mangroves, saltmarsh, mudflats and exposed reefs. Habitat modification and disturbance precludes the occurrence of this species on the Subject site. |
| Grey-headed flying fox (*Pteropus poliocephalus*) | **RECORDED ON SUBJECT SITE** | This species occurs from central eastern Qld south to Vic. In NSW they mainly occur in coastal areas and along river valleys. They typically roost in conspicuous camps in lowland rainforest and swamp forest, often in isolated remnants or on islands in rivers. They forage on fruit, nectar and pollen in rainforests and eucalypt forests. This species was recorded on the Subject site by Winders Barlow & Morrison (1990). |
| Koala (*Phascolarctos cinereus*) | **RECORDED ON SUBJECT SITE** | The Koala occurs in eucalypt woodlands and forests throughout eastern Australia. They inhabit areas where there are appropriate food trees. This species was recorded on the Subject site by Warren (1994). |
| Little bent-wing bat (*Miniopterus australis*) | **RECORDED ON SUBJECT SITE** | This species occurs in coastal north-east NSW and eastern Qld. It inhabits moist eucalypt forest, rainforest and dense coastal scrub. It generally occupies caves and tunnels during the day, and may occasionally roost singularly or in small collectives under the bark of mature paperbark trees. This species was recorded by Warren (1994) within a small area across the north-west of the Subject site. |

| Species | Likelihood of occurrence in the Study area | Notes |
|---|---|---|
| Long-nosed potoroo (*Potorous tridactylus*) | Unlikely, although recorded on Crown land adjacent to site. | This species occurs in coastal areas from the Gladstone area in Qld to south-west Vic and are regarded as uncommon north of Sydney. They inhabit a range of vegetation communities including rainforest, moist and dry forests, and heathlands. While a population of this species has been identified in Crown land south-east of the Boyd Street access (Warren 1993), suitable habitat required for the species does not occur on the Subject site. |
| Magpie goose (*Anseranas semipalmata*) | Unlikely | The Magpie goose occurs mainly in coastal and sub-coastal areas of northern Australia. The species is now a rare vagrant in NSW. It generally inhabits open lakes, swamps and permanent wetlands which are dominated by rush and sedge vegetation, with grasslands nearby. Suitable habitat for this species does not occur on the Subject site. |
| Mangrove honeyeater (*Lichenostomus fasciogularis*) | **Possible** | The Mangrove honeyeater is common in Qld but rare in NSW, where it is known from a few scattered localities, including the Tweed, Richmond and Clarence River estuaries. It primarily inhabits mangroves but also occurs in other near-coastal forests and woodlands, including casuarinas and paperbark swamp forests. Suitable habitat for this species may occur on the Subject site, particularly throughout the mangrove community occurring in the eastern portion of the site. |
| Masked owl (*Tyto novaehollandiae*) | **RECORDED ON SUBJECT SITE** | In NSW this species is recorded sporadically in the north-east along the coast and tablelands. It inhabits dry eucalypt forest and woodlands. It has a large home range of 500 – 1000 hectares covering forested and partly open country. This species was recorded during a bird survey of the Cobaki site by Debus (1994), in the Tall open sclerophyll forest community dominated by Blackbutt in the northern portion of the site. |
| Mitchell's rainforest snail (*Thersites mitchellae*) | Unlikely | This snail is restricted to remnant areas of lowland subtropical rainforest and swamp sclerophyll forest with a rainforest understorey on alluvial soils with a basaltic influence on the coastal plain between the Richmond and Tweed Rivers (NPWS 2000). |

| Species | Likelihood of occurrence in the Study area | Notes |
|---|---|---|
| Wallum sedgefrog (*Litoria olongburensis*) | **Possible**, recorded on Crown land adjacent to site. | This species is found in coastal areas from Fraser Island in south-east Queensland to Yuraygir NP south of Grafton in northern NSW. Its preferred habitat comprises paperbark swamps and sedge swamps of 'wallum' country, where it forages and breeds amongst emergent low vegetation. Suitable habitat for this species may occur on the Subject site, although current habitat modification may decrease the likelihood of its presence. |
| Osprey (*Pandion haliaetus*) | **RECORDED ON SUBJECT SITE** | This raptor is thinly distributed in coastal Australia. It nests in singularly overtopping, generally dead trees. The Osprey hunts in coastal rivers, estuaries and streams and may gather nesting material from nearby forests. This species has been recorded on the Subject site (Warren 1993), with a nest located in the southern portion of the subject site. |
| Powerful owl (*Ninox strenua*) | **Possible**, recorded in the vicinity of the Osprey nest site (Warren 1993), although not confirmed by Debus (1994). | This owl is extensively distributed in the forests of the south-east of mainland Australia, from Portland in western Victoria to the Clarke Range in Queensland, mainly from the Great Dividing Range to the coast (Garnett 1992). The Powerful owl inhabits open eucalypt forests and may forage along the forest edge. It prefers the gullies of coastal forests below 1500m where prey densities are often highest and preferred roost trees are common (Debus & Chafer 1994). Suitable habitat for this species may occur on the Subject site. |
| Rose-crowned fruit-dove (*Ptilinopus regina*) | **Possible** | The Rose-crowned fruit-dove occurs along the coast and the ranges of Qld and eastern NSW. It occurs mainly in subtropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. Suitable habitat for this species may occur on the Subject site. |
| Square-tailed kite (*Lophoictinia isura*) | **Possible** | This species is uncommon, yet widespread. It is thinly distributed through open forests, woodland and sandplains, both coastal and subcoastal. Suitable habitat for this species may occur on the Subject site. |

| Species | Likelihood of occurrence in the Study area | Notes |
|---|---|---|
| Wallum froglet (*Crinia tinnula*) | **RECORDED ON SUBJECT SITE** | The Wallum froglet is found in coastal areas from south-east Qld to the central coast of NSW. It is found only in acid Paperbark swamps and sedge swamps of the coastal 'wallum' country. Suitable habitat for this species occurs on the Subject site. This species has been recorded by McNamara (1983), WBM (1990), Warren (1992) and more recently by JWA (2007, 2008). |
| White-eared monarch (*Monarcha leucotis*) | Unlikely | This species is restricted to eastern Qld and the NSW north coast. It occurs primarily in coastal rainforest, swamp forest and wet eucalypt forest and appears to prefer forest edges. Habitat required by this species does not occur on the Subject site. |
| Wompoo fruit dove (*Ptilinopus magnificus*) | **Possible** | This species is found along the coast and coastal ranges from Cape York to the Hunter River in NSW. It occurs in rainforests, low-elevation moist Eucalypt forest and Brushbox forests. They most often occur in mature forests, but are also found in remnant and regenerating forest. There has been one (1) recording of this species within 10km of the Subject site (NPWS Wildlife Atlas). Suitable habitat for this species may occur on the Subject site. |
| Yellow-bellied sheath-tailed bat (*Saccolaimus flaviventris*) | **RECORDED ON SUBJECT SITE** | This species occur across northern Australia and in NSW there are only a few scattered records. It roosts in tree hollows in a wide range of habitats. This species was recorded by Warren (1994) in a variety of forested habitats across the subject site. |

### *1.3.5 Results of Fauna Survey*

1.3.5.1 Amphibians

Thirteen (13) amphibian species were recorded during site surveys on the Cobaki Lakes site. One (1) of these species, the Wallum Froglet is listed as Threatened on Schedule 2 of the TSC Act (1995).

**TABLE 7**
**AMPHIBIAN SPECIES RECORDED ON THE SUBJECT SITE**

| Common name | Scientific name |
|---|---|
| Broad-palmed frog | *Litoria latopalmata* |
| Cane toad* | *Bufo marinus* |
| Common eastern froglet | *Crinia signifera* |
| Eastern dwarf tree frog | *Litoria fallax* |

| | |
|---|---|
| Freycinet's frog | *L. freycineti* |
| Graceful tree frog | *L. gracilenta* |
| Green tree frog | *L. caerulea* |
| Peron's marsh frog | *Limnodynastes peronii* |
| Red-backed toadlet | *Pseudophryne coriacea* |
| Rocket frog | *L. nasuta* |
| Tyler's tree frog | *Litoria tyleri* |
| Verreaux's frog | *L. verreauxii* |
| **Wallum froglet** | ***Crinia tinnula*** |
| **Wallum sedgefrog** | ***L. olongburensis (recorded in SEPP 14 wetlands adjacent to Cobaki Lakes site)*** |

* Introduced species
**Threatened species are shown in bold**

1.3.5.2 Reptiles

Ten (10) reptile species have been identified as occurring at the Cobaki Lakes site. No Threatened reptiles were recorded.

**TABLE 8**
**REPTILE SPECIES RECORDED ON THE SUBJECT SITE**

| Common name | Scientific name |
|---|---|
| Eastern bearded dragon | *Pogona barbata* |
| Eastern blue-tongued skink | *Tiliqua scincoides* |
| Eastern water dragon | *Physignathus lesueurii* |
| Frilled lizard | *Chlamydosaurus kingii* |
| Garden skink | *Lamphropholis delicata* |
| Green tree-snake | *Dendrelaphis punctulatus* |
| Lace monitor | *Varanus varius* |
| Land mullet | *Egernia major* |
| Spot-sided ctenotus | *Ctenotus sp.* |
| Small-eyed snake | *Rhinoplocephalus nigrescens* |

1.3.5.3 Birds

One hundred and thirty-eight (138) bird species were recorded in the Study area. Four (4) Threatened species were recorded, the Black-necked stork, Osprey, Masked owl, and Powerful owl. **TABLE 9** shows the bird species recorded during the surveys.

**TABLE 9**
**BIRD SPECIES RECORDED DURING THE SURVEYS**

| Scientific name | Common name |
|---|---|
| *Pelicanus conspicillatus* | Australian Pelican |
| *Anhinga melanogaster* | Australian Darter |
| *Falco cenchroides* | Australian Kestrel |
| *Alisterus scapularis* | Australian King Parrot |
| *Gymnorhina tibicen* | Australian Magpie |
| *Grallina cyanoleuca* | Australian Magpie-lark |

| Scientific name | Common name |
|---|---|
| *Aegotheles cristatus* | Australian Owlet Nightjar |
| *Alcedo azurea* | Azure Kingfisher |
| *Geopelia humeralis* | Bar-shouldered Dove |
| *Cygnus atratus* | Black Swan |
| *Coracina novaehollandiae* | Black-faced Cuckoo-shrike |
| *Monarcha melanopsis* | Black-faced Monarch |
| ***Ephippiorhynchus asiaticus*** | **Black-necked Stork** |
| *Elanus axillaris* | Black-shouldered Kite |
| *Haliastur indus* | Brahminy Kite |
| *Macropygia amboinensis* | Brown Cuckoo-dove |
| *Accipiter fasciatus* | Brown Goshawk |
| *Lichmera indistincta* | Brown Honeyeater |
| *Coturnix australis* | Brown (swamp) Quail |
| *Acanthiza pusilla* | Brown Thornbill |
| *A. reguloides* | Buff-rumped Thornbill |
| *Cacomantis variolosus* | Brush cuckoo |
| *Gallirallus philippensis* | Buff-banded Rail |
| *Ardea ibis* | Cattle Egret |
| *Scythrops novaehollandiae* | Channel-billed Cuckoo |
| *Coracina tenuirostris* | Cicadabird |
| *Todiramphus chloris* | Collared Kingfisher |
| *Accipiter cirrhocephalus* | Collared Sparrowhawk |
| *Eudynamys scolopacea* | Common Koel |
| *Ocyphaps lophotes* | Crested Pigeon |
| *Eurystomus orientalis* | Dollarbird |
| *Taeniopygia bichenovii* | Double-barred Finch |
| *Gallinula tenebrosa* | Dusky Moorhen |
| *Artamus cyanopterus* | Dusky Woodswallow |
| *Platycercus eximius* | Eastern Rosella |
| *Acanthorhynchus tenuirostris* | Eastern Spinebill |
| *Psophodes olivaceus* | Eastern Whipbird |
| *Eopsaltria australis* | Eastern Yellow Robin |
| *Chalcophaps indica* | Emerald Dove |
| *Hirundo ariel* | Fairy Martin |
| *Cuculus pyrrophanus* | Fan-tailed Cuckoo |
| *Sphecotheres viridis* | Figbird |
| *Todiramphus macleayii* | Forest Kingfisher |
| *Eolophus roseicapillus* | Galah |
| *Cisticola exilis* | Golden-Headed Cisticola |
| *Pachycephala pectoralis* | Golden Whistler |
| *Ardea alba* | Great Egret |
| *Cracticus torquatus* | Grey Butcherbird |
| *Anas gibberifrons* | Grey Teal |
| *Rhipidura fuliginosa* | Grey Fantail |
| *Colluricincla harmonica* | Grey Shrike-thrush |
| *Accipiter novaehollandiae* | Grey Goshawk |
| *Ardea intermedia* | Intermediate Egret |
| *Sericornis magnirostris* | Large-billed Scrubwren |

| Scientific name | Common name |
|---|---|
| *Dacelo novaeguineae* | Laughing Kookaburra |
| *Myiagra rubecula* | Leaden Flycatcher |
| *Meliphaga lewinii* | Lewin's Honeyeater |
| *Phalacrocorax sulcirostris* | Little Black Cormorant |
| *Philemon citreogularis* | Little Friarbird |
| *Megalurus gramineus* | Little Grassbird |
| *Phalacrocorax melanoleucos* | Little Pied Cormorant |
| *Colluricincla harmonica* | Little Shrike-thrush |
| *Acanthiza nana* | Little Thornbill |
| *Climacteris minor* | Little Treecreeper |
| *Anthochaera chrysoptera* | Little Wattlebird |
| *Chenonetta jubata* | Maned Duck |
| *Gerygone levigaster* | Mangrove Gerygone |
| *Circus aeruginosus* | Marsh Harrier |
| *Vanellus miles* | Masked Lapwing |
| ***Tyto novaehollandiae*** | **Masked Owl** |
| *Dicaeum hirundinaceum* | Mistletoebird |
| *Philemon corniculatus* | Noisy Friarbird |
| *Manorina melanocephala* | Noisy Miner |
| *Pitta versicolor* | Noisy Pitta |
| *Oriolus sagittatus* | Olive-backed Oriole |
| ***Pandion haliaetus*** | **Osprey** |
| *Aviceda subcristata* | Pacific Baza |
| *Anas superciliosa* | Pacific Black Duck |
| *Ardea pacifica* | Pacific Heron |
| *Platycercus adscitus* | Pale-headed Rosella |
| *Cuculus pallidus* | Pallid Cuckoo |
| *Geopelia placida* | Peaceful Dove |
| *Falco peregrinus* | Peregrine Falcon |
| *Centropus phasianinus* | Pheasant Coucal |
| *Cracticus nigrogularis* | Pied Butcherbird |
| *Phalacrocorax varius* | Pied Cormorant |
| *Strepera graculina* | Pied Currawong |
| ***Ninox strenua*** | **Powerful Owl** |
| *Porphyrio porphyrio* | Purple Swamphen |
| *Merops ornatus* | Rainbow Bee-eater |
| *Trichoglossus haematodus* | Rainbow Lorikeet |
| *Malurus melanocephalus* | Red-backed Fairy-wren |
| *Emblema temporalis* | Red-browed Firetail |
| *Anthus novaeseelandiae* | Richard's Pipit |
| *Petroica rosea* | Rose Robin |
| *Platalea regia* | Royal Spoonbill |
| *Rhipidura rufifrons* | Rufous Fantail |
| *Nycticorax caledonicus* | Rufous Night heron |
| *Pachycephala rufiventris* | Rufous Whistler |
| *Todiramphus sanctus* | Sacred Kingfisher |
| *Threskiornis aethiopica* | Sacred Ibis |
| *Ptilonorhynchus violaceus* | Satin Bowerbird |

| Scientific name | Common name |
|---|---|
| *Myiagra cyanoleuca* | Satin Flycatcher |
| *Trichoglossus chlorolepidotus* | Scaly-breasted Lorikeet |
| *Myzomela sanguinolenta* | Scarlet Honeyeater |
| *Chrysococcyx lucidus* | Shining Bronze-cuckoo |
| *Larus novaehollandiae* | Silver Gull |
| *Zosterops lateralis* | Silvereye |
| *Mirafra javanica* | Singing Bushlark |
| *Ninox boobook* | Southern Boobook |
| *Dicrurus bracteatus* | Spangled Drongo |
| *Monarcha trivirgatus* | Spectacled Monarch |
| *Pardalotus punctatus* | Spotted Pardalote |
| *Threskiornis spinicollis* | Straw-necked Ibis |
| *Pardalotus striatus* | Striated Pardalote |
| *Acanthiza lineata* | Striated Thornbill |
| *Cacatua galerita* | Sulphur-crested Cockatoo |
| *Malurus cyaneus* | Superb Fairy-wren |
| *Podargus strigoides* | Tawny Frogmouth |
| *Megalurus timoriensis* | Tawny Grassbird |
| *Corvus orru* | Torresian Crow |
| *Hirundo nigricans* | Tree Martin |
| *Daphoenositta chrysoptera leucocephala* | Varied Sitella |
| *Lalage leucomela* | Varied Triller |
| *Malurus lamberti* | Variegated Fairy-wren |
| *Aquila audax* | Wedge-tailed Eagle |
| *Hirundo neoxena* | Welcome Swallow |
| *Haliastur sphenurus* | Whistling Kite |
| *Haliaeetus leucogaster* | White-bellied Sea-eagle |
| *Sericornis frontalis* | White-browed Scrub-wren |
| *Phylidonyris nigra* | White-cheeked Honeyeater |
| *Egretta novaehollandiae* | White-faced Heron |
| *Gerygone olivacea* | White-throated Gerygone |
| *Melithreptus albogularis* | White-throated Honeyeater |
| *Hirundapus caudacutus* | White-throated Needletail |
| *Cormobates leucophaeus* | White-throated Treecreeper |
| *Rhipidura leucophrys* | Willie Wagtail |
| *Lichenostomus chrysops* | Yellow-faced honeyeater |

**Threatened species are shown in Bold**

1.3.5.4 Mammals

Thirty-three (33) mammal species were recorded as occurring on the site, including seven (7) Threatened species - the Koala, Eastern free-tail bat, Common bent-wing bat, Little bent-wing bat, Yellow-bellied sheathtail bat, Greater broad-nosed bat, and the Grey-headed flying-fox. Seven (7) introduced species were recorded, including the Domestic dog, Cat, House mouse, Black rat, Hare, Rabbit, Cow and Fox.

**TABLE 10**
**MAMMALS RECORDED DURING THE FIELD SURVEY**

| Scientific Name | Common Name |
|---|---|
| *Rattus rattus* | Black rat* |
| *Scotorepens sp.nov.* | Broad-nosed bat |
| *Rattus fuscipes* | Bush rat |
| *Felis catus* | Cat* |
| ***Miniopterus schreibersii*** | **Common bent-wing bat** |
| *Trichosurus vulpecula* | Common brushtail possum |
| *Bos taurus* | Cow* |
| *Canis familiaris* | Dog* |
| *Scotorepens orion* | Eastern broad-nosed bat |
| *Vespadelus pumilus* | Eastern forest bat |
| ***Mormopterus norfolkensis*** | **Eastern free-tail bat** |
| *Melomys cervinipes* | Fawn-footed melomys |
| *Vulpes vulpes* | Fox* |
| *Chalinolobus gouldii* | Gould's wattle bat |
| *Melomys burtoni* | Grassland melomys |
| ***Scoteanax rueppellii*** | **Greater broad-nosed bat** |
| *Petauroides volans* | Greater glider |
| ***Pteropus poliocephalus*** | **Grey-headed flying-fox** |
| *Lepus capensis* | ?Hare* |
| *Mus musculus* | House mouse* |
| ***Phascolarctos cinereus*** | **Koala** |
| *Vespadelus darlingtoni* | Large forest bat |
| ***Miniopterus australis*** | **Little bent-wing bat** |
| *Pteropus scapulatus* | Little red flying fox |
| *Perameles nasuta* | Long-nosed bandicoot |
| *Isoodon macrourus* | Northern brown bandicoot |
| *Oryctolagus cuniculus* | Rabbit* |
| *Petaurus breviceps* | Sugar glider |
| *Rattus lutreolus* | Swamp rat |
| *Wallabia bicolor* | Swamp wallaby |
| *Tadarida australis* | White-striped mastiff bat |
| ***Saccolaimus flaviventris*** | **Yellow-bellied sheathtail bat** |
| *Antechinus flavipes* | Yellow-footed antechinus |

* Introduced species
**Threatened species are shown in bold**

### *1.3.6 Compliance with Biodiversity Survey Guidelines (DEC 2004)*

1.3.6.1 Background

The Department of Environment and Conservation (DEC) have prepared a set of guidelines for use by decision makers when considering a proposed development, activity or action pursuant to Parts 4 and 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), and Part 6 of the *Threatened Species Conservation Act 1995* (TSC Act).

The Guidelines aim to facilitate informed decision-making at the local scale for individual development activities with particular regard to:

- preliminary animal and plant assessments;
- Section 5A Assessments of Significance under the EP&A Act5;
- Species Impact Statements (SISs);
- licensing under Part 6 of the TSC Act;
- Local Environmental Studies (LESs), Regional Environmental Studies (RESs) and spot re-zoning;
- Development Applications (DAs); and
- Clearing Applications (CAs) under the NVC Act.

The Guidelines aim to inform the process of survey and assessment of threatened biodiversity by describing and discussing:

- the chronological steps within the threatened biodiversity assessment process;
- the strategies, policies and legislation relevant to threatened biodiversity;
- appropriate survey techniques for detecting threatened biodiversity;
- the information required for an Assessment of Significance6; and
- reporting requirements and standards.

The Guidelines aim to provide a consistent and systematic approach to survey and assessment of threatened biodiversity. In particular, the guidance provided will assist in:

- setting appropriate aims for survey and assessment of threatened biodiversity;
- the planning of suitable survey techniques and the appropriate level of effort;
- the provision of adequate reporting;
- a justifiable interpretation of results; and
- making an informed and justifiable decision.
-

1.3.6.2 Summary

A summary of the minimum survey requirements under the Biodiversity Survey Guidelines (DEC 2004) and the compliance of the fauna survey with these guidelines is contained in **TABLES 11 – 16**.

**TABLE 11**
**COMPLIANCE WITH DEC GUIDELINES FOR AMPHIBIAN SURVEYS**

| Method | Suggested minimum effort | Survey period | Compliance |
|---|---|---|---|
| Systematic day habitat searches | One hour per stratification unit | Varies according to seasonal peak of activity of target species | Warren 1992, JWA 2007 |
| Night habitat search of damp & watery sites | 30 mins on 2 separate nights per stratification unit | As above | Warren 1992 |

| Method | Suggested minimum effort | Survey period | Compliance |
|---|---|---|---|
| Nocturnal call playback | At least 1 playback on each of 2 separate nights | As above | Warren 1992, JWA 2007 |
| Night watercourse search | 2 hours per 200m of water edge | As above | Warren 1992, JWA 2007 |

**TABLE 12**
**COMPLIANCE WITH DEC GUIDELINES FOR REPTILE SURVEYS**

| Method | Effort per stratification unit up to 100 ha on coast & ranges, & up to 200 ha west of the ranges | Survey period | Compliance |
|---|---|---|---|
| Habitat search | 30 minute search on 2 separate days targeting specific habitat | November - March | WBM 1990, Warren 1994 |
| Pitfall traps | 24 trap nights, preferably using 6 traps for a minimum of 4 consecutive nights | November - March | WBM 1991b |
| Spotlighting | 30 minute search on 2 separate nights targeting specific habitat | November - March | WBM 1990 |

**TABLE 13**
**COMPLIANCE WITH DEC GUIDELINES FOR DIURNAL BIRD SURVEYS**

| Method | Suggested minimum effort | Survey period | Compliance |
|---|---|---|---|
| Area search | Until species – time curve approached | All year | WBM1991, Debus 1994 |
| Wetland census | 1 hour census at dawn or dusk for each identified wetland | All year | Debus 1994 |
| Water source census | A 20 minute census at dawn or dusk, for each identified water source | All year | Debus 1994 |

**TABLE 14**
**COMPLIANCE WITH DEC GUIDELINES FOR NOCTURNAL BIRD SURVEYS**

| Method | Suggested minimum effort | Survey period | Compliance |
|---|---|---|---|
| Call playback | Sites should be 800m – 1 km apart, & each site must have playback session repeated as follows:<br><br>At least 5 visits per site, on different nights req'd for Powerful owl, Barking owl and Grass owl<br>At least 6 visits per site for Sooty owl<br>At least 8 visits per site for Masked owl<br><br>Sites for Bush stone curlew should be 2-4 km apart & conducted during breeding season | All year | Debus 1994, JWA 2007 |
| Day habitat search | Search habitat for pellets & likely hollows. Flush Bush stone curlews by walking through potential habitat | All year | Debus 1994, JWA 2007 |
| Stag-watching | Observing potential roost hollows for 30 mins prior & 1 hr following sunset | All year | Debus 1994, JWA 2007 |
| Spotlighting | Spotlighting for Bush stone curlew & Plains wanderer by foot or from vehicle | All year | Debus 1994, WBM 1990, JWA 2007 |

**TABLE 15**
**COMPLIANCE WITH DEC GUIDELINES FOR MAMMAL SURVEYS (EXCLUDING BATS)**

| Method | Effort per stratification unit up to 50 ha, plus additional effort for every additional 100 hectares | Animal sampled | Compliance |
|---|---|---|---|
| Small Elliott traps | 100 trap nights over 3-4 consecutive nights | Small mammals | McNamara 1983, WBM 1990 &1991b, Warren 1992, Warren 1993 & 1994 |
| Large Elliott traps | 100 trap nights over 3-4 consecutive nights | Medium - large mammals | - |
| Arboreal Elliott traps | 24 trap nights over 3-4 consecutive nights | Arboreal mammals | WBM 1991b, Warren 1993 & 1994 |

| Method | Effort per stratification unit up to 50 ha, plus additional effort for every additional 100 hectares | Animal sampled | Compliance |
|---|---|---|---|
| Wire cage traps | 24 trap nights over 3-4 consecutive nights | Medium - large mammals | WBM 1991b, Warren 1993 & 1994 |
| Pitfall traps | 24 trap nights over 3-4 consecutive nights | Small mammals | WBM 1991b |
| Hair tubes | 10 large & 10 small tubes in pairs for at least 4 days/nights | Small & medium mammals | Warren 1993 & 1994 |
| Arboreal hair tubes | 3 tubes in each of 10 habitat trees up to 100 ha of stratification unit, for at least 4 days/nights | Arboreal mammals | - |
| Spotlighting (on foot) | 2 x 1 hour & 1km up to 200 ha of stratification unit, walking at 1 km/hr on 2 separate nights | Arboreal & terrestrial mammals | WBM 1990,1991, Warren 1993 1994 |
| Spotlighting (by car) | 2 x 1 hour & 1km of track at max speed of 5 km/hr, up to 200 ha of stratification unit, on 2 separate nights | Arboreal & terrestrial mammals | Warren 2007 unpublished data |
| Sand plots | 6 soil plots for 4 nights | Mostly medium to large terrestrial mammals | - |
| Call playback | 2 sites per stratification unit up to 200 ha, plus an additional site per 100 ha above 200 ha. Each playback site must have the session conducted twice on consecutive nights | Gliders, Koalas | WBM 1991a, JWA 2007 |
| Stag-watching | Observing potential roost hollows for 30 mins prior to sunset & 1 hr following sunset | Gliders & possums | WBM 1991a, |
| Scat & sign search | 30 minutes searching each relevant habitat, including trees for scratch marks | All mammals | Warren 1994 |
| Track search | 1 km of track search with emphasis on where substrate is soft | Mostly medium to large terrestrial mammals | McNamara 1983, WBM 1990 &1991b, Warren 1992, Warren 1993 & 1994, JWA 2007 |
| Collection of predator scats | Opportunistic collection of predator scats for hair analysis | All mammals | - |

**TABLE 16**
**COMPLIANCE WITH DEC GUIDELINES FOR BAT SURVEYS**

| Method | Effort per 100 ha (or part thereof) of stratification unit targeting preferred habitat | Survey period | Compliance |
|---|---|---|---|
| Harp trapping | 4 trap nights over 2 consecutive nights (with 1 trap outside the flyways for 1 night) | October - March | Warren 1992, |
| Anabat | 2 Anabats for 2 nights from dawn til dusk | October - March | Warren 1994, |
| Mist netting | Targeted survey: 1 trap set for 2 hrs at dusk for 2 nights | October - March | - |
| Spotlighting & transect walking | Targeted survey near food resources: 2 x 1 hr spotlighting on 2 separate nights | All year | Warren 1993 and 1994 |
| Day habitat search | Search for bat excreta at or near potential habitats | All year | - |

# Appendix 4 – Mapped Corridors & Fauna Assemblages In The Study Area

## 1.1 Background

The following sections describe the corridors and associated fauna assemblages that have been mapped on and adjcant to the subject site. With the aid of innovative Geographic Information System (GIS) analysis tools, key habitats and linking corridors for priority fauna assemblages have been delineated across north-east New South Wales and are provided within the the NPWS Key Habitats and Corridors database.

## 1.2 Mapped corridors

The NPWS Key Habitats and Corridors database maps the Cobaki-Terranora Regional Corridor as traversing a large area of the eastern portion of the Subject site (**VOLUME 1**). The corridor is a link between Cobaki Wetlands and Terranora Broadwater. This corridor is derived from the following fauna assemblages:

- Wet Escarpment UNC;
- Wet Escarpment Foothills;
- Moist Escarpment Foothills UNC;
- Dry Coastal Foothills UNC; and
- Coastal Complex UNC.

Three (3) Sub-regional corridors branch off this Regional corridor - the Pigabeen corridor, the McPherson corridor and the Cobaki corridor (**VOLUME 1**). The Pigabeen corridor traverses the central portion of the site in a generally east-west direction, linking Pigabeen with Cobaki Wetlands. This corridor is comprised of the following fauna assemblages:

- Wet Escarpment UNC;
- Wet Escarpment Foothills;
- Moist Escarpment Foothills UNC; and
- Coastal Complex UNC.

The McPherson corridor traverses the northern portion of the site, forking off to the north and west, and forming a link between the Cobaki Wetlands and Mt Tomewin. This corridor is comprised of the following fauna assemblages:

- Wet Escarpment UNC;
- Wet Escarpment Foothills;
- Moist Escarpment Foothills UNC;
- Dry Coastal Foothills UNC; and
- Coastal Complex UNC.

The Cobaki corridor branches off the Cobaki-Terranora Regional Corridor across a small portion of the far-eastern edge of the Subject site, linking Cobaki Wetlands with Cobaki Broadwater. This corridor is derived from the following fauna assemblages:

- Wet Escarpment UNC;
- Moist Escarpment Foothills UNC;
- Dry Coastal Foothills UNC; and
- Coastal Complex UNC.

## 1.3 Fauna assemblages

Details on all fauna assemblages within corridors in the vicinity of the site are shown below:

**Coastal Complex Assemblage:**

Comprises 11 species including frogs, birds and bats characteristic of forests and associated environments of the coastal fringe and the floodplains of the Tweed, Richmond and Clarence Rivers. Many areas mapped as assemblage hubs and hot spots are within reserves, but many potential corridors linking these reserves cross freehold tenures.

**Dry Coastal Foothills Assemblage:**

A large assemblage of 21 species that occupies the drier productive forests of the coastal plains and foothills. This assemblage includes many high-priority species that have undergone substantial reductions in range. The habitat features mapped for this assemblage are under-represented in the reserve system. Key habitats for this assemblage are mapped within the Bungawalbyn and Lower Clarence Valleys.

**Moist Escarpment-Foothills Assemblage:**

A widespread assemblage occupying moist open forests of the escarpment and foothills. The assemblage consists of 13 priority species, including several renowned for their sensitivity to loss of habitat and disturbance (e.g. Greater Glider, Yellow-bellied Glider, Rufous Bettong, Powerful and Masked Owls). Key habitats are reasonably widespread, and commonly occur within public lands. Potential corridors link the rather widespread assemblage, and its key habitats, across all tenures. Four broad bands of potential corridors provide important altitudinal links from the escarpment forests to the foothills and tablelands.

**Wet Escarpment Assemblage:**

Consists of 11 species, again characteristic of the wet escarpment forests, but demonstrating more widespread distributions than species of the Northern Escarpment and Wet Eastern Tablelands assemblages.

**Wet Escarpment-Foothills Assemblage:**

Comprises 19 species occupying wet forests of the foothills and escarpment in the UNC analysis area. Key habitats and potential corridors extend to rainforests and wet sclerophyll forests in the north of the area, extending to lower elevations than in the Northern Escarpment and Wet Escarpment assemblages.

# Appendix 5 - Assessment of Commonwealth Legislation

## 1. Introduction

The *Environment Protection & Biodiversity Conservation (EPBC) Act (1999)* was passed by Commonwealth Parliament in June 1999 and came into force on 16 July, 2000. A person must not, without an approval under the Act, take an action that has or will have, or is likely to have, a significant impact on a matter of National Environmental Significance (NES). These matters are listed as:

(a) the world heritage values of a declared World Heritage property;

(b) the ecological character of a declared Ramsar wetland;

(c) a threatened species or endangered community listed under the Act;

(d) a migratory species listed under the Act; or

(e) the environment in a Commonwealth marine area or on Commonwealth land.

The Act also prohibits the taking, without an approval under the Act, of:

(a) a nuclear action; or

(b) an action in a Commonwealth marine area or on Commonwealth land that has or will have, or is likely to have, a significant impact on the environment.

An action includes a project, development, undertaking or an activity or series of activities. An action does not require approval if it is a lawful continuation of a use of land, sea or seabed that was occurring before the commencement of the Act. An enlargement, expansion or intensification of a use is not a continuation of a use.

The *EPBC Act (1999)* does not require Commonwealth approval for the rezoning of land. It does, however, suggest that when rezoning land, planning authorities should consider whether to allow actions that could significantly affect NES matters or the environment of Commonwealth land.

Matters of NES in NSW are:

(a) Declared World Heritage Areas;

(b) Declared Ramsar Wetlands;

(c) Listed Threatened Species (Schedule 1 and 2 of Commonwealth Endangered Species Protection Act 1992);

(d) Listed Ecological Communities in NSW; and

(e) Listed migratory species (JAMBA and CAMBA).

# 2. Subject Site Assessment

## *2.1 Background*

A Commonwealth Assessment will be required for proposed activities on the subject site if they affect a matter of NES. Matters of NES in NSW were identified in the previous section. There are no declared World Heritage Areas or Ramsar Wetlands in the Locality, Study area or Subject site.

## *2.2 Listed Threatened species*

A number of species listed as threatened in the *Commonwealth Endangered Species Protection Act (1992)* are known from the wider locality, these are:

**Flora**

- Coolamon (*Syzygium moorei*)
- *Corokia whiteana*
- Floyd's/Crystal Creek Walnut (*Endiandra floydii*)
- Red-fruited ebony (*Diospyros mabacea*)
- Red Lilly Pilly (*Syzygium hodgkinsoniae*)
- Rough-shelled Bush Nut (*Macadamia tetraphylla*)
- Rusty Rose Walnut (*Endiandra hayesii*)
- Scented Acronychia (*Acronychia littoralis*)
- Small-leaved hazelwood (*Symplocos baeuerlenii*)
- Small-leaved tamarind (*Diploglottis campbellii*)
- Southern Swamp Orchid (*Phaius australis*)
- Spiny Gardenia (*Randia moorei*)
- Stinking Cryptocarya (*Cryptocarya foetida*)
- Sweet Myrtle (*Austromyrtus/Gossia fragrantissima*)
- Three-leaved bosistoa/Yellow Satinheart (*Bosistoa transversa*)

Three (3) Commonwealth Threatened flora species were recorded on the Subject site. These include specimens of Coolamon, Spiny gardenia and Scented acronychia.

**Fauna**

- Grey-headed flying-fox (*Pteropus poliocephalus*)
- Long-nosed potoroo (*Potorous tridactylus tridactylus*)
- Mitchell's rainforest snail (*Thersites mitchellae*)
- Wallum sedgefrog (*Litoria olongburensis*)

One (1) Commonwealth Threatened fauna species, the Grey-headed flying-fox, was recorded on the Subject site. The Long-nosed potoroo and the Wallum sedgefrog were recorded on land adjacent to the Subject site, in the SEPP 14 wetlands to the east and in Crown land to the south-east, respectively.

If the proposed development is deemed to have a significant impact on any of these species, Commonwealth approval will be required.
An action has, will have, or is likely to have a significant impact on a critically endangered or endangered species if it does, will, or is likely to:

- lead to a long-term decrease in the size of a population; or

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

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

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

An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

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

It is considered that the proposed development will not result in any such impacts on the Grey-headed Flying-fox, Wallum Sedge Frog, Long-nosed Potoroo, Coolamon, Spiny Gardenia and Scented Acronychia.

It is considered that the Subject site does not support an important population of any species listed in the *EPBC Act (1999)* and a significant impact on these species will not be incurred.

### *2.3 Listed Ecological Communities in NSW*

None of the ecological communities currently listed in the *EPBC Act (1999)* occur in the study area or wider locality.

### *2.4 Listed Migratory Species*

Listed migratory species in NSW are considered predominantly in the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA).

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

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

(* Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a migratory species by direct competition, modification of habitat, or predation.)

An area of important habitat is:

1. habitat utilised by a migratory species occasionally or periodically within a region that supports an *ecologically significant proportion* of the population of the species, or
2. habitat utilised by a migratory species which is at the limit of the species range, or
3. habitat within an area where the species is declining.

It is considered that although two (2) listed migratory species, the Osprey and Black-tailed godwit, are known or likely to occur occasionally in the Study area, no area of important habitat occurs in the Study area for listed migratory species.

### *2.5 Requirement for Commonwealth Assessment*

**On the basis of the above assessment, it is concluded that Commonwealth Assessment is not required for the Proposed development of the subject site.**