

JAMES WARREN & Associates Pty Ltd

ENVIRONMENTAL CONSULTANTS



**AMENDED**  
**ECOLOGICAL ASSESSMENT**  
**VOLUME 1**

LOT 73 DP 851 902  
BAYSIDE WAY

BRUNSWICK HEADS

JULY 2011

**A REPORT TO CODLEA PTY LTD**

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## TABLE OF CONTENTS

<b>1</b>	<b>INTRODUCTION</b>	<b>2</b>
1.1	BACKGROUND	2
1.2	LOCALITY	3
1.2.1	<i>Introduction</i>	3
1.2.2	<i>The Subject Site</i>	3
1.2.3	<i>Soils and Geology</i>	4
1.2.4	<i>Landuse Zones</i>	4
1.3	LITERATURE REVIEW	4
1.4	THE PROPOSED DEVELOPMENT	5
1.5	STRUCTURE OF THIS ASSESSMENT	5
<b>2</b>	<b>DIRECTOR GENERAL'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS</b>	<b>7</b>
2.1	INTRODUCTION	7
2.2	DGEARS TO BE ADDRESSED	7
2.3	COMPLIANCE WITH RELEVANT LEGISLATION	8
<b>3</b>	<b>STATUTORY CONSIDERATIONS</b>	<b>9</b>
3.1	COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 (EPBC ACT).	9
3.1.1	<i>Introduction</i>	9
3.1.2	<i>Occurrence of Matters of NES on Subject Site</i>	10
3.1.3	<i>Assessment Against EPBC Act Principal Significant Impact Guidelines</i>	10
3.1.4	<i>Requirement for Commonwealth Referral</i>	14
3.2	SEPP 44 KOALA HABITAT ASSESSMENT	14
<b>4</b>	<b>FLORA AND FAUNA</b>	<b>16</b>
4.1	INTRODUCTION	16
4.2	IMPACT ASSESSMENT	16
4.2.1	<i>Introduction</i>	16
4.2.2	<i>Wallum Vegetation</i>	17
4.2.3	<i>Significant Trees</i>	20
4.2.4	<i>Endangered Ecological Communities (EECs)</i>	23
4.2.5	<i>Threatened Fauna Recorded on the Site</i>	26
4.2.6	<i>Threatened Fauna species that may possibly occur on the Site</i>	33
<b>5</b>	<b>NATIVE VEGETATION AND WILDLIFE CORRIDORS</b>	<b>39</b>
5.1	INTRODUCTION	39
5.2	NATIVE VEGETATION	39
5.2.1	<i>Avoidance of Impacts</i>	39
5.2.2	<i>Potential Impacts</i>	39
5.2.3	<i>Mitigation/Offsets</i>	41
5.3	WILDLIFE CORRIDORS	42
5.3.1	<i>Introduction</i>	42
5.3.2	<i>Background</i>	42
5.3.3	<i>Literature Review</i>	42
5.3.4	<i>Bayside Corridor Descriptions</i>	43
5.3.5	<i>Bayside Corridor Fauna Analysis</i>	45
<b>6</b>	<b>IMPACTS ON THE RIPARIAN ZONE OF SIMPSON'S CREEK</b>	<b>51</b>
6.1	INTRODUCTION	51
6.2	SITE ASSESSMENT	51
6.3	BRUNSWICK ESTUARY MANAGEMENT STUDY AND MANAGEMENT PLAN	51
<b>7</b>	<b>OWNERSHIP AND MANAGEMENT OF THE PROPOSED CONSERVATION AREAS (RIPARIAN) AND BUFFER ZONES</b>	<b>52</b>
7.1	INTRODUCTION	52



## Amended Ecological Assessment (Volume 1) - Bayside Brunswick

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7.2	DEVELOPMENT CONSTRAINTS	52
7.3	DESCRIPTION OF ENVIRONMENTAL PROTECTION AREAS	52
7.4	MANAGEMENT OF ENVIRONMENTAL PROTECTION AREAS	53
7.5	MAINTENANCE	53
7.6	OWNERSHIP	53
<b>8</b>	<b>SUMMARY OF IMPACTS, MITIGATION &amp; OFFSETS</b>	<b>54</b>
	<b>REFERENCES</b>	<b>56</b>



# 1 INTRODUCTION

## 1.1 Background

James Warren and Associates were engaged by Codlea Pty Ltd to complete an Ecological Assessment (EA) for Lot 73 DP 851 902 Bayside Way, Brunswick Heads.

Under section 3A of the *Environmental Planning & Assessment Act 1979* (EPA Act 1979), a major projects application was lodged with the Department of Planning (DoP). Revised Director General's Environmental Assessment Requirements (DGEARs) were issued dated 14<sup>th</sup> October 2010 (**MP 05\_0091**).

To address the relevant DGEARs the assessment involved the following:

- Mapping and ground truthing vegetation units and determining their conservation status 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), and with reference to the Byron Shire Flora and Fauna Study (1999);
- Searching for and recording species and communities listed under the NSW Threatened Species Conservation Act (*TSC Act 1995*);
- Searching for and recording flora listed as Rare or Threatened Australian Plant taxa (ROTAP; Briggs & Leigh 1996);
- Determining the suite of threatened fauna (*TSC Act 1995*) that occurs in the locality and assessing their potential occurrence on the Subject site;
- Assessing habitat provided by the site in relation to adjacent habitat and making an assessment of the corridor value of the site;
- Surveying and categorising significant trees on the site for their habitat value;
- Addressing statutory requirements as stated within the Director General's Environmental Assessment Requirements (DGEARs) (i.e. Commonwealth *Environment Protection and Biodiversity Act 1999* (EPBC Act) and NSW *Threatened Species Conservation Act* (*TSC Act 1995*); and
- Presenting the report in a format that address the Director General's Environmental Assessment Requirements (DGEARs).

Subsequent to the preparation of the EA (JWA 2010) DoP completed a 'test of adequacy'. Comments were outlined in a letter from the DoP dated 13<sup>th</sup> January 2011. Meetings were then held with the DoP in Sydney (i.e. 25<sup>th</sup> February & 10<sup>th</sup> March 2011) and negotiations resulted in an amendment to the residential layout.

This updated EA has been prepared to address DoP issues and the amended residential layout. In particular, the development layout has been amended to remove eleven lots from the south east corner of the site. This area will become Park 1 (**FIGURE 1**) and will be dedicated to the Tweed Shire Council as a conservation area on completion of revegetation works. Revegetation will include: Wallum vegetation (**SECTION 4.2.2**),



Wallum froglet habitat (**SECTION 4.2.5.8**), proposed EEC offsets (**SECTION 4.2.4**) and proposed significant tree offset area (**SECTION 4.2.3**) and is discussed further in the relevant sections.

## **1.2 Locality**

### **1.2.1 Introduction**

The locality is defined as the area within a 10 km radius of the subject site. The locality therefore extends from Byron Bay in the south, to Hastings Point in the north and the Coastal foreshore in the east to Main Arm and Nightcap National Park in the west (**FIGURE 1**).

Prominent features in the locality include Brunswick Heads and township, Ocean Shores, Bangalow, Mullumbimby, Billinudgel, Middle Pocket, Goonengerry, Coolamon plateau, Mount Matheson, the north coast railway line, the Brunswick River, Simpson's Creek, Marshall's Creek, Mullumbimby Creek, Mount Chincogan, Belongil Creek, Tyagarah lagoon, Cumbebin Swamp and the coastal beaches and headlands.

Dominant habitat types are Coastal and Wallum heath, Scribbly gum forest, Wet and Dry sclerophyll forest, Mangrove, Coastal foreshore, Lowland rainforest, Fresh and Saline swamp, Paperbark wetland, Pasture and Camphor laurel dominated forest (**FIGURE 2**).

There are five (5) dedicated conservation reserves in the locality (**FIGURE 3**). These reserves are:

- Tyagarah NR
- Brunswick Heads NR
- Billinudgel NR
- Marshall's Creek NR
- Julian Rocks NR

State Wetlands numbers 61 -72 occur in the locality. SEPP 69 occurs to the east of the Subject site along Simpsons Creek. These wetlands are protected by State Environmental Planning Policy No. 14 - Coastal Wetlands (SEPP 14) (**FIGURE 4**).

SEPP 26 Littoral Rainforests numbers 15, 16 and 18 also occur in the locality. These rainforests are protected by State Environmental Planning Policy No. 26 - Littoral Rainforest (SEPP 26) (**FIGURE 5**).

Land uses within the locality include residential, tourism, retail, fishing, agriculture and conservation.

### **1.2.2 The Subject Site**

The subject site is defined as the area subject to the proposed development. The subject site for the proposed development is formally described as is Lot 73, DP 851902 Brunswick Heads. The site covers approximately 31.33 hectares and is bound by residential development to the north-east, Simpsons Creek (tidal) to the east and native regrowth



heath and swamp sclerophyll vegetation to the south. The western boundary adjoins a rural property.

An aerial photograph of the subject site is provided as **FIGURE 6**.

The majority of the subject site is cleared and is currently subject to an approved slashing regime. Scattered Scribbly gums occur across the slashed area. A dirt track traverses the eastern portion of the site, roughly running north-south, separating the slashed area with the forested Environmental Protection Zone adjacent to Simpsons Creek. This track also provides access to Simpsons Creek in the south west corner of the subject site.

### **1.2.3 Soils and Geology**

The soils on the site are dominated by Tyagarah aeolian landscape, which is characterised by sediment basins of mixed estuarine and aeolian origin, forming level to gently undulating plains. Such environments contain deep (>150cm), sandy podsoles and acid peats characteristic of back barrier dune systems of Pleistocene derivation.

### **1.2.4 Landuse Zones**

The Byron Shire LEP Landuse zones (**FIGURE 7**) for this area include: sections zoned as 7(a) and 7(b) along Simpson's Creek and an area zoned as 2(a) residential. These zoned lands are listed by the Byron Shire LEP as:

- 2(a) (Residential zone)
- 7(a) (Wetlands zone)
- 7(b) (Coastal habitat zone).

## **1.3 Literature Review**

A number of reports and other sources were reviewed for the purpose of this assessment. These include:

- NPWS Wildlife Atlas and Database
- NRAC Report Vertebrates of Upper North Coast NSW
- NRAC Report Flora of Upper North Coast NSW
- Byron Flora and Fauna Study 1999
- Byron Shire Biodiversity Conservation Strategy (2004)
- JWA Reports for land in the Brunswick Heads area (2001-2003)
- Brunswick Estuary Management Plan (Issue No. 2 January 2009)
- Brunswick Heads Bypass proposal (RTA 2002)
- Byron Shire Coastline Management Strategy (2003)



- Fauna Impact Statement Mixed density Urban Residential Development, Brunswick Heads (Woodward-Clyde 1996)

## 1.4 The Proposed Development

The proposed development is for a residential subdivision of 178 lots including the following (**FIGURE 8**):

- 176 single dwelling lots (i.e. ranging from 450 m<sup>2</sup> to 1136.6m<sup>2</sup>);
- 1 lot comprising of 16 dual occupancy dwellings (i.e 4966.7m<sup>2</sup>);
- Large areas for environmental restoration including;
  - Lot B167 (7292 m<sup>2</sup>);
  - Lot B160 (9400 m<sup>2</sup>);
  - Park 1 (P1) (2.6800 ha); and
  - Central stormwater management area (1.24 ha); and
  - approximately 10.37 hectares of land adjacent to Simpsons Creek for the purposes of an environmental park

It should be noted that after restoration the land zoned 7(b) Coastal Habitat (i.e. 10.37 ha) will be dedicated to the Byron Shire Council for conservation.

## 1.5 Structure of this Assessment

The Ecological Assessment and associated documents have been prepared in response to the relevant DGEARs, and contain the following sections:

### VOLUME 1

**SECTION 1** - Introduction, background and relevant site information

**SECTION 2** - DGEARs

**SECTION 3** - Responses to DGEARs

**SECTION 4** - Summary of Impacts, Mitigation and Offsets

### VOLUME 2

**APPENDIX 1** - Listed EPBC Fauna Assessment

**APPENDIX 2** - Grey-head Flying-fox Camps

**APPENDIX 3** - Flora Assessment

**APPENDIX 4** - Tree Survey



**APPENDIX 5 - Fauna Assessment**

**APPENDIX 6 - Key Thresholds Assessment**

**APPENDIX 7 - Tree Table with TPZ & SRZ**

**APPENDIX 8 - Literature Review: Buffers**

**APPENDIX 9 - Wallum Froglet Compensatory Habitat**





## 2 DIRECTOR GENERAL'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

### 2.1 Introduction

Under section 3A of the *Environmental Planning & Assessment Act 1979* (EPA Act 1979), a major projects application was lodged with the Department of Planning (DoP). Revised Director General's Environmental Assessment Requirements (DGEARs) were issued dated 14<sup>th</sup> October 2010 (MP 09\_0166).

The following sections describe which DGEARs and legislation, Guidelines and Policies will be addressed in this report.

### 2.2 DGEARs to be addressed

The following DGEARs have been addressed in this report:

#### *General requirements*

- 6 Consideration of impacts, if any, on matters of National Environmental Significance under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

#### *Flora and fauna*

- 3.1 Assess the potential impacts of the development on flora and fauna taking into consideration impacts on any threatened species, populations, ecological communities and/or critical habitat and relevant recovery plan in accordance with DECC's Guidelines for Threatened Species Assessment (2005), having particular regard for the Wallum vegetation and the Wallum Froglet identified on the site. Provide measures for the conservation of the flora and fauna, where relevant.
- 3.2 Address any impacts on migratory species, RAMSAR wetlands and species listed under Section 18 and 18A of the EPBC Act.
- 3.3 Address impacts of clearing of native vegetation, and outline measures for the conservation of existing wildlife corridor values and/or connective importance of any vegetation on the Subject land. Particular consideration should be given to minimising impacts on the creek line running north/south on the western side of the lot, in consultation with council.
- 3.4 Address direct and indirect impacts on the riparian zone, and identify conservation (riparian) buffer zones between the development areas and the adjoining vegetation, having regard to a recommended 50m buffer width and findings, conclusions and recommendations of the Brunswick Estuary Management Study and Management Plan.
- 3.5 Address ownership of the proposed conservation areas (riparian) and buffer zones, and management regimes to be undertaken in these areas and zones.



***The following DGEARs are not applicable as a footbridge is no longer included as part of the development application.***

- 3.6 Address the preliminary design for the footbridge over Simpson's Creek and its potential impacts on the aquatic habitat, including any requirements of the Department of Primary Industries (Fisheries) regarding this habitat.
- 3.7 Address potential impacts of the proposed beach access through Tyagarah Nature Reserve and any requirements of the Department of Environment and Climate Change (DECC).

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

## **2.3 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.

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 identify 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.

The assessment has been completed in accordance with:

- Guidelines for Threatened Species Assessment (DEC & DPI, 2005);
- Threatened Species Assessment Guidelines: The Assessment of Significance (DECC 2007);
- EPBC Act Policy Statement 1.1 Significant Impact Guidelines (DEH 2006); and
- Principles for the use of biodiversity offsets in NSW (DECCW 2010).



### 3 STATUTORY CONSIDERATIONS

#### 3.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

##### 3.1.1 Introduction

This section provides a response to the following relevant DGEARs:

*DGEAR 6 - "Consideration of impacts, if any, on matters of National Environmental Significance under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)."*

AND

*DGEAR 3.2 - "Address any impacts on migratory species, RAMSAR wetlands and species listed under Section 18 and 18A of the EPBC Act."*

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.

Relevant matters of NES are:

- Listed threatened species;
- Listed ecological communities in New South Wales;
- Listed migratory species (JAMBA and CAMBA).



### **3.1.2 Occurrence of Matters of NES on Subject Site**

#### **3.1.2.1 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.

#### **3.1.2.2 Listed Threatened Species**

No Commonwealth threatened flora species were recorded on the subject site.

One Commonwealth listed threatened fauna species was recorded on the subject site - the Grey-headed flying-fox (*Pteropus poliocephalus*).

Ten (10) Commonwealth listed threatened fauna species were considered a possible occurrence on the site. An assessment of EPBC listed fauna considered a possible occurrence on the subject site is provided as **APPENDIX 1 (VOLUME 2)**.

#### **3.1.2.3 Listed Ecological Communities**

No Commonwealth threatened ecological communities were recorded on the subject site.

#### **3.1.2.4 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).

One (1) migratory species, as listed within schedules of the EPBC Act (1999), was recorded on site (i.e. Cattle egret) and eighteen (18) are considered as possible occurrences over time. An assessment of EPBC listed migratory fauna considered a possible occurrence on the subject site is provided as **APPENDIX 1 (VOLUME 2)**.

### **3.1.3 Assessment Against EPBC Act Principal Significant Impact Guidelines**

#### **3.1.3.1 Background**

The Assessment against the EPBC Act is made using Principal Significant Impact Guidelines 1.1 (DEH 2006). The guidelines outline a self-assessment process to assist in determining whether an action should be referred to the Department of Environment Water Heritage and the Arts (DEWHA) (now the Department of Sustainability, Environment, Water, Population and Communities (SEWPC)) for a decision on whether Commonwealth assessment and approval is required under the Act. The following sections assess the proposed development (the action) against these guidelines.



### 3.1.3.2 Critically Endangered and Endangered Species

#### ***Significant Impact Criteria***

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
- introduce disease that may cause the species to decline; or
- interfere with the recovery of the species.

#### ***Assessment of Proposed Action***

Potential habitat for the following species occurs on the Subject site:

- Regent Honeyeater (*Anthochaera phrygia*); and
- Swift parrot (*Lathamus discolor*).

Whilst potential habitat occurs on the subject site, the following surveys have not recorded their presence:

- Woodward Clyde site survey 1996;
- JWA site survey 2003 and 2004;
- JWA site survey 2008; and
- JWA site survey 2009.

Details of the above listed surveys are provided in **APPENDIX 5 (VOLUME 2)**.

Therefore, it is considered that the proposed development will not result in any of the above significant impacts on populations of these species.



### 3.1.3.3 Vulnerable Species

#### ***Significant Impact Criteria***

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

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

#### ***Assessment of Proposed Action***

The Grey headed flying-fox (*Pteropus poliocephalus*) has been recorded on site. However, the latest recording was in 1996 (Woodward-Clyde 1996) and the species has not been recorded in more recent fauna surveys by JWA (e.g. JWA 2003 & 2004, JWA 2008, JWA 2009).

Grey-headed flying-foxes are found up to 200 kms inland of the east coast of Australia, from North Queensland to Victoria (DEC 2005). The positions of Grey headed flying-foxes camps in the region are listed in **APPENDIX 2 (VOLUME 2)** (B. Roberts *pers. comm.* August 2010). There are four (4) camps within 10 km of the subject site (i.e. Ewingsdale, Myocum, Ocean Shores and Marshalls Creek) and the NSW Parks and Wildlife database indicates two (2) records approximately 1 km north of the site.

Therefore, it is considered that the proposed development is unlikely to result in any of the above significant impacts on populations of the Grey headed flying-fox.

Whilst potential habitat for the following species occurs on the subject site:

- Australian Painted Snipe (*Rostratula australis*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Long-nosed Potoroo (*Potorous tridactylus tridactylus*);
- New holland mouse (*Pseudomys novaehollandiae*); and
- Wallum sedge frog (*Litoria olongburensis*);

the following surveys have not recorded their presence:



- Woodward Clyde site survey 1996;
- JWA site survey 2003 and 2004;
- JWA site survey 2008; and
- JWA site survey 2009.

A habitat assessment for fauna considered a possible occurrence and details of the above listed surveys are provided in **APPENDICES 1 & 5 (VOLUME 2)** respectively.

It is considered that the proposed development will not result in any of the above significant impacts on populations of these species.

#### 3.1.3.4 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 a number of listed migratory species are known or likely to occur occasionally on the subject site as follows:

- Bar-tailed godwit (*Limosa lapponica*)
- Black-faced monarch (*Monarcha melanopsis*)
- Cattle egret (*Ardea ibis*)
- Fork-tailed swift (*Apus pacificus*)



- Latham's snipe (*Gallinago hardwickii*)
- Little curlew/Little whimbrel (*Numenius minutus*)
- Pacific golden plover (*Pluvialis fulva*)
- Painted snip (*Rostratula benghalensis*)
- Rainbow bee-eater (*Merops ornatus*)
- Regent Honeyeater (*Anthochaera phrygia*)
- Rufous fantail (*Rhipidura rufifrons*)
- Satin flycatcher (*Myiagra cyanoleuca*)
- Swift parrot (*Lathamus discolor*)
- Tristan albatross (*Diomedea exulans*)
- Whimbrel (*Numenius phaeopus*)
- White bellied sea eagle (*Haliaeetus leucogaster*)
- White-throated Needletail (*Hirundapus caudacutus*)

However, no area of important habitat, as defined above, occurs on the subject site for listed migratory species.

### **3.1.4 Requirement for Commonwealth Referral**

An assessment of the Commonwealth listed species, including migratory species, known to occur on the site or considered as possible occurrences has shown that populations of these species do not occur on the site. The proposed development will not cause a significant adverse impact on any of these species.

## **3.2 SEPP 44 Koala Habitat Assessment**

### **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 as follows:

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

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

The Subject site occurs in the Byron 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?*

Yes. The listed Koala feed tree Scribbly gum occurs over much of the eastern portion of the site, and to a lesser degree in the western portion of the site. A small area of the Koala feed trees species Swamp mahogany also occurs.

**3. Is there core Koala habitat on the subject land?**

No. As defined in SEPP 44 'core koala habitat' is defined as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

Targeted Koala surveys and results are listed below:

- Woodward Clyde survey (1996) - low levels of Koala activity recorded (i.e. scratches on trees and small number of scats recorded - see **APPENDIX 5 (VOLUME 2)**;
- JWA (2003 & 2004) - low levels of Koala activity recorded (i.e. scats recorded at the base of several Scribbly gums - see **APPENDIX 5 (VOLUME 2)**;
- JWA (2008) - low levels of Koala activity recorded (i.e. scratches on trees and small number of scats recorded - see **APPENDIX 5 (VOLUME 2)**; and
- JWA (2009) - low levels of Koala activity recorded on the site (i.e. small number of scats recorded. Higher levels of Koala activity were recorded in vegetated lands to the south - see **APPENDIX 5 (VOLUME 2)**.

The presence of only a small number of scats, combined with a lack of historical observations of Koalas on the site suggests that the subject site does not comprise core Koala habitat.

**4. Is there a requirement for the preparation of a Plan of Management for identified core Koala habitat?**

No.



## 4 FLORA AND FAUNA

### 4.1 Introduction

This section provides a response to the following relevant DGEAR:

*DGEAR 3.1 - Assess the potential impacts of the development on flora and fauna taking into consideration impacts on any threatened species, populations, ecological communities and/or critical habitat and relevant recovery plan in accordance with DECC's Guidelines for Threatened Species Assessment (2005), having particular regard for the Wallum vegetation and the Wallum Froglet identified on the site. Provide measures for the conservation of the flora and fauna, where relevant.*

This section examines the potential impacts of the development on the significant environmental values of the site as outlined above in DGEAR 3.1. The impact assessment has been completed in accordance with Steps 3 and 4 of the “Guidelines for Threatened Species Assessment” (DEC & DPI 2005) as follows:

- Step 3 - Evaluation of impacts; and
- Step 4 - Avoid, mitigate and then offset.

The following assessment includes consideration of the measures to avoid or minimise the impacts, potential impacts, mitigation and where appropriate offset strategies.

In accordance with the Guidelines (DEC & DPI 2005) impacts on the threatened species and the endangered ecological communities, as listed under the Threatened Species Conservation Act (1995), are assessed with the response to a set of questions. The impact assessment is completed in accordance with Step 5 of the Guidelines (DEC & DPI 2005) as follows:

- Step 5 - Key Thresholds

This assessment is provided in **APPENDIX 6 (VOLUME 2)**.

### 4.2 Impact Assessment

#### 4.2.1 Introduction

As required by DGEAR 3.1, this section discussed the potential impacts of the proposed development, both direct and indirect, on the significant ecological values of the site. These values include:

- Wallum vegetation;
- Significant trees;
- Endangered Ecological Communities;
- Threatened fauna species recorded on the site; and



- Threatened fauna species that may possibly occur on the site.

In accordance with the “*Guidelines for Threatened Species Assessment*” (DEC & DPI 2005), measures to avoid, mitigate and then offset potential impacts have been considered.

#### **4.2.2 Wallum Vegetation**

##### **4.2.2.1 Background**

Wallum vegetation is defined by Keith (2004) as “Wallum Sand Heaths” and is found on the nutrient poor ancient sand deposits along the east coast of Australia. Wallum vegetation can also be described as vegetation, across the full range of structural formations, occurring on dunefields, beach ridge plains and sandy backbarrier flats in southern Queensland and northern NSW (Griffith *et al* 2003). Wallum communities are often found in a mosaic pattern with Swamp forest communities, as occurs on the Subject site (Keith 2004).

Wallum vegetation is represented by seven vegetation communities on the subject site as follows (**FIGURE 9**):

- Tall closed forest (*E. robusta* and *M. quinquenervia*) (1e)
- Mid closed forest (*E. robusta* and *M. quinquenervia*) (1f)
- Tall closed sclerophyll forest (*E. signata* and *Endiandra sieberi*) (2a)
- Tall open forest (*Eucalyptus racemosa*, *Allocasuarina littoralis* and *Banksia aemula*) (2b)
- Tall closed heath - (*B. aemula* and *A. littoralis*) (3a)
- Low closed dry heath (3b)
- Low closed wet heath (3c)

##### **4.2.2.2 Avoidance of Impacts**

The development footprint avoids wallum vegetation communities as much as possible by utilising land that is zoned 2(a) residential and has been previously disturbed through an approved and sustained slashing program.

Approximately, 7.01ha of intact Wallum vegetation occurs on the subject site. 6.63ha (95%) of this intact vegetation exists within the 7(a) and has been avoided.

Approximately 14.97ha of highly disturbed wallum vegetation (i.e. subject to regular slashing) occurs on the subject site. The majority of this disturbed vegetation occurs within the 2(a) residential land. Therefore only 1.74ha (12%) of this vegetation has been avoided. It is worth noting that despite the proposed removal of this vegetation as result of the development, the alternative outcome of continued slashing of this vegetation would likely lead to increased weed incursions and decreased native species diversity in the long-term.



#### 4.2.2.3 Impacts

As discussed above development of the site will result in the loss of some wallum vegetation. An overlay of the development footprint on the wallum vegetation is shown in **FIGURE 10** and a summary of different wallum vegetation communities to be lost is shown in **TABLE 1**.

As discussed above the majority of Wallum vegetation to be removed (i.e. 13.23 ha or 97%) has been previously disturbed (i.e. cleared) and is currently subject to an approved slashing regime.

**TABLE 1**  
**POTENTIAL LOSS OF WALLUM VEGETATION**

Wallum vegetation community		Total Area (ha)	Loss (ha)	Loss (%)
1e <sup>1</sup>	Tall closed forest ( <i>E. robusta</i> , <i>M. quinquenervia</i> and <i>Leptospermum polygalifolium</i> )	1.82	0.00	0.3
1f <sup>5</sup>	Mid closed forest ( <i>L. polygalifolium</i> , <i>M. quinquenervia</i> and <i>E. robusta</i> )	0.17	0.01	3.3
2a	Tall closed forest ( <i>E. racemosa</i> and <i>Endiandra sieberi</i> )	0.89	0.00	0.0
2b	Tall open forest ( <i>E. racemosa</i> , <i>Allocasuarina littoralis</i> and <i>Banksia aemula</i> )	2.99	0.22	7.5
3a	Tall closed heath ( <i>B. aemula</i> and <i>A. littoralis</i> )	1.14	0.15	13.0
3b	Low closed dry heath	9.75	8.58	88.0
3c	Low closed wet heath	5.22	4.65	88.9
<b>TOTAL</b>		<b>21.98</b>	<b>13.61</b>	<b>61.9</b>

#### 4.2.2.4 Mitigation

A Vegetation Management Plan (VMP) will outline appropriate management practices which will ensure the integrity of the remaining Wallum vegetation is maintained.

The VMP will provide the following:

- A clear aim and set of objectives;

<sup>1</sup> Vegetation community considered to be representative of the EEC Swamp Sclerophyll Forest



- A set of measurable performance criteria;
- A strategy to rehabilitate/revegetate areas;
- Guidelines for the establishment and maintenance of protective vegetated buffers to the retained Swamp sclerophyll EEC;
- A strategy to control and manage weeds in the retained areas of vegetation (i.e. utilising best practice methods);
- A strategy to encourage natural regeneration after weed control;
- A species list to be used in landscaped areas;
- A species list to be used in rehabilitation/revegetate areas (i.e. providing details of what species will be planted in specific areas and/or vegetation communities e.g. Wallum vegetation);
- A species list that will outline replacement species for significant trees lost including Koala food trees (i.e. replacement numbers will also be provided); and
- A monitoring and maintenance and reporting schedule.

#### 4.2.2.5 Offsets

A Wallum Froglet Compensatory Habitat Plan (WFCHP) will be completed which will provide strategies for the creation of artificial “wallum” wetland habitat. A draft WFCHP is included as **APPENDIX 9 (VOLUME 2)**.

Approximately, 5.24ha of revegetation work will be completed in accordance with the VMP and the WFCHP. All revegetation works will utilise Wallum species. Whilst the loss of disturbed/slashed wallum vegetation communities is unavoidable, revegetation works on the subject site will result in a long term net gain of intact Wallum vegetation on the site (**TABLE 2**).

**TABLE 2**  
**POTENTIAL NET GAIN OF WALLUM VEGETATION**

Wallum Vegetation	Existing area (ha)	Impacts (ha)	Rehabilitation (ha)	Net Gain (ha)
Intact wallum vegetation	7.01	0.38	5.24	4.86
Slashed/disturbed wallum vegetation	14.97	13.23	n/a	n/a



### 4.2.3 Significant Trees

#### 4.2.3.1 Background

A tree location survey was completed by LandPartners in May 2010. In accordance with the Byron Shire Council Tree Preservation Order, all trees above 10cm dbh<sup>2</sup> and/or 3m in height on the subject site were located by survey (**FIGURE 11**).

JWA subsequently assigned a significance value to all trees over 20cm dbh (**FIGURE 11**). Details of the tree survey are provided in **APPENDIX 4 (VOLUME 2)**. The environmental attributes used to determine the ranking are provided in **TABLE 3**.

**TABLE 3**  
**ENVIRONMENTAL ATTRIBUTES USED TO DETERMINE SIGNIFICANCE RANKING**

Conservation Significance Category	Significance Ranking	Environmental attributes
Very high	1	<ul style="list-style-type: none"><li>• Old growth trees (i.e. &gt;900mm dbh<sup>3</sup>)</li><li>• Trees forming part of an Endangered ecological community</li></ul>
High	2	<ul style="list-style-type: none"><li>• Habitat trees (i.e. trees with obvious hollows, fissures, nests etc.)</li><li>• Preferred Koala food trees showing evidence of activity (i.e. scats)</li><li>• Preferred Glossy black-cockatoo food trees showing evidence of activity (i.e. chewed cones)</li></ul>
Moderate-High	3	<ul style="list-style-type: none"><li>• Mature preferred Koala food tree species (i.e. &gt;300mm dbh) - no evidence of activity</li><li>• Mature preferred Glossy black-cockatoo food trees (i.e. &gt;300mm dbh) - no evidence of activity</li></ul>
Moderate	4	<ul style="list-style-type: none"><li>• Immature/sub-mature preferred Koala food tree species (i.e. &lt;300mm dbh) - no evidence of activity</li><li>• Immature/sub-mature preferred Glossy black-cockatoo food trees (i.e. &lt;300mm dbh) - no evidence of activity</li></ul>
Low-Moderate	5	<ul style="list-style-type: none"><li>• Mature native tree species (i.e. &gt;300mm dbh) not fulfilling any of the above criteria</li></ul>
Low	6	<ul style="list-style-type: none"><li>• Immature/sub-mature native tree species (i.e. &lt;300mm dbh) not fulfilling any of the above criteria</li></ul>

#### 4.2.3.2 Avoidance

The proposed development layout was designed to retain as many trees, assigned a significance value, as possible. The majority of significant trees (74.5%) will be retained with the focus on retention of Significance Ranking 1 & 2 trees.

<sup>2</sup> Diameter at breast height

<sup>3</sup> Diameter at breast height



DoP's 'test of adequacy' letter dated 13th January 2011 raised the following issue in relation to surveyed significant trees within the development area:

*“Further discussion is required on the impact of proposed cut and fill on long-term health of trees to be retained, particularly in the west of the site and north-east.”*

The following methodology is based on AS 4970-2009 - Protection of trees on development sites, including the identification of impacts on Tree Protection Zones (TPZ) and Structural Root Zones (SRZ). This methodology has now been applied to all identified significant trees to determine the likelihood of long-term retention.

Methodology for determining TPZ and SRZ AS4970 compliance:

- Natural surface levels provided are 1x1 m grids taken by aerial survey.
- Design surface levels have been designed in CivilCAD. Road alignments were designed to typically grade to the central drainage area at 0.5% with lots typically grading to the road at 1%. Lots around the drainage area are typically in cut and moving away they tend to be in fill.
- All trees have been located on site by survey and numbered, identified by tree height, tree spread radius & tree trunk diameter. A total of 1269 trees were surveyed.
- Trees with a trunk diameter greater than 200mm have been given a conservation significance ranking between 1 and 6 or “No Significance”. 1 being “Very High Conservation Significance” and 6 being “Low Conservation Significance”.
- A total of 573 trees with a trunk diameter greater than 200mm were ranked with conservation significance.
- CivilCAD was then used to calculate the level difference between the design surface and the natural surface. -ve values indicate that the tree is in cut, +ve values indicate that the tree is in fill. Trees that aren't within the earthworks have no cut or fill depths. Of a total of 573 trees, approx 40% are within proposed earthworks.
- The TPZ radius is calculated as  $12 \times \text{DBH}$  in accordance with AS4970-2009 Protection of trees on development sites.
- The Structural Root Zone (SRZ) is calculated as  $(D \times 50)^{0.42} \times 0.64$  in accordance with AS4970-2009. Note that D is the trunk diameter above the root buttress. It is assumed that the DBH = D.
- The TPZ and SRZ were plotted in AutoCAD on all significant trees with a diameter greater than 200mm that are within or beside the earthworks extent. These circles were then imported into CivilCAD.
- In CivilCAD a 1x1m grid was created and the level difference computed between the design surface and the natural surface for each point.
- The 1x1m grid was checked within each tree's TPZ to determine the minimum and maximum level of cut or fill and entered into the Cut Fill Range column.
- The grid within each tree's SRZ was also checked to determine the extent of cut and any trenching within the SRZ.



- A tree was shown as removed if there was fill above 300mm within the TPZ or there is cut greater than 300mm. Some high value conservation trees in fill above 300mm are to be kept by creating a depression within the TPZ. The design surface around trees in cut up to 300mm can be locally raised within the TPZ so they can be retained.
- The SRZ circles are checked to determine if there is any significant cut or trenching for services.
- By checking the extent of cut/fill within the TRZ and the trenching/cut within the SRZ each tree is then classed as Staying or Going (CivilTech's spreadsheet "1133 - Bayside Brunswick - TPZ SRZ.xls" - **APPENDIX 7 (VOLUME 2)**).

There are a number of instances where specific measures are required to ensure adequate protection of trees to be retained. These are as follows:

1. Localised raising of earthworks design levels to ensure suitable cut levels within the TPZ and/or SRZ of a specific tree. An example is provided in **FIGURE 12**;
2. Localised lowering of earthworks design levels to ensure suitable fill levels within the TPZ and/or SRZ of a specific tree. An example is provided in **FIGURE 12**;
3. Incorporation of low retaining walls within earthworks design to ensure suitable cut/fill levels within the TPZ and/or SRZ of a specific tree. An example is provided in **FIGURE 12**; and
4. In some instances there will be an encroachment of cut/fill into the TPZ of specific trees >300mm, but not into the SRZ. An alternate TPZ has been identified in accordance with the AS 4970-2009 (**FIGURE 12**).

**FIGURES 13 - 18** provide the results of the above methodology applied to all trees above 200mm dbh within the development footprint. Proposed cut & fill on the subject site has been amended where possible to retain significant trees. Any trees that are still required to be removed will be offset as part of rehabilitation works on the site.

#### 4.2.3.3 Impacts

A total of 573 trees of significance have been identified within and immediately adjacent to the development footprint at the Bayside Brunswick site. Of these trees, the majority (74.5%) will be retained (**TABLE 4**). Trees to be lost and retained are shown in **FIGURES 13 - 18**.

**TABLE 4**  
**SIGNIFICANT TREES TO BE RETAINED**

Tree Category	Existing No.	No. to be retained	% Retained
Significance 1	149	138	92%
Significance 2	45	40	89%
Significance 3	101	56	55%
Significance 4	4	4	100%





Significance 5	261	81	69%
Significance 6	13	9	70%
<b>TOTAL</b>	<b>573</b>	<b>427</b>	<b>74.5%</b>

#### 4.2.3.4 Mitigation

Further to the above measures to ensure the retention of significant trees, there are a number of instances where proposed tree retention does not specifically comply with AS 4970-2009, however it is considered that the retention of the tree/s is still a likely outcome. In these instances it is proposed to retain the tree and monitor the health of the tree for a period of time after the completion of earthworks. If the tree shows a decline in health, the tree will be removed and offset at a rate of 2:1 within a suitable revegetation area on the site.

#### 4.2.3.5 Offsets

A total of 146 trees will be removed as a consequence of the proposed development. These trees will be offset through revegetation works on the subject site at a rate of 2:1. Therefore, a total of 292 trees will be planted so as to offset the loss of trees from the development footprint. Trees will be planted at 5m centres (i.e. 400 trees/ha) and a minimum offset area of approximately 0.73 ha is therefore required. Areas identified for offset planting are identified in **FIGURES 17 & 18**.

Offset planting will also include locally native shrubs, groundcovers and food tree for the Glossy black cockatoo (i.e. *Allocasuarina littoralis*). The VMP will outline the species to be replaced and the location of replacement plantings.

### 4.2.4 **Endangered Ecological Communities (EECs)**

#### 4.2.4.1 Background

Three (3) Endangered Ecological Communities (EEC's) were recorded on the site:

- Swamp Sclerophyll Forest;
- Swamp Oak Floodplain Forest; and
- Coastal Saltmarsh.

#### 4.2.4.2 Avoidance of Impacts

The development layout has generally avoided areas of vegetation considered to be representative of EECs. The footprint utilises land that is zoned 2(a) residential, has been previously disturbed and is currently subject to an approved slashing regime.



#### 4.2.4.3 Impacts

No areas of Swamp oak floodplain forest or Coastal saltmarsh EEC will be affected by the proposed development. Furthermore, no development will occur within 243 m and 143 m of the Swamp Oak forest and the Coastal Saltmarsh respectively (**FIGURE 19**).

Some small losses of the Swamp sclerophyll forest EEC are unavoidable.

**TABLE 5** provides a summary of the existing EEC areas and the potential impacts of the proposed development. Impacts on the EECs are also depicted in **FIGURE 19**.

**TABLE 5**  
**IMPACTS ON EECs**

EEC's	Existing area (ha)	Impacts (ha)	Loss (%)
Swamp Sclerophyll Forest	5.41	0.16	2.96
Swamp Oak Forest	0.23	Nil	0
Coastal Saltmarsh	0.24	Nil	0

#### 4.2.4.4 Mitigation

DoP's 'test of adequacy' letter dated 13th January 2011 raised the following issue in relation to the Endangered Ecological Communities on the site:

*"Discussion is required on appropriate buffers to swamp EECs on the site."*

Buffers may be employed for a range of conservation purposes, to protect a specific environmental value (such as water quality in a stream) or a range of values (such as buffering an area of National Park from an urban area). In the majority of cases, buffers are used because of the multiple environmental benefits they provide.

A buffer may take any of a number of forms, depending upon the nature of the environmental value to be protected, the impacts associated with nearby land use and the interaction between these factors. A detailed literature review of the types and purposes of buffers is provided in **APPENDIX 8 (VOLUME 2)**.

Buffering retained areas of EEC will be achieved through a combination of vegetation retention and rehabilitation/revegetation works. **FIGURE 19** shows the location of EECs on the subject site and identifies associated buffers to these areas. A description of buffers to each of the EECs is provided below:



#### Swamp oak floodplain forest

- A small area of this EEC occurs in the north-eastern portion of the subject site adjoining Simpson's Creek.
- This area will be buffered from the development through retention and rehabilitation of existing vegetation.
- The buffer of retained vegetation will be a minimum width of approximately 243m (**FIGURE 19**).

#### Coastal saltmarsh

- Two (2) small areas of this EEC occur in the north-eastern portion of the subject site adjoining Simpson's Creek.
- These areas will be buffered from the development through retention and rehabilitation of existing vegetation.
- The buffer of retained vegetation two these two (2) areas will be a minimum width of approximately 143m & 230m respectively (**FIGURE 19**).

#### Swamp sclerophyll forest

- A large area of this EEC occurs in the eastern portion of the site in association with other vegetation communities. An area of this EEC occurs in the north-western corner of the site and forms part of a larger EEC which extends onto adjoining lands. A number of smaller patches occur in western portion of the site.
- The large area of this EEC in the eastern portion of the site will be buffered from the development through a combination of retention/rehabilitation of existing vegetation and revegetation works. The buffer will be a minimum width of approximately 15 m, but will generally exceed 30m (**FIGURE 19**).
- The area of this EEC in the north-western portion of the site will be buffered from the development through retention/rehabilitation of existing vegetation. The buffer will be a minimum width of approximately 19m (**FIGURE 19**). A bio-retention treatment area may be required within this buffer area to ensure adequate treatment of stormwater prior to release into this EEC.
- The smaller areas of this EEC on the site generally occur as small, isolated stands of vegetation surrounded by cleared areas. These stands of trees will be buffered from the development through revegetation works. These small stands of trees occur within an allotment designated for "Park Living". A single building entitlement will occur on this land, with the balance of the land to be rehabilitated as EEC/Compensatory habitat. The buffers to these stands of EEC will range from a dense screen of edge plantings (i.e. 2-3m wide), to revegetation of adjacent constructed road batters and currently cleared areas (i.e. approximately 10-20m wide).

#### 4.2.4.5 Offsets

The location and extent of proposed EEC offsets are depicted in **FIGURE 20**. With the implementation of the VMP (see **SECTION 4.2.2.4**) there will be a long-term net gain of 1.87 ha of Swamp sclerophyll forest. **TABLE 6** provides a summary of the existing EEC areas, the potential impacts of the proposed development and the proposed offsets.



**TABLE 6**  
**PROPOSED OFFSETS FOR EECs**

EEC's	Existing area (ha)	Impacts (ha)	Offsets (ha)	Net loss/ gain (ha)
Swamp Sclerophyll Forest	5.41	0.16	1.97	1.87 gain
Swamp Oak Forest	0.23	Nil	n/a	n/a
Coastal Saltmarsh	0.24	Nil	n/a	n/a

The WFCHP (see **APPENDIX 9 - VOLUME 2**) will guide the construction of the frog habitat will also include details of the Swamp sclerophyll forest EEC offset plantings in this portion of the site. The VMP will guide the rehabilitation and management of Swamp sclerophyll forest EEC offsets elsewhere on the subject site.

#### **4.2.5 Threatened Fauna Recorded on the Site**

##### **4.2.5.1 Background**

Details of the fauna survey completed on the Bayside Brunswick site are contained in **APPENDIX 5 (VOLUME 2)**. Seven (7) threatened fauna species have been recorded on or adjacent to the subject site as follows:

- Common planigale (*Planigale maculata*);
- Glossy black cockatoo (*Calyptorhynchus lathami*);
- Grey headed flying fox (*Pteropus poliocephalus*);
- Koala (*Phascolarctos cinereus*);
- Little bentwing bat (*Miniopterus australis*);
- Osprey (*Pandion haliaetus*); and
- Wallum froglet (*Crinia tinnula*).

Threatened fauna sightings on the subject site and within regenerating heathlands to the south are shown in **(FIGURES 21 - 24)**.

##### **4.2.5.2 Common planigale**

###### **Location & Area**

The Common planigale has been recorded from intact vegetation in the eastern portion of the subject site as well as in a number of locations on adjoining lands to the south of the site (**FIGURE 22**).



Potential habitat is contained within all intact vegetation communities in the 7a zoned land adjacent to Simpsons Creek. This area covers approximately 10.37 ha. Large areas of habitat also occur to the south of the subject site where the species has also been recorded.

#### ***Avoidance of impacts***

In order to avoid and minimise environmental impacts, the footprint utilises land that is zoned 2(a) residential, has been previously disturbed (i.e. agriculture) and is currently subject to an approved slashing regime. Vegetation considered as habitat for the Common planigale (i.e. Intact Rainforest, Sclerophyll forest, Grasslands and marshlands) will be unaffected by the proposed development.

#### ***Potential Impacts***

The proposed development will not result in any direct impacts on this habitat however, potential indirect impacts may include:

- Predation by domestic cats and dogs, and the invasive cane toad; and
- An increase in disturbance due to the increase in local population.

#### ***Mitigation***

A VMP will be completed for the areas of retained vegetation. This will provide protection for retained areas of Common planigale habitat and enhance the site as a quality habitat. The VMP will also include details on measures to exclude domestic animals, pest animals and human traffic from retained habitat areas (i.e. fencing, signage etc.).

#### ***Offsets***

No offset is required.

#### **4.2.5.3 Glossy black cockatoo**

##### ***Location & Area***

The Glossy black cockatoo has been recorded in a number of locations on adjoining lands to the south of the site (**FIGURE 23**). This species has not been recorded from the subject site despite numerous surveys however potential habitat is considered to be contained within vegetation communities 2b and 3a (i.e. Vegetation containing *Allocasuarina littoralis*) (**FIGURE 23**) and covers approximately **1.14 ha** on the subject site. Large areas of habitat also occur to the south of the subject site where the species has been recorded.

##### ***Avoidance of impacts***

The majority of vegetation containing food trees for the Glossy black cockatoo (i.e. 2.01ha - 98.5%) will be unaffected by the proposed development (**FIGURE 15**).

##### ***Potential Impacts***

The proposed development will result in minor impacts on potential Glossy black cockatoo habitat i.e. 0.03ha (1.5%) will be removed. Potential indirect impacts may include:

- Predation/disturbance by domestic cats and dogs;



- Loss of tree hollows;
- Increase risk of fire which may reduce the abundance and recovery of she-oaks; and
- Illegal bird smuggling and egg-collecting.

### **Mitigation**

A VMP (see **SECTION 4.2.2.4**) will be completed for the areas of retained vegetation (i.e. Environmental Protection Zones and SEPP 14 Wetlands). This will provide protection for retained areas which contain a food source for the Glossy black cockatoo. The VMP will also include details on measures to exclude domestic animals, pest animals and human traffic from retained habitat areas (i.e. fencing, signage etc.).

### **Offsets**

Areas identified for offset planting are identified in **FIGURES 17 & 18**.

Offset planting will also include locally native shrubs, groundcovers and food tree for the Glossy black cockatoo (i.e. *Allocasuarina littoralis*). The VMP will outline the species to be replaced and the location of replacement plantings.

#### **4.2.5.4 Grey headed flying-fox**

### **Location & Area**

Potential habitat for the Grey headed flying fox is contained within all intact vegetation communities in the 7a zoned land, between the Crown Land Road and Simpsons Creek (**FIGURE 9**).

### **Avoidance of impacts**

In order to avoid and minimise environmental impacts, the development footprint utilises land that is zoned 2(a) residential, has been previously disturbed (i.e. agriculture) and is currently subject to an approved slashing regime. Vegetation containing habitat for the Grey headed flying fox will be unaffected by the proposed development.

### **Potential Impacts**

Potential habitat for this species covers a total area of 10.37 ha on the subject site. The proposed development will not result in any direct impacts on this habitat. However, a small number of potential forage trees (mostly Heath-leaved banksia) will be lost within the development footprint. No potential roost habitat will be lost. Potential indirect impacts may include:

- electrocution on powerlines; and
- general disturbance and/or disturbance to roosting sites due to the increase in local human population.



### **Mitigation**

A VMP (see **SECTION 4.2.2.4**) will be completed for the areas of retained vegetation. This will provide protection for retained areas which contain habitat for the Grey headed flying fox.

### **Offsets**

No offset is required.

#### **4.2.5.5 Koala**

### **Location & Area**

Habitat for the Koala is found within both the wet and dry Sclerophyll communities on the Subject site (i.e. a total area of approximately 8 ha) (**FIGURE 24**).

### **Avoidance of impacts**

In order to avoid and minimise environmental impacts, the footprint utilises land that is zoned 2(a) residential, has been previously disturbed (i.e. agriculture) and is currently subject to an approved slashing regime. However, this area does contain scattered Koala food trees.

### **Potential Impacts**

Primary and secondary Koala Habitat occurs on the Subject site and extensively to the south of the site (**FIGURE 24**). Potential habitat was determined by the presence of preferred Koala food trees as outlined by the Byron Shire Council fact sheet, "Why trees are important?" (BSC undated). Although, surveys have not identified a resident population, the presence of scats indicates that Koalas utilise the subject site and areas to the south. Impacts on primary and secondary Koala habitat are shown in **FIGURE 24**, and detailed in **TABLE 7**.

**TABLE 7**  
**POTENTIAL LOSS OF KOALA HABITAT**

	Total Habitat (ha)	Habitat lost in Development Area (ha)
<b>Primary Koala Habitat</b>		
	2.79	0.16 (5.6%)
<b>Secondary Koala Habitat</b>		
	5.27	1.48 (28.0%)



### **Mitigation**

A survey for the presence of Koalas will be completed prior to clearing and the removal of any large habitat or Koala food trees. In addition, an ecologist will be present during all clearing of native vegetation.

### **Offsets**

Koala food trees will be planted to offset any losses as a result of clearing for the proposed development. Trees will be included in a landscape design and planted at an approximate replacement ratio of 2:1. Specific details of Koala food tree planting will be outlined in the VMP. Thirty eight primary Koala food trees (i.e. *E. robusta*) > 0.2 cm will be lost and 76 will be planted. This will result in a net gain of 38 trees.

#### **4.2.5.6 Little bentwing bat**

##### **Location & Area**

Potential habitat for the Little bentwing bat is contained within all intact vegetation communities in the 7a zoned land, between the Crown Land Road and Simpsons Creek (FIGURE 9).

##### **Avoidance of Impacts**

In order to avoid and minimise environmental impacts, the development footprint utilises land that is zoned 2(a) residential, has been previously disturbed (i.e. agriculture) and is currently subject to an approved slashing regime. Vegetation containing habitat for the Little bentwing bat will be unaffected by the proposed development (FIGURE 25).

##### **Potential Impacts**

Potential habitat for this species covers a total area of 10.37 ha on the subject site. The development will not result in the loss of any potential habitat for this species. However, potential indirect impacts may include:

- death and/or injury from predation/disturbance by domestic dogs and cats; and
- death and/or disease from the use of domestic pesticides.

### **Mitigation**

A VMP (see SECTION 4.2.2.4) will be completed for the areas of retained vegetation (i.e. Environmental Protection Zones and SEPP 14 Wetlands). This will provide protection for retained areas of Little bentwing bat.

### **Offsets**

No offset is required.

#### **4.2.5.7 Osprey**

##### **Location & Area**





The Osprey hunts over coastal rivers, estuaries and streams. Forage area for this species occurs over Simpsons Creek. In addition, there are potential nest trees within the intact vegetation communities in the 7a zoned land, between the Crown Land Road and Simpsons Creek (**FIGURE 9**).

### ***Avoidance of Impacts***

The proposed development was designed to utilise existing cleared and disturbed areas. Large areas, within the environmental Protection zone, in the east of the site will remain unaffected. These areas will remain available as potential nest sites for the Osprey.

### ***Potential Impacts***

Simpsons Creek will not be affected by the proposed development. However, potential indirect impacts may include:

- loss of potential nest trees on the Subject site within the residential footprint;
- disturbances and degradation to water quality from the disposal of treated effluent or stormwater runoff (e.g. increases in turbidity);
- disturbance from human activity to areas of any potential nest sites; and
- disturbance from straying domestic pets and death and/or disease from the ingestion of fish containing discarded fishing tackle.

### ***Mitigation***

A VMP (see **SECTION 4.2.2.4**) will be completed for the areas of retained vegetation (i.e. Environmental Protection Zones and SEPP 14 Wetlands). This will provide protection for retained areas containing potential Osprey nest sites.

### ***Offsets***

No offset is required.

#### **4.2.5.8 Wallum froglet**

### ***Background***

DoP's 'test of adequacy' letter dated 13th January 2011 raised the following issues in relation the Wallum froglet:

*"It appears that there is consistent evidence (numerous sitings over a 10 year period in some areas of the site) of Wallum froglet usage in areas not mapped as core habitat, this requires further explanation."*

*"A draft of the Wallum Froglet Compensatory Habitat Plan must be included in the EA for exhibition. This is a significant part of the impact offset for this species and there is a high amount of uncertainty as to whether this approach will be successful, adequate details of the proposal will need to be available for review by government agencies, Council and the public."*



*“The National recovery plan for the wallum sedgefrog and other wallum-dependent frog species (2006), Report to Department of Environment and Water Resources, Canberra should be referred to.”*

The Wallum froglet (*Crinia tinnula*) is listed as Vulnerable within schedules of the Threatened Species Conservation Act (1995). Wallum froglets inhabit acid paperbark swamps and sedge swamps of the coastal ‘wallum’ country. Habitat for these frogs can be described as core and forage habitat. Core habitat consists of Pleistocene sandy areas of Wallum country where acid, tannin stained water remains as ponds for up to 3-4 months. This allows the full metamorphosis of the frogs from eggs to tadpoles to adults. Core habitat for this species on the subject site is considered to occur within the drainage lines where sedges have proliferated and water sits for prolonged periods. Land near the drains (i.e. adjoining areas of grassland and slashed areas) is considered to provide forage habitat when inundated during wet periods.

### **Location & Area**

Wallum froglet habitat is found throughout the subject site including ‘wallum vegetation’ and drainage lines communities and associated slashed grass/sedge lands (**FIGURE 21**) (i.e. core habitat) (**FIGURE 21**). Records of this species also occur within regeneration heathlands to the south of the subject site (**FIGURE 21**). This species appears to disperse into adjoining slashed areas during suitable conditions (i.e. localised flooding after heavy rain).

Whilst numerous records have occurred over a 10 year period in some areas of the site not mapped as core habitat, records of this species do not necessarily equate with breeding habitat. Breeding habitat must retain water for extended periods of time.

Furthermore, the Wallum froglet is known to move into adjacent habitats during rainfall events. During a study of the habitat and movements of the Wallum froglet by White & Pike (2006), froglets were often located away from breeding ponds in nearby heath and woodland and could be found up to 100m from a pond. Froglet movement between ponds and foraging sites nearby appeared to be directed by the occurrence of rainfall events.

### **Avoidance of impacts**

The proposed development was designed to utilise existing cleared and disturbed areas and avoid likely Wallum froglet core habitat. Large areas, within the Environmental Protection Zone, in the east of the site, will remain unaffected. Additionally, likely core habitat in the drainage line running into the Environmental Protection Zone has been avoided.

### **Potential Impacts**

To provide adequate stormwater conveyance from the site to existing drainage lines to the south, the proposed development will result in unavoidable impacts on some core habitat areas (i.e. within the existing site drain).

The direct impact of the proposed development on core Wallum froglet habitat is depicted in **FIGURE 27**. The proposed development will result in the removal of 0.57 ha (10.3%) of the available core habitat (i.e. 5.49 ha) on the subject site.



Potential indirect impacts include:

- Impact of pest vertebrate species; and
- Reduction of water quality and modification to acidity in coastal wetlands.

### **Mitigation**

An Erosion and Sediment Control Plan and Stormwater Management Plan will also ensure that storm water runoff into core habitat areas will be of a high quality (**FIGURES 28 & 29**).

A frog survey will be undertaken immediately before any construction works are undertaken in Wallum froglet core habitat.

### **Offsets**

The loss of Wallum froglet habitat will be offset through the creation of compensatory habitat areas (**FIGURE 30**). These areas will be designed to provide additional core habitat areas on the subject site and will be created in accordance with a WFCHP (see **APPENDIX 9 - VOLUME 2**).

**TABLE 8** summarises the net gain of potential Wallum froglet habitat after these proposed rehabilitation measures.

**TABLE 8**  
**NET GAIN OF POTENTIAL WALLUM FROGLET HABITAT AFTER REHABILITATION**

Total Habitat (ha)	Habitat Retained (ha)	Total Habitat Lost (ha)	Constructed Wallum Frog Habitat (ha)	Net gain (ha)
5.49 (FIGURE 11)	4.92 (FIGURE 27)	0.57	0.86	0.29

#### **4.2.6 Threatened Fauna species that may possibly occur on the Site**

In addition to the Threatened fauna species recorded on or adjacent to the subject site, a further fourteen (14) threatened fauna species were considered either likely to occur or a possible occurrence on the Subject site based on the availability of suitable habitat (**APPENDIX 5 - VOLUME 2**). An impact assessment for these species is provided in the following table (**TABLE 9**):

- Australasian bittern;
- Black bittern;
- Black-necked stork;
- Collared kingfisher;



- Common blossom bat;
- Eastern long-eared bat;
- Grass owl;
- Greater broad-nosed bat;
- Large-footed myotis;
- Long-nosed potoroo;
- Mangrove honeyeater;
- Swift parrot;
- Wallum sedge-frog; and
- White-eared monarch.



**TABLE 9**  
**POTENTIAL IMPACTS, AVOIDANCE, MITIGATION AND OFFSETS for THREATENED FAUNA PREDICTED TO OCCUR ON THE SITE**

Species/EECs/ Significant Vegetation	Habitat	Vegetation Communities	Avoidance	Impacts	Mitigation	Offsets
<b>Australasian bittern</b>	Freshwater habitats, dense Saltmarsh vegetation in estuaries and flooded grasslands	4a, 4b and 4c		Nil	na	No offset is required.
<b>Black bittern</b>	Riparian habitats	Intact <sup>4</sup> communities along Simpsons Creek		Nil	na	No offset is required.
<b>Black-necked stork</b>	Swamp, mangroves, mudflats, dry floodplains and irrigated land	4a, 4b and 4c Intact communities along Simpsons Creek		Nil	na	No offset is required.
<b>Collared kingfisher</b>	Mangroves	4a		Nil	na	No offset is required.

<sup>4</sup> Intact vegetation communities are contained within the 7a zoned land, between the Crown Land Road and Simpsons Creek, and will be retained.



Amended Ecological Assessment (Volume 1) - Bayside Brunswick

Species/EECs/ Significant Vegetation	Habitat	Vegetation Communities	Avoidance	Impacts	Mitigation	Offsets
<b>Common blossom bat</b>	Vegetation containing plants with nectar producing flowers	All communities except 3b and 3c.		5.68 ha (32.7%) will be affected	A VMP will be completed for the areas of retained vegetation; This will provide protection for retained areas containing potential habitat/food resources for the Common blossom bat.	Suitable forage species will be included in the planting list for both landscaping and rehabilitation areas.
<b>Eastern long-eared bat</b>	Vegetation containing old growth trees with hollows	All communities except 3b and 3c.		5.68 ha (32.7%) will be affected	A VMP will be completed for the areas of retained vegetation; This will provide protection for retained areas containing habitat/food resources for the Eastern long-eared bat.	Suitable forage species will be included in the planting list for both landscaping and rehabilitation areas.
<b>Grass owl</b>	Intact coastal heath	3a		0.15 ha (13%) will be affected	A VMP will be completed for the areas of retained vegetation; This will provide protection for retained areas containing habitat/food resources for the Grass owl.	Suitable forage species will be included in the planting list for both landscaping and rehabilitation areas.
<b>Greater broad-nosed bat</b>	Rainforest and moist forests	All Intact vegetation communities		Nil	na	No offset is required.



Amended Ecological Assessment (Volume 1) - Bayside Brunswick

Species/EECs/ Significant Vegetation	Habitat	Vegetation Communities	Avoidance	Impacts	Mitigation	Offsets
<b>Large-footed myotis</b>	Habitats containing water creeks, rivers, estuaries and dams	All Intact vegetation communities		Nil	na	No offset is required.
<b>Long-nosed potoroo</b>	Dense coastal heath	3a		0.15 ha (13%) will be affected	na	Suitable forage species will be included in the planting list for both landscaping and rehabilitation areas.
<b>Mangrove honeyeater</b>	Mangroves	4a		Nil	na	No offset is required.
<b>Swift parrot</b>	Winter flowering eucalyptus species	Community 7 (scattered trees)		73% of the scattered trees	A VMP will be completed for the areas of retained vegetation; This will provide protection for retained areas containing habitat/food resources for the Swift parrot.	Suitable forage species will be included in the planting list for both landscaping and rehabilitation areas.



Amended Ecological Assessment (Volume 1) - Bayside Brunswick

Species/EECs/ Significant Vegetation	Habitat	Vegetation Communities	Avoidance	Impacts	Mitigation	Offsets
<b>Wallum sedge-frog</b>	The Wallum sedge-frog utilises similar habitat to the Wallum froglet i.e. 'wallum vegetation' and drainage lines ( <b>FIGURE 9</b> )			Removal of 0.57 ha (10.3%) of habitat.	The mitigation and offsets proposed for the Wallum froglet will benefit the Wallum sedge frog (see <b>SECTION 4.3.6</b> ).	
<b>White-eared monarch</b>	Coastal rainforest, swamp forest and wet eucalypt forest.	All Intact vegetation communities		Nil	na	No offset is required.





## 5 NATIVE VEGETATION AND WILDLIFE CORRIDORS

### 5.1 Introduction

This section provides a response to the following relevant DGEAR:

*DGEAR 3.8 - “Address impacts of clearing of native vegetation, and outline measures for the conservation of existing wildlife corridor values and/or connective importance of any vegetation on the Subject land. Particular consideration should be given to minimising impacts on the creek line running north/south on the western side of the lot, in consultation with council.”*

This section details the extent of native vegetation clearing that will result from the proposed development. Measures for the conservation of the existing wildlife corridor values and connective importance of the vegetated land on the subject site are considered. 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.

DGEAR 3.8 states that “*particular consideration should be given to minimising impacts on the creek line running north/south on the western side of the lot*”. Surveys of this area indicate that there is a small depression in this area but no obvious Creek line. Swamp Sclerophyll vegetation is present in this area but will be unaffected by the development. The area will become part of the buffer to the Pacific Highway.

### 5.2 Native Vegetation

#### 5.2.1 Avoidance of Impacts

In order to avoid and minimise environmental impacts, the footprint utilises land that is zoned 2(a) residential, has been previously disturbed and is currently subject to an approved slashing regime.

#### 5.2.2 Potential Impacts

Development of the site will result in the loss of vegetation for the construction of buildings, access roads, driveways and associated infrastructure. An overlay of the development footprint on the vegetation is shown in **FIGURE 25**.

A summary of vegetation types that will be lost is shown in **TABLE 10**.



**TABLE 10**  
**POTENTIAL LOSS OF NATIVE VEGETATION**

Description		Total Area (ha)	Loss (ha)	Loss (%)
<b>Swamp sclerophyll communities</b>				
1a	Tall closed forest ( <i>Eucalyptus robusta</i> ) <sup>5</sup>	0.14	0.00	0.0
1b	Tall closed woodland ( <i>Eucalyptus robusta</i> ) <sup>4</sup>	0.14	0.10	74.6
1c	Tall closed forest ( <i>Melaleuca quinquenervia</i> ) <sup>4</sup>	2.52	0.00	0.0
1d	Tall closed forest ( <i>Eucalyptus racemosa</i> , <i>Eucalyptus robusta</i> ) <sup>4</sup>	0.61	0.05	7.6
1e	Tall closed forest ( <i>Eucalyptus robusta</i> , <i>Melaleuca quinquenervia</i> , <i>Leptospermum polygalifolium</i> ) <sup>4</sup>	1.82	0.00	0.3
1f	Mid closed forest ( <i>E. robusta</i> and <i>M. quinquenervia</i> ) <sup>4</sup>	0.17	0.01	3.3
<b>Dry sclerophyll communities</b>				
2a	Tall closed forest ( <i>Eucalyptus racemosa</i> , <i>Endiandra sieberi</i> )	0.89	0.00	0.0
2b	Tall open forest ( <i>Eucalyptus racemosa</i> , <i>Allocasuarina littoralis</i> , <i>Banksia aemula</i> )	2.99	0.22	7.5
<b>Heath communities</b>				
3a	Tall closed heath ( <i>Banksia aemula</i> , <i>Allocasuarina littoralis</i> )	1.14	0.15	13.0
3b	Low closed dry heath ( <i>B. aemula</i> and <i>A. littoralis</i> )	9.75	8.58	88.0
3c	Low closed wet heath ( <i>Lepyrodia interrupta</i> and <i>Xanthorrhoea fulva</i> )	5.22	4.65	88.9
<b>Estuarine communities</b>				
4a	Mid-high mid-dense forest ( <i>Avicennia marina</i> , <i>Aegiceras corniculatum</i> )	0.93	0.00	0.0
4b	Mid-high forest ( <i>Casuarina glauca</i> , <i>Melaleuca quinquenervia</i> ) <sup>6</sup>	0.23	0.00	0.0
4c	Closed rushland/fermland ( <i>Juncus kraussii</i> , <i>Acrostichum speciosum</i> ) <sup>7</sup>	0.24	0.00	0.0
<b>Other communities</b>				
5	Tall closed grassland ( <i>Andropogon virginicus</i> )	3.61	3.37	93.3
6	Drainage lines	0.52	0.51	98.6
7	Scattered trees ( <i>Eucalyptus racemosa</i> )	1.39	1.25	89.9

<sup>5</sup> Denotes vegetation communities considered to be representative of the EEC Swamp Sclerophyll Forest

<sup>6</sup> Vegetation community representative of the EEC Swamp Oak Forest

<sup>7</sup> Vegetation community representative of the EEC Coastal Saltmarsh



In total, 18.91 hectares (58%) of the site will be subject to development. However, most development will occur in areas of already cleared and disturbed land (70%).

Additional impacts on vegetation communities may 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 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.

### 5.2.3 Mitigation/Offsets

Approximately 13ha of vegetation will remain unaffected by the proposed development. A large portion of this is intact native vegetation communities with very few weeds. The VMP will outline appropriate management practices which will ensure the integrity of the remaining native vegetation is maintained.

In addition, the WFCHP (**APPENDIX 9 - VOLUME 2**) will provide strategies for the creation of artificial “wallum” wetland habitat which will be suitable as core Wallum froglet habitat. This will include regeneration/revegetation works utilising suitable ‘aquatic’ and ‘wallum’ native plant species.

Approximately, 5.24 ha of revegetation work will be completed in accordance with the VMP and the WFCHP. This will result in a long term net gain of intact native vegetation on the site (**TABLE 11**).

**TABLE 11**  
**POTENTIAL NET GAIN OF NATIVE VEGETATION**

Intact Vegetation	Existing area (ha)	Impacts (ha)	Rehabilitation (ha)	Net Gain (ha)
All communities ex. 3b & 3c	15.95	4.41	5.24	0.78



## 5.3 Wildlife corridors

### 5.3.1 Introduction

The following sections provide a discussion of the background to the site corridor issues, and an assessment of the corridor values of existing vegetation within and to the immediate west of Stage 4a of the proposed development. An assessment of additional corridors within and adjacent to the subject site is also provided for comparison purposes.

### 5.3.2 Background

Wildlife corridor mapping, for the locality, is provided by the NPWS Key Habitats and Corridors project (NPWS undated) and the Byron Shire Local Environment Study (BSC undated) (**FIGURES 31 & 32**). The majority of the central portion of the subject site is mapped by NPWS as Key Habitat, with a Regional Corridor passing through the eastern portion of the site (**FIGURE 32**). Ground truthing (JWA 2010) has shown that the Key Habitat marked is largely comprised of cleared and disturbed land. The BSC Wildlife Corridors Plan maps a large part of the eastern portion of the site as Vegetated Corridor (**FIGURE 31**). This area corresponds with land zoned for environmental protection by the BSC. There is a smaller portion of land within the site that is mapped as part of a Non-vegetated Corridor.

During meetings with DoP (25<sup>th</sup> February & 10<sup>th</sup> March 2011) it was requested that an assessment of the corridor values of existing vegetation within and surrounding Stage 4a of the proposed development be completed. In particular, the assessment was to provide details on how the existing corridor values of this area could be maintained if the Stage 4a development proceeded in its current form.

### 5.3.3 Literature Review

Based largely on the patch-matrix-corridor model of landscape ecology, wildlife corridors are a frequently discussed landscape feature and are a recommended management tool to enhance landscape connectivity.

Connectivity is a measurement of the relationships within and between areas of vegetation. These relationships exist in a continuum from high to isolated (also referred to as 'degree of connectedness'). Connectivity relates to physical features of the landscape and the behaviour of species dependant on that landscape.

The fundamental question that must be asked in the discussion of corridors is whether the particular corridor is capable of facilitating sufficient delivery of the target species to the recipient habitat patch(es). A detailed literature review of the principles of corridors and connectivity is provided in **APPENDIX 11 (VOLUME 2)**.



### **5.3.4 Bayside Corridor Descriptions**

#### **5.3.4.1 Stage 4a Corridor**

The corridor of existing vegetation in the western portion of the Stage 4a area will be retained and rehabilitated (**FIGURE 33**). Approximately 60% of this corridor is covered by isolated pockets of vegetation (**PLATES 1 & 2**). These pockets of vegetation contain Swamp sclerophyll and regrowth wet heath species (i.e. Broad-leaved paperbark, Swamp mahogany and *Leptospermum* spp.) and are interspersed with cleared areas (approximately 40% of the corridor) that are maintained via a periodic slashing regime.

The corridor, running along the western boundary of Stage 4a and extending onto adjoining land to the west, ranges in width from 30 m to 80 m.

It should be noted that the Stage 4a area is not identified by either the NPWS corridor mapping or by the BSC corridor mapping.

#### **5.3.4.2 Western Corridor**

The western corridor (**FIGURE 33**) includes Lot B167 (to the west of the Bayside Brunswick site) and the vegetated land to the north and south, extending to the Pacific Highway to the west. Collectively, this forms an extensive vegetated corridor ranging in width from approximately 100m to 250m.

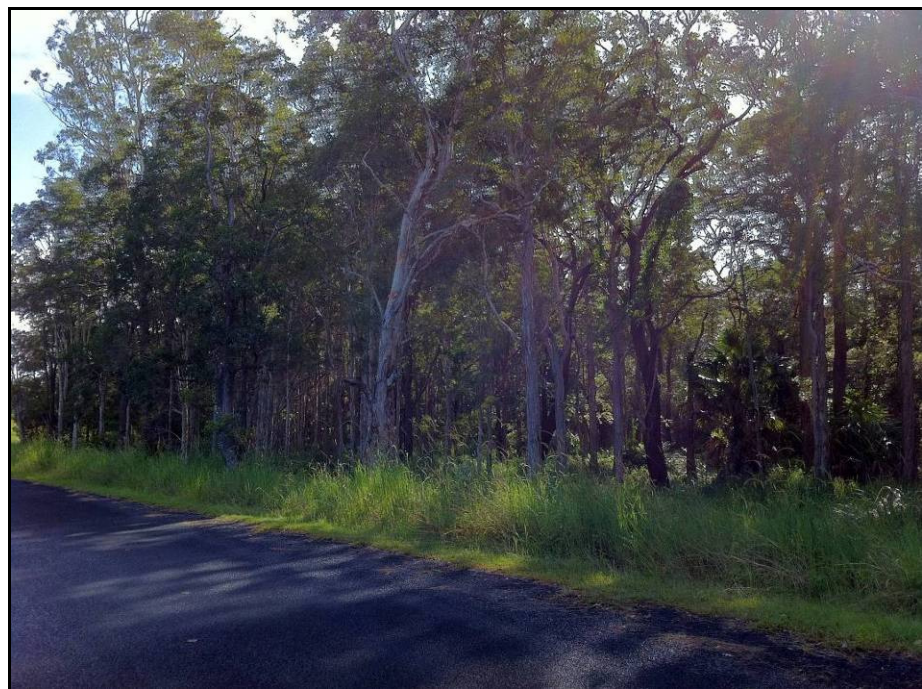
The corridor is generally comprised of Swamp sclerophyll forest (approximately 90% of corridor) (**PLATE 3**) and Dry sclerophyll forest (approximately 10% of corridor) (**PLATE 4**).



**PLATE 1:** Taken from centre of Stage 4a corridor looking south (see **FIGURE 34** for photo orientation).



**PLATE 2:** taken from centre of Stage 4a corridor looking north (see **FIGURE 34** for photo orientation).



**PLATE 3:** taken from the western edge of the Western Corridor looking east towards the Bayside Brunswick site (see **FIGURE 34** for photo orientation).





**PLATE 4:** taken from the eastern edge of the Western Corridor (see **FIGURE 34** for photo orientation).

### **5.3.5 Bayside Corridor Fauna Analysis**

#### **5.3.5.1 Introduction**

Criteria have been developed by JWA to assess the importance of site habitats for fauna movement/dispersal. Six (6) categories have been developed based on an analysis of the following criteria:

- corridor dimension;
- continuity;
- habitat diversity and quality;
- extent of internal and external disturbance; and
- importance of the corridor for linking significant habitats.

#### **5.3.5.2 Fauna Movement Objectives**

**TABLE 12** describes the criteria utilised to define the six (6) fauna movement categories.



**TABLE 12**  
**FAUNA MOVEMENT CORRIDOR CATEGORIES**

CATEGORY	CRITERIA
Category 1 Corridors	<ul style="list-style-type: none"> <li>• The corridor is of sufficient dimension to support many of the ecological processes functioning in the habitats that it is linking;</li> <li>• Facilitates gene flow by providing a continuum of breeding territories rather than runways which allows only physical movement of individuals;</li> <li>• Contain a wide diversity of habitats;</li> <li>• Contain core habitats free from edge effects and with minimal internal disturbance;</li> <li>• Connect habitats of at least Sub-regional importance (i.e. significant in far north-eastern NSW);</li> </ul>
Category 2 Corridors	<ul style="list-style-type: none"> <li>• The corridor is of sufficient dimension to support many of the ecological processes functioning in the habitats that it is linking;</li> <li>• Facilitates gene flow by providing a continuum of breeding territories rather than runways which allows only the physical movement of individuals;</li> <li>• Contain a limited diversity of habitat;</li> <li>• Contain core habitats free from edge effects and with minimal internal disturbance;</li> <li>• Connect habitats of at least local to sub-regional importance.</li> </ul>
Category 3 Corridors	<ul style="list-style-type: none"> <li>• Fragmented habitat likely to provide a linkage with high quality ecological areas;</li> <li>• Facilitate gene flow by allowing physical movement of individuals but does not generally contain breeding habitat;</li> <li>• Contain a low diversity of habitats;</li> <li>• Edge effects and internal disturbance are significant;</li> <li>• Connect habitats of local to sub-regional importance;</li> </ul>
Category 4 Corridors	<ul style="list-style-type: none"> <li>• Detached remnants that may contain populations of small terrestrial species largely isolated from other populations.</li> <li>• Small pockets of habitat that provide stepping stones for larger scansorial species such as Koalas and locally nomadic and migratory fauna following blossom or fruiting cycles.</li> <li>• Contain a low diversity of habitats;</li> <li>• Edge effects and internal disturbance are significant;</li> <li>• Provides stepping stones between habitats of local - regional importance.</li> </ul>
Category 5 Corridors	<ul style="list-style-type: none"> <li>• Drains, creeks, forest roads etc, that provide open flyways for Microchiropteran bats;</li> <li>• Creeks and rivers that are used as a navigation aid by Flying foxes;</li> <li>• Contain a low diversity of habitats;</li> <li>• Edge effects and internal disturbance are significant;</li> <li>• Connect habitats of local to regional importance;</li> </ul>





CATEGORY		CRITERIA
Category Corridors	6	<ul style="list-style-type: none"><li>• Cleared or isolated non-native habitats that have a low value as dispersal habitat.</li><li>• Do not generally link habitats of importance.</li></ul>

Vegetation within and adjacent to Stage 4a were assessed according to the above criteria. Fauna movement corridors identified on and adjacent to Stage 4a are shown in **FIGURE 33** and are described below.

#### 5.3.5.3 Corridor Values for Fauna Groups

The values for fauna groups of each of the Stage 4 and western corridors on and adjacent to the Subject site respectively, were assessed according to habitats provided. A summary is shown in **TABLE 13**.



**TABLE 13**  
**CORRIDOR VALUES FOR FAUNA GROUPS**

Corridor	Fauna Group For Which Corridor Has Value									
	Amphibians	Reptiles	Cryptic Wetland Birds	Forest Interior Birds	Local & Regional Migrants	Small terrestrial mammals	Koalas	Other arboreal mammals	Microchiropteran bats	Megachiropteran bats
Stage 4a Corridor	Mod.	Low	Low	Low	Low	Low	Low	Low	Mod.	Mod.
Western Corridor	High	High	Mod.	Mod.	Mod.	High	High	High	High	High



#### 5.3.5.4 Results of Fauna Corridor Analysis

The broad band of habitat extending along Simpsons Creek is the most important corridor in the study area. It is of sufficient width to allow the movement of a wide range of species, is free of significant internal disturbance and edge effects, and connects habitats of sub-regional significance.

The Western Corridor supports a diversity of vegetation types and is likely to facilitate the free movement of amphibians, reptiles, birds and mammals. The Western Corridor is considered to be a Category 2 corridor (**TABLE 3**) as it is considered to:

- Be of sufficient dimension to support many of the ecological processes functioning in the habitats that it is linking;
- Facilitate gene flow by providing a continuum of breeding territories rather than runways which allows only the physical movement of individuals;
- Contain a moderate diversity of habitat;
- Contain core habitats free from edge effects
- Internal disturbance is minimal;
- Connect habitats of at least local to sub-regional importance (i.e. key habitat and non-vegetated corridors as mapped by the NPWS [**FIGURE 31**] and BSC [**FIGURE 32**] respectively).

Vegetation within Stage 4a on the site may be used by fauna as habitat (including threatened species), but offers limited opportunities for movement. Disturbance adapted species (particularly Koalas) may utilise patches of scattered vegetation within Stage 4a as 'stepping stone' habitat when dispersing. This area is not identified as a corridor by NPWS or BSC and is considered to represent a Category 4 corridor (**TABLE 3**) on the subject site as it consists of:

- Detached remnants that may contain populations of small terrestrial species largely isolated from other populations.
- Small pockets of habitat that provide stepping stones for larger scansorial species such as Koalas;
- Stepping stones for locally nomadic and migratory fauna following blossom or fruiting cycles;
- A low diversity of habitats;
- Edge and internal disturbance which are considered significant; and
- Provide stepping stones between habitats of local - regional importance.

#### 5.3.5.5 Impacts of development on existing corridors

In summary, it is considered that the Western Corridor (Category 2) provides an important movement and dispersal conduit for fauna (including threatened fauna) in the locality. Movement of fauna north-south on either side of the development footprint will be



maintained and improved with the completion of the VMP. There will be no impacts on the Western Corridor as a result of the proposed development.

The existing corridor in the proposed Stage 4a of the development will also be retained. As part of the proposal, the cleared areas within this corridor, and on the subject site, will be rehabilitated and will provide further habitat for the Wallum froglet. The proposed rehabilitation works will widen this corridor to a range of 50 m to 150 m.

It is considered that given the excellent movement opportunities provided by the Western corridor, as well as vegetation along Simpsons Creek and on lands to the south of the subject site, there are no further requirements for the provision of corridors within the subject site.



## 6 IMPACTS ON THE RIPARIAN ZONE OF SIMPSON'S CREEK

### 6.1 Introduction

This section provides a response to the following relevant DGEAR:

*DGEAR 3.4 - "Address direct and indirect impacts on the riparian zone, and identify conservation (riparian) buffer zones between the development areas and the adjoining vegetation, having regard to a recommended 50m buffer width and findings, conclusions and recommendations of the Brunswick Estuary management Study and Management Plan."*

This section details the direct and indirect impacts on the riparian zone of Simpson's Creek.

### 6.2 Site Assessment

A large area of land, between the Crown Land Road and Simpsons Creek, will be set aside as a Conservation area. A Vegetation Management Plan (VMP) will be completed for this area which includes land under Environmental Protection Zoning 7a and SEPP 14 Wetlands. The VMP will include measures to reduce the potential indirect impacts of the development such as weeds, humans, feral and domestic animals. The proposed development will have minor effects on the riparian Zone of Simpsons Creek. **FIGURE 19** illustrates the distances of the proposed development from riparian zone (i.e. EECs) along Simpsons Creek.

### 6.3 Brunswick Estuary Management Study and Management Plan

The Brunswick Estuary Management Plan (BEMP) covers the tidal reaches of the Brunswick River, Kings Creek, Marshals Creek and Simpson's Creek. The estuary is within the Cape Byron Marine Park, which was declared in November 2002. The report documents the findings of a combined Estuary Management Study and Plan for the Brunswick Estuary.

The report (BEMP 2009) recommends the incorporation of a 50-metre wide undeveloped conservation zone alongside all new development and subdivisions adjacent to waterways within the new Bryon LEP and/or DCP, in accordance with the Mullumbimby and Brunswick Heads Settlement Strategies and the NSW Planning Reforms LEP standard template.

Land under Environmental Protection Zoning 7a and SEPP 14 Wetlands occurs adjacent to Simpsons Creek, forming a buffer between the Creek and the development foot print. At the widest point, the buffer will be approximately 300m and at the narrowest 70m. Additionally, proposed stormwater management strategies, including erosion control, will ensure that runoff, from the proposed development, into Simpsons Creek is treated and will be of a high quality (**FIGURES 28 & 29**).



## **7 OWNERSHIP AND MANAGEMENT OF THE PROPOSED CONSERVATION AREAS (RIPARIAN) AND BUFFER ZONES**

### **7.1 Introduction**

This section provides a response to the following relevant DGEAR:

*DGEAR 3.5 - “Address ownership of the proposed conservation areas (riparian) and buffer zones, and management regimes to be undertaken in these areas and zones”*

This section will discuss the location of proposed Environmental Protection Areas on the subject site and address the management and maintenance of these Protected Areas.

### **7.2 Development Constraints**

The Development Layout has been designed in accordance with the following constraints i.e. the layout is situated within land that:

- is zoned as residential;
- has a continual clearing history (i.e approved slashing);
- is outside existing areas of intact native vegetation;
- is outside SEPP 14 Wetlands;
- avoids significant trees (i.e. high significance score); and
- is above highest predicted flood levels including the level modelled with the affect of Global warming.

### **7.3 Description of Environmental Protection Areas**

The remaining areas outside the development layout will be the subject of a VMP. 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.



## **7.4 Management of Environmental Protection Areas**

A VMP will be completed for the 7a zoned area which includes areas of SEPP 14 Wetlands. The plan will include 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.

## **7.5 Maintenance**

The maintenance of the Environmental Protection Areas will be described in detail in the VMP. The Plan will detail a 5 year maintenance program with the aim that maintenance becomes public responsibility in the long term.

## **7.6 Ownership**

Codlea Pty Ltd will retain responsibility of the 7a Protected Land during the implementation of the VMP. After this period, discussions and negotiations will be undertaken with the Byron Shire Council regarding ownership and responsibility.



## 8 SUMMARY OF IMPACTS, MITIGATION & OFFSETS

The proposed development comprises of a residential subdivision of approximately 178 Lots. The provision of 2 parks (i.e. Park 1 and 2 totalling 2.28ha) and the dedication of an approximately 10.37 hectare parcel of land adjacent to Simpson's Creek for the purposes of an Environmental Park are also proposed.

In order to avoid and minimise environmental impacts, the development footprint utilises disturbed land that is zoned 2(a) residential. This land consists of Low closed wet and dry heath communities and is currently subject to an approved slashing regime. In total, 17 hectares (57%) of the site will be subject to development. However, most development will occur in areas of already cleared and disturbed land. There will also be a loss of 146 trees (25%) of varying ecological significance.

Vegetation Management Plan will be prepared for the Subject site. The plan will outline both mitigation and compensatory strategies. The plan will set out a strategy for the rehabilitation and management of the Environmental Protection Zone on the Subject site (i.e. the areas covering approximately 10.37 ha between the development footprint and Simpson's creek), outline a compensatory replacement planting strategy to offset the loss of the ecologically significant trees and the treatment of the ecological buffered to the Endangered ecological ecosystems found on the site. All Koala and Glossy black cockatoo food trees impacted by the development will be replaced at a ratio of 2:1 in accordance with the VMP.

The proposed development is likely to impact on native fauna in a number of ways. However, impacts are likely to be minor due to the disturbed nature of the slashed heath areas of the development footprint. To mitigate the loss of habitat for the Wallum froglet, an area of constructed Wallum froglet habitat is proposed within Park 1 and 2. These areas will result in the net gain of almost 3000 m<sup>2</sup> of Wallum froglet habitat. A Wallum Froglet Compensatory Management Plan will guide the construction and management of this habitat.

The eastern part of the site is mapped as a regional movement corridor. The movement corridor passes through the intact forested areas on the site and will not be affected by the proposed development.

Description and justification of measures to mitigate any adverse effects have been provided in accordance with relevant Threatened Species Assessment Guidelines. Consideration has been given to measures to avoid or minimise the impacts. Where measures to avoid and mitigate are not possible, then offset strategies have been considered.

An assessment of impacts through assessing key thresholds has been completed in accordance with DEC & DPI guidelines. It is considered that the proposed development will not reduce the long term viability of the EEC's or threatened fauna species on the subject site will not be reduced by the proposed development. The Proposal is unlikely to accelerate the extinction or place at risk the EEC's or threatened fauna species on the subject site.

An assessment of the Commonwealth listed species, including migratory species, known to occur on the site or considered as possible occurrence has shown that populations of these





species do not occur on the site. The proposed development will not cause a significant adverse impact on any of these species.

Through retention of intact habitat areas and the majority of habitat trees, and the provision of additional habitat areas (i.e. core habitat for the Wallum froglet and additional food trees for the Koala and Glossy black cockatoo), it is considered that the proposed development represents an ecologically sustainable development.



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# APPENDICES TO ECOLOGICAL ASSESSMENT

## VOLUME 2

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## TABLE OF CONTENTS

APPENDIX 1 - LISTED EPBC FAUNA HABITAT ASSESSMENT .....	3
APPENDIX 2 - GREY HEADED FLYING FOX CAMPS .....	16
APPENDIX 3 - FLORA ASSESSMENT .....	18
APPENDIX 4 - TREE SURVEY .....	47
APPENDIX 5 - FAUNA ASSESSMENT .....	63
APPENDIX 6 - KEY THRESHOLDS ASSESSMENT .....	84
APPENDIX 7 - TREE TABLE WITH TPZ & SRZ.....	112
APPENDIX 8 LITERATURE REVIEW: BUFFERS .....	139
APPENDIX 9 - WALLUM FROGLET COMPENSATORY HABITAT .....	145
APPENDIX 10 - COMPENSATORY HABITAT PLAN TUGUN BYPASS .....	151
APPENDIX 11 - LITERATURE REVIEW: CORRIDORS & CONNECTIVITY.....	156





## **APPENDIX 1**

### **LISTED EPBC FAUNA HABITAT ASSESSMENT**



## LISTED EPBC FAUNA HABITAT ASSESSMENT

The Department of Sustainability, Environment, Water, Population and Communities' Environmental Reporting Tool (DSEWPC 2010) was used to determine the suite of fauna species that may potentially occur within 10 kms of Bayside Brunswick, including migratory terrestrial bird species. Each of these species was then assessed as to the possibility of their occurrence on the subject site. The presence of suitable habitat was used as the criteria for a possible occurrence (TABLE 1).

**TABLE 1**  
**POSSIBLE OCCURRENCE OF COMMONWEALTH THREATENED SPECIES ON THE SUBJECT SITE**

Species	Status <sup>1</sup>	Habitat <sup>2</sup>	Possible Occurrence
Australian Painted Snipe ( <i>Rostratula australis</i> )	V	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	Possible
Bar-tailed godwit ( <i>Limosa lapponica</i> )	M	Bar-tailed Godwits arrive in Australia each year in August from breeding grounds in the northern hemisphere. Birds are more numerous in northern Australia. Bar-tailed Godwits inhabit estuarine mudflats, beaches and mangroves. They are common in coastal areas around Australia. They are social birds and are often seen in large flocks and in the company of other waders.	Possible
Black-breasted Button-quail ( <i>Turnix melanogaster</i> )	V	Preferred habitat is drier low closed forests, including dry rainforests, vine forest and vine thickets, often in association with Hoop Pine, and Bottle tree scrubs. The understorey may be dense or sparse, but a deep, moist leaf-litter layer, in which the birds forage, is an important component of habitat. Birds have been recorded using Lantana thickets at edges of rainforest or Lantana understorey of forest or rainforest.	Unlikely

<sup>1</sup> As listed under the Commonwealth EPBC ACT. E = Endangered, V = Vulnerable, CE = Critically endangered, M = Migratory.

<sup>2</sup> Habitat and Ecology notes modified from DECC (2005)



## Appendices (Volume 2) - Bayside Brunswick

Species	Status <sup>1</sup>	Habitat <sup>2</sup>	Possible Occurrence
Black-faced monarch ( <i>Monarcha melanopsis</i> )	M	The Black-faced Monarch is found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	Possible
Black-throated Finch (southern) ( <i>Poephila cincta cincta</i> )	E	Eucalypt woodland and riverside vegetation, including paperbark and wattle shrubland. Areas close to water with a dense understorey of seeding grass and shrubs are favoured.	Unlikely
Campbell Albatross ( <i>Thalassarche melanophrys impavida</i> )	V M	The diet of the Black-browed Albatross primarily consists of a combination of fish, molluscs (mostly cephalopods) and crustaceans (mostly krill). The diet also includes other items such as carrion, jellyfish and salps that are taken less frequently. The Black-browed Albatross is believed to forage during both day and night. It obtains most of its food while settled on the surface of the water by reaching down to seize a food item in the bill or, less frequently, by submerging momentarily to capture prey just below the surface. The Black-browed Albatross is a well-known scavenger that regularly trails fishing vessels to collect discarded items.	Unlikely
Cattle egret ( <i>Bubulcus ibis</i> )	M	Originally found in Africa, Europe and Asia, the Cattle Egret is now found on nearly every continent, with birds in Australia originating from Asia. In Australia it is most widespread and common in north-eastern Western Australia across the Top End, Northern Territory, and in south-eastern Australia from Bundaberg, Queensland to Port Augusta, South Australia, including Tasmania.  The Cattle Egret is found in grasslands, woodlands and wetlands, and is not common in arid areas. It also uses pastures and croplands, especially where drainage is poor. Will also forage at garbage dumps, and is often seen with cattle and other stock.	Recorded



## Appendices (Volume 2) - Bayside Brunswick

Species	Status <sup>1</sup>	Habitat <sup>2</sup>	Possible Occurrence
Coxen's Fig-Parrot ( <i>Cyclopsitta diophthalma coxeni</i> )	E M	Usually recorded from drier rainforests and adjacent wetter eucalypt forest but rarely seen due to its small size and cryptic habits. Also found in the wetter lowland rainforests that are now largely cleared in NSW. The bird shows a decided preference for fig trees, but also feeds on other fruiting rainforest species.	Unlikely
Eastern curlew <i>Numenius madagascariensis</i>	M	<p>The Eastern Curlew is widespread in coastal regions in the north-east and south of Australia, including Tasmania, and scattered in other coastal areas. It is rarely seen inland. It breeds in Russia and north-eastern China. On passage, they are commonly seen in Japan, Korea and Borneo. Small numbers visit New Zealand.</p> <p>The Eastern Curlew is found on intertidal mudflats and sandflats, often with beds of seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons.</p>	Unlikely
Fork-tailed swift <i>Apus pacificus</i>	M	<p>The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher.</p> <p>In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. They sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines.</p>	Possible



## Appendices (Volume 2) - Bayside Brunswick

Species	Status <sup>1</sup>	Habitat <sup>2</sup>	Possible Occurrence
Great egret ( <i>Ardea alba</i> )	M	Great Egrets occur throughout most of the world. They are common throughout Australia, with the exception of the most arid areas.  Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. Great Egrets can be seen alone or in small flocks, often with other egret species, and roost at night in groups.	Unlikely
Green and golden bell frog ( <i>Litoria aurea</i> )	V	Inhabits freshwater marshes, dams and stream-sides, particularly those containing bullrushes ( <i>Typha</i> spp.) or spikerushes ( <i>Eleocharis</i> spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow ( <i>Gambusia holbrooki</i> ), have a grassy area nearby and diurnal sheltering sites available.	Unlikely
Grey-headed Flying-fox ( <i>Pteropus poliocephalus</i> )	V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	Recorded



## Appendices (Volume 2) - Bayside Brunswick

Species	Status <sup>1</sup>	Habitat <sup>2</sup>	Possible Occurrence
Grey-tailed tattler ( <i>Heteroscelus brevipes</i> )	M	<p>Grey-tailed Tattlers breed in Siberia and on passage are seen along the East Asian-Australasian Flyway (the migration route to Australia). When non-breeding they are found in China, Philippines, Taiwan, Vietnam, Malay Peninsula, Indonesia, New Guinea, Micronesia, Fiji, New Zealand and Australia. They are more commonly seen in the north of Australia.</p> <p>Grey-tailed Tattlers are usually seen in small flocks on sheltered coasts with reefs and rock platforms or with intertidal mudflats. They are also found in intertidal rocky, coral or stony reefs, platforms and islets that are exposed at high tide, also shores of rock, shingle, gravel and shells and on intertidal mudflats in embayments, estuaries and coastal lagoons, especially those fringed with mangroves.</p>	Unlikely
Kermadec petrel ( <i>Pterodroma neglecta neglecta</i> )	V	<p>Ranges over subtropical and tropical waters of the South Pacific. Breeds on islands across the South Pacific. In Australia it breeds on Ball's Pyramid and Phillip Island (near Norfolk Island).</p> <p>Nests in a crevice amongst rocks. Diet is squid and crustaceans. Vagrant birds occur in coastal NSW waters, particularly after storm events.</p>	Unlikely
Large-eared Pied Bat, Large Pied Bat ( <i>Chalinolobus dwyeri</i> )	V	<p>Roosts in caves, crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Hirundo ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. Found in well-timbered areas containing gullies.</p>	Possible



## Appendices (Volume 2) - Bayside Brunswick

Species	Status <sup>1</sup>	Habitat <sup>2</sup>	Possible Occurrence
Latham's snipe ( <i>Gallinago hardwickii</i> )	M	<p>Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland.</p> <p>Latham's Snipe are seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. They also use crops and pasture.</p>	Possible
Little curlew ( <i>Numenius minutus</i> )	M	<p>The Little Curlew is widespread in the north of Australia and scattered elsewhere. It is an irregular visitor to New Zealand and Tasmania. It breeds in Siberia and is seen on passage through Mongolia, China, Japan, Indonesia and New Guinea.</p> <p>Little Curlews may gather in large flocks on coastal and inland grasslands and black soil plains in northern Australia, near swamps and flooded areas. They also feed on playing fields, paddocks and urban lawns.</p>	Possible
Little tern ( <i>Sterna albifrons</i> )	M	<p>The Little Tern is almost exclusively coastal with sheltered environments preferred. However, the species may also occur several kilometers from the sea in harbours, inlets and rivers.</p> <p>The Little Tern nests in small, scattered colonies on sandy beaches or shingle pits. These nesting sites are particularly vulnerable to human disturbance, predation and natural catastrophes.</p>	Unlikely



## Appendices (Volume 2) - Bayside Brunswick

Species	Status <sup>1</sup>	Habitat <sup>2</sup>	Possible Occurrence
Long-nosed Potoroo (SE mainland) ( <i>Potorous tridactylus tridactylus</i> )	V	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.	Possible
New Holland mouse ( <i>Pseudomys novaehollandiae</i> )	V	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. The New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. The species peaks in abundance during early to mid stages of vegetation succession typically induced by fire.	Possible
Northern giant-petrel ( <i>Macronectes halli</i> )	V M	<p>The Northern Giant-petrel has a circumpolar pelagic distribution, usually between 40-64°S in open oceans. Their range extends into subtropical waters (to 28°S) in winter and early spring, and they are a common visitor in NSW waters, predominantly along the south-east coast during winter and autumn.</p> <p>Breeding in Australian territory is limited to Macquarie Island and occurs during spring and summer.</p> <p>Adults usually remain near the breeding colonies throughout the year (though some do travel widely) while immature birds make long and poorly known circumpolar and trans-oceanic movements. Hence most birds recorded in NSW coastal waters are immature birds.</p> <p>There are marked differences in diet between the sexes. Females obtain most of their prey live from the sea, while males also scavenge from the carcasses of penguins and seals on land. At sea, both sexes are aggressive opportunists, feeding on fish, cephalopods, birds and crustaceans, including euphausiids or krill, and regularly scavenge on fishing vessels.</p>	Unlikely





## Appendices (Volume 2) - Bayside Brunswick

Species	Status <sup>1</sup>	Habitat <sup>2</sup>	Possible Occurrence
Pacific golden plover ( <i>Pluvialis fulva</i> )	M	<p>The Pacific Golden Plover breeds on the Arctic tundra in western Alaska. It winters in South America and islands of the Pacific Ocean to India, Indonesia and Australia. In Australia it is widespread along the coastline.</p> <p>The Pacific Golden Plover is found on muddy, rocky and sandy wetlands, shores, paddocks, saltmarsh, coastal golf courses, estuaries and lagoons.</p>	Possible
Painted snipe ( <i>Rostratula benghalensis</i> )	M	The Painted Snipe inhabits inland and coastal shallow freshwater wetlands, occurring in both ephemeral and permanent wetlands, particularly where there is grass. Individuals have been spotted in artificial dams, sewage ponds and waterlogged grasslands.	Possible
Rainbow bee-eater ( <i>Merops ornatus</i> )	M	The Rainbow Bee-eater is most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels.	Possible
Regent Honeyeater ( <i>Anthochaera phrygia</i> )	E M	Dry box-ironbark eucalypt woodland and dry sclerophyll forest associations. Along creek flats, or in broad river valleys and foothills.	Possible
Rufous fantail ( <i>Rhipidura rufifrons</i> )	M	<p>Strongly migratory in the south of its range, it moves northwards in winter, and virtually disappears from Victoria and New South Wales at this time.</p> <p>The Rufous Fantail is found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. During migration, it may be found in more open habitats or urban areas.</p>	Possible



## Appendices (Volume 2) - Bayside Brunswick

Species	Status <sup>1</sup>	Habitat <sup>2</sup>	Possible Occurrence
Satin flycatcher ( <i>Myiagra cyanoleuca</i> )	M	<p>The Satin Flycatcher is a migratory species, moving northwards in winter to northern Queensland and Papua New Guinea, returning south to breed in spring.</p> <p>The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. It is also found in New Guinea. The Satin Flycatcher is not a commonly seen species, especially in the far south of its range, where it is a summer breeding migrant.</p> <p>The Satin Flycatcher is found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.</p>	Possible
Giant Barred Frog ( <i>Mixophyes iteratus</i> )	E	Giant Barred Frogs forage and live amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m.	Unlikely
Southern giant-petrel ( <i>Macronectes giganteus</i> )	E	<p>The Southern Giant Petrel has a circumpolar pelagic range from Antarctica to approximately 20° S and is a common visitor off the coast of NSW.</p> <p>It is an opportunistic scavenger and predator, and scavenges from fishing vessels and animal carcasses on land. It is also an active predator of cephalopods (ink fish) and euphausiids (krill), as well as smaller birds (particularly penguins) both at land and at sea.</p>	Unlikely



## Appendices (Volume 2) - Bayside Brunswick

Species	Status <sup>1</sup>	Habitat <sup>2</sup>	Possible Occurrence
Spectacled Monarch ( <i>Monarcha trivirgatus</i> )	M	<p>The Spectacled Monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. It is much less common in the south. It is also found in Papua New Guinea, the Moluccas and Timor.</p> <p>The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.</p> <p>Resident in Queensland to Rockhampton, summer breeding migrant further south.</p>	Unlikely
Spotted Quoll ( <i>Dasyurus maculatus</i> )	E	<p>The range of the Spotted-tailed Quoll is now only found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland.</p> <p>Use 'latrine sites', often on flat rocks among boulder fields and rocky cliff-faces; these may be visited by a number of individuals; latrine sites can be recognised by the accumulation of the sometimes characteristic 'twisty-shaped' faeces deposited by animals.</p> <p>Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.</p> <p>Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.</p>	Unlikely



## Appendices (Volume 2) - Bayside Brunswick

Species	Status <sup>1</sup>	Habitat <sup>2</sup>	Possible Occurrence
Swift parrot ( <i>Lathamus discolor</i> )	E M	Migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany, Spotted Gum, Red Bloodwood, Mugga Ironbark, and White Box.	Possible
Three-toed Snake-tooth Skink ( <i>Coeranoscincus reticulatus</i> )	V	Found mostly in closed forest and possibly open layered Eucalyptus forest. Generally recorded in moist layered forest on loamy basaltic soils, but also found in closed forest overlying silica sand dunes at Cooloola.	Unlikely
Tristan albatross ( <i>Diomedea exulans</i> )	E M	<p>The Wandering Albatross visits Australian waters extending from Fremantle, Western Australia, across the southern water to the Whitsunday Islands in Queensland between June and September.</p> <p>They breed on a number of islands just north of the Antarctic Circle: South Georgia Island (belonging to the UK), Prince Edward and Marion Islands (South Africa), Crozet and Kerguelen Islands (French Southern Territories) and Macquarie Island (Australia).</p> <p>They feed in pelagic, offshore and inshore waters, often at night, taking fish and cephalopods such as squid, crustaceans and carrion, and will often follow ships feeding on the refuse they trail.</p>	Unlikely
Wallum Sedge Frog ( <i>Litoria alongburensis</i> )	V	Paperbark swamps and sedge swamps of the coastal "wallum" country. Wallum is a Banksia dominated lowland heath ecosystem characterised by acidic waterbodies. Olongburra Frogs are usually found amongst sedges and rushes in coastal wetlands.	Possible



## Appendices (Volume 2) - Bayside Brunswick

Species	Status <sup>1</sup>	Habitat <sup>2</sup>	Possible Occurrence
Water Mouse, False Water Rat ( <i>Xeromys myoides</i> )	V	The water mouse lives in mangrove communities, adjacent freshwater lagoons, swamps and sedged lakes close to coastal foredunes.	Unlikely
Whimbrel ( <i>Numenius phaeopus</i> )	M	<p>Whimbrels are common across northern Australia and uncommon to rare further south. They breed in central Siberia to Iceland. The subspecies <i>variegatus</i> is the one mainly found in Australia and also the Bay of Bengal through to Melanesia, Micronesia and to New Zealand in small numbers.</p> <p>Whimbrels are found mainly on the coast, on tidal and estuarine mudflats, especially near mangroves. They are sometimes found on beaches and rocky shores.</p>	Possible
White bellied sea eagle ( <i>Haliaeetus leucogaster</i> )	M	White-bellied Sea-Eagles have been recorded in the northern hemisphere from India to China and south through Asia, New Guinea and Australia. They occur along the coastline of Australia and also range inland over large rivers and wetlands.	Possible
White-throated Needletail ( <i>Hirundapus caudacutus</i> )	M	The White-throated Needletail is widespread in eastern and south-eastern Australia. They occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland. They also commonly occur over heathland but less often over treeless areas, such as grassland or swamps.	Possible



## **APPENDIX 2**

### **GREY HEADED FLYING FOX CAMPS**



## GREY HEADED FLYING FOX IN THE REGION

Grey-headed flying-foxes are found up to 200 kms inland of the east coast of Australia, from North Queensland to Victoria (DEC 2005). The positions of Grey headed flying-fox camps, in the region, are listed below (B. Roberts pers. comm. August 2010) (TABLE 1).

**TABLE 1**  
**Grey headed flying fox camps in the region**

COLONY NAME	LONG.	LAT.	OCCUPATION	NOTES
Big Island	153.51046991	-28.20700499	annual	
Brooks Rd	153.36003824	-28.30182291		
Caddy's Island	153.51562226	-28.19136931	annual	
Chinderah	153.55697696	-28.25421390		
Dallis Park 1	153.38540954	-28.35731310		destroyed
Dallis Park 2	153.38765808	-28.35549236	annual	destroyed
Daveys Island	153.51262113	-28.19657100		
Dulguigan	153.39191553	-28.29215774		destroyed
Ewingsdale*	153.56882600	-28.64225643	occasional	
Marshall's Creek*	153.54229873	-28.51132163	rare	
Mt. Warning	153.22971766	-28.41222173		
Myocum*	153.52836957	-28.59514080	occasional	
Ocean Shores*	153.54181915	-28.53145232	continuous	
Oxley Cove	153.54478683	-28.23259890	annual	
Pottsville	153.56435675	-28.38732598	occasional	
Stotts Island	153.49451901	-28.27250760		
Terania Creek	153.30588938	-28.58151815	annual	
Uki	153.33296557	-28.41485185	annual	
Canungra	153.18140995	-28.04106165	annual	
Cascade Gardens	153.42640843	-28.02046144	continuous	
Curumbin Valley	153.41712409	-28.18706508	occasional	
Helensvale	153.33381210	-27.90238861	continuous	
Mudgeeraba	153.36232828	-28.10712475	occasional	
Southport	153.41246259	-27.98051380	continuous	
Tallebudgera	153.44354369	-28.11586799	annual	

\* Indicates camps are within 10 kms of the subject site.



## **APPENDIX 3 FLORA ASSESSMENT**





## FLORA ASSESSMENT

### 1. Introduction

This section discusses the methods used in the vegetation assessment and presents the results of the assessment.

### 2. Methods

#### 2.1 NPWS Database Search

A search of the NPWS database was completed to find records of threatened plant species within 10 kms of the subject site.

#### 2.2 Literature Review

A number of other surveys have been completed in the locality, including a 1996 survey of the subject site by Woodward Clyde (**SECTION 1.3**). These reports were reviewed for records of threatened flora species.

#### 2.3 Site Survey

Initial site surveys were completed in September 2003 and January 2004. The site was traversed a number of times by foot by one scientist over a period of 8 hours and a general plant species list was compiled. Subsequent site visits were undertaken for cryptic orchid searches following a period of rain. Targeted searches were completed for all threatened flora species considered likely to occur on the site.

More recent visits to update vegetation communities and GPS potential habitat trees were undertaken in January, April and May 2009. During these visits one 10 x 10 m quadrat was placed in each community. All flora species within each quadrat was recorded and the structure of the vegetation described. This data was used to verify previous data collected and supplement where appropriate.

### 3. Results

#### 3.1 NPWS Database Search

A search of the NPWS Database revealed twenty-five (25) threatened flora species within 10 kms of the subject site (**TABLE 1**).

**TABLE 1**  
**NPWS DATABASE RECORDS OF THREATENED FLORA SPECIES WITHIN 10 KM**

Common Name	Botanical Name
Arrow-head vine	<i>Tinospora tinosporoides</i>
Ball nut	<i>Floydia praelta</i>
Basket fern	<i>Drynaria rigidula</i>
Brown fairy-chain orchid	<i>Peristeranthus hillii</i>
Corokia	<i>Corokia whiteana</i>
Crystal creek walnut	<i>Endiandra floydii</i>



## Appendices (Volume 2) - Bayside Brunswick

Common Name	Botanical Name
Davidson's plum	<i>Davidsonia jerseyana</i>
Durobby	<i>Syzygium moorei</i>
Green-leaved rose walnut	<i>Endiandra muelleri</i> subsp. <i>bracteata</i>
Hairy joint grass	<i>Arthraxon hispidus</i>
Hairy quandong	<i>Elaeocarpus williamsianus</i>
Marblewood	<i>Acacia bakeri</i>
Native justicia	<i>Calophanoides hygrophiloides</i>
Pink nodding orchid	<i>Geodorum densiflorum</i>
Queensland xylosma	<i>Xylosma terrae-reginae</i>
Rough-shelled bush nut	<i>Macadamia tetraphylla</i>
Rusty rose walnut	<i>Endiandra hayesii</i>
Scented acronychia	<i>Achronychia littoralis</i>
Slender marsdenia	<i>Marsdenia longilobis</i>
Spiny gardenia	<i>Randia moorei</i>
Stinking cryptocarya	<i>Cryptocarya foetida</i>
Sweet myrtle	<i>Austromyrtus fragrantissima</i>
White lace flower	<i>Archidendron hendersonii</i>
Yiel yiel	<i>Grevillia hilliana</i>

### 3.2 Threatened flora recorded from other sources

Numerous records of threatened flora exist from surveys completed within the locality (TABLE 2)<sup>3</sup>.

TABLE 2  
ADDITIONAL RECORDS OF THREATENED FLORA SPECIES WITHIN 5 KMS OF THE SUBJECT SITE

Common Name	Botanical Name
Rusty rose walnut	<i>Endiandra hayesii</i>
Basket fern	<i>Drynaria rigidula</i>
Corokia	<i>Corokia whiteana</i>
Rough-shelled Bush nut	<i>Macadamia tetraphylla</i>
Bush sauropus	<i>Souropus albiflorus</i> subsp. <i>microcladus</i>
Arrow-head vine	<i>Tinospora tinosporoides</i>
Red boppel nut	<i>Hicksbeachia pinnatifolia</i>
Ball nut	<i>Floydia praealta</i>
Green-leaved rose walnut	<i>Endiandra muelleri</i> subsp. <i>bracteata</i>
Crystal Creek Walnut	<i>Endiandra floydii</i>
Hairy quandong	<i>Elaeocarpus williamsianus</i>
Small-leaved tamarind	<i>Diploglottis campbellii</i>
Red-fruited ebony	<i>Diospyros mabacea</i>

<sup>3</sup> Sources include: Woodward-Clyde (1996); JWA Reports; NRAC study (1995); Landmark Byron Fauna Study (1999); and NPWS Wildlife Atlas.



### 3.3 Community descriptions

Seven (7) broad vegetation communities were recorded (**TABLE 3; FIGURE 9 - VOLUME 1**). A description of these communities is provided in the following sections. The descriptions follow Walker & Hopkins (1990). Their conservation status is discussed with reference to the Comprehensive Regional Assessment (CRA) 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 northeast 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.

A Byron Shire-based supplementary assessment was made using standard conservation assessments (Hager and Benson, Griffith etc.) in the Byron Shire Flora and Fauna Study (1999) providing descriptions and Conservation status of Plant communities and their listings within Byron Shire. These descriptions are utilised in the appraisal of the Conservation status of plant communities recorded on the subject site.

Three (3) Endangered Ecological Community (EECs) occurs on the site:

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.
- Swamp Oak Floodplain Forest.
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions.

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

Community	Description
<b>1</b>	<b>Swamp sclerophyll communities</b>
	1a Tall closed forest ( <i>Eucalyptus robusta</i> )
	1b Tall closed woodland ( <i>E. robusta</i> )
	1c Tall closed forest ( <i>Melaleuca quinquenervia</i> )
	1d Tall closed forest ( <i>E. signata</i> and <i>E. robusta</i> )
	1e Tall closed forest ( <i>E. robusta</i> and <i>M. quinquenervia</i> )
	1f Mid closed forest ( <i>E. robusta</i> and <i>M. quinquenervia</i> )
<b>2</b>	<b>Dry sclerophyll communities</b>
	2a Tall closed forest ( <i>E. signata</i> and <i>Endiandra sieberi</i> )
	2b Tall open forest ( <i>E. signata</i> , <i>Allocasuarina littoralis</i> and <i>Banksia aemula</i> )
<b>3</b>	<b>Heath communities</b>
	3a Tall closed heath ( <i>B. aemula</i> and <i>A. littoralis</i> )
	3b Low closed dry heath ( <i>Lepyrodia interrupta</i> and <i>Xanthorrhoea fulva</i> )
	3c Low closed wet heath ( <i>Monotoca elliptica</i> , <i>Caustis recurvata</i> and <i>Styphelia viridis</i> )
<b>4</b>	<b>Estuarine communities</b>



## Appendices (Volume 2) - Bayside Brunswick

	4a	Mid-high mid-dense forest ( <i>Avicennia marina</i> and <i>Aegiceras corniculatum</i> )
	4b	Mid-high forest ( <i>Casuarina glauca</i> and <i>M. quinquenervia</i> )
	4c	Closed rushland/fernland ( <i>Juncus kraussii</i> and <i>Acrostichum speciosum</i> )
5	Tall closed grassland ( <i>Andropogon virginicus</i> )	
7	Drainage lines	
6	Scattered trees ( <i>E. robusta</i> )	

### 3.4 Community 1 - Swamp sclerophyll communities

#### Community 1a - Tall closed forest (*Eucalyptus robusta*)

##### *Location and area*

This community occurs as a small patch in the south-western corner of the subject site and extends across the southern boundary.

##### *Description*

This community is dominated by Swamp mahogany, with scattered Paperbark occurring within the midstorey. Other midstorey species include Blueberry ash, Green styphelia, Satinwood and Tea-tree. The ground layer consists of Saw sedge, Swamp water fern, Bracken and some sedges. An area of Sphagnum moss, sedge and Swamp water fern occurs within this community.

##### *Conservation status*

This community is best classified as CRA RFA Forest Ecosystem community 142 (Swamp mahogany). The Regional Forestry Agreement document (CRA Unit 1999) provides the following data on this ecosystem:

- The pre 1750 area of this ecosystem was estimated to be approximately 699 hectares. 578 hectares (82%) remains.
- This ecosystem is listed as **Rare**.
- The extent present in the Comprehensive, Adequate and Representative (CAR) Reserve System has determined approximately 39.5 % of the remaining forest type is reserved within the CAR Reserve system. Approximately 25.7% is within dedicated reserves, 12.3% is within informal reserves and 1.4% is reserved in tabulated prescription reserves.
- Swamp mahogany communities have been identified as a high priority for conservation on private lands.

The Byron Shire Flora and Fauna Study (1999) describe this community as Swamp mahogany. In the Byron Shire, Swamp Mahogany forests occur mainly on aeolian sands with smaller areas mapped on metasediments and on alluvial soils.



The study (1999) lists the following data for this community:

- The area of this community remaining in Byron shire is estimated to be approximately 132.30 hectares, however this includes Swamp box community. This is estimated to constitute 35% of the Pre-1750 extent of this community type.
- This community is considered to be **inadequately conserved** north of the Evans River (Griffith 1993).
- A small area of this community is reserved in Billinudgel NR.

**This community is representative of the EEC Swamp Sclerophyll Forest on Coastal Floodplain and, by definition, is of State significance.**

Community 1 b - Tall closed woodland (*E. robusta*)

*Location and area*

This community occurs as a small patch in the north west of the site adjacent to a drainage line.

*Description*

This community consists of scattered Swamp mahogany adjacent to the drainline, along with the occasional Paperbark, Blueberry ash and Coast banksia. Midstorey elements (Green styphelia, Satinwood, Tea-tree) occur mostly around the bases of trees, as this community has been fragmented by slashing. The ground layer consists of Saw sedge, Bracken, Swamp water fern, Feather plant, Whiskey grass and Grass trees. Heath rush and Clubmosses occur in wetter parts of the community, particularly adjacent to the drain.

*Conservation status*

This community is best classified as CRA RFA Forest Ecosystem community 142 (Swamp mahogany). This Community is discussed for Community 1a.

The Byron Shire Flora and Fauna Study (1999) describe this community as Swamp mahogany. This Community is discussed for Community 1a.

**This community is representative of the EEC Swamp Sclerophyll Forest on Coastal Floodplain and, by definition, is of State significance.**

Community 1c - Tall closed forest (*Melaleuca quinquenervia*)

*Location and area*

This community occurs in two (2) main locations on the site:

- i. as a long strip between the site and the Pacific Highway in the west of the site, and
- ii. in the far east of the subject site occupying lowland between the Scribbly gum communities and the Mangrove complex that occurs on the Simpson's Creek estuary. The majority of this eastern Paperbark community occurs within the 7(b) zone, however there are some small areas that extend into the subject site.



### *Description*

The western community consists of Paperbark forest to approximately 18m in height. The occasional Swamp mahogany occurs along the northern and eastern margin of this community. The mid-storey is sparse and contains occasional Blueberry ash and Satinwood.

The understorey is tall (to 2m) and dense. It consists of Fox-tail sedges, Native ginger, Twigrush and an occasional Midgeberry. Batwing coral fern, Swamp water fern and Red-fruited saw sedges also occur. Common silkpod and Sweet smilax are common vines. A single King fern was recorded in this community.

The eastern portion of this community consists of two main contiguous clumps. The southern-most clump is relatively undisturbed, its canopy is dense and around 16m in height, consisting almost entirely of Broad-leaved paperbark. The mid-storey is relatively dense, and dominated by Blueberry ash and an occasional Satinwood. The understorey is dominated by Feather plant, Twigrush and Red-fruited saw sedge.

The northern clump is smaller in size, less mature and more open (although there is evidence of regrowth). The occasional Lemon-scented tea-tree and Swamp box occurs.

### *Conservation status*

This community type is best described by the CRA RFA Forest ecosystem type 112 (Paperbark). The Regional Forestry Agreement document (CRA Unit 1999) provides the following data on this ecosystem:

- The pre 1750 area of this ecosystem has not been calculated. The current area is calculated to be 28577 hectares.
- This ecosystem is listed as **Vulnerable**.
- The extent present in the Comprehensive, Adequate and Representative (CAR) Reserve System has not been determined. However, NPWS (1995) note that analogous communities have been reserved in a number of conservation areas in upper North East NSW.
- Paperbark communities have been identified as a high priority for conservation on private lands.

The Byron Shire Flora and Fauna Study (1999) describes this community as Paperbark. This community occurs on low-lying, regularly inundated acid peat areas of the region.

The study (1999) listed the following data for this community:

- The area of this community remaining in Byron shire is estimated to be 115.06 hectares, estimated to constitute 36% of the Pre-1750 extent.
- This community is considered to be adequately conserved (Hager and Benson 1994). However, the Paperbark - Bangalow palm complex was mapped in with this group, and is considered to be of Local Significance (Broadbent & Stewart 1986), limited in distribution to far north-eastern NSW (Harden 1991, 1993)
- A small area of this community is reserved in Billinudgel NR and Brunswick Heads NR.

**This community is representative of the EEC Swamp Sclerophyll Forest on Coastal Floodplain and, by definition, is of State significance.**



Community - 1d Tall closed forest (*E. signata* and *E. robusta*)

*Location and area*

This community occurs as a long narrow 'finger' extending in a roughly north-south direction, and is associated with a relatively deep (over 1m in places) wetland channel.

*Description*

This community is dominated by Swamp mahogany and Scribbly gums up to 22m in height. The mid-storey is varied from dense areas of Tea tree, to patchy areas of Blueberry ash, and occasional Satinwood.

The ground layer is generally dense and comprised of Saw sedge, along with some Swamp water fern and Feather plant. Dense areas of Pouched coral fern occur in the northern part of this community.

*Conservation status*

This community is best described as Forest ecosystem type 142 (Swamp mahogany). This community is discussed for Community 1a.

The Byron Shire Flora and Fauna Study (1999) describe this community as Swamp mahogany. This Community is discussed for Community 1a.

**This community is representative of the EEC Swamp Sclerophyll Forest on Coastal Floodplain and, by definition, is of State significance.**

Community - 1e Tall closed forest (*E. robusta* and *M. quinquenervia*)

*Location and area*

This community occurs along the eastern portion of the subject site, and occurs within lower-elevation areas.

*Description*

The occasional Scribbly gum and Swamp mahogany occur as emergents above a dense midstorey of Tea-tree (*L. petersonii*, *L. polygalifolium*) and some Broom heath. The occasional Blueberry ash and Satinwood occurs. Some Wallum banksias also occur. The ground layer consists of dense Saw sedge and some Swamp water fern, Common ground fern and sedges. In some areas closest to the north and near the 4wd track the mid-storey and ground cover have been slashed or are highly disturbed by human and vehicular traffic.

*Conservation status*

This complex contains elements of both CRA Forest Ecosystem 65 (Heathy Scribbly Gum) and Forest ecosystem 74 (Lowlands Scribbly Gum). The following data is available for these ecosystems:

Forest Ecosystem 65 (Heathy scribbly gum)



- The pre 1750 area of this ecosystem was estimated to be approximately 10544 hectares. 7758 hectares (73.6%) remains.
- This ecosystem is not considered Endangered, Vulnerable or Rare.
- The extent present in the Comprehensive, Adequate and Representative (CAR) Reserve System has determined approximately 39.9 % of the remaining forest type is reserved within the CAR Reserve system. Approximately 31.3% is within dedicated reserves, 5.8% is within informal reserves and 2.8% is reserved in tabulated prescription reserves.

#### Forest Ecosystem 74 (Lowlands Scribbly gum)

- The pre 1750 area of this ecosystem was estimated to be approximately 6783 hectares. 3496 hectares (51.5%) remains.
- This ecosystem is listed as **Vulnerable**.
- The extent present in the Comprehensive, Adequate and Representative (CAR) Reserve System has determined approximately 29.7 % of the remaining forest type is reserved within the CAR Reserve system. Approximately 26.4% is within dedicated reserves, 1.0% is within informal reserves and 2.3% is reserved in tabulated prescription reserves.
- Lowlands Scribbly gum communities have been identified as a high priority for conservation on private lands.

The Byron Shire Flora and Fauna Study (1999) describe this community as Wallum banksia-Scribbly gum.

The Wallum banksia-Scribbly gum community occurs on sand substrates, on coastal (Holocene) sands and on Pleistocene sands.

The study (1999) lists the following data for the Wallum Banksia-Scribbly Gum community:

- 67.16 hectares of this community remains in Byron shire. A pre-1750 estimate of this community has not been made.
- The regional conservation status is **unknown**.
- This community is reserved in small areas in Tyagarah NR and in Brunswick NR.

**This community is representative of the EEC Swamp Sclerophyll Forest on Coastal Floodplain and, by definition, is of State significance.**

#### Community 1f - Mid closed forest (*E. robusta* and *M. quinquenervia*)

##### *Location and area*

This community occurs as a small patch in the western portion of the site almost connecting a patch of community 1b and 1c.

##### *Description*

Swamp mahogany and Scribbly gum occur as emergents above a dense midstorey of Tea-tree and Paperbark and some Broom heath. The occasional Blueberry ash and Satinwood occurs. Some Wallum banksias are also present. The ground layer consists of dense Saw sedge and some Swamp water fern, Common ground fern and sedges. In some areas





closest to the north and near the 4wd track the mid-storey and ground cover have been slashed or are highly disturbed by human and vehicular traffic.

#### *Conservation status*

This complex contains elements of both CRA Forest Ecosystem 65 (Heathy Scribbly Gum) and Forest ecosystem 74 (Lowlands Scribbly Gum). The following data is available for these ecosystems:

##### Forest Ecosystem 65 (Heathy scribbly gum)

- The pre 1750 area of this ecosystem was estimated to be approximately 10544 hectares. 7758 hectares (73.6%) remains.
- This ecosystem is not considered Endangered, Vulnerable or Rare.
- The extent present in the Comprehensive, Adequate and Representative (CAR) Reserve System has determined approximately 39.9 % of the remaining forest type is reserved within the CAR Reserve system. Approximately 31.3% is within dedicated reserves, 5.8% is within informal reserves and 2.8% is reserved in tabulated prescription reserves.

##### Forest Ecosystem 74 (Lowlands Scribbly gum)

- The pre 1750 area of this ecosystem was estimated to be approximately 6783 hectares. 3496 hectares (51.5%) remains.
- This ecosystem is listed as **Vulnerable**.
- The extent present in the Comprehensive, Adequate and Representative (CAR) Reserve System has determined approximately 29.7 % of the remaining forest type is reserved within the CAR Reserve system. Approximately 26.4% is within dedicated reserves, 1.0% is within informal reserves and 2.3% is reserved in tabulated prescription reserves.
- Lowlands Scribbly gum communities have been identified as a high priority for conservation on private lands.

The Byron Shire Flora and Fauna Study (1999) describe this community as Wallum banksia-Scribbly gum.

The Wallum banksia-Scribbly gum community occurs on sand substrates, on coastal (Holocene) sands and on Pleistocene sands.

The study (1999) lists the following data for the Wallum Banksia-Scribbly Gum community:

- 67.16 hectares of this community remains in Byron shire. A pre-1750 estimate of this community has not been made.
- The regional conservation status is **unknown**.
- This community is reserved in small areas in Tyagarah NR and in Brunswick NR.

This community is representative of the EEC Swamp Sclerophyll Forest on Coastal Floodplain and, by definition, is of State significance.



### 3.5 Community 2 - Dry sclerophyll communities

#### Community 2a - Tall closed forest (*E. signata*, *Endiandra sieberi*, *Lophostemon confertus* and *E. intermedia*)

##### *Location and area*

This community occurs adjacent to Paperbark communities in the east of the subject site within the 7(b) zone.

##### *Description*

This community is co-dominated by Scribbly gum, Brushbox and Hard corkwood. The occasional Pink bloodwood also occurs. The midstorey is generally sparse, with Tea-tree (*Leptospermum polygalifolium*) and Blueberry ash commonly occurring. Other midstorey species include Beach acronychia, Denhamia, Mock olive, Coast banksia and Coast canthium.

The ground layer is relatively sparse and covered with a layer of leaf litter, however, Bracken, Feather plant, Spiny-headed matrush and Midyim occur occasionally. Smooth smilax is a common climber and is extremely dense in some parts of the midstorey.

##### *Conservation status*

The CRA classification most analogous to this community is Forest Ecosystem 74 (Lowlands Scribbly Gum), although it should be noted that the subject community has a more diverse canopy structure. This community is discussed for Community 1e.

The Byron Shire Flora and Fauna Study (1999) describe this community as Scribbly gum. This community was recorded mainly on rhyolitic soils with small areas recorded on basalt, metasediments and aeolian influenced soils. This community occurs on sand on the subject site.

The Byron Flora and Fauna study lists the following data for this community:

- The area of this community remaining in Byron shire is estimated to be 84.18 hectares, estimated to constitute 66% of the Pre-1750 extent.
- This community is considered to be well represented over parts of its range, but not in far north east NSW (Griffiths 1993).
- This community is reserved in the hinterland in Mt. Jerusalem NP and on the coast as small areas in Tyagarah NR and Brunswick NR.

This community is considered to have a moderate conservation value.

#### Community 2b - Tall open forest (*E. signata*, *Allocasuarina littoralis* and *Banksia aemula*)

##### *Location and area*

This community occurs as three fragmented patches to the east of the existing Crown Road, and further patch adjacent to the Paperbark swamp in the west of the site.



### *Description*

This community is dominated by Scribbly gum and Black she-oak in addition to Wallum banksias. Black she-oak is limited to the southern portion of this community. The midstorey consists of a variety of species including Broom heath, Tea-tree, Egg and bacon peas, Sweet wattle, Coast banksia, Spiny banksias and Prickly moses. The ground layer consists of Heath rush, Sedges, Spiny-headed matrush, Blue flax lily and Climbing guinea flower.

There are areas particularly to the south and immediate west of the 4WD track which have been slashed or are highly disturbed.

### *Conservation status*

This community is best described by CRA RFA Forest Ecosystem 65 (Heathy Scribbly Gum), described for Community 1e.

The conservation status of this community is relatively high in terms of species diversity and habitat. The level of disturbance is restricted to small areas within the community and the relatively undisturbed areas are dense and continuous (rather than fragmented).

The Byron Shire Flora and Fauna Study (1999) describe this community as Scribbly Gum and Wallum banksia-Scribbly gum. This community occurs on sand substrates, on coastal (Holocene) sands and on Pleistocene sands.

The study (1999) lists the following data for the Wallum Banksia-Scribbly Gum community:

- The area of this community remaining in Byron shire is estimated to be 67.16 hectares. A pre-1750 estimate of this community has not been made.
- The regional conservation status is unknown.
- This community is reserved in small areas in Tyagarah NR and in Brunswick NR.

This community is considered to have a moderate conservation value.

## **3.6 Community 3 - Heath communities**

### Community 3a - Tall closed heath (*B. aemula* and *A. littoralis*)

#### *Location and area*

This community occurs in the south east of the site adjacent to Simpson's Creek.

#### *Description*

This community is dominated by Tea-tree and Heath-leaved banksias, Coastal beard heath and Blueberry ash. The occasional immature Paperbark also occurs. Common understorey species include Feather plant, Red-fruited saw-sedge and grass trees.



### *Conservation status*

This community is best described as Non-forest Ecosystem 64 (Heath). The following data is available for this ecosystem:

- The pre 1750 area of this ecosystem has not been calculated. The current area is estimated to be approximately 9805 hectares. No reserved areas of Type 64 (Heath) have been calculated.
- This ecosystem is listed as **Vulnerable**.
- The extent present in the Comprehensive, Adequate and Representative (CAR) Reserve System has not been determined. However, NPWS (1995) note that analogous communities have been reserved in a number of conservation areas in upper North East NSW.
- Heath communities have been identified as a high priority for conservation on private lands.

The Byron Shire Flora and Fauna Study (1999) describes this community as Tea-tree. This community was mapped mainly on aolian/estuarine-alluvium soils with smaller areas being mapped on sand, rhyolite/basalt, sediments and metasediments.

The study (1999) lists the following data for the Tea-tree community:

- The area of this community remaining in Byron shire is estimated to be approximately 46.10 hectares. A pre-1750 estimate of this community has not been made.
- The regional conservation status of Teatree is unknown.
- Reserved in Billinudgel NR, Tyagarah NR, and Brunswick Heads NR.

This community is considered to have a moderate conservation value.

### Community 3b - Low closed dry heath (*Monotoca elliptica*, *Caustis recurvata* and *Styphelia viridis*)

#### *Location and area*

This community cover large areas of the central portion of the site.

#### *Description*

This community occurs as a low, dense ground cover consisting of a wide diversity of heath species, and is regularly slashed. Common species include Broom heath, Curly sedge, Green styphelia, Tea-tree, Prickly moses, Coast banksia, Baeckia, Grass tree, Heath rush, Saw sedge, Rice flower and Beard heath.

#### *Conservation status*

This community is best classified as RFA Non-forest ecosystem type 64 (Heath), and is discussed for Community 3a.

The Byron Shire Flora and Fauna Study (1999) describe this community as Wallum banksia or Heathland shrubland (with Coast banksia/ Wallum banksia/ Dwarf banksia). These communities were mapped mainly on sand substrates on coastal (Holocene) sands and on



## Appendices (Volume 2) - Bayside Brunswick

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Pleistocene sands. The associations were also mapped on metasediments with smaller areas recorded on sandstone and alluvium in Byron Shire.

The study (1999) listed the following data for the Wallum banksia/Dwarf banksia /Heath community:

- The area of this community remaining in Byron shire is estimated to be approximately 533.78 hectares.
- Only small areas are reserved, the regional conservation status is **unknown**.
- Small areas also occur on private lands along the Brunswick river and also west of Brunswick Heads along Marshalls Creek.
- A small area of this community is reserved in Brunswick River NR.

The conservation status of this community is reduced by the current management practice of regular slashing.

### Community 3c - Low closed wet heath (*Lepyrodia interrupta* and *Xanthorrhoea fulva*)

#### *Location and area*

This community occurs in low-lying areas throughout the central portion of the site.

#### *Description*

This community consists of slashed heath species with a few scattered trees (mainly Paperbark). Lowland wet areas are dominated by Heath rush, Twigrushes, sedges, Swamp Xanthorrhoea, Native lasiandra, Button grass, and low-nutrient bog plants such as Sundew, Native yam, Scrambling guinea flower, grass lilies and other forbs.

Slightly more elevated areas particularly toward the south of the Site are dominated by Rice flower, Zierias, stunted Geebung, Blue flax lily, some Bracken fern, Bottlebrush, Midgenberry, Pink beard heath and Spiny headed Matrush.

#### *Conservation status*

This community is best classified as RFA Non-forest ecosystem type 64 (Heath), and is discussed for Community 3a.

The Byron Shire Flora and Fauna Study (1999) describe this community as Wallum banksia or Heathland shrubland (with Coast banksia/ Wallum banksia/ Dwarf banksia). This is discussed for Community 3b.

The conservation status of this community is reduced by the current management practice of regular slashing.



### 3.7 Community 4 - Estuarine communities

#### Community 4a - Mid-high mid-dense forest (*Avicennia marina* and *Aegiceras corniculatum*)

##### *Location and area*

This community flanks the Simpson's Creek estuary to the north-east of the subject site, and occurs within the 7(b) zone.

##### *Description*

This community is dominated by Grey and River mangrove extending into the tidal zone of Simpsons Creek. Areas of Salt rush and Saltwater couch also occur.

##### *Conservation status*

Mangrove communities are classified by the CRA RFA (1999) as Non-forest ecosystem 77 (Mangrove). The following data is available for this ecosystem:

- The pre 1750 area of this ecosystem has not been calculated. The current area is estimated to be approximately 734 hectares. The reserved areas of Type 77 (Mangrove) have not been calculated.
- This ecosystem is listed as **Rare**.
- The extent present in the Comprehensive, Adequate and Representative (CAR) Reserve System has not been determined. However, NPWS (1995) note that analogous communities have been reserved in a number of conservation areas in upper North East NSW.
- Mangrove communities have been identified as a high priority for conservation on private lands.

The Byron Shire Flora and Fauna Study (1999) describe this community as Grey mangrove/River mangrove and Saltmarsh. Mangrove communities were mapped mainly on estuarine, alluvial and aolian influenced soils in Byron Shire, while Saltmarsh communities have not been assessed.

The study (1999) lists the following data for the Grey mangrove/River mangrove community:

- The area of this community remaining in Byron shire is estimated to be approximately 60.24 hectares. A pre-1750 estimate of this community has not been made.
- Only small areas are reserved, but Mangrove forest is reserved under SEPP 14 - Coast wetlands (Griffith 1993).
- A small area of this community is reserved in Brunswick River NR.

This community is considered to have a high conservation value.

#### Community 4b - Mid-high forest (*Casuarina glauca* and *M. quinquenervia*)

##### *Location and area*

This community occurs as small patch flanking the Simpson's Creek estuary to the north-east of the subject site, and occurs within the 7(b) zone.



*Description*

This community is dominated by *Casuarina glauca* with the presence of some Paperbarks.

*Conservation status*

There are no relevant classifications in the CRA RFA (1999) forest or non-forest community type classifications, or the Byron study (1999).

**This community is considered to be representative of the EEC Swamp Oak Floodplain Forest and, by definition, is of State significance.**

Community 4c - Closed rushland/fernland (*Juncus kraussii* and *Acrostichum speciosum*)

*Location and area*

This community occurs as two small patches, at the edge of the Mangrove forest, within the 7(b) zone.

*Description*

This community is dominated by Mangrove fern, with the presence of Crinum lily, Salt rush and Salt couch. At the time of the last survey (May 2009) this community was inundated with 2-3 inches of water.

*Conservation status*

There are no relevant classifications in the CRA RFA (1999) forest or non-forest community type classifications, or the Byron study (1999). The conservation status of this community is considered to be relatively low.

**This community is considered to be representative of the EEC Coastal Salt Marsh and, by definition, is of State significance.**

Community 5 - Tall closed grassland (*Andropogon virginicus*)

*Location and area*

This community occurs in the northern portion of the site adjacent to the residential development.

*Description*

This community is nearly completely dominated by Whiskey grass (up to 1 metre in height), although some Pigeon grass, Bracken, Mat rush and Saw sedge also occur. Several small 'islands' of vegetation occur within this community close to the Child care centre. These include Heath-leaved banksia, Satinwood, Blueberry ash, Narrow-leaved geebung, Sweet wattle and Black she-oak.



#### *Conservation status*

There are no relevant classifications in the CRA RFA (1999) forest or non-forest community type classifications, or the Byron study (1999). The conservation status of this community is considered to be relatively low.

#### Community 6 - Scattered trees

Scribbly gums occur throughout the central portion of the site, as single occurrences or as clumps with an undergrowth of grasses, *B. aemula* and Grass trees. The distribution of these trees has been maintained by the regime of slashing.

#### *Conservation status*

There are no relevant classifications in the CRA RFA (1999) forest or non-forest community type classifications, or the Byron study (1999). The conservation status of this community is considered to be relatively low.

This community is considered to have a moderate conservation value.

#### Community 7 - Drainage lines

##### *Location and area*

Several constructed drainage lines occur on the site, with a central drainage line running north south and another drainage line running east west.

##### *Description*

Drainage lines on the site maintain permanent (tannin-stained) freshwater and are poorly vegetated, with the occasional Water lilly, Water primrose and Pondweed occurring. Fringing vegetation includes Swamp water fern, Saw sedge, Pouched coral fern and Cyperus, while occasional scattered trees also occur, including immature Paperbark, Satinwood, Coast wattle and Heath-leaved banksias.

#### *Conservation status*

There are no relevant classifications in the CRA RFA (1999) forest or non-forest community type classifications, or the Byron study (1999).

The conservation status of drainage lines is relatively low due to the level of disturbance affecting this community, although these communities have a significant habitat value due to the occurrence of the threatened Wallum froglet.

### **3.8 Garden Weeds**

There is a small area of dense weed species in the far north-west corner of the site, adjacent to residences at the end of Kingsford Drive. This area contains some weed species which are highly invasive and listed on the Byron Shire Council Undesirable Trees List. These species include:





- Umbrella tree (*Schefflera actinophylla*<sup>4</sup>)
- Nasturtium (*Nasturtium* sp.)
- Camphor laurel (*Cinnamomum camphora*)
- Paspalum (*Paspalum* sp.)
- Happy plant (*Agave* sp.)
- Mickey mouse plant (*Ochna serrulata*)
- Aloe vera (*Aloe* sp.)
- Cocos palm (*Syagrus romanzoffiana*)
- Small-leaved privet (*Ligustrum sinense*)
- Cottoneaster (*Cottoneaster* sp.)
- Ground asparagus fern (*Asparagus aethiopicus*)
- Durlanta (*Durlanta* sp.)
- Mother of millions (*Bryophyllum* sp.)
- Groundsel (*Baccharis halimifolia*)
- Madeira vine (*Anredera cordifolia*)

### 3.9 Flora species list

In total 200 flora species were recorded at the subject site, including 164 native species and 36 weeds (**TABLE 4**). No threatened or ROTAP (Rare or Threatened Australian Plant, Briggs & Leigh 1995) species were observed. Ticks along side each species indicates the vegetation communities in which they were commonly observed. Species not ticked were incidental observations from the site (i.e. outside vegetation quadrats).

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<sup>4</sup> Native to north Queensland

**TABLE 4**  
**PLANT SPECIES LIST FOR EACH VEGETATION COMMUNITY**

Grouping/Family	Botanical Name	Common Name	Vegetation Communities																
			Swamp Sclerophyll						Dry Sclerophyll		Heath			Estuarine			Grasslands	Drainage	Scattered Trees
			1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	5	6	7
<b>Mosses</b>																			
Lycopodiaceae	<i>Lycopodiella cernua</i>						✓												
Sphagnaceae	<i>Sphagnum cuspidatum</i>		✓			✓	✓												
Selaginellaceae	<i>Selaginella</i> sp.	Selaginella																	
<b>Ferns and Fern Allies</b>																			
Adiantaceae	<i>Pellaea falcata</i>	Sickle fern			✓														
Blechnaceae	<i>Blechnum indicum</i>	Swamp water fern	✓			✓	✓		✓										
Osmundaceae	<i>Todea barbara</i>	King fern					✓												
Aspleniaceae	<i>Asplenium australasicum</i>	Bird's nest fern					✓												
Blechnaceae	<i>Blechnum cartilagineum</i>	Grissle fern								✓	✓								
Blechnaceae	<i>Blechnum minus</i>	Soft water fern																	
Cyatheaceae	<i>Cyathea</i> sp.	Tree fern																	
Davalliaceae	<i>Nephrolepis cordifolia</i> *	Fishbone fern																	
Dennstaedtiaceae	<i>Histiopteris incisa</i>	Batwing coral fern					✓												
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Bracken fern	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
Dicksoniaceae	<i>Calochlaena dubia</i>	Soft bracken					✓												
Gleicheniaceae	<i>Gleichenia dicarpa</i>	Pouched coral fern				✓	✓												
Polypodiaceae	<i>Platynerium superbum</i>	Staghorn					✓												
Polypodiaceae	<i>Platynerium bifurcatum</i>	Elkhorn fern																	

Grouping/Family	Botanical Name	Common Name	Vegetation Communities																
			Swamp Sclerophyll						Dry Sclerophyll		Heath			Estuarine			Grasslands	Drainage	Scattered Trees
			1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	5	6	7
Schizaeaceae	<i>Schizaea dichotoma</i>	Branched coral fern				✓													
Schizaeaceae	<i>Lygodium microphyllum</i>	Climbing fern				✓													
<b>Monocotyledons</b>																			
Agavaceae	<i>Agave</i> sp*																		
Agavaceae	<i>Dracaena fragrans</i> *	Happy plant																	
Agavaceae	<i>Sansevieria trifasciata</i> *	Mother-in-laws-tongue							✓	✓	✓								
Arecaceae	<i>Chrysanthemoides monilifera</i> *	Bitou bush																	
Arecaceae	<i>Livistona australis</i>	Cabbage palm																	
Asphodelaceae	<i>Aloe</i> sp.*	Aloe																	
Commelinaceae	<i>Archontophoenix cunninghamiana</i>	Bangalow palm																	
Commelinaceae	<i>Commelina cyanea</i>	Native wandering jew																	
Cyperaceae	<i>Baumea muelleri</i>																		
Cyperaceae	<i>Baumea juncea</i>		✓																
Cyperaceae	<i>Caustis recurvata</i>	Curly sedge	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cyperaceae	<i>Cyperus difformis</i>	Rice sedge	✓																
Cyperaceae	<i>Cyperus exaltatus</i>		✓																
Cyperaceae	<i>Gahnia clarkei</i>	Saw sedge	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cyperaceae	<i>Gahnia sieberiana</i>	Tall saw sedge	✓			✓				✓									
Cyperaceae	<i>Schoenus brevifolius</i>	Zig-zag bog rush																	
Dioscoraceae	<i>Dioscorea transversa</i>	Native yam																	

Grouping/Family	Botanical Name	Common Name	Vegetation Communities																
			Swamp Sclerophyll						Dry Sclerophyll		Heath			Estuarine			Grasslands	Drainage	Scattered Trees
			1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	5	6	7
Juncaceae	<i>Juncus kraussii</i>	Salt rush																	
Juncaceae	<i>Juncus usitatus</i>																		
Lomandraceae	<i>Lomandra laxa</i>																		
Lomandraceae	<i>Lomandra longifolia</i>	Long-leaved matrush				✓	✓		✓	✓									
Orchidaceae	<i>Cryptostylis erecta</i>					✓													
Orchidaceae	<i>Caladenia concinna</i>	Spider orchid																	
Orchidaceae	<i>Cymbidium madidum</i>				✓														
Orchidaceae	<i>Geodorum</i> sp.	Nodding orchard							✓										
Philydraceae	<i>Philydrum lanuginosum</i>	Frogsmouth																	
Phormiaceae	<i>Dianella caerulea</i>	Blue flax lily				✓				✓	✓	✓	✓						
Pittosporaceae	<i>Pittosporum revolutum</i>	Hairy pittosporum							✓										
Poaceae	<i>Andropogon virginicus</i> *	Whiskey grass				✓				✓		✓					✓	✓	✓
Poaceae	<i>Axonopus affinus</i> *	Narrow leafed carpet grass																	
Poaceae	<i>Cynodon dactylon</i>	Couch								✓	✓								
Poaceae	<i>Eleusine indica</i> *	Crowsfoot grass																	
Poaceae	<i>Entolasia marginata</i>									✓	✓								
Poaceae	<i>Eragrostis</i> sp.	Love grass																	
Poaceae	<i>Imperata cylindrica</i>	Bladey grass								✓									
Poaceae	<i>Melinis repens</i> *	Red natal grass																	
Poaceae	<i>Opismenus hirtellus</i> ssp. <i>imbecillis</i>	Basket grass																	

Grouping/Family	Botanical Name	Common Name	Vegetation Communities																
			Swamp Sclerophyll						Dry Sclerophyll		Heath			Estuarine			Grasslands	Drainage	Scattered Trees
			1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	5	6	7
Poaceae	<i>Paspalum wettsteinii</i> *	Broad leafed paspalum	✓	✓	✓	✓	✓	✓	✓	✓	✓								
Poaceae	<i>Pennisetum alopecuroides</i>	Swamp foxtail							✓										
Poaceae	<i>Phragmites australis</i>	Phragmites																	
Poaceae	<i>Setaria</i> sp.*	Pigeon grass																	
Poaceae	<i>Sporobolus virginicus</i>	Saltwater couch																	
Poaceae	<i>Themeda triandra</i>	Kangaroo grass																	
Restionaceae	<i>Baloskion tetraphyllum</i>	Feather plant				✓				✓		✓							
Restionaceae	<i>Empodisma minus</i>					✓													
Restionaceae	<i>Lepyrodia interrupta</i>	Heath rush																	
Restionaceae	<i>Baloskion pallens</i>					✓													
Restionaceae	<i>Sporadanthus interruptus</i>								✓		✓								
Smilacaceae	<i>Smilax australis</i>	Prickley smilax	✓	✓	✓	✓	✓	✓	✓	✓									
Smilacaceae	<i>Smilax glycyphylla</i>	Smooth smilax			✓														
Typhaceae	<i>Typha orientalis</i>	Broad-leaved cumbungi																	
Xanthorrhoeaceae	<i>Xanthorrhoea australis</i>	Grass tree				✓				✓	✓	✓	✓	✓					
Xanthorrhoeaceae	<i>Xanthorrhoea fulva</i>	Swamp grass tree							✓	✓			✓						
Xanthorrhoeaceae	<i>Xanthorrhoea johnsonii</i>	Grass tree								✓									
Zingiberaceae	<i>Alpinia caerulea</i>	Native ginger																	
Dicotyledons																			
Apiaceae	<i>Platysace ericoides</i>																		
Apocynaceae	<i>Parsonsia straminea</i>	Common silkpod	✓	✓	✓	✓	✓	✓	✓	✓									

Grouping/Family	Botanical Name	Common Name	Vegetation Communities																
			Swamp Sclerophyll						Dry Sclerophyll		Heath			Estuarine			Grasslands	Drainage	Scattered Trees
			1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	5	6	7
Apocynaceae	<i>Vinca minor</i> *	Periwinkle																	
Araliaceae	<i>Astrotricha longifolia</i>																		
Araliaceae	<i>Schefflera actinophylla</i> *	Umbrella tree																	
Areaceae	<i>Syagrus romanzoffiana</i> *	Cocos palm																	
Asteraceae	<i>Ageratina adenophora</i> *	Crofton weed																	✓
Asteraceae	<i>Ageratum houstonianum</i> *	Blue billygoat weed																	
Asteraceae	<i>Baccharis halimifolia</i> *	Groundsel																	
Asteraceae	<i>Taraxacum</i> sp.*	False dandelion																	
<i>Baeckea linifolia</i>	<i>Eugenia uniflora</i> *	Brazilian cherry																	
<i>Baeckea linifolia</i>	<i>Baeckea linifolia</i>	Weeping baeckea								✓									
Basellaceae	<i>Anredera cordifolia</i> *	Madeira vine																	
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga vine								✓									
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black she-oak				✓				✓	✓								
Casuarinaceae	<i>Casuarina glauca</i>	Swamp oak															✓		
Celastraceae	<i>Denhamia celastroides</i>	Denhamia							✓										
Convolvulaceae	<i>Ipomoea indica</i> *	Coastal morning glory																	
Crassulaceae	<i>Bryophyllum delagoense</i> *	Mother of millions																	
Cupressaceae	<i>Callitris columellaris</i>	Coastal cypress pine																	
Cyperaceae	<i>Scleria tricuspidata</i>					✓													
Dilleniaceae	<i>Hibbertia obtusifolia</i>										✓								
Dilleniaceae	<i>Hibbertia diffusa</i>									✓	✓								

Grouping/Family	Botanical Name	Common Name	Vegetation Communities																
			Swamp Sclerophyll						Dry Sclerophyll		Heath			Estuarine			Grasslands	Drainage	Scattered Trees
			1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	5	6	7
Dilleniaceae	<i>Hibbertia scandens</i>	Climbing guinea flower	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				
Droseraceae	<i>Drosera peltata</i>												✓						
Droseraceae	<i>Drosera sp.</i>												✓						
Droseraceae	<i>Drosera spathulata</i>												✓						
Ebenaceae	<i>Diospyros australis</i>	Black plum																	
Elaeocarpaceae	<i>Elaeocarpus reticulatus</i>	Blueberry ash	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
Elaeocarpaceae	<i>Tetradlea thymifolia</i>	Black-eyed susan				✓			✓	✓	✓	✓							
Epacridaceae	<i>Epacris microphylla</i>	Coral heath	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓		✓
Epacridaceae	<i>Melichrus procumbens</i>	Jam tarts																	
Epacridaceae	<i>Monotoca elliptica</i>	Broom heath																	
Epacridaceae	<i>Monotoca scoparia</i>	Prickly-leaved monotoca								✓									
Epacridaceae	<i>Styphelia viridis</i>	Green styphelia	✓																
Epacridaceae	<i>Trochocarpa laurina</i>	Tree heath							✓										
Epacridaceae	<i>Woollsia pungens</i>																		
Ericaceae	<i>Leucopogon lanceolatus</i>																		
Ericaceae	<i>Leucopogon ericoides</i>	Pink beard heath																	
Ericaceae	<i>Leucopogon parviflorus</i>	Coastal beard heath																	
Ericaceae	<i>Leucopogon pimeleoides</i>									✓									
Ericaceae	<i>Ricinus communis</i> *	Castor oil plant																	
Euphorbiaceae	<i>Chamaesyce hirta</i> *	Asthma plant/Sand spurge							✓	✓	✓	✓	✓						
Euphorbiaceae	<i>Macaranga tanarius</i>	Macaranga								✓	✓								

Grouping/Family	Botanical Name	Common Name	Vegetation Communities																
			Swamp Sclerophyll						Dry Sclerophyll		Heath			Estuarine			Grasslands	Drainage	Scattered Trees
			1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	5	6	7
Fabaceae	<i>Aotus ericoides</i>																		
Fabaceae	<i>Aotus lanigera</i>																		
Fabaceae	<i>Crotalaria incana</i> *	Woolly rattlepod																	
Fabaceae	<i>Dillwynia retorta</i>	Egg & bacon pea							✓	✓	✓	✓	✓						
Fabaceae	<i>Gompholobium latifolium</i>									✓	✓								
Fabaceae	<i>Hardenbergia violacea</i>	False sarsparilla																	
Fabaceae	<i>Jacksonia scoparia</i>	Dogwood				✓				✓									
Fabaceae	<i>Jacksonia stackhousei</i>	Wallum dogwood																	
Fabaceae	<i>Kennedia rubicunda</i>	Red coral pea								✓									
Fabaceae	<i>Oxylobium robustum</i>	Tree shaggy pea																	
Fabaceae	<i>Pultenaea retusa</i>	Blunt bush pea																	
Fabaceae	<i>Pultenaea villosa</i>																		
Haemodoraceae	<i>Haemodorum austroqueenslandicum</i>																		
Lauraceae	<i>Cassytha glabella</i>	Devil's twine								✓									
Lauraceae	<i>Cinnamomum camphora</i> *	Camphor laurel																	
Lauraceae	<i>Cryptocarya microneura</i>	Murrogan																	
Lauraceae	<i>Endiandra sieberi</i>	Hard corkwood				✓	✓			✓	✓	✓	✓				✓	✓	✓
Lobeliaceae	<i>Pratia purpurascens</i>	White root				✓													
Lycopodiaceae	<i>Lycopodiella cernua</i>																		
Malaceae	<i>Cotoneaster</i> sp.*	Cotoneaster																	



Grouping/Family	Botanical Name	Common Name	Vegetation Communities																
			Swamp Sclerophyll						Dry Sclerophyll		Heath			Estuarine			Grasslands	Drainage	Scattered Trees
			1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	5	6	7
Melastomataceae	<i>Melastoma affine</i>	Native lasiandra																	
Meliaceae	<i>Dysoxylum mollissimum</i> ssp. <i>molle</i>	Red bean								✓	✓								
Menispermaceae	<i>Sarcopetalum harveyanum</i>	Pearl vine																	
Menispermaceae	<i>Stephania japonica</i>	Snake vine																	
Mimosaceae	<i>Acacia melanoxylon</i>	Blackwood wattle																	
Mimosaceae	<i>Acacia obtusifolia</i>	Stiff-leaf wattle																	
Mimosaceae	<i>Acacia sophorae</i>	Coastal wattle																	
Mimosaceae	<i>Acacia suaveolens</i>	Sweet wattle	✓	✓	✓		✓	✓	✓	✓	✓								
Mimosaceae	<i>Acacia ulicifolia</i>	Prickly moses	✓	✓	✓		✓	✓	✓	✓	✓								
Myrsinaceae	<i>Rapanea howittiana</i>	Brush muttonwood																	
Myrsinaceae	<i>Rapanea variabilis</i>	Muttonwood																	
Myrtaceae	<i>Acmena smithii</i>	Common lilly pilly																	
Myrtaceae	<i>Austromyrtus dulcis</i>	Midgenberry	✓	✓	✓	✓	✓	✓	✓	✓							✓	✓	✓
Myrtaceae	<i>Baeckea frutescens</i>									✓									
Myrtaceae	<i>Baeckea virgata</i>																		
Myrtaceae	<i>Callistemon citrinus</i>	Crimson bottlebrush																	
Myrtaceae	<i>Corymbia intermedia</i>	Pink bloodwood																	
Myrtaceae	<i>Eucalyptus signata</i>	Scribbly gum	✓	✓	✓	✓	✓	✓	✓	✓	✓								✓
Myrtaceae	<i>Eucalyptus robusta</i>	Swamp mahogany	✓		✓	✓			✓	✓									
Myrtaceae	<i>Homoranthus virgatus</i>																		

Grouping/Family	Botanical Name	Common Name	Vegetation Communities																
			Swamp Sclerophyll						Dry Sclerophyll		Heath			Estuarine			Grasslands	Drainage	Scattered Trees
			1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	5	6	7
Myrtaceae	<i>Leptospermum juniperinum</i>									✓									
Myrtaceae	<i>Leptospermum liversidgei</i>	Lemon-scented teatree				✓				✓									
Myrtaceae	<i>Leptospermum polygalifolium</i>	Teatree				✓				✓									
Myrtaceae	<i>Lophostemon confertus</i>	Brushbox					✓		✓	✓	✓								
Myrtaceae	<i>Lophostemon suaveolens</i>	Swamp box								✓	✓								
Myrtaceae	<i>Melaleuca quinquenervia</i>	Broad-leaved paperbark	✓	✓	✓	✓	✓	✓	✓	✓	✓								
Myrtaceae	<i>Melaleuca sieberi</i>	Sieber's paperbark																	
Myrtaceae	<i>Syzygium oleosum</i>	Blue lilly pilly																	
Ochnaceae	<i>Ochna serrulata*</i>	Ochna																	
Oleaceae	<i>Ligustrum sinense*</i>	Small-leaved privet																	
Oleaceae	<i>Notelaea johnstoni</i>	Large mock olive							✓										
Passifloraceae	<i>Passiflora edulis*</i>	Passionfruit																	
Passifloraceae	<i>Passiflora foetida*</i>	White passionfruit																	
Poaceae	<i>Trifolium subterraneum*</i>									✓									
Proteaceae	<i>Banksia aemula</i>	Wallum banksia				✓			✓	✓	✓								
Proteaceae	<i>Banksia ericifolia</i>	Heath-leaved banksia																	
Proteaceae	<i>Banksia integrifolia</i>	Coast banksia		✓															✓
Proteaceae	<i>Banksia serrata</i>	Saw banksia																	
Proteaceae	<i>Banksia spinulosa</i> var. <i>spinulosa</i>																		

Grouping/Family	Botanical Name	Common Name	Vegetation Communities																
			Swamp Sclerophyll						Dry Sclerophyll		Heath			Estuarine			Grasslands	Drainage	Scattered Trees
			1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	5	6	7
Proteaceae	<i>Hakea</i> sp.	Hakea																	
Proteaceae	<i>Persoonia linearis</i>	Narrow-leaved Geebung																	
Proteaceae	<i>Persoonia stradbokensis</i>	Geebung				✓	✓		✓	✓	✓	✓							
Proteaceae	<i>Strangea linearis</i>																		
Rubiaceae	<i>Canthium coprosmoides</i>	Coast canthium																	
Rubiaceae	<i>Cyclophyllum longipetalum</i>	Coast canthium							✓										
Rutaceae	<i>Acronychia imperforata</i>	Beach acronychia							✓	✓									
Rutaceae	<i>Boronia rosmarinifolia</i>	Heath boronia																	
Rutaceae	<i>Phebalium squameum</i>	Satinwood	✓	✓	✓	✓	✓	✓	✓	✓	✓								
Rutaceae	<i>Zieria smithii</i>	Sandfly ziera							✓	✓	✓								
Santalaceae	<i>Exocarpos latifolius</i>	Broad-leaved Native Cherry																	
Santalaceae	<i>Leptomeria acida</i>	Currant bush								✓									
Sapindaceae	<i>Cupaniopsis anacardioides</i>	Tuckeroo	✓	✓	✓	✓	✓	✓	✓	✓							✓		✓
Sapindaceae	<i>Dodonaea triquetra</i>	Hopbush				✓			✓	✓									
Sapindaceae	<i>Guioa semiglauca</i>	Guioa							✓	✓									
Sapindaceae	<i>Jagera pseudorhus</i>	Foambark																	
Solanaceae	<i>Solanum capsicoides</i> *	Devil's apple																	
Thymelaeaceae	<i>Pimelea latifolia</i>	Rice flower								✓									
Tropaeolaceae	<i>Tropaeolum majus</i> *	Nasturtium																	
Verbenaceae	<i>Duranta erecta</i> *	Sky flower																	

Grouping/Family	Botanical Name	Common Name	Vegetation Communities																
			Swamp Sclerophyll						Dry Sclerophyll		Heath			Estuarine			Grasslands	Drainage	Scattered Trees
			1a	1b	1c	1d	1e	1f	2a	2b	3a	3b	3c	4a	4b	4c	5	6	7
Verbenaceae	<i>Lantana camara</i> *	Lantana																	
Viscaceae	<i>Notothixos</i> sp.	Mistletoe																	
Vitaceae	<i>Cissus hypoglauca</i>	Five-leaf water vine																	

\* Introduced Species

<sup>k</sup> Koala feed trees as listed in Schedule 2 of SEPP 44 Policy

## **APPENDIX 4 TREE SURVEY**

## TREE SURVEY

### 1. Introduction

This section describes the survey of significant trees.

### 2. Methods

A tree location survey was completed by LandPartners in May 2010. In accordance with the Byron Shire Council Tree Preservation Order, all trees above 10cm dbh<sup>5</sup> and/or 3 m in height on the subject site were located by survey (**FIGURE 11 - Volume 1**). Numbered metal tags were placed on all surveyed trees with the exception of tree numbers 738 to 745 (i.e. Melaleucas in swamp). Information was collected as follows:

- common name;
- tree number;
- dbh;
- height; and
- spread.

JWA subsequently collected the following information for each surveyed tree above 200 mm dbh:

- scientific name;
- whether Koala food tree species and/or evidence of scratches on trunk or scats at the base;
- whether Glossy black cockatoo food trees species and/or evidence of chewed cones at the base; and
- evidence of characteristics indicating tree is a ‘habitat tree’ such as:
  - hollows,
  - peeling or creviced bark,
  - wide spreading canopies providing abundant blossom or foliage,
  - epiphytic or parasitic growths, and
  - trees with large diameters and large heights in relation to surrounding trees.

The data collected was then used to assign a ‘significance ranking’ to all surveyed trees. The environmental attributes used to determine the ranking are provided in **TABLE 1**.

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<sup>5</sup> Diameter at breast height

**TABLE 1**  
**ENVIRONMENTAL ATTRIBUTES USED TO DETERMINE SIGNIFICANCE RANKING**

Conservation Significance Category	Significance Ranking	Environmental attributes
Very high	1	<ul style="list-style-type: none"> <li>• Old growth trees (i.e. &gt;900mm dbh<sup>6</sup>)</li> <li>• Trees forming part of an Endangered ecological community</li> </ul>
High	2	<ul style="list-style-type: none"> <li>• Habitat trees (i.e. trees with obvious hollows, fissures, nests etc.)</li> <li>• Preferred Koala food trees showing evidence of activity (i.e. scats)</li> <li>• Preferred Glossy black-cockatoo food trees showing evidence of activity (i.e. chewed cones)</li> </ul>
Moderate-High	3	<ul style="list-style-type: none"> <li>• Mature preferred Koala food tree species (i.e. &gt;300mm dbh) - no evidence of activity</li> <li>• Mature preferred Glossy black-cockatoo food trees (i.e. &gt;300mm dbh) - no evidence of activity</li> </ul>
Moderate	4	<ul style="list-style-type: none"> <li>• Immature/sub-mature preferred Koala food tree species (i.e. &lt;300mm dbh) - no evidence of activity</li> <li>• Immature/sub-mature preferred Glossy black-cockatoo food trees (i.e. &lt;300mm dbh) - no evidence of activity</li> </ul>
Low-Moderate	5	<ul style="list-style-type: none"> <li>• Mature native tree species (i.e. &gt;300mm dbh) not fulfilling any of the above criteria</li> </ul>
Low	6	<ul style="list-style-type: none"> <li>• Immature/sub-mature native tree species (i.e. &lt;300mm dbh) not fulfilling any of the above criteria</li> </ul>

### 3. Results

The following table sets out the trees surveyed, data used to assign significance ranking and the ranking (TABLE 2).

**TABLE 2**  
**DATA COLLECTED DURING ASSESSMENT OF TREE SIGNIFICANCE**

No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
1	<i>Eucalyptus signata</i>	1	15	5	1.1	Habitat tree + OLD GROWTH (>900mm)
12	<i>Eucalyptus signata</i>	1	15	5	1.3	Habitat tree + OLD GROWTH (>900mm)
67	<i>Eucalyptus signata</i>	1	15	3	1	Habitat tree + OLD GROWTH (>900mm)

<sup>6</sup> Diameter at breast height

No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
88	<i>Eucalyptus signata</i>	1	15	5	1.5	Habitat tree + OLD GROWTH (>900mm)
92	<i>Eucalyptus signata</i>	1	15	4	1.2	Habitat tree + OLD GROWTH (>900mm)
104	<i>Eucalyptus signata</i>	1	15	4	0.9	Habitat tree + OLD GROWTH (>900mm)
157	<i>Eucalyptus signata</i>	1	15	5	0.9	Habitat tree + OLD GROWTH (>900mm)
160	<i>Eucalyptus signata</i>	1	15	5	0.9	Habitat tree + OLD GROWTH (>900mm)
161	<i>Eucalyptus signata</i>	1	15	5	1	Habitat tree + OLD GROWTH (>900mm)
412	<i>Eucalyptus signata</i>	1	15	5	1.2	Habitat tree + OLD GROWTH (>900mm)
413	<i>Eucalyptus signata</i>	1	15	5	1.2	Habitat tree + OLD GROWTH (>900mm)
469	<i>Eucalyptus signata</i>	1	15	4	1.2	Habitat tree + OLD GROWTH (>900mm)
472	<i>Eucalyptus signata</i>	1	15	5	1.5	Habitat tree + OLD GROWTH (>900mm)
483	<i>Eucalyptus signata</i>	1	12	3	1	Habitat tree + OLD GROWTH (>900mm)
559	<i>Eucalyptus signata</i>	1	15	5	1.5	Habitat tree + OLD GROWTH (>900mm)
560	<i>Banksia aemula</i>	1	15	3	1.5	Habitat tree + OLD GROWTH (>900mm)
656	<i>Eucalyptus signata</i>	1	15	4	1.2	Habitat tree + OLD GROWTH (>900mm)
808	<i>Eucalyptus signata</i>	1	15	4	1	Habitat tree + OLD GROWTH (>900mm)
1027	<i>Eucalyptus signata</i>	1	14	2	1.2	Habitat tree + OLD GROWTH (>900mm)
114	<i>Eucalyptus signata</i>	1	15	5	1.2	OLD GROWTH (>900mm)
163	<i>Eucalyptus signata</i>	1	15	5	1.3	OLD GROWTH (>900mm)
225	<i>Eucalyptus signata</i>	1	10	5	0.9	OLD GROWTH (>900mm)
226	<i>Eucalyptus signata</i>	1	10	5	0.9	OLD GROWTH (>900mm)
414	<i>Eucalyptus signata</i>	1	15	4	0.9	OLD GROWTH (>900mm)
502	<i>Banksia aemula</i>	1	10	4	0.9	OLD GROWTH (>900mm)
543	<i>Banksia aemula</i>	1	15	4	1.1	OLD GROWTH (>900mm)
565	<i>Eucalyptus signata</i>	1	15	5	1.5	OLD GROWTH (>900mm)
575	<i>Banksia aemula</i>	1	15	3	1	OLD GROWTH (>900mm)
577	<i>Eucalyptus signata</i>	1	15	4	1	OLD GROWTH (>900mm)
626	<i>Eucalyptus signata</i>	1	15	5	1	OLD GROWTH (>900mm)
628	<i>Eucalyptus signata</i>	1	15	4	0.9	OLD GROWTH (>900mm)
636	<i>Banksia aemula</i>	1	15	4	0.9	OLD GROWTH (>900mm)
647	<i>Melaleuca quinquenervia</i>	1	15	5	1.5	OLD GROWTH (>900mm)
655	<i>Eucalyptus signata</i>	1	15	4	1	OLD GROWTH (>900mm)
657	<i>Eucalyptus signata</i>	1	15	4	1.2	OLD GROWTH (>900mm)
660	<i>Eucalyptus signata</i>	1	15	4	1	OLD GROWTH (>900mm)
664	<i>Eucalyptus signata</i>	1	15	2	1.5	OLD GROWTH (>900mm)
687	<i>Melaleuca quinquenervia</i>	1	15	3	1.1	OLD GROWTH (>900mm)
723	<i>Eucalyptus signata</i>	1	15	4	1.2	OLD GROWTH (>900mm)
727	<i>Eucalyptus signata</i>	1	15	4	1	OLD GROWTH (>900mm)
738	<i>Melaleuca quinquenervia</i>	1	15	4	1.2	OLD GROWTH (>900mm)
781	<i>Banksia aemula</i>	1	15	4	1	OLD GROWTH (>900mm)
802	<i>Eucalyptus signata</i>	1	12	2	1	OLD GROWTH (>900mm)



No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
807	<i>Eucalyptus signata</i>	1	15	5	1.5	OLD GROWTH (>900mm)
870	<i>Melaleuca quinquenervia</i>	1	15	4	1.2	OLD GROWTH (>900mm)
890	<i>Eucalyptus signata</i>	1	15	3	1	OLD GROWTH (>900mm)
921	<i>Banksia aemula</i>	1	12	3	1	OLD GROWTH (>900mm)
954	<i>Eucalyptus signata</i>	1	15	3	1	OLD GROWTH (>900mm)
955	<i>Eucalyptus signata</i>	1	15	3	1	OLD GROWTH (>900mm)
1038	<i>Eucalyptus signata</i>	1	15	3	1.2	OLD GROWTH (>900mm)
1042	<i>Eucalyptus signata</i>	1	15	3	1.2	OLD GROWTH (>900mm)
1045	<i>Melaleuca quinquenervia</i>	1	15	3	0.9	OLD GROWTH (>900mm)
1071	<i>Eucalyptus signata</i>	1	15	4	1.2	OLD GROWTH (>900mm)
1072	<i>Eucalyptus signata</i>	1	15	4	1	OLD GROWTH (>900mm)
1179	<i>Melaleuca quinquenervia</i>	1	15	2	1	OLD GROWTH (>900mm)
1262	<i>Melaleuca quinquenervia</i>	1	6	2	1	OLD GROWTH (>900mm)
15	<i>Eucalyptus robusta</i>	1	10	2	0.25	Primary Koala food tree
16	<i>Eucalyptus robusta</i>	1	10	2	0.4	Primary Koala food tree
21	<i>Eucalyptus robusta</i>	1	15	3	0.4	Primary Koala food tree
28	<i>Eucalyptus robusta</i>	1	15	4	0.5	Primary Koala food tree
32	<i>Eucalyptus robusta</i>	1	10	3	0.3	Primary Koala food tree
54	<i>Eucalyptus robusta</i>	1	10	3	0.3	Primary Koala food tree
62	<i>Eucalyptus robusta</i>	1	15	4	0.45	Primary Koala food tree
64	<i>Eucalyptus robusta</i>	1	15	3	0.5	Primary Koala food tree
176	<i>Eucalyptus robusta</i>	1	10	1	0.2	Primary Koala food tree
181	<i>Eucalyptus robusta</i>	1	10	3	0.4	Primary Koala food tree
188	<i>Eucalyptus robusta</i>	1	10	2	0.4	Primary Koala food tree
288	<i>Eucalyptus robusta</i>	1	15	2	0.4	Primary Koala food tree
289	<i>Eucalyptus robusta</i>	1	15	2	0.4	Primary Koala food tree
290	<i>Eucalyptus robusta</i>	1	15	1	0.2	Primary Koala food tree
293	<i>Eucalyptus robusta</i>	1	15	3	0.4	Primary Koala food tree
294	<i>Eucalyptus robusta</i>	1	15	2	0.3	Primary Koala food tree
295	<i>Eucalyptus robusta</i>	1	15	4	0.6	Primary Koala food tree
296	<i>Eucalyptus robusta</i>	1	15	2	0.35	Primary Koala food tree
454	<i>Eucalyptus robusta</i>	1	14	3	0.6	Primary Koala food tree
455	<i>Eucalyptus robusta</i>	1	14	3	0.5	Primary Koala food tree
456	<i>Eucalyptus robusta</i>	1	14	3	0.5	Primary Koala food tree
457	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
458	<i>Eucalyptus robusta</i>	1	6	2	0.4	Primary Koala food tree
686	<i>Eucalyptus robusta</i>	1	12	1	0.4	Primary Koala food tree
706	<i>Eucalyptus robusta</i>	1	10	1	0.3	Primary Koala food tree
707	<i>Eucalyptus robusta</i>	1	12	2	0.6	Primary Koala food tree
712	<i>Eucalyptus robusta</i>	1	10	1	0.3	Primary Koala food tree
716	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
717	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
724	<i>Eucalyptus robusta</i>	1	12	2	0.6	Primary Koala food tree
812	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
813	<i>Eucalyptus robusta</i>	1	10	2	0.3	Primary Koala food tree
814	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
816	<i>Eucalyptus robusta</i>	1	12	2	0.5	Primary Koala food tree
819	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
820	<i>Eucalyptus robusta</i>	1	5	1	0.3	Primary Koala food tree
822	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree

No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
823	<i>Eucalyptus robusta</i>	1	10	2	0.3	Primary Koala food tree
824	<i>Eucalyptus robusta</i>	1	10	2	0.3	Primary Koala food tree
825	<i>Eucalyptus robusta</i>	1	10	2	0.3	Primary Koala food tree
826	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
1219	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
1221	<i>Eucalyptus robusta</i>	1	14	2	0.6	Primary Koala food tree
1228	<i>Eucalyptus robusta</i>	1	10	2	0.25	Primary Koala food tree
1231	<i>Eucalyptus robusta</i>	1	10	2	0.25	Primary Koala food tree
1232	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
1233	<i>Eucalyptus robusta</i>	1	8	2	0.2	Primary Koala food tree
1237	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
1238	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
1239	<i>Eucalyptus robusta</i>	1	10	2	0.25	Primary Koala food tree
1246	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
1247	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
1248	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
1250	<i>Eucalyptus robusta</i>	1	10	2	0.25	Primary Koala food tree
1263	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
1264	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
1267	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree
1269	<i>Eucalyptus robusta</i>	1	10	2	0.3	Primary Koala food tree
666	<i>Eucalyptus robusta</i>	1	15	2	1.2	Primary Koala food tree + OLD GROWTH (>900mm)
809	<i>Eucalyptus robusta</i>	1	15	5	1.5	Primary Koala food tree + OLD GROWTH (>900mm)
810	<i>Eucalyptus robusta</i>	1	15	4	1	Primary Koala food tree + OLD GROWTH (>900mm)
988	<i>Eucalyptus robusta</i>	1	15	3	1	Primary Koala food tree + OLD GROWTH (>900mm)
159	<i>Eucalyptus robusta</i>	1	10	3	0.4	Primary Koala food tree + SCATS
29	<i>Melaleuca quinquenervia</i>	1	10	3	0.3	
33	<i>Melaleuca quinquenervia</i>	1	10	3	0.3	
43	<i>Melaleuca quinquenervia</i>	1	12	3	0.25	
50	<i>Melaleuca quinquenervia</i>	1	10		0.2	
52	<i>Melaleuca quinquenervia</i>	1	10	2	0.25	
56	<i>Melaleuca quinquenervia</i>	1	15	3	0.3	
57	<i>Melaleuca quinquenervia</i>	1	15	3	0.25	
59	<i>Melaleuca quinquenervia</i>	1	15	3	0.3	
166	<i>Melaleuca quinquenervia</i>	1	10	1	0.3	
168	<i>Melaleuca quinquenervia</i>	1	10	2	0.3	
173	<i>Melaleuca quinquenervia</i>	1	10	2	0.45	
175	<i>Melaleuca quinquenervia</i>	1	10	2	0.35	
183	<i>Leptospermum polygalifolium</i>	1	10	2	0.35	
185	<i>Melaleuca quinquenervia</i>	1	10	2	0.25	
192	<i>Melaleuca quinquenervia</i>	1	10	2	0.25	
195	<i>Melaleuca quinquenervia</i>	1	10	2	0.3	
668	<i>Leptospermum polygalifolium</i>	1	12	1	0.4	
671	<i>Leptospermum polygalifolium</i>	1	12	1	0.4	
682	<i>Melaleuca quinquenervia</i>	1	8	1	0.2	
714	<i>Melaleuca quinquenervia</i>	1	14	2	0.7	

No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
715	<i>Melaleuca quinquenervia</i>	1	8	1	0.2	
719	<i>Melaleuca quinquenervia</i>	1	10	2	0.3	
739	<i>Melaleuca quinquenervia</i>	1	8	1	0.2	
740	<i>Melaleuca quinquenervia</i>	1	8	1	0.2	
741	<i>Melaleuca quinquenervia</i>	1	8	1	0.2	
742	<i>Melaleuca quinquenervia</i>	1	8	1	0.2	
743	<i>Melaleuca quinquenervia</i>	1	8	1	0.2	
744	<i>Melaleuca quinquenervia</i>	1	8	1	0.2	
872	<i>Melaleuca quinquenervia</i>	1	3	1		
878	<i>Melaleuca quinquenervia</i>	1	12	2	0.6	
914	<i>Allocasuarina littoralis</i>	2	12	3	1	Glossy black-cockatoo food tree - MATURE + CHEWED CONES
66	<i>Eucalyptus signata</i>	2	15	3	0.8	Habitat tree
73	<i>Eucalyptus signata</i>	2	12	5	0.8	Habitat tree
74	<i>Eucalyptus signata</i>	2	12	5	0.7	Habitat tree
77	<i>Eucalyptus signata</i>	2	12	3	0.6	Habitat tree
89	<i>Eucalyptus signata</i>	2	15	3	0.4	Habitat tree
90	<i>Eucalyptus signata</i>	2	15	4	0.8	Habitat tree
98	<i>Eucalyptus signata</i>	2	15	3	0.8	Habitat tree
108	<i>Eucalyptus signata</i>	2	15	3	0.5	Habitat tree
109	<i>Eucalyptus signata</i>	2	15	3	0.5	Habitat tree
110	<i>Eucalyptus signata</i>	2	15	5	0.8	Habitat tree
291	<i>Eucalyptus signata</i>	2	15	2	0.35	Habitat tree
463	<i>Eucalyptus signata</i>	2	10	4	0.8	Habitat tree
480	<i>Eucalyptus signata</i>	2	10	4	0.8	Habitat tree
500	<i>Eucalyptus signata</i>	2	10	1	0.3	Habitat tree
535	<i>Eucalyptus signata</i>	2	10	2	0.3	Habitat tree
538	<i>Eucalyptus signata</i>	2	10	2	0.8	Habitat tree
546	<i>Eucalyptus signata</i>	2	5	2	0.4	Habitat tree
558	<i>Eucalyptus signata</i>	2	14	4	0.7	Habitat tree
562	<i>Banksia aemula</i>	2	10	2	0.8	Habitat tree
573	<i>Eucalyptus signata</i>	2	14	3	0.7	Habitat tree
574	<i>Eucalyptus signata</i>	2	14	3	0.7	Habitat tree
576	<i>Eucalyptus signata</i>	2	8	2	0.7	Habitat tree
644	<i>Eucalyptus signata</i>	2	12	3	0.5	Habitat tree
652	<i>Eucalyptus signata</i>	2	10	2	0.8	Habitat tree
654	<i>Eucalyptus signata</i>	2	12	2	0.4	Habitat tree
665	<i>Eucalyptus signata</i>	2	14	4	0.7	Habitat tree
722	<i>Eucalyptus signata</i>	2	12	2	0.4	Habitat tree
725	<i>Eucalyptus signata</i>	2	15	3	0.8	Habitat tree
750	<i>Eucalyptus signata</i>	2	8	1	0.2	Habitat tree
803	<i>Eucalyptus signata</i>	2	14	3	0.7	Habitat tree
805	<i>Eucalyptus signata</i>	2	14	2	0.6	Habitat tree
888	<i>Eucalyptus signata</i>	2	14	3	0.6	Habitat tree
903	<i>Eucalyptus signata</i>	2	10	1	0.3	Habitat tree
948	<i>Eucalyptus signata</i>	2	8	1	0.25	Habitat tree
952	<i>Eucalyptus signata</i>	2	15	3	0.8	Habitat tree
953	<i>Eucalyptus signata</i>	2	14	2	0.7	Habitat tree

No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
956	<i>Eucalyptus signata</i>	2	14	2	0.6	Habitat tree
977	<i>Eucalyptus signata</i>	2	15	3	0.9	Habitat tree
978	<i>Eucalyptus signata</i>	2	15	3	0.9	Habitat tree
989	<i>Eucalyptus signata</i>	2	14	3	0.7	Habitat tree
990	<i>Eucalyptus signata</i>	2	14	2	0.7	Habitat tree
1024	<i>Banksia aemula</i>	2	12	1	0.4	Habitat tree
1029	<i>Eucalyptus signata</i>	2	15	3	0.8	Habitat tree
235	<i>Eucalyptus robusta</i>	2	10	3	0.7	Primary Koala food tree + SCATS
602	<i>Allocasuarina littoralis</i>	3	12	2	0.4	Glossy black-cockatoo food tree
608	<i>Allocasuarina littoralis</i>	3	12	2	0.4	Glossy black-cockatoo food tree
611	<i>Allocasuarina littoralis</i>	3	10	2	0.3	Glossy black-cockatoo food tree
612	<i>Allocasuarina littoralis</i>	3	10	1	0.3	Glossy black-cockatoo food tree
619	<i>Allocasuarina littoralis</i>	3	14	2	0.6	Glossy black-cockatoo food tree
620	<i>Allocasuarina littoralis</i>	3	10	1	0.3	Glossy black-cockatoo food tree
622	<i>Allocasuarina littoralis</i>	3	10	1	0.3	Glossy black-cockatoo food tree
1177	<i>Allocasuarina littoralis</i>	3	10	1	0.3	Glossy black-cockatoo food tree
511	<i>Allocasuarina littoralis</i>	3	4	1	0.4	Glossy black-cockatoo food tree - MATURE
641	<i>Allocasuarina littoralis</i>	3	8	1	0.7	Glossy black-cockatoo food tree - MATURE
764	<i>Allocasuarina littoralis</i>	3	10	2	0.3	Glossy black-cockatoo food tree - MATURE
830	<i>Allocasuarina littoralis</i>	3	12	2	0.5	Glossy black-cockatoo food tree - MATURE
832	<i>Allocasuarina littoralis</i>	3	5	1	0.3	Glossy black-cockatoo food tree - MATURE
833	<i>Allocasuarina littoralis</i>	3	15	2	0.7	Glossy black-cockatoo food tree - MATURE
835	<i>Allocasuarina littoralis</i>	3	12	2	0.5	Glossy black-cockatoo food tree - MATURE
837	<i>Allocasuarina littoralis</i>	3	8	2	0.6	Glossy black-cockatoo food tree - MATURE
840	<i>Allocasuarina littoralis</i>	3	14	2	1.2	Glossy black-cockatoo food tree - MATURE
850	<i>Allocasuarina littoralis</i>	3	10	2	0.4	Glossy black-cockatoo food tree - MATURE
857	<i>Allocasuarina littoralis</i>	3	10	2	0.8	Glossy black-cockatoo food tree - MATURE
859	<i>Allocasuarina littoralis</i>	3	12	2	0.5	Glossy black-cockatoo food tree - MATURE
860	<i>Allocasuarina littoralis</i>	3	10	2	0.8	Glossy black-cockatoo food tree - MATURE
917	<i>Allocasuarina littoralis</i>	3	12	3	1	Glossy black-cockatoo food tree - MATURE
926	<i>Allocasuarina littoralis</i>	3	12	3	1	Glossy black-cockatoo food tree - MATURE
20	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree
22	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree
23	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree
162	<i>Eucalyptus robusta</i>	3	10	3	0.5	Primary Koala food tree

No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
220	<i>Eucalyptus robusta</i>	3	10	1	0.25	Primary Koala food tree
243	<i>Eucalyptus robusta</i>	3	12	1	0.45	Primary Koala food tree
244	<i>Eucalyptus robusta</i>	3	12	2	0.45	Primary Koala food tree
245	<i>Eucalyptus robusta</i>	3	12	1	0.3	Primary Koala food tree
255	<i>Eucalyptus robusta</i>	3	15	3	0.5	Primary Koala food tree
264	<i>Eucalyptus robusta</i>	3	10	2	0.3	Primary Koala food tree
272	<i>Eucalyptus robusta</i>	3	15	3	0.6	Primary Koala food tree
275	<i>Eucalyptus robusta</i>	3	15	3	0.6	Primary Koala food tree
276	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree
278	<i>Eucalyptus robusta</i>	3	15	3	0.5	Primary Koala food tree
279	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree
280	<i>Eucalyptus robusta</i>	3	15	2	0.3	Primary Koala food tree
281	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree
282	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree
284	<i>Eucalyptus robusta</i>	3	15	5	0.8	Primary Koala food tree
286	<i>Eucalyptus robusta</i>	3	15	2	0.3	Primary Koala food tree
298	<i>Eucalyptus robusta</i>	3	15	3	0.6	Primary Koala food tree
300	<i>Eucalyptus robusta</i>	3	15	2	0.3	Primary Koala food tree
302	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree
303	<i>Eucalyptus robusta</i>	3	15	2	0.3	Primary Koala food tree
304	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree
313	<i>Eucalyptus robusta</i>	3	15	1	0.35	Primary Koala food tree
314	<i>Eucalyptus robusta</i>	3	15	3	0.5	Primary Koala food tree
315	<i>Eucalyptus robusta</i>	3	15	3	0.35	Primary Koala food tree
317	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree
323	<i>Eucalyptus robusta</i>	3	15	1	0.5	Primary Koala food tree
328	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree
329	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree
333	<i>Eucalyptus robusta</i>	3	15	3	0.5	Primary Koala food tree
336	<i>Eucalyptus robusta</i>	3	10	1	0.8	Primary Koala food tree
357	<i>Eucalyptus robusta</i>	3	10	2	0.35	Primary Koala food tree
363	<i>Eucalyptus robusta</i>	3	10	4	0.7	Primary Koala food tree
364	<i>Eucalyptus robusta</i>	3	10	2	0.4	Primary Koala food tree
365	<i>Eucalyptus robusta</i>	3	15	4	0.7	Primary Koala food tree
366	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree
372	<i>Eucalyptus robusta</i>	3	15	3	0.5	Primary Koala food tree
373	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree
385	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree
386	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree
392	<i>Eucalyptus robusta</i>	3	15	2	0.5	Primary Koala food tree
402	<i>Eucalyptus robusta</i>	3	14	4	0.8	Primary Koala food tree
405	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree
423	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree
430	<i>Eucalyptus robusta</i>	3	10	1	0.3	Primary Koala food tree
442	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree
443	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree
444	<i>Eucalyptus robusta</i>	3	14	2	0.5	Primary Koala food tree
460	<i>Eucalyptus robusta</i>	3	10	1	0.3	Primary Koala food tree
482	<i>Eucalyptus robusta</i>	3	10	1	0.25	Primary Koala food tree
552	<i>Eucalyptus robusta</i>	3	15	4	0.8	Primary Koala food tree

No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
553	<i>Eucalyptus robusta</i>	3	15	3	0.8	Primary Koala food tree
554	<i>Eucalyptus robusta</i>	3	15	3	0.8	Primary Koala food tree
568	<i>Eucalyptus robusta</i>	3	6	2	0.5	Primary Koala food tree
579	<i>Eucalyptus robusta</i>	3	15	3	0.8	Primary Koala food tree
580	<i>Eucalyptus robusta</i>	3	10	2	0.3	Primary Koala food tree
634	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree
1160	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree
1161	<i>Eucalyptus robusta</i>	3	14	3	0.7	Primary Koala food tree
1162	<i>Eucalyptus robusta</i>	3	12	2	0.5	Primary Koala food tree
1206	<i>Eucalyptus robusta</i>	3	6	1	0.4	Primary Koala food tree
1207	<i>Eucalyptus robusta</i>	3	12	2	0.5	Primary Koala food tree
1208	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree
1212	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree
1256	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree
1266	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree
841	<i>Allocasuarina littoralis</i>	3	10	2	0.8	
842	<i>Allocasuarina littoralis</i>	3	10	2	0.8	
906	<i>Allocasuarina littoralis</i>	3	15	2	0.8	
910	<i>Allocasuarina littoralis</i>	3	14	2	0.6	
913	<i>Allocasuarina littoralis</i>	3	12	2	0.5	
916	<i>Allocasuarina littoralis</i>	3	10	1	0.4	
931	<i>Allocasuarina littoralis</i>	3	8	2	0.6	
939	<i>Allocasuarina littoralis</i>	3	15	3	0.8	
942	<i>Allocasuarina littoralis</i>	3	10	2	0.3	
24	<i>Eucalyptus robusta</i>	4	10	3	0.25	Primary Koala food tree
241	<i>Eucalyptus robusta</i>	4	12	2	0.25	Primary Koala food tree
257	<i>Eucalyptus robusta</i>	4	15	2	0.2	Primary Koala food tree
919	<i>Allocasuarina littoralis</i>	4	8	1	0.25	
868	<i>Eucalyptus signata</i>	5	14	4	0.8	Habitat tree
2	<i>Eucalyptus signata</i>	5	15	4	0.5	
3	<i>Eucalyptus signata</i>	5	12	4	0.35	
4	<i>Eucalyptus signata</i>	5	12	4	0.4	
5	<i>Banksia aemula</i>	5	5	3	0.4	
6	<i>Eucalyptus signata</i>	5	12	4	0.4	
7	<i>Eucalyptus signata</i>	5	15	4	0.6	
9	<i>Eucalyptus signata</i>	5	10	3	0.3	
10	<i>Eucalyptus signata</i>	5	15	5	0.7	
13	<i>Eucalyptus signata</i>	5	15	4	0.5	
17	<i>Eucalyptus signata</i>	5	12	2	0.35	
45	<i>Eucalyptus signata</i>	5	10	4	0.45	
61	<i>Lophostemon suaveolens</i>	5	15	4	0.5	
65	<i>Eucalyptus signata</i>	5	15	5	0.6	
72	<i>Eucalyptus signata</i>	5	12	4	0.5	
78	<i>Melaleuca quinquenervia</i>	5	12	2	0.5	
86	<i>Melaleuca quinquenervia</i>	5	8	2	0.35	
91	<i>Eucalyptus signata</i>	5	15	4	0.8	
93	<i>Eucalyptus signata</i>	5	15	3	0.8	
94	<i>Eucalyptus signata</i>	5	10	3	0.5	
95	<i>Eucalyptus signata</i>	5	10	3	0.5	
96	<i>Eucalyptus signata</i>	5	10	3	0.4	

No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
97	<i>Eucalyptus signata</i>	5	10	4	0.5	
99	<i>Eucalyptus signata</i>	5	15	3	0.8	
100	<i>Eucalyptus signata</i>	5	15	3	0.5	
101	<i>Eucalyptus signata</i>	5	15	3	0.5	
102	<i>Eucalyptus signata</i>	5	15	3	0.5	
103	<i>Eucalyptus signata</i>	5	15	3	0.5	
105	<i>Eucalyptus signata</i>	5	15	3	0.5	
106	<i>Eucalyptus signata</i>	5	15	4	0.8	
107	<i>Eucalyptus signata</i>	5	15	3	0.5	
113	<i>Eucalyptus signata</i>	5	15	5	0.7	
116	<i>Eucalyptus signata</i>	5	15	5	0.8	
123	<i>Eucalyptus signata</i>	5	10	3	0.5	
125	<i>Melaleuca quinquenervia</i>	5	10	2	0.4	
127	<i>Melaleuca quinquenervia</i>	5	10	2	0.3	
128	<i>Melaleuca quinquenervia</i>	5	10	2	0.3	
135	<i>Melaleuca quinquenervia</i>	5	10	2	0.3	
140	<i>Melaleuca quinquenervia</i>	5	10	2	0.3	
142	<i>Melaleuca quinquenervia</i>	5	10	2	0.3	
143	<i>Melaleuca quinquenervia</i>	5	10	3	0.5	
146	<i>Melaleuca quinquenervia</i>	5	10	4	0.9	
158	<i>Eucalyptus signata</i>	5	10	3	0.4	
198	<i>Eucalyptus signata</i>	5	10	5	0.65	
223	<i>Eucalyptus signata</i>	5	10	3	0.3	
227	<i>Banksia aemula</i>	5	10	2	0.45	
239	<i>Eucalyptus signata</i>	5	15	3	0.7	
240	<i>Eucalyptus signata</i>	5	15	3	0.7	
250	<i>Acacia melanoxydon</i>	5	10	3	0.5	
312	<i>Eucalyptus signata</i>	5	15	2	0.35	
338	<i>Melaleuca quinquenervia</i>	5	10	2	0.4	
345	<i>Melaleuca quinquenervia</i>	5	10	2	0.4	
349	<i>Melaleuca quinquenervia</i>	5	10	1	0.4	
351	<i>Melaleuca quinquenervia</i>	5	10	2	0.5	
352	<i>Melaleuca quinquenervia</i>	5	10	2	0.4	
356	<i>Melaleuca quinquenervia</i>	5	10	2	0.6	
359	<i>Melaleuca quinquenervia</i>	5	10	2	0.4	
374	<i>Melaleuca quinquenervia</i>	5	15	2	0.4	
387	<i>Melaleuca quinquenervia</i>	5	15	2	0.4	
388	<i>Melaleuca quinquenervia</i>	5	15	2	0.4	
403	<i>Melaleuca quinquenervia</i>	5	14	2	0.8	
404	<i>Melaleuca quinquenervia</i>	5	12	1	0.4	
432	<i>Melaleuca quinquenervia</i>	5	10	2	0.3	
434	<i>Eucalyptus signata</i>	5	12	3	0.5	
435	<i>Melaleuca quinquenervia</i>	5	14	2	0.5	
439	<i>Melaleuca quinquenervia</i>	5	15	1	0.8	
452	<i>Eucalyptus signata</i>	5	14	3	0.5	
461	<i>Eucalyptus signata</i>	5	15	4	0.8	
464	<i>Banksia aemula</i>	5	4	1	0.3	
465	<i>Banksia aemula</i>	5	5	1	0.4	
466	<i>Banksia aemula</i>	5	5	1	0.4	
467	<i>Banksia aemula</i>	5	5	1	0.4	

No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
468	<i>Banksia aemula</i>	5	10	1	0.3	
470	<i>Banksia aemula</i>	5	5	1	0.4	
471	<i>Banksia aemula</i>	5	12	1	0.4	
473	<i>Banksia aemula</i>	5	5	1	0.4	
474	<i>Banksia aemula</i>	5	4	1	0.3	
475	<i>Banksia aemula</i>	5	6	2	0.5	
476	<i>Banksia aemula</i>	5	5	1	0.4	
477	<i>Banksia aemula</i>	5	5	1	0.4	
478	<i>Banksia aemula</i>	5	6	2	0.5	
479	<i>Banksia aemula</i>	5	12	1	0.4	
481	<i>Banksia aemula</i>	5	12	2	0.4	
484	<i>Banksia aemula</i>	5	4	1	0.3	
485	<i>Banksia aemula</i>	5	5	1	0.4	
486	<i>Banksia aemula</i>	5	6	1	0.3	
490	<i>Banksia aemula</i>	5	4	1	0.3	
493	<i>Banksia aemula</i>	5	4	1	0.3	
495	<i>Banksia aemula</i>	5	4	1	0.3	
496	<i>Banksia aemula</i>	5	6	1	0.5	
497	<i>Eucalyptus signata</i>	5	10	1	0.3	
498	<i>Banksia aemula</i>	5	6	2	0.5	
499	<i>Banksia aemula</i>	5	5	2	0.4	
503	<i>Eucalyptus signata</i>	5	12	1	0.4	
504	<i>Eucalyptus signata</i>	5	10	1	0.3	
505	<i>Banksia aemula</i>	5	4	1	0.3	
506	<i>Banksia aemula</i>	5	6	2	0.5	
507	<i>Banksia aemula</i>	5	5	2	0.4	
508	<i>Banksia aemula</i>	5	5	2	0.4	
510	<i>Eucalyptus signata</i>	5	5	2	0.4	
512	<i>Eucalyptus signata</i>	5	12	1	0.4	
513	<i>Banksia aemula</i>	5	4	2	0.3	
514	<i>Eucalyptus signata</i>	5	10	2	0.3	
515	<i>Eucalyptus signata</i>	5	12	2	0.4	
518	<i>Eucalyptus signata</i>	5	10	2	0.3	
525	<i>Eucalyptus signata</i>	5	10	2	0.3	
526	<i>Eucalyptus signata</i>	5	10	2	0.3	
527	<i>Eucalyptus signata</i>	5	10	2	0.3	
529	<i>Banksia aemula</i>	5	10	2	0.3	
531	<i>Eucalyptus signata</i>	5	4	2	0.3	
532	<i>Eucalyptus signata</i>	5	12	2	0.4	
533	<i>Eucalyptus signata</i>	5	12	2	0.4	
534	<i>Eucalyptus signata</i>	5	10	2	0.3	
536	<i>Eucalyptus signata</i>	5	15	4	0.8	
537	<i>Banksia aemula</i>	5	12	2	0.4	
547	<i>Eucalyptus signata</i>	5	15	4	0.8	
555	<i>Eucalyptus signata</i>	5	12	2	0.4	
556	<i>Eucalyptus signata</i>	5	14	3	0.6	
557	<i>Eucalyptus signata</i>	5	14	3	0.5	
561	<i>Banksia aemula</i>	5	10	2	0.8	
563	<i>Banksia aemula</i>	5	8	2	0.7	
564	<i>Eucalyptus signata</i>	5	8	2	0.6	



No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
566	<i>Banksia aemula</i>	5	15	3	0.8	
567	<i>Banksia aemula</i>	5	6	2	0.5	
570	<i>Eucalyptus signata</i>	5	12	2	0.4	
571	<i>Eucalyptus signata</i>	5	14	3	0.7	
572	<i>Eucalyptus signata</i>	5	10	2	0.3	
578	<i>Eucalyptus signata</i>	5	15	3	0.8	
601	<i>Melaleuca quinquenervia</i>	5	12	2	0.4	
603	<i>Melaleuca quinquenervia</i>	5	4	1	0.4	
605	<i>Eucalyptus signata</i>	5	12	2	0.4	
609	<i>Melaleuca quinquenervia</i>	5	10	2	0.3	
610	<i>Melaleuca quinquenervia</i>	5	12	2	0.4	
623	<i>Eucalyptus signata</i>	5	12	2	0.5	
624	<i>Melaleuca quinquenervia</i>	5	15	3	0.7	
625	<i>Eucalyptus signata</i>	5	13	2	0.5	
627	<i>Eucalyptus signata</i>	5	14	3	0.6	
629	<i>Eucalyptus signata</i>	5	14	4	0.7	
630	<i>Eucalyptus signata</i>	5	15	4	0.8	
631	<i>Eucalyptus signata</i>	5	14	4	0.7	
632	<i>Eucalyptus signata</i>	5	14	3	0.6	
633	<i>Eucalyptus signata</i>	5	14	3	0.6	
635	<i>Eucalyptus signata</i>	5	12	2	0.4	
637	<i>Banksia aemula</i>	5	8	3	0.7	
642	<i>Banksia aemula</i>	5	10	1	0.4	
643	<i>Eucalyptus signata</i>	5	8	2	0.6	
649	<i>Banksia aemula</i>	5	12	2	0.4	
650	<i>Banksia aemula</i>	5	8	2	0.7	
651	<i>Banksia aemula</i>	5	8	2	0.7	
653	<i>Eucalyptus signata</i>	5	15	3	0.8	
658	<i>Eucalyptus signata</i>	5	12	2	0.4	
659	<i>Eucalyptus signata</i>	5	15	4	0.7	
662	<i>Eucalyptus signata</i>	5	15	1	0.8	
720	<i>Eucalyptus signata</i>	5	10	2	0.3	
721	<i>Eucalyptus signata</i>	5	12	2	0.4	
728	<i>Eucalyptus signata</i>	5	12	2	0.4	
737	<i>Eucalyptus signata</i>	5	14	2	0.5	
746	<i>Eucalyptus signata</i>	5	8	1	0.2	
749	<i>Eucalyptus signata</i>	5	14	2	0.6	
751	<i>Eucalyptus signata</i>	5	14	3	0.8	
753	<i>Eucalyptus signata</i>	5	14	3	0.8	
761	<i>Banksia aemula</i>	5	14	2	0.6	
765	<i>Banksia aemula</i>	5	10	2	0.8	
767	<i>Eucalyptus signata</i>	5	10	1	0.4	
772	<i>Banksia aemula</i>	5	5	1	0.3	
774	<i>Banksia aemula</i>	5	12	2	0.4	
775	<i>Banksia aemula</i>	5	5	1	0.3	
777	<i>Eucalyptus signata</i>	5	8	2	0.6	
779	<i>Eucalyptus signata</i>	5	10	2	0.9	
782	<i>Banksia aemula</i>	5	10	2	0.8	
784	<i>Banksia aemula</i>	5	10	2	0.8	
791	<i>Banksia aemula</i>	5	10	2	0.8	

No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
792	<i>Eucalyptus signata</i>	5	4	1	0.3	
793	<i>Eucalyptus signata</i>	5	8	2	0.7	
794	<i>Eucalyptus signata</i>	5	15	3	0.8	
795	<i>Eucalyptus signata</i>	5	14	2	0.5	
796	<i>Eucalyptus signata</i>	5	15	2	0.7	
797	<i>Eucalyptus signata</i>	5	14	2	0.6	
798	<i>Banksia aemula</i>	5	14	3	0.7	
799	<i>Banksia aemula</i>	5	14	3	0.7	
800	<i>Banksia aemula</i>	5	10	2	0.8	
801	<i>Eucalyptus signata</i>	5	10	2	0.8	
817	<i>Banksia aemula</i>	5	15	2	0.8	
829	<i>Banksia aemula</i>	5	12	2	0.5	
834	<i>Banksia aemula</i>	5	12	2	0.5	
838	<i>Banksia aemula</i>	5	12	1	0.5	
839	<i>Banksia aemula</i>	5	10	1	0.4	
844	<i>Banksia aemula</i>	5	10	1	0.4	
851	<i>Banksia aemula</i>	5	6	1	0.5	
856	<i>Banksia aemula</i>	5	10	1	0.4	
858	<i>Banksia aemula</i>	5	5	2	0.3	
864	<i>Eucalyptus signata</i>	5	12	2	0.5	
865	<i>Eucalyptus signata</i>	5	15	2	0.7	
866	<i>Eucalyptus signata</i>	5	14	4	0.8	
867	<i>Eucalyptus signata</i>	5	14	4	0.8	
869	<i>Xanthorrhoea johnsonii</i>	5	14	3	0.8	
873	<i>Eucalyptus signata</i>	5	8	1	0.2	
875	<i>Eucalyptus signata</i>	5	10	1	0.3	
876	<i>Eucalyptus signata</i>	5	10	2	0.3	
881	<i>Eucalyptus signata</i>	5	12	2	0.4	
883	<i>Eucalyptus signata</i>	5	12	1	0.4	
884	<i>Eucalyptus signata</i>	5	12	2	0.4	
885	<i>Eucalyptus signata</i>	5	14	3	0.6	
886	<i>Eucalyptus signata</i>	5	10	2	0.3	
889	<i>Eucalyptus signata</i>	5	14	2	0.6	
892	<i>Eucalyptus signata</i>	5	15	3	0.8	
893	<i>Eucalyptus signata</i>	5	10	2	0.3	
895	<i>Eucalyptus signata</i>	5	10	2	0.3	
900	<i>Eucalyptus signata</i>	5	15	3	0.8	
904	<i>Eucalyptus signata</i>	5	14	2	0.6	
905	<i>Eucalyptus signata</i>	5	15	3	0.8	
911	<i>Banksia aemula</i>	5	10	1	0.3	
915	<i>Banksia aemula</i>	5	10	1	0.3	
918	<i>Banksia aemula</i>	5	8	1	0.25	
935	<i>Eucalyptus signata</i>	5	10	2	0.4	
950	<i>Eucalyptus signata</i>	5	8	1	0.25	
987	<i>Eucalyptus signata</i>	5	15	3	0.8	
991	<i>Eucalyptus signata</i>	5	15	3	0.8	
1005	<i>Melaleuca quinquenervia</i>	5	15	3	0.8	
1020	<i>Melaleuca quinquenervia</i>	5	15	3	0.8	
1021	<i>Melaleuca quinquenervia</i>	5	14	2	0.5	
1022	<i>Eucalyptus signata</i>	5	12	1	0.4	

No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
1025	<i>Eucalyptus signata</i>	5	14	2	0.6	
1028	<i>Eucalyptus signata</i>	5	12	2	0.5	
1031	<i>Eucalyptus signata</i>	5	15	3	0.8	
1032	<i>Eucalyptus signata</i>	5	15	3	0.8	
1033	<i>Eucalyptus signata</i>	5	15	3	0.8	
1039	<i>Eucalyptus signata</i>	5	15	3	0.8	
1040	<i>Eucalyptus signata</i>	5	14	3	0.7	
1041	<i>Melaleuca quinquenervia</i>	5	14	2	0.6	
1043	<i>Eucalyptus signata</i>	5	13	1	0.6	
1047	<i>Eucalyptus signata</i>	5	10	2	0.8	
1049	<i>Eucalyptus signata</i>	5	12	1	0.5	
1050	<i>Eucalyptus signata</i>	5	14	3	0.7	
1051	<i>Banksia aemula</i>	5	14	3	0.6	
1062	<i>Banksia aemula</i>	5	6	1	0.5	
1063	<i>Banksia aemula</i>	5	12	2	0.6	
1064	<i>Eucalyptus signata</i>	5	8	1	0.6	
1065	<i>Eucalyptus signata</i>	5	8	1	0.6	
1066	<i>Eucalyptus signata</i>	5	14	2	0.7	
1067	<i>Eucalyptus signata</i>	5	14	3	0.7	
1101	<i>Melaleuca quinquenervia</i>	5	14	3	0.6	
1103	<i>Melaleuca quinquenervia</i>	5	14	2	0.7	
1109	<i>Melaleuca quinquenervia</i>	5	12	1	0.4	
1111	<i>Melaleuca quinquenervia</i>	5	14	2	0.7	
1114	<i>Melaleuca quinquenervia</i>	5	14	1	0.6	
1115	<i>Melaleuca quinquenervia</i>	5	14	2	0.7	
1123	<i>Melaleuca quinquenervia</i>	5	12	2	0.4	
1124	<i>Melaleuca quinquenervia</i>	5	13	2	0.6	
1128	<i>Melaleuca quinquenervia</i>	5	12	2	0.4	
1129	<i>Melaleuca quinquenervia</i>	5	10	1	0.3	
1130	<i>Melaleuca quinquenervia</i>	5	12	2	0.4	
1131	<i>Melaleuca quinquenervia</i>	5	10	1	0.3	
1132	<i>Melaleuca quinquenervia</i>	5	14	2	0.6	
1163	<i>Melaleuca quinquenervia</i>	5	14	2	0.6	
1164	<i>Melaleuca quinquenervia</i>	5	12	2	0.5	
1165	<i>Melaleuca quinquenervia</i>	5	12	1	0.4	
1166	<i>Melaleuca quinquenervia</i>	5	10	1	0.3	
1168	<i>Melaleuca quinquenervia</i>	5	12	2	0.4	
1169	<i>Melaleuca quinquenervia</i>	5	10	1	0.3	
1181	<i>Banksia ericifolia</i>	5	12	2	0.5	
46	<i>Eucalyptus signata</i>	6	10	2	0.2	
63	<i>Lophostemon suaveolens</i>	6	10	2	0.25	
76	<i>Eucalyptus signata</i>	6	12	1	0.2	
259	<i>Melaleuca quinquenervia</i>	6	15	1	0.2	
309	<i>Melaleuca quinquenervia</i>	6	15	1	0.2	
377	<i>Melaleuca quinquenervia</i>	6	15	1	0.25	
437	<i>Melaleuca quinquenervia</i>	6	10	1	0.25	
492	<i>Banksia aemula</i>	6	3	1	0.2	
780	<i>Banksia aemula</i>	6	8	1	0.2	
925	<i>Banksia aemula</i>	6	8	1	0.25	
937	<i>Eucalyptus signata</i>	6	8	1	0.2	

No.	Species	Significance Ranking	Height (m)	Spread (m)	DBH (m)	Notes
1120	<i>Melaleuca quinquenervia</i>	6	8	1	0.2	
1121	<i>Melaleuca quinquenervia</i>	6	8	1	0.2	

## **APPENDIX 5**

### **FAUNA ASSESSMENT**

# FAUNA ASSESSMENT

## 1. Introduction

This section includes a description of the methods used in determining the suite of fauna species that are likely to use the study area and a discussion of the results of the fauna assessment.

## 2. Methods

### 2.1 NPWS Database search

A search of the NPWS database was conducted to find records of threatened fauna species within 10km of the subject site.

### 2.2 Literature review

A number of sources were reviewed to identify records of threatened species in the locality including:

- Woodward Clyde (1996) Bayside Brunswick Flora and Fauna Assessment
- NRAC study (1995)
- NPWS Wildlife Atlas
- Landmark Byron Fauna Study (1999)
- JWA (2000) Flora and Fauna Assessment for the Brunswick Heads bypass
- JWA reports for the locality

### 2.3 Site survey (2003 and 2004)

A site survey was completed by JWA in September 2003 and January 2004. The area was traversed a number of times by one (1) scientist on foot over a period of eight (8) hours and all incidental fauna observations were recorded. Target searches for the threatened frogs Wallum froglet and the Wallum sedge frog were undertaken in late summer following a period of rain.

### 2.4 Fauna Survey (2008)

#### Introduction

A comprehensive fauna survey was carried out by two (2) scientists between the 14<sup>th</sup> to the 18<sup>th</sup> November 2008. Spotlighting was also conducted during this period. The weather was generally fine and warm during the survey period. The survey techniques utilised were in accordance with the *Threatened Biodiversity Survey and Assessment: Guidelines for Development and Activities* (DECCW 2004).

#### Survey Techniques

Detailed fauna surveys were designed to target identified threatened species. The following survey techniques were utilised in this assessment.

### **Opportunistic Sightings**

The 'random meander' technique (Cropper 1993) was used to traverse the site. 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 undertaken during the site visit.

### **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.

Four (4) lines of Type 'A' Elliot traps with ten (25) traps in each line were set for a period of four (4) nights for a total of one hundred and sixty (160) trap nights. An additional five (5) arboreal Elliot traps were set along each line. Ten (10) cage traps were also deployed for four (4) nights for a total of twenty-four (28) trap nights. Both the Elliot traps and the Cage traps were baited with a mixture of rolled oats, honey and peanut butter. The cage traps were also baited with fruit.

### **Pitfall Traps**

Four (4) pitfall lines of five (5) buckets (20 litre) spaced five (5) metres apart (incorporating drift fencing) were set for a period of four (4) nights. A total of 80 bucket nights were achieved during this component of the Study.

### **Hair Tubes**

Four (4) lines of ten (10) hair tubes each were laid on the site. Each Hair Tube was baited with rolled oats, honey and peanut butter and then set for a period of four (4) nights. Hair tube records were analysed by Barbara Triggs.

### **Call Playback Techniques**

Call playback was carried out over four (4) nights at various locations throughout the site for a period of one (1) hour. Target species included: Masked owl, Barking Owl, Sooty owl and Koala. Calls were broadcast, and then followed by a five (5) minute listening period.

### **Harp Netting**

Two (2) Harp traps were set in potential flyways over four (4) nights. Flyways were chosen on the basis of adequate cover on both sides of the trap, and screening was incorporated to enhance capture success. An overall total of eight (8) trap nights was achieved in this component of the Study.

### **Anabat Recording**

An Anabat II sonar detector (Titley Electronics, Ballina) was used to down-load the ultrasonic calls of Microchiropteran bats. Recording was undertaken for twelve (12) hours per night over two (2) nights. A total of twenty-four (24) hours of recording was undertaken. Recording times commenced from slightly before dusk. Recording was

undertaken by positioning the Anabat II sonar detector facing across possible bat flyways. Anabat records were identified by Dr. Greg Ford.

### **Spotlighting**

Spotlighting was undertaken by two (2) scientists for two and a half (2.5) hours on four consecutive nights for a total of ten (10) hours spotlighting. The weather for the spotlighting survey was generally fine and warm.

All vegetated areas were traversed on foot and spotlighting was carried out using a 50W spotlight powered by a 12V battery. The observer walked at approximately 1km/h allowing intensive listening as an adjunct to visual detection.

### ***Site survey (2009)***

During site surveys in April and May 2009 to update vegetation communities and GPS potential Habitat trees all incidental fauna observations were recorded. Koala scats were also recorded beneath Koala food trees.

### ***Habitat assessment***

Habitat on the subject site was assessed to determine its value for native fauna species. The assessment focused on identifying habitat features 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 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.
- Presence of caves and man-made structures that may be suitable for microchiropteran bat roost sites.
- Presence of Wallum sedge frog and Wallum froglet habitat.

## **3. Results and Discussion**

### ***3.1 NPWS Database search***

The results of the search of the NPWS database are shown in **TABLE 1**.



**TABLE 1**  
**NPWS DATABASE RECORDS OF THREATENED FAUNA SPECIES**  
**WITHIN 10 KMS OF THE SUBJECT SITE**

Scientific Name	Common Name
<b>Mammals</b>	
<i>Syconycteris australis</i>	Common blossom bat
<i>Planigale maculata</i>	Common planigale
<i>Dugong dugon</i>	Dugong
<i>Miniopterus schreibersii oceanensis</i>	Eastern bentwing-bat
<i>Nyctophilus bifax</i>	Eastern long-eared bat
<i>Nyctimene robinsoni</i>	Eastern tube-nosed bat
<i>Scoteanax rueppellii</i>	Greater broad-nosed bat
<i>Pteropus poliocephalus</i>	Grey-headed flying-fox
<i>Megaptera novaeangliae</i>	Humpback whale
<i>Phascolarctos cinereus</i>	Koala
<i>Myotis macropus</i>	Large-footed myotis
<i>Miniopterus australis</i>	Little bent-wing bat
<i>Potorous tridactylus</i>	Long-nosed potoroo
<b>Birds</b>	
<i>Botaurus poiciloptilus</i>	Australasian bittern
<i>Ninox connivens</i>	Barking Owl
<i>Esacus neglectus</i>	Beach stone-curlew
<i>Ixobrychus flavicollis</i>	Black bittern
<i>Ephippiorhynchus asiaticus</i>	Black-necked stork
<i>Amaurornis olivaceus</i>	Bush-hen
<i>Burhinus grallarius</i>	Bush-stone curlew
<i>Todiramphus chloris</i>	Collared kingfisher
<i>Irediparra gallinacea</i>	Comb-crested jacana
<i>Cyclopsitta diophthalma coxeni</i>	Double-eyed fig-parrot
<i>Stictonetta nervosa</i>	Freckled duck
<i>Calyptrorhynchus lathamii</i>	Glossy black cockatoo
<i>Tyto capensis</i>	Grass owl
<i>Sterna albifrons</i>	Little tern
<i>Anseranas semipalmata</i>	Magpie goose
<i>Lichenostomus fasciolaris</i>	Mangrove honeyeater
<i>Pandion haliaetus</i>	Osprey
<i>Haematopus longirostris</i>	Pied oystercatcher
<i>Ptilinopus regina</i>	Rose-crowned fruit dove
<i>Haematopus fuliginosus</i>	Sooty oystercatcher
<i>Lathamus discolor</i>	Swift parrot
<i>Monarcha leucotis</i>	White-eared monarch
<i>Gygis alba</i>	White tern
<i>Ptilinopus magnificus</i>	Wompoo fruit dove
<b>Reptiles</b>	
<i>Chelonia mydas</i>	Green turtle
<i>Caretta caretta</i>	Loggerhead turtle

Scientific Name	Common Name
<b>Amphibians</b>	
<i>Litoria aurea</i>	Green and golden bell frog
<i>Crinia tinnula</i>	Wallum froglet
<i>Litoria olongburensis</i>	Wallum sedge frog

### 3.2 Literature review

Threatened species recorded in studies in the locality are shown in **TABLE 2**.

**TABLE 2**  
**THREATENED FAUNA SPECIES RECORDED IN STUDIES IN THE LOCALITY<sup>7</sup>**

<b>Birds</b>	Glossy black cockatoo	<b>Amphibians</b>	Wallum froglet
	Collared kingfisher		Wallum sedge frog
	Comb-crested jacana		
	Black Bittern		
	Bush hen		
	Osprey	<b>Mammals</b>	Common planigale
	Freckled duck		Brush-tailed phascogale
	Black-necked stork		Greater Broad-nosed bat
	Pied oystercatcher		Koala
	Sooty oyster catcher		Long-nosed potoroo
	Rose-crowned fruit-dove		Common blossom bat
	Grass owl		Eastern long-eared bat
	Mangrove honeyeater		Yellow-bellied sheath-tailed bat
	White-eared monarch		Little bent-wing bat
	Powerful owl		

### 3.3 Results of Woodward Clyde survey (1996)

A survey of the subject site by Woodward Clyde (1996) recorded the following:

- six (6) amphibian species,
- six (6) reptile species,
- seven (7) mammal species; and
- twenty (20) bird species.

Species are listed in **TABLE 3**.

**TABLE 3**  
**FAUNA RECORDED DURING THE WWC (1996) SURVEY**

Common Name	Scientific Name
<b>Mammals</b>	
Little bent wing bat	<i>Miniopterus australis</i>
White-striped mastiff bat	<i>Nyctinomus australis</i>

<sup>7</sup> Sources include: Woodward-Clyde (1996); JWA Reports; NRAC study (1995); Landmark Byron Fauna Study (1999); and NPWS Wildlife Atlas

Common Name	Scientific Name
Mountain brushtail possum	<i>Trichosurus caninus</i>
Dog *	<i>Canis familiaris</i>
Northern brown bandicoot	<i>Isodon macrourus</i>
Swamp wallaby	<i>Wallabia bicolor</i>
<b>Grey-headed flying fox</b>	<b><i>Pteropus poliocephalus</i></b>
<b>Reptiles</b>	
Garden skink	<i>Lampropholis delicata</i>
Striped skink	<i>Ctenotus robustus</i>
Eastern water skink	<i>Eulampus quoyii</i>
Lace monitor	<i>Varanus varius</i>
Eastern water dragon	<i>Physignathus lesueurii</i>
Eastern brown snake	<i>Pseudonaja textilis</i>
<b>Amphibians</b>	
<b>Wallum froglet</b>	<b><i>Crinia tinnula</i></b>
Common eastern froglet	<i>Crinia signifera</i>
Eastern sign-bearing froglet	<i>Crinia parinsignifera</i>
Striped marsh frog	<i>Limnodynastes peronii</i>
Cane toad*	<i>Bufo marinus</i>
Rocket frog	<i>Litoria nasuta</i>
<b>Birds</b>	
<b>Osprey</b>	<b><i>Pandion haliaetus</i></b>
Bar-shouldered dove	<i>Geopelia humeralis</i>
Black-faced cuckoo shrike	<i>Coracina novaehollandiae</i>
Superb blue wren	<i>Malurus cyaneus</i>
White-browed scrub wren	<i>Sericornis frontalis</i>
Noisy miner	<i>Manorina melanophrys</i>
White-cheeked honeyeater	<i>Phylidonyris nigra</i>
Little wattlebird	<i>Anthochaerus chrysoptera</i>
Grey fantail	<i>Rhipidura fuliginosa</i>
Kookaburra	<i>Dacelo novaeguineae</i>
Brown honeyeater	<i>Lichmera indistincta</i>
Rainbow lorikeet	<i>Trichoglossus haemotodus</i>
Scaly-breasted lorikeet	<i>Trichoglossus chlorolepidotus</i>
Pied currawong	<i>Strepera graculina</i>
Eastern whipbird	<i>Psophodes olivaceus</i>
Rainbow bee-eater	<i>Merops ornatus</i>
Welcome swallow	<i>Hirundo neoxena</i>
Pied butcherbird	<i>Cracticus nigrogularis</i>
Torresian crow	<i>Corvus orvu</i>
Whistling kite	<i>Milvus sphenurus</i>

\* indicates introduced species

Threatened species are shown in bold

### 3.4 Results of fauna survey (2003 and 2004)

In total, nine (9) amphibian species, four (4) reptile species, forty-two (42) bird species and six (6) mammal species were recorded on the subject site.

Two (2) threatened species were recorded - the Koala and Wallum froglet.

Wallum froglets were recorded throughout the drainage lines communities on the site and within regenerating heathlands to the south (FIGURE 21 - VOLUME 1).

Koala scats were found at the base of several Scribbly gums in the east of the site and evidence of Koala activity was recorded extensively on adjoining lands to the south (FIGURE 23 - VOLUME 1).

Fauna recorded from the site survey are shown in TABLE 4.

**TABLE 4**  
**FAUNA RECORDED DURING THE SURVEY**

Common Name	Scientific Name	Observation
<b>Mammals</b>		
Black rat *	<i>Rattus rattus</i>	scats
Koala	<i>Phascolarctos cinereus</i>	scats
Common brushtail possum	<i>Trichosurus vulpecula</i>	scats
Dog *	<i>Canis familiaris</i>	scats and tracks
Cat *	<i>Felis catus</i>	scats
Swamp wallaby	<i>Wallabia bicolor</i>	sighting
<b>Reptiles</b>		
Common sun skink	<i>Lampropholis</i>	sighting
Swamp snake	<i>Hemiaspis signata</i>	sighting
Eastern water dragon	<i>Physignathus</i>	sighting
Land mullet	<i>Egernia major</i>	sighting
<b>Amphibians</b>		
Wallum froglet	<i>Crinia tinnula</i>	call
Common eastern froglet	<i>Crinia signifera</i>	Call/sighting
Eastern sign-bearing froglet	<i>Crinia parinsignifera</i>	Call/sighting
Striped marsh frog	<i>Limnodynastes</i>	call
Spotted grass frog	<i>Limnodynastes</i>	call
Eastern dwarf tree frog	<i>Litoria fallax</i>	call
Rocket frog	<i>Litoria nasuta</i>	call
Tusked frog	<i>Adelotus brevis</i>	call
Eastern pobblebonk	<i>Limnodynastes dumerilii</i>	call
<b>Birds</b>		
Australian Nankeen kestrel	<i>Falco cenchroides</i>	Sighting
Bar-shouldered dove	<i>Geopelia humeralis</i>	sighting
Black faced cuckoo shrike	<i>Coracina novaehollandiae</i>	sighting
Black-shouldered kite	<i>Elanus axillaris</i>	sighting
Blue-faced honeyeater	<i>Entomyzon cyanotis</i>	sighting
Cattle egret	<i>Ardea ibis</i>	sighting
Crested pigeon	<i>Ocyphaps lophotes</i>	sighting
Eastern rosella	<i>Platycercus eximius</i>	sighting

Common Name	Scientific Name	Observation
Eastern spinebill	<i>Acanthorhynchus tenuirostris</i>	sighting
Eastern yellow robin	<i>Eopsaltria australis</i>	sighting
Eastern whipbird	<i>Psophodes olivaceus</i>	sighting
Galah	<i>Eolophus roseicapillus</i>	sighting
Glossy ibis	<i>Plegadis falcinellus</i>	sighting
Grey fantail	<i>Rhipidura fuliginosa</i>	sighting
Kookaburra	<i>Dacelo novaeguineae</i>	sighting
Lewin's honeyeater	<i>Meliphaga lewinii</i>	sighting
Little black cormorant	<i>Phalacrocorax sulcirostris</i>	sighting
Little wattlebird	<i>Anthochaera</i>	sighting
Magpie	<i>Gymnorhina tibicen</i>	sighting
Magpie lark	<i>Grallina cyanoleuca</i>	sighting
Masked plover	<i>Thinornis rubricollis</i>	sighting
Noisy miner	<i>Manorina melanocephala</i>	sighting
Noisy friarbird	<i>Philemon corniculatus</i>	sighting
Pacific black duck	<i>Anas superciliosa</i>	sighting
Pied butcherbird	<i>Cracticus nigrogularis</i>	sighting
Pied currawong	<i>Strepera graculina</i>	sighting
Purple swamp hen	<i>Porphyrio porphyrio</i>	sighting
Rainbow bee-eater	<i>Merops ornatus</i>	sighting
Rainbow lorikeet	<i>Trichoglossus</i>	sighting
Red-browed finch	<i>Neochmia temporalis</i>	sighting
Sacred ibis	<i>Threskiornis aethiopicus</i>	sighting
Silvereye	<i>Zosterops lateralis</i>	sighting
Spangled drongo	<i>Dicrurus bracteatus</i>	sighting
Spotted turtledove*	<i>Streptopelia</i>	sighting
Straw-necked ibis	<i>Threskiornis spinicollis</i>	sighting
Superb fairy wren	<i>Malurus cyaneus</i>	sighting
Torresian crow	<i>Corvus orru</i>	sighting
Variegated fairy wren	<i>Malurus lamberti</i>	sighting
Welcome swallow	<i>Hirundo neoxena</i>	sighting
Whistling kite	<i>Milvus sphenurus</i>	sighting
White-faced heron	<i>Ardea novaehollandiae</i>	sighting
Willy wagtail	<i>Rhipidura leucophrys</i>	sighting
Wood duck	<i>Chenonetta jubata</i>	sighting

\* indicates introduced species

Threatened species are shown in **bold**

### 3.5 Results of Fauna Survey (2008)

#### Amphibians

The Wallum froglet (*Crinia tinnula*), a listed threatened species (NSW TSC Act), and the invasive Cane toad (*Bufo marinus*) were recorded on the subject site.

#### Reptiles

Four (4) reptile species were recorded during the site survey. The survey was completed in late winter and during a relatively warm period. Reptile activity could be expected to be moderate. **TABLE 5** lists the reptile species recorded during the survey.

**TABLE 5**  
**REPTILE SPECIES RECORDED ON THE SUBJECT SITE**

Common name	Scientific name	Status*	Method of identification
Wall skink	<i>Cryptoblepharus virgatus</i>	Common	Visual
Common garden skink	<i>Lampropholis delicata</i>	Common	Visual
Pale- flecked Garden Sunskink	<i>Lampropholis guichenoti</i>	Common	Visual
Bearded dragon	<i>Pogona barbata</i>	Common	Visual

#### Birds

Fifty-two (52) bird species were recorded on the subject site. **TABLE 6** shows the bird species recorded during the survey.

**TABLE 6**  
**BIRD SPECIES RECORDED ON THE SUBJECT SITE**

Scientific name	Common name
<i>Alectura lathamii</i>	Australian brush-turkey
<i>Aegotheles cristatus</i>	Australian owl-nightjar
<i>Geopelia humeralis</i>	Bar-shouldered dove
<i>Coracina novaehollandiae</i>	Black-faced cuckoo-shrike
<i>Haliastur indus</i>	Brahminy kite
<i>Lichmera indistincta</i>	Brown honeyeater
<i>Coturnix ypsilophora</i>	Brown quail
<i>Acanthiza pusilla</i>	Brown thornbill
<i>Ardea ibis</i>	Cattle egret
<i>Ocyphaps lophotes</i>	Crested pigeon
<i>Platycercus eximius</i>	Eastern rosella
<i>Acanthorhynchus tenuirostris</i>	Eastern spinebill
<i>Eopsaltria australis</i>	Eastern yellow robin
<i>Sphecotheres viridis</i>	Figbird
<i>Todiramphus macleayi</i>	Forest kingfisher
<i>Rhipidura fuliginosa</i>	Grey fantail
<i>Colluricincla harmonica</i>	Grey shrike-thrush

Scientific name	Common name
<i>Dacelo novaeguineae</i>	Laughing kookaburra
<i>Meliphaga lewinii</i>	Lewin's honeyeater
<i>Chrysococcyx minutillus</i>	Little bronze cuckoo
<i>Philemon citreogularis</i>	Little friarbird
<i>Anthochaera chrysoptera</i>	Little wattlebird
<i>Gymnorhina tibicen</i>	Magpie
<i>Grallina cyanoleuca</i>	Magpie-lark
<i>Vanellus miles</i>	Masked lapwing
<i>Philemon corniculatus</i>	Noisy friarbird
<i>Manorina melanocephala</i>	Noisy miner
<i>Oriolus sagittatus</i>	Olive-backed oriole
<b><i>Pandion haliaetus</i></b>	<b>Osprey</b>
<i>Pelecanus conspicillatus</i>	Pelican
<i>Centropus phasianinus</i>	Pheasant coucal
<i>Cracticus nigrogularis</i>	Pied butcherbird
<i>Strepera gracula</i>	Pied currawong
<i>Merops ornatus</i>	Rainbow bee-eater
<i>Trichoglossus haematodus</i>	Rainbow lorikeet
<i>Malurus melanocephalus</i>	Red-backed fairy-wren
<i>Neochmia temporalis</i>	Red-browed finch
<i>Zosterops lateralis</i>	Silvereye
<i>Larus novaehollandiae</i>	Silver gull
<i>Ninox boobook</i>	Southern boobook
<i>Pardalotus striatus</i>	Striated pardalote
<i>Podargus strigoides</i>	Tawny frogmouth
<i>Megalurus timoriensis</i>	Tawny grassbird
<i>Corvus orru</i>	Torresian crow
<i>Hirundo neoxena</i>	Welcome swallow
<i>Haliastur sphenurus</i>	Whistling kite
<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle
<i>Sericornis frontalis</i>	White-browed scrubwren
<i>Egretta novaehollandiae</i>	White-faced heron
<i>Gerygone olivacea</i>	White-throated gerygone
<i>Rhipidura leucophrys</i>	Willie wagtail
<i>Lichenostomus chrysops</i>	Yellow-faced honeyeater

\* indicates introduced species

Threatened species are shown in **bold**

## Mammals

Ten (10) mammal species were recorded including two threatened species (TABLE 7).

**TABLE 7**  
**MAMMALS SPECIES RECORDED ON THE SUBJECT SITE**

Scientific Name	Common Name	Method of Identification
<i>Isodon Macrourus</i>	Northern brown bandicoot	Visual
<i>Pteropus alecto</i>	Black flying-fox	Visual
<i>Rattus Lutreolus</i>	Swamp rat	Visual
<i>Rattus rattus</i>	Black rat*	Visual
<b><i>Pteropus poliocephalus</i></b>	<b>Grey-headed flying-fox</b>	Visual
<i>Lepus capensis</i>	Hare*	Visual
<i>Mus musculus</i>	House mouse*	Visual
<i>Perameles nasuta</i>	Long-nosed bandicoot	Visual
<i>Macropus rufogriseus</i>	Red-necked wallaby	Visual
<i>Wallabia bicolor</i>	Swamp wallaby	Visual

\* indicates introduced species

Threatened species are shown in bold

### 3.6 Results of Fauna Survey (2009)

Two (2) mammal, two (2) reptile and twenty three (23) bird species were recorded (TABLE 8).

**TABLE 8**  
**FAUNA RECORDED DURING THE SURVEY**

Common Name	Scientific Name	Observation
<b>Mammals</b>		
Koala	<i>Phascolarctos cinereus</i>	scats
Swamp wallaby	<i>Wallabia bicolor</i>	sighting
<b>Reptiles</b>		
Common sun skink	<i>Lampropholis delicata</i>	sighting
Eastern water dragon	<i>Physignathus lesueurii</i>	sighting
<b>Birds</b>		
Cattle egret	<i>Ardea ibis</i>	sighting
Crested pigeon	<i>Ocyphaps lophotes</i>	sighting
Eastern rosella	<i>Platycercus eximius</i>	sighting
Eastern spinebill	<i>Acanthorhynchus tenuirostris</i>	sighting
Eastern yellow robin	<i>Eopsaltria australis</i>	sighting
Eastern whipbird	<i>Psophodes olivaceus</i>	sighting
Galah	<i>Eolophus roseicapillus</i>	sighting



Common Name	Scientific Name	Observation
Glossy black cockatoo	<i>Calyptorhynchus lathami</i>	Chewed cones
Grey fantail	<i>Rhipidura fuliginosa</i>	sighting
Kookaburra	<i>Dacelo novaeguineae</i>	sighting
Lewin's honeyeater	<i>Meliphaga lewinii</i>	sighting
Little wattlebird	<i>Anthochaera</i>	sighting
Magpie	<i>Gymnorhina tibicen</i>	sighting
Magpie lark	<i>Grallina cyanoleuca</i>	sighting
Noisy miner	<i>Manorina melanocephala</i>	sighting
Noisy friarbird	<i>Philemon corniculatus</i>	sighting
Pied butcherbird	<i>Cracticus nigrogularis</i>	sighting
Pied currawong	<i>Strepera graculina</i>	sighting
Rainbow lorikeet	<i>Trichoglossus</i>	sighting
Silvereye	<i>Zosterops lateralis</i>	sighting
Superb fairy wren	<i>Malurus cyaneus</i>	sighting
Willy wagtail	<i>Rhipidura leucophrys</i>	sighting
Wood duck	<i>Chenonetta jubata</i>	sighting

\* indicates introduced species

Threatened species are shown in **bold**

### 3.7 Habitat assessment

#### 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*), Fletchers frog (*Lechriodus fletcheri*) and the Barred frogs of the *Mixophyes* genus.

The subject site provides good quality habitat for a range of lowland and wallum frogs. The main drainage lines provide vegetated areas and areas of moderately tall grasses and shrubs for shelter, although periodic slashing reduces the vegetation cover. After a period of heavy rain (February 25<sup>th</sup> 2004), it was observed that much of the subject site was inundated and a large number and variety of frogs were observed and heard calling throughout the inundated area. The frog species observed included Wallum froglets (Vulnerable TSC Act 1995).

The Paperbark forest, Sawsedge and Swamp mahogany communities, although small in area, may also provide habitat for the Wallum sedge frog and Wallum froglet.

Sedge and Grasslands provide suitable habitat for a range of Amphibian species, particularly along drainage depressions, soaks and drainage lines. Species likely to occur in the sedge and grassland communities include the Common eastern froglet, Eastern sign-bearing froglet, Striped marsh frog, Spotted grass frog, Eastern dwarf tree frog, Rocket frog and Whistling tree frog.

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 that 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.

### 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 decorticated 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 particularly in surrounding areas; availability of water in drainage lines; the variety of habitat types in surrounding areas; and reliable sources of prey. In particular very good habitat and deep litter layers are present in forest types to the east and west of the subject site, and dense heathland to the south provide ample shelter for a number of reptile species.

## Birds

The significance of near coastal environments of the N.S.W. Far North Coast and South-east Queensland as overwintering 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 overwinter in the locality. Species such as the Fantail cuckoo, Sacred kingfisher, Rainbow bee-eater, Tree martin, Black-faced cuckoo-shrike, Wattlebirds, Honeyeaters, Cicada bird, Golden whistler, Rufous whistler, Rose robin, Grey fantail, White-throated gerygone, Silvereye, Olive-backed oriole and Spangled drongo, were recorded during the site survey. The small-flowering species and ample water sources present on the subject site support a relatively large number of insects for insectivorous birds.

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 flowering eucalypt species, Broad-leaved paperbark and Coast banksia for Scaly-breasted and Rainbow lorikeets as these species flower during the lorikeet's winter breeding period. A predominance of important nectar-bearing plants in the genera *Eucalyptus*, *Banksia*, *Melaleuca* and *Callistemon* on the Site provide a continuity of food for a variety of 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. Small patches of closed wet forest occur toward the west of the Site. 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). These species are likely to be very occasional visitors to the subject site, due to the areas of open water and proximity to local rainforest patches.

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. Adjacent areas of vegetation represent quality habitat for frugivorous birds, particularly toward the west and north-west. However, the Site itself provides few fruiting species.

The subject site provides quality foraging resources for a range of nectarivorous birds, offering a number of flowering *Acacia*, *Banksia*, *Eucalyptus*, *Callistemon* and *Leptospermum* species. The level of disturbance to the drainage line and intermittent flow may preclude the occurrence of birds associated with permanent watercourses. However, species such as bitterns and rails may possibly occur in those areas with retained vegetation for shelter.

There are a number of large trees with hollows (Scribbly gums and old growth Banksias) on the Site and the surrounding areas particularly to the east, north and south-east. These hollows are suitable for a variety of hollow-nesting birds. The Study area may also represent forage habitat for hollow-dependent avifauna breeding in wet and dry Sclerophyll forests in the locality.

### 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.

In general medium-large terrestrial mammals such as macropods select habitats that 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.

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.

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* species. These mammals 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 Scribbly gums with hollows necessary for hollow-dependent mammals, and, as with the birds, the Study area may represent forage habitat for hollow-dependent mammals resident in Sclerophyll forests in the locality. Suitable habitat trees have been mapped (APPENDIX 4).

The structural complexity and habitat diversity of the site is likely to support a relatively high diversity and abundance of ground dwelling mammals. However, the majority of the site has been slashed, reducing the habitat value in the short term.

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. The site provides a relatively low diversity and abundance of fruiting species and represents relatively poor

foraging habitat for frugivorous bats. The nectarivorous Common blossom bat may forage on Banksias throughout the site.

There are numerous Scribbly gums with hollows and fissures suitable as roost habitat for hollow-dependant bats on the site. Areas of rainforest, to the north and north west of the site may also 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 Grey-headed flying-fox and Common blossom bat.

### **3.8 Koala Habitat**

The primary Koala feed trees Scribbly gum and Swamp mahogany occur on the subject site, with numerous Scribbly gums present. A variety of secondary browse trees (Pink bloodwood, Swamp turpentine, Broad-leaved paperbark, She-oak) also occur on the Site. Primary and secondary Koala Habitat has been mapped according to known the presence of known primary and secondary food trees and field evidence of the presence of Koala (i.e. scratches and scats) (**FIGURE 14**).

### **3.9 Threatened species considered possible occurrences in the Study area**

Based on the presence of potential habitats, threatened fauna species known from the locality were assessed for the likelihood of their occurrence on the site.

The following oceanic and coastal species will not occur in the Study area and are not considered in **TABLE 9**:

- Sooty and pied oystercatcher;
- Red-tailed tropicbird;
- Black-winged petrel;
- Great knot;
- Humpback whale;
- Dugong;
- Australian fur seal;
- Loggerhead turtle; and
- Green turtle.

**TABLE 9**  
**LIKELIHOOD OF OCCURRENCE OF THREATENED FAUNA SPECIES ON THE SITE**

Species	Likelihood of occurrence	Notes
Australasian bittern	Possible	The Australasian bittern generally prefers freshwater habitats although it may also use dense saltmarsh vegetation in estuaries and flooded grasslands (Smith <i>et al.</i> 1995, in NPWS 1999).
Beach stone-curlew	Unlikely	This species occurs on sandy shores and well-worn reefs and on estuarine mudflats.
Black bittern	Possible	This species occurs in riparian habitats.
Black-necked stork	Possible	The Black-necked stork occurs in swamps, mangroves, mudflats, dry floodplains and irrigated land. The Black-necked stork may use grassland habitats in the Study area during periods of inundation.
Bush hen	Unlikely	The Bush hen is normally associated with moist stands of deep rank grass along permanent running streams.
Bush stone-curlew	Unlikely	This species forages and breeds in open-grassed woodlands or sparsely treed rangelands, often with a non-existent shrub layer and abundant leaf litter.
Collared kingfisher	Possible	The Collared kingfisher is restricted to mangroves in Australia.
Comb-crested jacana	Unlikely	This species lives on floating vegetation in freshwater lakes and ponds, and has been recorded less than 1 km to the north of the subject site.
Common blossom bat	Possible	Common Blossom Bats in NSW, the Southern part of their range, feed mostly on nectar. There are a number of blossom producing trees in the Study area.
Common planigale	Recorded on the site (Nov 2008)	This species occupies a wide range of habitats from rainforest, sclerophyll forest, grasslands, marshlands, rocky areas and even some suburban areas.

Species	Likelihood of occurrence	Notes
Double-eyed fig-parrot	Unlikely	This is a very rare species that lives in the canopy of dense rainforest.
Eastern long-eared bat	Possible	This species typically roosts in old growth trees with hollows. It may occasionally roost in dense forested vegetation, dead rainforest foliage and under the bark of paperbarks.
Freckled duck	Unlikely	Preferred habitats for the Freckled duck are freshwater swamps or creeks rich in plankton with a heavy growth of cumbungi, lignum or tea-tree.
Glossy black cockatoo	Recorded on the site JWA 2009	Found in coastal forests and open inland woodland in eastern Australia. The Glossy black-cockatoos distribution is limited to habitat which contains sufficient seed reserves of their three favoured species of food trees: <i>Allocasuarina littoralis</i> , <i>A. torulosa</i> and <i>A. verticillata</i> (Forshaw 1981) and suitable large hollow bearing trees for nesting. There are numerous <i>Allocasuarina littoralis</i> on the subject site.
Grass owl	Possible	The Grass owl occupies coastal heath and grassland across northern Australia (Reader's Digest 1993). Areas of tall grass in the Study area may provide some marginal habitat for this species.
Greater broad-nosed bat	Possible	This species forages over a range of habitats, including rainforest and moist forests (SFNSW 1995). Creeks and small rivers are favoured corridors (Hoye and Richards 1995).
Green and golden bell frog	Unlikely	This species appears to be associated with semi-permanent or permanent water including marshes, dams and stream-sides. These waterways frequently contained bullrushes ( <i>Typha</i> sp.) or spike rushes ( <i>Eleocharis</i> sp.). Bell frogs seem to have disappeared from many of these habitats in NSW, and, in the Greater Sydney Region, are most frequently found in disturbed sites, often extremely so, such as disused industrial sites, brick pits, mines, recently cleared bushland or council tips. Records of this species occur 5km to the south of the site (NPWS Atlas).

Species	Likelihood of occurrence	Notes
Grey-headed flying fox	<b>Recorded by Woodward Clyde (1996)</b>	This species travels along the east coast of Australia, foraging on fruiting and blossoming species. Numerous Banksia on the site provide suitable forage for this species.
Koala	<b>Recorded on site JWA 2003-2004 JWA 2009</b>	The preferred Koala food trees Swamp mahogany and Scribbly gum occur on the site. Koalas may use the site and area surrounding for feeding and roosting.
Large-footed myotis	<b>Possible</b>	This bat forages over water bodies such as creeks, rivers, estuaries, dams etc. Suitable forage habitat occurs in Simpson Creek, and to a lesser extent in drainage lines on the site.
Little bent-wing bat	<b>Recorded by Woodward Clyde (1996)</b>	This species generally occupies caves and tunnels during the day and, at night, forages for small insects beneath the canopy of well timbered habitats. It may occasionally roost singularly or in small collectives under the bark of mature paperbark trees.
Long-nosed potoroo	<b>Possible</b>	The preferred habitat of this species is dense coastal heath. Suitable habitat occurs in the study area particularly to the south of the Sites. Long-nose potoroos have been recorded in the vicinity and from Tyagarah Nature Reserve.
Magpie goose	<b>Unlikely</b>	The Magpie goose generally inhabits open lakes, swamps and permanent wetlands which are dominated by rush and sedge vegetation.
Mangrove honeyeater	<b>Possible</b>	The Mangrove honeyeater inhabits mangroves along coastal estuaries, creeks and rivers, preferring well-developed mangroves for nesting and roosting.
Osprey	<b>Recorded by Woodward Clyde (1996)</b>	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.



Species	Likelihood of occurrence	Notes
Pied oystercatcher	Unlikely	This species occurs on the coastline and in estuaries around Australia. It inhabits open beaches, intertidal flats and sandbanks and occasionally rocky headlands.
Rose crowned fruit dove	Unlikely	The Rose-crowned fruit dove prefers tall tropical and subtropical evergreen or semi-deciduous rainforest, especially with a dense regrowth of vines.
Swift parrot	Possible	The Swift parrot breeds in Tas. During spring and summer and migrates to south-eastern Australia for winter. Mainland populations of this species favour winter-flowering eucalypt forest and woodland, usually where abundant supplies of Eucalypt nectar exist.
Wallum froglet	Recorded on site JWA 2003 - 2004 WoodwardClyde(1996) JWA 2009	The Wallum froglet is found in Paperbark swamps growing in areas with acid sandy (Wallum) soils, warm temperate grassland or near the edge of ponds.
Wallum sedge-frog	Possible	The Wallum sedge-frog clings to emergent reeds in Wallum swamp habitats. A small area of suitable habitat occurs within the Scribbly gum, Swamp Mahogany community on the Site.
White-eared monarch	Possible	This species occurs in rainforest, particularly the edges of subtropical rainforest, contiguous wet sclerophyll forest and occasionally into mangrove swamps or streamside vegetation in Eucalypt woodland.
Wompoo fruit dove	Unlikely	This species is primarily associated with large undisturbed patches of tropical or subtropical evergreen rainforest. Occasionally this species will occur in patches of monsoon forest, closed gallery forest, wet sclerophyll forest, tall open forest, open woodlands or vine thickets near rainforests (Marchant and Higgins 1993).

## **APPENDIX 6**

### **KEY THRESHOLDS ASSESSMENT**

## KEY THRESHOLDS ASSESSMENT

### 1. Background

Assessments of significance (TSC Act) are not required as the project is being assessed under Part 3A of the Environmental Planning and Assessment Act 1979. However, the Department of Environment and Climate Change and the Department of Primary Industries have provided guidelines for assessing the impacts of development on threatened species through assessing key thresholds with the response to a set of questions (DEC & DPI 2005).

This section firstly provides a discussion on how the proposal addresses the 'Guiding Principles' for threatened species assessment set out in section 1.2 of the *Guidelines for Threatened Species Assessment* (DEC & DPI 2005). Secondly, this section provides an impact assessment the threatened species and the endangered ecological communities, as listed under the Threatened Species Conservation Act (1995) The impact assessment follows Steps 5 of the Guidelines (DEC & DPI 2005).

### 2. Guiding Principles for Threatened Species Assessment

#### 2.1 Introduction

The Guidelines for Threatened Species Assessment (DEC & DPI 2005) outlines six (6) environmental outcomes to be delivered by proposed developments. The guiding principles are as follows:

1. Maintain or improve biodiversity values (i.e. there is no net impact on threatened species or native vegetation).
2. Conserve biological diversity and promote ecologically sustainable development.
3. Protect areas of high conservation value (including areas of critical habitat).
4. Prevent the extinction of threatened species.
5. Protect the long-term viability of local populations of a species, population or ecological community.
6. Protect aspects of the environment that are matters of national environmental significance.

This section will discuss how the proposed development is in accordance with each guideline.

#### 2.2 Guiding principles

Maintain or improve biodiversity values (i.e. there is no net impact on threatened species or native vegetation).

There will be no net impact on the threatened species or the native vegetation within the Subject site. The impacts of the proposed development are discussed in **SECTION 4 (VOLUME 1)** in the context of the avoidance strategies taken in layout design, proposed mitigation measures and offsets. There will be a net gain in Wallum vegetation (4.86 ha), Endangered Ecological Communities (1.87 ha) and overall intact native vegetation (0.78 ha). In addition Koala food trees will be replaced at a ratio of 2:1 resulting in a net gain of 38 trees.

Conserve biological diversity and promote ecologically sustainable development.

Ecologically sustainable development (ESD) is a concept that has developed over the last 30 years following widespread concern about the effects of growth and development on the natural environment (DECCW 2008). Ecologically sustainable development (ESD) has been defined as: *'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'*.

The key principles of ESD are:

- **The precautionary principle**  
Reduce the chance of serious environmental problems, even if we are not sure these problems will occur.
- **Inter-generational equity**  
The present generation should ensure the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
- **Conservation of biological diversity and ecological integrity**  
Maintain or enhance the range of native plants and animals and the health of natural areas.
- **Improved valuation, pricing and incentive mechanisms**  
Environmental factors should be included in the valuation of assets and services, such as: polluter pays - that is, those who generate pollution and waste should bear the cost of avoiding waste, containing it or abatement, and, the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.

The proposed development at Bayside Brunswick is in accordance with the key principles of ESD.

Protect areas of high conservation value (including areas of critical habitat).

The proposed development has protected all areas, on the subject site, with high conservation value with the exception of the loss of a small area of Swamp sclerophyll EEC in the western portion of the site. This loss will be offset by the restoration of 1.97 ha of Swamp sclerophyll resulting in a net gain of 1.87 ha.

Prevent the extinction of threatened species.

The proposed development will prevent the extinction of threatened species and EECs found on the subject site by providing, improving and managing quality habitat for these species and EECs.

Protect the long-term viability of local populations of a species, population or ecological community.

The proposed development will not accelerate the extinction of the species, population or ecological community or place it at risk. A discussion in the context of each listed species/EEC is provided in the following section.

Protect aspects of the environment that are matters of national environmental significance.

The Proposed development will protect matters of Nation Environmental Significance (NES). An assessment against the EPBC Act is provided in **APPENDIX 1 - VOLUME 2**.

## **2. Key Thresholds Assessment Questions**

### **2.1 Introduction**

The response to the first and last questions considers all threatened fauna and EEC's on the site collectively. The 2<sup>nd</sup> and 3<sup>rd</sup> questions will be considered either for individual species/EEC or like groups.

1. *Will the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts, maintain or improve biodiversity values?*

Biodiversity should be considered on three (3) levels:

- Genetic diversity - the variation of the genes within a species.
- Species diversity - the number of different types of plants and animals.
- Ecosystem diversity - this is the variety of habitat on earth.

The proposed development will maintain Biodiversity on all of these levels. The proposed development will utilise land zoned 2(a), which has a significant disturbance history and is, at present, subject to an approved slashing regime. The diverse range of ecosystems within the 7(a) land will be retained. The diversity of plants and animals within the site will also be relatively unaffected with the retention of the 7 (a) land. The effective management of this land may, overtime, improve the biodiversity values of the site.

2. *Is the proposal likely to reduce the long-term viability of a local population of the species, population, or ecological community?*
3. *Is the proposal likely to accelerate the extinction of the species, population or ecological community or place it at risk?*

### **2.2 Endangered Ecological Communities (EECs)**

Three (3) Endangered Ecological Communities (EEC's) occur on the site:

- Swamp Sclerophyll Forest
- Swamp Oak Floodplain Forest
- Coastal Saltmarsh

### Swamp Sclerophyll Forest

Swamp sclerophyll forest occurs in an area zoned 7a Environmental Protection in the east of the site. Smaller patches also occur in the far west of the site and are not zoned for environmental protection. 9% of this community (in the west of the site) will be affected.

Small areas of Swamp sclerophyll communities are known from the following National Parks and Nature Reserves in Northern Region Conservation Reserves (NSW Scientific Committee 2004):

- Bungawalbin Nature Reserve;
- Tuckean Nature Reserve;
- Moonee Beach Nature Reserve;
- Hat Head National Park;
- Crowdy Bay National Park;
- Myall Lakes National Park; and
- Garigal National Park.

None of these occur within the locality of the site. While Paperbark Communities within the Byron Shire are reserved in Billinudgel, Tyagarah and Cumbebin Nature Reserves (Byron Shire Council 1999). Although, it is evident that Swamp sclerophyll communities are poorly conserved within the locality, the proposal is unlikely to accelerate the extinction of this EEC or place it at risk.

### Swamp Oak Floodplain Forest

The EEC Swamp Oak Floodplain Forest will not be affected by the proposed development.

The extent of Swamp Oak Floodplain Forest within the Byron LGA has not been mapped. This community will remain intact on the subject site so it is unlikely that the proposal will accelerate the extinction or place it at risk of this EEC.

### Coastal Saltmarsh

The EEC Coastal Salt Marsh will not be affected by the proposed development.

The extent of Coastal saltmarsh within the Byron LGA has not been mapped. In the locality, saltmarsh communities occur in TNR, adjacent to the site. The extent of Coastal saltmarsh reserved within other conservation reserves in the locality is not known. Although, it is evident that Saltmarsh communities are poorly conserved within the locality, the proposal is unlikely to accelerate the extinction of this EEC or place it at risk.

**The long term viability of the EEC's on the subject site will not be reduced by the proposed development.**

The Proposal is unlikely to accelerate the extinction or place at risk the EEC's on the subject site.

### 2.3 Fauna

Seven threatened fauna species have been recorded on the subject site and sixteen (16) are considered possible occurrences over time (**APPENDIX 5**). These species will be assessed against the Key Threshold Assessment Questions.

#### Australasian bittern

##### *Extent of local population*

The NPWS database contains three (3) records of this species within 10 kilometres of the subject site and seven (7) sightings within the Byron Shire LGA. There are no records from the Tyagarah Nature Reserve (TNR).

The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

##### *Habitat and life-cycle*

The Australasian Bittern is widespread but uncommon over south-eastern Australia. In NSW it may be found over most of the state except for the far north-west. The Australasian Bittern favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.). It hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. Feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. Breeding occurs in summer from October to January when nests are built in secluded places in densely-vegetated wetlands on a platform of reeds (DEC 2005).

##### *Potential impacts of the proposed development*

The NSW National Parks and Wildlife Service consider the following direct and indirect impacts as threats to the survival of the Australasian bittern (DEC 2005):

- Drainage of wetlands and ponds.
- Reduced water quality due to siltation, pollution and salinity.
- Predation by foxes and cats.
- Use of herbicides, pesticides and other chemicals near wetland areas.
- Grazing and associated frequent burning of wetland areas.

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

#### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

#### Black bittern

##### *Extent of local population*

The NPWS database contains two (2) records of this species within 10 kilometres of the subject site and fifty seven (57) sightings within the Byron Shire LGA. There is one (1) record from the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

##### *Habitat and life-cycle*

The Black bittern inhabits both terrestrial and estuarine wetlands, generally in areas with permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. It feeds predominantly on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding undertaken at dusk and at night. During the day the animal, roosts in trees or on the ground amongst dense reeds. When disturbed, it freezes in a characteristic bittern posture (stretched tall, bill pointing up, so that shape and streaked pattern blend with upright stems of reeds), or will fly up to a branch or flush for cover where it will freeze again.

The species is generally solitary, but occur in pairs during the breeding season, from December to March. Like other bitterns, but unlike most herons, nesting is solitary. Nests, built in spring are located on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks. Between three and five eggs are laid and both parents incubate and rear the young (DEC 2005).

##### *Potential impacts of the proposed development*

The NSW National Parks and Wildlife Service consider the following direct and indirect impacts as threats to the survival of the Black bittern (DEC 2005): clearing of riparian vegetation; predation by foxes and feral cats on eggs and juveniles; and grazing and trampling of riparian vegetation by stock.

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.



### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

### Black-necked stork

#### *Extent of the local population*

The NPWS database contained five (5) records of this species within 10km of the site, and thirty eight (38) sightings of this species in the Byron Shire LGA. There is also one (1) record from the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

#### *Habitat and life-cycle*

Black-necked storks are mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sandflats, and mangrove vegetation.

They mainly forage in shallow, still water, preferring open wetlands, and taking a variety of prey, including eels and other fish, frogs, turtles, snakes, and small invertebrates, such as crabs and small insects. Vertebrates form the main mass of the diet, with medium-sized eels contributing the greatest biomass and were also the only food seen to be delivered to nestlings.

In NSW, breeding activity has been recorded in most months, with activities from nest construction to fledging of young recorded from May to January. Most activity, however, takes place between June and December, and clutches present May to September. In NSW, Storks usually nest in a tall, live and isolated paddock tree, but also in other trees, including paperbarks, or even lower shrubs within wetlands. The nest is a large platform, 1-2 m in diameter, made in a live or dead tree, in or near a freshwater swamp. Nests, built in spring are located on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks. Between three and five eggs are laid and both parents incubate and rear the young (DEC 2005).

#### *Potential impacts of the proposed development*

The NSW National Parks and Wildlife Service consider the following direct and indirect impacts as threats to the survival of the Black necked stork (DEC 2005):

- Degradation of wetland habitats through pollution and salinisation;

- Loss of paddock trees used for nesting, or potentially providing nesting sites for Black-necked Storks;
- Powerlines, especially close to wetlands or over floodplains, are a significant cause of mortality of Storks and one of the most critical threats to the species in NSW;
- Modification or degradation of wetlands through changes in natural water flows. It is important to maintain or reintroduce flows to provide wetland habitats suitable for foraging by Storks as they require large amounts of vertebrate prey from such habitats; and
- Loss of wetland habitat through clearing and draining for flood mitigation, agriculture and residential development.

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

#### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

#### Collared kingfisher

##### *Extent of the local population*

The NPWS database contained five (5) records of this species within 10 kilometres of the subject site and one (1) sighting within the Byron LGA. There is one (1) record from the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

##### *Habitat and life-cycle*

This species is distributed around northern Australia. In NSW it is locally common in the Tweed River estuary where it breeds. Rarely found south of this area. This species is restricted to mangroves and estuarine habitats of larger river systems. Threats include destruction of mangrove habitat, loss of coastal trees containing hollows and termite nests, pollution of estuaries and the use of pesticides to protect residential developments.

Mangrove habitats will not be directly affected by the proposed development. There may be some minor impacts associated with increased disturbance from visitors to creek habitats.

### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

### Common blossom bat

#### *Extent of the local population*

The NPWS database contained sixteen (16) records of this species within 10 kilometres and thirty two (32) sightings within the Byron Shire LGA. There are six (6) records from the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

#### *Habitat and life-cycle*

The Common blossom-bat shows preference with regards to feeding sites, often repeatedly visiting the same sites on consecutive nights within a flowering season and returning to the aforementioned site over several years. They require a year round supply of nectar and pollen, which is gathered from a mosaic of coastal complex vegetation types. When these vegetation types are in short supply of nectar and pollen (Nov/Dec in northern NSW) Common Blossom-bats have been known to utilise riverine areas containing Black Bean, Silky Oak and Weeping Bottlebrush. Common Blossom-bats often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps. They have also been recorded in a range of subtropical forest types, rainforest, wet sclerophyll forest and coastal Eucalypt forest. Individuals of the species generally roost individually in dense foliage and vine thickets of the sub-canopy, staying in the same general area for a season. They change roost sites daily, but each roost site is generally only 50m or so away from other recent roosts (DEC 2005, Churchill 1998).

#### *Potential impacts of the proposed development*

The NSW National Parks and Wildlife Service consider the following direct and indirect impacts as threats to the survival of the Common blossom-bat (DEC 2005): predation by foxes and feral cats, which may occur whilst the bat is feeding on low hanging flowers and fruit; inappropriate fire regimes applied in heathland habitats leading to reduced flowering of Banksia, Callistemon and Melaleuca species; clearing of coastal habitat for urban development or sandmining; and weeds, such as Bitou Bush, that suppress the regeneration of key food trees, such as Coastal Banksia (DEC 2005).

A relatively small number of potential forage trees (mostly Heath-leaved Banksia) will be lost. Approximately, 5ha of potential habitat for this species will be lost, however, no roost habitat will be affected. Substantial areas of quality forage habitat occur east and south of the site in TNR.

### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

### Common planigale

#### *Extent of local population*

The NPWS database contained fifteen (15) records of this species within 10 kilometres of the subject site and 53 within the Byron LGA. There are seven (7) records from the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was recorded in a survey in November 2008 on land to the south of the subject site (**FIGURE 22 - VOLUME 1**).

#### *Habitat and life-cycle*

The Common planigale inhabits rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually in locations with close proximity to water. They are active at night and during the day shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks. The species are fiercely carnivorous hunters and agile climbers, preying on insects and small vertebrates, some nearly their own size. They breed from October to January where the female builds a nest lined with grass, eucalypt leaves or shredded bark (DEC 2005).

#### *Potential impacts of the proposed development*

The NSW National Parks and Wildlife Service consider the following direct and indirect impacts as threats to the survival of the Common planigale (DEC 2005): predation by foxes, cats and cane toads; loss and fragmentation of habitat through clearing for agriculture and development in coastal areas; frequent burning and grazing that reduces ground cover such as hollow logs and bark; and disturbance of vegetation surrounding water bodies.

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

## Eastern long-eared bat

### *Extent of local population*

The NPWS database contained twenty one (21) records of this species within 10km of the site, and no records from the TNR. The NPWS online database contained ninety one (91) sightings of this species in the Byron Shire LGA. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

### *Habitat and life-cycle*

The Eastern long-eared bat can be found in lowland subtropical rainforest and wet and swamp eucalypt forest, extending into adjacent moist eucalypt forest. It shows particular preference to coastal rainforest and patches of coastal. The bats roost in tree hollows, the hanging foliage of palms, in dense clumps of foliage of rainforest trees, under bark and in shallow depressions on trunks and branches, among epiphytes, in the roots of strangler figs, among dead fronds of tree ferns and less often in buildings (DEC 2005).

### *Potential impacts of the proposed development*

The NSW National Parks and Wildlife Service consider the following direct and indirect impacts as threats to the survival of the Eastern long-eared bat (DEC 2005): clearing, fragmentation and isolation of lowland subtropical rainforest, wet and swamp eucalypt forest and coastal scrub, particularly forest and scrub close to the coast, for agricultural, residential and other development; loss of hollow-bearing trees and stands of palms and rainforest trees used for roosting and maternity sites; invasion of habitat by weeds, particularly by Bitou Bush on the coast; and the use of pesticides.

Approximately, 5ha of potential habitat for this species will be lost, however, no roost habitat will be affected. Substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

## Freckled Duck

### *Extent of the local population*

The NPWS database contained four (4) records of this species within 10km of the site, and no records from the TNR. The NPWS online database contained six (6) sightings of this species in the Byron Shire LGA. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

#### *Habitat and life-cycle*

The Freckled duck prefers permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. In drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Generally they rest in dense cover during the day, usually in deep water. Feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates.

Nesting usually occurs between October and December but can take place at other times when conditions are favourable. Nests are usually located in dense vegetation at or near water level (DEC 2005).

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

#### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

#### Glossy black-cockatoo

##### *Extent of local population*

The Glossy black-cockatoo is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia.

The NPWS database contained one (1) record of this species within 10km of the site and thirty five (35) sightings within the Byron Shire LGA. There are no records within the TNR. This species was recorded on the subject site by evidence of chewed Casuarina cones (**FIGURE 23 - VOLUME 1**). The local population for this species is considered to be comprised of all individuals recorded at the site as well as any individuals within adjoining areas (contiguous or otherwise) that are known or likely to use habitat in the study area.

##### *Life-cycle attributes*

The Glossy black-cockatoo inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black she-oak (*Allocasuarina littoralis*), Forest she-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur. It feeds almost exclusively on the seeds of several species of she-oak (*Casuarina* and *Allocasuarina* species), shredding the cones with the massive bill.

The Glossy black-cockatoo is dependent on large hollow-bearing eucalypts for nest sites. Adults breed during the autumn and winter. One or two eggs are laid between March and August. During the 29 days of incubation the female is dependent on the male for food as she usually remains on the nest in a large tree hollow, lined with chips and dust. Only one young bird is raised per season and a juvenile may associate with its parents for an indefinite period after fledging at approximately 60 days.

#### *Potential impacts of the proposed development*

Based on the results of the site survey it is considered that the subject site provides suitable habitat for this species. There are scattered occurrences of mature Forest oak (*A. torulosa*) which provide forage opportunities and potential nesting sites (i.e. trees with large hollows) were also observed.

The DECCW website lists the following threats to the Glossy black-cockatoo:

- Reduction of suitable habitat through clearing for development;
- Loss of tree hollows;
- Excessively frequent fire which reduces the abundance and recovery of she-oaks and also may destroy nest trees; and
- Illegal bird smuggling and egg-collecting.

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

#### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

#### Grass owl

##### *Extent of local population*

The NPWS database contained eighteen (18) records of this species within 10km of the site and twenty-five (25) sightings within the Byron Shire LGA. There are four (4) records within the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

### *Habitat and life-cycle*

Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. They rest by day in a 'form' (i.e. a trampled platform in a large tussock or other heavy vegetative growth). If disturbed they burst out of cover and fly low and slowly, before dropping straight down again into cover. They always breeds on the ground and nests are found in trodden grass which is usually accessed by tunnels through the vegetation (DEC 2005).

### *Potential impacts of the proposed development*

The NSW National Parks and Wildlife Service consider the following direct and indirect impacts as threats to the survival of the Grass owl (DEC 2005):

- Loss of suitable habitat due to grazing, agriculture and development.
- Habitat disturbance and degradation by stock.
- Use of pesticides in agriculture to control rodent populations thereby limiting seasonal food sources for owls, reducing reproductive potential, and potentially poisoning owls.
- Frequent burning, which reduces ground cover needed for safe roosting and nesting, and can reduce prey abundance.

The proposed development will result in the reduction of forage habitat for this species (i.e. approximately 14ha) and the loss of marginal roosting/resting habitat. Extensive areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

### Greater broad-nosed bat

#### *Extent of the local population*

The NPWS database contained three (3) records of this species within 10km of the site and five (5) sightings within the Byron Shire LGA. There are no records from the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.



### *Habitat and life-cycle*

The Greater broad-nosed bat utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest. It is most commonly found in tall wet forest. The species usually roosts in tree hollows but has also been found in buildings. It forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects. This species has been known to eat other bat species. Little is known of its reproductive cycle, however a single young is born in January. Prior to birth, females congregate at maternity sites located in suitable trees and exclude males during the birth and raising of the single young (DECC 2005).

### *Direct and indirect Impacts*

The NSW National Parks and Wildlife Service consider the following, direct and indirect impacts, as threats to the survival of the Greater broad-nosed bat (DEC 2005): disturbance to roosting and summer breeding sites; loss of foraging and roosting habitat from vegetation clearing; a reduction in the availability of insects, or the accumulation of toxic residues in bats' fat stores due to the use of pesticides and herbicides; and an alteration to food resources due to changes in water regimes (DECC 2005).

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

### Grey-headed flying-fox

#### *Extent of local population*

The NPWS database contained forty-three (43) records of this species within 10km of the site, and 259 sightings in the Byron Shire LGA. There are four (4) records from the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

### *Habitat and life- cycle*

The Grey-headed flying fox can be found in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating,

birth and the rearing of young. Annual mating commences in January and a single young is born each October or November. Site fidelity to camps is high with some camps being used for over a century. This species will travel up to 50 km to forage, feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. They also forage in cultivated gardens and fruit crops and can inflict severe crop damage (DECC 2005).

#### *Direct and Indirect impacts*

The NSW National Parks and Wildlife Service consider the following, direct and indirect impacts, as threats to the survival of the Grey-headed flying fox (DEC 2005): loss of foraging and roosting habitat due to vegetation clearing; death and/or injury from unregulated shooting; electrocution on powerlines; and disturbance to roosting sites.

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

#### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

### Koala

#### *Extent of local population*

The NPWS database contained 1254 records of this species within 10km of the site and 1478 recorded sightings in the Byron LGA. There are three (3) records from the TNR. This species was recorded on the subject site (**FIGURE 24 - VOLUME 1**). The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site.

#### *Habitat and Life-cycle*

Koalas inhabit eucalypt woodlands and forests. They feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will search for preferred browse species. They are often observed being inactive for most of the day, feeding and moving mostly at night. They spend most of their time in trees, but will descend and traverse open ground to move between trees. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size. They are generally non-gregarious, but have complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery. Females breed at two years of age and produce one young per year (DEC 2005).

#### *Potential impacts of the proposed development*

The NSW National Parks and Wildlife Service consider the following direct and indirect impacts as threats to the survival of the Koala (DEC 2005): Human-induced climate change, especially in the form of prolonged drought; loss, modification and fragmentation of

existing habitat; predation by feral and domestic dogs; intense fires that scorch or kill the tree canopy of preferred nesting and feeding trees. Death as a result of motor vehicles is another listed threat.

The proposed development will add to the ongoing reduction and fragmentation of habitat for this species, and will result in the loss of approximately 0.5 ha of wet sclerophyll forest in which the preferred Koala food tree Swamp mahogany and Scribbly gum occur, and 0.22 hectares of dry sclerophyll forest dominated by the preferred Koala food tree Scribbly gum. Koala habitat will, however, be retained within the environmental protection area and Koala food trees will be replaced at a ratio of 2:1.

#### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species. Conversely, the proposed revegetation and regeneration practices outlined in this report could embellish the amount of suitable habitat which occurs on the subject site.

#### Large-footed myotis

##### *Extent of the local population*

The NPWS database contained 208 records of this species within 10km of the site, and 217 sightings in the Byron Shire LGA. There is one (1) recording from the TNR.

This species has been recorded along Simpsons Creek adjacent to the sewage treatment plant. Both AKF (1995) and WWC (1996) have recorded the species foraging along similar tidal creeks in the Tweed Shire

The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

##### *Habitat and Life-cycle*

The Large footed myotis generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. It will forage over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW females have one young each year usually in November or December (DEC 2005).

##### *Direct and indirect impacts*

The NSW National Parks and Wildlife Service consider the following, direct and indirect impacts, as threats to the survival of the Large footed myotis (DEC 2005):

- Reduction in stream water quality affecting food resources
- Loss or disturbance of roosting sites.

- Clearing adjacent to foraging areas.
- Application of pesticides in or adjacent to foraging areas.

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

#### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

#### Little bent-wing bat

##### *Extent of the local population*

The NPWS database contained 101 records of this species within 10km of the site and one hundred and twenty-eight (128) sightings in the Byron Shire LGA. There is one (1) record from the TNR. This species was recorded on the subject site by the 1996 (WWC) survey. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

##### *Habitat and life-cycle*

The Little bent-wing bat shows a preference for well timbered areas including rainforest, wet and dry sclerophyll forest, Melaleuca swamps and dense coastal banksia scrub. They roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common bent-wing bat (*M. schreibersii*) and, in winter, the two species may form mixed clusters.

##### *Direct and indirect impacts*

The NSW National Parks and Wildlife Service consider the following, direct and indirect impacts, as threats to the survival of the Little bent-wing bat (DEC 2005): death and/or injury from predation by foxes and feral cats, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges; disturbance of colonies, especially in nursery or hibernating caves; destruction of caves that provide seasonal or potential roosting sites; changes to habitat, especially surrounding maternity/nursery caves and winter roosts; and death and/or disease from the use of pesticides.

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

#### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species.

Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

#### Long-nosed potoroo

##### *Extent of the local population*

The NPWS database contained fifteen (15) records of this species within 10 kms of the site, and twenty (20) sightings in the Byron Shire LGA. Two (2) records occur approximately 2 kms south of the subject site. There are eleven (11) records from the TNR. The Long-nosed potoroo was not recorded in recent fauna surveys.

The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

##### *Habitat and life-cycle*

The Long-nosed potoroo inhabits coastal heaths and dry and wet sclerophyll forests. They are also found in areas of dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. They often digs small holes in the ground in a similar way to bandicoots.

##### *Potential impacts of the proposed development*

The NSW National Parks and Wildlife Service consider the following, direct and indirect impacts, as threats to the survival of the Long-nosed potoroo (DEC 2005): habitat loss and fragmentation from land clearing for residential and agricultural development; predation from foxes, dogs and cats; and logging regimes or other disturbances that reduce the availability and abundance food resources, particularly hypogeous fungi, and ground cover

The slashing of heathland communities on the site over a long period of time has significantly reduced suitable habitat for the Long-nosed potoroo, however some suitable habitat occurs in the east of the site. The proposed development is unlikely to significantly reduce suitable habitat for this species, although it will reduce opportunities for movement, and increase the risks of predation from straying dogs.

##### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

## Magpie goose

### *Extent of the local population*

The NPWS database contained one (1) record of this species within 10km of the site which also occurs within the Byron Shire LGA. There are no records from the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

### *Habitat and Life-cycle*

Magpie geese are found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. They are equally at home in aquatic or terrestrial habitats and are often seen walking and grazing on land. They feed on grasses, bulbs and rhizomes. Breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level. Most breeding now occurs in monsoonal areas in northern Australia (DEC 2005).

### *Direct and indirect impacts*

The NSW National Parks and Wildlife Service consider the following, direct and indirect impacts, as threats to the survival of the Magpie goose (DEC 2005):

- Drainage of swamps, ponds, dams and other wetlands;
- Degradation of habitat through pollution;
- Changing water flow in and from wetlands;
- Disturbance to breeding and feeding sites; and
- Fox predation on eggs and goslings.

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

## Mangrove honeyeater

### *Extent of the local population*

The NPWS database contained three (3) records of this species within 10km of the site which comprises of all the records within the Byron Shire LGA. There are no records from the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

### *Habitat and Life-cycle*

The primary habitat of the species is mangrove woodlands and shrublands but Mangrove honeyeaters also range into adjacent forests, woodlands and shrublands, including Casuarina and Paperbark swamp forests and associations dominated by eucalypts or banksias. They occasionally forage in parks and gardens of coastal towns and villages. The Mangrove honey eater usually builds a nest in a densely foliated mangrove tree and breeds in late winter and early summer. Mangrove honeyeaters eat nectar, from flowers, and invertebrates, including marine snails and crabs. They generally forage in mangroves, mainly taking food from among the foliage but also feeding at flowers, and from the trunks and roots. They also sometimes forage among flowering trees and shrubs in adjacent habitats (DEC 2005).

### *Direct and indirect impacts*

The NSW National Parks and Wildlife Service consider the following, direct and indirect impacts, as threats to the survival of the Mangrove honey eater (DEC 2005):

- The unknown but apparently small population of this species in NSW, restricted to a few known sites, leaves the mangrove Honeyeater vulnerable to declines resulting from unpredicted and random events.
- Clearing of mangroves, especially old stands, and adjoining forest and woodland vegetation, for residential, infrastructure or tourism, development, or for aesthetic reasons associated with such development.
- Use of herbicides and pesticides in agriculture and to protect tourist and residential areas that may affect habitat of the species or prey densities.
- Pollution of estuaries and mangrove vegetation and accumulation of herbicide and pesticide residues resulting from agricultural, tourism and residential use of pesticides.

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

### Osprey

#### *Extent of the local population*

The NPWS database contained thirty-two (32) records of this species within 10km of the site and fifty-three (53) within the Byron Shire LGA. There is one (1) record from the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

#### *Habitat and life-cycle*

Ospreys forage for fish in fresh, brackish or saline waters of rivers, lakes, estuaries and inshore coastal waters. A breeding pair requires a suitable foraging area with nesting sites nearby. The nest is a large bulky structure of dead sticks, often located in a tall dead tree or on artificial structures such as power transmission poles or towers. It is used year after year for as long as it lasts (Marchant and Higgins 1993; DEC 2005).

#### *Direct and Indirect Impacts*

The NSW National Parks and Wildlife Service consider the following, direct and indirect impacts, as threats to the survival of the Osprey (DEC 2005): loss of potential nest trees near the coast due to coastal urban development; disturbances and degradation to water quality from the disposal of treated effluent or stormwater runoff (e.g. increases in turbidity); disturbance from human activity to areas of any potential nest sites; disturbance from straying domestic pets and death and/or disease from the ingestion of fish containing discarded fishing tackle.

Simpson's Creek (i.e. forage area for the Osprey adjacent to the subject site) will not be affected by the proposed development. There may be minor indirect impacts to this species with the removal of potential nest trees.

### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.



## Swift Parrot

### *Extent of local population*

The NPWS database contained one (1) record of this species within 10km of the site, and one (1) sighting in the Byron Shire LGA. There are no records from the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

### *Habitat and Life-cycle*

The Swift parrot migrates to the Australian south-east mainland between March and October. On the mainland they generally occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Preferred feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*). Commonly used lerp infested trees include Inland Grey Box (*E. macrocarpa*), Grey Box (*E. moluccana*) and Blackbutt (*E. pilularis*). Some individuals have been recorded returning to foraging sites on a cyclic basis depending on food availability. Following winter they return to Tasmania where they breed from September to January, nesting in old trees with hollows and feeding in forests dominated by Tasmanian Blue Gum (*Eucalyptus globulus*).

### *Potential impacts of the proposed development*

The NSW National Parks and Wildlife Service consider the following impact as being the major threat to the survival of the Swift parrot (DEC 2005): clearing and degradation of rainforest remnants.

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species. Conversely, the proposed revegetation and regeneration practices outlined in this report could embellish the amount of suitable habitat which occurs on the subject site.

## Wallum froglet

### *Extent of the local population*

The NPWS database contained fifty-two (52) records of this species within 10km of the site and 107 sightings of this species in the Byron Shire LGA. There are seventeen (17) records from the TNR. This species was recorded on the subject site (**FIGURE 21 - VOLUME 1**).

The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

#### *Habitat and life-cycle*

Wallum froglets are found only in acid paperbark swamps and sedge swamps of the coastal 'wallum' country. The species is a late winter breeder. Males call in choruses from within sedge tussocks or at the water edge (DECC 2005).

#### *Direct and indirect Impacts*

The NSW National Parks and Wildlife Service consider the following, direct and indirect impacts, as threats to the survival of the Wallum froglet (DEC 2005):

- Impact of pest vertebrate species
- Destruction and degradation of coastal wetlands as a result of roadworks, coastal developments and sandmining.
- Reduction of water quality and modification to acidity in coastal wetlands.
- Grazing and associated frequent burning of coastal wetlands.

Wallum froglets have been recorded within the drainage lines on the subject site and adjacent vegetation. Approximately 0.57 ha of suitable Wallum froglet habitat will be lost and the proposed development is likely to have a minor impact on the froglet population. However, Wallum habitat will be retained on site in addition to incorporating Wallum froglet habitat into the site Storm Water Management Plan. This will result in a net gain of almost 3000m<sup>2</sup> of Wallum froglet habitat. A substantial population of this species occurs to the east and south of the site in TNR.

#### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

#### Wallum sedge-frog

##### *Extent of the local population*

The NPWS database contained twenty-four (24) records of this species within 10km of the site and thirty (30) sightings of this species in the Byron Shire LGA. There are twelve (12) records from the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

### *Habitat and life-cycle*

Paperbark swamps and sedge swamps of the coastal “wallum” country. Wallum is a Banksia dominated lowland heath ecosystem characterised by acidic water bodies. Olongburra Frogs are usually found amongst sedges and rushes in coastal wetlands (DECC 2005).

### *Direct and indirect Impacts*

The NSW National Parks and Wildlife Service consider the following, direct and indirect impacts, as threats to the survival of the Wallum sedge frog (DEC 2005):

- Predation by vertebrate pest species.
- Destruction and degradation of coastal wallum and coastal wetlands for roadworks, coastal developments and sand mining.
- Reduction of water quality and changes to acidity in coastal wetlands.
- Grazing and associated frequent burning of coastal wetlands.

Approximately 0.57 ha of suitable habitat for this species will be lost. However, this is considered to be a minor impact in the context of the large areas of quality habitat to the east and south of the site in TNR. In addition the Wallum sedge-frog will benefit from the compensatory habitat planned for the Wallum froglet.

### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

### White-eared monarch

#### *Extent of local population*

The White-eared monarch is endemic to the coastal lowlands and eastern slopes of the Great Divide of eastern Australia, extending from Cape York Peninsula south to north-eastern NSW. In NSW, White-eared Monarchs are generally found from the Queensland border south to Iluka at the mouth of the Clarence River, and inland as far as the Richmond Range. There are occasional records south of the Clarence River, near Woolgoolga and around Port Macquarie.

The NPWS database contained nine (9) records of this species within 10km of the site and 171 sightings of this species in the Byron Shire LGA. There are no records from the TNR. The local population for this species is considered to comprise of all individuals that are likely to occur on the subject site as well as any individuals within contiguous habitat, which could reasonably be expected to be mating with individuals on the subject site, including those individuals utilising the TNR.

This species was not recorded on the subject site but is considered to be a possible occurrence over time.

### *Life-cycle attributes*

The White-eared monarch is highly active when foraging, characteristically sallying, hovering and fluttering around the outer foliage of rainforest trees. They are usually observed high in the canopy or sub-canopy. They eat insects, but their diet is not well studied. They breed from about September to March, usually nesting high in the canopy, and often at the edge of patches of rainforest. In NSW, White-eared Monarchs occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest. They appear to prefer the ecotone between rainforest and other open vegetation types or the edges of rainforest, such as along roads.

### *Potential impacts of the proposed development*

The NSW National Parks and Wildlife Service consider the following, direct and indirect impacts, as threats to the survival of the Wallum sedge frog (DEC 2005):

- Predation by vertebrate pest species
- Destruction and degradation of coastal wallum and coastal wetlands for roadworks, coastal developments and sand mining.
- Reduction of water quality and changes to acidity in coastal wetlands.
- Grazing and associated frequent burning of coastal wetlands.

The development will not result in the loss of any potential habitat for this species. In addition, substantial areas of similar or better habitat occur in the 7(b) zone and to the east and south within the TNR.

### *Likelihood of local extinction*

The proposed development is not considered to represent a significant impact in relation to the distribution of habitat, in the locality, for the local population of this species. Therefore, it is considered that the proposed development is unlikely to result in the extinction, either in the short- or long-term, of the local population of this species.

**The long term viability of any of the above discussed fauna on the subject site will not be reduced by the proposed development.**

**The Proposal is unlikely to accelerate the extinction or place at risk the threatened fauna species recorded on the subject site.**

### *2. Will the proposal adversely affect critical habitat?*

Critical habitats are areas of land that are critical to the survival of a particular threatened species, population or ecological communities. Critical habitat areas are listed under the Threatened Species Conservation Act (1995). There is currently no habitat listed or recommend for any of the species or EEC's found on the subject site.

**APPENDIX 7**  
**TREE TABLE WITH TPZ & SRZ**

## TREE TABLE WITH TPZ & SRZ

No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
78	<i>Melaleuca quinquenervia</i>	5	12	2	0.5			0.19	6	2.5	F0.09 - F0.38	Yes	Going	
86	<i>Melaleuca quinquenervia</i>	5	8	2	0.35			0.41	4.2	2.1	F0.31 - F0.38	Yes	Going	
91	<i>Eucalyptus signata</i>	5	15	4	0.8			0.39	9.6	3.0	F0.27 - F0.71	No	Going	
95	<i>Eucalyptus signata</i>	5	10	3	0.5			0.56	6	2.5	F0.29 - F0.73	Yes	Going	
105	<i>Eucalyptus signata</i>	5	15	3	0.5			0.54	6	2.5	0.41 - 0.61	No	Going	
106	<i>Eucalyptus signata</i>	5	15	4	0.8			0.52	9.6	3.0	0.36 - 0.63	No	Going	
107	<i>Eucalyptus signata</i>	5	15	3	0.5			0.47	6	2.5	0.40 - 0.67	Yes	Going	
113	<i>Eucalyptus signata</i>	5	15	5	0.7			0.51	8.4	2.8	0.39 - 0.57	Yes	Going	
116	<i>Eucalyptus signata</i>	5	15	5	0.8				9.6	3.0	0.00 - 0.66	No	Going	
309	<i>Melaleuca quinquenervia</i>	6	15	1	0.2		0.91		2.4	1.7	C0.7 - C1.1	Yes	Going	
312	<i>Eucalyptus signata</i>	5	15	2	0.35		0.52		4.2	2.1	C0.58	No	Going	
338	<i>Melaleuca quinquenervia</i>	5	10	2	0.4		0.36		4.8	2.3	C0.12 - C0.67	Yes	Going	
349	<i>Melaleuca quinquenervia</i>	5	10	1	0.4		2.65		4.8	2.3	C2.8	Yes	Going	
351	<i>Melaleuca quinquenervia</i>	5	10	2	0.5		2.68		6	2.5	C3.2	Yes	Going	
352	<i>Melaleuca quinquenervia</i>	5	10	2	0.4		2.38		4.8	2.3	C3.1	Yes	Going	
356	<i>Melaleuca quinquenervia</i>	5	10	2	0.6		2.42		7.2	2.7	C2.2	Yes	Going	
359	<i>Melaleuca quinquenervia</i>	5	10	2	0.4		0.45		4.8	2.3	C1.2	Yes	Going	
403	<i>Melaleuca quinquenervia</i>	5	14	2	0.8			0.09	9.6	3.0	C0.07 - F0.43	No	Going	
404	<i>Melaleuca quinquenervia</i>	5	12	1	0.4			0.11	4.8	2.3	C0.07 - F0.29	No	Going	
432	<i>Melaleuca quinquenervia</i>	5	10	2	0.3			0.21	3.6	2.0	F0.12 - F0.50	No	Going	
434	<i>Eucalyptus signata</i>	5	12	3	0.5			0.26	6	2.5	F0.11 - F0.33	No	Going	
437	<i>Melaleuca quinquenervia</i>	6	10	1	0.25			0.30	3	1.8	0.0 - F0.39	No	Going	
439	<i>Melaleuca quinquenervia</i>	5	15	1	0.8			0.12	9.6	3.0	0.0 - F0.4	No	Going	
473	<i>Banksia aemula</i>	5	5	1	0.4				4.8	2.3	0 - C0.18	No	Going	

No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
479	<i>Banksia aemula</i>	5	12	1	0.4		0.30		4.8	2.3	C0.34	Yes	Going	
481	<i>Banksia aemula</i>	5	12	2	0.4		0.17		4.8	2.3	C0.28	Yes	Going	
518	<i>Eucalyptus signata</i>	5	10	2	0.3		0.02		3.6	2.0	0.0 - C0.18	No	Going	
525	<i>Eucalyptus signata</i>	5	10	2	0.3		0.22		3.6	2.0	C0.2	Yes	Going	
526	<i>Eucalyptus signata</i>	5	10	2	0.3		0.27		3.6	2.0	C0.26	Yes	Going	
527	<i>Eucalyptus signata</i>	5	10	2	0.3		0.28		3.6	2.0	C0.29	Yes	Going	
529	<i>Banksia aemula</i>	5	10	2	0.3		0.29		3.6	2.0	C0.31	Yes	Going	
531	<i>Eucalyptus signata</i>	5	4	2	0.3		0.21		3.6	2.0	0.0 - C0.32	Yes	Going	
532	<i>Eucalyptus signata</i>	5	12	2	0.4				4.8	2.3	0.0 - C0.32	Yes	Going	
536	<i>Eucalyptus signata</i>	5	15	4	0.8		0.12		9.6	3.0	0.0 - C0.22	Yes	Going	
547	<i>Eucalyptus signata</i>	5	15	4	0.8			0.73	9.6	3.0	F0.37 - F0.98	No	Going	
555	<i>Eucalyptus signata</i>	5	12	2	0.4			0.23	4.8	2.3	F0.14 - F0.46	No	Going	
556	<i>Eucalyptus signata</i>	5	14	3	0.6			0.90	7.2	2.7	F0.54 - F1.00	No	Going	
557	<i>Eucalyptus signata</i>	5	14	3	0.5			0.89	6	2.5	F0.55 - F0.99	No	Going	
561	<i>Banksia aemula</i>	5	10	2	0.8			0.34	9.6	3.0	F0.03 - F0.59	No	Going	
563	<i>Banksia aemula</i>	5	8	2	0.7			0.76	8.4	2.8	F0.48 - F0.99	No	Going	
564	<i>Eucalyptus signata</i>	5	8	2	0.6			0.60	7.2	2.7	F0.45 - F0.77	No	Going	
570	<i>Eucalyptus signata</i>	5	12	2	0.4			0.21	4.8	2.3	0.0 - F0.25	No	Going	
601	<i>Melaleuca quinquenervia</i>	5	12	2	0.4			0.70	4.8	2.3	F0.82	Yes	Going	
603	<i>Melaleuca quinquenervia</i>	5	4	1	0.4			0.70	4.8	2.3	F0.44 - F0.87	Yes	Going	
605	<i>Eucalyptus signata</i>	5	12	2	0.4			0.65	4.8	2.3	F0.44 - F0.78	No	Going	
609	<i>Melaleuca quinquenervia</i>	5	10	2	0.3			0.41	3.6	2.0	F0.56	Yes	Going	
610	<i>Melaleuca quinquenervia</i>	5	12	2	0.4			0.44	4.8	2.3	F0.56	Yes	Going	
623	<i>Eucalyptus signata</i>	5	12	2	0.5			0.55	6	2.5	F0.39 - F0.69	No	Going	
624	<i>Melaleuca quinquenervia</i>	5	15	3	0.7			0.90	8.4	2.8	F0.60 - F1.06	No	Going	
625	<i>Eucalyptus signata</i>	5	13	2	0.5			0.47	6	2.5	F0.35 - F0.70	No	Going	

No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
627	<i>Eucalyptus signata</i>	5	14	3	0.6			0.48	7.2	2.7	F0.27 - F1.07	No	Going	Design of parking to be confirmed
629	<i>Eucalyptus signata</i>	5	14	4	0.7			0.47	8.4	2.8	F0.26 - F0.77	No	Going	
630	<i>Eucalyptus signata</i>	5	15	4	0.8			0.41	9.6	3.0	F0.23 - F0.74	No	Going	
631	<i>Eucalyptus signata</i>	5	14	4	0.7			0.47	8.4	2.8	F0.21 - F0.72	No	Going	
649	<i>Banksia aemula</i>	5	12	2	0.4			0.01	4.8	2.3	F0.17	No	Going	
650	<i>Banksia aemula</i>	5	8	2	0.7			0.14	8.4	2.8	F0.07 - F0.21	Yes	Going	
651	<i>Banksia aemula</i>	5	8	2	0.7			0.02	8.4	2.8	C0.07 - F0.08	Yes	Going	
653	<i>Eucalyptus signata</i>	5	15	3	0.8			0.29	9.6	3.0	0.0 - F0.53	No	Going	
662	<i>Eucalyptus signata</i>	5	15	1	0.8			0.46	9.6	3.0	0.00 - F0.63	No	Going	
991	<i>Eucalyptus signata</i>	5	15	3	0.8			0.23	9.6	3.0	-	No	Going	
1005	<i>Melaleuca quinquenervia</i>	5	15	3	0.8			0.02	9.6	3.0	C0.05 - F0.15	No	Going	
1020	<i>Melaleuca quinquenervia</i>	5	15	3	0.8				9.6	3.0	F0.36 - F0.50	Yes	Going	
1021	<i>Melaleuca quinquenervia</i>	5	14	2	0.5			0.48	6	2.5	F0.39 - F0.57	No	Going	
1022	<i>Eucalyptus signata</i>	5	12	1	0.4			0.14	4.8	2.3	F0.16 - F0.50	No	Going	
1031	<i>Eucalyptus signata</i>	5	15	3	0.8			0.22	9.6	3.0	F0.29	Yes	Going	
1039	<i>Eucalyptus signata</i>	5	15	3	0.8			0.59	9.6	3.0	F0.57	Yes	Going	
1040	<i>Eucalyptus signata</i>	5	14	3	0.7			0.53	8.4	2.8	F0.42 - F0.56	Yes	Going	
1041	<i>Melaleuca quinquenervia</i>	5	14	2	0.6			0.80	7.2	2.7	F0.64 - F0.78	No	Going	
1043	<i>Eucalyptus signata</i>	5	13	1	0.6			0.30	7.2	2.7	F0.11 - F0.57	No	Going	
1049	<i>Eucalyptus signata</i>	5	12	1	0.5		0.16		6	2.5	C0.02 - C0.24	Yes	Going	
1064	<i>Eucalyptus signata</i>	5	8	1	0.6			0.34	7.2	2.7	F0.37	Yes	Going	
1065	<i>Eucalyptus signata</i>	5	8	1	0.6			0.26	7.2	2.7	F0.47	Yes	Going	
1066	<i>Eucalyptus signata</i>	5	14	2	0.7		0.18		8.4	2.8	C0.18	Yes	Going	
1067	<i>Eucalyptus signata</i>	5	14	3	0.7			0.20	8.4	2.8	F0.17 - F0.65	No	Going	
1103	<i>Melaleuca quinquenervia</i>	5	14	2	0.7		0.21		8.4	2.8	C0.41 - C0.08	Yes	Going	
1111	<i>Melaleuca quinquenervia</i>	5	14	2	0.7			0.29	8.4	2.8	?	Yes	Going	



No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
1114	<i>Melaleuca quinquenervia</i>	5	14	1	0.6			0.77	7.2	2.7	F0.58 - F0.90	No	Going	Alternate TPZ
1115	<i>Melaleuca quinquenervia</i>	5	14	2	0.7			0.48	8.4	2.8	F0.38 - F0.55	No	Going	
1120	<i>Melaleuca quinquenervia</i>	6	8	1	0.2			0.20	2.4	1.7	F0.35	Yes	Going	
1121	<i>Melaleuca quinquenervia</i>	6	8	1	0.2			0.02	2.4	1.7	F0.07	Yes	Going	
1123	<i>Melaleuca quinquenervia</i>	5	12	2	0.4			0.23	4.8	2.3	F0.07	No	Going	
1168	<i>Melaleuca quinquenervia</i>	5	12	2	0.4			0.47	4.8	2.3	C0.46	Yes	Going	
1169	<i>Melaleuca quinquenervia</i>	5	10	1	0.3			0.55	3.6	2.0	C0.57	Yes	Going	
1181	<i>Banksia ericifolia</i>	5	12	2	0.5		1.53		6	2.5	C1.47	No	Going	
2	<i>Eucalyptus signata</i>	5	15	4	0.5				6	2.5	-	No	Staying	
3	<i>Eucalyptus signata</i>	5	12	4	0.35				4.2	2.1	-	No	Staying	
4	<i>Eucalyptus signata</i>	5	12	4	0.4				4.8	2.3	-	No	Staying	
5	<i>Banksia aemula</i>	5	5	3	0.4				4.8	2.3	0.0 - F0.77	No	Staying	
6	<i>Eucalyptus signata</i>	5	12	4	0.4				4.8	2.3	-	No	Staying	
7	<i>Eucalyptus signata</i>	5	15	4	0.6				7.2	2.7	-	No	Staying	
9	<i>Eucalyptus signata</i>	5	10	3	0.3				3.6	2.0	-	No	Staying	
10	<i>Eucalyptus signata</i>	5	15	5	0.7				8.4	2.8	-	No	Staying	
13	<i>Eucalyptus signata</i>	5	15	4	0.5				6	2.5	0.0 - F0.27	No	Staying	
17	<i>Eucalyptus signata</i>	5	12	2	0.35				4.2	2.1	-	No	Staying	
29	<i>Melaleuca quinquenervia</i>	1	10	3	0.3				3.6	2.0	-	No	Staying	
33	<i>Melaleuca quinquenervia</i>	1	10	3	0.3				3.6	2.0	-	No	Staying	
43	<i>Melaleuca quinquenervia</i>	1	12	3	0.25				3	1.8	-	No	Staying	
45	<i>Eucalyptus signata</i>	5	10	4	0.45				5.4	2.4	-	No	Staying	
46	<i>Eucalyptus signata</i>	6	10	2	0.2				2.4	1.7	-	No	Staying	
50	<i>Melaleuca quinquenervia</i>	1	10		0.2				2.4	1.7	-	No	Staying	
52	<i>Melaleuca quinquenervia</i>	1	10	2	0.25				3	1.8	-	No	Staying	
56	<i>Melaleuca quinquenervia</i>	1	15	3	0.3				3.6	2.0	-	No	Staying	

No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
57	<i>Melaleuca quinquenervia</i>	1	15	3	0.25				3	1.8	-	No	Staying	
59	<i>Melaleuca quinquenervia</i>	1	15	3	0.3				3.6	2.0	-	No	Staying	
61	<i>Lophostemon suaveolens</i>	5	15	4	0.5				6	2.5	-	No	Staying	
63	<i>Lophostemon suaveolens</i>	6	10	2	0.25				3	1.8	-	No	Staying	
65	<i>Eucalyptus signata</i>	5	15	5	0.6				7.2	2.7	-	No	Staying	
72	<i>Eucalyptus signata</i>	5	12	4	0.5				6	2.5	-	No	Staying	
76	<i>Eucalyptus signata</i>	6	12	1	0.2				2.4	1.7	-	No	Staying	
93	<i>Eucalyptus signata</i>	5	15	3	0.8				9.6	3.0	-	No	Staying	
94	<i>Eucalyptus signata</i>	5	10	3	0.5				6	2.5	-	No	Staying	
96	<i>Eucalyptus signata</i>	5	10	3	0.4				4.8	2.3	0.0 - F0.10	No	Staying	
97	<i>Eucalyptus signata</i>	5	10	4	0.5				6	2.5	-	No	Staying	
99	<i>Eucalyptus signata</i>	5	15	3	0.8				9.6	3.0	-	No	Staying	
100	<i>Eucalyptus signata</i>	5	15	3	0.5				6	2.5	-	No	Staying	
101	<i>Eucalyptus signata</i>	5	15	3	0.5				6	2.5	-	No	Staying	
102	<i>Eucalyptus signata</i>	5	15	3	0.5				6	2.5	-	No	Staying	
103	<i>Eucalyptus signata</i>	5	15	3	0.5				6	2.5	-	No	Staying	
123	<i>Eucalyptus signata</i>	5	10	3	0.5				6	2.5	0.00 - 0.15	No	Staying	
125	<i>Melaleuca quinquenervia</i>	5	10	2	0.4				4.8	2.3	-	No	Staying	
127	<i>Melaleuca quinquenervia</i>	5	10	2	0.3				3.6	2.0	-	No	Staying	
128	<i>Melaleuca quinquenervia</i>	5	10	2	0.3				3.6	2.0	0.00 - 0.05	No	Staying	
135	<i>Melaleuca quinquenervia</i>	5	10	2	0.3				3.6	2.0	-	No	Staying	
140	<i>Melaleuca quinquenervia</i>	5	10	2	0.3			0.19	3.6	2.0	-	No	Staying	
142	<i>Melaleuca quinquenervia</i>	5	10	2	0.3				3.6	2.0	0.0 - F0.1	No	Staying	
143	<i>Melaleuca quinquenervia</i>	5	10	3	0.5				6	2.5	-	No	Staying	
146	<i>Melaleuca quinquenervia</i>	5	10	4	0.9				10.8	3.2	-	No	Staying	
158	<i>Eucalyptus signata</i>	5	10	3	0.4				4.8	2.3	0 - F0.17	No	Staying	

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166	<i>Melaleuca quinquenervia</i>	1	10	1	0.3				3.6	2.0	-	No	Staying	
168	<i>Melaleuca quinquenervia</i>	1	10	2	0.3				3.6	2.0	-	No	Staying	
173	<i>Melaleuca quinquenervia</i>	1	10	2	0.45				5.4	2.4	-	No	Staying	
175	<i>Melaleuca quinquenervia</i>	1	10	2	0.35				4.2	2.1	-	No	Staying	
183	<i>Leptospermum polygalifolium</i>	1	10	2	0.35				4.2	2.1	-	No	Staying	
185	<i>Melaleuca quinquenervia</i>	1	10	2	0.25				3	1.8	-	No	Staying	
192	<i>Melaleuca quinquenervia</i>	1	10	2	0.25				3	1.8	-	No	Staying	
195	<i>Melaleuca quinquenervia</i>	1	10	2	0.3				3.6	2.0	-	No	Staying	
198	<i>Eucalyptus signata</i>	5	10	5	0.65				7.8	2.8	-	No	Staying	
223	<i>Eucalyptus signata</i>	5	10	3	0.3				3.6	2.0	-	No	Staying	
227	<i>Banksia aemula</i>	5	10	2	0.45				5.4	2.4	0.0 - F0.24	No	Staying	
239	<i>Eucalyptus signata</i>	5	15	3	0.7				8.4	2.8	0.0 - F0.28	No	Staying	
240	<i>Eucalyptus signata</i>	5	15	3	0.7				8.4	2.8	0.0 - F0.45	No	Staying	
250	<i>Acacia melanoxylon</i>	5	10	3	0.5				6	2.5	-	No	Staying	
259	<i>Melaleuca quinquenervia</i>	6	15	1	0.2				2.4	1.7	-	No	Staying	
345	<i>Melaleuca quinquenervia</i>	5	10	2	0.4			0.21	4.8	2.3	F0.11 - F0.25	No	Staying	
374	<i>Melaleuca quinquenervia</i>	5	15	2	0.4			0.03	4.8	2.3	F0.04 - F0.15	No	Staying	
377	<i>Melaleuca quinquenervia</i>	6	15	1	0.25			0.10	3	1.8	F0.1 - F0.13	No	Staying	
387	<i>Melaleuca quinquenervia</i>	5	15	2	0.4		0.10		4.8	2.3	C0.01 - C0.21	No	Staying	Locally raise cut
388	<i>Melaleuca quinquenervia</i>	5	15	2	0.4		0.19		4.8	2.3	C0.11 - C0.26	No	Staying	Locally raise cut
435	<i>Melaleuca quinquenervia</i>	5	14	2	0.5				6	2.5	0.0 - F0.27	No	Staying	
452	<i>Eucalyptus signata</i>	5	14	3	0.5			0.04	6	2.5	C0.04 - F0.18	No	Staying	
461	<i>Eucalyptus signata</i>	5	15	4	0.8				9.6	3.0	C0.13 - F0.13	No	Staying	
464	<i>Banksia aemula</i>	5	4	1	0.3				3.6	2.0	-	No	Staying	
465	<i>Banksia aemula</i>	5	5	1	0.4				4.8	2.3	-	No	Staying	
466	<i>Banksia aemula</i>	5	5	1	0.4				4.8	2.3	-	No	Staying	

No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
467	<i>Banksia aemula</i>	5	5	1	0.4				4.8	2.3	-	No	Staying	
468	<i>Banksia aemula</i>	5	10	1	0.3				3.6	2.0	-	No	Staying	
470	<i>Banksia aemula</i>	5	5	1	0.4				4.8	2.3	-	No	Staying	
471	<i>Banksia aemula</i>	5	12	1	0.4				4.8	2.3	-	No	Staying	
474	<i>Banksia aemula</i>	5	4	1	0.3				3.6	2.0	-	No	Staying	
475	<i>Banksia aemula</i>	5	6	2	0.5				6	2.5	-	No	Staying	
476	<i>Banksia aemula</i>	5	5	1	0.4				4.8	2.3	-	No	Staying	
477	<i>Banksia aemula</i>	5	5	1	0.4				4.8	2.3	-	No	Staying	
478	<i>Banksia aemula</i>	5	6	2	0.5				6	2.5	-	No	Staying	
484	<i>Banksia aemula</i>	5	4	1	0.3				3.6	2.0	-	No	Staying	
485	<i>Banksia aemula</i>	5	5	1	0.4				4.8	2.3	-	No	Staying	
486	<i>Banksia aemula</i>	5	6	1	0.3				3.6	2.0	-	No	Staying	
490	<i>Banksia aemula</i>	5	4	1	0.3				3.6	2.0	-	No	Staying	
492	<i>Banksia aemula</i>	6	3	1	0.2				2.4	1.7	-	No	Staying	
493	<i>Banksia aemula</i>	5	4	1	0.3				3.6	2.0	-	No	Staying	
495	<i>Banksia aemula</i>	5	4	1	0.3				3.6	2.0	-	No	Staying	
496	<i>Banksia aemula</i>	5	6	1	0.5				6	2.5	-	No	Staying	
497	<i>Eucalyptus signata</i>	5	10	1	0.3				3.6	2.0	-	No	Staying	
498	<i>Banksia aemula</i>	5	6	2	0.5				6	2.5	-	No	Staying	
499	<i>Banksia aemula</i>	5	5	2	0.4				4.8	2.3	-	No	Staying	
503	<i>Eucalyptus signata</i>	5	12	1	0.4		0.16		4.8	2.3	0.0 - C.28	No	Staying	Locally raise cut
504	<i>Eucalyptus signata</i>	5	10	1	0.3		0.20		3.6	2.0	0.0 - C.28	No	Staying	Locally raise cut
505	<i>Banksia aemula</i>	5	4	1	0.3				3.6	2.0	0.0 - C0.12	No	Staying	
506	<i>Banksia aemula</i>	5	6	2	0.5				6	2.5	-	No	Staying	
507	<i>Banksia aemula</i>	5	5	2	0.4				4.8	2.3	-	No	Staying	
508	<i>Banksia aemula</i>	5	5	2	0.4				4.8	2.3	-	No	Staying	

No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
510	<i>Eucalyptus signata</i>	5	5	2	0.4				4.8	2.3	-	No	Staying	
512	<i>Eucalyptus signata</i>	5	12	1	0.4				4.8	2.3	-	No	Staying	
513	<i>Banksia aemula</i>	5	4	2	0.3				3.6	2.0	-	No	Staying	
514	<i>Eucalyptus signata</i>	5	10	2	0.3				3.6	2.0	-	No	Staying	
515	<i>Eucalyptus signata</i>	5	12	2	0.4				4.8	2.3	-	No	Staying	
533	<i>Eucalyptus signata</i>	5	12	2	0.4				4.8	2.3	-	No	Staying	
534	<i>Eucalyptus signata</i>	5	10	2	0.3				3.6	2.0	-	No	Staying	
537	<i>Banksia aemula</i>	5	12	2	0.4				4.8	2.3	0.0 - C0.06	No	Staying	
566	<i>Banksia aemula</i>	5	15	3	0.8				9.6	3.0	0.0 - F0.21	No	Staying	
567	<i>Banksia aemula</i>	5	6	2	0.5				6	2.5	-	No	Staying	
571	<i>Eucalyptus signata</i>	5	14	3	0.7				8.4	2.8	0.0 - F0.25	No	Staying	
572	<i>Eucalyptus signata</i>	5	10	2	0.3				3.6	2.0	0.0 - F0.23	No	Staying	
578	<i>Eucalyptus signata</i>	5	15	3	0.8				9.6	3.0	-	No	Staying	
632	<i>Eucalyptus signata</i>	5	14	3	0.6			0.12	7.2	2.7	F0.03 - F0.22	No	Staying	
633	<i>Eucalyptus signata</i>	5	14	3	0.6				7.2	2.7	0.0 - F0.48	No	Staying	
635	<i>Eucalyptus signata</i>	5	12	2	0.4				4.8	2.3	-	No	Staying	
637	<i>Banksia aemula</i>	5	8	3	0.7				8.4	2.8	-	No	Staying	
642	<i>Banksia aemula</i>	5	10	1	0.4				4.8	2.3	-	No	Staying	
643	<i>Eucalyptus signata</i>	5	8	2	0.6				7.2	2.7	-	No	Staying	
658	<i>Eucalyptus signata</i>	5	12	2	0.4				4.8	2.3	-	No	Staying	
659	<i>Eucalyptus signata</i>	5	15	4	0.7				8.4	2.8	0.00 - F0.29	No	Staying	
668	<i>Leptospermum polygalifolium</i>	1	12	1	0.4				4.8	2.3	-	No	Staying	
671	<i>Leptospermum polygalifolium</i>	1	12	1	0.4				4.8	2.3	-	No	Staying	
682	<i>Melaleuca quinquenervia</i>	1	8	1	0.2				2.4	1.7	-	No	Staying	
714	<i>Melaleuca quinquenervia</i>	1	14	2	0.7				8.4	2.8	-	No	Staying	
715	<i>Melaleuca quinquenervia</i>	1	8	1	0.2				2.4	1.7	-	No	Staying	

Alternate TPZ

No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
719	<i>Melaleuca quinquenervia</i>	1	10	2	0.3				3.6	2.0	-	No	Staying	
720	<i>Eucalyptus signata</i>	5	10	2	0.3			0.44	3.6	2.0	-	No	Staying	
721	<i>Eucalyptus signata</i>	5	12	2	0.4			1.27	4.8	2.3	-	No	Staying	
728	<i>Eucalyptus signata</i>	5	12	2	0.4				4.8	2.3	-	No	Staying	
737	<i>Eucalyptus signata</i>	5	14	2	0.5			0.43	6	2.5	-	No	Staying	
739	<i>Melaleuca quinquenervia</i>	1	8	1	0.2				2.4	1.7	-	No	Staying	
740	<i>Melaleuca quinquenervia</i>	1	8	1	0.2				2.4	1.7	-	No	Staying	
741	<i>Melaleuca quinquenervia</i>	1	8	1	0.2				2.4	1.7	-	No	Staying	
742	<i>Melaleuca quinquenervia</i>	1	8	1	0.2				2.4	1.7	-	No	Staying	
743	<i>Melaleuca quinquenervia</i>	1	8	1	0.2				2.4	1.7	-	No	Staying	
744	<i>Melaleuca quinquenervia</i>	1	8	1	0.2				2.4	1.7	-	No	Staying	
746	<i>Eucalyptus signata</i>	5	8	1	0.2			0.70	2.4	1.7	-	No	Staying	
749	<i>Eucalyptus signata</i>	5	14	2	0.6				7.2	2.7	-	No	Staying	
751	<i>Eucalyptus signata</i>	5	14	3	0.8				9.6	3.0	-	No	Staying	
753	<i>Eucalyptus signata</i>	5	14	3	0.8				9.6	3.0	-	No	Staying	
761	<i>Banksia aemula</i>	5	14	2	0.6				7.2	2.7	-	No	Staying	
765	<i>Banksia aemula</i>	5	10	2	0.8				9.6	3.0	-	No	Staying	
767	<i>Eucalyptus signata</i>	5	10	1	0.4				4.8	2.3	-	No	Staying	
772	<i>Banksia aemula</i>	5	5	1	0.3				3.6	2.0	-	No	Staying	
774	<i>Banksia aemula</i>	5	12	2	0.4				4.8	2.3	-	No	Staying	
775	<i>Banksia aemula</i>	5	5	1	0.3				3.6	2.0	-	No	Staying	
777	<i>Eucalyptus signata</i>	5	8	2	0.6				7.2	2.7	-	No	Staying	
779	<i>Eucalyptus signata</i>	5	10	2	0.9			0..01	10.8	3.2	-	No	Staying	
780	<i>Banksia aemula</i>	6	8	1	0.2				2.4	1.7	-	No	Staying	
782	<i>Banksia aemula</i>	5	10	2	0.8			0.13	9.6	3.0	-	No	Staying	
784	<i>Banksia aemula</i>	5	10	2	0.8				9.6	3.0	-	No	Staying	

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791	<i>Banksia aemula</i>	5	10	2	0.8			0.14	9.6	3.0	-	No	Staying	
792	<i>Eucalyptus signata</i>	5	4	1	0.3				3.6	2.0	-	No	Staying	
793	<i>Eucalyptus signata</i>	5	8	2	0.7				8.4	2.8	-	No	Staying	
794	<i>Eucalyptus signata</i>	5	15	3	0.8				9.6	3.0	-	No	Staying	
795	<i>Eucalyptus signata</i>	5	14	2	0.5				6	2.5	-	No	Staying	
796	<i>Eucalyptus signata</i>	5	15	2	0.7				8.4	2.8	-	No	Staying	
797	<i>Eucalyptus signata</i>	5	14	2	0.6				7.2	2.7	-	No	Staying	
798	<i>Banksia aemula</i>	5	14	3	0.7				8.4	2.8	-	No	Staying	
799	<i>Banksia aemula</i>	5	14	3	0.7				8.4	2.8	-	No	Staying	
800	<i>Banksia aemula</i>	5	10	2	0.8				9.6	3.0	-	No	Staying	
801	<i>Eucalyptus signata</i>	5	10	2	0.8				9.6	3.0	-	No	Staying	
817	<i>Banksia aemula</i>	5	15	2	0.8				9.6	3.0	-	No	Staying	
829	<i>Banksia aemula</i>	5	12	2	0.5				6	2.5	-	No	Staying	
834	<i>Banksia aemula</i>	5	12	2	0.5			0.34	6	2.5	-	No	Staying	
838	<i>Banksia aemula</i>	5	12	1	0.5			0.34	6	2.5	-	No	Staying	
839	<i>Banksia aemula</i>	5	10	1	0.4			0.24	4.8	2.3	-	No	Staying	
841	<i>Allocasuarina littoralis</i>	3	10	2	0.8				9.6	3.0	-	No	Staying	
842	<i>Allocasuarina littoralis</i>	3	10	2	0.8				9.6	3.0	-	No	Staying	
844	<i>Banksia aemula</i>	5	10	1	0.4				4.8	2.3	-	No	Staying	
851	<i>Banksia aemula</i>	5	6	1	0.5			0.38	6	2.5	-	No	Staying	
856	<i>Banksia aemula</i>	5	10	1	0.4			0.32	4.8	2.3	-	No	Staying	
858	<i>Banksia aemula</i>	5	5	2	0.3			0.15	3.6	2.0	-	No	Staying	
864	<i>Eucalyptus signata</i>	5	12	2	0.5			0.08	6	2.5	-	No	Staying	
865	<i>Eucalyptus signata</i>	5	15	2	0.7			0.07	8.4	2.8	-	No	Staying	
866	<i>Eucalyptus signata</i>	5	14	4	0.8			0.26	9.6	3.0	-	No	Staying	
867	<i>Eucalyptus signata</i>	5	14	4	0.8				9.6	3.0	-	No	Staying	

No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
869	<i>Xanthorrhoea johnsonii</i>	5	14	3	0.8				9.6	3.0	-	No	Staying	
872	<i>Melaleuca quinquenervia</i>	1	3	1					0	0.0	-	No	Staying	
873	<i>Eucalyptus signata</i>	5	8	1	0.2				2.4	1.7	-	No	Staying	
875	<i>Eucalyptus signata</i>	5	10	1	0.3				3.6	2.0	-	No	Staying	
876	<i>Eucalyptus signata</i>	5	10	2	0.3				3.6	2.0	-	No	Staying	
878	<i>Melaleuca quinquenervia</i>	1	12	2	0.6				7.2	2.7	-	No	Staying	
881	<i>Eucalyptus signata</i>	5	12	2	0.4				4.8	2.3	-	No	Staying	
883	<i>Eucalyptus signata</i>	5	12	1	0.4				4.8	2.3	-	No	Staying	
884	<i>Eucalyptus signata</i>	5	12	2	0.4				4.8	2.3	-	No	Staying	
885	<i>Eucalyptus signata</i>	5	14	3	0.6				7.2	2.7	-	No	Staying	
886	<i>Eucalyptus signata</i>	5	10	2	0.3				3.6	2.0	-	No	Staying	
889	<i>Eucalyptus signata</i>	5	14	2	0.6				7.2	2.7	-	No	Staying	
892	<i>Eucalyptus signata</i>	5	15	3	0.8				9.6	3.0	-	No	Staying	
893	<i>Eucalyptus signata</i>	5	10	2	0.3				3.6	2.0	-	No	Staying	
895	<i>Eucalyptus signata</i>	5	10	2	0.3				3.6	2.0	-	No	Staying	
900	<i>Eucalyptus signata</i>	5	15	3	0.8				9.6	3.0	-	No	Staying	
904	<i>Eucalyptus signata</i>	5	14	2	0.6			0.31	7.2	2.7	-	No	Staying	
905	<i>Eucalyptus signata</i>	5	15	3	0.8			0.42	9.6	3.0	-	No	Staying	
906	<i>Allocasuarina littoralis</i>	3	15	2	0.8			0.44	9.6	3.0	-	No	Staying	
910	<i>Allocasuarina littoralis</i>	3	14	2	0.6			0.04	7.2	2.7	-	No	Staying	
911	<i>Banksia aemula</i>	5	10	1	0.3		0.17		3.6	2.0	-	No	Staying	
913	<i>Allocasuarina littoralis</i>	3	12	2	0.5				6	2.5	-	No	Staying	
915	<i>Banksia aemula</i>	5	10	1	0.3				3.6	2.0	-	No	Staying	
916	<i>Allocasuarina littoralis</i>	3	10	1	0.4				4.8	2.3	-	No	Staying	
918	<i>Banksia aemula</i>	5	8	1	0.25				3	1.8	-	No	Staying	
919	<i>Allocasuarina littoralis</i>	4	8	1	0.25				3	1.8	-	No	Staying	



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925	<i>Banksia aemula</i>	6	8	1	0.25				3	1.8	-	No	Staying	
931	<i>Allocasuarina littoralis</i>	3	8	2	0.6				7.2	2.7	-	No	Staying	
935	<i>Eucalyptus signata</i>	5	10	2	0.4			0.56	4.8	2.3	-	No	Staying	
937	<i>Eucalyptus signata</i>	6	8	1	0.2			0.44	2.4	1.7	-	No	Staying	
939	<i>Allocasuarina littoralis</i>	3	15	3	0.8			0.32	9.6	3.0	-	No	Staying	
942	<i>Allocasuarina littoralis</i>	3	10	2	0.3			0.40	3.6	2.0	-	No	Staying	
950	<i>Eucalyptus signata</i>	5	8	1	0.25			0.63	3	1.8	-	No	Staying	
987	<i>Eucalyptus signata</i>	5	15	3	0.8				9.6	3.0	-	No	Staying	
1025	<i>Eucalyptus signata</i>	5	14	2	0.6			0.05	7.2	2.7	F0.02 - F0.15	No	Staying	
1028	<i>Eucalyptus signata</i>	5	12	2	0.5			0.01	6	2.5	C0.05 - F0.15	No	Staying	
1032	<i>Eucalyptus signata</i>	5	15	3	0.8			0.07	9.6	3.0	F0.02 - F0.19	No	Staying	
1033	<i>Eucalyptus signata</i>	5	15	3	0.8			0.04	9.6	3.0	F0.02 - F0.19	No	Staying	
1047	<i>Eucalyptus signata</i>	5	10	2	0.8			0.08	9.6	3.0	C0.14 - F0.33	No	Staying	
1050	<i>Eucalyptus signata</i>	5	14	3	0.7			0.15	8.4	2.8	C0.07 - F0.35	No	Staying	
1051	<i>Banksia aemula</i>	5	14	3	0.6			0.16	7.2	2.7	C0.07 - F0.35	No	Staying	
1062	<i>Banksia aemula</i>	5	6	1	0.5				6	2.5	C0.23 - F0.03	No	Staying	
1063	<i>Banksia aemula</i>	5	12	2	0.6			0.03	7.2	2.7	C0.03 - F0.05	No	Staying	
1101	<i>Melaleuca quinquenervia</i>	5	14	3	0.6		0.07		7.2	2.7	C0.24 - F0.25	No	Staying	
1109	<i>Melaleuca quinquenervia</i>	5	12	1	0.4			0.14	4.8	2.3	F0.04 - F0.18	No	Staying	
1124	<i>Melaleuca quinquenervia</i>	5	13	2	0.6			0.16	7.2	2.7	0.0 - F0.33	No	Staying	
1128	<i>Melaleuca quinquenervia</i>	5	12	2	0.4				4.8	2.3	0.0 - F0.31	No	Staying	
1129	<i>Melaleuca quinquenervia</i>	5	10	1	0.3				3.6	2.0	0.0 - 0.34	No	Staying	
1130	<i>Melaleuca quinquenervia</i>	5	12	2	0.4				4.8	2.3	-	No	Staying	
1131	<i>Melaleuca quinquenervia</i>	5	10	1	0.3				3.6	2.0	-	No	Staying	
1132	<i>Melaleuca quinquenervia</i>	5	14	2	0.6				7.2	2.7	-	No	Staying	
1163	<i>Melaleuca quinquenervia</i>	5	14	2	0.6			0.05	7.2	2.7	F0.01 - F0.18	No	Staying	

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1164	<i>Melaleuca quinquenervia</i>	5	12	2	0.5			0.16	6	2.5	F0.11 - F0.25	No	Staying	
1165	<i>Melaleuca quinquenervia</i>	5	12	1	0.4			0.07	4.8	2.3	0.0 - F0.13	No	Staying	
1166	<i>Melaleuca quinquenervia</i>	5	10	1	0.3		0.17		3.6	2.0	C0.2 - C0.13	No	Staying	
602	<i>Allocasuarina littoralis</i>	3	12	2	0.4	Glossy black-cockatoo food tree		0.65	4.8	2.3	F0.5 - F0.87	No	Going	
608	<i>Allocasuarina littoralis</i>	3	12	2	0.4	Glossy black-cockatoo food tree		0.32	4.8	2.3	F0.45	Yes	Going	
611	<i>Allocasuarina littoralis</i>	3	10	2	0.3	Glossy black-cockatoo food tree	0.12		3.6	2.0	C0.44 - F0.08	No	Going	
612	<i>Allocasuarina littoralis</i>	3	10	1	0.3	Glossy black-cockatoo food tree	0.15		3.6	2.0	C0.44 - F0.21	No	Going	
619	<i>Allocasuarina littoralis</i>	3	14	2	0.6	Glossy black-cockatoo food tree		0.15	7.2	2.7	C0.44 - F0.41	No	Going	
620	<i>Allocasuarina littoralis</i>	3	10	1	0.3	Glossy black-cockatoo food tree		0.12	3.6	2.0	C0.22 - F0.34	No	Going	
622	<i>Allocasuarina littoralis</i>	3	10	1	0.3	Glossy black-cockatoo food tree		0.40	3.6	2.0	F0.33 - F0.45	No	Going	
1177	<i>Allocasuarina littoralis</i>	3	10	1	0.3	Glossy black-cockatoo food tree	0.72		3.6	2.0	C0.76	No	Going	
511	<i>Allocasuarina littoralis</i>	3	4	1	0.4	Glossy black-cockatoo food tree - <b>MATURE</b>			4.8	2.3	-	No	Staying	
641	<i>Allocasuarina littoralis</i>	3	8	1	0.7	Glossy black-cockatoo food tree - <b>MATURE</b>			8.4	2.8	-	No	Staying	
764	<i>Allocasuarina littoralis</i>	3	10	2	0.3	Glossy black-cockatoo food tree - <b>MATURE</b>			3.6	2.0	-	No	Staying	
830	<i>Allocasuarina littoralis</i>	3	12	2	0.5	Glossy black-cockatoo food tree - <b>MATURE</b>			6	2.5	-	No	Staying	

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832	<i>Allocasuarina littoralis</i>	3	5	1	0.3	Glossy black-cockatoo food tree - <b>MATURE</b>		0.60	3.6	2.0	-	No	Staying	
833	<i>Allocasuarina littoralis</i>	3	15	2	0.7	Glossy black-cockatoo food tree - <b>MATURE</b>		0.60	8.4	2.8	-	No	Staying	
835	<i>Allocasuarina littoralis</i>	3	12	2	0.5	Glossy black-cockatoo food tree - <b>MATURE</b>		0.38	6	2.5	-	No	Staying	
837	<i>Allocasuarina littoralis</i>	3	8	2	0.6	Glossy black-cockatoo food tree - <b>MATURE</b>		0.45	7.2	2.7	-	No	Staying	
840	<i>Allocasuarina littoralis</i>	3	14	2	1.2	Glossy black-cockatoo food tree - <b>MATURE</b>			14.4	3.6	-	No	Staying	
850	<i>Allocasuarina littoralis</i>	3	10	2	0.4	Glossy black-cockatoo food tree - <b>MATURE</b>		0.49	4.8	2.3	-	No	Staying	
857	<i>Allocasuarina littoralis</i>	3	10	2	0.8	Glossy black-cockatoo food tree - <b>MATURE</b>		0.40	9.6	3.0	-	No	Staying	
859	<i>Allocasuarina littoralis</i>	3	12	2	0.5	Glossy black-cockatoo food tree - <b>MATURE</b>		0.22	6	2.5	-	No	Staying	
860	<i>Allocasuarina littoralis</i>	3	10	2	0.8	Glossy black-cockatoo food tree - <b>MATURE</b>		0.22	9.6	3.0	-	No	Staying	
917	<i>Allocasuarina littoralis</i>	3	12	3	1	Glossy black-cockatoo food tree - <b>MATURE</b>			12	3.3	-	No	Staying	
926	<i>Allocasuarina littoralis</i>	3	12	3	1	Glossy black-cockatoo food tree - <b>MATURE</b>			12	3.3	-	No	Staying	
914	<i>Allocasuarina littoralis</i>	2	12	3	1	Glossy black-cockatoo food tree - <b>MATURE + CHEWED CONES</b>			12	3.3	-	No	Staying	
108	<i>Eucalyptus signata</i>	2	15	3	0.5	Habitat tree		0.29	6	2.5	0.00 - 0.63	Yes	Going	
109	<i>Eucalyptus signata</i>	2	15	3	0.5	Habitat tree		0.36	6	2.5	0.00 - 0.64	Yes	Going	

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546	<i>Eucalyptus signata</i>	2	5	2	0.4	Habitat tree		0.87	4.8	2.3	F0.60 - F0.98	No	Going	
558	<i>Eucalyptus signata</i>	2	14	4	0.7	Habitat tree		0.92	8.4	2.8	F0.82 - F1.10	No	Going	
562	<i>Banksia aemula</i>	2	10	2	0.8	Habitat tree		0.41	9.6	3.0	F0.12 - F0.70	No	Going	
66	<i>Eucalyptus signata</i>	2	15	3	0.8	Habitat tree			9.6	3.0	-	No	Staying	
73	<i>Eucalyptus signata</i>	2	12	5	0.8	Habitat tree			9.6	3.0	-	No	Staying	
74	<i>Eucalyptus signata</i>	2	12	5	0.7	Habitat tree			8.4	2.8	0.0 - F0.19	No	Staying	
77	<i>Eucalyptus signata</i>	2	12	3	0.6	Habitat tree			7.2	2.7	-	No	Staying	
89	<i>Eucalyptus signata</i>	2	15	3	0.4	Habitat tree			4.8	2.3	-	No	Staying	
90	<i>Eucalyptus signata</i>	2	15	4	0.8	Habitat tree			9.6	3.0	0.0 - F0.35	No	Staying	
98	<i>Eucalyptus signata</i>	2	15	3	0.8	Habitat tree			9.6	3.0	-	No	Staying	
110	<i>Eucalyptus signata</i>	2	15	5	0.8	Habitat tree		0.18	9.6	3.0	0.00 - 0.64	No	Staying	Locally steepen batter - Non complying
291	<i>Eucalyptus signata</i>	2	15	2	0.35	Habitat tree			4.2	2.1	-	No	Staying	
463	<i>Eucalyptus signata</i>	2	10	4	0.8	Habitat tree			9.6	3.0	0 - F0.14	No	Staying	
480	<i>Eucalyptus signata</i>	2	10	4	0.8	Habitat tree			9.6	3.0	0.0 - C0.42	Yes	Staying	Locally raise cut
500	<i>Eucalyptus signata</i>	2	10	1	0.3	Habitat tree	0.13		3.6	2.0	F0.21 - C0.40	Yes	Staying	Locally raise cut
535	<i>Eucalyptus signata</i>	2	10	2	0.3	Habitat tree			3.6	2.0	-	No	Staying	
538	<i>Eucalyptus signata</i>	2	10	2	0.8	Habitat tree			9.6	3.0	-	No	Staying	
573	<i>Eucalyptus signata</i>	2	14	3	0.7	Habitat tree			8.4	2.8	0.0 - F0.21	No	Staying	
574	<i>Eucalyptus signata</i>	2	14	3	0.7	Habitat tree		0.03	8.4	2.8	0.0 - F0.28	No	Staying	
576	<i>Eucalyptus signata</i>	2	8	2	0.7	Habitat tree			8.4	2.8	-	No	Staying	
644	<i>Eucalyptus signata</i>	2	12	3	0.5	Habitat tree			6	2.5	-	No	Staying	
652	<i>Eucalyptus signata</i>	2	10	2	0.8	Habitat tree		0.34	9.6	3.0	0.0 - F0.53	No	Staying	Locally depress fill in SRZ - Non complying
654	<i>Eucalyptus signata</i>	2	12	2	0.4	Habitat tree			4.8	2.3	0.0 - F0.48	No	Staying	Locally depress fill in SRZ - Non complying
665	<i>Eucalyptus signata</i>	2	14	4	0.7	Habitat tree	0.08		8.4	2.8	C0.23 - F0.03	No	Staying	

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722	<i>Eucalyptus signata</i>	2	12	2	0.4	Habitat tree			4.8	2.3	-	No	Staying	
725	<i>Eucalyptus signata</i>	2	15	3	0.8	Habitat tree			9.6	3.0	-	No	Staying	
750	<i>Eucalyptus signata</i>	2	8	1	0.2	Habitat tree			2.4	1.7	-	No	Staying	
803	<i>Eucalyptus signata</i>	2	14	3	0.7	Habitat tree			8.4	2.8	-	No	Staying	
805	<i>Eucalyptus signata</i>	2	14	2	0.6	Habitat tree			7.2	2.7	-	No	Staying	
868	<i>Eucalyptus signata</i>	5	14	4	0.8	Habitat tree			9.6	3.0	-	No	Staying	
888	<i>Eucalyptus signata</i>	2	14	3	0.6	Habitat tree			7.2	2.7	-	No	Staying	
903	<i>Eucalyptus signata</i>	2	10	1	0.3	Habitat tree			3.6	2.0	-	No	Staying	
948	<i>Eucalyptus signata</i>	2	8	1	0.25	Habitat tree		0.68	3	1.8	-	No	Staying	
952	<i>Eucalyptus signata</i>	2	15	3	0.8	Habitat tree		0.54	9.6	3.0	-	No	Staying	
953	<i>Eucalyptus signata</i>	2	14	2	0.7	Habitat tree		0.55	8.4	2.8	-	No	Staying	
956	<i>Eucalyptus signata</i>	2	14	2	0.6	Habitat tree		0.27	7.2	2.7	-	No	Staying	
977	<i>Eucalyptus signata</i>	2	15	3	0.9	Habitat tree		0.28	10.8	3.2	-	No	Staying	
978	<i>Eucalyptus signata</i>	2	15	3	0.9	Habitat tree		0.42	10.8	3.2	-	No	Staying	
989	<i>Eucalyptus signata</i>	2	14	3	0.7	Habitat tree		0.47	8.4	2.8	-	No	Staying	
990	<i>Eucalyptus signata</i>	2	14	2	0.7	Habitat tree		0.37	8.4	2.8	-	No	Staying	
1024	<i>Banksia aemula</i>	2	12	1	0.4	Habitat tree		0.11	4.8	2.3	F0.04 - F0.22	No	Staying	
1029	<i>Eucalyptus signata</i>	2	15	3	0.8	Habitat tree		0.01	9.6	3.0	C0.05 - F0.25	No	Staying	
559	<i>Eucalyptus signata</i>	1	15	5	1.5	Habitat tree + <b>OLD GROWTH</b> (>900mm)		<b>0.81</b>	18	3.9	F0.4 - F1.13	No	Going	
560	<i>Banksia aemula</i>	1	15	3	1.5	Habitat tree + <b>OLD GROWTH</b> (>900mm)		0.51	18	3.9	F0.03 - F1.03	No	Going	
1	<i>Eucalyptus signata</i>	1	15	5	1.1	Habitat tree + <b>OLD GROWTH</b> (>900mm)			13.2	3.4	0.0 - F1.03	No	Staying	Provide low rock RW between reserve and SRZ

No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
12	<i>Eucalyptus signata</i>	1	15	5	1.3	Habitat tree + <b>OLD GROWTH</b> (>900mm)			15.6	3.7	0.0 - F1.03	No	Staying	Provide low rock RW between reserve and SRZ
67	<i>Eucalyptus signata</i>	1	15	3	1	Habitat tree + <b>OLD GROWTH</b> (>900mm)			12	3.3	-	No	Staying	
88	<i>Eucalyptus signata</i>	1	15	5	1.5	Habitat tree + <b>OLD GROWTH</b> (>900mm)			18	3.9	-	No	Staying	
92	<i>Eucalyptus signata</i>	1	15	4	1.2	Habitat tree + <b>OLD GROWTH</b> (>900mm)		0.09	14.4	3.6	0.0 - F0.61	No	Staying	Provide low rock RW between reserve and SRZ
104	<i>Eucalyptus signata</i>	1	15	4	0.9	Habitat tree + <b>OLD GROWTH</b> (>900mm)		0.36	10.8	3.2	0.00 - 0.69	No	Staying	Locally steepen batter
157	<i>Eucalyptus signata</i>	1	15	5	0.9	Habitat tree + <b>OLD GROWTH</b> (>900mm)			10.8	3.2	0 - F0.65	No	Staying	Locally steepen batter
160	<i>Eucalyptus signata</i>	1	15	5	0.9	Habitat tree + <b>OLD GROWTH</b> (>900mm)			10.8	3.2	0.0 - F0.78	No	Staying	Locally steepen batter
161	<i>Eucalyptus signata</i>	1	15	5	1	Habitat tree + <b>OLD GROWTH</b> (>900mm)			12	3.3	-	No	Staying	
412	<i>Eucalyptus signata</i>	1	15	5	1.2	Habitat tree + <b>OLD GROWTH</b> (>900mm)		0.44	14.4	3.6	C0.17 - F0.91	No	Staying	Locally depress fill in SRZ
413	<i>Eucalyptus signata</i>	1	15	5	1.2	Habitat tree + <b>OLD GROWTH</b> (>900mm)		0.64	14.4	3.6	F0.11 - F0.91	No	Staying	Locally depress fill in SRZ
469	<i>Eucalyptus signata</i>	1	15	4	1.2	Habitat tree + <b>OLD GROWTH</b> (>900mm)			14.4	3.6	C0.15 - F0.05	No	Staying	
472	<i>Eucalyptus signata</i>	1	15	5	1.5	Habitat tree + <b>OLD GROWTH</b> (>900mm)			18	3.9	C0.15 - F0.30	No	Staying	Locally raise cut
483	<i>Eucalyptus signata</i>	1	12	3	1	Habitat tree + <b>OLD GROWTH</b> (>900mm)		0.26	12	3.3	C0.16 - F0.59	No	Staying	Locally raise cut

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656	<i>Eucalyptus signata</i>	1	15	4	1.2	Habitat tree + OLD GROWTH (>900mm)			14.4	3.6	0.00 - F0.53	No	Staying	
808	<i>Eucalyptus signata</i>	1	15	4	1	Habitat tree + OLD GROWTH (>900mm)			12	3.3	-	No	Staying	
1027	<i>Eucalyptus signata</i>	1	14	2	1.2	Habitat tree + OLD GROWTH (>900mm)		0.12	14.4	3.6	C0.04 - F0.21	No	Staying	
114	<i>Eucalyptus signata</i>	1	15	5	1.2	OLD GROWTH (>900mm)		0.66	14.4	3.6	0.00 - 0.67	Yes	Going	
577	<i>Eucalyptus signata</i>	1	15	4	1	OLD GROWTH (>900mm)		0.31	12	3.3	0.0 - F0.39	Yes	Going	
626	<i>Eucalyptus signata</i>	1	15	5	1	OLD GROWTH (>900mm)		0.45	12	3.3	F0.38 - F0.86	No	Going	
628	<i>Eucalyptus signata</i>	1	15	4	0.9	OLD GROWTH (>900mm)		0.31	10.8	3.2	C0.05 - F0.69	Yes	Going	
664	<i>Eucalyptus signata</i>	1	15	2	1.5	OLD GROWTH (>900mm)	0.14		18	3.9	C0.23 - F0.42	No	Going	
1042	<i>Eucalyptus signata</i>	1	15	3	1.2	OLD GROWTH (>900mm)		0.45	14.4	3.6	F0.11 - F0.73	No	Going	
1045	<i>Melaleuca quinquenervia</i>	1	15	3	0.9	OLD GROWTH (>900mm)		0.37	10.8	3.2	F0.12 - F0.55	No	Going	
1179	<i>Melaleuca quinquenervia</i>	1	15	2	1	OLD GROWTH (>900mm)	1.59		12	3.3	C1.63	No	Going	
163	<i>Eucalyptus signata</i>	1	15	5	1.3	OLD GROWTH (>900mm)			15.6	3.7	0.0 - F0.40	No	Staying	
225	<i>Eucalyptus signata</i>	1	10	5	0.9	OLD GROWTH (>900mm)			10.8	3.2	-	No	Staying	
226	<i>Eucalyptus signata</i>	1	10	5	0.9	OLD GROWTH (>900mm)			10.8	3.2	0.0 - C0.2	No	Staying	

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414	<i>Eucalyptus signata</i>	1	15	4	0.9	OLD GROWTH (>900mm)		0.38	10.8	3.2	C0.08 - F0.85	No	Staying	Locally depress fill in SRZ
502	<i>Banksia aemula</i>	1	10	4	0.9	OLD GROWTH (>900mm)	0.15		10.8	3.2	0.0 - C0.49	Yes	Staying	Locally raise cut
543	<i>Banksia aemula</i>	1	15	4	1.1	OLD GROWTH (>900mm)			13.2	3.4	-	No	Staying	
565	<i>Eucalyptus signata</i>	1	15	5	1.5	OLD GROWTH (>900mm)		0.36	18	3.9	C0.05 - F0.53	No	Staying	Locally steepen batter - Non complying
575	<i>Banksia aemula</i>	1	15	3	1	OLD GROWTH (>900mm)			12	3.3	0.0 - F0.28	No	Staying	
636	<i>Banksia aemula</i>	1	15	4	0.9	OLD GROWTH (>900mm)			10.8	3.2	-	No	Staying	
647	<i>Melaleuca quinquenervia</i>	1	15	5	1.5	OLD GROWTH (>900mm)			18	3.9	-	No	Staying	
655	<i>Eucalyptus signata</i>	1	15	4	1	OLD GROWTH (>900mm)			12	3.3	0.00 - F0.53	No	Staying	
657	<i>Eucalyptus signata</i>	1	15	4	1.2	OLD GROWTH (>900mm)			14.4	3.6	0.00 - F0.47	No	Staying	
660	<i>Eucalyptus signata</i>	1	15	4	1	OLD GROWTH (>900mm)		0.37	12	3.3	C0.47 - F0.47	No	Staying	Locally depress fill in SRZ - Non complying
687	<i>Melaleuca quinquenervia</i>	1	15	3	1.1	OLD GROWTH (>900mm)			13.2	3.4	-	No	Staying	
723	<i>Eucalyptus signata</i>	1	15	4	1.2	OLD GROWTH (>900mm)			14.4	3.6	-	No	Staying	
727	<i>Eucalyptus signata</i>	1	15	4	1	OLD GROWTH (>900mm)			12	3.3	-	No	Staying	
738	<i>Melaleuca quinquenervia</i>	1	15	4	1.2	OLD GROWTH (>900mm)			14.4	3.6	-	No	Staying	



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781	<i>Banksia aemula</i>	1	15	4	1	OLD GROWTH (>900mm)			12	3.3	-	No	Staying	
802	<i>Eucalyptus signata</i>	1	12	2	1	OLD GROWTH (>900mm)			12	3.3	-	No	Staying	
807	<i>Eucalyptus signata</i>	1	15	5	1.5	OLD GROWTH (>900mm)			18	3.9	-	No	Staying	
870	<i>Melaleuca quinquenervia</i>	1	15	4	1.2	OLD GROWTH (>900mm)			14.4	3.6	-	No	Staying	
890	<i>Eucalyptus signata</i>	1	15	3	1	OLD GROWTH (>900mm)			12	3.3	-	No	Staying	
921	<i>Banksia aemula</i>	1	12	3	1	OLD GROWTH (>900mm)			12	3.3	-	No	Staying	
954	<i>Eucalyptus signata</i>	1	15	3	1	OLD GROWTH (>900mm)		0.40	12	3.3	-	No	Staying	
955	<i>Eucalyptus signata</i>	1	15	3	1	OLD GROWTH (>900mm)		0.42	12	3.3	-	No	Staying	
1038	<i>Eucalyptus signata</i>	1	15	3	1.2	OLD GROWTH (>900mm)		0.32	14.4	3.6	F0.07 - F0.56	No	Staying	Locally depress fill
1071	<i>Eucalyptus signata</i>	1	15	4	1.2	OLD GROWTH (>900mm)	0.22		14.4	3.6	C0.29 - F0.25	Yes	Staying	Non Complying TPZ, locally raise cut levels
1072	<i>Eucalyptus signata</i>	1	15	4	1	OLD GROWTH (>900mm)	0.32		12	3.3	C0.32 - F0.23	Yes	Staying	Non Complying TPZ, locally raise cut levels
1262	<i>Melaleuca quinquenervia</i>	1	6	2	1	OLD GROWTH (>900mm)			12	3.3	-	No	Staying	
245	<i>Eucalyptus robusta</i>	3	12	1	0.3	Primary Koala food tree		0.05	3.6	2.0	0.0 - F0.70	No	Going	
255	<i>Eucalyptus robusta</i>	3	15	3	0.5	Primary Koala food tree			6	2.5	0.0 - F0.85	No	Going	
275	<i>Eucalyptus robusta</i>	3	15	3	0.6	Primary Koala food tree			7.2	2.7	0.0 - F1.33	No	Going	

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276	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree		1.11	4.8	2.3	0.0 - F1.30	Yes	Going	
278	<i>Eucalyptus robusta</i>	3	15	3	0.5	Primary Koala food tree		0.84	6	2.5	F0.66 - F1.03	No	Going	
279	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree		1.14	4.8	2.3	F0.0 - F1.2	No	Going	
280	<i>Eucalyptus robusta</i>	3	15	2	0.3	Primary Koala food tree			3.6	2.0	F0.15 - F0.63	No	Going	
282	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree		0.09	4.8	2.3	F0.15 - F0.68	No	Going	
284	<i>Eucalyptus robusta</i>	3	15	5	0.8	Primary Koala food tree		0.19	9.6	3.0	F0.0 - F0.79	No	Going	
298	<i>Eucalyptus robusta</i>	3	15	3	0.6	Primary Koala food tree		0.44	7.2	2.7	F0.36 - F0.74	No	Going	
302	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree		0.34	4.8	2.3	0.0 - F0.62	No	Going	
313	<i>Eucalyptus robusta</i>	3	15	1	0.35	Primary Koala food tree	0.36		4.2	2.1	C0.16 - C0.55	Yes	Going	
314	<i>Eucalyptus robusta</i>	3	15	3	0.5	Primary Koala food tree	0.22		6	2.5	C0.02 - C0.55	Yes	Going	
315	<i>Eucalyptus robusta</i>	3	15	3	0.35	Primary Koala food tree	0.17		4.2	2.1	C0.03 - C0.37	Yes	Going	
317	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree	0.05		4.8	2.3	C0.22 - F0.07	No	Going	
323	<i>Eucalyptus robusta</i>	3	15	1	0.5	Primary Koala food tree	0.68		6	2.5	C0.24 - C1.09	Yes	Going	
333	<i>Eucalyptus robusta</i>	3	15	3	0.5	Primary Koala food tree	0.35		6	2.5	C0.43	No	Going	
336	<i>Eucalyptus robusta</i>	3	10	1	0.8	Primary Koala food tree	0.22		9.6	3.0	C1.33 - F0.18	Yes	Going	
357	<i>Eucalyptus robusta</i>	3	10	2	0.35	Primary Koala food tree	2.36		4.2	2.1	C2.7	Yes	Going	
363	<i>Eucalyptus robusta</i>	3	10	4	0.7	Primary Koala food tree	0.07		8.4	2.8	C0.56 - F0.03	Yes	Going	
364	<i>Eucalyptus robusta</i>	3	10	2	0.4	Primary Koala food tree		0.03	4.8	2.3	C0.1 - F0.08	Yes	Going	
365	<i>Eucalyptus robusta</i>	3	15	4	0.7	Primary Koala food tree		0.03	8.4	2.8	C0.23 - F0.25	Yes	Going	
366	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree		0.01	4.8	2.3	C0.26 - F0.10	Yes	Going	

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372	<i>Eucalyptus robusta</i>	3	15	3	0.5	Primary Koala food tree	0.35		6	2.5	C0.07 - C0.36	Yes	Going	
402	<i>Eucalyptus robusta</i>	3	14	4	0.8	Primary Koala food tree		0.12	9.6	3.0	C0.07 - F0.49	No	Going	
405	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree		0.10	4.8	2.3	C0.07 - F0.29	No	Going	
423	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree		0.50	4.8	2.3	F0.26 - F0.60	No	Going	
430	<i>Eucalyptus robusta</i>	3	10	1	0.3	Primary Koala food tree		0.41	3.6	2.0	F0.21 - F0.55	No	Going	
444	<i>Eucalyptus robusta</i>	3	14	2	0.5	Primary Koala food tree	1.21		6	2.5	C1.25	Yes	Going	
454	<i>Eucalyptus robusta</i>	1	14	3	0.6	Primary Koala food tree	0.10		7.2	2.7	0.0 - C0.25	No	Going	
482	<i>Eucalyptus robusta</i>	3	10	1	0.25	Primary Koala food tree		0.42	3	1.8	F0.37 - F0.47	No	Going	
552	<i>Eucalyptus robusta</i>	3	15	4	0.8	Primary Koala food tree		0.23	9.6	3.0	F0.13 - F0.78	No	Going	
553	<i>Eucalyptus robusta</i>	3	15	3	0.8	Primary Koala food tree		0.14	9.6	3.0	F0.10 - F0.63	No	Going	
554	<i>Eucalyptus robusta</i>	3	15	3	0.8	Primary Koala food tree		0.21	9.6	3.0	F0.10 - F0.63	No	Going	
1160	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree	0.51		4.8	2.3	C0.2 - F0.86	No	Going	
1161	<i>Eucalyptus robusta</i>	3	14	3	0.7	Primary Koala food tree	0.01		8.4	2.8	C0.36 - F0.48	Yes	Going	
1212	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree		0.34	4.8	2.3	0.0 - F0.51	No	Going	
1256	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree		0.53	4.8	2.3	0.0 - F0.58	No	Going	
15	<i>Eucalyptus robusta</i>	1	10	2	0.25	Primary Koala food tree			3	1.8	-	No	Staying	
16	<i>Eucalyptus robusta</i>	1	10	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
20	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
21	<i>Eucalyptus robusta</i>	1	15	3	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
22	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	

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23	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	Locally steepen batter - Non complying
24	<i>Eucalyptus robusta</i>	4	10	3	0.25	Primary Koala food tree			3	1.8	-	No	Staying	
28	<i>Eucalyptus robusta</i>	1	15	4	0.5	Primary Koala food tree			6	2.5	-	No	Staying	
32	<i>Eucalyptus robusta</i>	1	10	3	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	
54	<i>Eucalyptus robusta</i>	1	10	3	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	
62	<i>Eucalyptus robusta</i>	1	15	4	0.45	Primary Koala food tree			5.4	2.4	-	No	Staying	
64	<i>Eucalyptus robusta</i>	1	15	3	0.5	Primary Koala food tree			6	2.5	-	No	Staying	
162	<i>Eucalyptus robusta</i>	3	10	3	0.5	Primary Koala food tree			6	2.5	0.0 - F0.74	No	Staying	
176	<i>Eucalyptus robusta</i>	1	10	1	0.2	Primary Koala food tree			2.4	1.7	-	No	Staying	
181	<i>Eucalyptus robusta</i>	1	10	3	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
188	<i>Eucalyptus robusta</i>	1	10	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
220	<i>Eucalyptus robusta</i>	3	10	1	0.25	Primary Koala food tree			3	1.8	-	No	Staying	
241	<i>Eucalyptus robusta</i>	4	12	2	0.25	Primary Koala food tree			3	1.8	-	No	Staying	
243	<i>Eucalyptus robusta</i>	3	12	1	0.45	Primary Koala food tree			5.4	2.4	-	No	Staying	
244	<i>Eucalyptus robusta</i>	3	12	2	0.45	Primary Koala food tree			5.4	2.4	0.0 - F0.14	No	Staying	
257	<i>Eucalyptus robusta</i>	4	15	2	0.2	Primary Koala food tree			2.4	1.7	-	No	Staying	
264	<i>Eucalyptus robusta</i>	3	10	2	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	
272	<i>Eucalyptus robusta</i>	3	15	3	0.6	Primary Koala food tree			7.2	2.7	0.0 - F0.30	No	Staying	
281	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree			4.8	2.3	F0 - F0.55	No	Staying	
286	<i>Eucalyptus robusta</i>	3	15	2	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	

No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
288	<i>Eucalyptus robusta</i>	1	15	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
289	<i>Eucalyptus robusta</i>	1	15	2	0.4	Primary Koala food tree			4.8	2.3	0.0 - F0.32	No	Staying	
290	<i>Eucalyptus robusta</i>	1	15	1	0.2	Primary Koala food tree			2.4	1.7	-	No	Staying	
293	<i>Eucalyptus robusta</i>	1	15	3	0.4	Primary Koala food tree			4.8	2.3	0.0 - F0.13	No	Staying	
294	<i>Eucalyptus robusta</i>	1	15	2	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	
295	<i>Eucalyptus robusta</i>	1	15	4	0.6	Primary Koala food tree			7.2	2.7	0.0 - F0.48	No	Staying	
296	<i>Eucalyptus robusta</i>	1	15	2	0.35	Primary Koala food tree			4.2	2.1	0.0 - F0.60	No	Staying	
300	<i>Eucalyptus robusta</i>	3	15	2	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	
303	<i>Eucalyptus robusta</i>	3	15	2	0.3	Primary Koala food tree			3.6	2.0	0.0 - F0.36	No	Staying	
304	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
328	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree	0.02		4.8	2.3	C0.07 - CF0.07	No	Staying	
329	<i>Eucalyptus robusta</i>	3	15	3	0.4	Primary Koala food tree	0.02		4.8	2.3	C0.07 - CF0.07	No	Staying	
373	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree		0.09	4.8	2.3	F0.07 - F0.18	No	Staying	
385	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree		0.27	4.8	2.3	F0.22 - F0.26	No	Staying	
386	<i>Eucalyptus robusta</i>	3	15	2	0.4	Primary Koala food tree		0.26	4.8	2.3	F0.22 - F0.29	No	Staying	
392	<i>Eucalyptus robusta</i>	3	15	2	0.5	Primary Koala food tree		0.27	6	2.5	F0.15 - F0.29	No	Staying	
442	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree	0.24		4.8	2.3	C0.16 - C0.37	No	Staying	Locally raise cut
443	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree	0.23		4.8	2.3	C0.16 - C0.37	No	Staying	Locally raise cut
455	<i>Eucalyptus robusta</i>	1	14	3	0.5	Primary Koala food tree			6	2.5	0.0 - C0.15	No	Staying	Locally raise cut
456	<i>Eucalyptus robusta</i>	1	14	3	0.5	Primary Koala food tree			6	2.5	0.0 - C0.10	No	Staying	

No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
457	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	0.0 - C0.03	No	Staying	Alternate TPZ
458	<i>Eucalyptus robusta</i>	1	6	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
460	<i>Eucalyptus robusta</i>	3	10	1	0.3	Primary Koala food tree			3.6	2.0	0.0 - F0.11	No	Staying	
568	<i>Eucalyptus robusta</i>	3	6	2	0.5	Primary Koala food tree			6	2.5	-	No	Staying	
579	<i>Eucalyptus robusta</i>	3	15	3	0.8	Primary Koala food tree			9.6	3.0	-	No	Staying	
580	<i>Eucalyptus robusta</i>	3	10	2	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	
634	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree			4.8	2.3	0.0 - F0.26	No	Staying	
686	<i>Eucalyptus robusta</i>	1	12	1	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
706	<i>Eucalyptus robusta</i>	1	10	1	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	
707	<i>Eucalyptus robusta</i>	1	12	2	0.6	Primary Koala food tree			7.2	2.7	-	No	Staying	
712	<i>Eucalyptus robusta</i>	1	10	1	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	
716	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
717	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
724	<i>Eucalyptus robusta</i>	1	12	2	0.6	Primary Koala food tree			7.2	2.7	-	No	Staying	
812	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
813	<i>Eucalyptus robusta</i>	1	10	2	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	
814	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
816	<i>Eucalyptus robusta</i>	1	12	2	0.5	Primary Koala food tree			6	2.5	-	No	Staying	
819	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
820	<i>Eucalyptus robusta</i>	1	5	1	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	

No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
822	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
823	<i>Eucalyptus robusta</i>	1	10	2	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	
824	<i>Eucalyptus robusta</i>	1	10	2	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	
825	<i>Eucalyptus robusta</i>	1	10	2	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	
826	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
1162	<i>Eucalyptus robusta</i>	3	12	2	0.5	Primary Koala food tree		0.17	6	2.5	C0.18 - F0.25	No	Staying	
1206	<i>Eucalyptus robusta</i>	3	6	1	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
1207	<i>Eucalyptus robusta</i>	3	12	2	0.5	Primary Koala food tree			6	2.5	-	No	Staying	
1208	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
1219	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
1221	<i>Eucalyptus robusta</i>	1	14	2	0.6	Primary Koala food tree			7.2	2.7	-	No	Staying	
1228	<i>Eucalyptus robusta</i>	1	10	2	0.25	Primary Koala food tree			3	1.8	-	No	Staying	
1231	<i>Eucalyptus robusta</i>	1	10	2	0.25	Primary Koala food tree			3	1.8	-	No	Staying	
1232	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
1233	<i>Eucalyptus robusta</i>	1	8	2	0.2	Primary Koala food tree			2.4	1.7	-	No	Staying	
1237	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
1238	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
1239	<i>Eucalyptus robusta</i>	1	10	2	0.25	Primary Koala food tree			3	1.8	-	No	Staying	
1246	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
1247	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	

No.	Species	Rank	Height (m)	Spread (m)	DBH (m)	Tree Notes	Cut Depth at Tree (m)	Fill Depth at Tree(m)	TPZ (m)	SRZ (m)	TPZ Cut Fill Range (m)	SRZ encroached?	Tree Outcome	Construction Notes
1248	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
1250	<i>Eucalyptus robusta</i>	1	10	2	0.25	Primary Koala food tree			3	1.8	-	No	Staying	
1263	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
1264	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
1266	<i>Eucalyptus robusta</i>	3	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
1267	<i>Eucalyptus robusta</i>	1	12	2	0.4	Primary Koala food tree			4.8	2.3	-	No	Staying	
1269	<i>Eucalyptus robusta</i>	1	10	2	0.3	Primary Koala food tree			3.6	2.0	-	No	Staying	
666	<i>Eucalyptus robusta</i>	1	15	2	1.2	Primary Koala food tree + <b>OLD GROWTH</b> (>900mm)			14.4	3.6	-	No	Staying	
809	<i>Eucalyptus robusta</i>	1	15	5	1.5	Primary Koala food tree + <b>OLD GROWTH</b> (>900mm)			18	3.9	-	No	Staying	
810	<i>Eucalyptus robusta</i>	1	15	4	1	Primary Koala food tree + <b>OLD GROWTH</b> (>900mm)			12	3.3	-	No	Staying	
988	<i>Eucalyptus robusta</i>	1	15	3	1	Primary Koala food tree + <b>OLD GROWTH</b> (>900mm)			12	3.3	0.0 - F0.80	No	Staying	Construct Low RW. Alternate TPZ
159	<i>Eucalyptus robusta</i>	1	10	3	0.4	Primary Koala food tree + <b>SCATS</b>			4.8	2.3	-	No	Staying	
235	<i>Eucalyptus robusta</i>	2	10	3	0.7	Primary Koala food tree + <b>SCATS</b>			8.4	2.8	-	No	Staying	



## **APPENDIX 8**

### **LITERATURE REVIEW: BUFFERS**

## LITERATURE REVIEW: BUFFERS

### Types of Buffers

A buffer may take any of a number of forms, depending upon the nature of the environmental value to be protected, the impacts associated with nearby land use and the interaction between these factors. The management context within which the buffer exists is also an important consideration. Examples of buffers include:

- Riparian buffers
- Vegetated barriers
- Filter strips
- Shelterbelts and windbreaks
- Distance buffers (i.e. open space)
- Restrictive barriers (i.e. fences, impenetrable vegetation, water etc.)

### Purposes of Buffers

Buffers may be employed for a range of conservation purposes, to protect a specific environmental value (such as water quality in a stream) or a range of values (such as buffering an area of National Park from an urban area). In the majority of cases, buffers are used because of the multiple environmental benefits they provide.

Wetlands or vegetation communities subject to periodic inundation, in particular, can be subjected to a variety of stressors resulting from human actions. Stressors potentially occurring in these environments include:

- Enrichment/eutrophication
- Organic loading and reduced dissolved oxygen
- Contaminant toxicity
- Acidification
- Salinisation
- Sedimentation/burial
- Turbidity/shade
- Vegetation removal
- Thermal alteration
- Dehydration
- Inundation
- Fragmentation of habitat
- Other human presence

Examples of situations where buffers are used to protect specific environmental values are discussed in the following sections.

- Protection of Water Quality

Buffer zones are often used to remove nutrients, sediment and/or contaminants from runoff, especially along the banks of watercourses or margins of wetlands. Riparian buffer zones improve water quality in different ways depending upon the pathway of delivery of water to the buffer (Correll 1997). Groundwater passing through the buffer zone may be cleansed of nitrate and acidity due to a combination of de-nitrification, bio-storage and changes in soil composition (Correll 1997). Overland storm flows entering laterally from uplands may be cleansed of suspended particulates, with adhering nutrients, inorganic toxins and pesticides as well as some dissolved nutrients and toxins (Correll 1997). When a stream is in flood, waters flooding out into the buffer zone may also be cleansed of sediments, nutrients and toxic materials as a result of particulate trapping and binding of materials on leaf litter and soils (Correll 1997). Correll (1997) notes a number of external and internal factors that limit the effectiveness of the functions of a riparian buffer zone. Factors external to the buffer zone include: watershed area and gradient; stream channel morphology, soil mineralogy and texture; bedrock type and depth and climate. Internal factors include: the width and type of vegetation, waterlogging and organic content of soils; hydraulic conductivity; soil nutrient content and geochemistry (Correll 1997).

According to the US Department of Agriculture (NCBC 1999a), properly installed, well-maintained buffers can reduce nutrient and pesticide runoff into water bodies by 50% or more, sediment loadings by 75% and pathogen loadings by 60%.

Leishman (1986) has shown that stormwater outlets are significant sources of high nutrient levels. This research also showed that water moving through a vegetated creek bank will drop most of its total phosphorus between 15 and 30 metres away from the pollutant source. The research also showed that water with 600ppm of total phosphorus at a road edge will drop to 250ppm 10 metres down slope of the road edges and to near background level 30metres down slope.

The relationship between pollutant removal and buffer width is nonlinear, with ever greater width required to achieve ever smaller increases in pollutant removal efficiency (Desbonnet *et al* 1994). Desbonnet *et al* (1994) has shown that a 25 metre vegetated buffer will remove 80% of sediment, a 20 metre buffer will remove 70% of Suspend Solids, a 23 metre vegetated buffer will remove 70% of Nitrogen and a 35 metre buffer will remove 70% of Phosphorus. Their research also showed that vegetated buffers of 15-30 metres will protect wetland habitat from low-intensity disturbances whilst a 30-45 metre vegetated buffer will protect wetland habitat from high intensity disturbances. According to the work of Desbonnet *et al* (1994) vegetated buffer width would need to be increased to 600 metres to achieve 99% sediment and pollutant removal.

Correll (1997) cautions that the efficacy of Riparian Buffer Zones in removing pollutants from surface and groundwater is highly dependent upon hydrology. For effective removal of particulates, dissolved nutrients and toxic materials, surface flow must occur as sheet flow rather than highly focused flows and vegetation in the buffer zone must provide enough friction to surface flows.

Additional benefits of riparian buffer zones include:

- Shading and evaporative cooling of the stream channel (Correll 1997);
- Provision of litter and large woody debris to stream channel communities (Correll 1997).
- Provision of unique habitat to wildlife (Belt *et al* 1992).

- Control of Human Access

Buffers can be used to restrict access of people to areas of environmental value. Areas of open space provide a distance buffer and can provide a psychological and social restriction on negative human behaviours such as dumping of rubbish or weeds. Buffers can also be designed to provide a physical barrier to access through the use of fencing, impenetrable vegetation, areas of water and so on.

- Control of Animal Access

Feral fauna species such as Dogs, Cats, Foxes and Cane toads are known to access new areas by utilising man-made and disturbed areas. A well managed native forested buffer zone may reduce access by these species to the main conservation zone.

- Protection of Significant Plants, Nests etc.

Buffers may be used to protect a particular feature of environmental value, such as a significant plant or the nest of a significant bird. In this case, the buffer will have a number of purposes, such as restriction of access by humans or pets and reducing visual and aural disturbance to an acceptable level.

- Reduction of Edge Effect

Three types of edge effects characterise the interface between remnant bushland and other land uses.

1. Abiotic effects are those changes in light, temperature, humidity and wind that occur when a remnant edge is formed by the creation of new surrounding land uses, such as clearing land for grazing or agriculture.
2. Direct biological effects include changes in the number and abundance of species brought about by changed environmental conditions. For example, the spread of species that adapt well to the altered climatic conditions, and the reduction in recruitment of species that do not prosper.
3. Indirect biological effects are changes in the way species interact, in particular modified patterns of competition, pollination, and the dispersal of seeds (Donatiu 2001).

Edges and canopy gaps in remnant forests are the sites where weed species are able to establish and persist. Lateral light penetration along the edges and increased light levels from canopy gaps can result in the establishment of early successional rainforest trees and weed species (Kooyman 1996).

A vegetated buffer zone can reduce the impacts of edge effect on retained areas of vegetation.

- Visual and Noise Buffers

Buffers can be used to obscure incompatible scenery, such as areas of housing, from natural areas (Davies & Lane 1995). Vegetated buffers or other physical screens reduce the amount of visual (especially lighting) and noise disturbance to buffered habitats. These forms of disturbance can have a range of detrimental impacts to wildlife, including disruption of foraging, breeding and nesting and increases in stress levels. Distance buffers can be effective in reducing disturbance to wildlife sensitive to human intrusion, such as birds nesting on beaches.

- Spray Drift Buffers

Marrs *et al* (1993) note an increasing need to protect semi-natural vegetation from the potential effects of herbicide drift. They note that earlier estimates using established perennials suggested zones needed to be 6-10m wide. Marrs *et al* (1993) found that seedlings of some species were affected at greater distances than established plants and, on sites where seedling establishment is an important mechanism for community regeneration, buffer zones may need to be 20m wide.

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**APPENDIX 9**  
**WALLUM FROGLET COMPENSATORY HABITAT**

# WALLUM FROGLET COMPENSATORY HABITAT

## 1. Background

Few attempts to replicate or re-instate breeding areas for 'Acid frogs' have been undertaken and documented in Australia. It is recognised, however, that the Wallum froglet will rapidly re-colonise disturbed areas previously containing 'Wallum' vegetation. In these instances common attributes are shallow water bodies in sandy soils and of low pH and electrical conductivity (Ecosense Consulting Pty Ltd, 2005).

Compensatory habitat for 'Acid frog' species was created during the construction of the Tugun Bypass. The relevant sections of the Compensatory Habitat Plan prepared for the Tugun Bypass are attached as **APPENDIX 10 - Volume 2**. The design requirements of the Tugun Bypass frog ponds were determined through consultation with a number of recognised authorities on 'Acid frogs'.

A number of recommendations were provided by these experts based on observations made during field & laboratory work (Ecosense Consulting Pty Ltd, 2005):

- Ponds should be constructed in sandy substrates (which previously contained 'Wallum') with an underlying organic hardpan;
- Ponds should generally be shallow and constructed in areas of high groundwater;
- Water quality should exhibit the following characteristics:
  - pH <5 (as influenced by humic soils);
  - hardness < 100 p.p.m;
  - salinity < 350 uS.cm<sup>-1</sup>;
- Ponds should be ephemeral to prevent habitation by fish but have a minimum hydro-period of 4-6 weeks for the Wallum froglet; and
- Pond fringes should be densely planted with emergent species to prevent predation by the Cane toad (*Bufo marinus*).

Four (4) frog ponds were constructed within compensatory habitat areas adjoining the Tugun Bypass. Both the Wallum froglet and the Wallum sedge frog (*Litoria olongburensis*) have been recorded within these constructed ponds (Pacific Alliance 2010). Furthermore, water treatment basins constructed around the bypass have had the added benefit of providing additional frog habitat. Wallum froglets have been recorded calling from several water treatment basins on numerous occasions during monitoring events (PacificLink Alliance, 2007).

The loss of Wallum froglet habitat will be mitigated through the creation of compensatory habitat areas (**FIGURE 27 - Volume 1**). These areas will be designed to provide additional core habitat areas on the subject site and will be created in accordance with a Wallum Froglet Compensatory Habitat Plan (WFCHP).

**TABLE 1** shows the net gain/loss of potential wallum froglet habitat after these proposed rehabilitation measures.



**TABLE 1**  
**NET GAIN OF POTENTIAL WALLUM FROGLET HABITAT AFTER REHABILITATION**

Total Habitat (ha)	Habitat Retained (ha)	Total Habitat Lost (ha)	Constructed Wallum Frog Habitat (ha)	Net gain/loss (ha)
5.49	4.92	0.57	0.86	0.29

The area designated as 'Proposed froglet habitat' on the plans will be subject to excavation prior to rehabilitation works (**FIGURE 30 - Volume 1**). Extensive engineering and revegetation is therefore likely to be required in establishing the acid frog habitat. It should be noted that acidic conditions within the 'proposed froglet habitat' need to be maintained in order to provide suitable habitat for acid frogs. Treatment with lime of Acid sulphate soils within and immediately adjacent to the 'proposed froglet habitat' area should therefore be avoided. Alternatively, stockpiles of acidic soil should be created during the initial excavations preceding the creation of the habitat area. This soil should be used to line pondage areas to ensure acidic conditions are created and maintained.

The specific details of the habitat design will be outlined in a Wallum Froglet Compensatory Habitat Plan (WFCP) to be prepared at the DA stage. The following will be included in the plan:

- Creation of artificial ponds that are conducive to *C. tinnula* foraging through earthworks (e.g. excavation). A number of small shallow scrapes and holes should be randomly excavated within the 'proposed froglet habitat' area resulting in the creation of isolated ponds allowing inundation by rain/flooding.
- The ponds may need to be clay lined to avoid drawdown by infiltration. The ponds should be ephemeral in nature but need to hold water for a minimum of 30 days after significant rainfall events to promote successful breeding;
- Control of exotic plant species through the use of best practice techniques;
- Regeneration/revegetation works (i.e. utilising suitable 'aquatic' and 'wallum' plant species);
- Pest control (i.e. Gambusia and Cane toads) of areas within and adjacent to the 'proposed froglet habitat'; and
- Provision of bollards (or similar) to exclude traffic.

## **2. Stormwater Management and Wallum Froglet Habitat Construction**

Stormwater management within the proposed development includes the regrading of the main drainage line through the centre of the site. This construction will involve the cut of material (for fill use on other parts of the site) to allow adequate stormwater drainage from the site. The drain area will then be re-contoured and Wallum froglet core and forage

habitat will be created within this stormwater management system (**FIGURE 30 - Volume 1**). It should be noted that Core wallum froglet habitat will also function as forage habitat. A typical section and plan view of the proposed stormwater treatment and frog habitat swale is provided in **FIGURE 1 - Volume 2**. The re-contoured central drainage line will be comprised of two parts:

1. Low flow channel (forage habitat)
  - conveys the first flush stormwater;
  - includes sub-soil drainage and a bio-filtration trench;
  - will be rehabilitated with Swamp sclerophyll vegetation which will eventually provide forage habitat for Wallum froglets during suitable conditions.
2. High flow channel (Core habitat)
  - Construction will create core Wallum froglet habitat on the slightly more elevated areas on either side of the low-flow channel (separated from the low-flow channel by earth berms);
  - These areas will receive pre-treated stormwater during 1 year (and greater) storm events;
  - The core Wallum froglet habitat will include the creation of melon holes by using an excavator bucket to form holes approximately 60cm deep by at least 1.8m long;
  - These holes will be created to intercept the water table to ensure water is available for an extended period of time and allow for successful breeding;
  - It would be expected that the water in these melon holes would evaporate during extended dry periods;
  - Dense plantings of Saw-sedge (*Gahnia* spp.), Curly sedge (*Baloskion* spp.) and Matrush (*Lomandra* spp.) will occur around the margins of these melon holes to ensure almost complete coverage of the hole by the sedges;
  - The narrow design of the melon holes, coupled with the dense planting of Rushes and Sedges, will assist in the prevention of mosquito breeding, protect tadpoles from predation and preclude the occurrence of Cane toads.

The entire central drainage area, including the low flow channel and the created core Wallum froglet habitat, will be planted with a combination of Swamp sclerophyll (i.e. Swamp mahogany & Broad-leaved paperbark) and Wet heath species.

Water quality will be the major determinant in the success of the compensatory habitat. In June and October 2009 water quality sampling was completed on the Bayside Brunswick site by Waste Solutions Australia Pty Ltd. Water samples taken from the main drainage line (i.e. the area where compensatory habitat is to be created) have revealed a pH ranging from 3.07 - 4.36, and electrical conductivity ranging from 129.6 uS.cm<sup>-1</sup> - 138 uS.cm<sup>-1</sup>. No measurement of hardness was obtained, however due to the low pH readings it is likely that the hardness of the water is quite low.

A comparison of the compensatory habitat proposed at Bayside Brunswick with the design criteria of the Tugun Bypass frog ponds is provided in **TABLE 2**.

**TABLE 2**  
**COMPARISON OF BAYSIDE BRUNSWICK & TUGUN BYPASS COMPENSATORY HABITAT**

DESIGN CRITERIA FOR THE TUGUN BYPASS FROG PONDS	PROPOSED BAYSIDE BRUNSWICK COMPENSATORY HABITAT
Ponds should be constructed in sandy substrates (which previously contained 'Wallum') with an underlying organic hardpan;	The proposed compensatory habitat area occurs on a sandy substrate (Waste Solutions Australia Pty Ltd 2010) which historically contained 'Wallum' vegetation. If necessary, topsoil/organic material will be stockpiled during initial earthworks and used to line constructed frog habitat areas.
Ponds should generally be shallow and constructed in areas of high groundwater;	Constructed melon holes will be a maximum of approximately 60cm deep and will be created to intercept the water table.
Water quality should exhibit the following characteristics: <ul style="list-style-type: none"> <li>○ pH &lt;5 (as influenced by humic soils);</li> <li>○ hardness &lt; 100 p.p.m; and</li> <li>○ salinity &lt; 350 uS.cm<sup>-1</sup>.</li> </ul>	Water quality results (Waste Solutions Australia Pty Ltd 2010) from the proposed compensatory habitat area are as follows: <ul style="list-style-type: none"> <li>○ pH of 3.07 - 4.36;</li> <li>○ hardness has not been determined however the low pH readings are likely to result in a hardness &lt; 100 p.p.m;</li> <li>○ salinity of 129.6 uS.cm<sup>-1</sup> - 138 uS.cm<sup>-1</sup>.</li> </ul>
Ponds should be ephemeral to prevent habitation by fish but have a minimum hydro-period of 4-6 weeks for the Wallum froglet; and	Proposed melon holes will be constructed to ensure water is available for an extended period of time and allow for complete metamorphosis of the tadpoles.
Pond fringes should be densely planted with emergent species to prevent predation by the Cane toad ( <i>Bufo marinus</i> ).	Dense plantings of Saw-sedge ( <i>Gahnia</i> spp.), Curly sedge ( <i>Baloskion</i> spp.) and Matrush ( <i>Lomandra</i> spp.) will occur around the margins of the melon holes.

Further to the comparison above, which shows the similarities between the two compensatory habitat proposals, it is noted that the configuration of the frog ponds at the Tugun Bypass comprised a small number or larger ponds, whereas the Bayside Brunswick proposal provides a larger number of small ponds (melon holes). This design feature has been incorporated to discourage the use of the ponds by Mosquitoes. As the Tugun Bypass ponds are not immediately adjacent to a residential area, this would not likely have been a design consideration.

A Wallum Froglet Compensatory Habitat Plan (WFCHP) will be completed to guide the construction of the frog habitat during the completion of the earthworks. The plan will be

prepared in accordance with the National recovery plan for the wallum sedgefrog and other wallum-dependent frog species (Queensland Environmental Protection Agency 2006). The WFCHP will include (but not be limited to) the following:

- detailed frog pond design criteria;
- performance criteria;
- a detailed habitat and population monitoring program; and
- contingencies in the event that constructed habitats perform poorly.

**APPENDIX 10**  
**COMPENSATORY HABITAT PLAN**  
**TUGUN BYPASS**



# TUGUIN BYPASS

stewart road to kennedy drive



**Compensatory  
Habitat**

September 2005

## COMPENSATORY HABITAT – TUGUN BYPASS

### 8.0 List of Appendices

#### Appendix A *Frog Ponds*

Few attempts to replicate or reinstate breeding areas for 'acid frogs' have been undertaken and documented in Australia. It is well recognised however that the Wallum Froglet and to a lesser extent, the Wallum Sedge Frog will rapidly recolonise disturbed areas, previously described as 'Wallum'. In these instances common attributes are shallow water bodies in sandy soils and of low pH and electrical conductivity. It is therefore anticipated that with careful and planned intent, artificial ponds can be constructed to replace those impacted by the proposed Tugun Bypass.

Consultation with recognised authorities on 'acid frogs' has been undertaken to determine the design requirements and location for artificial ponds. A list of these people is provided below.

<b>Dr. Glen Ingram</b>	Biodiversity Assessment and Management Pty Ltd
<b>Dr. Michael Mahoney</b>	University of Newcastle
<b>Dr. Ed Meyer</b>	Griffith University
<b>Mr. Harry Hines</b>	Queensland Parks and Wildlife Service
<b>Mr. Robert Payne</b>	Ecological Survey and Management
<b>Mr. Ben Lewis</b>	Lewis Ecological Surveys

A number of recommendations were provided during these discussions based on observations made during field and laboratory work. A summary of commonalities is provided below:

- ponds should be constructed in sandy substrates (which previously contained 'Wallum') with an underlying organic hardpan,
- ponds should generally be shallow and constructed in areas of high groundwater,
- water quality should exhibit the following characteristics:
  - pH < 5 (as influenced by humic acids)
  - hardness < 100 p.p.m.
  - salinity < 350  $\mu\text{S}\cdot\text{cm}^{-1}$
- ponds should be ephemeral to prevent habitation by fish but have a minimum hydro-period of 4-6 weeks for the Wallum Froglet and 8 weeks for the Wallum Sedge Frog.
- pond fringes should be densely planted with emergent species to prevent predation by *Bufo marinus*,

In consideration of the above recommendations, the *Tugun Bypass Species Impact Statement* (2004) and Ingram (2005) the following locations and design criteria for ponds are proposed.

#### **Location**

- within the road corridor\*, east and west of the proposed bypass (chainage 4500 – 5100 metres), and
- where required, within the catchment of ephemeral drainage lines (refer Figure 4).

\* dependent on the retention of Block C, frog ponds may also be constructed in this location.

October 2005  
Page 22 of 30

## COMPENSATORY HABITAT – TUGUN BYPASS



Figure 4: Proposed locations of artificial frog ponds

### Design criteria

#### a) 'above ground'

- a minimum of 1.5 metres deep with a gradient sloping to 0.3 metres at the pond edges,
- approximately 15 to 20 metres long and 5 to 10 metres wide,
- incorporate a slow release liner, similar to those used in dam construction and sedimentation traps or to increase the permanency of surface water (>80%),
- margins revegetated with species consistent with the local habitat requirements for the Wallum Sedge Frog, such as *Restio* spp.,
- utilise dense *Restio* stands that would be disturbed from within the footprint by a process of 'slabbing'. Slabbing depth should be a minimum depth of 30 cm to ensure organic layers are collected,
- Construction during a dry period (spring) leading to a pronounced rainfall period as to enable machinery to access the site with minimal damage and enhance the likelihood that transplanted vegetation would survive,
- Be interspersed with existing breeding ponds, thereby increasing the interconnectivity of aquatic habitats, and
- Where practical, connected by terrestrial vegetated corridors.



## COMPENSATORY HABITAT – TUGUN BYPASS

### b) 'below ground'

- be generally spoon shaped and constructed to a depth immediately above the organic hard pan layer or to a maximum depth of one (1) metre, whichever is the lesser,
- approximately 15 to 20 metres long and 5 to 10 metres wide,
- intersect a major ephemeral drainage line,
- revegetate the pond margins with species consistent with the local habitat requirements for the Wallum Sedge Frog, such as *Restio* spp...

If approved, ponds would be constructed as early within the Construction Phase as practically possible. Once constructed, ponds would be monitored and their performance evaluated. The following performance criteria, monitoring program and contingencies are proposed.

### **Performance Criteria**

- ponds are to contain surface water for a period >10 weeks per annum, for at least two of the three year monitoring periods,
- waters within ponds are to have a pH < 5 and an electrical conductivity < 350  $\mu\text{S}\cdot\text{cm}^{-1}$ .
- ponds are to contain a margin of emergent macrophytes > 200 mm thick,
- ponds are not to contain fish.

### **Monitoring Program**

- Post construction, frog survey shall be undertaken on a seasonal basis (four times a year) for the first two years and also include event (immediately after heavy rain) survey between April and August for the Wallum Froglet and between September and April for the Wallum Sedge Frog,
- During survey the following activities shall also be undertaken,
  - i. water quality monitoring for the parameters of pH and electrical conductivity,
  - ii. recording of water depth and general environmental conditions.

### **Contingencies**

- ponds that contain fish shall be reduced in capacity and hydroperiod,
- restoration of macrophytes shall be undertaken where margins < 200 mm thick,
- new ponds shall be constructed when the water quality of existing ponds exceeds the designated performance criteria for two of the three year periods, and
- ponds shall be increased in capacity, have their liners checked or their catchment areas increased where the hydroperiod does not accord with the required performance criteria. Consideration shall however, be given to the seasonal conditions at those times.

## **APPENDIX 11**

### **LITERATURE REVIEW: CORRIDORS & CONNECTIVITY**

## LITERATURE REVIEW: CORRIDORS & CONNECTIVITY

Based largely on the patch-matrix-corridor model of landscape ecology, wildlife corridors are a frequently discussed landscape feature and recommended management tool to enhance landscape connectivity (Bennett 1990).

Connectivity is a measurement of the relationships within and between areas of vegetation. These relationships exist in a continuum from high to isolated (also referred to as 'degree of connectedness'). Connectivity relates to physical features of the landscape and the behaviours of species dependant on that landscape, namely:

- The capacity of the area to provide a range of habitats for flora & fauna species;
- The capacity of flora and fauna species to travel within and between suitable habitats;
- the associated ecological processes;
- the distance between suitable habitats;
- the presence of interlinking or traversable habitats;
- the size and shape of habitat patches;
- the extent of physical barriers to movement of species;
- the extent of a species' range or territory and degree of mobility;
- the ability of a species to tolerate altered habitats and respond to disturbances such as changes to surrounding land uses; and
- species habitat requirements.

Some examples of connectivity along the continuum are provided in **TABLE 1**.

**TABLE 1**  
**EXAMPLES OF LEVELS OF CONNECTIVITY**

High	Medium	Low/Reduced	Isolated
The vegetation forms an unbroken expanse and/or, although there may be a narrow gap (e.g. cleared fence line), adjoins vegetation on the adjacent property along most of its perimeter on that particular	The vegetation forms an unbroken expanse, but is relatively small (reduced core environment), <b>OR</b> The vegetation is linked by a relatively narrow corridor. <b>OR</b> There is a break in the vegetation (e.g. fire management line, minor road or track) between the vegetation which could inhibit or restrict the	Vegetation is separated by a wide gap which would restrict the movement of some species and prohibit the movement of others due to the width of the gap. <b>OR</b> Vegetation patch is relatively small and provides no core habitat. <b>OR</b> Vegetation forms a "stepping stone" or part	The patch of vegetation is very small and isolated, with no other vegetation on the subject lot(s) or on any adjacent properties.

side, is in relatively good condition, provides habitats for different species and would facilitate the movement of a range of flora and fauna species of different sizes and habitat requirements (core and edge environments) for which the vegetation provides habitat.	movement of some species. <b>OR</b> The condition of the vegetation community is reduced.	of a series of "stepping stones" linking otherwise isolated patches of vegetation. The size and condition of the patches of vegetation will also be a factor in determining the degree of connectivity.	
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The fundamental question that must be asked in the discussion of such corridors is whether the particular corridor is capable of facilitating sufficient delivery of the target species to the recipient habitat patch(es). It is implicit that corridor capability can only be measured or evaluated on a site by site and species by species basis. A given strip of habitat may be effective for one species and completely ineffective for another.

Wildlife corridors are a frequently debated option to enhance landscape connectivity (e.g. Simberloff et al. 1992; Bennett 1990). In Australia, several studies have investigated the value of corridors for birds (Saunders and de Rebeira 1991). However, corridors will not always be synonymous with connectivity.

This is the case in particular for highly mobile species, which can move rapidly over extensive and often fragmented landscapes (Law et al. 1999). For such animals, patches of remnant vegetation in the matrix may act as stepping stones to aid their movement.

Depending on the relative size and condition, small and isolated areas of vegetation may still play a role in ecosystem processes—such as, hydrological processes, soil development, nutrient cycling, microclimate variation—although the role and contribution to biodiversity may be significantly reduced. Such patches of vegetation may still have a degree of internal connectivity and may support small populations of vertebrates and invertebrates, a reduced diversity (subset) of flora species typical of the ecosystem and may provide a refuge or "resting point" for more mobile animals such as birds, bats and migratory species.

There is no evidence in the scientific literature that suggests there is a minimum required corridor width to facilitate fauna movement. Rather, Bennett (1990) notes that the optimum corridor width depends upon the objectives of the corridor, the ecology and movements of the target species and the structure of the landscape in which the corridor is located. Although it is widely acknowledged that the wider

the corridor the more effective it will be, there is evidence that linear habitats significantly less than 100m wide provide effective movement corridors for a range of species.

A summary of the habitat/movement requirements of fauna groups is presented in **TABLE 2** below.

**TABLE 2**  
**MOVEMENT REQUIREMENTS OF FAUNA GROUPS**

Target Group or Species	Habitat/Movement Requirements
Amphibians	A narrow riparian corridor is sufficient for Amphibian movement habitat provided it: <ul style="list-style-type: none"> <li>Retains clean fresh water for up to 30 days on a seasonal basis;</li> <li>Contains or is surrounded by native riparian/wetland vegetation.</li> </ul>
Reptiles	<ul style="list-style-type: none"> <li>A diversity of habitats is required to allow the movement of sun-loving and shade-loving species.</li> <li>Regular occurrences of rocks, holes, cavities, litter, dense grass/herbs for reptiles to seek shelter during their movements.</li> </ul>
Birds (General)	<ul style="list-style-type: none"> <li>The mobility of birds enhances their capabilities in terms of dispersal and they are less reliant on contiguous tracts of habitat than all other fauna groups (with the exception of bats).</li> <li>In grazing lands a densely vegetated corridor 50m wide is adequate to enable most birds to move between remnant habitat areas up to 1.2km apart.</li> </ul>
Insectivorous birds	Insectivorous birds rely on habitats with insect generating features such as dense groundcover vegetation, flowering species and water bodies.
Nectarivorous birds	Nectarivorous birds rely on habitats that provide flowers as a forage resource.
Small Medium terrestrial mammals	<ul style="list-style-type: none"> <li>Small terrestrial mammals generally occur in highest densities in association with a complex vegetation structure, particularly in areas with a dense understorey layer that provides shelter from predators and which offers nesting opportunities. However, some inhabit drier open forests.</li> <li>Medium sized terrestrial species may disperse through more disturbed areas as they are less prone to predation than smaller mammals.</li> </ul>
Macropods	<ul style="list-style-type: none"> <li>The Swamp wallaby requires dense habitats for shelter but will readily graze in open areas.</li> <li>The Eastern grey kangaroo favours more open habitats but will move through dense vegetation if required.</li> <li>Macropods may be sensitive to edge effects such as an increase in light, noise and activity. Minimisation of these effects will enhance the value of the corridor.</li> <li>Minimisation of dog predation can enhance the value of corridors.</li> </ul>
Common brushtail possum & Mountain brushtail possum	<ul style="list-style-type: none"> <li>The common brushtail is a highly adaptable species readily move through highly fragmented habitats and urban gardens. It does not appear to be sensitive to edge effects such as light noise and activity. Any form of revegetation will be of benefit to this species.</li> <li>The Mountain Brushtail possum replaces the common brushtail in wet forest and rainforest but will sometimes range into open forest.</li> <li>Minimisation of dog predation will enhance the value of the corridor for these species.</li> </ul>

Target Group or Species	Habitat/Movement Requirements
Koala	<ul style="list-style-type: none"> <li>• Koalas will readily move along linear corridors (and include them as a component of a home range) if suitable habitat is present.</li> <li>• Any form of revegetation will be of benefit to Koalas.</li> <li>• Koalas can be sensitive to edge effects and predation by dogs.</li> </ul>
Microchiropteran bats	<ul style="list-style-type: none"> <li>• These species readily disperse through disturbed landscapes, although an open flyway of any structure will encourage movement between habitat areas.</li> <li>• Sub-canopy foragers will benefit from retention of canopy elements.</li> </ul>
Megachiropteran bats	<ul style="list-style-type: none"> <li>• Megachiropteran bats use riparian corridors (amongst other features) for navigation.</li> <li>• Movements of this group are extensive and unrestricted by cleared or developed areas.</li> </ul>

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**VOLUME 2**  
**FIGURE 1**  
PREPARED: BW  
DATE: 04 July 2011  
FILE: N97066\_Frog Habitat.cdr

TITLE  
**TYPICAL**  
**WALLUM FROGLET**  
**HABITAT PLAN**  
**& SECTION**