Volume 2

Flora and Fauna Assessment

JAMES WARREN & Associates Pty Ltd

ENVIRONMENTAL CONSULTANTS

FLORA AND FAUNA ASSESSMENT

LOTS 1 & 2 DP 725785
PACIFIC HIGHWAY, MOONEE

NOVEMBER 2007

A REPORT TO THE ROTHWELL BOYS

Brisbane Office
28/115 Wickham Street
FORTITUDE VALLEY QLD 4006
PH: 07 3257 2703

Head Office
PO Box 490
ALSTONVILLE NSW 2477
PH: 02 6628 6778

Sunshine Coast Office
7 Gannawarra Street
CURRIMUNDI QLD 4551
PH: 07 5437 8011

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background

James Warren and Associates have been engaged by The Rothwell boys to complete a Flora and Fauna Assessment for Lots 1 & 2 DP 725785 Pacific Highway, Moonee (the Subject site).

The assessment has 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 vegetation of the Coffs Harbour City Council LGA (Fisher, Body and Gill 1996) and the Coffs Harbour Vegetation Management Strategy (Ecograph 2002);
- Searching for and recording Threatened (*TSC Act 1995*), ROTAP (Briggs & Leigh 1996) and regionally significant plant species (Sheringham & Westaway 1995), and assessing the occurrence of Endangered Ecological Communities (EECs);
- Determining the suite of Threatened fauna (*TSC Act 1995*) that occurs in the locality and assessing their potential occurrence in the Study area;
- Completion of a detailed fauna survey program;
- Assessing habitat provided by the site in relation to adjacent habitat and making an assessment of the corridor value of the site; and
- Addressing statutory requirements including *State Environmental Planning Policy No. 44 (SEPP 44 – Koala Habitat Protection)*, Section 5A of the *Environmental Planning & Assessment Act (1979)* and the *Commonwealth EPBC Act (1999)*.

1.2 Locality

1.2.1 Introduction

The Locality is defined as the area within a 10km radius of the Subject site. The Locality therefore extends from Coffs Harbour in the south to Woolgoolga in the north and from Mt Coramba in the west to the coastline in the east (**FIGURE 1**).

Prominent features in the locality include the towns of Coffs Harbour, Woolgoolga and Moonee Beach, the coastline, Moonee Creek and its tributaries and Moonee Beach Nature Reserve.

Dominant habitat types are eucalypt forest, swamp sclerophyll forest and intertidal communities. Land uses within the locality include forestry, tourism, grazing, conservation and agriculture.

There are four (4) dedicated conservation reserves in the locality:

- Moonee Beach Nature Reserve, an area of 336 hectares immediately east of the Subject site;
- Ulidarra National Park, an area of 680 hectares to the south-west of the Subject site;
- Bruxner Park Flora Reserve, an area of 407 hectares adjoining Ulidarra National Park; and
- Kororo Nature Reserve, an area of 11 hectares south of the site.

SOURCE: Topographic map 'Moonee Beach' SCALE: 1 : 30 000 @ A4 JAMES WARREN & ASSOCIATES PTY LIMITED Environmental Consultants	CLIENT Resource Design Management Pty Ltd PROJECT Flora & Fauna Assessment Lots 1 & 2 DP725785 Pacific Highway, Moonee, NSW Coffs Harbour City LGA	**FIGURE 1** PREPARED: vja DATE: July 2006 FILE : 02066_FFA_locality.cdr	TITLE **LOCALITY PLAN**

State Environmental Planning Policy (SEPP) 14 wetland number 318 occurs to the north of the site, while SEPP 14 wetland number 319 is located about 2km to the south-east of the Subject site, to the south of the Moonee Creek estuary (**FIGURE 2)**.

A small area of SEPP (State Environmental Planning Policy) 26 Littoral Rainforest occurs to the south of the site between Digger's Head and White Bluff as SEPP 26 number 68B (**FIGURE 3**).

1.2.2 The Subject site

The Subject site consists of Lots 1 & 2 in DP 725785 Pacific Highway, Moonee. The site covers an area of approximately 96 hectares much of which is cleared and used for grazing cattle. Open areas of grassland and slashed heath dominate the site with scattered trees throughout. Denser areas of vegetation occur in association with Skinners and Moonee Creeks that flow along the northern and eastern boundaries respectively, and as a narrow finger of vegetation that extends along the ridgeline in the central part of the property. The Subject site is bordered by Moonee Creek to the east and the Pacific Highway to the west. Land to the north of the site is generally cleared but includes isolated trees and vegetation. Land to the south is characterised by open eucalypt forest with a largely cleared midstorey. The Subject site is shown in **FIGURE 4**.

1.2.3 The Study area

The Study area is defined as the Subject site together with any proximate areas that may be affected by the proposed development. The Study area for this assessment includes the adjacent sections of Moonee and Skinners Creeks, land to the immediate north and south and the adjacent portion of Moonee Beach Nature Reserve, as shown in **FIGURE 4**.

1.3 Landuse Zones

The Subject site is zoned 2A Residential Low Density over the majority of the site. A small fringe of 7A Environmental Protection land occurs to the north along Skinners Creek, and along the south eastern border adjacent to Moonee Creek. A small fringe of the site along Skinners Creek in the north is zoned 6A Open Space Public Recreation.

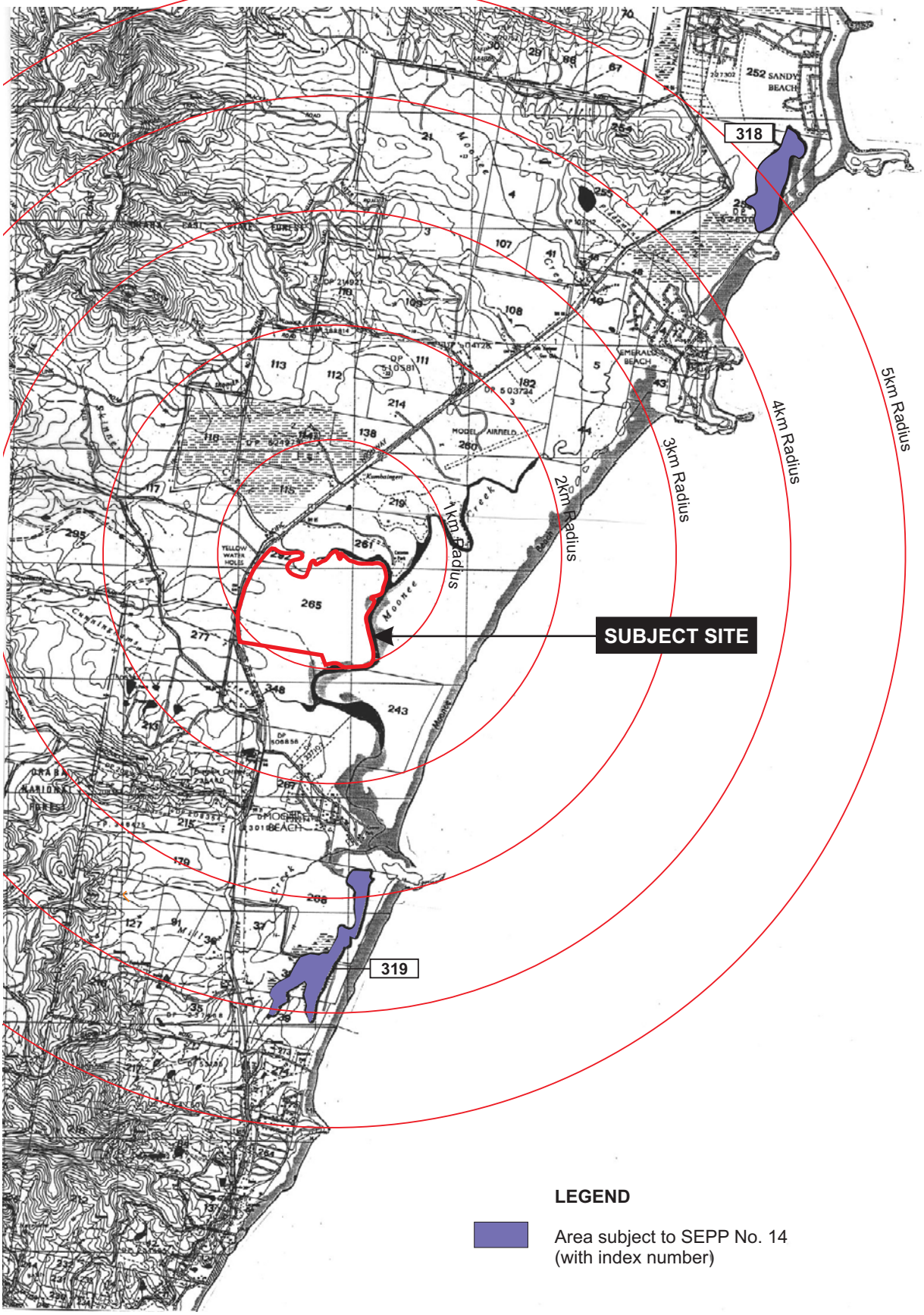
Landuse zones for the site are shown as **FIGURE 5**.

1.4 Soils and Geology

Soils on the Subject site are part of the Newports Creek type, characterised by low, level to gently undulating coastal back barrier floodplains on Pleistocene estuarine sediments. Soils are deep, poorly drained Yellow Podzolics and Humic Gleys (DLWC 1999).

1.5 The Proposed Development

The Proposed development (**FIGURE 6**) consists of a fifteen (15) stage residential development with a total allotment number of 534 lots. The development areas occur in the east, west and south of the Subject site. Residential lots will account for 30% of land on the site, while other areas of land are to be allocated to open space and for the construction of roads.



SOURCE: State Env. Planning Policy No. 14
Coastal Wetlands Map 21 Amend. No. 7

SCALE: 1 : 50 000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

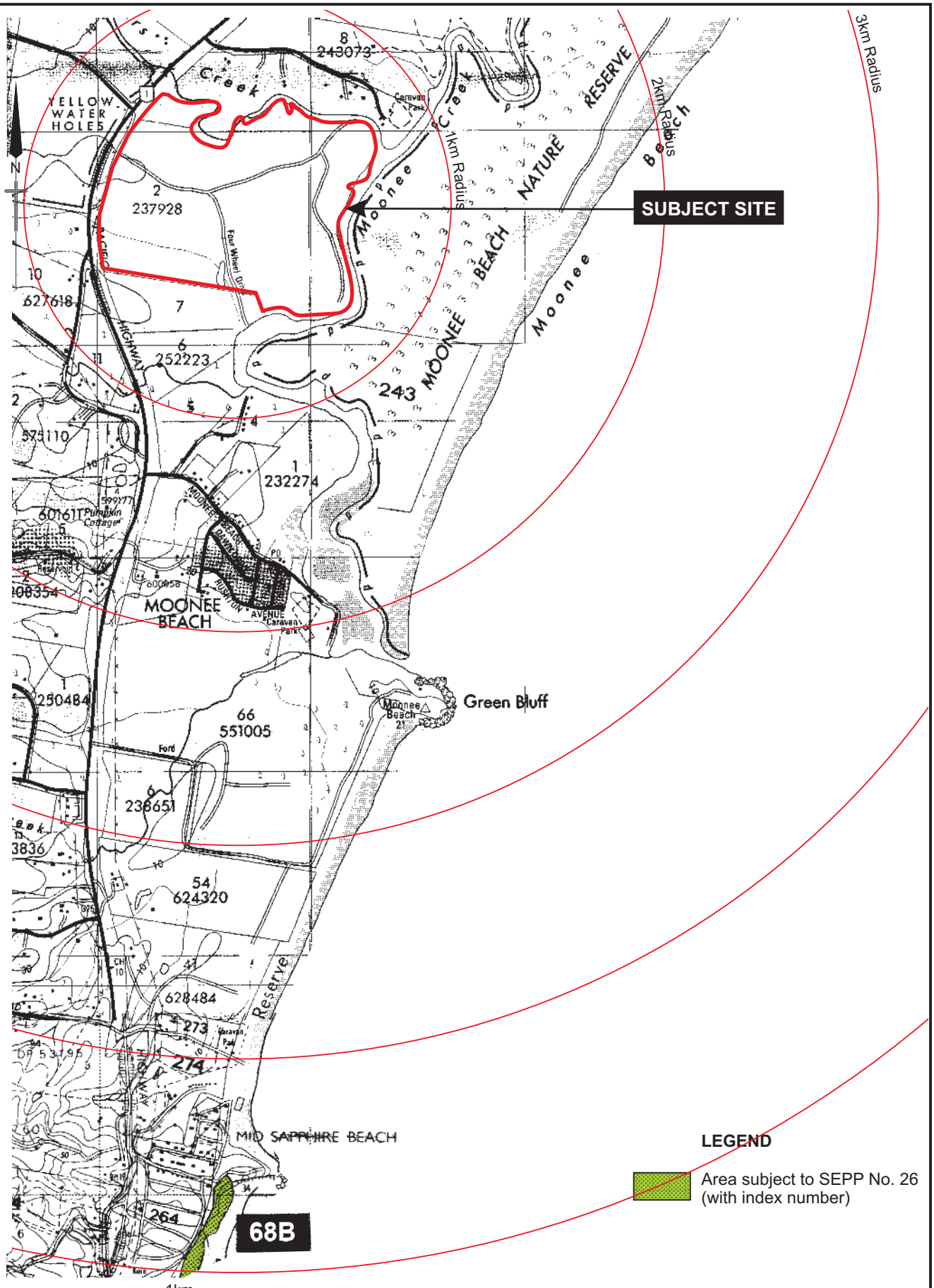
PROJECT
Flora & Fauna Assessment
Lots 1 & 2 DP725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 2

PREPARED: vja
DATE: July 2006
FILE : 02066_FFA_sepp14.cdr

TITLE

SEPP No. 14 COASTAL WETLANDS



SOURCE: Topographic map 'Moonee Beach'
State Env. Planning Policy No. 26
Littoral Rainforests Map 2 Amend. No. 1
SCALE: 1 : 25 000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

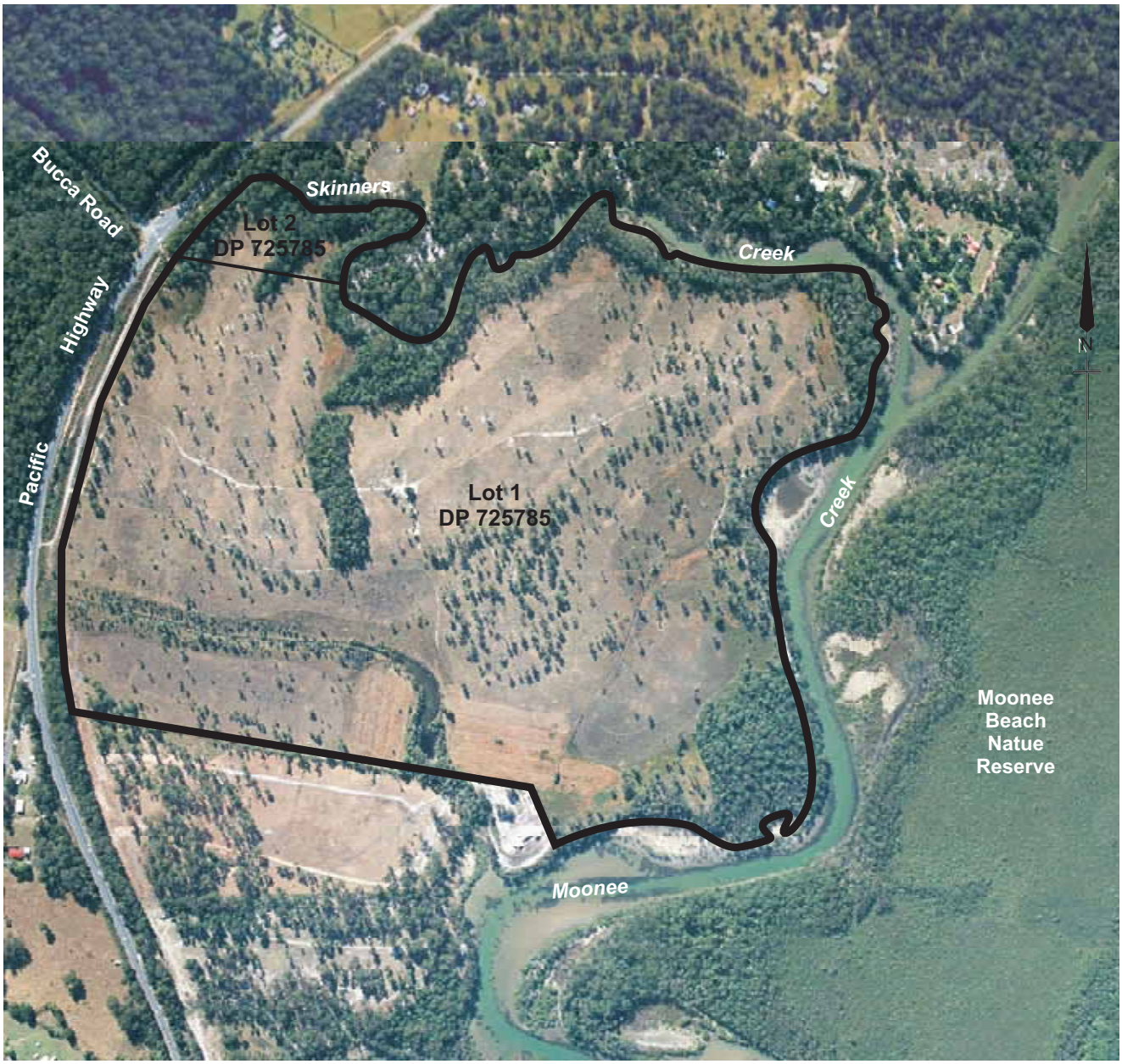
PROJECT
Flora & Fauna Assessment
Lots 1 & 2 DP725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 3

PREPARED: vja
DATE: July 2006
FILE : 02066_FFA_sepp26.cdr

TITLE

SEPP No. 26 LITTORAL RAINFORESTS



LEGEND

Subject site

0 100 200m

SOURCE: Aerial photo taken July 2006

SCALE: 1 : 10 000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

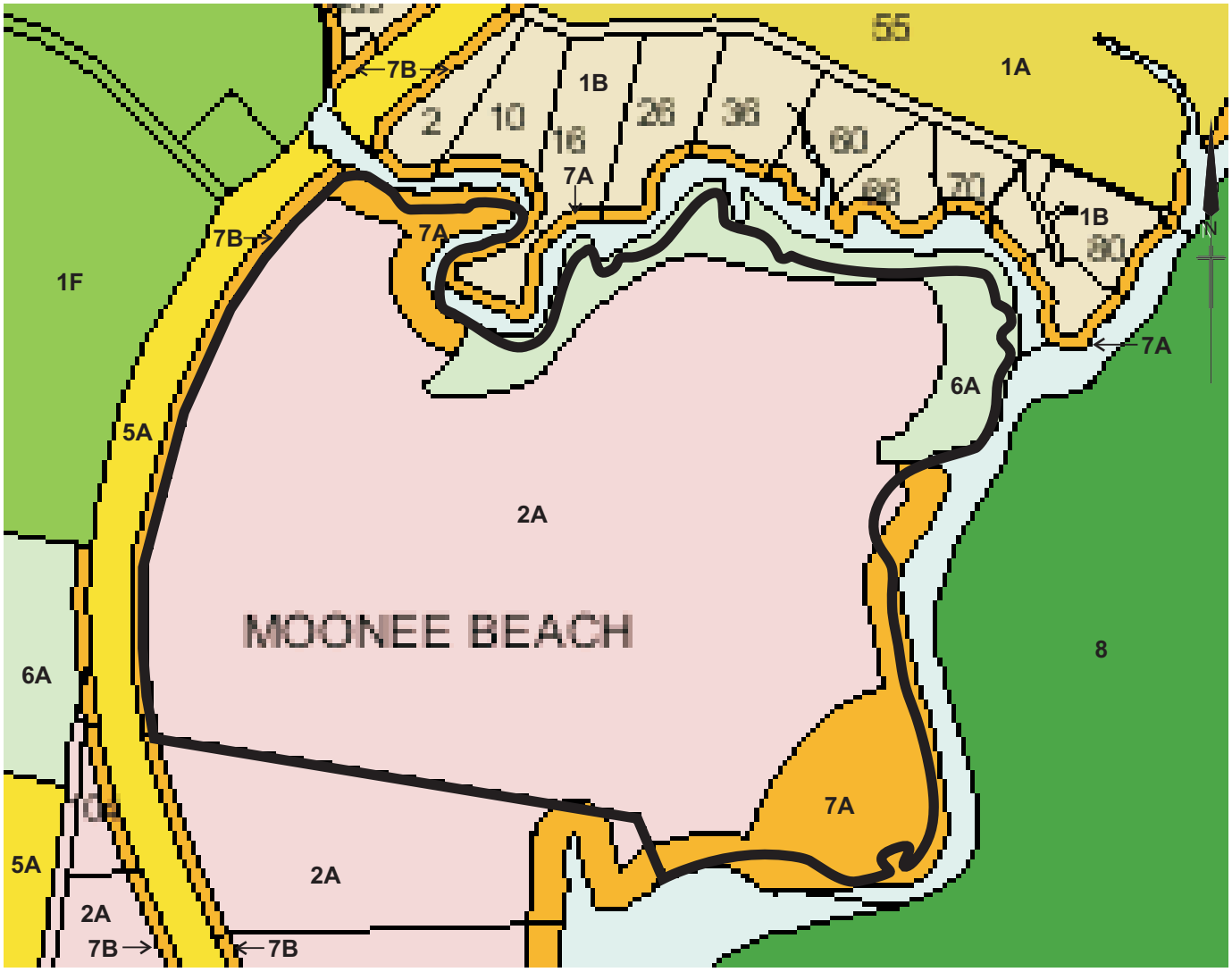
PROJECT
Flora & Fauna Assessment
Lots 1 & 2 DP725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 4

PREPARED: vja
DATE: July 2006
FILE : 02066_FFA_site.cdr

TITLE

THE SUBJECT SITE



LEGEND

- 1A Rural Agriculture
- 1B Rural Living
- 1F Rural State Forest
- 2A Residential Low Density
- 5A Special Uses
- 6A Open Space Public Recreation
- 7A Environmental Protection Habitat & Catchment
- 7B Environmental Protection Scenic Buffer
- 8 National Park &Reserves
- Subject site

0 200m

SOURCE: Coffs Harbour City Council's Web Site 18.01.06

SCALE: 1 : 10 000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

PROJECT
Flora & Fauna Assessment
Lots 1 & 2 DP725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 5

PREPARED: vja
DATE: July 2006
FILE : 02066_FFA_lep.cdr

TITLE

Coffs Harbour City Council's LANDUSE ZONINGS

Legend

- Underground Stormwater Drainage
- Interallottment Drainage
- Bioretention Zones
- Stormwater Drainage Outlets
- Vegetation Filter Zone
- 3 Catchment No
- 0.52 ha Catchment Area
- Catchment Boundary
- Creek Buffers
- APZ
- Subject Site

0 100 200m

SOURCE: Auspacific Engineers Pty Ltd (Ref: 04-1600-P5B.pdf)

SCALE: 1 : 8000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

PROJECT
Flora & Fauna Assessment
Lots 1 & 2 Dp725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 6

PREPARED: VJA/BW
DATE: 08 November 2007
FILE: 02066_FFA_concept.cdr

TITLE

PROPOSED DEVELOPMENT LAYOUT

1.6 Literature Review

A number of Flora and Fauna Reports and other sources of information were reviewed in the course of this assessment. These include:

- DLWC (1999) Soil landscape series sheet 9537 Coffs Harbour.
- Moonee Development Control Plan (2004) Coffs Harbour City Council.
- NPWS Atlas of NSW Wildlife records. Moonee Beach Nature Reserve.
- NPWS Atlas of NSW Wildlife records. Coffs Harbour Local Government Area.
- Clancy, G.P. & V.A. (1998) Flora and Fauna Assessment Moonee Release Area. A report prepared for Coffs Harbour City Council.
- JWA (2003) Preliminary study. Lots 1 & 2 DP 725785, Pacific Highway, Moonee.
- JWA (2004) Wallum Froglet Assessment. Lots 1 & 2 DP 725785, Pacific Highway, Moonee.
- JWA (2004) Flora and Fauna Assessment. Lots 6 & 7 DP 252223, Pacific Highway, Moonee.
- JWA (2003) Flora and Fauna Assessment. Lot 122 DP 1052566 Moonee Beach Road, Moonee.
- JWA (2000) Flora and Fauna Assessment. Heritage Park, Moonee.
- Anne Harrison (2005) Landscape Concept & Open Space Management Plan for Lot 1 & 2 DP725785 Pacific Highway Moonee.
- WBM Oceanics (2005) Moonee Creek Estuary Processes Study.

2 FLORA ASSESSMENT

2.1 Introduction

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

2.2 Methods

2.2.1 NPWS Database search

A search of the NPWS database was conducted to find records of Threatened species within 10km of the Subject site.

2.2.2 Site survey

A site survey was completed at the Subject site between the 10th and 14th of May 2004. The site was comprehensively surveyed and a general plant species list was compiled. An additional survey was completed on the 23rd and 24th of September 2004 to target Threatened orchid species considered possible occurrences on the site.

2.3 Results

2.3.1 NPWS Database search

A search of the NPWS Database revealed ten (10) Threatened Flora species within 10km of the Subject site. These species are shown in **TABLE 1**.

TABLE 1
NPWS DATABASE RECORDS OF THREATENED FLORA SPECIES
WITHIN 10 KM OF THE SUBJECT SITE

Botanical name	Common name
Amorphospermum whitei	Rusty plum
Boronia umbellata	
Marsdenia longiloba	Clear milkvine
Parsonsia dorrigoensis	Milky silkpod
Phaius australis	A swamp orchid
Quassia sp. 'Moonee Creek'	Moonee beach Quassia
Sarcochilus fitzgeraldii	Ravine orchid
Senna acclinis	
Thesium australe	Australian toadflax
Zieria prostrata	

2.3.2 Threatened flora known from the locality

The Clancy report (1998) on the Moonee Release Area recorded Rusty plum (*Amorphospermum whitei*) to the south of the site, and notes that *Quassia* sp. B (Moonee Creek) is also known from the area. A JWA survey to the south of Moonee village (2004) also recorded Quassia sp. 'Moonee Creek'.

There has also been an unverified record of the Threatened species Dwarf heath casuarina (*Allocasuarina defungens*) on the Subject site (Mark Graham *pers comm.* 2004).

2.3.3 Site survey

Six (6) broad vegetation types, consisting of distinct vegetation communities were identified in the Subject site. These communities are described in Section 2.3.4 and are shown in **FIGURE 7**.

One hundred and sixty-seven (167) species were recorded at the Subject site. None of these are Threatened or ROTAP (Briggs & Leigh 1995) species. Samples of Casuarina on the site were sent to the NSW Herbarium to determine if the Threatened species Dwarf heath casuarina (*Allocasuarina defungens*) occurs on the site, but were noted as being inadequate to make a determination. It seems highly unlikely that this species occurs within the open grassland community of the Subject site. A full list of species recorded at the site is included as **APPENDIX 1**.

Two (2) regionally significant (Sheringham & Westaway 1995) flora species were recorded on the site: White stringybark (*Eucalyptus globoidea*) and Christmas bells (*Blandfordia grandiflora*). Both these species were also recorded on the site by Clancy (1998).

Three (3) Endangered Ecological Communities (EECs) occur on the site:

- Coastal saltmarsh
- Swamp oak floodplain forest
- Swamp sclerophyll forest on coastal floodplain

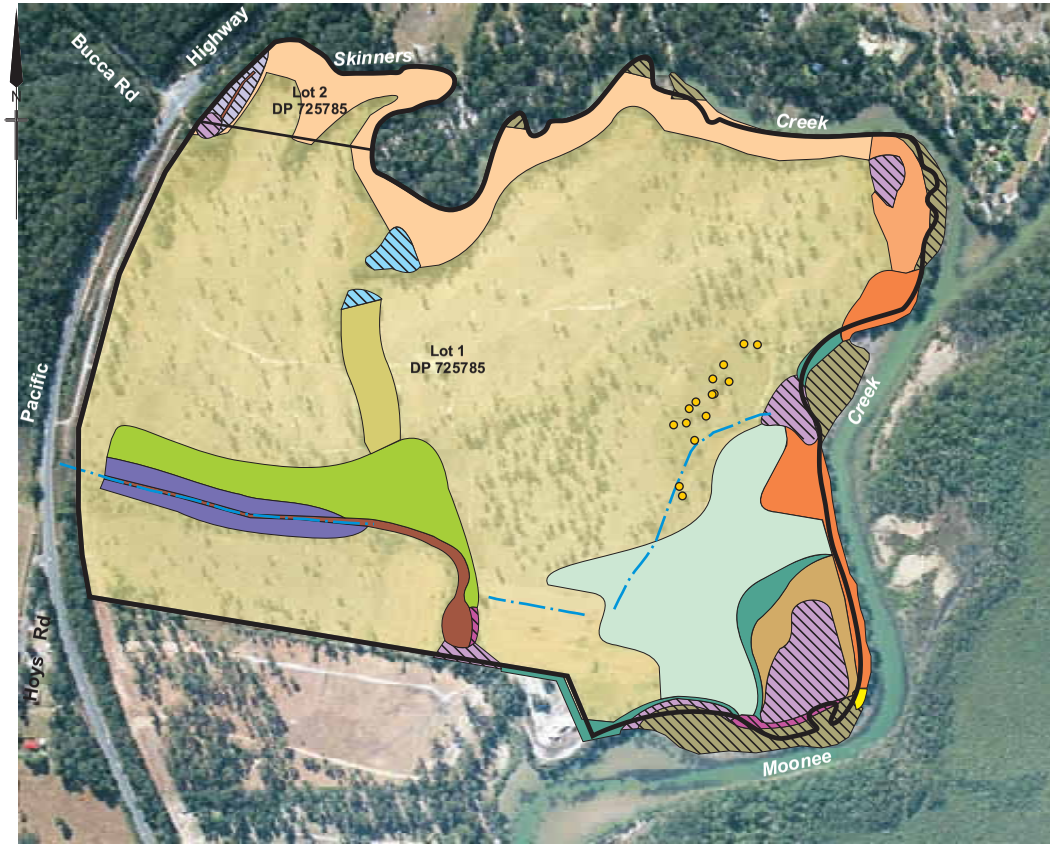
These EECs have been gazetted by the NSW Scientific Committee, with the latter two recently declared in December 2004.

2.3.4 Community descriptions

Seventeen (17) vegetation communities were recorded. The vegetation communities are shown in **TABLE 2**. The conservation status of these communities is discussed with reference to the Comprehensive Regional Assessment completed for NSW Forest and Non-forest ecosystems as part of the Regional Forestry Agreement (RFA) process (CRA Unit 1999). The RFA establishes the framework for the management of the forests of upper north-east and lower north-east regions. The RFA document sets out percentage reservation status of forest and non-forest Ecosystems in the CAR Reserve System based on vegetation modelling to establish the pre-1750 extent of forest ecosystems in the region.

Vegetation communities are also described at a local level with reference to the following documents:

- Fisher, Body and Gill (1996) The vegetation of the Coffs Harbour City Council LGA
- Ecograph (2002) Coffs Harbour Vegetation Management Strategy



LEGEND

Dry sclerophyll forest/woodland communities

Community 1a - Tall closed forest
(Eucalyptus pilularis +/- mixed species)

Community 1b - Tall mid-dense forest
(Eucalyptus planchoniana, Syncarpia glomulifera, Corymbia intermedia)

Community 1c - Tall mid-dense forest
(Syncarpia glomulifera, Eucalyptus robusta)

Community 1d - Tall mid-dense forest
(Eucalyptus planchoniana, Eucalyptus tindaliae, Eucalyptus pilularis, Syncarpia glommulifera)

Community 1e - Tall open forest
(Eucalyptus siderophloia)

Community 1f - Tall closed forest
(Eucalyptus planchoniana, Syncarpia glomulifera, Eucalyptus pilularis)

Swamp sclerophyll communities

Community 2a - Tall mid-dense forest
(Eucalyptus robusta, Lophostemon suaveolens, Melaleuca quinquenervia, Syncarpia glomulifera)

Community 2b - Mid-high swamp sclerophyll forest
(Melaleuca quinquenervia)

Community 2c - Mid-high swamp sclerophyll forest
(Melaleuca sieberi)

Community 2d - Mid-high swamp sclerophyll woodland
(Melaleuca quinquenervia, M. linariifolia)

Community 2e - Mid-high swamp she-oak woodland
(Casuarina glauca)

Heathland/sedgeland/fernland communities

Community 3a - Tall closed heath
(Ochrosperma leneare, Leptospermum polygalifolium, Leucopogon parviflorus)

Community 3b - Slashed heath
(Mixed species)

Grassland communities

Community 4a - Low closed grassland
(Andropogon virginicus, Themeda triandra) with scattered trees.

Community 4b - Low closed grassland
(Themeda triandra, Juncus sp.*)*

Intertidal communities

Community 5a - Low open mangrove forest/Saltmarsh
(Aegicerus corniculatum, Juncus kraussii, Sporobolus virginicus)

Wetland communities

Community 6a - Wetland
(Nymphaea sp., *Eleocharis* sp., *Philydrum lanuginosum)*

Individual *Melaleuca sieberi*

Endangered Ecological Community

Drainage line

0 100 200m

SOURCE: JWA Site Investigations

SCALE: 1 : 8 000 @ A3

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

PROJECT
Flora & Fauna Assessment
Lots 1 & 2 DP725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 7

PREPARED: vja
DATE: July 2006
FILE : 02066_FFA_veg.cdr

EXISTING SITE VEGETATION

TABLE 2
VEGETATION COMMUNITIES PRESENT ON THE SUBJECT SITE

1		**Dry Sclerophyll forest/woodland communities**
	1a	Tall closed forest (*Eucalyptus pilularis* +/- mixed species)
	1b	Tall mid-dense forest (*Eucalyptus planchoniana*, *Syncarpia glomulifera*, *Corymbia intermedia*)
	1c	Tall mid-dense forest (*Syncarpia glomulifera, Eucalyptus robusta*)
	1d	Tall mid-dense forest (*Eucalyptus planchoniana*, *E. tindaliae*, *E. pilularis*, *Syncarpia glomulifera*)
	1e	Tall open forest (*Eucalyptus siderophloia*)
	1f	Tall closed forest (*Eucalyptus planchoniana*, *Syncarpia glomulifera*, *Eucalyptus pilularis*)
2		**Swamp sclerophyll communities**
	2a	Tall mid-dense forest (*Eucalyptus robusta*, *Lophostemon suaveolens, Melaleuca quinquenervia*, *Syncarpia glomulifera*)
	2b	Mid-high swamp sclerophyll forest (*Melaleuca quinquenervia*)
	2c	Mid-high swamp sclerophyll forest (*Melaleuca sieberi*)
	2d	Mid-high swamp sclerophyll woodland (*Melaleuca quinquenervia, M. linarifolia*)
	2e	Mid-high Swamp she-oak woodland (*Casuarina glauca*)
3		**Heathland communities**
	3a	Tall closed heath (*Ochrosperma lineare*, *Leptospermum polygalifolium*, *Leucopogon parviflorus*)
	3b	Slashed heath (mixed species)
4		**Grassland/sedgeland communities**
	4a	Low closed grassland (*Andropogon virginicus*, *Themeda triandra*) with scattered trees.
	4b	Low closed grassland (*Themeda triandra, Juncus* sp.)
5		**Intertidal communities**
	5a	Low open mangrove forest/Saltmarsh (*Aegicerus corniculatum*, *Juncus kraussii, Sporobolus virginicus*)
6		**Wetland communities**
	6a	Wetland (*Nymphaea* sp., *Eleocharis* sp., *Philydrum lanuginosum*)

2.3.4.1 Community 1(a) – Tall closed forest (*Eucalyptus pilularis* +/- mixed species)

Location and area
This community occurs along the north-eastern margin of the site.

Description
This community is dominated by Blackbutt with Smooth-barked apple, Pink bloodwood and Turpentine also present. Several large mature Blackbutt and Rusty gum occur in the north-east corner of the site. Midstorey species include Broad-leaved paperbark and Hopbush, while Saw sedge and several grass species occur as groundcovers.

Conservation status
The most relevant Forest Ecosystem type considered in the CRA report (1999) is Forest Ecosystem 72 (Low Relief Coastal Blackbutt) (CRA Unit 1999). The Regional Forestry Agreement document provides the following data on this ecosystem:

- Pre 1750 there was 1574 hectares of this ecosystem type in the upper north-east section of the NSW North Coast Bioregion. 859 hectares (54.6%) remains.
- The ecosystem is considered to be **Rare**.
- 10.4% of the total forest ecosystem area is within the Comprehensive, Adequate & Representative (CAR) reserve system, including 9.1% in dedicated reserves and 0.6% in informal reserves. A further 0.6% is protected by tabulated prescriptions.
- This community has been identified as a priority for conservation on private land.

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is an amalgam of Map Unit N34a – Dry Blackbutt (*Eucalyptus pilularis*, *Angophora costata*) and Map Unit N44a (*Eucalyptus pilularis*, *E. resinifera*, *Corymbia intermedia*). It is also noted that these communities comprise potential Koala habitat.

Under Fisher, Body & Gill (1996), Map Unit N34a (*Eucalyptus pilularis*, *Angophora costata*) is considered Regionally Significant, while Map Unit N44a (*Eucalyptus pilularis*, *E. resinifera*, *Corymbia intermedia*) is considered Regionally Significant and Ecologically Significant (comprising tree species utilised by Koalas).

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 57 hectares of Map Unit N34a within the Coffs Harbour LGA, comprising 0.24% of mapped bushland within the Coffs Harbour LGA. Map Unit N44a covers an area of 587 hectares, comprising 2.51% of mapped bushland within the Coffs Harbour LGA.

The conservation status of this community on the Subject site is relatively high due to the low levels of disturbance of the midstorey and groundstorey and the relative maturity of canopy trees.

2.3.4.2 Community 1(b) – Tall Open Forest (*Eucalyptus planchoniana*, *Syncarpia glomulifera*, *Corymbia intermedia*)

Location and area
This community occurs in several areas along the north-eastern margin of the site.

Description
The northern area of this community is dominated by Needlebark stringybark, which occurs along with Turpentine as open woodland with a slashed grass understorey. The mid area of this community is dominated by Needlebark stringybark along with secondary occurrences of Pink bloodwood and Turpentine. Some of this area is maintained by slashing, and as a result has no midstorey and a grassy understorey. Un-slashed areas have a scattered midstorey of Heath species (*Leptospermum*, *Baeckea*), with some Sawsedge. The narrow band of the community flanking Moonee Creek is primarily composed of Needlebark stringybark and Turpentine and some Grey ironbark in the southern sections, along with a sparse midstorey of Dogwood, *Melaleuca nodosa*, *Baeckea* and Geebung.

Conservation status
The most relevant Forest Ecosystem type considered in the CRA report (1999) is Forest Ecosystem 20 (Clarence Lowland Needlebark Stringybark) (CRA Unit 1999). The Regional Forestry Agreement document provides the following data on this ecosystem:

- Pre 1750 there was 12496 hectares of this ecosystem type in the upper north-east section of the NSW North Coast Bioregion. 10817 hectares (86.6%) remains.
- The ecosystem is not considered to be Vulnerable, Rare, or Endangered.
- 55.4% of the total forest ecosystem area is within the Comprehensive, Adequate & Representative (CAR) reserve system, including 26.6% in dedicated reserves and 21.9% in informal reserves. A further 6.9% is protected by tabulated prescriptions.

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is Map Unit N42a – Needlebark stringybark (*Eucalyptus planchoniana, Corymbia intermedia*), which is considered Locally Significant.

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 15 hectares of Map Unit N42a within the Coffs Harbour LGA, comprising 0.06% of mapped bushland within the Coffs Harbour LGA.

The northern part of this community has been substantially modified due to slashing which has removed any midstorey and understorey, while other areas occur as narrow bands of vegetation. The conservation status is considered to be moderate.

2.3.4.3 Community 1(c) – Tall mid-dense forest (*Syncarpia glomulifera, Eucalyptus robusta*)

Location and area
This community occurs along with paperbark and heath communities as a wedge of vegetation in the south-east corner of the site.

Description
This community is comprised of emergent Turpentine and Swamp mahogany along with occurrences of Pink bloodwood, Needlebark stringybark, and Swamp turpentine. There is a dense midstorey of Black wattle, immature Turpentine, Swamp mahogany,Swamp turpentine and some Tea tree and Broad-leafed paperbark The ground layer consists of dense Saw sedge and bracken, and deep leaf litter and debris.

Conservation status
The most relevant Forest Ecosystem type considered in the CRA report (1999) is Forest Ecosystem 147 (Turpentine) (CRA Unit 1999). Some elements of Forest Ecosystem 142 (Swamp mahogany) are also present. Details on these ecosystems are as follows:

FE 147 – Turpentine

- Pre 1750 there was 6784 hectares of this ecosystem type in the upper north-east section of the NSW North Coast Bioregion. 8430 hectares (91.7%) remains.
- The ecosystem is not considered to be Vulnerable, Rare, or Endangered.
- 55.6% of the total forest ecosystem area is within the Comprehensive, Adequate & Representative (CAR) reserve system, including 52.3% in dedicated reserves and 0.9% in informal reserves. A further 2.5% is protected by tabulated prescriptions.

FE 142 – Swamp mahogany

- Pre 1750 there was 695 hectares of this ecosystem type in the upper north-east section of the NSW North Coast Bioregion. 578 hectares (83.2%) remains.
- The ecosystem is considered to be **Rare**.
- 39.5% of the total forest ecosystem area is within the Comprehensive, Adequate & Representative (CAR) reserve system, including 25.7% in dedicated reserves and 12.3% in informal reserves. A further 1.4% is protected by tabulated prescriptions.
- This Forest Ecosystem has been identified as a priority for protection on private land.

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is an amalgamation of Map Unit SF49 – Turpentine (*Syncarpia glomulifera*, *Eucalyptus microcorys*), which is considered Regionally Significant, and Map Unit N52 – Swamp mahogany (*Eucalyptus robusta*), considered Ecologically Significant (comprising tree species utilised by Koalas).

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 31 hectares of Map Unit SF49 within the Coffs Harbour LGA, comprising 0.13% of mapped bushland within the Coffs Harbour LGA. Map Unit N52 covers an area of 149 hectares, comprising 0.64% of mapped bushland within the Coffs Harbour LGA.

This community, while small in size, has a high diversity and contains elements of Swamp Mahogany forest (Rare – CRA; Ecologically Significant – Fisher *et al.*). Its conservation value is considered to be moderate – high.

2.3.4.4 Community 1(d) - Tall Open Sclerophyll Forest (*E. planchoniana*, *E. tindaliae*, *E. pilularis*, *Syncarpia glomulifera*)

Location and area
This community occurs along the northern boundary of the site along Skinners creek.

Description
This community consists of dry sclerophyll forest which is generally dominated by the stringybarks (*E. planchoniana*, *E. tindaliae*), with secondary occurrences of Blackbutt, Turpentine and Rusty gum. The community runs along the southern bank of Skinners Creek in a narrow band, and is quite open, with a sparse midstorey of regenerating Hopbush, Geebung, Dogwood and Mock olive. Some Forest oak also occasionally occurs. Groundcover consists of Blady grass, Kangaroo grass, Spiny-headed matrush and Bracken.

Along the eastern side of the site this community has more of an intact understorey with heathy species present, such as Hill Banksia, Tea tree and Curly wigs along with some scattered Broad-leaved paperbark. Towards the western half of this community, there is a secondary occurrence of Tallowwood, with several large mature trees occurring.

Conservation status
This community is not well described by any Forest Ecosystem, but is more an amalgam of FE 27 (Coastal Sands Blackbutt) and FE 20 (Clarence Lowland Needlebark

Stringybark). The Regional Forestry Agreement document provides the following data on FE 27 – Coastal Sands Blackbutt

- Pre 1750 there was 4518 hectares of this ecosystem type in the upper north-east section of the NSW North Coast Bioregion. 3101 hectares (68.6%) remains.
- The ecosystem is not considered to be Vulnerable, Rare, or Endangered.
- 63.1% of the total forest ecosystem area is within the Comprehensive, Adequate & Representative (CAR) reserve system, including 63% in dedicated reserves and 0% in informal reserves. A further 0.1% is protected by tabulated prescriptions.

FE 20 (Clarence Lowland Needlebark Stringybark) is described for Community 1(b).

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is an amalgam of Map Unit N42a – Needlebark stringybark (*Eucalyptus planchoniana*, *Corymbia intermedia*), which is considered Locally Significant, and Map Unit N44a (*Eucalyptus pilularis*, *E. resinifera*, *Corymbia intermedia*), considered Regionally Significant and Ecologically Significant (comprising tree species utilised by Koalas).

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 15 hectares of Map Unit N42a within the Coffs Harbour LGA, comprising 0.06% of mapped bushland within the Coffs Harbour LGA. Map Unit N44a covers an area of 587 hectares, comprising 2.51% of mapped bushland within the Coffs Harbour LGA.

The conservation status of this community is reduced due to the lack of developed midstorey, and the high edge ratio along the northern margins of the site. However, conservation values are considered to be moderate.

2.3.4.5 Community 1(e) – Tall open forest (*Eucalyptus siderophloia*)

Location and area
This community occurs as a small area at the end of the access track along the eastern side of the site, adjacent to Moonee Creek.

Description
This community consists of scattered Northern grey ironbark fringing mangrove communities in the south-east corner of the Subject site. Mid storey is largely absent, while ground cover is predominantly composed of Sedges.

Conservation status
This community is best described by Forest Ecosystem 71 (Ironbark) (CRA Unit 1999).
The Regional Forestry Agreement document provides the following data on this ecosystem:

- Pre-1759 there was 24667 hectares of this ecosystem type in the upper-north section of the NSW North Coast Bioregion. 7713 hectares (31.3%) remains.
- This ecosystem is not considered Rare, Vulnerable or Endangered.
- 4.7% of the total (pre-1750) forest ecosystem is within the Comprehensive, Adequate & Representative (CAR) reserve system, of which 4.1% is held in dedicated reserves and 0.1% held I informal reserves. A further 0.1% is protected by tabulated prescriptions.
- This forest ecosystem has been identified as a priority for protection on Private land.

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is Map Unit N56a – Moist Grey Ironbark/Grey Gum/Tallowwood/White mahogany (*Eucalyptus siderophloia*, which is considered Regionally Significant.

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 14 hectares of Map Unit N56a within the Coffs Harbour LGA, comprising 0.06% of mapped bushland within the Coffs Harbour LGA.

The conservation value of this community is diminished by its small size, simple structure and sparse density of trees. Conservation status is considered to be moderate.

2.3.4.6 Community 1(f) – Tall closed forest (*Eucalyptus planchoniana*, *Syncarpia glomulifera*, *Eucalyptus pilularis*)

Location and area
This community occurs as a rectangular area bisected by an access road in the middle of the site.

Description
This community has a mixed composition with numerous species present in the canopy, and appears to be relatively immature regrowth. Needlebark stringybark appears to dominate, along with secondary occurrences of Turpentine, Blackbutt, and Tindale's stringybark. Other species present include the occasional Tallowwood and Smooth-barked apple.

The midstorey in this community is relatively dense at times with immature Turpentine, along with Hopbush, Mock olive and some Black she-oak. The ground layer is generally sparse, consisting of Blady grass, Juncus sp. Flax lilly and Gahnia, along with regenerating Mock olive and Turpentine. Some occasional Egg and bacon peas also occur, while some Hairpin banksia occurs in the more open northern end of the community.

Conservation status
The most relevant Forest Ecosystem type considered in the CRA report (1999) is Forest Ecosystem 20 (Clarence Lowland Needlebark Stringybark) (CRA Unit 1999). This is discussed for Community 1(b).

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is Map Unit N42a – Needlebark stringybark (*Eucalyptus planchoniana, Corymbia intermedia*), which is considered Locally Significant.

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 15 hectares of Map Unit N42a within the Coffs Harbour LGA, comprising 0.06% of mapped bushland within the Coffs Harbour LGA.

It should be noted that the mixed composition of this community is not adequately represented by Forest Ecosystem 20. Conservation value is considered to be moderate.

2.3.4.7 Community 2(a) - Tall mid-dense sclerophyll forest (*Eucalyptus robusta*, *Lophostemon suaveolens*, *Melaleuca quinquenervia*, *Syncarpia glomulifera*)

Location and area

This community occurs around a drainage line in the north-west corner of the site.

Description

This community is comprised of a mixture of species, with Sclerophyllous species (Swamp mahogany, Swamp turpentine and Turpentine), Broad-leaved paperbark and Cheese tree present. Some scattered Willow bottlebrush also occurs. There are some elements of rainforest present in this community, represented by Black wattle, Cheese tree, and Creek sandpaper fig.

A midstorey of regenerating Cheese tree occurs within this community along with some immature Paperbark and Lantana. The understorey is composed of Saw-sedge and sedges along with some ferns (Cartilaginous fern, Maidenhairs) and forbs (Pastel flower, Centella) present. Several vine species are present: Wonga vine, Water vine and Common silkpod. The western boundary of this community has been recently disturbed by earthworks for telecommunication.

Conservation status

This community is an amalgam of Forest Ecosystem types 142 (Swamp mahogany) and 112 (Paperbark). FE 142 is described for Community 1(c). The Regional Forestry Agreement document provides the following data on FE 112 (Paperbark):

- 28577 hectares of this ecosystem type remains within the upper north east section of the NSW North Coast Bioregion. The original extent (ie. Pre 1750) has not been calculated.
- The ecosystem is considered to be **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 priority for conservation on private land.

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is an amalgamation of Map Unit N52 – Swamp mahogany (*Eucalyptus robusta*), which is considered Ecologically Significant (comprising tree species utilised by Koalas), and Map Unit N20a – Paperbark (*Melaleuca quinquenervia*, *Lophostemon suaveolens*), considered Ecologically Significant (comprising tree species utilised by Koalas).

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 149 hectares of Map Unit N52 within the Coffs Harbour LGA, comprising 0.13% of mapped bushland within the Coffs Harbour LGA. Map Unit N20a covers an area of 58 hectares, comprising 0.25% of mapped bushland within the Coffs Harbour LGA.

This community is representative of the Endangered Ecological Community (EEC) Swamp sclerophyll forest on coastal floodplains, and has a high conservation value.

2.3.4.8 Community 2 (b) - Paperbark (*Melaleuca quinquenervia*)

Location and area
This community occurs in several areas on the site: south of the dam, in the south-east corner, mid-way along the eastern margin and in the north-east and north-west corners.

Description
This community occurs in moist, low-lying areas of the site, and consists of Broad-leaved paperbark, mostly to the exclusion of other species. Around the dam area, Common silkpod occurs throughout, while in the south-east corner and mid-way along the eastern edge a fringe of heath occurs (*Banksia spinulosa*, *Leptospermum polygalifolium*) along with an understorey of Saw sedge.

In the north-east corner Paperbarks are mature and occur to a height of 15 metres, in addition to an area of maturing individuals. A dense understorey of Saw sedge occurs. A small pocket of Paperbark occurs within sclerophyll forest around the drainage line in the north-west in conjunction with Tallowwood, Creek sandpaper fig, and a ground cover of thick Long-leaved Mat rush.

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

- 28577 hectares of this ecosystem type remains within the upper north east section of the NSW North Coast Bioregion. The original extent (ie. Pre 1750) has not been calculated.
- The ecosystem is considered to be **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 priority for conservation on private land.

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is Map Unit N20 – Paperbark (*Melaleuca quinquenervia*), which is considered Ecologically Significant (comprising tree species utilised by Koalas).

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 485 hectares of Map Unit N20 within the Coffs Harbour LGA, comprising 2.07% of mapped bushland within the Coffs Harbour LGA.

This community is representative of the Endangered Ecological Community (EEC) Swamp sclerophyll forest on coastal floodplains, and has a high conservation value.

2.3.4.9 Community 2(c) - Paperbark (*Melaleuca sieberi* +/- *Melaleuca quinquenervia*)

Location and area
This community occurs as two small areas within vegetation communities to the north of the 'finger' community central to the site.

Description
The two small areas north of the 'finger' are less developed and occupy a small area divided by sedgeland. Some emergent Swamp mahogany occurs sporadically throughout. Some Broad-leaved paperbark also occurs along with an understorey of Saw sedge and sedges.

Conservation status
This community is best described by Forest Ecosystem 112 (Paperbark) (CRA Unit 1999). Data on this ecosystem is described for Community 2(b).

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is Map Unit N50 – Paperbark (*Melaleuca* sp., *Casuarina glauca*, *Eucalyptus robusta*), which is considered Ecologically Significant (comprising tree species utilised by Koalas).

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 475 hectares of Map Unit N50 within the Coffs Harbour LGA, comprising 2.03% of mapped bushland within the Coffs Harbour LGA.

This community is representative of the Endangered Ecological Community (EEC) Swamp sclerophyll forest on coastal floodplains, and has a high conservation value.

2.3.4.10 Community 2(d) – Mid-high swamp sclerophyll woodland (*Melaleuca quinquenervia, M. linarifolia*)

Location and area
This community occurs around the southern drainage line.

Description
This community consists of scattered immature Broad-leaved and Flax-leaved paperbark occur. The occasional Sieber's paperbark also occurs. The midstorey is absent, while the ground layer occurs as a mixture of grassland, sedgeland and occasional heath species, which is described as Community 4b.

Conservation status
This community is considered a depauperate version of Forest Ecosystem 112 (Paperbark) (CRA Unit 1999). Data on this ecosystem is described for Community 2(b).

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is Map Unit N20 – Paperbark (*Melaleuca quinquenervia*), which is considered Ecologically Significant (comprising tree species utilised by Koalas).

This community is representative of the Endangered Ecological Community (EEC) Swamp sclerophyll forest on coastal floodplains. The conservation value has been reduced due to the immature growth stage and significant disturbance and modification from slashing and grazing,

2.3.4.11 Community 2(e) – Mid-high Swamp she-oak woodland (*Casuarina glauca*)

Location and area
This community occurs as a narrow band adjacent to saltmarsh and mangrove in the south-east corner of the site, and in a small patch adjacent to the dam.

Description
This community is entirely comprised of Swamp oak, and is bounded by saltmarsh to the south and Paperbark to the north. Tree height is to about 10 metres, with very little understorey or mid-storey. The small area by the dam also contains some patchy Black she-oak.

Conservation status
This community is best described by Forest Ecosystem 143 (Swamp oak). The Regional Forestry Agreement document provides the following data on this ecosystem:

- Pre-1750 there was 11165 hectares of this ecosystem type in the upper-north section of the NSW North Coast Bioregion. 2883 hectares (25.8%) remains.
- The ecosystem is considered to be **Rare**.
- 8.3% of the total forest ecosystem area is within the Comprehensive, Adequate & Representative (CAR) reserve system, including 7.6% in dedicated reserves and 0.2% in informal reserves. A further 0.5% is protected by tabulated prescriptions.

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is Map Unit N26a – Swamp Oak (*Casuarina glauca*), which is considered Ecologically Significant (comprising tree species utilised by Koalas).

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 28 hectares of Map Unit N26a within the Coffs Harbour LGA, comprising 0.12% of mapped bushland within the Coffs Harbour LGA.

This community is representative of the Endangered Ecological Community (EEC) Swamp oak floodplain forest and has a high conservation value.

2.3.4.12 Community 3(a) - Tall closed heath (*Ochrosperma lineare*, *Leptospermum polygalifolium*, *Leucopogon parviflorus*)

Location and area
This community occurs in the south-eastern corner of the site.

Description
This community is comprised of a number of species including *Leptospermum polygalifolium, Ochrosperma lineare*, *Melaleuca linarifolia*, *Melaleuca whitei*, Coastal bearded heath, Green styphelia, Prickly monotoca, and Pink boronia. Devil's twine occurs throughout. The most prominent area of this community occurs in the south-east corner near Eucalypt and Paperbark communities. Other heath areas occur as thin bands running along the property boundaries in the south-east corner, and along the southern boundary to the Paperbark community adjacent to the dam. This community is quite dense, but persists narrowly along the fence line in a hedge-like manner.

Conservation status
This community is best described by Non-Forest Ecosystem 64 (Heath). The Regional Forestry Agreement document provides the following data on this ecosystem:

- The pre 1750 extent of this ecosystem type was not calculated. 9805 hectares remains.
- The ecosystem is considered to be **Vulnerable**.
- The extent of this ecosystem type contained within the Comprehensive, Adequate & Representative (CAR) reserve system has not been calculated.

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is Map Unit SG5804 – Dry Heath (*Banksia oblongifolia, Leptospermum polygalifolium, Hovea linearis, Pultenaea villosa*), which is considered Regionally Significant.

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 28 hectares of Map Unit SG5804 within the Coffs Harbour LGA, comprising 0.12% of mapped bushland within the Coffs Harbour LGA.

This heath community on the Subject site is relatively small in area, although prior to clearing is likely to have occupied much of the south-eastern corner of the site. Any future regeneration/expansion of this community is restricted by current slashing practices. The conservation value of this community is considered to be moderate.

2.3.4.13 Community 3(b) – Slashed heath (mixed species)

Location and area
This community occurs throughout much of the low lying areas in the south-eastern area of the site.

Description
The Subject site is maintained by slashing all cleared land, and heathlands which would once have been an extension of those in Community 3a are now maintained at ground level to a height of about 15 cm. Species present include various Epacrids and Peas, Straggly baeckea, Beard heath, Teatree, Swamp Grass tree, Rice flower, Heath rush, Grass lilies, Raspwort and Blue dampiera. Colonies of Clubmoss, sundews and sedges occur intermittently in wetter areas.

Conservation status
This community is considered a depauperate version of NFE 64 (Heath) due to continued slashing. Details of NFE 64 are provided for Community 3(a).

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is Map Unit SG5804 – Dry Heath (*Banksia oblongifolia, Leptospermum polygalifolium, Hovea linearis, Pultenaea villosa*), which is considered Regionally Significant.

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 28 hectares of Map Unit SG5804 within the Coffs Harbour LGA, comprising 0.12% of mapped bushland within the Coffs Harbour LGA.

The conservation value of this community has been greatly reduced by slashing and grazing activities.

2.3.4.14 Community 4(a) - Low open grassland (*Andropogon virginicus*, *Themeda triandra*) with scattered trees

Location and area
This community occurs throughout most of the site.

Description
Grassland on the site is comprised mostly of Whisky grass and Kangaroo grass, along with Blady grass and some Parramatta grass. Other species such as Spiny-headed mat rush, Native violet, Bracken and Pennywort occur patchily throughout the community. Some small patches of sedgeland (*Juncus planifolius*, *Juncus usitatus*) also occur, within low-lying areas.

A number of Eucalypts are scattered throughout this community, being more numerous on the eastern side of the site. Species most prevalent include Blackbutt, Needlebark stringybark and Turpentine.

Two areas immediately east and west of the dam in the south of the site were previously used for turf farming and can be clearly identified from the aerial photograph (**FIGURE 4**). These areas are dominated by Whisky grass and Paspalum, with some Blady grass and occasional Swamp water fern and Saw sedge.

A small area of fifteen (15) mature Sieber's paperbark (*Melaleuca sieberi*) occur scattered among grasslands to the east of the site, and are shown in **FIGURE 7**. These are old growth trees up to 12 metres high, with an open understorey of Whisky grass and Kangaroo grass and some small patches of sedgeland.

Conservation status
There is no appropriate CRA classification for this community. The community does not qualify as natural (native) grassland, due to the overall dominance of Whisky grass. The conservation status is therefore considered to relatively low. Individual trees within grasslands have elevated conservation significance.

Grasslands are not adequately described under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA.

Individual Sieber's paperbark (*Melaleuca sieberi*) within this community are not considered to constitute the Endangered Ecological Community (EEC) Swamp sclerophyll forest on coastal floodplain as the trees do not form any continuous canopy, and are scattered randomly, usually up to 40 metres apart. Other eucalypt species such as Blackbutt, Smooth-barked apple, Turpentine, and Needlebark stringybark also occur as scattered trees in this area, and are not species associated with this EEC.

While the Sieber's paperbark often have occasional species such as Saw sedge, (regrowth) Hairpin banksia and (regrowth) Swamp she-oak as individual plants around their bases, these species are absent from the grassland (and occasional areas of sedgeland) which form the basis of this community. The highly modified nature of the grassland community from a combination of slashing and grazing has resulted in a simplified grassland community without any structural characteristics which qualify as a forest community.

2.3.4.15 Community 4(b) - Low closed grassland (*Themeda triandra*, *Juncus* sp.)

Location and area
This community occurs in a broad low-lying area in the south of the site, adjacent to the drainage line.

Description
This community is a moist low-lying area with a mixed species composition. Kangaroo grass is prevalent, while some occasional Paspalum also occurs. Parramatta grass and Whisky grass are sporadic occurrences. Wetter parts of this community are dominated by sedges (*Juncus usitatus, Juncus planifolius, Ptilothrix deusta*) particularly nearer to the drainage line where there are a number of small depressions. Some occasional heath species occur (Raspwort, Riceflower, Beard heath, Tea tree) along with occasional regrowth Paperbark.

Conservation status
There is no appropriate CRA classification for this community. Conservation status is considered to be low to moderate.

This community is not adequately described under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA.

2.3.4.16 Community 5(a) – Low open Mangrove Forest/Saltmarsh (*Aegicerus corniculatum, Juncus krausii, Sporobolus virginicus*)

Location and area
This community occurs intermittently along the banks of Moonee Creek and Skinners Creek.

Description
Significant areas of this community occur adjacent to Moonee Creek, and represent the larger portions of Mangrove on the Subject site. River Mangroves in this section are relatively poorly developed, and form a narrow margin along the creek edge. Some broad areas of Saltmarsh occur which support areas of Salt rush (which occurs from sparse to dense populations) along with Salt couch. It is evident that the larger areas of tidal flats in the south-east corner of the site are occasionally used by vehicles.

Skinners Creek supports a smaller fringing mangrove community which also includes Grey Mangrove (*Avicennia marina*). Tidal and Salt marsh communities are smaller in size, and appear to be less disturbed than those along Moonee Creek.

Conservation status
This community is best described by Non-Forest Ecosystem 77 (Mangrove). The Regional Forestry Agreement document provides the following data on this ecosystem:

- The pre 1750 extent of this ecosystem type was not calculated. 734 hectares remains.
- The ecosystem is considered to be **Rare**.
- The extent of this ecosystem type contained within the Comprehensive, Adequate & Representative (CAR) reserve system has not been calculated.

The closest description of this community under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA is an amalgam of Map Unit

SG2502 – Mangrove/Saltmarsh complex (*Avicennia marina var. australasica, Aegicerus corniculatum*) which includes Map Unit SG6102 (*Sporobolus virginicus, Juncus krausii*).

The Coffs Harbour Vegetation Management Strategy (CHVMS) (Ecograph 2002) notes that there is 52 hectares of Map Unit SG2502 (incl. 6102) within the Coffs Harbour LGA, comprising 0.22% of mapped bushland within the Coffs Harbour LGA.

The conservation value of these communities is considered to be high. Coastal Saltmarsh has been classified as an Endangered Ecological Community (EEC) by the NSW Scientific Committee (NPWS 2004).

2.3.4.17 Community 6(a) - Wetland

Location and area
This community occurs in the south of the site and includes the dam and associated drainage line. An additional wetland area occurs in the north-west corner, where a creek feeds through a small gully to Skinners Creek.

Description
The dam area occurs as an area of open water with some fringing sedge vegetation which grades into denser vegetation, primarily *Eleocharis* sedgeland. Other wetland species include Bog rush (*Baumea rubiginosa*), *Cyperus* sp., Frogsmouth and Water fern. The drainage line feeding the dam has a patchy distribution of sedges and ferns and some regrowth Paperbark. The drainage line has been significantly disturbed by grazing cattle. Vegetation on the banks of the drainage line includes scattered Broad-leaved Paperbark and Sieber's paperbark.

The creekline in the north-west corner of the site is thickly vegetated with Long-leaved matrush (*Lomandra hystrix*) and Saw-sedge. While water remaining in the creek was shallow and stagnant at the time of the survey, it is evident that significant flow is channelled down to Skinners Creek in times of heavy rainfall.

Conservation status
There is no appropriate CRA classification for this community. Conservation status is considered to be moderate.

This community is not adequately described under the Fisher, Body & Gill (1996) classification system for vegetation in the Coffs Harbour LGA.

2.4 Coffs Harbour City Council Draft Vegetation Management Plan

Mapping of the site under the Coffs Harbour Draft Vegetation Management Plan identifies areas in the eastern part of the site as being of "very high ecological value". This ecological status is conferred primarily on the basis of the reservation status of Forest Ecosystem 72 (Low relief Coastal Blackbutt) under the CRA assessment process, as well as the presence of Paperbark (FE 112) communities. Under the Coffs Harbour Vegetation Management Study, ecosystem types that have met between 0-33% of their reservation target are considered of "very high ecological value".

Vegetation in the south-east corner of the site is identified as being of "high" ecological value with a small area of "medium" ecological value. Vegetation in the north of the site flanking Skinners Creek is mapped as being of "low" ecological value. Areas of ecological value under the CHVMS are shown in **FIGURE 8**.

Legend

Vegetation Value

- Very High
- High
- Medium
- Low
- Subject Site

0 300m

SOURCE: Coffs Harbour City Council Website (Accessed 14 July 2006)

SCALE: 1 : 10 000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

PROJECT
Flora & Fauna Assessment
Lots 1 & 2 Dp725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 8

PREPARED: VJA/BW
DATE: 08 November 2007
FILE: 02066_FFA_Veg value.cdr

TITLE

CHCC VEGETATION VALUE & PROPOSED DEVELOPMENT

3 FAUNA ASSESSMENT

3.1 Introduction

This section includes a description of the methods used in determining which fauna species use the Study area and a discussion of the results of the Fauna assessment. The fauna assessment involved a full fauna survey (i.e. specialised bird, bat and amphibian survey, spotlighting, hair sampling and trapping).

3.2 Methods

3.2.1 NPWS Database search

A search of the NPWS database was conducted to find records of Threatened fauna species within 10km of the Subject site and within Moonee Nature Reserve which is adjacent to the site.

3.2.2 Literature review

A comprehensive literature review was completed by JWA (2003) as part of a Flora and Fauna Assessment for a nearby site in the locality. This review used a number of sources to identify records of Threatened species in the locality.

The Flora and Fauna Assessment of the Moonee Release Area (Clancy 1998) was also consulted.

3.2.3 Habitat assessment

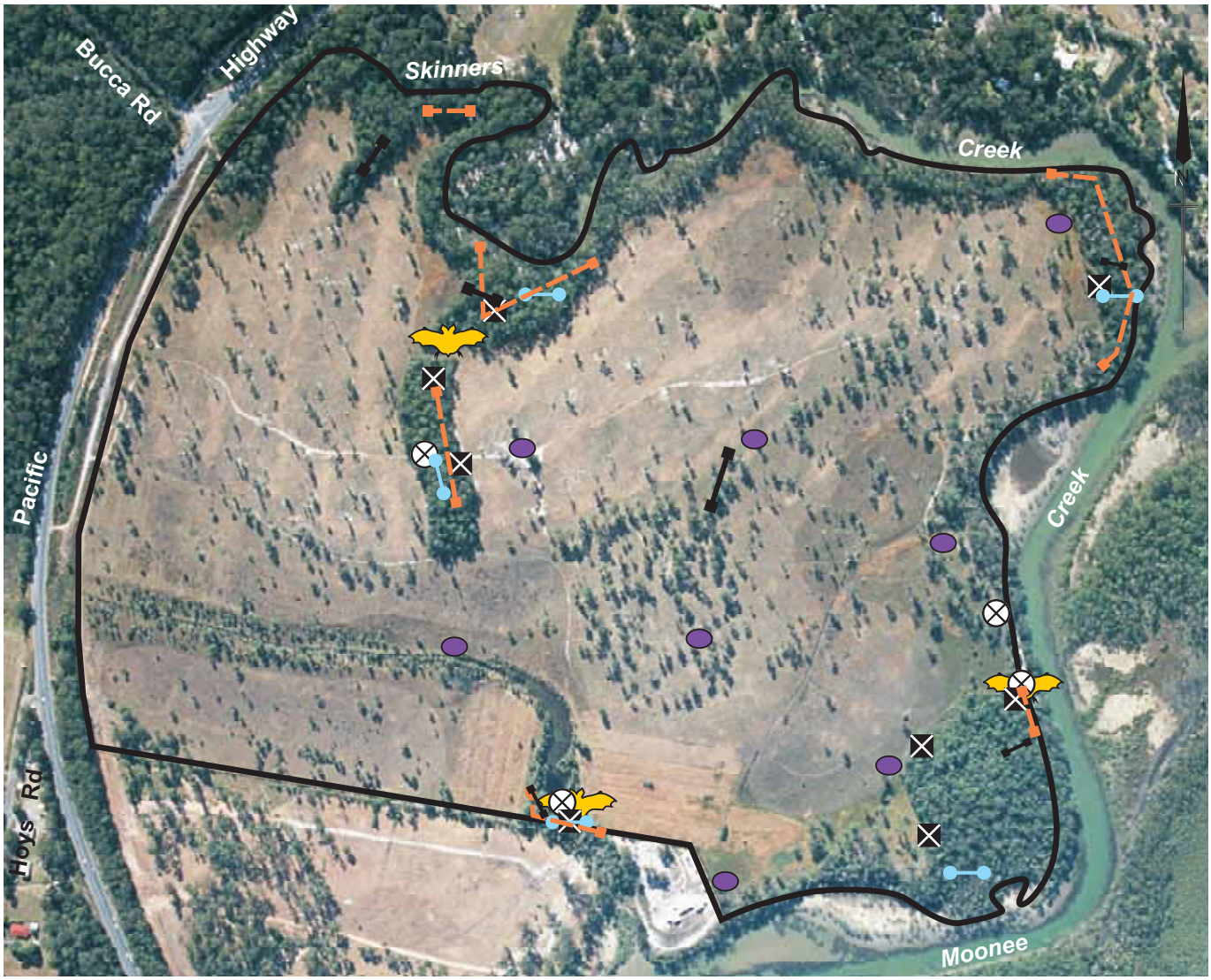
Site habitats were assessed to determine their value for native fauna species. This assessment was completed in conjunction with the flora survey. The assessment focused on identifying habitat features associated with Threatened species as well as other native fauna groups. Particular attention was paid 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 suitable as microchiropteran bat roost sites.

3.2.4 Fauna survey

3.2.4.1 Background

A detailed fauna survey was carried out over five (5) days between the 10th and the 14th of May 2004. The weather was generally fine and warm during the survey period, although nights were notably cool to cold.



LEGEND

- Hair tubes
- Elliott lines
- Pitfall lines
- Call playback locations
- Harp traps
- Cage traps
- Anabat locations

0 100 200m

SOURCE: JWA Site Investigations 2004

SCALE: 1 : 8000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

PROJECT
Flora & Fauna Assessment
Lots 1 & 2 DP725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 9

PREPARED: vja
DATE: July 2006
FILE : 02066_FFA_base.cdr

TITLE

FAUNA TRAPPING LOCATIONS

A second survey was completed over three (3) nights between the 22nd and the 24th of September 2004 targeting the Grass owl. The weather during this period was mild and windy with some light rain in the evenings of the 23rd and 24th.

An additional targeted survey for the Wallum froglet commenced 6th September 2005, and occurred over two (2) nights. The results of this survey are included as **APPENDIX 3**.

3.2.4.2 Survey Techniques

Detailed fauna surveys were designed to target identified threatened species. The following survey techniques were utilised in this assessment. **FIGURE 9** shows the location of trap and survey sites.

Active Searching
Logs, sheets of tin, cardboard, bark and leaves were overturned in search of reptiles and amphibians while incidentally traversing the site. Diggings were searched for signs of droppings. The site was actively searched for scats and bones. Active observation of bird activity was undertaken during all site visits.

Chewed cone survey
A ground search was undertaken where the feed tree species *Allocasurina littoralis* and *A. torulosa* occur on the site to look for the presence of chewed cones, a sign of feeding activity of the Glossy black cockatoo.

Tree hollow survey
A systematic survey was undertaken of scattered trees within grasslands on the site, which are likely to be removed for the proposed development. Any trees containing hollows, spouts, fissures etc were marked by GPS and mapped.

Stag watching
Each of the trees identified with hollows within the development area were observed for emerging fauna from before dusk for a period of one hour for one (1) night only. Observers positioned themselves so that the silhouette of any fauna dispersing from the tree could be clearly seen, and also utilised a 50W spotlight powered by 12V batteries to make periodic checks of the hollow.

Type 'A' Elliottt Box Traps and Cage Traps
Target species – ground-dwelling and arboreal mammals.
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.

Eighty-four (84) type 'A' Elliott traps and eight (8) cage traps were deployed over a period of four (4) nights. Each Elliott trap was baited with rolled oats, honey, peanut butter and vanilla essence, while cage traps were baited with either a combination of banana and apple or chicken necks.

Pitfall traps
Target species – Common planigale, reptiles, amphibians.

Five (5) pitfall lines of five (5) buckets (10 litre) spaced five (5) metres apart (incorporating drift fencing) were set for a period of three (3) nights. A total of 75 bucket nights were achieved during this component of the Study.

Hair Tubes
Target species – ground-dwelling mammals.
Six (6) lines of five (5) hair tubes each were laid on the site. Each Hair Tube was baited with rolled oats, honey, peanut butter and vanilla essence and then set for a period of fourteen (14) nights. Samples were identified 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: Powerful owl, Masked owl, Koala, Grass owl, Yellow-bellied glider, Squirrel glider and Wallum froglet. Calls were broadcast, and then followed by a five (5) minute listening period.

A targeted Grass owl call playback was undertaken at seven (7) selected sites for three consecutive nights on the 23rd, 24th, & 25th of September. Grass owl calls were broadcast and a ten minute listening period followed. Spotlighting was undertaken for 10 minutes at each of the sites following call broadcast to determine whether owls had flown in to the broadcast site.

Specialist avian survey
Target species - All diurnal avian species
A survey was carried out to sample diurnal bird species. A dawn and dusk census was completed by one (1) person walking through bushland along Skinners and Moonee Creeks for a total of two (2) hours over four (4) days. Incidental observations were recorded by both scientists while checking traps and mapping vegetation.

Harp Netting
Target species - All microchiropteran bats
Two (2) Harp traps were set in potential flyways over three (3) nights. Flyways were chosen on the basis of adequate cover on both sides of the trap, and screening was incorporated to enhance capture success.

One of the harp traps was left in position for the three nights due to lack of other suitable positions. The other was moved each night in order to adequately survey the entire site. A total of six (6) trap nights was achieved in this component of the Study.

Anabat Recording
Target species - All microchiropteran bats
An Anabat II sonar detector (Titley Electronics, Ballina) was used to down-load the ultrasonic calls of Microchiropteran bats. Recording was undertaken for ten (10) hours per night over two (2) nights, and for four (4) hours on the third night. 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 Richards.

Spotlighting
Target species - Powerful owl, Masked owl, Eastern grass owl, Brush-tailed phascogale, Yellow-bellied glider, Squirrel glider, Koala, Grey-headed flying fox and all nocturnal bird species. Spotlighting was undertaken by four investigators for one and a half (1.5)

hours each on the night of the 11th of May for a total of six (6) hours spotlighting. Additional spotlighting was carried out on the nights of the 12th and 13th of May by two investigators for totals of four (4) hours and three (3) hours respectively. The weather for the spotlighting survey was fine and warm.

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

Koala scat searches
A search for Koala scats (approximately 2 minutes per tree) was undertaken under primary Koala feed trees known to be extensively utilised within Coffs harbour LGA, primarily Tallowwood (*Eucalyptus microcorys*) and Swamp mahogany (*E. robusta*).

TABLE 3
SUMMARY OF TRAPPING EFFORT

Trap/survey type	Survey effort
Elliottt trapping	293 trap nights
Arboreal Elliottt trapping	33 trap nights
Total Elliott trapping	326 trap nights
Cage traps	32 trap nights
Pitfall traps	75 trap nights
Harp traps	6 trap nights
Hair tubes	420 trap nights
Anabat (bat calls)	3 nights
Spotlighting	14 hours
Call playback	4 nights + 3 nights targeted survey for Grass owls
Bird survey	Diurnal dusk/dawn survey – 8 hrs, 5 days opportunistic records
Amphibian survey	2 hours targeted survey, call playback, 3 nights opportunistic records
Reptile survey	1 hour targeted survey, 5 days, 4 nights opportunistic records

3.3 Results and Discussion

3.3.1 NPWS Database search

The results of the search of the NPWS database are shown in **TABLE 4**.

TABLE 4
NPWS DATABASE RECORDS OF THREATENED FAUNA SPECIES WITHIN 10 KM OF THE SUBJECT SITE

Scientific name	Common name
Coracina lineata	Barred Cuckoo-shrike
Ixobrychus flavicollis	Black Bittern
Ephippiorhynchus asiaticus	Black-necked Stork
Grus rubicundus	Brolga
Climacteris picumnus	Brown Treecreeper

Scientific name	Common name
Phascogale tapoatafa	Brush-tailed Phascogale
Burhinus grallarius	Bush Stone-curlew
Todiramphus chloris	Collared Kingfisher
Irediparra gallinacea	Comb-crested Jacana
Syconycteris australis	Common Blossom-bat
Dugong dugon	Dugong
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat
Stictonetta naevosa	Freckled Duck
Mixophyes iteratus	Giant Barred Frog
Calyptorhynchus lathami	Glossy Black-Cockatoo
Kerivoula papuensis	Golden-tipped Bat
Tyto capensis	Grass Owl
Calidris tenuirostris	Great Knot
Scoteanax rueppellii	Greater Broad-nosed Bat
Chelonia mydas	Green Turtle
Pteropus poliocephalus	Grey-headed Flying-fox
Megaptera novaeangliae	Humpback Whale
Phascolarctos cinereus	Koala
Miniopterus australis	Little Bentwing-bat
Sterna albifrons	Little Tern
Caretta caretta	Loggerhead Turtle
Tyto novaehollandiae	Masked Owl
Pandion haliaetus	Osprey
Grantiella picta	Painted Honeyeater
Haematopus longirostris	Pied Oystercatcher
Ninox strenua	Powerful Owl
Xanthomyza phrygia	Regent Honeyeater
Ptilinopus regina	Rose-crowned Fruit-Dove
Tyto tenebricosa	Sooty Owl
Haematopus fuliginosus	Sooty Oystercatcher
Macronectes giganteus	Southern Giant-Petrel
Lophoictinia isura	Square-tailed Kite
Petaurus norfolcensis	Squirrel Glider
Hoplocephalus stephensii	Stephens' Banded Snake
Ptilinopus superbus	Superb Fruit-Dove
Lathamus discolor	Swift Parrot
Monarcha leucotis	White-eared Monarch
Ptilinopus magnificus	Wompoo Fruit-Dove
Petaurus australis	Yellow-bellied Glider

A database search was also completed for records of Threatened fauna within Moonee Beach Nature Reserve. Eleven (11) Threatened species have been recorded from the Reserve and include:

- Osprey
- Black-necked stork
- Brown treecreeper
- Sooty oystercatcher
- Comb-crested jacana
- Little tern
- Squirrel glider
- Grey-headed flying fox
- Common blossom bat
- Little bent-wing bat
- Eastern bent-wing bat

3.3.2 Literature review

A full fauna survey was completed for Lot 122 DP 1053566, Moonee Beach Road, Moonee by JWA in 2003. This site occurs approximately 1 km south-east of the site. Six (6) Threatened species were recorded:

- Pied oystercatcher
- Osprey
- Glossy black cockatoo
- Little bent-wing bat
- Large-footed myotis
- Grey-headed flying-fox

The Clancy Flora and Fauna Assessment of the Moonee Release Area (1998) recorded eight (8) Threatened fauna species:

- Little bent-wing bat
- Common bent-wing bat
- Large-footed myotis
- Yellow-bellied glider
- Osprey
- Pied oystercatcher
- Sooty oystercatcher
- Glossy black cockatoo

From the Clancy survey three (3) Threatened species were recorded from the subject site itself:

- Yellow bellied glider – in the north-west corner of the site
- Common bent-wing bat – in the eastern part of the site
- Osprey - from nest in the south-east of the site.

The Threatened species records of Clancy on the site are shown as **APPENDIX 2**.

Clancy (1998) also notes that Koalas have been recorded in the north-west of the site along Skinners Creek.

3.3.3 Habitat assessment

3.3.3.1 Amphibians

Amphibians occurring in the region are poikilothermic, predominantly insectivorous and generally require free water for reproduction, with the exception of two highland genera (*Assa darlingtoni* and *Philoria* spp.) The habitat requirements of most species are unlikely to be determined by forest cover or floristics, but are more strongly influenced by factors such as climate, distance to water bodies, riparian vegetation, hydrological and morphological characteristics of water bodies and the availability of suitable micro-habitat for aestivation and shelter.

The majority of species that occur within the region lay eggs in or near temporary or permanent water bodies and rely on free water for larval development and

metamorphosis. Of these species, only a few are dependent on forested habitats beyond the riparian zone or beyond areas of temporary inundation. These species include the Red-eyed tree frog (*Litoria chloris*), Leseuer's frog (*Litoria leseueri*), Fletchers frog (*Lechriodus fletcheri*) and the Barred frogs of the *Mixophyes* genus.

The Subject site is likely to provide good quality habitat for a range of frogs. Although intermittent, the main drainage line in the south of the site provides areas of moderately deep leaf litter for shelter. The dam towards the south-east of the site provides good quality habitat, due to its relatively large size, and associated vegetation of sedges and ferns. Paperbark forest adjacent to the dam although small in area, may provide habitat for the Wallum froglet. This species, if it occurs, may extend into the Sedgeland community during suitable periods. Other areas of paperbark forest on the site, such as in the north-east corner are also suitable for the Wallum froglet.

The drainage line in the north-western corner of the site is another area of good quality habitat, with areas of dense Lomandra providing good shelter opportunities.

Grasslands provide suitable habitat for a range of Amphibian species, particularly along drainage depressions and soaks. Species commonly encountered in grassland communities include the Common eastern froglet, Eastern sign bearing froglet, Striped marsh frog, Spotted grass frog, Eastern dwarf tree frog, Rocket frog, Whistling tree frog and Cane toad. Sedgeland communities in low lying grassland areas may provide suitable habitat for these species.

Species typically encountered in or adjacent to Closed Forests include the Eastern dwarf tree frog, Red-eyed tree frog, Striped marsh frog, Cane toad and Dainty green tree frog. Relatively few species occur in conjunction with Closed Forest types when permanent water is absent. Species which typically occur in low elevation Rainforest and permanent streams such as the Giant barred frog (*Mixophyes iteratus*) are unlikely to occur at the Subject site.

3.3.3.2 Reptiles

As reptiles are poikilothermic, and predominantly insectivorous or carnivorous, their habitat requirements are less directly determined by vegetation species composition than other taxa which feed directly on plants. Reptile distributions are strongly influenced by structural characteristics of the vegetation, climate and other factors affecting thermoregulation such as shade and availability of shelter and basking sites (Smith *et al* 1994).

In a survey of the moist forest herpetofauna of North-eastern NSW, Smith *et al* (1989) found that few species discriminated between rainforest and wet sclerophyll forest, however, most species exhibited a response to differences in elevation and the availability of microhabitat components and other substrates.

The availability of microhabitats, of varying thermal properties is particularly important for most reptile species, as behavioural thermoregulation (regulation of body heat) is important in controlling critical body functions such as digestion, foraging activity and reproduction.

Reptile diversity and abundance is often (but not always) significantly higher in drier habitat types, particularly those with a wide variety of ground substrate microhabitats. This contrasts markedly with the distribution patterns of birds, and most mammals.

The single limiting factor in terms of species diversity in coastal vegetation is the lack of shelter sites (eg. logs, tree hollows and decorticating bark). Such habitat components characterise eucalypt forests and woodlands, where species diversity may be much higher, depending on disturbance factors.

The Subject site is considered to provide good quality habitat for reptiles due to the presence of: the combination of shelter and basking sites; fallen logs for shelter; forested areas with good canopy and leaf litter development; availability of water in drainage lines; and reliable sources of prey.

3.3.3.3 Birds

The significance of near coastal environments of the N.S.W. Far North Coast and South-East Queensland as over-wintering habitat for migratory birds has been established by many observers and bird banders including Keast (1968), Robertson (1973), Gravatt (1974), Porter (1982) and Robertson and Woodall (1983). These patterns may be attributable to the relatively high winter temperatures and long growing season of this region compared with the rest of south-eastern Australia (Fitzpatrick and Nix 1973; Edwards 1979; Nix 1982; Specht *et al* 1981).

Many insectivorous birds from higher latitudes and elevation over-winter in the locality. These include species such as the Fantail cuckoo, Sacred kingfisher, Rainbow bee-eater, Noisy pitta, Tree martin, Black-faced cuckoo-shrike, Cicada bird, Golden whistler, Rufous whistler, Rose robin, Grey fantail, White-throated gerygone, Silvereye, Olive-backed oriole and Spangled drongo.

Birds such as honeyeaters and lorikeets are Blossom nomads (*ibid.*). These birds move locally in response to variation in the availability of nectar and or pollen, important components in their diet. Porter (1982) highlights the importance of Forest red gum, Broad-leaved paperbark and Coast banksia for Scaly-breasted and Rainbow lorikeets as these species flower during the lorikeet's winter breeding period. A sequence of important nectar bearing plants in the genera Eucalyptus, Banksia, Melaleuca and Callistemon provide a continuity of food for nectarivorous birds.

Studies of bird usage in rainforest remnants by Holmes (1987), Connelly and Specht (1988) and Lott & Duigan (1993) indicate that the diversity and abundance of birds is related to the size of the Rainforest patches and their degree of isolation from major areas of native forest. Lott & Duigan (1993) and Howe *et al* (1981) also note that sites with a higher diversity of vegetation and those which are closer to water generally support a greater diversity of birds. Locally nomadic and migratory rainforest species such as the Wompoo, Rose-crowned and Superb fruit-doves, Common koel and Black-faced cuckoo-shrike are known to use scattered areas of habitat as "stepping-stones" between more intact areas of forest (Date *et al* 1992; Lott & Duigan 1993).

The variety of habitats present in the Study area is likely to result in a high diversity of resident and nomadic birds occurring on the site over the year. Habitat which occurs on the site includes open woodland, grassland, sclerophyll forest, wetland, and tidal communities such as mangrove and saltmarsh.

The Study area is likely to provide good quality foraging and breeding habitat for a range of rainforest birds. The Subject site provides foraging resources for nectarivorous birds due to the occurrence of Eucalypt, Melaleuca and Banksia species. The level of disturbance to the drainage line and intermittent flow may preclude the

occurrence of birds associated with permanent watercourses. However, the dam area may provide habitat suitable for species such as bitterns and rails.

The site provides a relatively low diversity and abundance of fruiting species. The Subject site and adjacent areas of vegetation represent moderate quality habitat for frugivorous birds.

There is a moderate number of trees with hollows necessary for hollow-nesting birds on the Subject site. The Study area may also represent important forage habitat for hollow-dependent avifauna breeding in forests in the locality.

3.3.3.4 Mammals

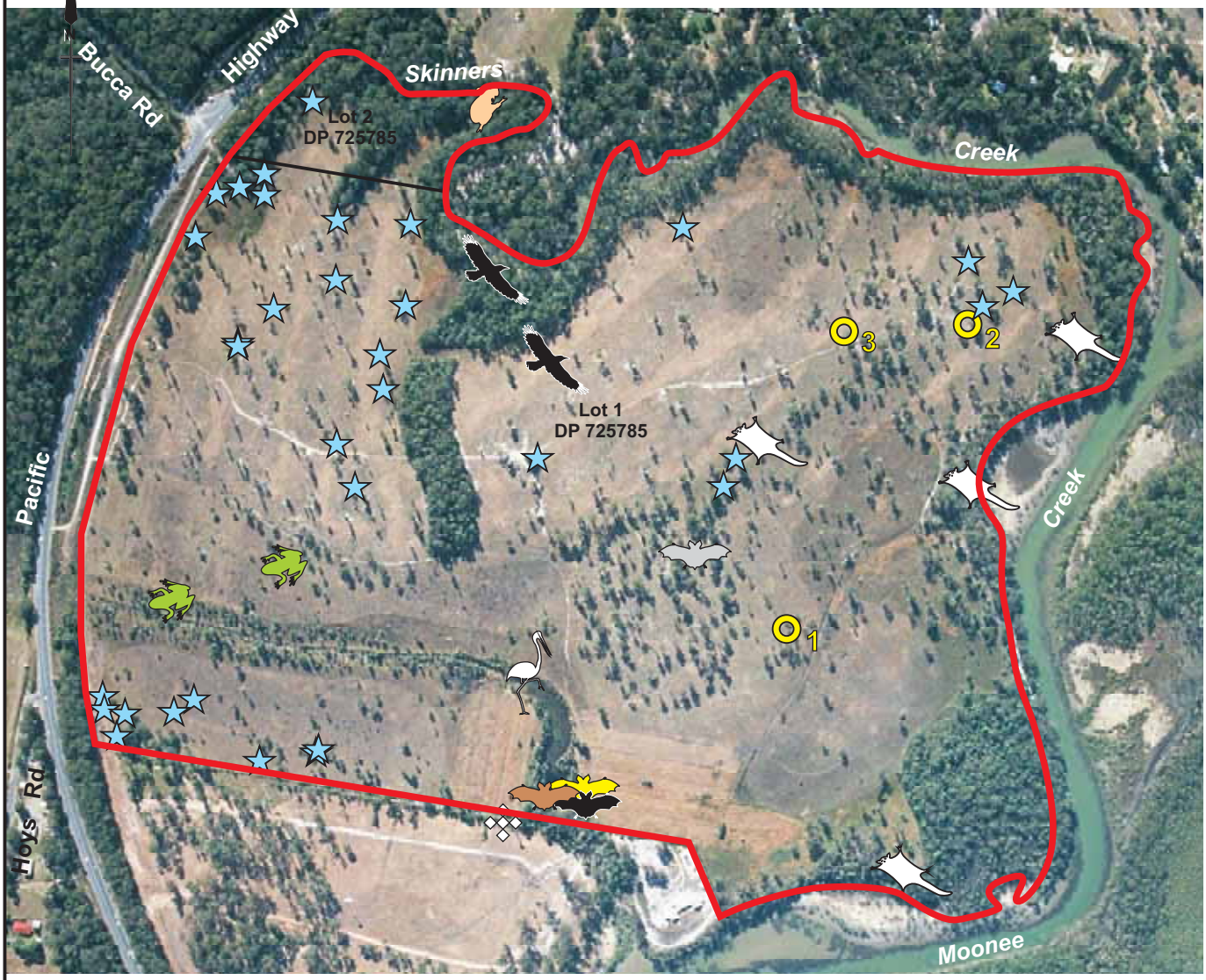
Small terrestrial mammals generally occur in highest densities in association with a complex vegetation structure. A dense understorey layer, which provides shelter from predators and provides nesting opportunities, is particularly important.

In general medium-large terrestrial mammals such as macropods select habitats which provide a dense cover for shelter and refuge and open areas for feeding. The larger species tend to occupy drier more open habitats: the smaller species, moister and more densely vegetated habitats.
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 sp. These species also feed extensively on insects, particularly under the shedding bark of eucalypts. The distribution of nectarivore/insectivores is considered to be related to the abundance of nectar and pollen producing plants, the abundance of bark shedding eucalypts which harbour insect prey, and the occurrence of sap and gum exudate producing trees (Sap feed trees) and shrubs (*e.g.* Acacia sp.). Arboreal nectarivores and insectivores are generally hollow dependent species.

There is a moderate number of trees with hollows necessary for hollow-dependent mammals (see Section 3.3.3.5), with nearly all of these trees occuring outside the development envelope. However, as with the birds, the Study area may represent important forage habitat for hollow-dependent mammals resident in forests in the locality. The primary Koala feed trees Tallowwood and Swamp mahogany occur on the Subject site. All Koala feed trees within the development area have been surveyed and are shown in **FIGURE 10**. Other trees known to be used by Koalas in the Coffs Harbour LGA which occur on the site include Broad-leaved paperbark, Blackbutt and Pink bloodwood.



Legend
- Squirrel glider
- Glossy black cockatoo
- Southern myotis
- Little bent-wing bat
- Common bent-wing bat
- Grey headed flying fox
- Osprey nest location (approximate)

Legend
- Black-necked stork
- Wallum froglet*
- Koala (scat)
- Koala feed tree (within development area only)
- Hollow bearing tree (within development area only) Refer to Section 3.3.3.5
- Subject Site

* These records may have been a mis-identification of the Beeping froglet (*Crinia parinsignifera*).

Note: Koala feed trees and hollow bearing trees have been located by GPS survey which may contain an error of up to 4 metres.

0 10m 20m

SOURCE: JWA Site Investigations 2004 & GPS Survey 2005

SCALE: 1 : 8000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

PROJECT
Flora & Fauna Assessment
Lots 1 & 2 Dp725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 10

PREPARED: VJA/BW
DATE: 08 November 2007
FILE: 02066_FFA_Fauna.cdr

TITLE
THREATENED FAUNA AND SIGNIFICANT HABITAT FEATURES RECORDED ON THE SITE

The structural complexity and habitat diversity of the site is likely to support a moderate diversity and abundance of ground dwelling mammals. Expected species include: Black rat, Swamp rat, House mouse, *Antechinus* sp., *Melomys* sp., and the Northern brown bandicoot.

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 high diversity and abundance of fruiting species and represents high quality foraging habitat for frugivorous bats. The nectarivorous Common blossom bat may forage on Broad-leaved paperbark and Hairpin Banksia throughout the site.

Several old-growth trees suitable for hollow-dependant bats occur along Skinners and Moonee Creeks. Areas of more mature forest along the northern edge of the site represent suitable roost habitat for the Threatened Black flying-fox and Grey-headed flying fox. Suitable roost habitat for the Common blossom bat (*ie*. Littoral rainforest) does not occur on the site.

3.3.3.5 Tree hollows within the development area

All of the trees within the development area of the site were inspected for the prescence of hollows, fissures or spouts. Most of the scattered trees within the development area are relatively immature, and attain an average height of approximately 15 metres. Only three (3) trees with hollows were recorded: a Tindale's stringybark about 20 metres in height with a small fissure approximately 20 cm long and 10 cm wide, a Turpentine about 15 metres in height with 2 small spouts of approximately 5 and 8 cm diameter, and a stag 15 metres in height with several vertical hollows. These trees were surveyed by GPS and are shown on **FIGURE 10**.

Stagwatching of these trees revealed a den of Feathertail gliders in the Turpentine. Care will need to be taken when removing this tree from the site, and a fauna handler will need to be present.

All mature trees with well developed hollows occur outside the development area, within the north-east and eastern portions of the site in vegetation communities flanking Skinners and Moonee Creeks.

3.3.4 Results of fauna survey

3.3.4.1 Introduction

This section provides the results of all records and observations of fauna for the duration of the survey. Approximate locations of all Threatened species recorded on the Subject site are shown in **FIGURE 10**.

3.3.4.2 Reptiles

Five (5) reptile species were recorded during the fauna survey and are shown in **TABLE 6**. No Threatened reptiles were recorded.

TABLE 6
REPTILE SPECIES RECORDED ON THE SUBJECT SITE

Common name	Scientific name	Method of identification
Dark flecked sun skink	*Lampropholis guichenoti*	Capture
Friendly sun skink	*Lampropholis amicula*	Capture
Eastern bearded dragon	*Pogona barbata*	Observed
Swamp snake	*Hemiaspis signata*	Capture
Southern calyptotis	*Calyptotis ruficauda*	Capture

3.3.4.3 Amphibians

Six (6) amphibian species were recorded during site surveys, and are shown in **TABLE 7**. One Threatened species, the Wallum froglet* was recorded previously however this species was not recorded during the main survey period (May 2004). The main survey was completed in late Autumn during a relatively long dry spell. Amphibian activity could be expected to be low. An additional survey was completed for Wallum froglets on the site in September 2005. The results of this survey are included as **APPENDIX 3**.

TABLE 7
AMPHIBIAN SPECIES RECORDED ON THE SUBJECT SITE

Common name	Scientific name	Method of identification
Common eastern froglet	*Crinia signifera*	Call
Eastern dwarf tree frog	*Litoria fallax*	Call
Striped marsh frog	*Limnodynastes peronii*	Call
Spotted grass frog	*Limnodynastes tasmaniensis*	Capture
Broad-palmed rocket frog	*Litoria latopalmata*	Capture
Wallum froglet*	***Crinia tinnula***	**Call**

***** Identification uncertain. See Bisosphere Environmental Consultants (2006) in **APPENDIX 3.**
Threatened species are shown in bold

3.3.4.4 Birds

Fifty-nine (59) bird species were recorded in the Study area. Two (2) Threatened species were recorded, the Glossy black cockatoo (*Calyptorynchus lathami*) and Osprey (*Pandion haliaetus*). The Black-necked stork (*Ephippiorhnchus asiaticus*) was also recorded on the site in a preliminary survey by JWA in 2003.

Birds recorded during the survey(s) are shown in **TABLE 8**.

TABLE 8
BIRD SPECIES RECORDED DURING THE SURVEY

Common Name	Scientific Name
Black duck	*Anas superciliosa*
Black-necked stork*	***Ephippiorhnchus asiaticus***
Brahminy kite	*Haliastur indus*
Brown goshawk	*Accipiter fasciatus*
Brown thornbill	*Acanthiza pusilla*
Eastern rosella	*Platycercus eximius*
Eastern yellow robin	*Eopsaltria australis*

Common Name	Scientific Name
Fan-tailed cuckoo	*Cacomantis flabelliformis*
Glossy black cockatoo	***Calyptorhynchus lathami***
Golden whistler	*Pachycephala pectoralis*
Grey fantail	*Rhipidura fuliginosa*
Grey shrike thrush	*Colluricincla harmonica*
Kookaburra	*Dacelo novaeguineae*
Lewins honeyeater	*Meliphaga lewinii*
Little lorikeet	*Glossopsitta pusilla*
Magpie	*Gymnorhina tibicen*
Magpie-lark	*Grallina cyanoleuca*
Masked lapwing	*Vanellus miles*
Mistletoe bird	*Dicaeum hirundinaceum*
Nankeen night heron	*Nycticorax caledonicus*
Noisy friarbird	*Philemon corniculatus*
Noisy minor	*Manorina melanocephala*
Osprey	***Pandion haliaetus***
Pelican	*Pelecanus conspicillatus*
Pied butcherbird	*Cracticus nigrogularis*
Pied cormorant	*Phalacrocorax varius*
Pied currawong	*Strepera graculina*
Purple swamp hen	*Porphyrio porphyrio*
Rainbow bee-eater	*Merops ornatus*
Rainbow lorikeet	*Trichoglossus haematodus*
Red browed finch	*Neochmia temporalis*
Sacred kingfisher	*Todiramphus sanctus*
Satin bowerbird	*Ptilonorhynchus violaceus*
Scaly breasted lorikeet	*Trichoglossus chlorolepidotus*
Scarlet honeyeater	*Myzomela sanguinolenta*
Scarlet robin	*Petroica multicolor*
Spotted pardalote	*Pardalotus punctatus*
Sprangled drongo	*Dicrurus bracteatus*
Striated pardalote	*Pardalotus striatus*
Superb wren	*Malurus cyaneus*
Tawny frogmouth	*Podargus strigoides*
Torresian crow	*Corvus orru*
Varied sitella	*Daphoenositta chrysoptera*
Variegated wren	*Malurus lamberti*
Wedge tailed eagle	*Aquila audax*
Welcome swallow	*Hirundo neoxena*
Whistling kite	*Haliastur sphenurus*
White cheeked honeyeater	*Phylidonyris nigra*
White faced heron	*Egretta novaehollandiae*
White ibis	*Threskiornis molucca*
White-bellied cuckoo shrike	*Coracina papuensis*
White-bellied sea eagle	*Haliaeetus leucogaster*
White-breasted woodswallow	*Artamus leucorynchus*
White-naped honeyeater	*Melithreptus lunatus*
White-necked heron	*Ardea pacifica*
White-throated treecreeper	*Cormobates leucophaeus*
Yellow faced honeyeater	*Lichenostomus chrysops*

Common Name	Scientific Name
Yellow-faced honeyeater	*Lichenostomus chrysops*
Yellow-tailed black cockatoo	*Calyptorhynchus funereus*

Threatened species are shown in bold
*** Recorded in 2003 JWA survey**

3.3.4.5 Mammals

Twenty-nine (29) mammal species were recorded, including six (6) Threatened species:

- Squirrel glider (*Petaurus norfolcensis*)
- Little bent-wing bat (*Miniopterus australis*)
- Common bent-wing bat (*Miniopterus schreibersii*)
- Large-footed myotis (*Myotis macropus*)
- Koala (*Phascolarctos cinereus*)
- Grey-headed flying-fox (*Pteropus poliocephalus*)

Seven (7) introduced species including the Black rat, House mouse, Cow, Pig, Horse, Cat and Dog were also recorded on the site. A complete list of mammals recorded on the site is shown in **TABLE 9**.

TABLE 9
MAMMALS RECORDED DURING THE FIELD SURVEY

Family Scientific Name	Common Name	Method of Identification
Dasyuridae		
Antechinus flavipes	Yellow-footed antechinus	Elliottt
Paramelidae		
Isodon macrourus	Northern brown bandicoot	Cage
Petauridae		
Petaurus norfolcensis	**Squirrel glider**	Spotlighting
Phalangeridae		
Trichosurus vulpecula	Common brushtail possum	Spotlighting
Macropodidae		
Macropus giganteus	Eastern grey kangaroo	Observed
Wallabia bicolor	Swamp wallaby	Observed
Phascolarctidae		
Phascolarctos cinereus	**Koala**	Scat
Pteripodidae		
Pteropus poliocephalus	**Grey-headed flying fox**	Call, sighting
Muridae		
Mus musculus	House mouse*	Elliottt
Rattus fuscipes	Bush rat	Elliottt
Rattus lutreolus	Swamp rat	Elliottt
Rattus rattus	Black rat*	Elliottt
Bovidae		
Bos taurus	European cattle*	Observed
Canidae		
Canis familiaris	Dog*	Scat, tracks
Acrobatidae		
Acrobates pygmaeus	Feathertail glider	Observed
Suidae		

Family Scientific Name	Common Name	Method of Identification
Sus scrofa	Pig*	Observed
Equidae		
Equus caballus	Horse*	Scat, tracks
Felidae		
Felis catus	Cat*	Scat, tracks
Vespertilionidae		
Chalinolobus gouldii	Gould's wattled bat	Anabat
Chalinolobus morio	Chocolate wattled bat	Anabat
Miniopterus australis	**Little bent-wing bat**	Harp trap, Anabat
Miniopterus schreibersii	**Common bent-wing bat**	Anabat
Nyctophilus gouldi	Gould's long-eared bat	Harp trap, Anabat
Vespadelus darlingtoni	Large forest bat	Anabat
Vespadelus regulus	Southern forest bat	Anabat
Vespadelus vulturnus	Little forest bat	Harp trap
Myotis macropus	**Large-footed myotis**	Harp trap
Scotorepens sp.	Broadnosed bat sp.	Anabat
Molossidae		
Mormopterus sp.	Freetail bat sp.	Anabat

* Introduced species

Threatened species are shown in bold

3.3.5 Threatened species considered possible occurrences in the Study area

Based on the assessment of habitats in the Study area, Threatened fauna species known from the locality were assessed for the likelihood of their occurrence in the Study area. The following oceanic and coastal species will not occur in the Study area and are not considered in the table:

Little tern; Dugong; Great knot; Southern giant-petrel; Humpback whale; Loggerhead turtle and Green turtle.

TABLE 10
LIKELIHOOD OF OCCURRENCE OF THREATENED FAUNA SPECIES IN THE STUDY AREA

Species	Likelihood of occurrence in the Study area	Notes
Barred cuckoo-shrike	Possible	This species occurs in rainforests, eucalypt forest and woodlands, clearings in secondary regrowth, swamp woodlands and timber along watercourses (NPWS 2002). Suitable habitat occurs on the Subject site.
Black bittern	Unlikely	This species occurs in riparian habitats. However, there are few local records and this species has not been recorded in Moonee Beach Nature Reserve.
Black-necked stork	Recorded on site	The Black-necked stork occurs in swamps, mangroves, mudflats, dry floodplains and irrigated land. It has been recorded from Moonee Beach Nature Reserve, and observed foraging near the dam on the site.

Species	Likelihood of occurrence in the Study area	Notes
Brolga	Possible	This species occurs in shallow wetlands and open grassland habitats. Suitable habitat occurs on the Subject site and may be utilised by this species, particularly after heavy rain.
Brown treecreeper	Possible	This species occupies eucalypt woodlands, particularly those without a dense understorey. It nests in tree hollows in permanent territories and has been recorded in Moonee Beach Nature Reserve.
Brush-tailed phascogale	Possible	This species inhabits dry sclerophyll open forest as well as heathlands, swamps, rainforest and wet sclerophyll forest. Suitable habitat occurs on the Subject site.
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. This species is poorly known from the locality.
Collared kingfisher	Possible	The Collared kingfisher is restricted to mangroves in Australia. Mangrove community around Moonee and Skinners Creeks may suit this species.
Comb-crested jacana	Possible	This species lives on floating vegetation in freshwater lakes and ponds. The dam on the site provides suitable habitat for this species, which has also been recorded in Moonee Beach Nature Reserve.
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 on the Subject site.
Eastern bent-wing bat	Unlikely	This species generally occupies caves and tunnels during the day and, at night, forages for small insects beneath the canopy of well timbered habitats. Suitable habitat does not occur on the Subject site.
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. Suitable habitat does not occur on the Subject site.
Giant barred frog	Unlikely	This species occurs in streams in rainforest habitats. Suitable habitat does not occur on the Subject site.

Species	Likelihood of occurrence in the Study area	Notes
Glossy black cockatoo	Recorded on site	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: *Allocasuarina littoralis*, *A. torulosa* and *A. verticillata* (Forshaw 1981) and suitable large hollow bearing trees for nesting. This species was observed flying over the site on several occasions.
Golden-tipped bat	Unlikely	This species occurs in rainforest habitats. Suitable habitat does not occur on the Subject site.
Grass owl	Possible	The Grass owl occupies coastal heath and grassland across northern Australia (Reader's Digest 1993). Some suitable habitat occurs on the Subject site. This species has been recorded to the south of the site.
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), while open woodland and dry open forest are also utilised (NPWS 2002). Suitable habitat occurs on the Subject site.
Grey-headed flying fox	Recorded on site	This species travels along the east coast of Australia, foraging on fruiting and blossoming species. It has been recorded in Moonee Beach Nature Reserve and on the Subject site.
Koala	Recorded on site	Preferred Koala trees occur on the site (Swamp mahogany, Tallowwood). They may occasionally use the site for feeding or roosting.
Little bent-wing bat	Recorded on site	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. This species has been recorded in Moonee Beach Nature Reserve and also on the Subject site.
Masked owl	Possible	Masked owls prefer heavier wooded eucalypt forests. However, the Subject site represents suitable hunting grounds within a larger territory.
Osprey	Recorded on site	This raptor is thinly distributed in coastal Australia. It nests in singularly overtopping, generally dead trees. The Osprey hunts in coastal rivers, estuaries and streams and may gather nesting material from nearby forests. Two Osprey nests occur on the site, with the species observed over the site and Moonee creek.

Species	Likelihood of occurrence in the Study area	Notes
Painted honeyeater	Unlikely	The species is locally nomadic, following flowering and fruiting of Mistletoe. In New South Wales and Queensland it is a specialist feeder on the fruits of Mistletoe growing on Boree (*Acacia pendula*), Brigalow (*Acacia harpophylla*), River Oak (*Casuarina cunninghamiana*), Red Ironbark (*Eucalyptus sideroxylon*) and Yellow-gum (*Eucalyptus leucoxylon*) (Garnett 1992). None of these species were recorded on site.
Pied oystercatcher	Possible	This species is a coastal shorebird. It forages and nests on ocean beaches and estuarine sandflats. The Pied oystercatcher has been recorded in Moonee Nature Reserve and during studies in the locality.
Powerful owl	Possible	The Powerful owl occurs in a variety of habitats, including coastal forests. The Subject site may provide suitable foraging habitat for this species.
Regent honeyeater	Possible	This species is very rarely recorded in the locality. However, the Coffs Harbour area is known as a preferred coastal foraging area for this species.
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. Suitable habitat does not occur on the Subject site.
Sooty owl	Unlikely	Occurs in rainforests, including dry rainforest, subtropical and warm temperate rainforest, and moist eucalypt forests. They roost by day in the hollow of a tall forest tree or in heavy vegetation, and hunt by night for small ground mammals or tree-dwelling mammals such as Common ringtail possums or Sugar gliders. They nest in very large tree-hollows. Suitable habitat does not occur on the Subject site.
Sooty oystercatcher	Unlikely	This species is a coastal shorebird. It prefers rocky shore habitats.
Large-footed myotis	Recorded on site	This species forages over fresh and saline waterbodies. This species was recorded on the Subject site. Skinners and Moonee Creeks, and the dam area on the site may provide suitable foraging habitat for this species.
Square-tailed kite	Possible	This species is thinly distributed through open forests, woodland and sandplains, both coastal and sub-coastal. The Subject site may provide suitable foraging habitat for this species

Species	Likelihood of occurrence in the Study area	Notes
Squirrel glider	Recorded on site	The Squirrel glider occupies wet and dry sclerophyll forests with open dry sclerophyll forests regarded as optimum habitat. This species was recorded in eucalypt woodland to the east of the site.
Stephen's banded snake	Possible	Rainforest and eucalypt forests and rocky areas up to 950m. Nocturnal, and shelters between loose bark and tree-trunks, amongst vines, or in hollow trunks, limbs, rock crevices or under slabs of rock during the day. At night it hunts frogs, lizards, birds and small mammals (NPWS 2002). Habitat on the site may suit this species.
Superb fruit-dove	Unlikely	This species occurs in rainforest habitat. Suitable habitat does not occur on the Subject site.
Swift parrot	Possible, but unlikely	Mainland populations of this species favour winter-flowering eucalypt forest and woodland, usually where abundant supplies of Eucalypt nectar exist. This species is rarely recorded in the locality. The last record within 5kms of the site is from 1983.
Wallum froglet	Recorded on site*	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.
White-eared monarch	Unlikely	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. Suitable habitat does not occur on the site.
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). Suitable habitat does not occur on the site.
Yellow-bellied glider	Recorded on site by Clancy (1998)	Preferred habitats are tall open mature sclerophyll forests with a range of eucalypt species in areas of high rainfall. Eucalypt forest on the site is relatively small in area, however may be utilised by Yellow-bellied gliders within the locality.

***** Identification uncertain. See Bisosphere Environmental Consultants (2006) in **APPENDIX 3.**

4 IMPACTS AND AMELIORATION

4.1 Impacts of the Proposed Development

4.1.1 Flora

The Proposed development will result in the loss of vegetation for the construction of houses, access roads, driveways and associated infrastructure. **FIGURE 11** shows the relationship of the development layout to vegetation communities occurring on the Subject site.

The Subject site covers approximately 96 hectares, the majority of which is open grassland with scattered trees. Major areas of vegetation (mostly dry sclerophyll forest) on the site occurring along the northern and eastern boundaries of the site are to be retained. The layout of the site has been planned in a manner which will be sensitive to the conservation of vegetation on the site. All areas of sclerophyllous vegetation are to be retained. Vegetation loss will be relatively minor, with vegetation loss restricted to individual trees within grazing land.

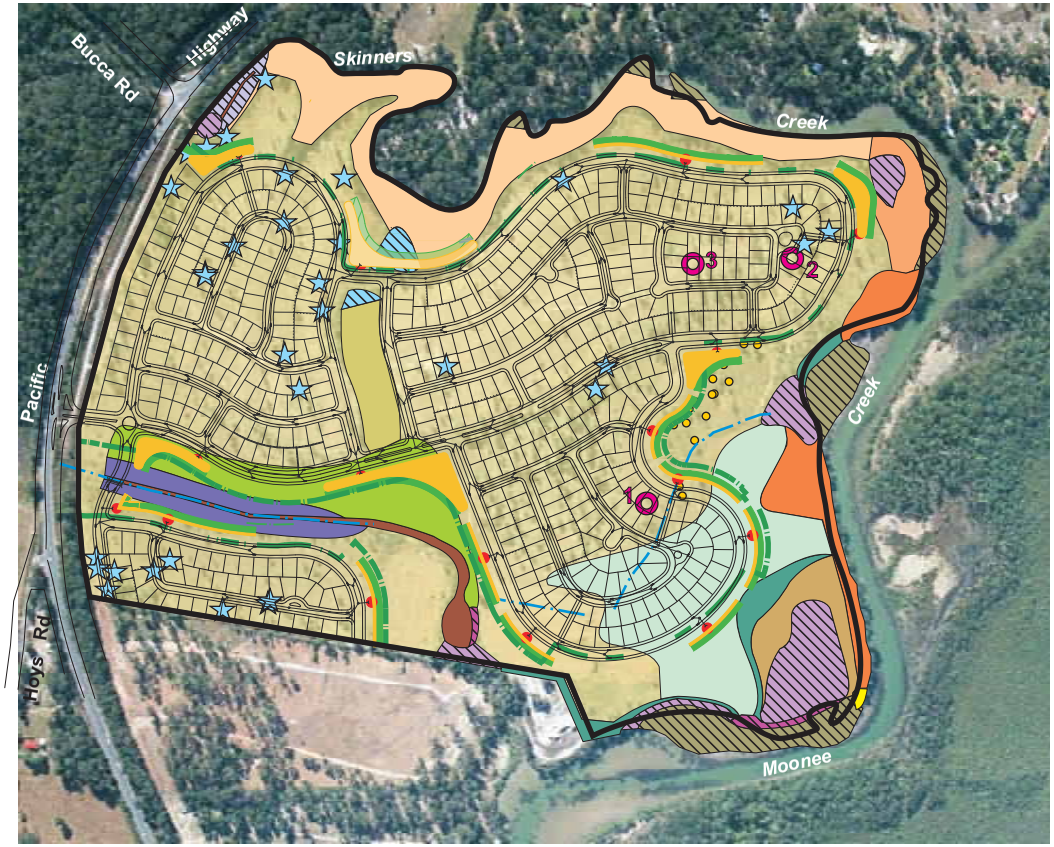
Approximately 56% of the total site area (approximately 54 hectares) will be subject to urban development. Nearly all urban development of the site occurs within grasslands with scattered trees on the site.

A summary of vegetation types to be lost and their respective areas is shown in **TABLE 11**.

TABLE 11
VEGETATION TO BE LOST AS A RESULT OF THE PROPOSED DEVELOPMENT

Vegetation Community	Area to be lost (ha)
Community 1(a):Tall Closed Forest	0.0151ha
Community 1(d): Tall Mid-dense Forest	0.1670ha
Community 1(f): Tall Closed Forest	0.0152ha
Community 2(c): Mid-high Swamp Sclerophyll Forest	0.2171ha
Community 2(d): Mid-high Swamp Sclerophyll Forest	0.2219ha
Community 3(a) Tall Closed Heath	0.0655ha
Community 3(b): Slashed Heath	4.4624
Community 4(a): Low Closed Grassland	45.9079
Community 4(b): Low Closed Grassland	2.6058
Community 6(a): Wetland	0.0118ha
TOTAL	**53.6897**

In total 53.6897 hectares of vegetation will be lost to the proposed development, the majority of which is grasslands with scattered trees, including the loss of thirty-three (33) primary Koala feed trees.



LEGEND

Dry sclerophyll forest/woodland communities

Community 1a - Tall closed forest
(Eucalyptus pilularis +/- mixed species)

Community 1b - Tall mid-dense forest
(Eucalyptus planchoniana, Syncarpia glomulifera, Corymbia intermedia)

Community 1c - Tall mid-dense forest
(Syncarpia glomulifera, Eucalyptus robusta)

Community 1d - Tall mid-dense forest
(Eucalyptus planchoniana, Eucalyptus tindaliae, Eucalyptus pilularis, Syncarpia glommulifera)

Community 1e - Tall open forest
(Eucalyptus siderophloia)

Community 1f - Tall closed forest
(Eucalyptus planchoniana, Syncarpia glomulifera, Eucalyptus pilularis)

Swamp sclerophyll communities

Community 2a - Tall mid-dense forest
(Eucalyptus robusta, Lophostemon suaveolens, Melaleuca quinquenervia, Syncarpia glomulifera)

Community 2b - Mid-high swamp sclerophyll forest
(Melaleuca quinquenervia)

Community 2c - Mid-high swamp sclerophyll forest
(Melaleuca sieberi)

Community 2d - Mid-high swamp sclerophyll woodland
(Melaleuca quinquenervia, M. linariifolia)

Community 2e - Mid-high swamp she-oak woodland
(Casuarina glauca)

Heathland/sedgeland/fernland communities

Community 3a - Tall closed heath
(Ochrosperma leneare, Leptospermum polygalifolium, Leucopogon parviflorus)

Community 3b - Slashed heath
(Mixed species)

Grassland communities

Community 4a - Low closed grassland
(Andropogon virginicus, Themeda triandra) with scattered trees.

Community 4b - Low closed grassland
(Themeda triandra, Juncus sp.)

Intertidal communities

Community 5a - Low open mangrove forest/Saltmarsh
(Aegicerus corniculatum, Juncus kraussii, Sporobolus virginicus)

Wetland communities

Community 6a - Wetland
(Nymphaea sp., *Eleocharis* sp., *Philydrum lanuginosum)*

Individual *Melaleuca sieberi*

Endangered Ecological Community

Drainage line

Koala feed tree (within development area only)

Hollow bearing tree (within development area only)

Development Legend

Underground Stormwater Drainage
Interallottment Drainage
Bioretention Zones
Stormwater Drainage Outlets
Vegetation Filter Zone
3 Catchment No
0.52 ha Catchment Area
Catchment Boundary
Creek Buffers
APZ
Subject Site

0 100 200m
1 : 8000

SOURCE: JWA Site Investigations; Auspacific Engineers Pty Ltd (Ref: 04-1600-P5B.pdf)
SCALE: 1 : 8000 @ A3

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd
PROJECT
Flora & Fauna Assessment
Lots 1 & 2 DP725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 11

PREPARED: VJA/BW
DATE: 07 November 2007
FILE: 02066_FFA_impact.cdr

TITLE **IMPACT OF PROPOSED DEVELOPMENT ON VEGETATION & SIGNIFICANT HABITAT FEATURES**

There will also be a loss of approximately 4.4 hectares of slashed heath and a minor loss of approximately 0.4 hectares of Swamp Sclerophyll forest from the site

Development of the walking tracks to the canoe launch ramps in the east of the site will be completed in a manner in which there will be negligible vegetation loss, although it is acknowledged that there may be some minor disturbance to native vegetation in the ground layer and mid-storey.

Additional impacts on vegetation communities and plants include:

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

4.1.2 Fauna

The proposed development will result in some loss of foraging, sheltering and breeding habitat for native fauna occurring in the locality. This loss may have a range of impacts including:

- Loss of three (3) hollow-bearing trees
- Loss of forage habitat for nectarivorous and insectivorous fauna species, including the loss of autumn/winter flowering plants.
- Minor decrease in the size of local fauna populations and increased susceptibility to threatening processes acting in the locality.
- Minor decrease in the size of the prey base for carnivorous species.
- Increased fragmentation of habitat in the locality.
- Some decrease in the genetic base for local fauna populations.
- Loss of sheltering and breeding habitat for native fauna.
- Reduction in opportunities for movement through the site.
- Loss of trees containing hollows represents a loss of shelter habitat for hollow-dependent fauna. Loss of sub-mature eucalypts represents a decrease in the future recruitment of hollows.

- Loss of eucalypts, paperbarks, banksias and flowering shrubs decrease the food supply for nectarivores.
- Animals may be killed or injured during the clearance of vegetation.
- Domestic dogs and cats prey on native fauna and may have significant impacts on the populations of native species.
- Development of the Subject site may favour native and introduced disturbance adapted competitors. For example, Cane toads may out-compete other Amphibians and Reptiles, aggressive open country bird species (eg Noisy miner, Crow, Pied currawong) may out-compete other birds, and non-native mammals (Black rat and House mouse) may out-compete other native small mammals).
- Increased light, noise and activity may cause reclusive species to move away from habitat edges.
- The Proposed development will result in an increase in traffic on and to the Subject site. This increases the likelihood of animals being killed or injured by vehicles.
- Alterations to site hydrology and land use may alter the water quality or hydrological regime in Paperbark Communities or neighbouring areas of Moonee Creek.

4.1.3 The Coffs Harbour City Council Moonee Development Control Plan

The Moonee Development Control Plan (DCP) was adopted by Coffs Harbour City Council on the 22 September 2004. The DCP applies to the Moonee Release Area, in which the Subject site occurs. Environmental mapping has been completed for the Moonee Release Area under the 2004 DCP.

FIGURE 12 shows the Moonee DCP environmental mapping in the context of the proposed development.

The proposed development has considered buffers to the Osprey nest to the south of the site, with the nest in the north-east corner of the site no longer in existence. However, this area is well buffered should Ospreys rebuild the nest in this part of the site. Impacts on the Wallum froglet are discussed in **APPENDIX 3**.

4.1.4 Impacts on Threatened species

The possible impacts of the Proposed development on Threatened fauna species recorded during the site survey are discussed as follows.

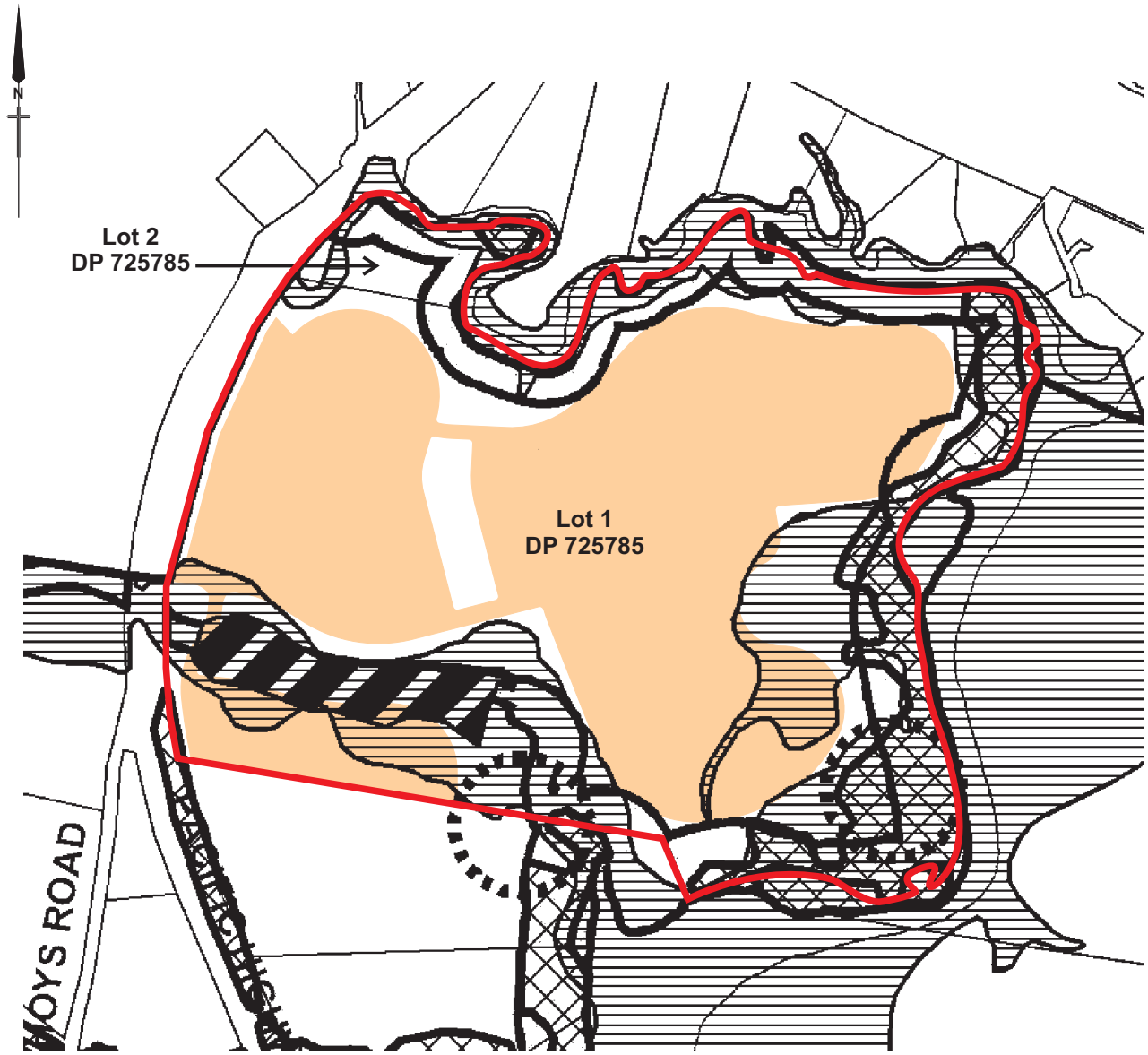
Wallum froglet *

Detailed information on Wallum froglets on the site and subsequent impacts from the proposed development are discussed in a separate report, included as **APPENDIX 3**.

***** Identification uncertain possible mis-identification of the Beeping froglet. See Bisosphere Environmental Consultants (2006) in **APPENDIX 3.**

Osprey

Osprey nests have been located in the south-eastern corner and south of the Subject site, as shown in **FIGURE 12** (Moonee DCP 2004). However, the nest in the south-eastern corner was not observed during site surveys, and is considered to have collapsed. The remaining nest, immediately south of the site remains and Ospreys were observed in the nest. The Moonee DCP requires a 50m minimum buffer around active Osprey nests. The proposed development will result in the loss of a small area of



Legend

- Creek Buffers
- Flooding
- SEPP 14 Wetlands
- Wetlands Buffer
- Protected Vegetation
- Osprey Nest Buffer
- Wallum Froglet Habitat
- Proposed Development Area
- Subject Site

0 300m

SOURCE: Coffs Harbour City Council
Moonee DCP Map 4

SCALE: 1 : 10 000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

PROJECT
Flora & Fauna Assessment
Lots 1 & 2 Dp725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 12

PREPARED: VJA/BW
DATE: 08 November 2007
FILE: 02066_FFA_dcp.cdr

TITLE
ENVIRONMENTAL MAPPING OF THE SUBJECT SITE BY CHCC DCP

eucalypt forest in the north-west of the site and scattered eucalypts within grasslands which represent potential future nesting trees for Ospreys utilising the site.

The Osprey nest on the neighbouring property to the south is likely to experience some minor disturbance (traffic, noise, construction) from the development in the southern Stage, being approximately 100 metres from developed areas. There is some potential for occupation of the proposed development to impact on the nesting Ospreys through disturbance, although this is not considered to be significant.

Glossy black-cockatoo
The proposed development will result in the removal of approximately 125 immature Black she-oak, a Glossy black cockatoo feed tree, from within grasslands with scattered trees on the site. The majority of these trees are saplings less than 2 metres in height, while other trees to be lost do not attain a height of more than 5 metres. No suitable nest trees for this species occur within the development area, however loss of eucalypts from the development area will decrease the future recruitment of suitable nest hollows. Disturbance from the proposed development may reduce the likelihood of Glossy black-cockatoos feeding in proximate areas, although Glossy black-cockatoos are known to forage close to disturbance sources.

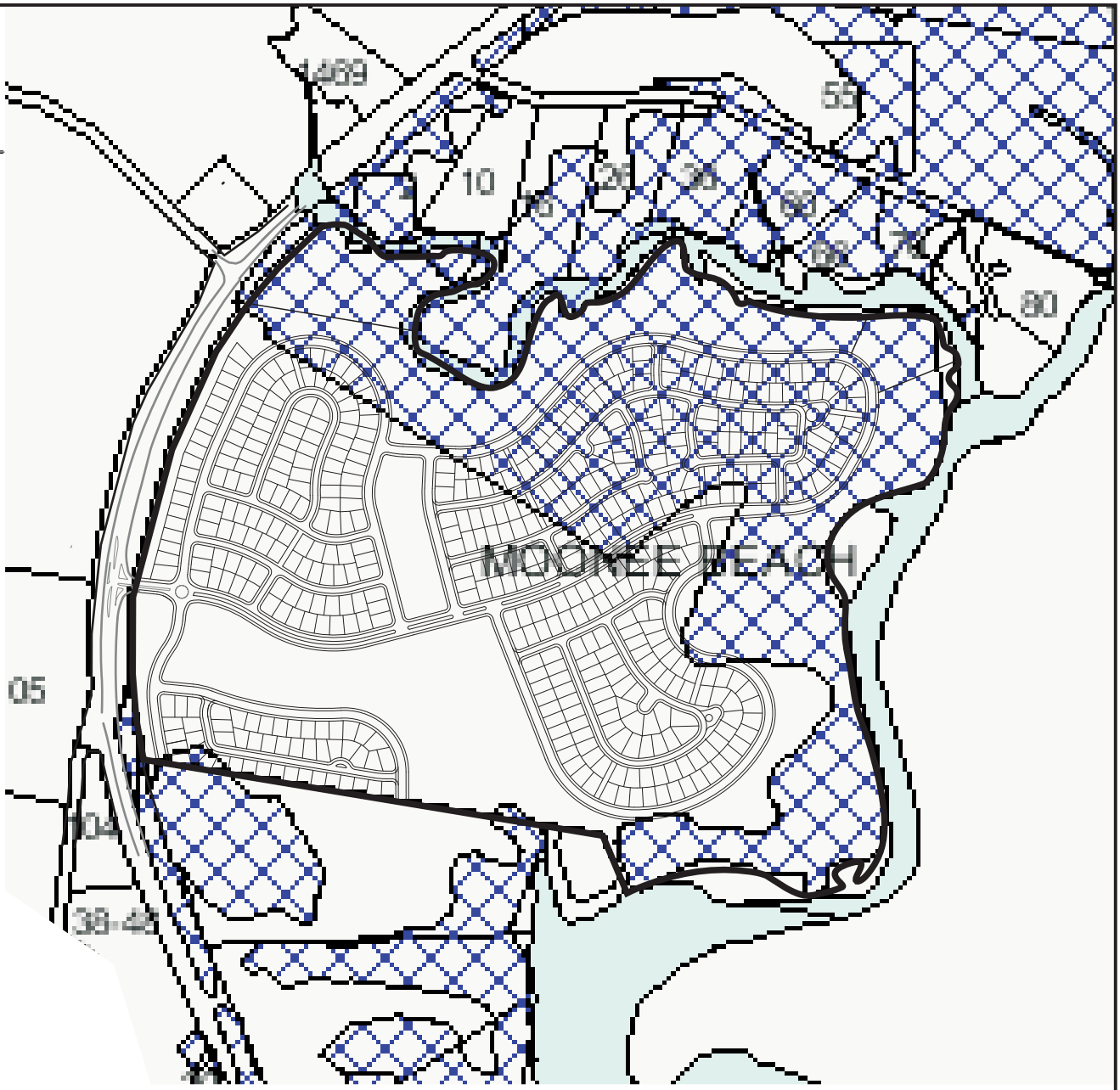
Black-necked stork
The proposed development will not result in disturbance to or the removal of habitat for this species within the main drainage line and pond in the south of the site. There will be some loss of low-lying sedgeland north of the drainage line, which following heavy rainfall events may provide suitable forage habitat for this species. Overall, impacts on this species are considered to be relatively low.

Koala
Koala habitat on the site has been mapped by CHCC, and occurs as large areas of Secondary habitat in the north and east of the site. This is shown in **FIGURE 13**. It should be noted that some of the mapped Secondary Koala habitat consists of scattered eucalypts within grasslands on the site. A number of tree species present on the subject site have also been identified in the Coffs Harbour Koala Plan of Management (KPoM) as feed tree species. These are:

- Broad-leaved paperbark
- Blackbutt
- Forest oak
- Tallowwood
- Swamp mahogany
- Forest red gum

Koala scats were found to the north of the site in vegetation fringing Skinners Creek where Tallowwood occur in an area of mapped Secondary Koala Habitat. Clancy (1998) notes that Koalas have previously been recorded in this area. Most scats found appeared to be relatively old, with only one recent scat.

The proposed development will contribute toward the loss of some Secondary Koala Habitat on the site, as scattered paddock trees in the north-east of the site. All primary Koala feed trees scattered within grasslands within the development area were surveyed, and are shown in **FIGURE 10**. No scats were found under any of these trees.



Legend

Koala Habitat Classification

- Primary
- Secondary
- Tertiary
- Subject Site

0 300m

SOURCE: Coffs Harbour City Council Website (Accessed 01 August 2006)

SCALE: 1 : 10 000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

PROJECT
Flora & Fauna Assessment
Lots 1 & 2 Dp725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 13

PREPARED: VJA/BW
DATE: 08 November 2007
FILE: 02066_FFA_koala.cdr

TITLE
CHCC KOALA HABITAT CLASSIFICATION & PROPOSED DEVELOPMENT

In total thirty-three (33) primary Koala feed trees will be lost to the development, the majority of which are Tallowwood (*Eucalyptus microcorys*).

Vegetation mapped as Secondary Koala Habitat along most of the northern and eastern boundaries will be retained. The proposed development is likely to limit opportunities for Koala movement over the site, with movement restricted to retained vegetation along the northern and eastern margins of the site. There is also the potential for Koalas to be injured or killed during clearing of vegetation on the site, or from vehicle strike within the developed urban areas. Urban development of the site also has the potential to increase risks to Koalas from straying dogs, and drowning in swimming pools.

Grey-headed flying-fox
The proposed development will result in the loss of foraging habitat for this species and reduce the foraging efficiency of any individuals foraging in the Study area. There is no suitable roosting habitat for this species in the Study area. The Grey-headed flying-fox is likely to continue to forage in retained areas of vegetation on the site, and will not be significantly affected by the proposed development.

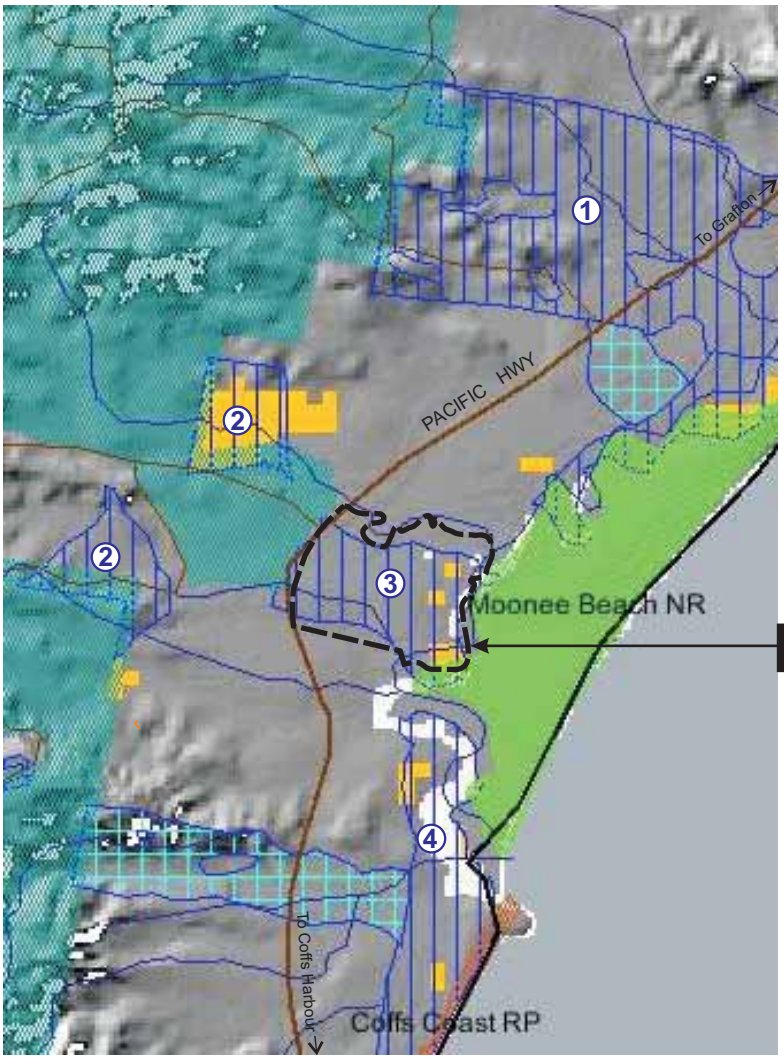
Squirrel glider
Squirrel gliders were recorded on the eastern margins of the Subject site in eucalypt woodland, and also within scattered eucalypts within grasslands in the centre of the site. This species is likely to utilise most of the sclerophyll and paperbark communities along the eastern edge of the site, including scattered eucalypts in grassland adjacent to these communities. The record of the Squirrel glider within scattered trees in the centre of the site suggests that the species may utilise much of this community over the eastern half of the site as stepping stone foraging habitat.

Loss of scattered trees within grasslands will result in a reduction of forage habitat for the Squirrel glider and diminish movement corridors. There are three (3) hollow-bearing trees occurring scattered throughout grasslands on the site which provide suitable denning habitat for this species. Stag watching of these trees did not record the presence of Squirrel gliders. These trees will be removed, resulting in a minor reduction in denning opportunities for this species on the site. There is potential for increased disturbance to Squirrel gliders feeding and denning in vegetated areas proximate to the development, and the further possibility of predation from cats. There is also the potential for direct mortality during construction.

Little bent-wing bat
The Little bent-wing bat forages on insects in forested habitats and roosts in caves, tunnels and similar structures. The proposed development will not result in loss or alteration of the southern drainage line and associated plant communities, and thus forage and roost habitat will be retained. The proposed development will result in the loss of some foraging habitat for this species in the open woodland environment of the site, and reduce the foraging efficiency of any individuals foraging in the Study area.

Common bent-wing bat (as for Little bent-wing bat)

Large-footed myotis
The Large-footed myotis forages over creeks and other water bodies. It roosts in caves, tunnels, under bridges and in tree-hollows. The proposed development will not affect



LEGEND

KEY HABITATS AND CORRIDORS

Regional Corridor
Subregional Corridor
Key Habitat

TENURE
Aboriginal area
Historical site
National Park
Nature Reserve
Regional Park
State Recreation Area
State Forest

① Moonee Regional Corridor
② Hoys Regional Corridor
③ Wedding Bells - Moonee Beach Regional Corridor
④ Moonee Nature Reserve Regional Corridor

0 1500m

SOURCE: CANRI Website 12.11.04
Key Habitats & Corridors in North East NSW

SCALE: 1 : 50 000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

PROJECT
Flora & Fauna Assessment
Lots 1 & 2 DP725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 14

PREPARED: vja
DATE: July 2006
FILE : 02066_FFA_corridor.cdr

TITLE

NPWS KEY HABITATS & CORRIDORS

foraging habitat for this species but may result in the loss of tree hollows that may currently be used by this species or may provide future potential roost sites.

4.1.5 Corridor impacts

The NPWS Key Habitats and Corridors database shows several regional habitat corridors within the locality of the site. These are shown in **FIGURE 14**. The Subject site itself occurs within the Wedding Bells – Moonee Beach Regional Corridor which links Moonee Beach Nature Reserve and Skinners Creek. This corridor is comprised of the following fauna assemblages identified by NPWS:

- Moist escarpment foothills UNC
- Dry coastal foothills UNC
  UNC = Upper North Coast

Details on all fauna assemblages within corridors in the vicinity of the site are shown in **APPENDIX 4**. To the south of the site lies the Moonee Nature Reserve – Sapphire Regional Corridor which links Moonee Beach Nature reserve and Hills Beach, and consists of the following fauna assemblages:

- Moist escarpment foothills UNC
- Dry coastal foothills UNC
- Coastal complex UNC

The Hoys Corridor occurs to the west of the site in two areas which link Skinners Creek with Skinners Road in the north and Cunninghams Creek in the south. Fauna assemblages consist of:

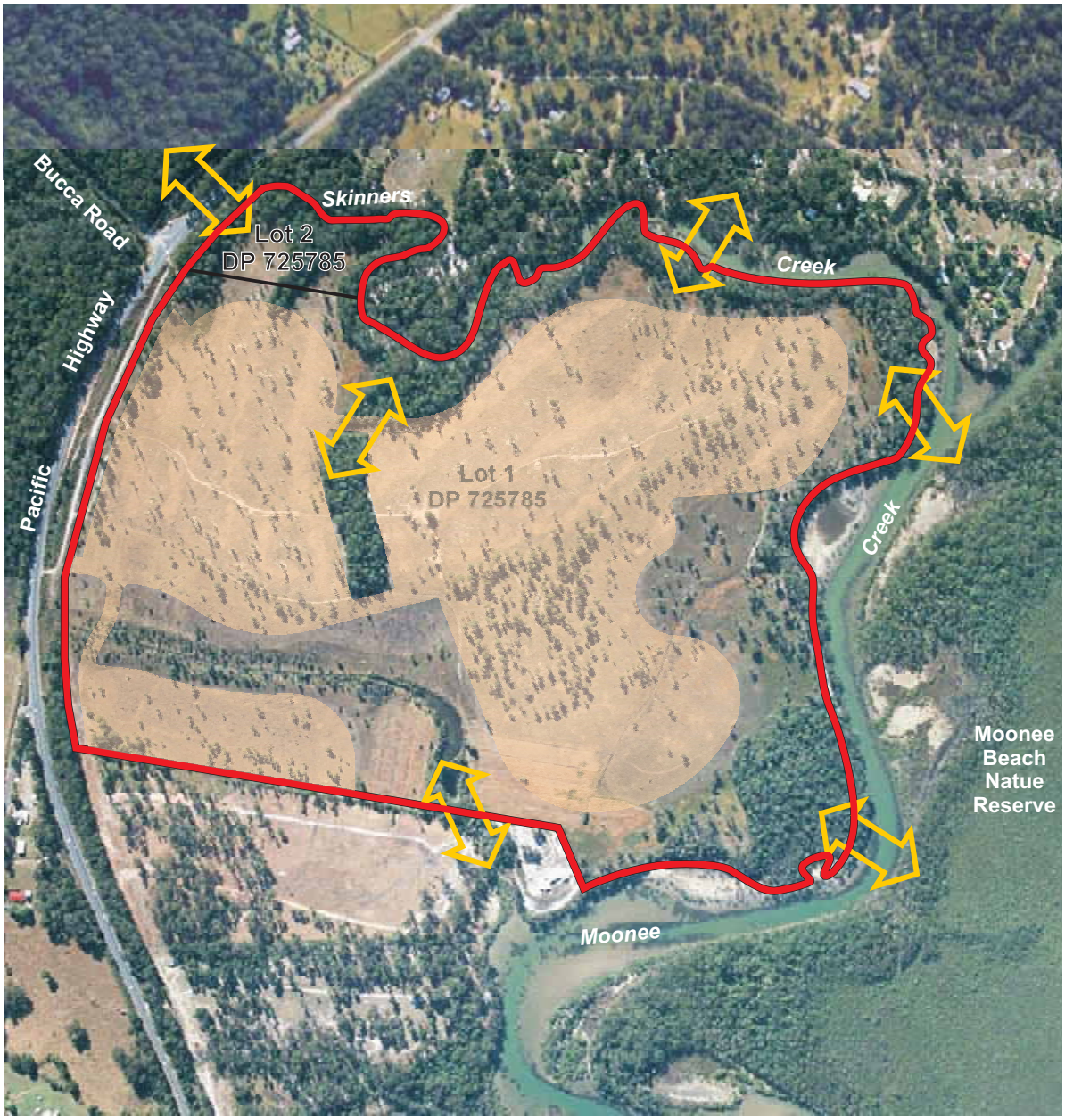
- Wet escarpment UNC
- Moist escarpment foothills UNC

The Proposed development will contribute towards a reduction in the overall effectiveness of the site as a corridor due to habitat loss and fragmentation and a reduction in the width and length of the corridor value of the site due to edge effects.

However, the northern and eastern parts of the site will retain movement habitat to consolidate the link between the Moonee Beach Nature Reserve and habitats on the southern side of Skinners Creek. Retention of the central ridge of vegetation on the site will also allow for dispersal between vegetated areas of the site. The majority of vegetation to be removed for development of the site consists of scattered eucalypts within an exotic grassland, which primarily provides movement opportunities for bird species. Loss of this 'stepping stone' habitat is considered unlikely to have any significant impacts on any bird species utilising the site, and many bird species are likely to continue to use street trees and landscaping trees to move across the site.

It is acknowledged that the Proposed development will result in a restriction in dispersal opportunities for the both the Squirrel and Feathertail glider.

Movement along the drainage line in the south of the site will not be adversely affected, due to the retention of this area. The access road across this drain is not likely to impede fauna movement, providing appropriate design is implemented, however there is potential for road kill of any Wallum froglets which may disperse along the drain environment.



Legend

Possible Fauna Movements to Habitat Corridors After Development

Proposed Development Area

Subject Site

0 300m

SOURCE: Aerial photo taken July 2006

SCALE: 1 : 10 000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

PROJECT
Flora & Fauna Assessment
Lots 1 & 2 Dp725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 15

PREPARED: VJA/BW
DATE: 08 November 2007
FILE: 02066_FFA_Fauna movt.cdr

TITLE
POSSIBLE FAUNA MOVEMENTS AFTER DEVELOPMENT

FIGURE 15 shows the extent of dispersal opportunities for fauna on the site following its development.

4.1.6 Impacts on Moonee Beach Nature Reserve

The proposed development has the potential to result in impacts on habitats within Moonee Beach Nature Reserve as a result of increased visitation to the reserve.

Nature Reserves, as opposed to National Parks, are managed for conservation purposes only and are not intended to provide for visitors. Impacts associated with increased visitation may include creation of informal pathways, trampling of vegetation, picking of wildflowers, increased disturbance of fauna, increased risk of fire, increased potential for dumping of rubbish and increased potential for invasion of exotic flora and fauna.

4.1.7 Impacts on Moonee Creek & Skinners Creek

The proposed development has the potential to result in impacts on habitats within Moonee Creek and Skinners Creek related to:

- Impacts on water quality and hydrology as a result of stormwater runoff from the proposed development.
- Increased visitation, with potential for trampling of intertidal vegetation, dumping of rubbish or refuse in creek habitats (particularly discarded fishing line, bait bags etc.), disturbance of fauna.

The policy of NSW Fisheries is for foreshore buffers to be established, with the width of the buffer to be extended for "ecologically sensitive areas". The proposed development layout allows for a buffer of 50m to both Moonee Creek and Skinners Creek.

The Landscape Concept Plan (2005) prepared for the site indicates that fishing platforms will be constructed along both Moonee and Skinners Creeks. A canoe platform will also be constructed on Moonee Creek, and a bridge spanning Skinners Creek is also proposed. The location of these facilities is shown in **FIGURE 16**.

Construction of these facilities has the potential to create disturbance to vegetation occurring on creek banks, and for erosion of topsoil during the construction process. No structures will be built into Moonee Creek itself.

The Moonee Creek Estuary Processes Study (WBM 2005) notes that the Moonee Creek estuary is in a *"relatively healthy and near pristine condition"*. This is due to the lack of urban pollutant input, buffering from native vegetation and a good natural flushing capacity. However future urban development within the Moonee Release Area is noted as likely to place increased pressure on the estuary system.

4.1.8 Other possible impacts

Other possible impacts from the proposed development include alterations to the hydrology, and impacts on water quality on the site.

SOURCE: Anne Harrison Landscape Architects (Ref: figure 16 from Landscape Report complete_ Oct07.pdf) SCALE: 1 : 8000 @ A3 JAMES WARREN & ASSOCIATES PTY LIMITED Environmental Consultants	CLIENT Resource Design Management Pty Ltd PROJECT Flora & Fauna Assessment Lots 1 & 2 DP725785 Pacific Highway, Moonee, NSW Coffs Harbour City LGA	**FIGURE 16** PREPARED: VJA/BW DATE: 07 November 2007 FILE: 02066_FFA_Landscape.cdr	TITLE **LANDSCAPE CONCEPT PLAN**

4.2 Amelioration

4.2.1 Introduction

This section discusses possible ameliorative measures and opportunities for enhancing the natural environment on the Subject site, *ie*. plant communities, fauna communities, Threatened species and conservation areas.

4.2.2 Amelioration for plant communities

The proposed development will have relatively little impact on vegetation communities occurring on the northern and eastern boundaries of the site. However, there will be a loss of scattered eucalypts within grasslands in the east and west of the site. It is recommended that mature eucalypts be retained where possible, particularly within parklands, and landscaping areas. It is also recommended that mature *Melaleuca sieberi* on the site be similarly retained.

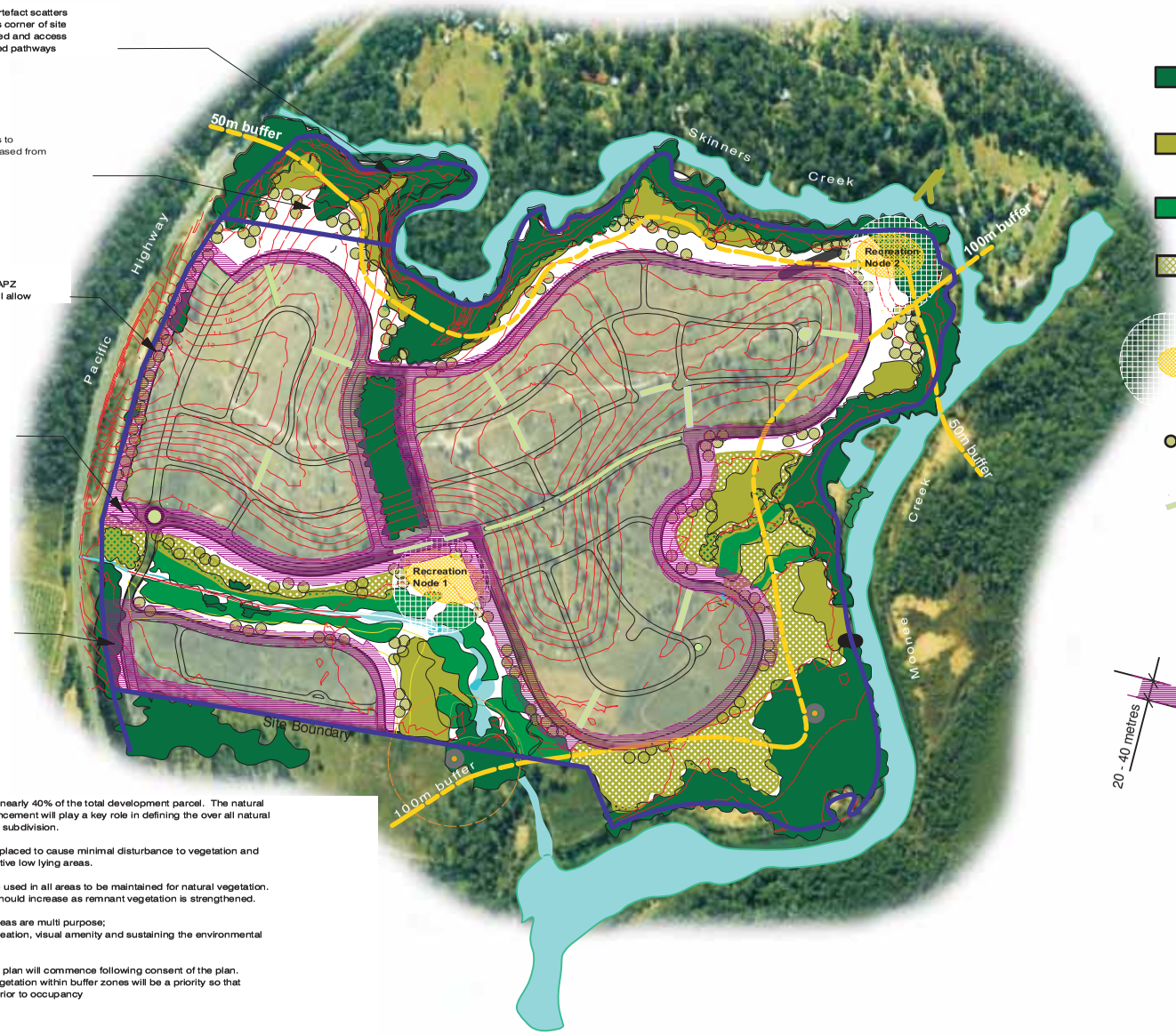
Other amelioration measures include:

- Weeds should be controlled during construction.
- Vegetation removed during construction should be mulched for use on the site. This will prevent the introduction of weeds from seeds in mulch brought in from elsewhere.
- Weeds should be controlled in landscaped areas and areas of retained vegetation.
- Known environmental weeds (e.g. Umbrella tree) should be avoided.
- Landscape plantings should include a majority of native species that will provide forage habitat for nectarivorous and frugivorous birds and bats.
- Landscaping trees should be situated where possible to reduce the amount of disturbance to retained areas of habitat.

A Landscape Management Plan (LMP) has been prepared by Anne Harrison (Landscape Architect) as part of the Landscape Concept Plan for the site. This plan is shown in **FIGURE 17**. As indicated on the VMP much of the slashed heathland on the site will be allowed to regenerate, while other vegetation communities will be enhanced from rehabilitation and revegetation works. This will result in an overall net gain of heathland community on the site, retain mature trees (including Sieber's paperbark) and appropriately buffer retained areas of Wallum froglet habitat within the drain line community in the south of the site. It is proposed that seed sources from the site be utilised in revegetation to maintain the genetic and species integrity of flora on the site.

4.2.3 Amelioration for fauna

While vegetation clearance for the proposed development will result in some loss of habitat for fauna utilising the site, this will be relatively minimal, with the best quality habitat on the site being retained. Amelioration for Threatened fauna not significantly affected by the proposed development is included below, while amelioration for the Osprey and Koala is discussed in Section 4.2.4. Amelioration measures for the Wallum froglet are discussed in **APPENDIX 3**.



Landscape Features

Open space comprises nearly 40% of the total development parcel. The natural landscape and its enhancement will play a key role in defining the over all natural coastal character of this subdivision.

Built areas are logically placed to cause minimal disturbance to vegetation and be well away from sensitive low lying areas.

Native species are to be used in all areas to be maintained for natural vegetation. Biodiversity of the site should increase as remnant vegetation is strengthened.

All green open space areas are multi purpose;
filtering stormwater, recreation, visual amenity and sustaining the environmental integrity of the site

All work outlined on this plan will commence following consent of the plan. The strengthening of vegetation within buffer zones will be a priority so that plants are established prior to occupancy

Legend

Existing forest, swamp and mangrove communities protected and enhanced. Grazing removed and recreation contained to structured path ways These areas will be fenced to allow rehabilitation to occur

Rehabilitation of indigenous forest communities. Natural buffer enhanced. Revegetation utilises existing seed source and fencing to aid re-establishment

Rehabilitation of existing wetland, sedgeland, swamp sclerophyll and heath communities. Revegetation utilises existing seed source and fencing to aid re-establishment

Revegetation of indigenous heath community. Slashing is to cease to allow natural recovery of plant species. The majority of this area will also be fenced to aid re-establishment

Intensive landscape management within this zone. Recreation facilities are contained within areas of grassed open space with feature planting and interconnected via pathways. Area will be regularly mown and monitored to ensure quality of all landscape and recreation features

Proposed grouped indigenous tree planting (no understorey)

connecting laneway or median strip, will be intensively managed and contain pathway, trees and grass

* Any area shown white internal to the site will be mown and operate with dual primary purposes of storm water filtration and secondly as open space suitable for a variety of recreation uses

Asset Protection Zone (APZ)

This zone has been identified for bushfire protection and complies with requirements recommended by the NSW Rural Fire Service. This zone also acts as an effective buffer between urban dwellings and natural vegetation. The APZ is part of the open space network and is characterised or may contain:

perimeter roads
block setbacks
walking / cycle tracks
playground / picnic facilities
trees with no understorey
will be slashed or mown regularly
will operate as storm water filtering areas

20 - 40 metres

0 100 200m
1 : 8000

SOURCE: Anne Harrison Landscape Architects (Ref: figure 17 from Landscape Report complete_ Oct07.pdf)
SCALE: 1 : 8000 @ A3
JAMES WARREN & ASSOCIATES PTY LIMITED Environmental Consultants

CLIENT
Resource Design Management Pty Ltd
PROJECT
Flora & Fauna Assessment
Lots 1 & 2 DP725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 17
PREPARED: VJA/BW
DATE: 07 November 2007
FILE: 02066_FFA_Veg Mgt.cdr

TITLE **LANDSCAPE CONCEPT & OPEN SPACE MANAGEMENT PLAN**

The following amelioration measures apply:

- Landowners should control dogs on the site. All animals should reside within fenced enclosures and be on a leash when outside of the enclosure. Cats should be banned from the site under the companion Animals Act (1998) to reduce likely impacts on local fauna.
- Appropriate disposal of rubbish and food scraps reduces opportunities for non-native predators and disturbance adapted competitors.
- Landscape and landfill materials should be sourced from a supplier where Cane toads do not occur.
- Mature habitat trees should be retained where possible.
- Compensatory Koala habitat trees to be planted in the north-west corner of the site and outside the development envelope for any Koala habitat trees removed.
- A qualified fauna handler should be on site when clearing occurs.
- 40 km/hr speed limit to be imposed on internal access roads.
- Planting of suitable feed trees (*Allocasuarina littoralis*, *A. torulosa*) around retained areas of the site for Glossy black cockatoos utilising the site.

4.2.4 Amelioration for Threatened species

Wallum froglet

See detailed separate report in **APPENDIX 3**.

Osprey

The loss of the Osprey nest in the south-east corner of the site, may have resulted in the parent birds utilising the nest site in the adjacent property in the south. A 50 metres buffer has been allowed to limit disturbance to the nest site. There is a possibility that Ospreys will rebuild nests within mature eucalypts on the site in the future.

Koala

Amelioration measures for the Koala have been based on the need to address the requirements for Secondary Koala Habitat within Coffs Harbour shire. These requirements are:

- the proposal will not result in significant barriers to koala movement;
- boundary fencing does not prevent the free movement of koalas;
- lighting and koala exclusion fencing is provided where appropriate on roadways adjacent to koala habitat;
- tree species listed in the KPoM for Secondary Koala Habitat are retained, where possible;
- new local roads are designed to reduce traffic speed to 40 kph in potential koala blackspots;
- preferred koala trees are used in landscaping where suitable;
- Koala habitat tree removed are replanted within the vicinity.
- threats to koalas by dogs have been minimised i.e. banning of dogs or confining of dogs to koala proof yards;
- fire protection zones, including fuel reduced zones and radiation zones, are provided generally outside of Secondary Koala Habitat.

The proposed development will result in the loss of some mapped Secondary koala habitat within vegetation in the north-west corner of the site, although most of the habitat to be lost consists of scattered trees within grasslands. In total, thirty-three (33) primary Koala feed trees (mostly Tallowwoods) will be lost to the proposed development.

It is recommended that:

- Traffic speeds be reduced to 40kph within the development. Koala signs may need to be located along roads within the development site, particularly in the north-west corner of the site adjacent to Skinners Creek where mature Tallowwood occur.
- Compensatory Koala habitat trees be planted in the north-west corner of the site and outside the development envelope for any Koala habitat trees removed.
- Dogs should be strictly controlled within the proposed development, i.e: must be contained within an appropriately fenced yard, and on a leash at all times when outside of a fenced enclosure.
- Building envelopes be located to reduce the extent of Bushfire Asset Protection Zones. If possible, houses backing onto bushland should be designed to a higher fire resistant rating to reduce the extent of APZs.
- Swimming pools should be fenced to restrict access by Koalas.

It is unlikely that Koala feed trees will be retained within the development envelope and it is not considered desirable that Koalas be able to access or move through areas of the site. Suitable movement habitat occurs along the northern and eastern boundaries.

Squirrel glider

While most suitable habitat for Squirrel gliders on the site will be retained, some loss and fragmentation of forage habitat will occur due to the loss of scattered trees within grasslands on the site. It is recommended that:

- Cats should be banned under the Companion Animals Act (1998) to reduce likely impacts on Squirrel gliders.
- Mature scattered eucalypts within grassland communities should be retained wherever possible, including the two hollow-bearing trees within the development area.
- A qualified fauna handler should be on site when clearing occurs.

Glossy black cockatoo

While all the Black she-oak to be lost to the proposed development are immature and do not currently constitute a food resource for the Glossy black cockatoo, it is recommended that this species should be included in plantings outside the development areas within areas to be regenerated.

4.2.5 General amelioration measures

General Amelioration measures and amelioration measures to reduce impacts on Moonee and Skinners Creeks and Moonee Beach Nature Reserve include:

- Stormwater management aim to achieve no significant net change in runoff into wetland areas on the site, and Moonee and Skinners Creeks.
- Restrictions should be placed on the use of fires during extended dry weather periods.
- Suitable measures (eg. Siltation fencing) be taken to prevent erosion of topsoil into Moonee and Skinners Creeks during construction of Fishing platforms, Canoe jetties and bridges.
- Signage encouraging responsible fishing practices (ie. Disposal of rubbish in appropriate facilities.)

The Moonee Creek Estuary Processes Study (WBM 2005) also highlighted a number of management issues for Moonee Creek. Relevant issues include:

- Stabilisation of banks
- Enforcement of current regulations regarding recreational uses of the estuary, including dog walking and horse riding
- Preservation and enhancement of existing riparian vegetation and estuarine habitats
- Conservation of existing areas of native vegetation throughout the catchment.

These measures should be incorporated into management measures for the proposed development.

5 STATUTORY CONSIDERATIONS

5.1 Introduction

This section includes assessments of the impacts of the Proposed development with regard to:

- Section 5A of the *Environment Protection & Assessment Act (1979)* (Assessment of Significance);
- *State Environmental Planning Policy No. 44* (SEPP 44) – Koala Habitat Protection; and
- the *Commonwealth Environment Protection and Biodiversity Conservation Act (1999)*.

5.2 Assessment of Significance (Seven Part Test)

5.2.1 Background

Under the *Threatened Species Conservation Amendment Act 2002*, the factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species, populations or ecological communities, or their habitats (known previously as the "8-part test"), have been revised. This affects s5A *EP&A Act*, s94 *Threatened Species Conservation Act 1995* (*TSC Act*) and s220ZZ *Fisheries Management Act 1994* (*FM Act*).

The revised factors maintain the same intent but focus consideration of likely impacts in the context of the local rather than the regional environment as the long-term loss of biodiversity at all levels arises primarily from the accumulation of losses and depletions of populations at a local level. This is the broad principle underpinning the *TSC Act*, State and Federal biodiversity strategies and international agreements. The consideration of impacts at a local level is designed to make it easier for local government to assess, and easier for applicants and consultants to undertake the Assessment of Significance because there is no longer a need to research regional and statewide information. The Assessment of Significance is only the first step in considering potential impacts. Further consideration is required when a significant effect is likely and is more appropriately considered when preparing a Species Impact Statement.

The Assessment of Significance should not be considered a "pass or fail" test as such, but a system allowing proponents to undertake a qualitative analysis of the likely impacts and ultimately whether further assessment needs to be undertaken via a Species Impact Statement. All factors must be considered and an overall conclusion must be drawn from all factors in combination. Where there is any doubt regarding the likely impacts, or where detailed information is not available, a Species Impact Statement should be prepared.

5.2.2 Flora

No Threatened flora species were recorded on the Subject site.

5.2.3 Endangered Ecological Communities (EECs)

5.2.3.1 Background

Three (3) Endangered Ecological Communities (EECs) occur on the site:

- Coastal saltmarsh
- Swamp oak floodplain forest
- Swamp sclerophyll forest on coastal floodplain

An Assessment of Significance will be completed for each of these communities.

5.2.3.2 Coastal saltmarsh

(a) In the case of a Threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

Not applicable.

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

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

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

Saltmarsh communities on the site generally occur in conjunction with mangrove communities. Typical Saltmarsh species on the site include Salt couch (*Sporobolus virginicus*) and Salt rush (*Juncus krausii*). None of the Coastal saltmarsh community occurring on the site will be modified or removed as part of the proposed development.

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

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

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

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

No habitat for Saltmarsh communities (i.e. intertidal areas) will be modified as a result of the proposed development. No further isolation of fragmentation of Saltmarsh communities on the site will occur as a result of the proposed development.

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

Critical habitat areas listed under the *Threatened Species Conservation Act (2002)* currently consist of habitat for Mitchell's rainforest snail in Stott's Island Nature Reserve, and habitat for the Little penguin population in Sydney's North Harbour.

Neither of these critical habitats will be adversely affected.

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

No Recovery plan has been prepared for the EEC Coastal saltmarsh.

A Draft Threat Abatement Plan has been prepared to address the invasion of native plant communities by Bitou bush – a Key Threatening Process (KTP).

Bitou bush does not occur within this EEC on the Subject site.

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

A "threatening process" means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of a species, population or ecological community. Key Threatening Processes have been listed in Schedule 3 of the *TSC Act (1995)*.

Key Threatening Processes (Schedule 3):

- Invasion and establishment of exotic vines and scramblers;
- Invasion and establishment of the Cane toad, *Bufo marinus*;
- Invasion of the yellow crazy ant;
- Feral pigs;
- Competition and habitat destruction by feral goats;
- Entanglement in, or digestion of anthropogenic debris in marine and estuarine environments;
- Introduction of the large earth Bumble bee, *Bombus terrestris*;
- Removal of dead wood and dead trees;
- Death or injury to marine species following capture in shark control programs on ocean beaches;
- Invasion of native plant communities by exotic perennial grasses;
- Infection of frogs by amphibian chytrid, causing the disease chytrodiomycosis
- Competition from feral honeybees;
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;
- Clearing of native vegetation;
- Anthropogenic climate change;
- Removal of Bush rock;
- High frequency fire;

- Invasion by Bitou Bush (*Chrysanthemoides monilifera*);
- Loss and/or degradation of sites used for hilltopping by butterflies;
- Predation by the European red fox (*Vulpes vulpes*);
- Predation by the Feral cat (*Felis catus*);
- Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island;
- Predation by the Plague Minnow (*Gambusia holbrooki*);
- Infection of native plants by *Phytophthora cinnamomi;*
- Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations;
- Importation of red imported fire ants into NSW; and
- Competition and grazing by the feral European rabbit.

The proposed development will not result in the removal or modification on any Coastal saltmarsh communities on the site. None of the Threatening process listed will affect saltmarsh communities on the site, nor will the Proposed development increase the impact on any threatening processes.

It should be noted that there is potential for disturbance to saltmarsh communities on the site from human traffic (e.g. trampling, bicycle riding etc).

On the basis of this assessment, it is considered that a Species Impact Statement (SIS) is not required.

5.2.3.3 Swamp oak floodplain forest

(a) In the case of a Threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

Not applicable.

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

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

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

The Subject site is not considered to constitute a significant area of the EEC Swamp oak floodplain forest in relation to the local distribution of this community. The Proposed development will not result in the modification or removal of this community on the site.

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

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

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

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

Swamp oak floodplain forest is associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains (NSW Scientific Committee 2004).

Approximately 56% of the total site area (approximately 54 hectares) will be subject to urban development. Nearly all urban development of the site occurs within grasslands with scattered trees on the site. Whilst development will occur in some low-lying areas of the site, historical and current land management practices (i.e. slashing and grazing) would preclude the establishment of this EEC in these areas. It is considered that no suitable habitat for this EEC will be removed or modified as a result of the proposed development.

The EEC Swamp oak floodplain forest on the site is already fragmented, and does not retain any connectivity with other nearby similar communities. The proposed development will not further isolate this community on the site.

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

Critical habitat areas listed under the *Threatened Species Conservation Act (2002)* currently consist of habitat for Mitchell's rainforest snail in Stott's Island Nature Reserve, and habitat for the Little penguin population in Sydney's North Harbour.

Neither of these critical habitats will be adversely affected.

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

No Recovery plan has been prepared for the EEC Swamp oak forest floodplain forest.

A Draft Threat Abatement Plan has been prepared to address the invasion of native plant communities by Bitou bush – a Key Threatening Process (KTP).

Bitou bush does not within this EEC on the Subject site.

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

A "threatening process" means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of a species, population or ecological community. Key Threatening Processes have been listed in Schedule 3 of the *TSC Act (1995)*.

Key Threatening Processes (Schedule 3):

- Invasion and establishment of exotic vines and scramblers;
- Invasion and establishment of the Cane toad, *Bufo marinus*;
- Invasion of the yellow crazy ant;
- Feral pigs;
- Competition and habitat destruction by feral goats;
- Entanglement in, or digestion of anthropogenic debris in marine and estuarine environments;
- Introduction of the large earth Bumble bee, *Bombus terrestris*;
- Removal of dead wood and dead trees;
- Death or injury to marine species following capture in shark control programs on ocean beaches;
- Invasion of native plant communities by exotic perennial grasses;
- Infection of frogs by amphibian chytrid, causing the disease chytrodiomycosis
- Competition from feral honeybees;
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;
- Clearing of native vegetation;
- Anthropogenic climate change;
- Removal of Bush rock;
- High frequency fire;
- Invasion by Bitou Bush (*Chrysanthemoides monilifera*);
- Loss and/or degradation of sites used for hilltopping by butterflies;
- Predation by the European red fox (*Vulpes vulpes*);
- Predation by the Feral cat (*Felis catus*);
- Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island;
- Predation by the Plague Minnow (*Gambusia holbrooki*);
- Infection of native plants by *Phytophthora cinnamomi;*
- Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations;
- Importation of red imported fire ants into NSW; and
- Competition and grazing by the feral European rabbit.

The proposed development will not result in the removal or modification of any Swamp oak communities on the site. None of the Threatening process listed will affect Swamp oak communities on the site, nor will the Proposed development increase the impact on any threatening processes.

On the basis of this assessment, it is considered that a Species Impact Statement (SIS) is not required.

5.2.3.4 Swamp sclerophyll forest on coastal floodplain

(a) In the case of a Threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

Not applicable.

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

- *(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- *(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Paperbark forest on the site occurs in several areas, mostly in small pockets adjoining other vegetation communities. One (1) small patch of Community 2(c) and Community 2 (d) – Paperbark communities will be modified for the construction of a bio-retention basin. No other patches of Swamp Sclerophyll forest will be affected by the proposed. The majority of the Paperbark areas on the site will be retained. The proposed development will not cause the Swamp Sclerophyll Forest on the subject site to be placed at risk of extinction.

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

- *(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- *(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
- *(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

Swamp sclerophyll forest on coastal floodplains is associated with humic clay-loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines, associated with coastal floodplains (NSW Scientific Committee 2004).

Approximately 56% of the total site area (approximately 54 hectares) will be subject to urban development. Nearly all urban development of the site occurs within grasslands with scattered trees on the site. Whilst development will occur in some low-lying areas

of the site, historical and current land management practices (i.e. slashing and grazing) would preclude the establishment of this EEC in these areas. It is considered that only 0.4 hectares of suitable habitat for this EEC will be removed or modified as a result of the proposed development.

The EEC Swamp sclerophyll forest on coastal floodplain on the site is already fragmented, and does not retain any connectivity with other nearby similar communities. The proposed development will not further isolate this community on the site.

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

Critical habitat areas listed under the *Threatened Species Conservation Act (2002)* currently consist of habitat for Mitchell's rainforest snail in Stott's Island Nature Reserve, and habitat for the Little penguin population in Sydney's North Harbour.

Neither of these critical habitats will be adversely affected.

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

No Recovery plan has been prepared for the EEC Swamp sclerophyll forest on Coastal floodplain.

A Draft Threat Abatement Plan has been prepared to address the invasion of native plant communities by Bitou bush – a Key Threatening Process (KTP).

Bitou bush does not occur within this EEC on the Subject site.

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

A "threatening process" means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of a species, population or ecological community. Key Threatening Processes have been listed in Schedule 3 of the *TSC Act (1995)*.

Key Threatening Processes (Schedule 3):

- Invasion and establishment of exotic vines and scramblers;
- Invasion and establishment of the Cane toad, *Bufo marinus*;
- Invasion of the yellow crazy ant;
- Feral pigs;
- Competition and habitat destruction by feral goats;
- Entanglement in, or digestion of anthropogenic debris in marine and estuarine environments;
- Introduction of the large earth Bumble bee, *Bombus terrestris*;
- Removal of dead wood and dead trees;
- Death or injury to marine species following capture in shark control programs on ocean beaches;
- Invasion of native plant communities by exotic perennial grasses;

- Infection of frogs by amphibian chytrid, causing the disease chytrodiomycosis
- Competition from feral honeybees;
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;
- Clearing of native vegetation;
- Anthropogenic climate change;
- Removal of Bush rock;
- High frequency fire;
- Invasion by Bitou Bush (*Chrysanthemoides monilifera*);
- Loss and/or degradation of sites used for hilltopping by butterflies;
- Predation by the European red fox (*Vulpes vulpes*);
- Predation by the Feral cat (*Felis catus*);
- Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island;
- Predation by the Plague Minnow (*Gambusia holbrooki*);
- Infection of native plants by *Phytophthora cinnamomi;*
- Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations;
- Importation of red imported fire ants into NSW; and
- Competition and grazing by the feral European rabbit.

The proposed development will result in the minor removal and modification of Swamp sclerophyll forest (Paperbark) on the site. The Proposed development will not increase the impact on any threatening processes. Vegetation to be lost to the proposed development consists of sclerophyll communities, sedgeland, and grassland with scattered trees.

On the basis of this assessment, it is considered that a Species Impact Statement (SIS) is not required.

5.2.4 Fauna

5.2.4.1 Background

A Section 5A assessment has been undertaken for each species recorded on the Subject site, or considered a possible occurrence at the Subject site.

(a) In the case of a Threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Tables showing the distribution, habitat and life cycle requirements of each species considered a possible occurrence at the Subject site are included as **APPENDIX 5**.

5.2.4.2 Barred cuckoo-shrike

Extent of the local population
The NPWS database contained two (2) records of this species within 10 kilometres of the Study area.

The NPWS online database contained six (6) sightings of this species in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and identified breeding and sheltering sites for the Barred cuckoo shrike as consisting of low elevation subtropical and littoral rainforest and coastal wet sclerophyll forest close to fruiting figs with the preferred habitat being a mature canopy. The Barred cuckoo-shrike forages in mature canopy and feeds on fruit and large insects including cicadas and phasmids with other small fruited figs as their preferred food.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Barred cuckoo-shrike, with the following results:

1st order disturbances	Urban development Weed invasion Loss of habitat trees (fig trees) in agricultural land Intensive horticulture

The proposed development will not result in significant loss of nesting or forage habitat for this species. Retention of all main areas on vegetation along Monee and Skinners Creeks provide suitable forage habitat for this species with connectivity to similar habitat to the west, north and south.

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

5.2.4.3 Black-necked stork

Extent of the local population
The NPWS database contained thirteen (13) records of this species within 10 kilometres of the Study area.

The NPWS online database contained one (1) sighting of this species in the Moonee Beach Nature Reserve, and twenty-six (26) sightings in the Coffs Harbour LGA.

This species was recorded on the Subject site foraging near the dam in the preliminary study (JWA 2003).

Stages of the life-cycle affected by the proposed development
The Black-necked stork inhabits swamps, mangroves, mudflats, dry floodplains, and irrigated land. It occasionally forages in open grassy woodland (Environment Australia 1999). An abundant supply of frogs and fish is required, together with suitable roost and nest trees, usually overhanging rivers and swamps (SFNSW 1995). It strides through the water probing for prey with its bill and may chase fish. The nest is a large flat pile of sticks, grass and rushes in a tree, usually near water (NPWS 2002).

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. This analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Black-necked stork, with the following results:

1st order disturbances	Drainage of wetlands Dams

2nd order disturbances	Power lines Intensive horticulture (tea trees)
3rd order disturbances	Pesticide contamination of wetlands Urban development Loss of nest trees
4th order disturbances	Shooting

Some loss of foraging habitat (sedgelands) for this species will occur in the south of the site. There may be some increase in the level of disturbance to foraging birds as a result of increased visitation to the dam and associated wetland area. Forage habitat around the dam and drainage line will not be affected by the proposed development.

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

5.2.4.4 Brolga

Extent of the local population
The NPWS database contained two (2) records of this species within 10 kilometres of the Study area.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and two (2) sightings in the Coffs Harbour LGA.

A pair of Brolgas has been recorded using the site regularly (Mark Graham - Coffs Harbour City Council *pers. comm.* 2004).

Stages of the life-cycle affected by the proposed development
Brolgas occur in northern and eastern Australia, but are generally uncommon and localised in the east (NPWS 2002). The species occurs around shallow swamps and swamp margins, floodplains, grasslands and pastoral lands, usually in pairs or parties (NPWS 2002).

Brolgas forage in swampland habitats, feeding mainly on the tubers of sedges. They also take grain, molluscs and insects. Breeding occurs from September to December in the south and February to June in the north. Its nest is a platform of dry grasses or sedge, 1.5m in diameter, in or beside swampy grasslands (Readers Digest 1997).

NPWS (2002) state that threats to the species include:

- Drainage of swamps and other wetlands;
- Reduced water quality from saltation and pollution;
- Use of herbicides, insecticides etc. near water;
- Destruction of nests by grazing stock;
- Frequent burning of wetlands;
- Predation by feral animals and domestic dogs;
- Alteration of hydrology into wetlands; and
- Collision with powerlines near nest sites and wetlands.

Some loss of foraging habitat (sedgelands) for this species will occur in the south of the site. There may be some increase in the level of disturbance to foraging birds as a

result of increased visitation to the dam and associated wetland area. Forage habitat around the dam and drainage line will not be affected by the proposed development.

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

5.2.4.5 Brown treecreeper

Extent of the local population
The NPWS database contained one (1) record of this species within 10 kilometres of the Study area.

The NPWS online database contained one (1) sighting of this species in the Moonee Beach Nature Reserve, and two (2) sightings in the Coffs Harbour LGA.

Stages of the lifecycle affected by the proposed development
The Brown Treecreeper is a medium-sized insectivorous bird that occupies eucalypt woodlands, particularly open woodland lacking a dense understorey. It is sedentary and nests in tree hollows within permanent territories, breeding in pairs or communally in small groups. Birds forage on tree trunks and on the ground amongst leaf litter and on fallen logs for ants, beetles and larvae (NPWS 2002).

The NPWS Threatened Species Unit discusses the following threats for the Brown treecreeper:

- Clearance and the fragmentation of woodland habitat including removal of dead timber;
- Habitat degradation, including loss of hollow bearing trees, threatens Brown Treecreeper populations;
- Grazing by stock in woodland areas leads to a decrease in the diversity of ground-dwelling invertebrates decreasing the availability of food for the birds; and
- Brown Treecreepers are likely to be threatened by such factors as increased competition with aggressive honeyeater species and increased levels of nest predation that are a consequence of fragmentation of habitat.

The proposed development will not result in the loss of suitable habitat for this species.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.6 Brush-tailed phascogale

Extent of the local population
The NPWS database contained one (1) record of this species within 10 kilometres of the Study area.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and three (3) sightings in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east

region. The analysis identified breeding and sheltering sites for the Brush-tailed phascogale as consisting of nests in tree hollows. The Brush-tailed phascogale forages in a broad range of habitats, more common in dry sclerophyll forest and woodlands associated with flatter landscapes where foxes are scarce or absent.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Brush-tailed phascogale, with the following results:

1st order disturbances	Predation by cats Predation – fox Baiting for dingoes Clearing – loss of habitat
2nd order disturbances	Intensive horticulture - Clearing for tea tree horticulture

The proposed development will result in the loss of a small area of suitable habitat for this species, with the majority of suitable habitat on the site retained.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.7 Collared kingfisher

Extent of the local population
The NPWS database contained one (1) record of this species within 10 kilometres of the Study area.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and nine (9) sightings in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development
In NSW the Collared kingfisher is locally common in the Tweed River estuary where it breeds. It is rarely found south of this area. The 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 unlikely to result in the local extinction of this species.

5.2.4.8 Comb-crested jacana

Extent of the local population
The NPWS database contained seven (7) records of this species within 10 kilometres of the Study area.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and seven (7) sightings in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development
This species inhabits floating vegetation on the surface of slow-moving rivers and permanent lagoons, swamps and dams, and occurs from Sydney to the Kimberleys in coastal and sub-coastal environments.

Threats to the species include:

- Drainage of swamps, ponds, dams and other wetlands.
- Removal of surface aquatic vegetation from habitat areas.
- Reduced water quality affecting food availability.
- Use of herbicides, insecticides and other chemicals near wetlands.
- Introduced water weeds choking out native aquatic plants.

Wetland habitat around the dam area will not be directly affected by the proposed development. There may be some minor impacts associated with increased disturbance from visitors to the wetland habitat.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.9 Common blossom bat

Extent of the local population
The NPWS database contained four (4) records of this species within 10 kilometres of the Study area.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and eight (8) sightings in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding and sheltering sites for Common blossom bat as consisting of subtropical and littoral rainforest. This species breeds twice, in the coastal complex and riverine rainforest in spring and in the coastal complex in autumn. It needs a diverse array of nectivorous plant communities nearby. The Common blossom bat forages in a diverse range of nectar producing plant communities year round; occasionally eating some rainforest fruits.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Common blossom bat, with the following results:

1st order disturbances	Clearing – habitat loss Management burns, including illegal
2nd order disturbances	Clearing resulting in fragmentation, increasing predation and decreasing food availability Wildfire Apiary Weed invasion Drainage of swamps Sand mining
3rd order disturbances	Logging of coastal sclerophyll forests with Banksia understorey

	Aerial spraying of bitou bush
4th order disturbances	Sand dune disturbance from recreational 4WDs
5th order disturbances	Barbed wire fences Introduced predators

This species forages on nectar-producing plants in Paperbark and Eucalypt habitats and is likely to forage on the Subject site at times. The proposed development will contribute toward the loss and fragmentation of habitat for this species and will result in a minor reduction in the availability of forage resources, primarily eucalypts within grassland areas.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species

5.2.4.10 Glossy black cockatoo

Extent of the local population
The NPWS database contained thirty-seven (37) records of this species within 10 kilometres of the Study area.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and one hundred and eighteen (118) sightings in the Coffs Harbour LGA.

This species was recorded flying over the Subject site on several occasions; however no signs of forage activity were observed.

Stages of the life-cycle affected by the proposed development
Breeding sites for the Glossy black cockatoo consist of nests in large trees with large hollows (dead or alive) near streams and within 5-20km of a food source. The Glossy black cockatoo will shelter in stands of tall trees in elevated locations like ridgelines within range of the feeding resource. There is a relationship between roost sites and surface water sites (Environment Australia 1999; Forshaw 1981).

The Glossy black cockatoo usually forages close to the nest but is capable of travelling up to 20km away. It feeds on adult *Allocasuarina littoralis* and *A. torulosa* with individual trees believed to be selected on the basis of the nitrogen content of seeds. It will occasionally use alternative foods (Environment Australia 1999).

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Glossy black cockatoo, with the following results:

1st order disturbances	Clearing for agriculture Grazing and associated burning Urban development Logging that reduces age classes of eucalypts and *Allocasuarina*
3rd order disturbances	Cats climbing into nests Firewood collection

The proposed development will not result in the loss of areas of forest containing Forest oak. This species is present in low numbers on the site in the central vegetated area, and in a small stand adjacent to the dam.

Forest oak is a common species in dry sclerophyll forests in this part of the coast. Blackbutt Forest is the largest group in the Urunga Management Area of State Forests NSW. The group includes Forest Types 36 (moist Blackbutt) and 37 (dry Blackbutt). Approximately 70% of all sites in moist and dry locations within the Urunga Management Area have Forest oak as a dominant sub-canopy species (Tweedie *et al* 1995).

Nest sites for the Glossy black-cockatoo consist of hollows in the trunk, stump, spout or limb of eucalypts, living or dead (Higgins (Ed.) in press). The diameter of the hollow has been recorded as around 21 to 22.5cm (Higgins (Ed.) in press).

The proposed development will result in the loss of a small number of trees that occur within grassland areas that provide possible, albeit marginal, nest sites for this species. The loss of sub-mature eucalypts represents a decrease in the future recruitment of nest trees.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.11 Greater broad-nosed bat

Extent of the local population
The NPWS database contained one (1) record of this species within 10 kilometres of the Study area.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and one (1) sighting in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding and sheltering sites for the Greater broad-nosed bat as consisting of hollows in dry sclerophyll and moist eucalypt forests and alluvial red gum forest. The Greater broad-nosed bat forages on beetles and moths in dry sclerophyll and moist eucalypt forests and rainforest.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Greater broad-nosed bat, with the following results:

1st order disturbances	Clearing – habitat loss Logging – loss of hollows & old re-growth
3rd order disturbances	Clearing – fragmentation Logging – loss of understorey Frequent burning Grazing
4th order disturbances	Weed invasion Wildfire Altered hydrology/microclimate – old growth-re-growth Barbed wire
4th order disturbances	Weed invasion

	Wildfire Altered hydrology/microclimate – old growth-regrowth Barbed wire

The proposed development will result in the loss of eucalypts within grasslands on the site. These represent possible, but marginal roost sites for this species. The loss of sub-mature eucalypts represents a decrease in the future recruitment of roost trees.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.12 Grey-headed flying fox

Extent of the local population
The NPWS database contained thirty-one (31) records of this species within 10 kilometres of the Study area.

The NPWS online database contained three (3) sightings of this species in the Moonee Beach Nature Reserve, and fifty-six (56) sightings in the Coffs Harbour LGA. This species was recorded on the Subject site foraging in flowering Blackbutts.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding and sheltering sites for the Grey-headed flying fox as consisting of mainly rainforest and moist riparian forest with a complex mosaic of rainforest, swamp and sclerophyll forest resources less than 40-50km from roost. There is high site fidelity with roosts often in riverine rainforest. The Grey-headed flying fox forages in subtropical rainforest with a mosaic of resources – rainforest fruit, nectar and pollen. The Grey-headed flying fox is less restricted to rainforest remnants than the Black flying fox.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Grey-headed flying fox, with the following results:

1st order disturbances	Clearing – habitat loss
2nd order disturbances	Direct disturbance to camps Drainage of swamps
3rd order disturbances	Powerlines Logging of Sclerophyll Management burns Shooting
4th order disturbances	Clearing resulting in fragmentation Wildfire
5th order disturbances	Disease – lyssavirus Apiary Barbed wire fences Weed invasion
6th order disturbances	Climate change

The proposed development will result in the minor loss of suitable forage habitat for this species. Suitable roosting habitat does not occur on site.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.13 Koala

Extent of the local population
The NPWS database contained thirty-six (36) records of this species within 10 kilometres of the Study area.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and four hundred and ninety-two (492) sightings in the Coffs Harbour LGA.

Koala scats were found on the site in vegetation in the north of the site flanking Skinners Creek.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified feeding sites for Koalas in coastal forested environments (not woodland) as areas with stands with a high diversity of known food trees (three or more) including Tallowwood, Grey gum, Forest oak, Sydney blue gum, Swamp mahogany and Red gums. The Koala shelters in larger trees with big lateral branches (not necessarily food trees). The Koala disperses over any open habitat (including pasture and grassland) as long as scattered trees are present.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Koala, with the following results:

1st order disturbances	Habitat clearing
2nd order disturbances	Introduced predators – foxes and dogs
3rd order disturbances	Intensive logging that removes the critical tree size classes from the stand (may be frequent or single and intensive) Logging that fails to retain stems in the 30-80 DBH size class.
4th order disturbances	Wildfire
5th order disturbances	Road kills
6th order disturbances	Disease

Impacts on the Koala have been considered in Section 4. The proposed development will result in some minor loss and fragmentation of habitat for this species. The proposed development will also result in the loss of Secondary Koala habitat as mapped under the CHCC KPoM. Suitable habitat will be retained on the site, however there is the potential of injury or mortality from vehicle strike, or harassment by dogs. A number of amelioration measures have been proposed to satisfy the requirements of the CHCC Koala Plan of Management.

Likelihood of local extinction

With the adoption of amelioration measures discussed in Section 4, the proposed development is unlikely to result in the local extinction of this species.

5.2.4.14 Large-footed myotis

Extent of the local population

The NPWS online database did not contain any records of this species in Moonee Beach Nature Reserve, Ulidarra National Park or the Coffs Harbour Shire.

The Large-footed myotis was recorded in the Moonee Release Area by Clancy (1998) flora foraging over Cunningham's Creek to the west of the Subject site. The Large-footed myotis was also recorded by JWA (2003) at Lot 122 DP 105 2566 Moonee Beach Road, approximately 1 km south-east of the site.

The Large-footed myotis was recorded near the dam on the Subject site during this survey.

Stages of the life-cycle affected by the proposed development

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding and sheltering habitat for the Large-footed myotis as consisting of any forested riparian and adjacent vegetation around water bodies and coastal lakes and streams greater than first order streams. Breeding is in hollows, as well as under bridges and in caves. The Large-footed myotis forages in still water bodies with associated vegetation (tree line), and feeds on aquatic and other flying insects and small fish.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Large-footed myotis, with the following results:

1st order disturbances	Clearing – habitat loss (riparian vegetation) Clearing - fragmentation
2nd order disturbances	Use of chemicals Grazing Use of chemicals – mosquito control, pesticides
3rd order disturbances	Altered hydrology - sedimentation Altered hydrology - altered flow Bridge removal Eutrophication from grazing, agriculture and sewage Dams
4th order disturbances	Logging – loss of hollows Frequent burning
5th order disturbances	Recreational activities – fly fishing, boating Weeds
6th order disturbances	Fish (trout)

The proposed development is highly unlikely to affect forage habitat or decrease the foraging efficiency of Large-footed myotis occurring in the area.

There are no known roost sites (caves, tunnels) for the Large-footed myotis in the Study area. However the species has been known to roost in tree hollows close to

water. Loss of scattered eucalypts within grasslands on the site is not considered likely to impact upon roost habitat for this species.

It is unlikely that the local population of Large-footed myotis is dependent upon tree hollows within the development area for its continued survival. It is likely that the extent of the local population of Large-footed myotis has been underestimated due to the lack of targeted survey in the locality.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.15 Little bent-wing bat

Extent of the local population
The NPWS database contained three (3) records of this species within 10 kilometres of the Study area.

The NPWS online database contained one (1) sighting of this species in the Moonee Beach Nature Reserve, and ten (10) sightings in the Coffs Harbour LGA.

The Little bent-wing bat was recorded on the Subject site.
Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding sites for Little bent-wing bat as consisting of limestone caves, where it usually occurs in association with the Common bent-wing bat. It congregates in high numbers in maternity roost (in 1000's). It also shelters in a range of artificial structures including culverts, drains, mines etc. The Little bent-wing bat forages on flying insects in forested areas, predominantly swamp forest, moist eucalypt forest, rainforest and some dry forests.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Little bent-wing bat, with the following results:

1st order disturbances	Clearing – habitat loss
2nd order disturbances	Disturbance to camps/caves by limestone mining (cave collapse, altered air flow, noise, dust etc) and recreational activities.
3rd order disturbances	Clearing – fragmentation Logging – loss of foraging habitat Frequent burning Altered hydrology/microclimate – old growth-regrowth
4th order disturbances	Grazing Wildfire Pesticides
5th order disturbances	Introduced predators

This species forages in a variety of habitats and is likely to forage in the Study area at times. The proposed development will contribute toward the loss and fragmentation of habitat for this species and will result in a minor reduction in the availability of forage resources. Roosting habitat will not be affected.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.16 Masked owl

Extent of the local population
The NPWS database contained two (2) records of this species within 10 kilometres of the Study area.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and six (6) sightings in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development
The Masked owl feeds in sclerophyll forest with sparse, open understorey, particularly in the ecotone between wet and dry forest and non-forest habitat. It feeds on medium and small terrestrial mammals, some arboreal mammals and birds (Environment Australia 1999; Kavanagh & Murray 1996). Studies by Kavanagh & Murray (1996) suggest that the Masked owl may forage over a large area (1,000ha) containing a mosaic or relatively undisturbed and disturbed environments.

Nesting occurs at any time of year in deep hollows (usually vertical) in large, live trees (tall Eucalypts are favoured) or ledges in caves (Environment Australia 1999; Debus 1993). This owl shelters in hollows and in densely foliaged native and exotic understorey trees.

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Masked owl, with the following results:

1st order disturbances	Clearing for agriculture
2nd order disturbances	Logging which increases structural density of forest which effects mid to ground layer and thus affects manoeuvrability
3rd order disturbances	Fire – high frequency
4th order disturbances	Clearing for urban development
5th order disturbances	Road-kills
6th order disturbances	Nest and roost site disturbance

This species forages over a wide area and may forage over the Study area at times. The proposed development will contribute toward the loss and fragmentation of habitat for this species and will result in some reduction in the availability of prey.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.17 Osprey

Extent of the local population
The NPWS database contained thirty-six (36) records of this species within 10 kilometres of the Study area.

The NPWS online database contained five (5) sightings of this species in the Moonee Beach Nature Reserve, and ninety (90) sightings in the Coffs Harbour LGA.
An active Osprey nest occurs on the northern boundary of the adjacent Lot 7, approximately 20 metres south of the subject site. Ospreys are also known to nest to the south of Moonee township (Draft Moonee DCP, 2003).

Ospreys were recorded within the nest tree, and flying over the Subject site to forage over Moonee Creek.

Stages of the life-cycle affected by the proposed development
Ospreys forage for fish in fresh, brackish or saline waters of rivers, lakes, estuaries and inshore coastal waters (NPWS 2002; Marchant and Higgins 1993). 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 (NPWS 2002).

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The RFA analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Osprey, with the following results:

1st order disturbances	Drainage of wetlands Chemical pollutants Urban development Loss of nest sites Commercial fishing (removal of prey, especially mullet)

Potential impacts on the Osprey are considered in Section 4 of this report. The Osprey nest in the adjacent property to the south is currently being utilised, while the nest site recorded in the south-east of the Subject site appears to have collapsed. A 50 metre buffer has been allowed for the nest site south of the site, and while there may be some disturbance to Ospreys during the construction period, this species is unlikely to be significantly affected by the proposed development.

Likelihood of local extinction
The proposed development has the potential to result in the disturbance of the current nest site by the resident pair of Ospreys. The proposed development is unlikely to result in the local extinction of this species.

5.2.4.18 Pied oystercatcher

Extent of the local population
The NPWS database contained eleven (11) records of this species within 10 kilometres of the Study area.

The NPWS online database contained two (2) sightings of this species in the Moonee Beach Nature Reserve, and forty-four (44) sightings in the Coffs Harbour LGA.

Pied oystercatchers have been observed foraging in the Moonee Creek Estuary (Clancy 1998).

Stages of the life-cycle affected by the proposed development
The Pied oystercatcher favours open beaches, intertidal flats and sandbanks and occasionally rocky headlands. They forage on exposed sand, mud or coral at low tide for molluscs, worms, crabs and small fish, using their strong straight bills to open bivalves and dismember crabs and other crustaceans (NPWS 2002).

Pied oystercatchers nest mostly on coastal or estuarine beaches although occasionally they use saltmarsh or grassy areas. Their nests are shallow scrapes in the sand above the high tide mark or among low growth behind the beach. The two to three eggs are stone-grey spotted black-brown, and laid between August and January (NPWS 2002).

The NPWS Threatened Species Unit (NPWS 2002) discusses the following threats for the Pied oystercatcher:

- Human disturbance and damage to feeding, nesting and roosting areas;
- Destruction of nests and chicks by vehicles, horses and dogs and people on foot;
- Predation by foxes, feral and domestic dogs and cats; and
- Pollution of estuaries and coastal areas.

Impacts on the Pied oystercatcher are likely to be minor and consist of: decreased foraging efficiency due to disturbance associated with increased human visitation to Moonee Creek and the coastal foreshore; potential for increased predation/disturbance from domestic dogs; potential for loss of nests, chick and eggs from pedestrian traffic and dogs.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.19 Powerful owl

Extent of the local population
The NPWS database contained four (4) records of this species within 10 kilometres of the Study area.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and eleven (11) sightings in the Coffs Harbour LGA. There are also two (2) records from Ulidarra National Park.

Stages of the life-cycle affected by the proposed development
Powerful owls have large home ranges (more than 1,000 hectares) and occupy a variety of vegetation types, from woodland and open forest to tall moist forest and rain forest (NPWS 2002). Powerful owls prefer gullies of coastal forests below 1,500m where prey densities are often highest and preferred roost trees are common (Debus & Chafer 1994).

Powerful owls are nocturnal carnivores, specialising in the predation of moderate to large arboreal mammals such as possums and gliders. Birds and Flying foxes are also taken (NPWS 2002; Kavanagh 1988). To survive, a Powerful owl needs to eat the equivalent of a large possum every two or three days (NPWS 2002).

Breeding sites for the Powerful owl consist of hollows (branch and trunk) in large, live, old trees in areas with a high density of arboreal mammals. Nests tend to be in drainage lines (including minor ones), sometimes well upslope (Environment Australia 1999). There are often dense thickets to protect breeding sites. Sheltering occurs in

tall thickets where available, near drainage lines, in rainforest vegetation near waterfalls and on rock ledges. Juveniles can occur in patches of tall, dense shrubs (Environment Australia 1999; Debus & Chafer 1994).

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Powerful owl, with the following results:

1st order disturbances	Logging which reduces the availability of arboreal mammals for prey.
2nd order disturbances	Fire which reduces prey
3rd order disturbances	Nest and roost site disturbance by logging and recreational bird watching
4th order disturbances	Habitat clearing
5th order disturbances	Habitat fragmentation
6th order disturbances	Introduced predators – dog and fox predation on juveniles
7th order disturbances	Road kills on adults
8th order disturbances	Cultivation for agriculture (juveniles)

This species forages over a wide area and may forage over the Study area at times. The proposed development will contribute toward some loss and fragmentation of habitat for this species and will result in some reduction in the availability of prey.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.20 Regent honeyeater

Extent of the local population
The NPWS database contained three (3) records of this species within 10 kilometres of the Study area.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and seven (7) sightings in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding and sheltering sites for Regent honeyeater as consisting of Ironbark and Spotted gum forest, Whitebox and yellowbox riparian habitats with predominance of Casuarina. They tend to breed close to nectar sources (food) trees. The trees used for nectar tend to be older since they have better nectar flows. The Regent honeyeater forages in nectar trees of coastal banksia, melaleucas, winter flowering eucalypts, coastal heath and mistletoes on She-oaks and eucalypts.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Regent honeyeater, with the following results:

1st order disturbances	Clearing for agriculture
2nd order disturbances	Urban development
3rd order disturbances	Firewood collection

	Logging that reduces age classes Decreased nectar
4th order disturbances	Changes fire regimes Native predators
5th order disturbances	Grazing Apiary

The proposed development will result in some loss of eucalypts within grasslands on the Subject site. The majority of eucalypt forest on the site will be retained.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.21 Square-tailed kite

Extent of the local population
The NPWS database contained one (1) record of this species within 10 kilometres of the Study area.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and six (6) sightings in the Coffs Harbour LGA.

Stages of the life-cycle affected by the proposed development
Square-tailed kites are uncommon yet widespread. They inhabit dry woodland and open forest mainly in coastal or subcoastal districts, preferring vegetation along major rivers and belts of trees in urban or semi-urban areas for hunting (NPWS 2002; Marchant & Higgins 1993).

Breeding sites for the Square-tailed kite as consist of nests in tall trees with large branches in tall, open sclerophyll forest and woodland with or adjacent to areas of high densities of passerine birds (Environment Australia 1999). The Square-tailed kite forages on a high density of passerine birds, particularly honeyeaters. It will occasionally take lorikeets, quail, pipits as well as fledglings and nestlings, lizards and insects (Environment Australia 1999; Marchant & Higgins 1993).

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Square-tailed kite, with the following results:

1st order disturbances	Clearing for agriculture
2nd order disturbances	Grazing and associated burning Logging which increases the structural density through reducing age classes, decreased nectar production Intensive horticulture Nest site loss
3rd order disturbances	Urban development
4th order disturbances	Egg collecting

This species forages over a wide area and is likely to forage over the Study area at times. The proposed development will contribute toward some loss and fragmentation of habitat for this species and will result in some reduction in the availability of prey.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.22 Squirrel glider

Extent of the local population
The NPWS database contained three (3) records of this species within 10 kilometres of the Study area.

The NPWS online database contained one (1) sighting of this species in the Moonee Beach Nature Reserve, and eight (8) sightings in the Coffs Harbour LGA.

This species was recorded on the eastern margins and within scattered trees within grasslands on the Subject site.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis identified breeding sites for Squirrel glider as tree hollows with a preference for small hollow entrances. A single study found that densities declined linearly when the abundance of trees with hollows fell below 6/ha (Smith, 1998). The preferred feeding habitat contains winter flowering eucalypts or banksias including Swamp mahogany, Spotted gum, Coast banksia and Swamp paperbark. Probable association with larger trees with high nectar flows. The Squirrel glider shelters in hollow bearing trees.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Squirrel glider, with the following results:

1st order disturbances	Habitat clearing
2nd order disturbances	High frequency burning
3rd order disturbances	Intensive logging that removes the critical tree size classes from the stand (may be frequent or single and intensive). Removal of large trees and hollows, includes firewood collection
4th order disturbances	Apiary – competition for hollows
5th order disturbances	Introduced predator – foxes, dogs and cats

The proposed development will result in the loss of eucalypts occurring within grasslands on the Subject site, and the subsequent fragmentation of habitat for this species. There will be some loss of habitat containing a relatively low density of tree hollows, along with the loss of three (3) hollow-bearing trees. The future recruitment of tree hollows will also be effected as a result of the loss of sub-mature eucalypts on the Subject site. Mature forest on the site with a greater density of tree hollows will not be affected.

Likelihood of local extinction

With the adoption of amelioration measures recommended in Section 4, the proposed development is unlikely to result in the local extinction of this species.

5.2.4.23 Stephen's banded snake

Extent of the local population

The NPWS database contained seven (7) records of this species within 10 kilometres of the Study area.

The NPWS online database contained no sightings of this species in the Moonee Beach Nature Reserve, and ten (10) sightings in the Coffs Harbour LGA.

Clancy (1998) notes that the Stephen's banded snake has been recorded on several occasions in an area about 2-3km south-west of the Subject site.

Stages of the life-cycle affected by the proposed development

Stephen's banded snake inhabits dry and moist hardwood forest and rainforest in coastal and near coastal areas from southern Queensland to Gosford in New South Wales (NPWS 2002; Cogger 1996; Wilson and Knowles 1988). Key elements of the preferred habitat for this species are a dense understorey and canopy structure which are required for foraging and movement (Ehmann 1992).

Identified breeding and sheltering sites for Stephens' banded snake as consisting of nests in stags, strangler figs, creepers and vines, hollow bearing trees, decorticating bark, stumps, rock crevices and slabs and arboreal termitaria (Environment Australia 1999).

Prey items consist of small mammals (including bats) and frogs and lizards in riparian vegetation and water (frogs).

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Stephens' banded snake, with the following results:

1st order disturbances	Any fire Grazing and associated burning changes the structure of understorey and ground cover
2nd order disturbances	Predation by introduced species Clearing for urban development Logging –changing canopy structure Road-kills
3rd order disturbances	Clearing for agriculture Clearing – partial for grazing Weed invasion

The proposed development will not result in the loss of appropriate habitat for this species. However, any local population may be affected by predation from dogs and cats. The proposed development may result in a reduction in the prey base of this species due to a decrease in the diversity and abundance of prey species associated with fragmentation and loss of habitat.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.24 Swift parrot

Extent of the local population
The NPWS database search contained seven (7) records of this species within 10kms. There are no recorded sightings of this species in the Moonee Beach Nature Reserve, however eighteen (18) sightings have been recorded in the Coffs Harbour LGA. In 1997 groups of Swift parrots, numbering up to 30 birds were seen in the Moonee Beach Caravan Park from April/May to September (Clancy 1998).

The most recent NPWS database record is from 1992. This species may occur in the Study area as an infrequent visitor.

Stages of the lifecycle affected by the proposed development
This species breeds only in eastern and northern Tasmania. Dispersal of the species to the mainland during non-breeding periods is reliant on seasonal availability of nectar resources along latitudinal and elevational range from coast to slopes (Environment Australia 1999; Garnett 1992).

The Swift parrot forages in winter flowering eucalypts such as Swamp mahogany (*Eucalyptus robusta*), Spotted gum (*Corymbia maculata*) and Red bloodwood (*C. gummifera*), as well as coastal banksias (NPWS 2002; Garnett 1992). They also feed on lerps and honeydew secretions as secondary food sources and may resort to other foods such as fruit (Environment Australia 1999). The Swift parrot is becoming increasingly reliant on small remnant patches of mature eucalypts in agricultural areas (NPWS 2002).

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Swift parrot, with the following results:

1st order disturbances	Clearing for agriculture
2nd order disturbances	Urban development Grazing and associated burning Logging that reduces size class of trees Firewood collection
3rd order disturbances	Mining coastal sands Intensive horticulture

The proposed development will result in the loss of some suitable forage habitat for this species. Mature eucalypt forest on the Subject site offering superior forage habitat will be retained.

Likelihood of local extinction
The proposed development is unlikely to result in the local extinction of this species.

5.2.4.25 Wallum froglet*

A 7 part test for the Wallum froglet has been completed separately as part of the detailed Wallum froglet report in **APPENDIX 3**.

5.2.4.26 Yellow-bellied glider

Extent of the local population
The NPWS database contained four (4) records of this species within 10 kilometres of the Study area.

The NPWS online database contained twenty-one (21) sightings of this species in the Coffs Harbour LGA.

Clancy (1998) also notes that the Yellow bellied glider has been recorded in the north-west corner of the Subject site.

Stages of the life-cycle affected by the proposed development
As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and identified breeding and sheltering sites for Yellow-bellied gliders as consisting of large hollow trees. It requires trees within gliding distance (on flat ground in tall forest >40m). In steep forest, glides may be much longer (up to 300m). Trees may be quite scattered. The Yellow-bellied glider forages in mature forests with high eucalypt species diversity, winter flowering eucalypts, smooth-barked eucalypts, and sap trees. Larger trees have higher nectar/sap yields.

The RFA analysis (Environment Australia 1999) ranked the significance of various forms of disturbance for the Yellow-bellied glider, with the following results:

1st order disturbances	Intensive logging that removes the critical tree size classes from the stand (may be frequent or single and intensive). Logging that fails to retain a high proportion of large trees and hollows.
2nd order disturbances	Habitat clearing
3rd order disturbances	High frequency burning

The proposed development will result in the loss of some foraging resources for this species. One (1) tree containing a hollow considered to be suitable for denning by this species will be removed. Retained mature eucalypt forest along Moonee and Skinners Creeks contains common feed tree species utilised by the Yellow-bellied glider (e.g. Pink bloodwood, Blackbutt etc.) and a high proportion of trees with hollows. Retained vegetation has connectivity to similar vegetation to the north, west and south of the site, which will maintain dispersal opportunities for any Yellow-bellied gliders occurring in the locality.

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

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

Thirty-three (33) endangered populations have been identified under the *TSC Act*. The following endangered populations occur in north-eastern NSW:

- Emu population in the NSW North Coast Bioregion and Port Stephens LGA;
- Long-nosed potoroo population, Cobaki Lakes and Tweed Heads West;
- Low growing form of *Zieria smithii*, Diggers Head; and
- *Glycine clandestina* (Broad-leaf form) in the Nambucca LGA.

The proposed development will not affect any of these endangered populations.

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

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

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

Not Applicable.

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

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

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

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

The Subject site is considered to provide potential habitat for the Threatened species mentioned above. For the majority of these species however, all suitable habitats on the Subject site will be retained. Threatened species with potential habitat within the proposed development area are:

- Brolga
- Black-necked stork
- Brush-tailed phascogale
- Common blossom bat
- Glossy black-cockatoo
- Greater broad-nosed bat
- Grey-headed flying fox
- Koala
- Squirrel glider
- Wallum froglet*

- Yellow-bellied glider

The loss of some areas of periodically inundated grassland and sedgeland from the site represents a minor reduction in forage area for the Brolga and Black-necked stork in the locality. These species are highly mobile and more suitable habitat is likely to occur within the locality. The removal of this sedgeland also represents a decrease in potential Wallum froglet habitat on the site. An assessment of potential habitat removal for this species has been completed separately as part of the detailed Wallum froglet report in **APPENDIX 3**.

No hollow-bearing trees will be removed which represent potential den sites for the Yellow-bellied glider, or nest sites for the Glossy black-cockatoo, while three (3) hollow-bearing trees which comprise suitable roost/den habitat for the Greater broad-nosed bat and Squirrel glider will be removed from within the development area.

Mature forest to be retained on the Subject site comprises a much higher density of tree hollows than trees within grassland to be removed from the site. These habitat trees to be retained are considered more suitable as den/nest trees and are more likely to be occupied by these Threatened species should they occur on the site.

Forage habitat for the Common blossom bat may be slightly reduced by the removal of Paperbarks and other flowering species from the development area. However, large areas of more suitable forage habitat will be retained.

The removal of thirty-three (33) preferred Koala feed trees from the development area represents a reduction in forage resources for the Koala on the Subject site, however, more suitable forage habitat will be retained on the Subject site. It is further recommended that Koala trees be replanted in the north-west corner of the site to consolidate Koala habitat.

Whilst the proposed development may reduce opportunities for dispersal across some areas of the site, it is worth noting that vegetation within the proposed development area currently consists of scattered trees within grassland, and provides dispersal opportunities for disturbance adapted species only. The retention of intact forest communities on the Subject site will ensure that dispersal opportunities will persist for fauna species on the Subject site.

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

Critical habitat areas listed under the *Threatened Species Conservation Act (2002)* currently consist of habitat for Mitchell's rainforest snail in Stott's Island Nature Reserve, and habitat for the Little penguin population in Sydney's North Harbour.

Neither of these critical habitats will be adversely affected.

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

An Approved recovery plan exists for the Yellow-bellied glider which is considered a possible occurrence on the Subject site. The objectives of this recovery plan are:

- Co-ordinate the recovery of the Yellow-bellied glider in NSW

- Encourage and assist in improving the protection and management of the Yellow-bellied glider and its habitat.
- Identify and monitor significant populations of this species.
- Facilitate strategic research into the ecology of the Yellow-bellied glider that is relevant to its conservation.
- Increase community awareness of the Yellow-bellied glider and encourage community involvement in its conservation.

The Yellow-bellied glider has previously been recorded from the Subject site (Clancy 1998), but was not recorded during this assessment. However, it is considered that this species may occasionally forage over the Study area. No den sites or feeding scars (sap trees) were located at the Subject site. It is considered that the proposed development is consistent with the objectives and actions of the Recovery Plan for the Yellow-bellied glider.

A Draft recovery plan exists for the Koala which is considered a possible occurrence on the Subject site. The objectives of this recovery plan are:

- To conserve Koalas in their existing habitat;
- To rehabilitate and restore Koala habitat and populations;
- To develop a better understanding of the conservation biology of Koalas;
- To ensure that the community has access to factual information about the distribution, conservation and management of Koalas at a national, state and local level;
- To manage captive, sick or injured Koalas and orphaned wild Koalas to ensure consistent and high standards of care; and
- To manage over-browsing to prevent both Koala starvation and ecosystem damage in discreet patches of habitat.

The proposed development will result in some minor loss and fragmentation of habitat for this species. The proposed development will also result in the loss of Secondary Koala habitat as mapped under the CHCC KPoM. Suitable habitat will be retained on the site, however there is the potential of injury or mortality from vehicle strike, or harassment by dogs. A number of amelioration measures have been proposed to satisfy the requirements of the CHCC Koala Plan of Management. It is considered that the proposed development is consistent with the objectives and actions of the Recovery Plan for the Koala.

A Draft recovery plan exists for the large forest owls (Powerful owl, Masked owl & Sooty owl) of which the Powerful owl is considered possible occurrences on the Subject site. The objectives of this recovery plan are to:

- To minimise further loss and fragmentation of habitat outside conservation reserves and State Forests by protection and fragmentation of significant owl habitat (including protection of individual nest sites).
- To minimise the impacts of development activities on large forest owls and their habitat outside conservation reserves and State forests.
- To assess the distribution and amount of high quality habitat for each owl species across public and private lands to get an estimate of the number and proportion of occupied territories of each species that are, and are not protected.

- To monitor trends in population parameters (numbers, distribution, territory fidelity and breeding success) across the range of the three species and across different land tenures and disturbance histories.
- To assess the implementation and effectiveness of forest management prescriptions designed to mitigate the impact of timber-harvesting operations on the three owl species and, (if necessary), to use this information to refine the prescriptions so that forestry activities on State forests are not resulting in adverse changes in species abundance and breeding success.
- To improve the recovery and management of the three large forest owls based on an improved understanding of key areas of their biology and recovery.
- To raise awareness of the conservation requirements of the three large forest owls among the broader community, to involve the community in owl conservation efforts and in so doing increase the information base about owl habitats and biology.
- To coordinate the implementation of the recovery plan and continually seek to integrate actions in this plan with actions in other recovery plans or conservation initiatives.

Neither the Powerful owl, Masked owl, nor the Sooty owl were recorded from the Subject site however it is considered that the Powerful owl may occasionally forage over the Study area. No nest sites were located at the Subject site. It is considered that the proposed development is consistent with the objectives of the Recovery Plan for the large forest owls.

Two Approved Threat abatement plans have been completed:

- Predation by the Plague Minnow
- Predation by the Red fox

The Plague Minnow has little relevance to the terrestrial fauna considered in this assessment. The occurrence of the Red fox constitutes a threat to ground nesting birds and ground dwelling mammals. No ground dwelling Threatened species were recorded on the site.

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

A "threatening process" means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of a species, population or ecological community. Key Threatening Processes have been listed in Schedule 3 of the *TSC Act (1995).*

Key Threatening Processes (Schedule 3):

- Invasion and establishment of exotic vines and scramblers;
- Invasion and establishment of the Cane toad, *Bufo marinus*;
- Invasion of the yellow crazy ant;
- Feral pigs;
- Competition and habitat destruction by feral goats;
- Entanglement in, or digestion of anthropogenic debris in marine and estuarine environments;
- Introduction of the large earth Bumble bee, *Bombus terrestris*;

- Removal of dead wood and dead trees;
- Death or injury to marine species following capture in shark control programs on ocean beaches;
- Invasion of native plant communities by exotic perennial grasses;
- Infection of frogs by amphibian chytrid, causing the disease chytrodiomycosis
- Competition from feral honeybees;
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;
- Clearing of native vegetation;
- Anthropogenic climate change;
- Removal of Bush rock;
- High frequency fire;
- Invasion by Bitou Bush (*Chrysanthemoides monilifera*);
- Loss and/or degradation of sites used for hilltopping by butterflies;
- Predation by the European red fox (*Vulpes vulpes*);
- Predation by the Feral cat (*Felis catus*);
- Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island;
- Predation by the Plague Minnow (*Gambusia holbrooki*);
- Infection of native plants by *Phytophthora cinnamomi;*
- Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations;
- Importation of red imported fire ants into NSW; and
- Competition and grazing by the feral European rabbit.

The proposed development will contribute towards the clearing of native vegetation, a key threatening process listed on Schedule 3 of the *TSC Act (1995)*. The final determination of the NSW Scientific Committee notes that clearing of native vegetation is recognised as a major factor contributing to loss of biological diversity, with impacts such as: destruction of habitat; fragmentation of habitat; riparian zone degradation; increased greenhouse gas emissions; increased habitat for invasive species; loss of leaf litter layer; loss or disruption of ecological function (*e.g.* loss of populations of pollinators or seed dispersers) and changes to soil biota.

The amount of native vegetation to be cleared is discussed in Section 4. In total approximately 54 hectares of vegetation will be lost from the Subject site, the majority of which consists of grassland with some scattered trees. Amelioration measures have been recommended to minimise the loss of native vegetation on the Subject site.

The Proposed development will not increase the impact of any other key threatening processes.

On the basis of this assessment, it is considered that a Species Impact Statement (SIS) is not required.

5.3 Koala Habitat Assessment

A Comprehensive Koala Plan of Management (KPoM) was prepared by the NSW NPWS in close consultation with Coffs Harbour City Council (CHCC) under the statutory provisions of SEPP 44 – Koala Habitat Protection. The adoption of the KPoM replaces the requirement under SEPP 44 for developments in Coffs Harbour LGA to address Koala issues individually and sets out a framework for conserving Koalas in Coffs Harbour LGA (Lunney *et al* 1999). The adoption of the KPoM does not negate the responsibility of Council or a proponent considering undertaking a development requiring Council consent to fully consider whether such an activity is likely to result in a significant effect on a threatened species, population or ecological community or their habitat.

The northern half of the Subject site, the eastern boundary flanking Moonee Creek, and a small area on the southern boundary, have been classified as Secondary Koala Habitat under the Coffs Harbour KPoM (**FIGURE 13**). The Koala habitat on the site generally corresponds to vegetation mapped as Open and Closed Dry sclerophyll forest.

Secondary Koala Habitat includes areas that generally have lower koala activity levels than those in primary habitat, but do support many koala populations particularly away from coastal areas. The KPoM notes that secondary habitat is important to dispersing and juvenile koalas, provides seasonal and drought foraging habitat and may act as fire refuges. The aim of the Coffs Harbour Koala Plan of Management (KPoM) in relation to Secondary Habitat is:

"To minimise further loss, fragmentation or isolation of existing secondary koala habitat and the creation of barriers to koala movement and, where appropriate, to encourage restoration of koala habitat."

The consent authority shall not grant consent to the carrying out of development in areas identified as Secondary Koala Habitat unless it is satisfied that:

- the proposal will not result in significant barriers to koala movement;
- boundary fencing does not prevent the free movement of koalas;
- lighting and koala exclusion fencing is provided where appropriate on roadways adjacent to koala habitat;
- tree species listed above under Secondary Koala Habitat are retained, where possible;
- new local roads are designed to reduce traffic speed to 40 kph in potential koala blackspots;
- preferred koala trees are used in landscaping where suitable;
- threats to koalas by dogs have been minimised i.e. banning of dogs or confining of dogs to koala proof yards;
- fire protection zones, including fuel reduced zones and radiation zones, are provided generally outside of Secondary Koala Habitat.

In addition, Koala habitat trees identified in the Coffs Harbour CKPOM are protected under the local Tree Preservation Order. Any of these trees required to be removed for development must be replaced in the vicinity according to the "*Guidelines for Planting Koala Trees In Coffs Harbour LGA*" contained in the Coffs Harbour CKPOM.

Impacts on Koalas have been discussed in Section 4 of this report. Amelioration measures have been recommended to satisfy the requirements of the Coffs Harbour KPoM.

5.4 Commonwealth Environment Protection and Biodiversity Conservation Act (1999)

5.4.1 Introduction

The *Environment Protection & Biodiversity Conservation (EPBC) Act (1999)* was passed by Commonwealth Parliament in June 1999 and came into force on 16 July, 2000. A person must not, without an approval under the Act, take an action that has or will have, or is likely to have, a significant impact on a matter of National Environmental Significance (NES). These matters are listed as:

(a) the world heritage values of a declared World Heritage property,
(b) the ecological character of a declared Ramsar wetland,
(c) a threatened species or endangered community listed under the Act,
(d) a migratory species listed under the Act, or
(e) the environment in a Commonwealth marine area or on Commonwealth land.

The Act also prohibits the taking, without an approval under the Act, of:

(a) a nuclear action, or
(b) an action in a Commonwealth marine area or on Commonwealth land, that has or will have, or is likely to have, a significant impact on the environment.

An action includes a project, development, undertaking or an activity or series of activities. An action does not require approval if it is a lawful continuation of a use of land, sea or seabed that was occurring before the commencement of the Act. An enlargement, expansion or intensification of a use is not a continuation of a use.

The *EPBC Act (1999)* does not require Commonwealth approval for the rezoning of land. It does, however, suggest that when rezoning land, planning authorities should consider whether to allow actions that could significantly affect NES matters or the environment of Commonwealth land.

Matters of NES in NSW are:

(a) Declared World Heritage Areas;
(b) Declared Ramsar Wetlands;
(c) Listed Threatened Species (Schedule 1 and 2 of *Commonwealth Endangered Species Protection Act 1992*);
(d) Listed Ecological Communities in NSW;
(e) Listed migratory species (JAMBA and CAMBA).

5.4.2 Subject Site Assessment

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.

5.4.3 Listed Threatened species

A number of species listed as threatened in the *Commonwealth Endangered Species Protection Act (1992)* are known from the wider locality, these are:

Flora

Botanical Name	Common Name
Boronia umbellata	
Cynanchum elegans	White-flowered wax plant
Marsdenia longiloba	Clear milkvine
Parsonia dorrigoensis	Milky silkpod
Persicaria elatior	Knotweed
Phaius australis	Lesser swamp-orchid
Quassia sp. Mooney Creek	Moonee quassia
Thesium australe	Austral toadflax
Tylophora woollsii	
Zieria prostrata	

Fauna *

Scientific name	Common name
Chalinolobus dwyeri	Large-eared pied-bat
Dasyurus maculatus	Eastern spotted-tailed quoll
Diomedea amsterdamensis	Amsterdam albatross
Diomedea antipodensis	Antipodean albatross
Diomedea dabbenena	Tristan albatross
Diomedea exulans	Wandering albatross
Diomedea gibsoni	Gibson's albatross
Emydura signata	Bellinger River emydura
Lathamus discolor	Swift parrot
Litoria aurea	Green and golden bell frog
Litoria olongburensis	Wallum sedge frog
Macronectes giganteus	Southern giant petrel
Macronectes halli	Northern giant petrel
Mixophyes balbus	Stuttering frog
Mixophyes iteratus	Southern barred frog
Petrogale penicillata	Brush-tailed rock-wallaby
Phyllodes imperialis (southern subsp. - ANIC 3333)	Imperial moth
Potorous tridactylus	Long-nosed potoroo
Pterodroma leucoptera leucoptera	Gould's petrel
Pterodroma neglecta neglecta	Kermadec petrel
Pteropus poliocephalus	Grey-headed Flying-fox
Rostratula benghalensis	Australian painted snipe
Thalassarche bulleri	Buller's albatross
Thalassarche cauta	Shy albatross
Thalassarche impavida	Campbell albatross
Thalassarche melanophris	Black-browed albatross
Thalassarche steadi	White-capped albatross
Turnix melanogaster	Black-breasted button quail
Xanthomyza Phrygia	Regent honeyeater

* Marine species (ie. whales, turtles and sharks) have not been included

No Commonwealth Threatened flora species were recorded on the Subject site.

Two Commonwealth Threatened fauna species, the Swift parrot and the Grey-headed Flying-fox, are considered possible occurrences at the site.

If the proposed development is deemed to have a significant impact on any of these species, Commonwealth approval will be required.

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

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

The Endangered Swift parrot is considered a possible but unlikely occurrence in the Study area. It is considered that the proposed development is unlikely to have a significant impact on this species, due to the retention of foraging habitat along Moonee and Skinners Creeks.

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

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

An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

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

It is considered that Proposed development will not result in any such impacts on the Vulnerable Grey-headed flying-fox, due to the retention of foraging habitat along Moonee and Skinners Creeks. This species forages widely and is likely to utilise a large area of forage habitat within the locality.

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

5.4.4 Listed Ecological Communities in NSW

None of the ecological communities currently listed in the *EPBC Act (1999)* occur in the study area or wider locality.

5.4.5 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) Commonwealth listed migratory species, the White-bellied sea eagle was recorded on the site.

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

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

(* Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a migratory species by direct competition, modification of habitat, or predation.)

An area of important habitat is:

1. habitat utilised by a migratory species occasionally or periodically within a region that supports an *ecologically significant proportion* of the population of the species, or
2. habitat utilised by a migratory species which is at the limit of the species range, or
3. habitat within an area where the species is declining.

It is considered that although a number of listed migratory species are known or likely to occur occasionally in the Study area, no area of important habitat occurs in the Study area for listed migratory species.

5.4.6 Requirement for Commonwealth Assessment

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

6 SUMMARY AND CONCLUSIONS

James Warren and Associates have been engaged by The Rothwell boys to complete a Flora and Fauna Assessment for Lots 1 & 2 DP 725785 Pacific Highway, Moonee.

The assessment has involved the following:

- Mapping and ground truthing vegetation units and determining their conservation status.
- Searching for and recording Threatened and regionally significant plant species.
- Determining the suite of Threatened fauna that occurs in the locality.
- Completion of a detailed fauna survey program.
- Assessing habitat provided by the site in relation to adjacent habitat and making an assessment of the corridor value of the site.
- Addressing statutory requirements including *State Environmental Planning Policy No. 44 (SEPP 44 – Koala Habitat Protection)*, Section 5A of the *Environmental Planning & Assessment Act (1979)* and the *Commonwealth EPBC Act (1999)*.

The Subject site consists of Lots 1 & 2 in DP 725785, Pacific Highway, Moonee. The site covers an area of approximately 96 hectares with much of the site cleared and used for grazing cattle. Open areas of grassland and slashed heath dominate the site with scattered trees throughout. Denser areas of vegetation occur in association with Skinners and Moonee Creeks that flow along the northern and eastern boundaries respectively, and as a narrow finger of vegetation that extends along the ridgeline in the central part of the property. The Subject site is bordered by Moonee Creek to the east and the Pacific Highway to the west.

The Subject site is zoned 2A Residential Low Density over the majority of the site. A small fringe of 7A Environmental Protection land occurs to the north along Skinners Creek, and along the south eastern border adjacent to Moonee Creek. A small fringe of the site along Skinners Creek in the north appears to be zoned 6A Open Space Public Recreation.

The Proposed development consists of an eleven (11) stage residential development with a total allotment number of 523 lots. The development areas occur in the east, west and south of the Subject site. Residential lots will account for 30% of land on the site, while other areas of land are to be allocated to open space and for the construction of roads.

A site survey was completed at the Subject site between the 10th and 14th of May 2004. The site was comprehensively surveyed and a general plant species list was compiled. An additional survey was completed on the 23rd and 24th of September 2004 to target Threatened orchid species considered possible occurrences on the site.

One hundred and sixty-seven (167) flora species were recorded at the Subject site. None of these are Threatened or ROTAP (Briggs & Leigh 1995) species. Two (2) significant (Sheringham & Westaway 1995) flora species were recorded on the site: White stringybark (*Eucalyptus globoidea*) and Christmas bells (*Blandfordia grandiflora*). Both these species were recorded on the site by Clancy (1998).

Six (6) broad vegetation types, consisting of seventeen (17) distinct vegetation communities were identified on the Subject site.

Three (3) Endangered Ecological Communities (EECs) occur on the site and include:

- Swamp sclerophyll forest on coastal floodplain
- Swamp oak floodplain forest on coastal floodplain
- Coastal saltmarsh

A number of forest ecosystems (CRA Unit 1999) occur on the site, and include:

- Forest Ecosystem 72 (Low Relief Coastal Blackbutt).This ecosystem is considered to be **Rare**, and has been identified as a priority for conservation on private land. The conservation status of this community on the Subject site is relatively high.
- Forest Ecosystem 20 (Clarence Lowland Needlebark Stringybark). This ecosystem is not considered to be Vulnerable, Rare, or Endangered. The conservation status of this community is considered to be moderate.
- Forest Ecosystem 147 (Turpentine). This ecosystem is not considered to be Vulnerable, Rare, or Endangered. The conservation status of this community is considered to be moderate.
- Forest Ecosystem 142 (Swamp mahogany). The ecosystem is considered to be **Rare**. This community has a high conservation value. This community is representative of the Endangered Ecological Community (EEC) Swamp sclerophyll forest on coastal floodplain.
- Forest Ecosystem 27 (Coastal Sands Blackbutt). This ecosystem is not considered to be Vulnerable, Rare, or Endangered. Conservation values are considered to be moderate.
- Forest Ecosystem 71 (Ironbark). This ecosystem is not considered to be Vulnerable, Rare, or Endangered. Conservation values are considered to be moderate. This forest ecosystem has been identified as a priority for protection on Private land.
- Forest Ecosystem 112 (Paperbark). The ecosystem is considered to be **Vulnerable**. Paperbark communities have been identified as a priority for conservation on private land. The conservation value of this community is considered to be high. This community is representative of the Endangered Ecological Community (EEC) Swamp sclerophyll forest on coastal floodplain.
- Forest Ecosystem 143 (Swamp oak). This ecosystem is considered to be **Rare**. The conservation value of this community is considered to be high. This community is representative of the Endangered Ecological Community (EEC) Swamp oak floodplain forest.
- Non-Forest Ecosystem 64 (Heath). The ecosystem is considered to be **Vulnerable**. It should be noted that heath community on the Subject site is small in area and its regeneration restricted by slashing practices. While this lowers the conservation value of this community, conservation status is considered to be moderate.
- Non-Forest Ecosystem 77 (Mangrove). The ecosystem is considered to be **Rare**. The conservation value of these communities is considered to be high. Coastal Saltmarsh (which occurs in tandem with parts of this community) has been classified as an Endangered Ecological Community (EEC) by the NSW Scientific Committee (NPWS 2004).

Additionally, several of the vegetation communities on the site are considered Regionally Significant, Locally Significant, or of Ecological Significance (Communities which comprise tree species utilised by Koalas) under vegetation mapping for the Coffs Harbour LGA by Fisher *et al*. (1996).

The vegetation communities with the highest conservation value occur primarily on the eastern side of the site flanking Moonee Creek, although some pockets of Mangrove community occur along Skinners Creek to the north of the site.

A detailed fauna survey was carried out over five (5) days between the 10th and the 14th of May 2004. A second survey was conducted over three (3) nights between the 22nd and the 24th of September 2004 targeting the Threatened Grass owl. The Subject site and Study area are known to constitute habitat for a variety of Threatened species. An additional targeted survey for the Wallum froglet commenced 6th September 2005, and occurred over two (2) nights. The results of this survey are included as **APPENDIX 3**.

The survey recorded five (5) reptile species, six (6) amphibian species (including a possible Threatened species, with an uncertain identification of the Wallum froglet*, fifty-nine (59) bird species (including three Threatened species: the Glossy black cockatoo, Osprey, and Black-necked stork), and twenty-nine (29) mammal species including six (6) Threatened species:

*Identification uncertain possible mis-identification of the beeping froglet. See Bisosphere Environmental Consultants (2006) in **APPENDIX 3.**

- Squirrel glider (*Petaurus norfolcensis*)
- Little bent-wing bat (*Miniopterus australis*)
- Common bent-wing bat (*Miniopterus schreibersii*)
- Large-footed myotis (*Myotis macropus*)
- Koala (*Phascolarctos cinereus*)
- Grey-headed flying-fox (*Pteropus poliocephalus*)

In total ten (10) Threatened species were recorded.

The Proposed development will result in the loss of vegetation for the construction of houses, access roads, driveways and associated infrastructure. There are potential associated impacts on flora, fauna (including Threatened species), Moonee Nature Reserve, and Moonee and Skinners Creeks adjacent to the site.

In total 54 hectares of vegetation will be lost to the proposed development, the majority of which is grasslands with scattered trees, including the loss of thirty-three (33) primary Koala feed trees and approximately one hundred and twenty-five (125) immature Black she-oak less than 5 metres in height, a feed tree of the Glossy black cockatoo. There will also be a loss of approximately 4.4 hectares of slashed heath and 0.4 hectares of Swamp sclerophyll forest.

Additional impacts on vegetation communities and plants include:

- Potential for degradation of retained areas of Paperbark in the drainage line in the south of the property.
- Potential for degradation of retained areas of vegetation along Moonee Creek.

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

The proposed development will result in minor loss of foraging, sheltering and breeding habitat for native fauna occurring in the locality. This loss may have a range of impacts including:

- Loss of forage habitat for nectarivorous and insectivorous fauna species, including the loss of autumn/winter flowering plants.
- Minor decrease in the size of local fauna populations and increased susceptibility to threatening processes acting in the locality.
- Minor decrease in the size of the prey base for carnivorous species.
- Increased fragmentation of habitat in the locality.
- Some decrease in the genetic base for local fauna populations.
- Loss of sheltering and breeding habitat for native fauna.
- Reduction in opportunities for movement through the site.
- Loss of 3 trees containing hollows represents a loss of shelter habitat for hollow-dependent fauna. Loss of sub-mature eucalypts represents a decrease in the future recruitment of hollows.
- Loss of eucalypts, paperbarks, banksias and flowering shrubs decrease the food supply for nectarivores.
- Animals may be killed or injured during the clearance of vegetation.
- Domestic dogs and cats prey on native fauna and may have significant impacts on the populations of native species.
- Development of the Subject site may favour native and introduced disturbance adapted competitors. For example, Cane toads may out-compete
- Amphibians and Reptiles, aggressive open country bird species (eg Noisy miner, Crow, Pied currawong) may out-compete other birds, and non-native mammals (Black rat and House mouse) may out-compete other native small mammals).
- Increased light, noise and activity may cause reclusive species to move away from habitat edges.
- The Proposed development will result in an increase in traffic on and to the Subject site. This increases the likelihood of animals being killed or injured by vehicles.

- Alterations to site hydrology and land use may alter the water quality or hydrological regime in Paperbark Communities or neighbouring areas of Moonee Creek.

Impacts of the proposed development on most Threatened species recorded on the site is not considered to be significant. However, there are potential impacts for the Wallum froglet*, Koala and Squirrel glider. These are discussed below, while the Wallum froglet is discussed in detail in **APPENDIX 3**.

*Identification uncertain. See Bisosphere Environmental Consultants (2006) in **APPENDIX 3.**

Koala habitat on the site has been mapped by CHCC, and occurs as large areas of Secondary habitat in the north and east of the site. It should be noted that some of the mapped Secondary Koala habitat consists of scattered eucalypts within grasslands on the site. The proposed development will contribute toward the loss of some Secondary Koala Habitat on the site, as scattered paddock trees in the north-east of the site. In total thirty-three (33) primary Koala feed trees scattered within grasslands within the development area will be lost to the development, the majority of which are Tallowwood (*Eucalyptus microcorys*).

Other impacts on koalas include:

- Fragmentation of Koala habitat on the site
- Potential for injury or death from vehicle strike
- Potential for drowning in swimming pools
- Potential for harassment, injury or death from straying dogs

Loss of scattered trees within grasslands will result in a reduction of forage habitat for the Squirrel glider and diminish movement corridors. There are three (3) hollow-bearing trees occurring within the development which may provide suitable roosting habitat for this species. Both of these trees will be removed, resulting in a reduction in denning opportunities for this species on the site. There is potential for increased disturbance to Squirrel gliders feeding and roosting in vegetated areas proximate to the development, and the further possibility of predation from cats. There is also some limited potential for direct mortality during construction.

The Proposed development will contribute towards a reduction in the overall effectiveness of the site as a corridor due to habitat loss and fragmentation and a reduction in the width and length of the corridor value of the site due to edge effects.

The proposed development has the potential to result in impacts on habitats within Moonee Beach Nature Reserve as a result of increased visitation to the reserve. Impacts associated with increased visitation may include trampling of vegetation, picking of wildflowers, increased disturbance of fauna, increased risk of fire, increased potential for dumping of rubbish and increased potential for invasion of exotic flora and fauna.

The proposed development has the potential to result in impacts on habitats within Moonee Creek and Skinners Creek related to:

- Impacts on water quality and hydrology as a result of stormwater runoff from the proposed development.
- Increased visitation, with potential for trampling of intertidal vegetation, dumping of rubbish or refuse in creek habitats (particularly discarded fishing line, bait bags etc.), disturbance of fauna.
- Erosion of topsoil and disturbance to creekbank vegetation from construction of bridges and fishing platforms.

A number of amelioration measures have been recommended in this report. The proposed development will have relatively little impact on vegetation communities occurring on the northern and eastern boundaries of the site. However, there will be some loss of scattered eucalypts within grasslands in the east and west of the site. It is recommended that mature eucalypts be retained where possible, particularly within parklands, and landscaping areas. It is also recommended that mature *Melaleuca sieberi* on the site be similarly retained.

Other amelioration measures include:

- Weeds should be controlled during construction.
- Vegetation removed during construction should be mulched for use on the site. This will prevent the introduction of weeds from seeds in mulch brought in from elsewhere.
- Weeds should be controlled in landscaped areas and areas of retained vegetation.
- Known environmental weeds (e.g. Umbrella tree) should be avoided.
- Landscape plantings should include a majority of native species that will provide forage habitat for nectarivorous and frugivorous birds and bats.
- Landscaping trees should be situated where possible to reduce the amount of disturbance to retained areas of habitat.

A Landscape Management Plan (LMP) has been prepared by Anne Harrison (Landscape Architect) as part of the Landscape Management Plan for the site. Under the VMP much of the slashed heathland on the site will be allowed to regenerate, while other vegetation communities will be enhanced from rehabilitation and revegetation works. This will result in an overall net gain of heathland community on the site, retain mature trees (including Siebers's paperbark) and appropriately buffer retained areas of Wallum froglet within the drainage line community in the south of the site. It is proposed that seed sources from the site be utilised in revegetation to maintain the genetic and species integrity of flora on the site.

While vegetation clearance for the proposed development will result in some loss of habitat for fauna utilising the site, this will be relatively minimal, with the best quality habitat on the site being retained. The following amelioration measures apply:

- Landowners should control dogs on the site. All animals should reside within fenced enclosures and be on a leash when outside of the enclosure. Cats should be banned under the Companion Animals Act (1998) to reduce likely impacts on local fauna.
- Appropriate disposal of rubbish and food scraps reduces opportunities for non-native predators and disturbance adapted competitors.

- Landscape and landfill materials should be sourced from a supplier where Cane toads do not occur.
- Mature habitat trees should be retained where possible.
- Compensatory Koala habitat trees to be planted in the north-west corner of the site and outside the development envelope for any Koala habitat trees removed.
- A qualified fauna handler should be on site when clearing occurs.
- 40 km/hr speed limit to be imposed on internal access roads.
- Planting of suitable feed trees (*A. littoralis, A. torulosa*) around retained areas of the site for Glossy black cockatoos utilising the site.

Amelioration measures for the Koala have been based on the need to address the requirements for Secondary Koala Habitat within Coffs Harbour shire. It is recommended that:

- Traffic speeds be reduced to 40kph within the development. Koala signs may need to be located along roads within the development site.
- Compensatory Koala habitat trees be planted in the north-west corner of the site and outside the development envelope for any Koala habitat trees removed.
- Dogs should be strictly controlled within the proposed development, i.e.: must be contained within an appropriately fenced yard, and on a leash at all times when outside of a fenced enclosure.
- Building envelopes be located to reduce the extent of Bushfire Asset Protection Zones. If possible, houses backing onto bushland should be designed to a higher fire resistant rating to reduce the extent of APZs.
- Swimming pools should be fenced to restrict access by Koalas.

It is unlikely that Koala feed trees will be retained within the development envelope and it is not considered desirable that Koalas be able to access or move through areas of the site. Suitable movement habitat occurs along the northern and eastern boundaries.

While most suitable habitat for Squirrel gliders on the site will be retained, some loss and fragmentation of forage habitat will occur due to the loss of scattered trees within grasslands on the site. It is recommended that:

- Cats should be banned under the Companion Animals Act (1998) to reduce likely impacts on Squirrel gliders.
- Mature scattered eucalypts within grassland communities should be retained wherever possible.
- A qualified fauna handler should be on site when clearing occurs.

General Amelioration measures and amelioration measures to reduce impacts on Moonee and Skinners Creeks and Moonee Beach Nature Reserve include:

- Stormwater management aim to achieve no significant net change in runoff into wetland areas on the site, and Moonee and Skinners Creeks.
- Restrictions should be placed on the use of fires during extended dry weather periods.

- Suitable measures (eg. Siltation fencing) be taken to prevent erosion of topsoil into Moonee and Skinners Creeks during construction of Fishing platforms, Canoe jetties and bridges.
- Signage encouraging responsible fishing practices (ie. Disposal of rubbish in appropriate facilities.)

A Section 5A assessment (Assessment of Significance) was undertaken for twenty-five (25) Threatened fauna species considered a possible occurrence at the Subject site over time, and three (3) Endangered Ecological Communities (EECs) recorded on the site. The assessment concluded that the impacts of the Proposed development would be unlikely to result in the local extinction of any of these species, and that there would be no significant impact upon any of the Endangered Ecological Communities occurring on the site. A Species Impact Statement is not required.

An assessment under the *Commonwealth Environment Protection and Biodiversity Conservation Act (1999)* concluded that the Proposed development will not have a significant impact on any matters of National Environmental Significance. Commonwealth assessment of the proposal is therefore not required.

REFERENCES

Clancy, G.P. & V.A. (1998) Flora and Fauna Assessment Moonee Release Area. A report prepared for Coffs Harbour City Council.

Coffs Harbour City Council (2004) Moonee Development Control Plan. http://www.coffsharbour.nsw.gov.au/asset/1/upload/Moonee_DCP4.PDF

Coffs Harbour City Council (1999) Koala Plan of Management. http://www.coffsharbour.nsw.gov.au/asset/1/upload/KPOM_a.pdf

Coffs Harbour City Council (2000) Local Environmental Plan. http://www.coffsharbour.nsw.gov.au/asset/1/upload/LEP_2000_(21.7.05).PDF

Coffs Harbour City Council (2000)Draft Vegetation Management Plan. http://www.coffsharbour.nsw.gov.au/asset/1/upload/Vegetation_Strategy2.pdf

Cogger H. G. (1996). Reptiles and Amphibians of Australia (Rev. Ed.) Reed International Books, Sydney.

Connelly, S. and Specht, A (1988) Big Scrub Conservation Strategy, NSW NPWS.

Crome, F. H. J. and Richards, G. C. (1988) Bats and gaps: Microchiropteran community structure in a Queensland rainforest. Ecology 69, 1960-1969.

Date, E.M. & Recher, H.F and Ford, H (1992) Status of rainforest pigeons in Northern New South Wales. Unpublished Report to NPWS.

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

Debus, S.J.S., & Chafer, C.J. (1994) The Powerful owl *Ninox strenua* in NSW. In Large Forest Owls of NSW. (Ed. S.J.S. Debus) pp. 21-38. Aust. Birds 28 Supplement, 1-64.

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

Edwards, K. (1979) Rainfall in NSW with special reference to soil conservation. Soil Conservation Service Sydney. Tech. Handbook No. 3.

Ehmann H., (1992) Encyclopaedia of Australian Animals. Reptiles Angus and Robertson.

Fisher, M., Body, M., and Gill, J. (1996) The vegetation of the Coffs Harbour City Council LGA. A report to Coffs Harbour City Council.

Fitzpatrick, E.A. and Nix H.A. (1973). The Climatic Factor in Australian Grassland Ecology. In R.M. Moore (Ed.) Australian Grasslands A.N.U. Press, Canberra.

Forshaw, J.M (1981) Australian Parrots. Second (revised) Edition. Lansdowne Press, Melbourne.

Garnett, S (Ed.) (1992) Threatened and Extinct Birds of Australia. Royal Australasian Ornithologists Union Report 82.

Gravatt, D. (1974) Birds that eat plant products in coastal south Queensland. Inst. For Aust. Seventh Triennial conference. Caloundra, Qld. Vol. 1. Working Papers pp. 339-348.

Hager, T. C. & Benson, J. S. (1994) Review of the conservation status of vegetation communities in New South Wales – Part 3: Assessment of the conservation status of forest plant communities in north eastern NSW. A report to the Australian Heritage Commission.

Hall, L. S. (1981) The Biogeography of Australian bats. In Ecological biogeography of Australia /9. (Ed. A. Keast) Pp. 1555-1583. W Junk, The Hague.

Harrison, A. (2005) Landscape Concept & Open Space Management Plan for Lot 1 & 2 DP725785 Pacific Highway Moonee. A report prepared for the Winten Property Group.

Holmes, G. (1987). Avifauna of the Big Scrub Region. Australasian and New South Wales National Parks & Wildlife Service.

Howe, R.W, Howe, T.D and Ford, H.A (1981) Bird Distribution on Small Rainforest Remnants in New South Wales Australian Wildlife Research (8).

Hoye, G.A. and Richards, G.C. (1995). Greater Broad-nosed bat *Scoteanax rueppellii* (Peters 1866) In Strahan, R (Ed.). The Mammals of Australia. The Australian Museum and Reed Books, Sydney.

JWA (2000) Flora and Fauna Assessment. Heritage Park, Moonee. A report to RDM.

JWA (2003) Preliminary study. Lots 1 & 2 DP 725785, Pacific Highway, Moonee. A report to Winten Property Group.

JWA (2003) Flora and Fauna Assessment. Lot 122 DP 1052566 Moonee Beach Road, Moonee. A report to Jock Palmer & Associates.

JWA (2004) Wallum froglet assessment – Lots 1 & 2 DP 725785 Pacific Highway Moonee. A report to Winten Property Group.

JWA (2003) Preliminary study – Lots 1 & 2 DP 72578 Pacific Highway Moonee. A report to Resource Design and Management.

Kavanagh, R.P. (1988) The impacts of predation by the Powerful Owl *Ninox strenua* on the Greater glider *Petauroides volans*. Aust. *J. Ecology* 13:445-450.

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

Keast, (1968) Seasonal movements of the Australian Honeyeaters *(Meliphagidae)*, and there ecological significance. *EMU* **89**: 140-154.

Kingston, M. B. & Boulton, S. C. (2002) Coffs Harbour Vegetation Management Study. A report prepared for Coffs Harbour City Council by Ecograph Consultants.

Lott & Duigan 1993. Conservation Significance and Long Term Viability of Sub-tropical Rainforest Remnants of the Big Scrub – North Eastern NSW. Department of Ecosystem Management, University of New England.

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

Nix, H. S. (1982) Environmental determinants of biogeography and evolution in Terra Australis. In 'Evolution of the Flora and Fauna of Arid Australia' (eds) Barker, W.R. and Greenslade, P.J.M. pp. 47-66 Peacock Pubs. Frewvill, S. Aust.

NSW National Parks and Wildlife Service (1996) Warrell Creek Nature Reserve Proposal Reference Statement. Unpublished document.

NSW National Parks & Wildlife Service (1999) Forest Ecosystem Classification and Mapping for the Upper and Lower North East CRA Regions for Joint Commonwealth NSW Regional Forest Agreement Steering Committee.

NSW National Park & Wildlife Service (2006) Atlas of NSW Wildlife. www.npws.nsw.gov.au

NSW National Park & Wildlife Service (2002) Threatened Species of the Upper North Coast of New South Wales – Fauna. Threatened Species Unit, Conservation Programs & Planning Division, Northern Directorate, Coffs Harbour.

NSW National Park & Wildlife Service (2002) Threatened Species of the Upper North Coast of New South Wales – Flora. Threatened Species Unit, Conservation Programs & Planning Division, Northern Directorate, Coffs Harbour.

NSW Scientific Committee (2004) Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions – endangered ecological community listing.
http://www.nationalparks.nsw.gov.au/npws.nsf/Content/swamp_schlerophyll_endangered

NSW Scientific Committee (2004) Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions – endangered ecological community listing.
http://www.nationalparks.nsw.gov.au/npws.nsf/Content/swamp_oak_floodplain_endangered

NSW Scientific Committee (2004) Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions – endangered ecological community listing.
http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Coastal_Saltmarsh_endangered

Porter, J.W. (1982) Terrestrial birds of the coastal lowlands of south east Queensland. Dept. of Forestry Queensland Tech. Pap. No. 30.

Readers Digest (1993) Birds of Australia Readers Digest Association. Far East Limited: Sydney.

Robertson, J.S. (1973) Winter Area Behaviour of Drongos and Forest Kingfishers. Aust. Bird Bander 11 (1);3-4.

Robertson, J.S. & Woodall,P.F. (1983) The status and movements of Honeyeaters at Wellington Point, south-east Queensland. Sunbird 13(1) 1-4

Sheringham, P. & Westaway, J. (1995) Significant Vascular Plants of Upper North East New South Wales. A report by the New South Wales National Parks and Wildlife Service for the Natural Resources Audit Council. NSW NPWS.

Smith, A.P & Lindenmeyer, D. (1988) Tree hollow requirements of Leadbeater's possums and gliders in timber production ash forests of the Victorian central highlands. Aust. Wildl. Res. 15:347-362

Smith, A.P. Hines, H. B. Pugh, D and Webber, P. (1989) Mammals, Reptiles and Amphibians of the Focal Peak Region. Unpublished Report. University of New England, Armidale.

Smith, A.P. Hines, H.B. and Webber, P. (1989b) Mammals, Reptiles and Amphibians of the rainforest of the Mount Warning Caldera Region. Unpublished report Department of Ecosystem Management, University of New England, Armidale.

Smith, A.P., Andrews and Moore, D.M. (1994) Terrestrial Fauna of the Grafton and Casino State Forest Management Areas - Description and Assessment of Forestry Impacts. In EIS for proposed forestry operations in the Casino Management Area. (1995) Supporting Document No 6. State Forests of New South Wales, Sydney. 135 pp.

Specht, R.L (1981) Foliage - Projective Cover And Standing Biomass. In Gillison, A.N. and Anderson, D.J (eds) Vegetation Classification of Australia. CSIRO. ANU Press Canberra.

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

WBM Oceanics (2005) Moonee Creek Estuary Processes Study Final Report. A report to Coffs Harbour City Council and DIPNR.

Wilson, S.K & Knowles, D.G (1988) Australia's Reptiles. Collins Australia, Sydney.

APPENDIX 1
PLANT SPECIES LIST

	Grouping and Family	Botanical Name	Common Name
Ferns and Fern Allies	Adiantaceae	*Adiantum hispidulum*	Rough maidenhair
Ferns and Fern Allies	Adiantaceae	*Adiantum aethiopicum*	Common maidenhair
Ferns and Fern Allies	Blechnaceae	*Blechnum indicum*	Swamp water fern
Ferns and Fern Allies	Dennstaedtiaceae	*Hypolepis muelleri*	Harsh ground fern
Ferns and Fern Allies	Dennstaedtiaceae	*Pteridium esculentum*	Bracken fern
Ferns and Fern Allies	Lindsaeaceae	*Lindsaea dimorpha*	
Ferns and Fern Allies	Polypodiaceae	*Platycerium bifurcatum*	Elkhorn fern
Ferns and Fern Allies	Sealaginellaceae	*Selaginella uliginosa*	Swamp selaginella
Gymnosperms	Pinaceae	*Pinus Elliottii**	Slash pine
Monocotyledons	Anthericaceae	*Sowerbaea juncea*	Vanilla plant
Monocotyledons	Blandfordiaceae	*Blandfordia grandiflora #*	Christmas bells
Monocotyledons	Cyperaceae	*Baumea articulata*	
Monocotyledons	Cyperaceae	*Baumea rubiginosa*	Bog rush
Monocotyledons	Cyperaceae	*Caustis blakei*	
Monocotyledons	Cyperaceae	*Caustis recurvata*	Curly wigs
Monocotyledons	Cyperaceae	*Cyperus difformis*	Rice sedge
Monocotyledons	Cyperaceae	*Eleocharis equisetina*	Sag
Monocotyledons	Cyperaceae	*Gahnia clarkei*	Tall saw sedge
Monocotyledons	Cyperaceae	*Gahnia sieberiana*	Red-fruited saw sedge
Monocotyledons	Cyperaceae	*Ptilothrix deusta*	Feather sedge
Monocotyledons	Iridaceae	*Patersonia sericea*	Silky purple flag
Monocotyledons	Juncaceae	*Juncus kraussii*	Salt rush
Monocotyledons	Juncaceae	*Juncus planifolius*	
Monocotyledons	Juncaceae	*Juncus remotiflorus*	
Monocotyledons	Juncaceae	*Juncus* sp.	
Monocotyledons	Juncaceae	*Juncus usitatus*	
Monocotyledons	Lomandraceae	*Lomandra hystrix*	Matrush
Monocotyledons	Lomandraceae	*Lomandra longifolia*	Long-leaved matrush
Monocotyledons	Luzuriagaceae	*Eustrephus latifolius*	Wombat berry
Monocotyledons	Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling lily
Monocotyledons	Orchidaceae	*Cryptostylis subulata*	
Monocotyledons	Orchidaceae	*Cryptostylis erecta*	
Monocotyledons	Orchidaceae	*Thelmyitra* sp.	
Monocotyledons	Phormiaceae	*Dianella caerulea*	Blue flax lily
Monocotyledons	Poaceae	*Avena* sp.*	Wild oats

	Grouping and Family	Botanical Name	Common Name
Monocotyledons	Poaceae	*Echinopogon* sp.	
Monocotyledons	Poaceae	*Entolasia* sp.	Panic
Monocotyledons	Poaceae	*Imperata cylindrica*	Blady grass
Monocotyledons	Poaceae	*Ischaemum australe*	
Monocotyledons	Poaceae	*Oplismenus hirtellus* ssp. *Imbecillis*	Basket grass
Monocotyledons	Poaceae	*Paspalum dilatatum**	Paspalum
Monocotyledons	Poaceae	*Phragmites australis*	Common reed
Monocotyledons	Poaceae	*Sporobolus indicus* var. *indicus**	Parramatta grass
Monocotyledons	Poaceae	*Sporobolus virginicus*	Salt couch
Monocotyledons	Poaceae	*Themeda triandra*	Kangaroo grass
Monocotyledons	Restionaceae	*Empodisma minus*	
Monocotyledons	Restionaceae	*Lepyrodia interrupta*	Heath rush
Monocotyledons	Restionaceae	*Lepyrodia scariosa*	
Monocotyledons	Smilacaceae	*Smilax glyciphylla*	Sweet sarsparilla
Monocotyledons	Xanthorrhoeaceae	*Xanthorrhoea fulva*	Swamp grass tree
Dicotyledons	Apiaceae	*Centella asiatica*	Pennywort
Dicotyledons	Apocynaceae	*Parsonsia straminea*	Common silkpod
Dicotyledons	Araliaceae	*Polyscias sambucifolia*	Elderberry panax
Dicotyledons	Asclepiadaceae	*Gomphocarpus physocarpus**	Balloon cotton bush
Dicotyledons	Asteraceae	*Ageratina adenophora**	Crofton weed
Dicotyledons	Asteraceae	*Ageratum houstonianum**	Blue billygoat weed
Dicotyledons	Asteraceae	*Baccharis halimifolia**	Groundsel
Dicotyledons	Avicenniaceae	*Avicennia marina* var *australasica*	Grey mangrove
Dicotyledons	Baueraceae	*Bauera capitata*	Dog rose
Dicotyledons	Caesalpinioideae	*Senna pendula* var *glabrata**	Winter senna
Dicotyledons	Casuarinaceae	*Allocasuarina littoralis*	Black she-oak
Dicotyledons	Casuarinaceae	*Allocasuarina torulosa*	Forest oak
Dicotyledons	Casuarinaceae	*Casuarina glauca*	Swamp oak
Dicotyledons	Chenopodiaceae	*Sarcocornia quinqueflora*	Samphire
Dicotyledons	Clusiaceae	*Hypericum gramineum*	Small St Johns wort
Dicotyledons	Dilleniaceae	*Hibbertia linearis*	
Dicotyledons	Dilleniaceae	*Hibbertia obtusifolia*	
Dicotyledons	Dilleniaceae	*Hibbertia scandens*	Climbing guinea flower
Dicotyledons	Dilleniaceae	*Hibbertia riparia*	
Dicotyledons	Dilleniaceae	*Hibbertia vestita*	
Dicotyledons	Droseraceae	*Drosera spathulata*	Spoon-leaved sundew
Dicotyledons	Elaeocarpaceae	*Elaeocarpus reticulatus*	Blueberry ash

	Grouping and Family	Botanical Name	Common Name
Dicotyledons	Epacridaceae	*Epacris calvertiana*	
Dicotyledons	Epacridaceae	*Epacris microphylla*	
Dicotyledons	Epacridaceae	*Leucopogon microphyllus*	
Dicotyledons	Epacridaceae	*Leucopogon parviflorus*	Coastal bearded heath
Dicotyledons	Epacridaceae	*Melichrus procumbens*	Jam tarts
Dicotyledons	Epacridaceae	*Monotoca scoparia*	Prickly monotoca
Dicotyledons	Epacridaceae	*Sprengelia sprengelioides*	
Dicotyledons	Epacridaceae	*Styphelia viridis*	Green styphelia
Dicotyledons	Epacridaceae	*Trochocarpa laurina*	Tree heath
Dicotyledons	Ericaceae	*Epacris obtusifolia*	Blunt-leaf heath
Dicotyledons	Euphorbiaceae	*Breynia oblongifolia*	Coffee bush
Dicotyledons	Euphorbiaceae	*Bridelia exaltata*	Brush ironbark
Dicotyledons	Euphorbiaceae	*Glochidion ferdinandi* var. *ferdinandi*	Cheese tree
Dicotyledons	Euphorbiaceae	*Glochidion ferdinandi var. pubens*	Hairy cheese tree
Dicotyledons	Euphorbiaceae	*Ricinocarpos pinifolius*	Wedding bush
Dicotyledons	Fabaceae	*Aotus lanigera*	
Dicotyledons	Fabaceae	*Bossiaea ensata*	
Dicotyledons	Fabaceae	*Dillwynia floribunda*	
Dicotyledons	Fabaceae	*Dillwynia glaberrima*	
Dicotyledons	Fabaceae	*Hovea purpurea*	
Dicotyledons	Fabaceae	*Jacksonia scorparia*	Dogwood
Dicotyledons	Fabaceae	*Pultenaea daphnoides*	
Dicotyledons	Fabaceae	*Pultenaea retusa*	
Dicotyledons	Fabaceae	*Pultenaea* species J	
Dicotyledons	Gompholobium	*Gompholobium pinnatum*	Pinnate wedge pea
Dicotyledons	Goodeniaceae	*Dampiera stricta*	Blue dampiera
Dicotyledons	Haloragaceaea	*Gonocarpus teucrioides*	Raspwort
Dicotyledons	Lauraceae	*Cassytha glabella*	Devil's twine
Dicotyledons	Lauraceae	*Cinnamomum camphora**	Camphor laurel
Dicotyledons	Lauraceae	*Cryptocarya microneura*	Murrogan
Dicotyledons	Lauraceae	*Endiandra sieberi*	Hard corkwood
Dicotyledons	Menispermaceae	*Stephania aculeata*	Prickly snake vine
Dicotyledons	Mimosaceae	*Acacia disparrima*	Hickory wattle
Dicotyledons	Mimosaceae	*Acacia brownii*	Heath wattle
Dicotyledons	Mimosaceae	*Acacia fimbriata*	Fringed wattle
Dicotyledons	Mimosaceae	*Acacia floribunda*	Gossamer wattle
Dicotyledons	Mimosaceae	*Acacia longissima*	Narrow leaf acacia
Dicotyledons	Mimosaceae	*Acacia myrtifolia*	Red-stemmed wattle
Dicotyledons	Mimosaceae	*Acacia sophorae*	Coastal wattle

	Grouping and Family	Botanical Name	Common Name
Dicotyledons	Mimosaceae	*Acacia suaveolens*	Sweet wattle
Dicotyledons	Mimosaceae	*Acacia ulicifolia*	Prickly moses
Dicotyledons	Moraceae	*Ficus coronata*	Creek sandpaper fig
Dicotyledons	Myrsinaceae	*Aegiceras corniculatum*	River mangrove
Dicotyledons	Myrtaceae	*Angophora costata*	Rusty gum
Dicotyledons	Myrtaceae	*Ochrosperma lineare*	Straggly baeckea
Dicotyledons	Myrtaceae	*Callistemon pachyphyllus*	Crimson bottlebrush
Dicotyledons	Myrtaceae	*Callistemon salignus*	Willow bottlebrush
Dicotyledons	Myrtaceae	*Corymbia intermedia*	Pink bloodwood
Dicotyledons	Myrtaceae	*Eucalyptus eugenoides*	Narrow-leaved stringybark
Dicotyledons	Myrtaceae	*Eucalyptus globoidea #*	White stringybark
Dicotyledons	Myrtaceae	*Eucalyptus microcorys*	Tallowwood
Dicotyledons	Myrtaceae	*Eucalyptus pilularis*	Blackbutt
Dicotyledons	Myrtaceae	*Eucalyptus planchoniana*	Bastard tallowwood
Dicotyledons	Myrtaceae	*Eucalyptus resinifera*	Red mahogany
Dicotyledons	Myrtaceae	*Eucalyptus robusta*	Swamp mahogany
Dicotyledons	Myrtaceae	*Eucalyptus siderophloia*	Northern grey ironbark
Dicotyledons	Myrtaceae	*Eucalyptus tereticornis*	Forest red gum
Dicotyledons	Myrtaceae	*Eucalyptus tindaliae*	Queensland white stringybark
Dicotyledons	Myrtaceae	*Kunzea capitata*	
Dicotyledons	Myrtaceae	*Leptospermum juniperinum*	Tea-tree
Dicotyledons	Myrtaceae	*Leptospermum polygalifolium*	Tea-tree
Dicotyledons	Myrtaceae	*Leptospermum whitei*	White's teatree
Dicotyledons	Myrtaceae	*Lophostemon suaveolens*	Swamp turpentine
Dicotyledons	Myrtaceae	*Lophostemon confertus*	Brushbox
Dicotyledons	Myrtaceae	*Melaleuca linariifolia*	Flax-leaved paperbark
Dicotyledons	Myrtaceae	*Melaleuca nodosa*	
Dicotyledons	Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved paperbark
Dicotyledons	Myrtaceae	*Melaleuca sieberi*	Sieber's paperbark
Dicotyledons	Myrtaceae	*Melaleuca thymifolia*	
Dicotyledons	Myrtaceae	*Syncarpia glomulifera*	Turpentine

	Grouping and Family	Botanical Name	Common Name
Dicotyledons	Myrtaceae	*Tristaniopsis laurina*	Water gum
Dicotyledons	Nymphaeceae	*Nymphaea* sp.	Waterlily
Dicotyledons	Oleaceae	*Notelaea ovata*	Mock olive
Dicotyledons	Onagraceae	*Ludwigia peploides*	Water primrose
Dicotyledons	Passifloraceaea	*Passiflora edulis* *	Passionfruit
Dicotyledons	Pittosporaceae	*Billardiera scandens*	Apple berry
Dicotyledons	Plantaginaceae	*Plantago spp.**	Plantains
Dicotyledons	Polygonaceae	*Persicaria strigosa*	Smartweed
Dicotyledons	Proteaceae	*Banksia integrifolia*	Coast banksia
Dicotyledons	Proteaceae	*Banksia oblongifolia*	Swamp banksia
Dicotyledons	Proteaceae	*Banksia spinulosa*	Hairpin banksia
Dicotyledons	Proteaceae	*Lomatia silaifolia*	Crinkle bush
Dicotyledons	Proteaceae	*Persoonia conjuncta*	Geebung
Dicotyledons	Proteaceae	*Persoonia stradbrokensis*	Geebung
Dicotyledons	Proteaceae	*Persoonia virgata*	Geebung
Dicotyledons	Ranunculaceae	*Clematis aristata*	Mountain clematis
Dicotyledons	Rhamnaceae	*Alphitonia excelsa*	Red ash
Dicotyledons	Rutaceae	*Boronia safrolifera*	Pink boronia
Dicotyledons	Sapindaceae	*Dodonaea triquetra*	Hop bush
Dicotyledons	Sapindaceae	*Guioa semiglauca*	Guioa
Dicotyledons	Solanaceae	*Solanum nigrum**	Black-berry nightshade
Dicotyledons	Thymelaeaceae	*Pimelea glauca*	
Dicotyledons	Thymelaeaceae	*Pimelea linifolia*	Slender riceflower
Dicotyledons	Verbenaceae	*Lantana camara**	Lantana
Dicotyledons	Violaceae	*Viola hederacea* subsp. *Hederaceae*	Native violet
Dicotyledons	Vitaceae	*Cissus hypoglauca*	Five-leaf water vine

* Introduced Species
# Significant (Sheringham & Westaway 1995)

APPENDIX 2

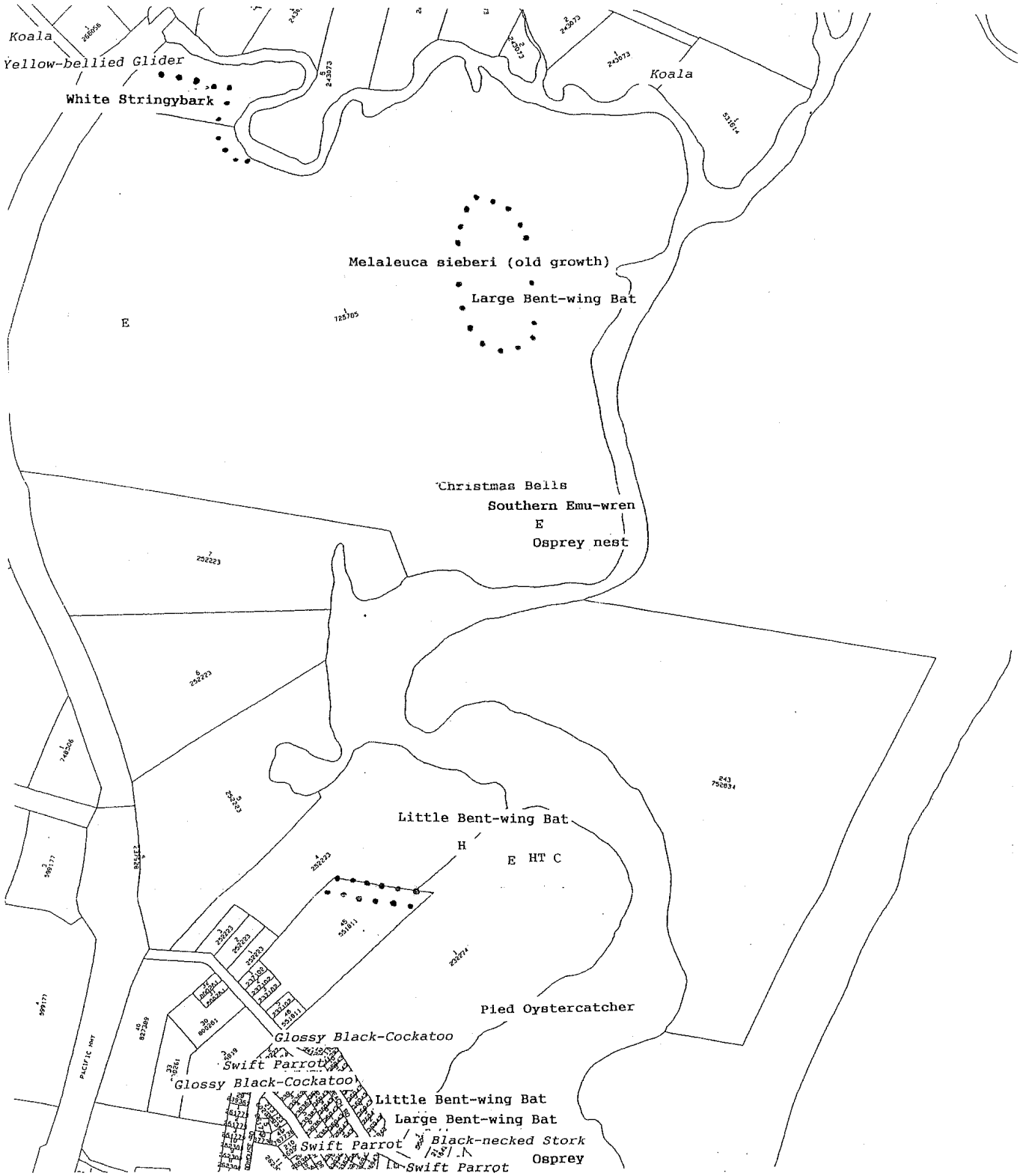
THREATENED FAUNA RECORDS ON THE SITE (CLANCY 1998)

MAP 2 Location of threatened and significant species, trap sites and proposed corridors, northern study area

KEY

E = Elliott trap line
C = Cage Trap
H = Harp Trap
HT = Hair Tube line

Proposed Corridors (Approximate only)



APPENDIX 3
WALLUM FROGLET ASSESSMENT

JAMES WARREN & Associates Pty Ltd

ENVIRONMENTAL CONSULTANTS

WALLUM FROGLET ASSESSMENT

LOTS 1 & 2 DP 725785
PACIFIC HIGHWAY MOONEE

NOVEMBER 2007

A REPORT TO THE ROTHWELL BOYS PTY LTD

TABLE OF CONTENTS

1 INTRODUCTION

James Warren and Associates have been engaged by the Rothwell Boys Pty Ltd to complete a Wallum froglet (*Crinia tinnula*) habitat assessment for land at Lots 1 & 2 DP 725785 Pacific Highway, Moonee. A detailed flora and fauna assessment has previously been completed by JWA for this site in November 2007. Subsequent to the completion of the flora and fauna assessment an investigation area for the Wallum froglet has been mapped as part of the Moonee DCP (CHCC 2004) and is shown as **FIGURE 1**. This assessment indicated that 'core' Wallum froglet habitat is generally concentrated around the constructed drainage line in the southern portion of the site where records of the species have occurred.

Surveys of the site by JWA have recorded a total of ten (10) Threatened fauna species, including the Wallum froglet (*Crinia tinnula*) in the south of the site around a constructed drainage line.

The aim of Wallum froglet habitat assessment is to:

- Provide an assessment of the potential Wallum froglet habitat investigation area which has been mapped by Coffs Harbour City Council (CHCC) as part of the Moonee Development Control Plan (Moonee DCP 2004);
- Address the likely impacts of the proposed development on the Wallum froglet (*Crinia tinnula*) habitat on the site; and
- Complete an Assessment of Significance (7 part test) as required under Section 5A of the *Environmental Planning & Assessment Act* (*EPA Act 1979*) for the Wallum froglet.

The proposed development involves a 523 residential lot development with associated curtilage, Fire protection Zones, Open space and Road access.

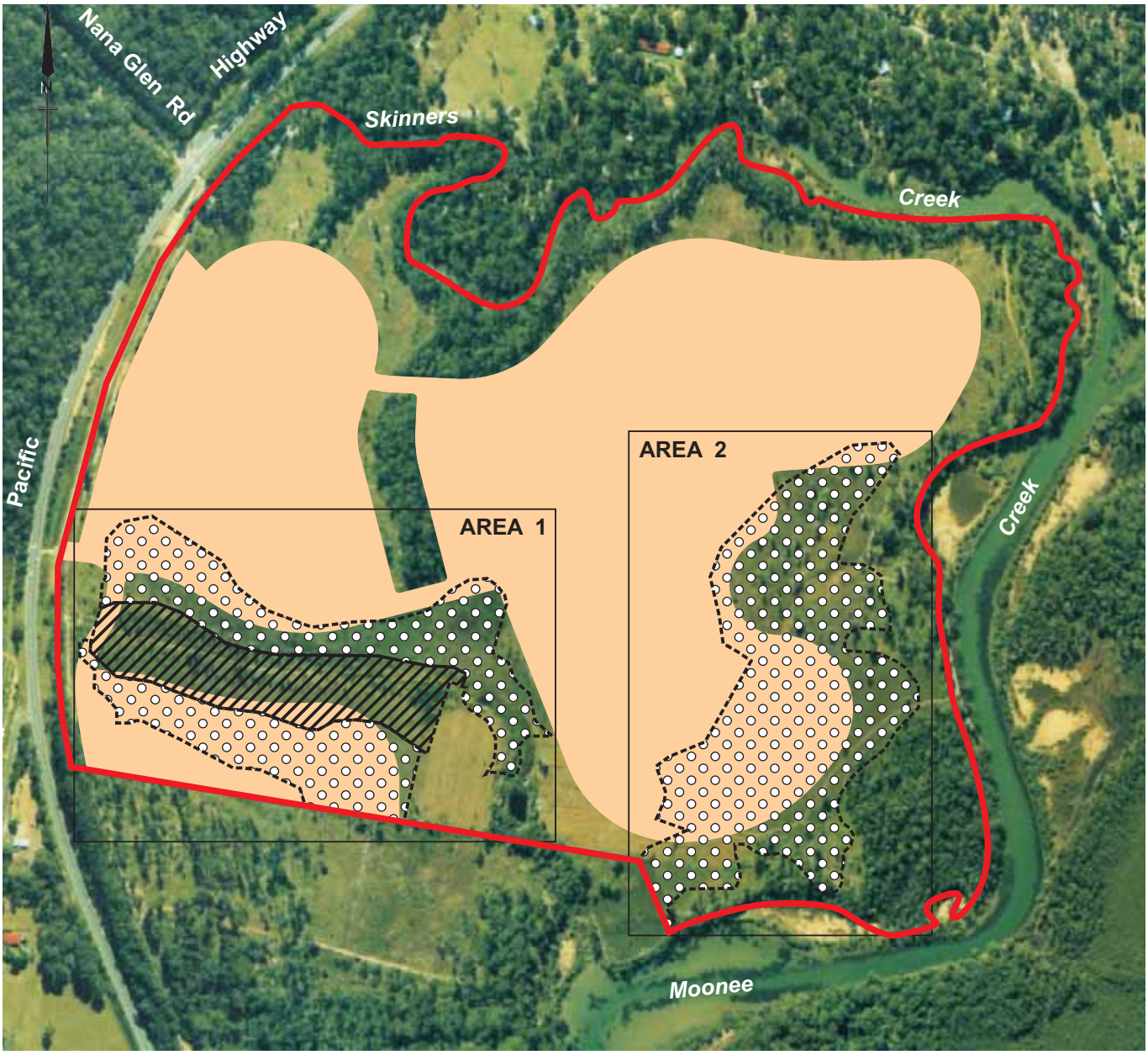
2 WALLUM FROGLET HABITAT ON THE SITE

The site covers an area of approximately 96 hectares and fronts the eastern side of the Pacific Highway. The majority of the site consists of cleared grazing land with scattered trees. The site is flanked to the east by Moonee Creek, and to the north by Skinners Creek. A variety of types of remnant native vegetation flanks both these watercourses.

The Wallum froglet investigation area mapped under the Moonee DCP generally corresponds to areas of slashed heath and grassland which can be subject to periodic waterlogging. Actual Wallum froglet habitat on the site generally corresponds with areas with a high water table.

Field surveys by JWA have predominantly recorded the Wallum froglet* within 'core' habitat within and immediately adjacent to the southern drainage line. Wallum froglet* records are shown in **FIGURE 2**.

***** Identification uncertain possible mis-identification of the Beeping froglet. See Bisosphere Environmental Consultants (2006) in **ANNEXURE 1.**



Legend

- Wallum froglet habitat (CHCC)
- Potential Wallum froglet habitat (CHCC)
- Proposed Development Area
- Subject Site

0 10m 20m

SOURCE: Coffs Harbour City Council Web Site
Moonee Development Control Plan 2004
Maps 4 & 5
SCALE: 1 : 8000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

PROJECT
Wallum Froglet Assessment
Lots 1 & 2 Dp725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 1

PREPARED: VJA/BW
DATE: 08 November 2007
FILE: 02066_WFA_CHCC.cdr

TITLE

CHCC WALLUM FROGLET HABITAT ON THE SITE

3 WALLUM FROGLET PROFILE

3.1 Introduction

Wallum froglets (*Crinia tinnula*) are a type of 'acid' frog so called because of their dependence on habitat with a specific range of conditions including ephemeral pools of slightly acidic water. This section profiles the Wallum froglet in terms of:

- Legislative status
- Biology
- Distribution
- Habitat requirements (forage, breeding)
- Threatening processes

The Wallum froglet is listed as a Schedule 2 (Vulnerable) Threatened species under the *Threatened Species Conservation Act* (*TSC Act 1995*). No Approved or Draft Recovery Plan has been prepared for the species under the Act. The species was listed because:

- Its population has been severely reduced
- It faces severe threatening processes
- It is an ecological specialist

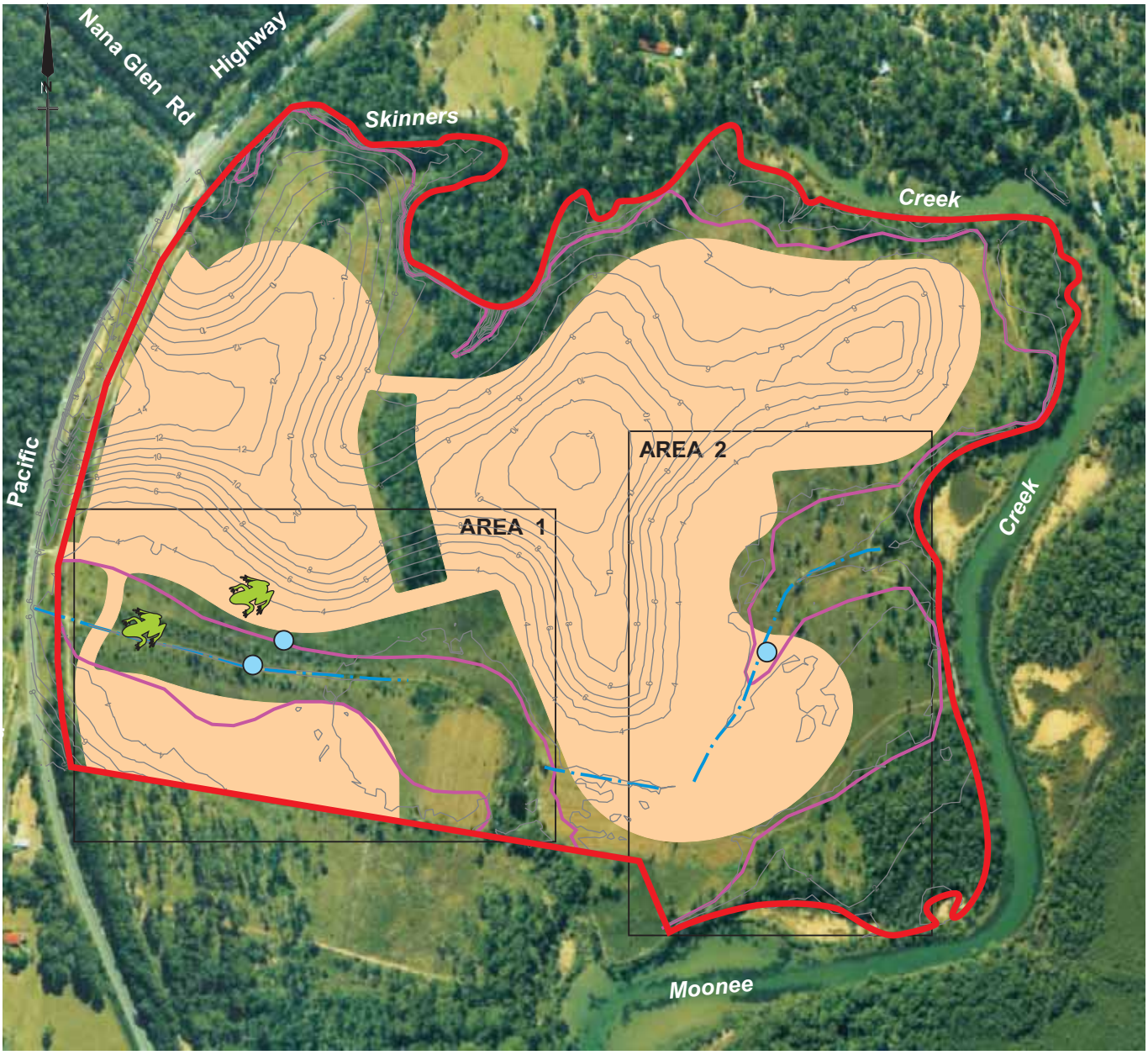
3.2 Wallum froglet species profile

The Wallum Froglet (C*rinia tinnula*) is the smallest of the 'acid frogs' being about 15 mm long (NPWS 2002). The term 'acid frog' refers to its preference for habitat that is slightly acidic. The species is highly cryptic and is difficult to distinguish from the relatively common Eastern froglet (*Crinia signifera*) (Cogger 2000). As a result, Wallum froglets are most often identified by their distinctive call.

Wallum froglets generally occur in low-lying Wallum habitats with a low pH containing wet heath or paperbark vegetation. A study of a Wallum froglet population at Kurnell noted that typical habitat for the species had a thick organic matter layer, was surrounded by low heath vegetation and were relatively unshaded (White & Pyke 2005).

Wallum froglet populations extend into adjacent areas of marginal habitat, such as grasslands, when weather conditions are suitable. The species is unusual among frogs in that it is a late winter breeder, with males calling in choruses from within sedge tussocks or at the waters edge (NPWS 2002). The mating call is a short high-pitched ring that has been described as bell-like or insect–like.

There are only five (5) records of the Wallum froglet in the Coffs Harbour LGA, making the occurrence of this species on the site significant. The species is not known from Moonee Beach Nature Reserve, which occurs adjacent to the site. The nearest record to the site occurs at Hearns Lake, approximately 7 km to the north. Two (2) additional



Legend

- Wallum froglet
- Water Sampling Site
- Drain
- Q100 Flood Line (Auspacific Engineers)
- Subject Site

0 10m 20m

SOURCE: JWA Site Investigations 2004

SCALE: 1 : 8000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

PROJECT
Wallum Froglet Assessment
Lots 1 & 2 Dp725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 2

PREPARED: VJA/BW
DATE: 08 November 2007
FILE: 02066_WFA_Frogs.cdr

TITLE

RECORDED WALLUM FROGLET SIGHTINGS

records of the Wallum froglet not listed in the Wildlife Atlas are also known from the Coffs Harbour LGA:

- Coffs Harbour Health Campus (Mark Graham CHCC *pers comm*. May 2004)
- Coffs Creek Link Road Bridge (CHCC *pers comm*. June 2006)

In Queensland, the Wallum Froglet is most often associated with paperbark swamps on coastal alluvial sands (Straughan and Main 1966). In NSW, this species is found in many coastal heath sites, some of which abut Paperbark swamps.

Environment Australia (1999) identified breeding habitat for the Wallum froglet as consisting of marshy or swampy areas with acidic, tannin stained water, typically associated with Wallum heath, paper barks and tea trees. Breeding habitat is often, but not always, ephemeral. Eggs are laid in acidic paperbark swamps. The tadpoles are free living and adults are terrestrial. The Wallum froglet forages around sedges and rushes adjacent to breeding habitat. The species is closely associated with the coastal zone and is found in altitudes up to 40m.

Breeding sites for the Wallum froglet are not well understood. It is assumed that breeding occurs in ephemeral puddles, coastal streams or wetlands as these are the habitats in which intense calling is observed. The incubation pond water must remain standing and of adequately high quality for 30 days to allow tadpole metamorphosis. Tadpoles are short-tailed, fat-bodied and have distinctively low tail-fins. A study of the Kurnell population of Wallum froglets found breeding habitats to be highly acidic, slightly saline, non-turbid and with fluctuating water levels (White & Pyke 2005). Wallum froglets have been found to move some distance from breeding habitat, with froglets at Kurnell recorded up to 100 metres from a pond, in nearby heath and woodland (White & Pyke 2005).

Foraging behaviour is poorly documented, although it is likely that the species forages on small arthropods amongst dense ground covers of sedges, ferns and grasses. The eggs are small 1.1 to 1.2mm in diameter, laid in clumps attached to submerged vegetation in standing, slightly acidic water with a pH range from 4.3 to 7.2 (Ehmann 1997).

Although the Wallum Froglet has a wide range, from Bribie, Moreton and Stradbroke Islands to south east Queensland and Kurnell south of Sydney, its distribution has been greatly reduced due to agricultural clearing, and, more recently residential encroachment. Their habitat is coastal heath mainly comprising paperbark/banksia swamps also know as costal 'Wallum' or Wallum heath.

These small patches of habitat are extremely vulnerable to disturbance. Alterations to habitat or surrounding areas may result in a change in acidity, thus allowing other more common frog species to move in and displace the Wallum froglet (Wildlife Preservation Society of Queensland 2003).

Wallum froglet and the other 'acid' frogs from the heaths of the coastal strip and sand islands of south-eastern Queensland and north-eastern New South Wales are in significant decline. Survival of these species is threatened by the encroachment of urbanisation into natural areas. Habitat destruction and modification can have significant impacts for highly specialized frogs such as the Wallum froglet (Queensland Museum 2003).

NPWS (2002) lists the following major Threats to the Wallum froglet:

- Destruction and degradation of coastal wetlands as a result of roadworks, coastal developments and sand-mining;
- Reduction of water quality and changes to acidity in coastal wetlands; and
- Grazing and associated frequent burning of coastal wetlands.

Suggested conservation actions (NPWS 2002) for the species includes:

- Protection of coastal wetlands from clearing, draining and development;
- Minimise pollutant run-off from development and roads adjoining wetlands;
- Retain wetland protection buffers in new coastal developments;
- Fence off swamps to prevent stock from grazing in these areas; and
- Protect swamps from fire during burning off activities.

3.3 Wallum habitat

Wallum is a term used to describe a specific coastal heath community type dominated by Wallum banksia (*Banksia aemula*) and a very high diversity of endemic heath plants growing on low nutrient, aolian sandy soils (often over a Coffee rock shelf). Frequently, these sands occur in the depressions behind coastal foredunes and flats. Wallum heaths often have a high water table and are known for their slightly acidic standing pools and often clear or tannin-stained waters. Wallum heath is also characterised by the suite of fauna species dependent specifically on the mosaic of microhabitats created by the Wallum flora. The biodiversity of Wallum heathland is very high and supports more rare and endangered species than any other habitat (Maher & Associates, 1997). Wallum froglets (*Crinia tinnula*) and Wallum sedge frogs (*Litoria olongburensis*) are among these endemic fauna species.

Once common along the coastlines of northern NSW and Southeast Queensland, Wallum has now mostly been cleared for agriculture and grazing. The remaining areas of Wallum heath also occur within range of the fastest growing centres of residential development, and are currently under threat from impacts associated with residential and commercial development such as stormwater runoff, altered fire regimes, clearing and pollution (NPWS 1995, Landmark 1999, Ehmann *et al*. 1997).

The Wallum froglet has been found in association with vegetation features such as *"fringing and emergent plants in or at the edges of (mostly) temporary swamps in wallum country"* (Ehmann 1997). White & Pyke (2005) found that fringing vegetation at non-breeding sites utilised by Wallum froglets in Kurnell was typically comprised of

species such as Heath myrtle (*Baeckea imbricata*), Mat rush (*Lomandra longifolia*), various epacrids (*Pimelia linifolia*, *Isopogon anemonifolia*), Heath banksia (*Banksia ericifolia*), Swamp bottlebrush (*Callistemon citrinus*), Dagger hakea (*Hakea teretifolia*) and Heath she-oak (*Allocasuarina distyla*). Breeding habitat at the Kurnell sites were characterised by emergent vegetation such as *Leptocarpus tenax*, *Baumea juncea* and *Lepidospermum flexosum* along with other species such as *Phylidrum lanuginosum* and *Villarsia exaltata*.

4 WALLUM FROGLET ASSESSMENT

4.1 Introduction

The Study area and surrounds were assessed for the presence of areas of habitat suitable for the Wallum froglet during surveys in November 2002, February 2003, May 2004 and August 2005.

Wallum froglets* were initially recorded on the site on the 20th of November 2002 and 27th February 2003. A full fauna survey completed between the 10th and 14th of May 2004 did not record the species.

The majority of Wallum froglet* records are associated with the southern drainage line and associated areas in the south of the site, although several individuals were heard calling from the junction of the central vegetated area and the strip of vegetation bordering the southern bank of Skinner's Creek following an extended period of heavy rain in February 2003.

The most recent survey effort has been undertaken in order to provide a more detailed analysis of how Wallum froglets utilise the site. While it is evident the species utilises the southern drainage line and adjacent areas, survey effort to date has not documented the use of much of the investigation area (as per Moonee DCP 2004) by this species. A targeted survey focussing on areas of potential habitat for Wallum froglets on the site was undertaken on the 5th and 6th of September 2005.

A final targeted survey for the species was completed by frog expert Dr. Arthur White (Biosphere Consulting) on the 25th and 26th of July 2006. This report is attached as **ANNEXURE 1**.

*Identification uncertain possible mis-identification of the Beeping froglet. See Bisosphere Environmental Consultants (2006) in **ANNEXURE 1.**

4.2 Methods

4.2.1 Habitat assessment

Aerial photography (scale 1:25000) of the Study area was used to assist in the identification and mapping of habitats. The area around the Subject site was surveyed in detail on foot to ground-truth habitat visible from aerial photography of the site.

A vegetation assessment was also undertaken of suitable Wallum froglet habitat. Vegetation communities were surveyed and mapped as part of the Flora and Fauna Assessment of the site (JWA 2004).

4.2.2 Water quality testing

To test the pH of water in suitable Wallum froglet habitat on the site, water samples were taken from three (3) areas on the site: the southern drain, isolated puddles north of the southern drain and the eastern drain. Sample sites and the location of the drainage lines are marked in **FIGURE 2**. Samples were taken on the 6th of September 2005 and analysed by Norsearch Environmental Analysis Laboratory, Lismore.

4.2.3 Wallum froglet survey

Survey methods used in previous JWA investigations on the site involved a combination of active listening while undertaking traverses of suitable habitat and utilising call playback to evoke responses from Wallum froglets. Details on survey effort for the Flora and Fauna Assessment are contained within the main document. The most recent survey by JWA (September 2005) utilised similar survey methods to those previously used.

The targeted survey by JWA commenced 5th September 2005, and occurred over two (2) nights. All areas of potential habitat mapped under the Moonee DCP in addition to habitat in the north of the site were surveyed by active listening, and random traverses on foot. Any calls heard were to be followed on foot to the approximate point of call (where possible), and a survey peg placed in the ground. All survey pegs were to be surveyed by GPS the following day.

Call playback was utilised as an adjunct to active listening techniques. A handheld call playback unit was deployed at various locations within potential habitat. A five (5) minute active listening period followed each two (2) minute session of call playback.

Both night and day surveys were completed for each area.

The survey methods employed by targeted Dr. Arthur White (Biosphere Consulting) on the 25th and 26th of July 2006 are provided in his report (attached as **ANNEXURE 1)**.

4.3 Results

4.3.1 Habitat assessment

4.3.1.1 Background

Vegetation within suitable Wallum froglet habitat has been significantly disturbed and modified from past agricultural and grazing practices. The site is currently grazed by a small herd of cattle and regularly slashed. As a result, heathlands on the site been severely modified. Two small areas adjacent to the dam have also been utilised for turf production and are evident from the aerial photo shown as **FIGURE 1**. These areas are now dominated by Whiskey Grass, an exotic species.

Areas of possible Wallum froglet habitat include:

- The southern drainage line and surrounding vegetation (referred to as Area 1)
- The eastern drainage line and slashed heath in the south-east portion of the site (referred to as Area 2)

Suitable habitat is discussed in greater detail below.

4.3.1.2 Area 1

Southern drainage line

The southern drainage line is fed from water draining from low lying land west of the Pacific Highway and channelled through a culvert under the highway. The drain itself is very disturbed due to access by cattle and has a patchy distribution of sedges and some Frogsmouth along with some regrowth Paperbark (*Melaleuca quinquenervia*). Vegetation fringing the drainage line includes Kangaroo grass (*Themed triandra*), Egg and bacon peas (*Pultanea* sp.), Long-leaved matrush (*Lomandra longifolia*) and regrowth Paperbark (*M. quinquenervia, M. sieberi*).

The dam area occurs as an area of open water with some fringing sedge vegetation which grades into denser vegetation, primarily *Eleocharis* sedgeland. Other wetland species include *Cyperus* sp., Frogsmouth and Water fern.

Paperbark woodland adjacent to southern drainage line

This community contains regenerating and immature Paperbarks including Broad-leaved paperbark (*M. quinquenervia*), Sieber's paperbark (*M. sieberi*) and Flax-leaved paperbark (M. *linariifolia*). Few other trees or shrubs occur due to regular slashing. The ground layer is as for neighbouring grassland and includes a diverse and sporadic mixture of grasses, sedges and forbs (see 3.3.1.2).

Several small depressions occur within this area which hold water and are fringed with sedges.

Grassland to the north of the southern drainage line

This community includes a variety of species including Kangaroo grass (*Themeda triandra*), Parramatta grass (*Sporobolus indicus* var. *indicus*), Paspalum (*Paspalum*

sp.), Whiskey grass (*Andropogon virginicus*),Sedges (*Juncus usitatus*, *J. planifolius*), Raspwort (*Gonocarpus teucrioides*), Spoon-leaved sundew (*Drosera spathulata*), Pennywort (*Centella asiatica*), Heath rush (*Lepyrodia interrupta*), Vanilla lily (*Sowerbaea juncea*), Straggly baeckea (*Ochrosperma lineare*), Hibbertia (*Hibbertia vestita*) and Slender riceflower (*Pimelea linifolia*). The occasional regrowth Paperbark (*M. quinquenervia, M. liariifolia*) also occurs.

Several small depressions occur within this area which hold water and are fringed with sedges. This community is low-lying and becomes swampy after rainfall events. The soil is peaty and has a layer of organic matter present.

Grassland to the south of the southern drainage line
This community consists of Kangaroo grass (*Themeda triandra*), Parramatta grass (*Sporobolus indicus* var. *indicus*), Long-leaved matrush (*Lomandra longifolia*), Blue dampiera (*Dampiera stricta*), Pennywort (*Centella asiatica*), and occasional Kunzea (*Kunzea capitata*), Bracken (*Pteridium esculentum*), Blady grass (*Imperata cylindrica*) and regrowth Swamp grass tree (*Xanthorrhoea fulva*).

While this community is also low-lying it is less prone to waterlogging (*pers. Obs.)*, and soils are not as peaty as those on the northern side of the drain. Furthermore, there is a higher incidence of 'drier' species such as grasses, matrush and bracken.

4.3.1.3 Area 2

Eastern drainage line
The eastern drainage line is a shallow swale which is sparsely vegetated for much of its length, and has a small area of associated vegetation at its northern point where the drain is more defined and water is deeper. Associated vegetation includes Swamp selaginella (*Selaginella uliginosa*), Sedges (*Juncus usitatus*), some regrowth Swamp bottlebrush (*Callistemon pachyphyllus*) along with immature Paperbarks (*M. quinquenervia, M. sieberi*). Some patchy saw-sedge (*Gahnia clarkei*) also occurs.

This drainage line is not as disturbed as the southern drainage line, and the water is less turbid. Numerous small freshwater crayfish are present.

South-eastern slashed heath
This community is regularly slashed to a height of approximately 15 cm. Species present include a mix of Kangaroo grass (*Themeda triandra*), Hibbertia (*Hibbertia vestita*), Beard heath (*Epacris calvertiana*), Sprengelia (*Sprengelia sprengelioides*), Silky purple flag (*Patersonia sericea*), Long-leaved matrush (*Lomandra longifolia*), Swamp selaginella (*Selaginella uliginosa*), Swamp grass tree (*Xanthorrhoea fulva*), Spoon-leaved sundew (*Drosera spathulata*), Tea-tree (*Leptospermum juniperum*), Straggly baeckea (*Ochrosperma lineare*), Blue dampiera (*Dampiera stricta*), Raspwort ((*Gonocarpus teucrioides*), Hairy pea (*Aotus lanigera*), Heath rush (*Lepyrodia interrupta*) and occasional Bracken (*Pteridium esculentum*) and Saw-sedge (*Gahnia clarkei*).

4.3.2 Water quality results

The results of the water sample analysis are shown in **TABLE 1**.

TABLE 1
WATER QUALITY RESULTS

Sample site	pH	Conductivity (mS/cm)
Eastern drain	5.74	0.772
Southern drain	6.06	0.467
Pond north of southern drain	5.60	0.484

Barker *et al*. (1995) note that spawn of the Wallum froglet are deposited in water with a pH range of 4.3 to 5.2. However, Ehmann (1997) notes that water with a pH range from 4.3 to 7.2 comprises suitable habitat for the species. White and Pyke (2005) recorded a pH range of between 4.2 and 6.7 for breeding sites of Wallum froglets at Kurnell.

It is evident from the test results that water pH is at the outer range of suitability for the Wallum froglet. Water quality within the southern drain in particular is likely to fluctuate, due to the source being located off site (west of the Pacific Highway) within grazing land.

4.3.3 Survey results

No Wallum froglets were recorded during the targeted survey.

Six (6) other amphibian species were recorded. These are shown in **TABLE 2** and support the findings of the 2004 survey on the site, with two (2) additional species recorded - the Beeping froglet (*Crinia parinsignifera*) and Dusky toadlet (*Uperoleia fusca*).

TABLE 2
AMPHIBIAN SPECIES RECORDED ON THE SUBJECT SITE (2005 SURVEY)

Common name	Scientific name	Method of identification
Beeping froglet	*Crinia parinsignifera*	Call, Capture
Common eastern froglet	*Crinia signifera*	Call, Capture
Dusky toadlet	*Uperoleia fusca*	Call
Eastern dwarf tree frog	*Litoria fallax*	Call
Striped marsh frog	*Limnodynastes peronii*	Call
Spotted grass frog	*Limnodynastes tasmaniensis*	Call, Capture

The Beeping froglet was most active within the southern drainage line and Wallum habitat, and occurred along with the Common eastern froglet, Striped marsh frog and Spotted grass frog. The Dwarf eastern tree frog generally occurred in association with

the dam and adjacent sedgeland. Frog activity in the eastern drain line was limited to the Beeping froglet and Common eastern froglet, with a small colony of Beeping froglets occurring in 2 small isolated pools approximately 150 metres north from the drainage line.

The Dusky toadlet was recorded in the Paperbark community in the north of the 'finger' of vegetation in the middle of the site. No other frog activity was recorded in this area of the site.

4.3.4 Arthur White July 2006 survey results

No Wallum froglets were recorded on the site. Both the Beeping froglet and Common eastern froglet were recorded in many locations on the site. Other species recorded on the site included the Striped marsh frog and Spotted grass frog.

Wallum froglets were recorded within Moonee Beach Nature Reserve adjacent to the site (where they have not been previously recorded) and at two other sites where they are known from the Coffs Harbour LGA.

4.4 Discussion

4.4.1 Survey limitations of JWA targeted survey (2005)

The survey was completed at the end of the breeding season, however, the species is known to call during unfavourable conditions and non–breeding times, particularly when wet weather is approaching (Barker & Griggs 1995, White & Pyke 2005).

4.4.2 Discussion of results

The best Wallum froglet habitat on the site, and where nearly all records have been made of the species occurs in and adjacent to the southern drainage line (referred to as Area 1). Area 1 represents suitable habitat in that it contains water with a suitable pH level, contains sedges and fringing vegetation, has a relatively sparse overstorey, and has a number of depressions fringed with sedges within periodically inundated grasslands adjacent to the drainage line. The associated grassland (with some heathy elements) north of the drainage line is considered to represent superior habitat for the Wallum froglet in comparison to grassland south of the drain due to it being lower lying, having a higher number of depressions suitable for breeding (land to the south has very few depressions) and the presence of a developed organic ground layer (generally lacking in land to the south of the drainage line).

The grassland environment to the south of the southern drainage line is considered to be unsuitable habitat for the Wallum froglet due to the proliferation of grassland and the general lack of heath species, the poor soil quality and lack of organic layer and general lack of suitable depressions for breeding.

Arthur White is of the opinion that the southern drain and immediate surrounds provides the probable extent of Wallum froglet foraging and dispersal activity on the site, with a potential habitat area extending up to fifty (50) metres on the northern

side of the drain and about thirty (30) metres on the southern side of the drain, as shown in **FIGURE 3**. He also notes that "*it is hard to believe that these areas prove any lasting benefit to Wallum froglets in the area*".

White (2006) considers that Wallum froglets are unlikely to disperse very far along the southern drain, due to decreasing water quality, and notes that dispersal is most likely to be in the area adjacent to the dam at the eastern end of the drainage line (the most favourable habitat on the site, and adjacent to breeding habitat on Lot 7, the neighbouring property to the south).

Slashed heathland present in Area 2 provides several indicators of suitable Wallum habitat: presence of a diverse heath environment, a developed organic ground layer and a small drainage line. However, Wallum froglets have not been recorded in Area 2 in any of the investigations completed by JWA, and Arthur White (2006) considers that this area is unlikely to be used at all by Wallum froglets.

It is considered that the single Wallum froglet record from the north of the site may have been a mis-identified Beeping froglet (*Crinia parinsignifera*), as this part of the site is not considered to constitute habitat for the species.

Following the failure to record Wallum froglets from targeted surveys by JWA (2005) and White (2006), White speculates that Wallum froglets are not permanent residents on the site, and inhabit the site only after particular events (eg. flooding of Moonee Creek) which render conditions suitable for the species. White (2006) also suggests that some records of Wallum froglets on the site may have been mis-identified Beeping froglets.

White also notes that Wallum froglets are unlikely to successfully maintain their presence on the subject site and are likely to be forced to retreat to core habitat areas (ie. off the site) when conditions become unsuitable. The southern drain was identified as habitat more suited for foraging and dispersal, particularly following flooding events when brackish water may be present within the drainline (refer to **FIGURE 3**).

In summary, White's results noted that:

- The best habitat for the Wallum froglet on the site occurs around the southern drainline, and below the dam (within the paperbark community), extending onto Lot 7 (adjacent to the site);
- No breeding habitat occurs on the site;
- The species is not a permanent resident on the site; and
- 'Potential habitat' mapped by CHCC is difficult to support, particularly habitat in the east of the site which is unlikely to be used at all.

5 IMPACTS AND AMELIORATION

5.1 Introduction

This section examines the impacts of the Proposed development with respect to both the Moonee DCP (2004) and site investigations undertaken by JWA. A brief discussion of the impacts and recommended amelioration measures has also been completed.

5.2 Impacts of the Proposed development on Wallum habitat

The investigations undertaken by JWA and Arthur White have considered the mapped Wallum froglet investigation area (CHCC), and the results show that habitat for the species on the site is restricted to the area adjacent to (and including) the southern drainline (**FIGURE 3**), and consists of foraging habitat only. White (2006) notes that no breeding habitat occurs on the site.

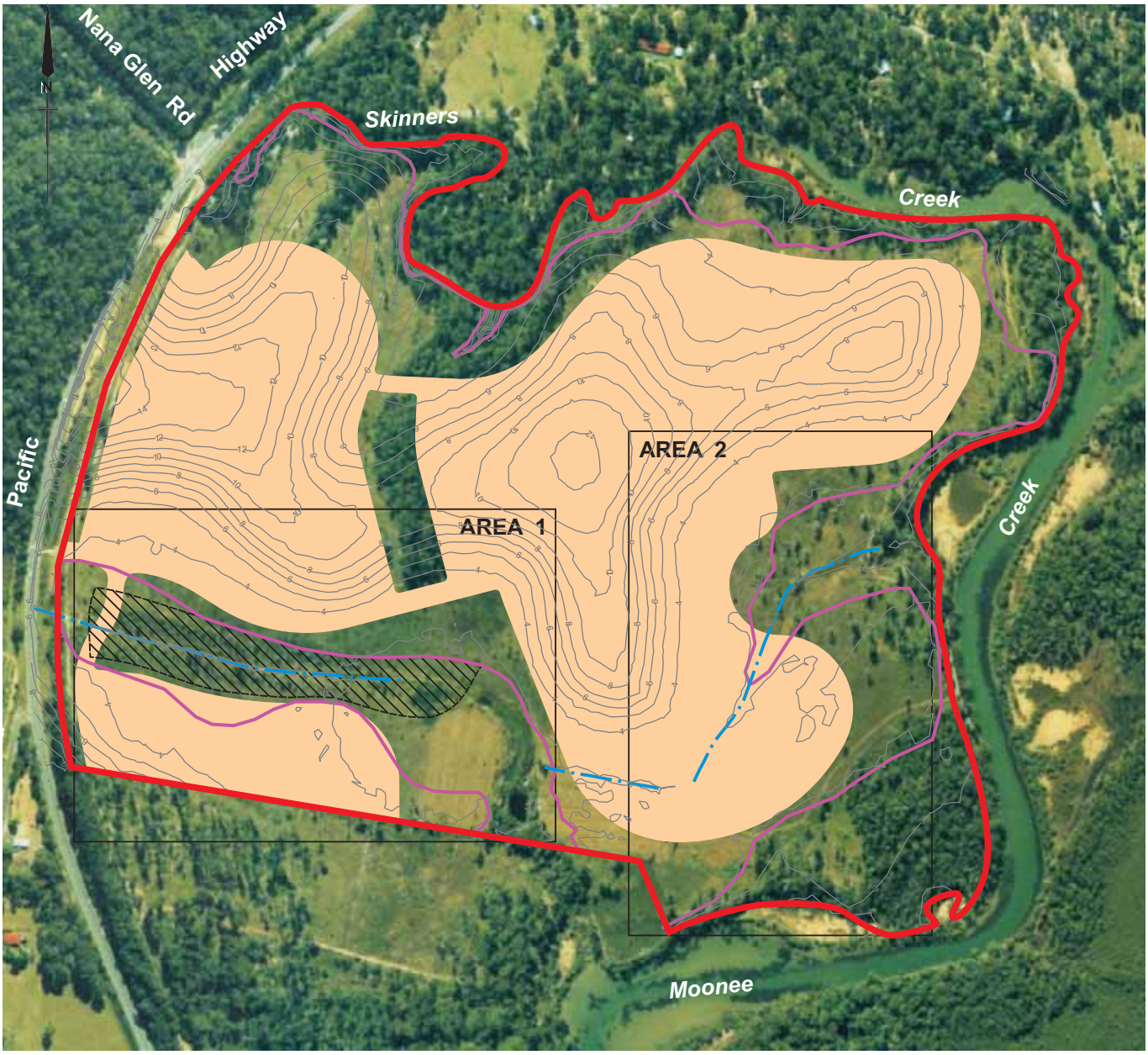
Development of the Subject site in accordance with the proposed development layout (refer to **FIGURE 3**) will result in the loss of 0.29 hectares of Wallum froglet habitat (as mapped by White 2006), which represents a loss of 4.5% of Wallum froglet habitat on the site. The areas to be lost occur at the peripheries of suitable habitat for the species, and their loss is considered likely to place negligible limits on available forage habitat for the species.

While the access road crossing the main drainage line in the south-west of the site has some potential for Wallum froglets being killed by vehicles on the site, this road has been situated as far to the east as possible (after consultation with Coffs Harbour City Council), away from better quality Wallum froglet habitat within the drainage line. This portion of the drain also represents very marginal habitat for the species, and impacts from the access road are not considered likely to be significant.

There is potential for run-off from the access roads both north and south of the drainage line into Wallum froglet habitat. Run-off may contain elevated nutrient levels (nitrogen, phosphorous), and pollutants (oil, petrol), which have the potential to compromise water quality (including the potential for pH change) within the drainage line environment.

Potential environmental impacts on Wallum froglets during the construction and occupation of the proposed development may include:

- Alteration of water quality in drainage lines due to soil runoff from the construction site.
- Alteration of hydrology of the drainage lines due to construction.
- Contamination or reduction of water quality in drainage lines due to runoff from chemicals or debris (fertilisers, etc).
- Introduction of weed species.
- Increased direct mortality due to increased vehicular traffic and construction works.
- Introduction of non-endemic species to the site.



Legend

- Core Wallum froglet habitat (JWA)
- Drain
- Q100 Flood Line (Auspacific Engineers)
- Subject Site

0 10m 20m

SOURCE: JWA Site Investigations & Flood line mapping (Auspacific Engineers)

SCALE: 1 : 8000 @ A4

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Resource Design Management Pty Ltd

PROJECT
Wallum Froglet Assessment
Lots 1 & 2 Dp725785
Pacific Highway, Moonee, NSW
Coffs Harbour City LGA

FIGURE 3

PREPARED: VJA/BW
DATE: 08 November 2007
FILE: 02066_WFA_Habitat.cdr

TITLE
JWA'S MAPPING OF CORE WALLUM FROGLET HABITAT ON THE SITE

- Increased potential for establishment of weeds in neighbouring areas of vegetation.
- Alteration of microhabitats due to loss of vegetation.

5.3 Discussion of impacts

Suitable habitat for the Wallum froglet on the site has been mapped by JWA and White (2006) on the basis of survey records and suitable habitat (refer to **FIGURE 3**). It is considered unrealistic to provide a plan of potential Wallum froglet habitat as the species is likely to disperse widely following heavy rainfall events, and other parts of the site mapped as 'potential' habit' by CHCC have been dismissed by White (2006) as unsuitable for the species. Habitat to be loss is minor and considered unlikely to have any significant impacts on Wallum froglets which may periodically utilise the site.

The amelioration measures in Section 5.4 are considered to reduce any significant impacts on any population of Wallum froglets which may occur on the site.

5.4 Amelioration measures for the Wallum froglet

A number of amelioration opportunities are recommended to protect and conserve Wallum froglet habitat on the site. These amelioration measures include:

- Stormwater management with the aim to achieve no significant net change in runoff into Paperbark communities and areas of mapped Wallum froglet habitat (as discussed in the Gilbert and Sutherland Stormwater Management Plan 2005). Stormwater management should anticipate flood events and may include:

    - Collection and recycling of rainwater for gardens;
    - Re-vegetation of buffer areas;
    - Management of urban runoff ;
    - Temporary management of construction runoff;
    - Use of silt fences and other appropriate measures prior to construction; and
    - Use of diversion bunds between the development area and Wallum froglet habitat area.

- Use of inert fill around roads and batters to reduce the risk of pH change within Wallum froglet habitat.
- Areas of native vegetation around Wallum froglet habitat to be retained and protected.
- Appropriate management of heath. Some periodic thinning of regrowth Paperbark may be required to prevent canopy closure around the drain environment. A closed canopy (over time) is likely to reduce the quality of Wallum froglet habitat around the drainage line.
- Creation of temporary ponding sites for surface water following rain along the southern drain (as discussed in White 2006).

- A Vegetation Management Plan (VMP) has been prepared for the Site. The VMP addresses:
    - Landscape and embellishment plantings;
    - Wetland plantings; and
    - Buffer plantings to embellish riparian vegetation areas where appropriate.

  A weed control program in developed areas and areas of retained habitat should also be implemented.
- Banning of cats in accordance with the *Companion Animals Act (1998)* and strict controls on dogs (ie. all dogs to be contained within a fully fenced enclosure and on a leash at all times when outside of the enclosure).
- Reduction of traffic speed on the site. Following consultation and on-site meetings with CHCC officers, the location of the collector road entering the site from the south has been relocated to abut the Pacific Highway corridor in order to reduce traffic impacts.
- A public education program to raise awareness of potential threats to local endemic species and ecological communities in the area should be implemented.

White (2006) also noted that habitat for the Wallum froglet extends off the site into the neighbouring Lot 7 to the immediate south and states:

> *"There is little value in conserving land on the subject site if access to these areas is cut off or becomes more difficult to cross as a result of changes to the land use in Lot 7. Efforts should be made to create a continuous habitat corridor that includes the section of the Southern Drain below the dam to Moonee Creek".*

In respect to White's comments it is evident that liaison with the adjacent landholder on Lot 7 is necessary to protect connective habitat which services the Subject site.

White also recommends:

- A water quality assessment be completed for water entering the southern drain from the western side of the Pacific Highway, and possible installation of a water treatment system if necessary; and
- A long tem management and maintenance plan be developed for the Wallum froglet habitat area along the southern drain, which should be a consent condition for the development of the site.

6 STATUTORY CONSIDERATIONS

6.1 Introduction

This section includes an assessment of the impacts of the Proposed development on the Wallum froglet with regard to Section 5A of the *Environment Protection & Assessment Act (1979)*.

The species is not listed under the *Environmental Protection and Biodiversity Conservation Act (EPBC Act 1999)*, and therefore does not require assessment.

6.2 Section 5A Assessments (Assessment of Significance)

Under the *Threatened Species Conservation Amendment Act 2002*, the factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species, populations or ecological communities, or their habitats (known previously as the "8-part test"), have been revised. This affects s5A *EP&A Act*, s94 *Threatened Species Conservation Act 1995* (*TSC Act*) and s220ZZ *Fisheries Management Act 1994* (*FM Act*).

The revised factors maintain the same intent but focus consideration of likely impacts in the context of the local rather than the regional environment as the long-term loss of biodiversity at all levels arises primarily from the accumulation of losses and depletions of populations at a local level. This is the broad principle underpinning the *TSC Act*, State and Federal biodiversity strategies and international agreements. The consideration of impacts at a local level is designed to make it easier for local government to assess, and easier for applicants and consultants to undertake the Assessment of Significance because there is no longer a need to research regional and statewide information. The Assessment of Significance is only the first step in considering potential impacts. Further consideration is required when a significant effect is likely and is more appropriately considered when preparing a Species Impact Statement.

The Assessment of Significance should not be considered a "pass or fail" test as such, but a system allowing proponents to undertake a qualitative analysis of the likely impacts and ultimately whether further assessment needs to be undertaken via a Species Impact Statement. All factors must be considered and an overall conclusion must be drawn from all factors in combination. Where there is any doubt regarding the likely impacts, or where detailed information is not available, a Species Impact Statement should be prepared.

(a) In the case of a Threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Extent of the local population
The NPWS database contains one (1) record of the Wallum froglet within 10 kilometres of the Study area. This record is from Hearns Lake, approximately 7km north of the

site. The NPWS database contains five (5) records of the species within the Coffs Harbour LGA, while two (2) additional records are also known (refer to Section 3.2 pp 4 & 5). Following recent survey work by Dr. Arthur White, the species is now known to reside within Moonee Nature Reserve, which occurs adjacent to the site, separated by Moonee Creek.

Following recent site investigations by White (2006) it is apparent that Wallum froglets are not permanent residents of the site and no core population exists on the site itself. Rather, Wallum froglets disperse onto the site when conditions area favourable, or when a flood event occurs.

Stages of the life-cycle affected by the proposed development
Wallum froglets are found only in acid paperbark swamps and sedge swamps of the coastal 'wallum' country (NPWS 2002). Wallum is a banksia-dominated lowland heath ecosystem characterised by acidic waterbodies. This species does not utilise open or free water in swamps but prefers the vegetated, muddy edges of pools, both temporary and permanent (White 1995). Refuge habitat consists of a dense cover of ground vegetation, with interspersed tree canopy cover.

Breeding occurs in late winter in ephemeral sites such as larger puddles in heath or puddles in watercourses and creek-lines (NPWS 2002; White 1995).

As part of the RFA process, Environment Australia (1999) conducted an analysis of the responses of forest fauna to various forms of land cover disturbance in the North-east region. The analysis was based on local expert knowledge and ranked the significance of various forms of disturbance for the Wallum froglet, with the following results:

1st order disturbances	Habitat clearing Wetland swamp drainage for mosquito control Altered hydrology from earthworks
2nd order disturbances	Mining/quarrying
3rd order disturbances	Fish Pollution
4th order disturbances	Tea-tree harvesting

Development of the Subject site in accordance with the proposed development layout will result in the loss of 0.29 hectares of Wallum froglet habitat (as mapped by White 2006), which represents a loss of 4.5% of the Wallum froglet habitat on the site. It is relevant to note that the species will only utilise the site when conditions are appropriate and is unlikely to persist on the site as a resident population due to fluctuating water quality. The retention of approximately 95% of foraging habitat for the species in the south of the site and adoption of amelioration measures is considered to adequately provide for the ongoing use of the site by the Wallum froglet.

Likelihood of local extinction

With the adoption of amelioration measures discussed in Section 5.4, the proposed development is considered unlikely to result in the local extinction of this species.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

Thirty-three (33) endangered populations have been identified under the *TSC Act*. The following endangered populations occur in north-eastern NSW:

- Emu population in the NSW North Coast Bioregion and Port Stephens LGA;
- Long-nosed potoroo population, Cobaki Lakes and Tweed Heads West;
- Low growing form of *Zieria smithii*, Diggers Head; and
- *Glycine clandestina* (Broad-leaf form) in the Nambucca LGA.

The proposed development will not affect any of these endangered populations.

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

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

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

Amelioration measures propose that some periodic thinning of Paperbarks along the southern drainline is necessary to continue to make habitat in this area suitable for the Wallum froglet. Vegetation flanking the southern drainline, while degraded by modification (removal of most structural components, slashing and grazing) is representative of the Endangered Ecological Community – 'Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions'.

Management of this community is considered unlikely to adversely effect the composition of this EEC to any significant degree.

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

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

The proposed development will not result in the loss of any habitat area for the Wallum froglet around the drainage line area to the south of the site.

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

The Proposed development will not further isolate or fragment areas of Wallum froglet habitat on the site. Wallum froglet habitat on the site already exists in relative isolation from any adjacent suitable habitat areas. The southern drainage line will be retained, buffered and allowed to regenerate to provide superior habitat for this species over time.

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

The Wallum froglet habitat on the site comprises foraging habitat only. No breeding habitat occurs on the site. Habitat on the site does not support a permanent population of the Wallum froglet, with the species only likely to utilise the habitat periodically when conditions are suitable. The habitat area is not considered likely to undergo any significant modification or fragmentation which will be to the detriment to the Wallum froglet from the Proposed development.

The Proposed development will not have any impacts on other known Wallum froglet populations or Wallum froglet habitat in the locality.

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

Critical habitat areas listed under the *Threatened Species Conservation Act (2002)* currently consist of habitat for Mitchell's rainforest snail in Stott's Island Nature Reserve, and habitat for the Little penguin population in Sydney's North Harbour.

Neither of these critical habitats will be adversely affected.

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

A Recovery plan has not been prepared for the Wallum froglet.

A Threat abatement plan has been prepared to address predation by the Plague minnow (*Gambusia holbrooki*). This species has been observed to prey upon the eggs and tadpoles of some other frog species, including other *Crinia* species (NPWS 2003). The Plague Minnow is also considered likely to predate upon the tadpoles of the Wallum froglet (in addition to 3 other Threatened frog species) (NPWS 2003).

No *Gambusia* were observed in the drainlines at the site, although it is likely that in times of inundation they dwell within the southern drainline, and it is likely that the

species is established within the central dam on the site (where Wallum froglets are unlikely to occur due to deeper water and the general absence of Wallum vegetation)). Given the diversity of other frog species within the drainline environment, it appears that the impacts of the Plague minnow are relatively minor.

A Threat abatement plan has also been prepared for the Red fox. This species is highly unlikely to have any impacts on the Wallum froglet on the site, and the proposed action is unlikely to increase the impacts of the Red fox on the site.

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

A "threatening process" means a process that threatens, or may have the capability to threaten, the survival or evolutionary development of a species, population or ecological community. Key Threatening Processes have been listed in Schedule 3 of the *TSC Act (1995).*

Key Threatening Processes (Schedule 3):

- Invasion and establishment of exotic vines and scramblers;
- Invasion and establishment of the Cane toad, *Bufo marinus*;
- Invasion of the yellow crazy ant;
- Feral pigs;
- Competition and habitat destruction by feral goats;
- Entanglement in, or digestion of anthropogenic debris in marine and estuarine environments;
- Introduction of the large earth Bumble bee, *Bombus terrestris*;
- Removal of dead wood and dead trees;
- Death or injury to marine species following capture in shark control programs on ocean beaches;
- Invasion of native plant communities by exotic perennial grasses;
- Infection of frogs by amphibian chytrid, causing the disease chytrodiomycosis
- Competition from feral honeybees;
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;
- Clearing of native vegetation;
- Anthropogenic climate change;
- Removal of Bush rock;
- High frequency fire;
- Invasion by Bitou Bush (*Chrysanthemoides monilifera*);
- Loss and/or degradation of sites used for hilltopping by butterflies;
- Predation by the European red fox (*Vulpes vulpes*);
- Predation by the Feral cat (*Felis catus*);
- Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island;
- Predation by the Plague Minnow (*Gambusia holbrooki*);
- Infection of native plants by *Phytophthora cinnamomi;*

- Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations;
- Importation of red imported fire ants into NSW; and
- Competition and grazing by the feral European rabbit.

The proposed development will contribute towards the clearing of native vegetation, a key threatening process listed on Schedule 3 of the *TSC Act (1995)*. The final determination of the NSW Scientific Committee notes that clearing of native vegetation is recognised as a major factor contributing to loss of biological diversity, with impacts such as: destruction of habitat; fragmentation of habitat; riparian zone degradation; increased greenhouse gas emissions; increased habitat for invasive species; loss of leaf litter layer; loss or disruption of ecological function (*e.g.* loss of populations of pollinators or seed dispersers) and changes to soil biota.

A total of approximately 1.5 hectares of mixed grassland and slashed heath will be removed within low lying areas of the site as a result of the proposed development (in addition to the loss of scattered trees within grazing land).

Vegetation loss will result in the loss of 0.29 hectares of Wallum froglet habitat (as mapped by White 2006), which represents a loss of 4.5% of the Wallum froglet habitat on the site. The areas to be lost occur at the peripheries of suitable habitat for the species, and their loss is considered likely to place negligible limits on available forage habitat for the species.

The proposed development includes adequate buffering to Wallum froglet habitat, and under a Vegetation Management Plan will result in significant restoration of the heathland environment on the site, which comprises suitable forage habitat for this species.

The Proposed development is unlikely to increase the impact of any other key threatening processes.

On the basis of this assessment, it is considered that a Species Impact Statement (SIS) is not required.

7 MOONEE DCP (2004)

7.1 Introduction

The Moonee Development Control Plan (DCP) was adopted in September 2004 by Coffs Harbour City Council. Objectives of the DCP were to adopt planning controls in order to achieve economic, social and environmental sustainability within the Moonee release area. Two maps (Maps 4 and 5) included in the DCP indicate constraints and limitations which apply to land within the release area. One of the criteria shown in these maps is the mapping of Wallum froglet habitat, as shown in **FIGURE 1**.

Following the study completed by Arthur White (2006) and field investigations by JWA, it is apparent that the mapping of Wallum froglet habitat is flawed. A discussion of the ramifications of the incorrect mapping follows in Section 7.2.

7.2 Discussion

The Wallum froglet mapping completed by CHCC is considered to be unsuitable for planning purposes and forms a poor basis on which to base any development or environmental considerations. A comparison of the Wallum froglet habitat mapping completed by White (2006) and that shown in the DCP is shown as **FIGURE 4**, where there is a clear incongruity evident. While Wallum froglet habitat within the southern drain is considered to be mapped correctly in part, White also states that this mapping should encompass the entire southern drainline (including the dam and adjacent paperbark community) and off the site into Lot 7 (refer to **FIGURE 3**). In respect to this White (2006) states:

> *"There is little value in conserving land on the subject site if access to these areas is cut off or becomes more difficult to cross as a result of changes to the land use in Lot 7. Efforts should be made to create a continuous habitat corridor that includes the section of the Southern Drain below the dam to Moonee Creek".*

This has ramifications for the recent approval given by CHCC for the construction of a dwelling on Lot 7 adjacent to Wallum froglet habitat (and within mapped 'potential habitat' under the Moonee DCP). In this respect the Moonee DCP has clearly failed to protect Wallum froglet habitat by approving this dwelling, and whether the area of breeding habitat identified by White on Lot 7 remains viable in the long term is difficult to determine. It is obviously apparent that any vegetation management or stormwater overflow on Lot 7 has a significant risk of affecting Wallum froglet breeding habitat, and hence the available foraging habitat on the Subject site itself. It is highly likely that over time, degradation by weed growth, edge effects and possible siltation will render both Lot 7 and the Subject site unsuitable habitat for the Wallum froglet. This frustrates the efforts being made by the Winten Group to provide for long term conservation of habitat for the species on the Subject site.

In regard to the 'potential habitat' mapped for the Wallum froglet under the DCP, this is considered to be misleading and inaccurate. White states that the eastern area of

'potential habitat' for the Wallum froglet is unlikely to be used at all by the species, while 'potential habitat' in the west of the site is considered to have little habitat value for the species, particularly as the best foraging habitat occurs within and adjacent to the southern drainline itself.

In summary, JWA consider that the Wallum froglet habitat mapping in the current DCP requires revision to reflect the current knowledge of Wallum froglet habitat on the Subject site and neighbouring lots to the south. Provision of the DCP with the current Wallum froglet mapping is considered misleading and unlikely to provide any useful data for future planning or environmental outcomes.

8 SUMMARY AND CONCLUSIONS

James Warren and Associates have been engaged by the Rothwell Boys to complete a Flora and Fauna Assessment of land at Lots 1 & 2 DP 725785 Pacific Highway, Moonee as part of a residential subdivision.

The site covers an area of approximately 96 hectares and fronts the eastern side of the Pacific Highway. The majority of the site consists of cleared grazing land with scattered trees. The site is flanked to the east by Moonee Creek, and to the north by Skinners Creek. A variety of types of remnant native vegetation flanks both these watercourses.

Surveys of the site by JWA have recorded a total of ten (10) Threatened fauna species, including the Wallum froglet (*Crinia tinnula*)*.

*Identification uncertain. See Bisosphere Environmental Consultants (2006) in **ANNEXURE 1.**

The aim of this additional report is to:

- Provide an assessment of the potential Wallum froglet habitat investigation area which has been mapped by Coffs Harbour City Council (CHCC) as part of the Moonee Development Control Plan (Moonee DCP 2004);
- Address the likely impacts of the proposed development on the Wallum froglet (*Crinia tinnula*) habitat on the site; and
- Complete an Assessment of Significance (7 part test) as required under Section 5A of the *Environmental Planning & Assessment Act* (*EPA Act 1979*) for the Wallum froglet.

The proposed development involves a 534 residential lot development with associated curtilage, Fire protection Zones, Open space and Road access.

JWA are of the opinion that habitat mapping for the Wallum froglet on the Subject site completed by Coffs Harbour City Council for the Moonee DCP (2004) is flawed and does not adequately reflect suitable habitat available on the site for the Wallum froglet. Sporadic results for the species from a number of field surveys on the site suggested that the Wallum froglet was not a permanent resident on the site. Dr. Arthur White completed a Wallum froglet survey on the site in July 2006 and did not record the species. He concluded that Wallum froglets utilise the site periodically when conditions are favourable, and that no breeding habitat occurred on the site, although potential breeding habitat did occur on neighbouring land to the south (Lot 7). White also noted that 'Potential habitat' mapped by CHCC is difficult to support, particularly habitat in the east of the site which is unlikely to be used at all.

As a result of field investigations, it is considered that the southern drain and adjacent land to the north and south comprise dispersal and forage habitat for the Wallum froglet on the site. White (2006) notes that no breeding habitat occurs on the site.

Development of the Subject site in accordance with the proposed development layout will result in the loss of 0.29 hectares of Wallum froglet habitat (as mapped by White 2006), which represents a loss of 4.5% of the Wallum froglet habitat on the site. The areas to be lost occur at the peripheries of suitable habitat for the species, and their loss is considered likely to place negligible limits on available forage habitat for the species.

Without adequate protection, urban development may potentially impact on the habitat of the Wallum froglet in the following ways:

- Alteration of water quality in drainage lines due to soil runoff from the construction site.
- Alteration of hydrology of the drainage lines due to construction.
- Contamination or reduction of water quality in drainage lines due to runoff from chemicals or debris (fertilisers, etc).
- Introduction of weed species.
- Increased direct mortality due to increased vehicular traffic and construction works.
- Introduction of non-endemic species to the site.
- Increased potential for establishment of weeds in neighbouring areas of vegetation.
- Alteration of microhabitats due to loss of vegetation.

It is considered that the proposed development of the Subject site in accordance with the proposed layout will retain areas of habitat for the Wallum froglet to ensure the continued survival of the species provided that the following amelioration measures are implemented.

- Stormwater management with the aim to achieve no significant net change in runoff into Paperbark communities and areas of mapped Wallum froglet habitat (as discussed in the Gilbert and Sutherland Stormwater Management Plan 2005). Stormwater management should anticipate flood events and may include:

    - Collection and recycling of rainwater for gardens;
    - Re-vegetation of buffer areas;
    - Management of urban runoff ;
    - Temporary management of construction runoff;
    - Use of silt fences and other appropriate measures prior to construction; and
    - Use of diversion bunds between the development area and Wallum froglet habitat area.

- Use of inert fill around roads and batters to reduce the risk of pH change within Wallum froglet habitat.

- Areas of native vegetation around Wallum froglet habitat to be retained and protected.
- Appropriate management of heath. Some periodic thinning of regrowth Paperbark may be required to prevent canopy closure around the drain environment. A closed canopy (over time) is likely to reduce the quality of Wallum froglet habitat around the drainage line.
- Creation of temporary ponding sites for surface water following rain along the southern drain (as discussed in White 2006).
- A Vegetation Management Plan (VMP) has been prepared for the Site. The VMP addresses:
    - Landscape and embellishment plantings;
    - Wetland plantings; and
    - Buffer plantings to embellish riparian vegetation areas where appropriate.

  A weed control program in developed areas and areas of retained habitat should also be implemented.
- Banning of cats in accordance with the *Companion Animals Act (1998)* and strict controls on dogs (ie. all dogs to be contained within a fully fenced enclosure and on a leash at all times when outside of the enclosure).
- Reduction of traffic speed on the site. Following consultation and on-site meetings with CHCC officers, the location of the collector road entering the site from the south has been relocated to abut the Pacific Highway corridor in order to reduce traffic impacts.
- A public education program to raise awareness of potential threats to local endemic species and ecological communities in the area should be implemented.

White (2006) also noted that habitat for the Wallum froglet extends off the site into the neighbouring Lot 7 to the immediate south and states:

> *"There is little value in conserving land on the subject site if access to these areas is cut off or becomes more difficult to cross as a result of changes to the land use in Lot 7. Efforts should be made to create a continuous habitat corridor that includes the section of the Southern Drain below the dam to Moonee Creek".*

In respect to White's comments it is evident that liaison with the adjacent landholder on Lot 7 is necessary to protect connective habitat which services the Subject site.

White also recommends:

- A water quality assessment be completed for water entering the southern drain from the western side of the Pacific Highway, and possible installation of a water treatment system if necessary; and

- A long tem management and maintenance plan be developed for the Wallum froglet habitat area along the southern drain, which should be a consent condition for the development of the site.

An Assessment of Significance (7 part test) (under Section 5A of the *EPA Act 1979*) was completed for the Wallum froglet. The assessment concluded that with the adoption of suggested amelioration measures, the proposed development is unlikely to result in the local extinction of this species, and a Species Impact Statement (SIS) is not required.

REFERENCES

Barker, J., Grigg, G. C., and Tyler, M. J. (1995) A Field guide to Australian frogs. Published by Surrey Beatty & Sons, Chipping Norton, NSW.

Coffs Harbour City Council (2004) Moonee Development Control Plan.

http://www.coffsharbour.nsw.gov.au/asset/1/upload/Moonee_DCP4.PDF

Cogger, H. G. (2000) Reptiles and Amphibians of Australia. 6th ed. Reed Books, Frenchs Forest, NSW.

Ehmann, H. (1997) (Ed.) Threatened frogs of New South Wales: Habitats, Status and Conservation. Pp.48-55. Frog and tadpole Study Group of NSW Inc.

Environment Australia (1999). Response to Disturbance of Forest Species in CRA Regions in NSW – Upper North East and Lower North East Regions.

Gilbert and Sutherland (2005). Amended stormwater assessment of the proposed residential development. The Glades Moonee Beach at Moonee Beach, Coffs Harbour. Prepared for the Winten Group Pty Ltd.

James Warren and Associates (2003) A Preliminary Study for Lots 1 & 2 DP 725785 Pacific Highway, Moonee. A report to Winten Property Group.

James Warren and Associates (2004) Flora and Fauna Assessment - Lots 1 & 2 DP 725785 Pacific Highway, Moonee. A report to Winten Property Group.

Landmark Ecological Services (1999) Byron Flora and Fauna Study. A report prepared for Byron Shire Council.

Mary Maher & Associates and Tim Low (1997). Conservation Assessment and Management of Coastal Bushland Remnants. Volume 1. Report to Maroochy Shire Council.

NSW NPWS (1995) Vertebrates of Upper North East New South Wales. A Report by NSW National Parks and Wildlife Service for the Natural Resources Audit Council.

NSW National Parks & Wildlife Service (2002) Threatened Species of the Upper North Coast of New South Wales – Fauna. Threatened Species Unit, Conservation Programs & Planning Division, Northern Directorate, Coffs Harbour.

NSW National Parks & Wildlife Service (2003) Approved NSW Threat Abatement Plan – Predation by *Gambusia holbrooki* - the Plague Minnow.

http://www.nationalparks.nsw.gov.au/PDFs/Threat_Abatement_Plan_Plaque_Minnow.pdf

NSW Scientific Committee (1999) Wallum froglet – vulnerable species listing.

http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Wallum+froglet+vulnerable+species+listing

NSW Scientific Committee (2004) Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions – endangered ecological community listing.

http://www.nationalparks.nsw.gov.au/npws.nsf/Content/swamp_schlerophyll_endangered

Pyke, G. H. & White, A. R. (2006) Patterns of use of breeding habitat for two closely-related Australian frogs, *Crinia tinnula* and *C. signifera*. Submitted as draft to the Journal of Herpetology.

Queensland Museum (1999) 'Disappearing frogs'.

http://www.qmuseum.qld.gov.au/features/frogs/disappearingfrogs.asp

Straughan, I.R. and Maine (1966). Queensland frogs. (Unpublished PhD thesis, University of Queensland, St Lucia).

White, A. W. & Pyke, G. H. (2005) Habitat and Movements of the Wallum Froglet Crinia tinnula at the Southern end of its Range. Unpublished paper.

White, A. W. (2006) Wallum Froglet Survey Lots 1 and 2 DP 725785 Moonee Beach.

Wildlife Preservation Society of Queensland (2003) Wallum froglet.

http://branches.wildlife.org.au/bayside/wildlife/amphibians/wallum.html

ANNEXURE 1

WALLUM FROGLET REPORT BY DR. ARTHUR WHITE (AUGUST 2006)

Biosphere Environmental Consultants Pty Ltd
Dr. Arthur White - ph & fax: (02) 9599 1161

Mail Address: 69 Bestic St. Rockdale NSW 2216 A.C.N. 065 241 732
e-mail :awh41103@bigpond.net.au A.B.N. 32 065 241 732

Wallum Froglet Survey
Lots 1 and 2 DP 725785
Moonee Beach

1.0 Introduction

Lots 1 and 2 occupy about 96 Ha of land between the Pacific Highway and Moonee Creek near Moonee Beach (Figure 1). Most of the site has been cleared for grazing and relatively little intact ground vegetation cover remains. Observations of Wallum Froglets *Crinia tinnula* have been made on the site and potential habitat for this species has been mapped by Coffs Harbour City Council (CHCC) as part of the Moonee Development Control Plan (2004).

Surveys for Wallum Froglets on the subject land have not always detected these frogs; furthermore, the surveys have yielded starkly differing assessments of the ground frog fauna on the site. In February 2003, the first record of Wallum Froglets being on the site was made by Mark Free of James Warren and Associates, as part of a preliminary site survey. Wallum Froglets were reported to be calling a wet area in the northern part of the site (near Site 50 Figure 2). No froglets were captured, nor were tape recordings made of the calls. An unverified record of Wallum Froglets was also made by Mark Free from the southern drain.

The next reported sighting took place during an on-site meeting in 2004 between Mark Graham (CHCC), DEC representatives, James Warren and Ken Maguire. Mark Graham (CHCC) recorded hearing Wallum Froglets calling in the Southern Drain. Again, no froglets were captured or tape recordings made of the calls. In the same year, however, during an extensive flora and fauna assessment of the site, Wallum Froglets were not detected anywhere on the site (Warren 2004). Later in 2004 (June), a single Wallum Froglet was heard calling from the buffer area on the northern side of the Southern Drain (I Colvin pers. comm.).


Pacific Highway
Skinners Creek
Southern Drain
Eastern Drain
Dam
Lot 7
Moonee Creek
Moonee Beach
Nature Reserve

FIGURE 1


K50
K38
K39-42
K31-36
K43-45
K1-10
K11-22
K23-30
K47-49
K37
OS9-10
OS5
OS8
OS6
OS7
Moonee Beach
Nature Reserve

FIGURE 2

In 2005 (J. Warren), targeted surveys for Wallum Froglets failed to locate any Wallum Froglets on the site, but the closely related Beeping Froglet *Crinia parinsignifera* was found in relatively high numbers. These froglets were scattered along the Southern Drain and in several other parts of the site. This survey relied on the presence of calling froglets and the use of playback recordings to elicit calling by Wallum Froglets as the means of detection. Recordings were made during this survey. Survey conditions were favourable and the failure to detect any Wallum Froglets was not expected. In 2006, further surveys by field biologists working for James Warren again failed to locate any Wallum Froglets but did detect Beeping Froglets.

The conflicting survey results has caused some concern about the true status of Wallum Froglets on the subject land, and the extent to which conservation measures should be enacted to cater for this species.

In July 2006, Dr Arthur White of Biosphere Environmental Consultants Pty Ltd was engaged by the developer to carry out an independent survey of the site. The survey had several aims, including:

1. to determine if Wallum Froglets are currently on the site
2. to assess whether Wallum Froglets may have occurred on the site in the past, and
3. to assess the extent of Wallum Froglet habitat on the subject site and surrounding lands.

These surveys were undertaken in late July 2006 during a period of sustained rainfall in the Coffs Harbour area and during the breeding season of the Wallum Froglet.

2.0 Description of Subject Land

The site is a roughly rectangular parcel of land (Figure 1). The site is low-lying with gentle hills occupying the northern section of the site. The general elevation of the site varied between 0 and 10 metres asl. The lower parts of the site are flood-prone and some of these areas become quite sodden after rain. The rainfall events that occurred prior to and during the current survey led to the formation of numerous small pools across the site; most of these were sampled during the tadpole surveys and their position is given on Figure 1.

Drainage lines have been established across the site at different times; the largest drain is the Southern Drain (Figure 1). This drain varies from between 3 and 5 metres wide and is approximately 1 metre below ground surface level. This drain collects runoff from agricultural land to the west of the subject land, as well as surface runoff from the subject site. The drain has been known to overflow after periods of exceptionally heavy rain. Flooding appears to results from the backflow of water up the drain as a result of the large water flows in Moonee Creek (G. Leonard CHCC pers comm.). Flooding under these circumstances may push brackish water back up the drain and spillover onto low-lying land on either side of the drain.

Water was flowing downstream in the Southern Drain at the time of the survey. Various species of sedges line the base of the drain along most of its course. The drain eventually discharges into a dam near the fence boundary with Lot 7. At the time of the survey, the dam was also spilling over to create a large boggy area below the dam face on Lot 7. This area has tall Broad-leaved Paperbarks trees *Meleleuca quinquenenervia* growing over a sedge and fern understorey.

In the south-eastern corner of the site were paddocks that have been used as part of a turf farm. Minor drains run across this part of the site and directs surface water into Moonee Creek. These drains are overgrown by grasses and are only 10 to 20 cms deep.

A more substantial drain is present in the eastern portion of the site (referred to as the Eastern Drain in Figure 1). This drain collects surface water from the eastern part of the site and discharges directly into Moonee Creek. The drain is lined in many places by sedges.

The only other "wet" area on the site occurs in the northern part of the site where a boggy area has formed in a low valley. Paperbarks and sedges grow here. Water pools here after rain but open water does not appear to remain in this area for long.

The rest of the site consists of pasture land with isolated tress. A small stand of dense trees occur in the northern part of the site (near K 50; Figure 2).

3.0 Methods

2.1 Weather Conditions

Weather conditions in the Coffs Harbour area were very favourable for Wallum Froglet surveys. Rain fell in the area on the 24th of July as scattered showers. Showers persisted during the two days of the current survey (i.e. the 25th and 326th of July with sunny weather returning on the morning of the 27th of July. Prior to this wet period, there had been no substantial rain in the Coffs Harbour area until mid-June when over 60 mm of rain fell.

Air temperatures during the survey period were also favourable for the survey; air temperatures on the 25th of July ranged from 10° to 17°, while they ranged from 9° to 16° on the 26th of July 2006. The water temperature in the upper water layer of the dam was 9° and was 10° in the Southern Drain near K 23 (Figure 2).

2.2 Adult Wallum Froglet Survey

Field surveys were carried out during the day and nights of the 25th and 26th of July 2006. During the day of the 26th of July, the site was traversed on foot. All

areas where freshwater had pooled or there were patches of potential habitat for Wallum Froglets were searched during the day. At each site, the calling ground frogs were noted and playback recordings of the mating call of the Wallum Froglets was played from a small hand-held amplifier.

During the night of the 25th and 26th of July, the sites were revisited and again calling surveys and playback recordings used to detect Wallum Froglets. At the completion of each call session, a ground search was done for all Crinia species; these were caught and placed in a plastic bag. Once the site had been satisfactorily searched, the froglets were taken out of the bag and examined individually, identified and released.

This procedure was used for all off-site search areas as well as those on-site.

2.3 Tadpole Survey

Every freshwater body that was more than 3 cms deep was netted using a small hand net (mesh 2 mm). Tadpoles that were captured were transferred to a clear plastic bag and identified using Anstis (2002) and released. Some tadpoles could not be identified as these were to small and had not developed the distinguishing features needed to satisfactorily identify them.

2.4 Habitat Assessment

Wallum Froglet habitat was assessed and mapped according to the criteria in Pyke and White (2006). In general, this species is most often associated with acid Paperbark swamps and sedge swamps of the coastal 'wallum' country in the northern end of its range (Lewis 1996). It typically occurs on low nutrient soils of coastal lowlands and sand islands (Hines *et al* 1999).

Distribution of the Wallum Froglet is determined by the pH of its habitat and it prefers pH levels of 5.5 (Pyke and White 2006) and the regularity of rain days (Robinson 2004). This species often inhabits sedge tussocks that line the acidic waterbodies of lowland heath ecosystems. Ground vegetation can be sedgeland, fernland or wet heath, but permanent or near permanent freshwater sources must be within 200 metres of these habitat areas. Breeding habitat typically consists of shallow, acidic (often tannin-stained) water sites that are associated with a deep humic layer (Pyke and White 2006).

2.5 Off-site surveys

Off-site surveys were conducted in six areas; namely:

1. Moonee Beach Nature Reserve (OS 5,6,7 and 8)
2. Lot 7 Moonee Beach (this lot is immediately south of the subject land and receives all of the flow-through water from the southern drain (OS 9 and 10).
3. Coffs Creek Link Road Site (off Brodie Drive) (OS 1)

4. Coffs Harbour Health Campus Site (Newports Creek) (OS 4)
5. Christmas Bells Road, Coffs Harbour Airport (OS2).
6. Wallum area on western side of Hogbin Drive, south of the airport (OS 3).

OS 1, OS 2 and OS 4 are areas where Walum Froglest have been previously reported. The purpose of visiting these sites was to see if Wallum Froglets were active, calling or responsive to playback tapes. Lot 7 was assessed as habitat appeared to extend off the subject land onto Lot 7; the Moonee Beach Nature Reserve was surveyed as breeding habitat for Wallum Froglets was not identified in the local area and the Nature Reserve appeared to contained potential Habitat (although Wallum Froglets have not been reported from the Nature Reserve).

4.0 Results

4.1 Survey Sites

As most of the potential frogs are were associated with flooded ditches or swales, their locations have been noted on Figure 2. Frog and tadpole surveys were carried out at each of these sites.

4.2 Adult Wallum Froglets

No Wallum Froglets were seen or heard on the site. Two other species of *Crinia*, *C. signifera* and *C. parinsignifera* were calling loudly and from many locations across the site. *C. parinsignifera* was making the single note mating call as well as protracted advertisement calls that resemble the beginnings of the mating call of *C. tinnula*. For this reason, extra efforts were made to collect as many of the *Crinia* from each site as possible.

Wallum Froglets were stimulated to call from two off-site locations using play-back recordings; these sites were a heath area alongside Christmas Bell Road near the Coffs Harbour airport (OS 2), and a paperbark/ sedgeland area on the western side of the Moonee Beach Nature Reserve (OS 6; Figure 2). Table 1 lists the frogs that were detected during the *Crinia* searches.

Table 1

SITE No.	DESCRIPTION	AMG	FROGS	TADPOLES
K1	N of southern Drain	514063 6659623	CS	Nil
K2	N of southern Drain	514061 6659612	CS	Nil
K3	N of southern Drain	514069 6659606	Nil	Nil
K4	N of southern Drain	514654 6659605	CS	CS
K5	N of southern Drain	514080 6659585	Nil	Cs
K6	N of southern Drain	514638 6659588	Nil	Nil
K7	N of southern Drain	514040 6659574	CS	Nil
K8	N of southern Drain	514041 6659570	CP, CP	CS, CP
K9	N of southern Drain	514047 6659562	CS	?
K10	Southern Drain	514064 6659529	CS, CP	CS, ?
K11	N of southern Drain	514128 6659514	CS	Nil

K12	N of southern Drain	514125 6659527	CS, CP	CS, CP. ?
K13	N of southern Drain	514164 6659517	CS	Nil
K14	N of southern Drain	514172 6659512	CS	C, ?
K15	N of southern Drain	514182 6658511	CS, CP	Nil
K16	N of southern Drain	514189 6659537	Nil	CS
K17	N of southern Drain	514207 6659526	Nil	NIl
K18	N of southern Drain	514240 6659489	CS	CS, ?
K19	N of southern Drain	514255 6659500	CS	Nil
K20	N of southern Drain	514274 6659524	CS, CP	CS, ?
K21	N of southern Drain	514305 6659510	CS	Nil
K22	N of southern Drain	514310 6659490	Nil	Nil
K23	Southern Drain	514293 6659474	CS	CS, ?
K24	N of southern Drain	514316 6659484	CS	CS
K25	N of southern Drain	514330 6659486	CS	Nil
K26	N of southern Drain	514349 6659481	CS	Nil
K27	N of southern Drain	514373 6659485	Nil	Nil
K28	N of southern Drain	514391 6659488	CS	CS
K29	N of southern Drain	514435 6659486	CS	Nil
K30	N of southern Drain	514460 6659474	CS, LF, SMF	CS, ?
K31	N of Dam Site	514477 6659461	CS	Nil
K32	N of Dam Site	514520 6659512	CS, CP	Nil
K33	N of Dam Site	514454 6659536	CS	CS, ?
K34	N of Dam Site	514552 6659544	CS	Nil
K35	N of Dam Site	514562 6659572	CS	CS
K36	N of Dam Site	514546 6659531	CS	CS, ?
K37	Dam	514543 6659450	CS, LF, SMF	CS, ?
K38	Northern Road	514544 6659706	CS, CP	?
K39	NE plain	514452 6659844	CS	CS
K40	NE Plain	514969 6659748	CS, CP	CS, CP, ?
K41	NE Plain	514946 6659734	CS	Nil
K42	NE Plain	514927 6659711	CS	Nil
K43	Eastern Drain	514907 6659638	CS	CS, ?
K44	NE Plain	514918 6659624	CS	Nil
K45	NE Plain	514931 6659610	CS	Nil
K46	NE Plain	514953 6659588	CS	Nil
K47	Eastern Area	514925 6659556	CS	CS
K48	Eastern Area	514913 6659520	CS, SGF	CS, ?
K49	Eastern Area	514904 6659481	Nil	Nil
K50	Northern Area	514476 6659909	CS	Nil
OS1	Coffs Creek Rd Res.	512121 6647886	CS, LF	CS
OS2	C'mas Bell Rd Airport	511940 6646128	CS, CT	?
OS3	Hogbin Drive	510334 6645689	CS	CS, ?
OS4	Hospital Site	508905 6645886	CS	Nil
OS5	Moonee Beach NR	515406 6659751	CS	CS, ?
OS6	Moonee Beach NR	515376 6659412	CS, CT	CS
OS7	Moonee Beach NR	515272 6659112	CS	CS, ?
OS8	Moonee Beach NR	515742 6659764	CS, SMF	CS
OS9	Lot 7 Below Dam	514566 6659278	CS	CS, ?
OS10	Lot 7 Below Dam	514570 6659184	CS	CS, ?

Code Used:
CS = Crinia signifera Common Eastern Froglet
CP = Crinia parinsignifera Beeping Froglet
CT = Crinia tinnula Wallum Froglet
SMF = Limnodynastes peronii Striped Marsh Frog
SGF = Limnodynastes tasmaniensis Spotted Grass Frog
LF = Litoria fallax Eastern Dwarf Tree Frog
? = tadpole too small to be identified

4.3 Tadpole Surveys

Tadpoles were collected at 16 sites on the subject land (Table 1). The tadpoles were in two obvious size classes; tadpoles with a body length of about 5 mm (these tadpoles were estimated to be about 4 to 5 weeks old), and very small tadpoles that were 2-5 days old. The smaller tadpoles could not be identified as they were too small. All of the larger (older) tadpoles were either *C. signifera* or *C. parinsignifera* (Table 1).

4.4 Habitat Assessment

No breeding habitat areas for Wallum Froglets were found on the subject land. Potential breeding habitat was present in Lot 7 (at OS9 and OS10) a well as three sites in the Moonee Beach nature Reserve (OS 5, OS 6, OS7).

Foraging and dispersal habitat was present on the subject land and this was confined to the lower section of the Southern Drain and low-lying sites within 50 m of the drain. The approximate extent of this habitat is indicated on Figure 3.

FIGURE 3

4.5 Off-site Wallum Froglet Activity

Although weather conditions were very favourable for the Wallum Froglet survey, no unassisted calling was heard by Wallum Froglets on or off the site. Wallum Froglets did respond to playback calls at two locations off-site: namely OS2 (Airport) and OS5 (Moonee Beach Nature Reserve).

5.0 Discussion

5.1 Presence of *Crinia tinnula* on the Subject Land

The failure to locate Wallum Froglets and the apparent absence of breeding habitat on site initially indicated that this species was not present on the site. If this was the case, the previous identifications of Wallum Froglets on the basis of the heard calls must be queried. The widespread occurrence of the Beeping Froglets *C. parinsignifera* provides many opportunities for call misidentification. In the absence of voucher specimens or recorded calls, the misidentification of some (or all) of the claimed Wallum Froglets calls can be challenged.

However, I do not discount all of the identifications and believe that some of them were made by Wallum Froglets. In the absence of calling habitat and the high number of competing Crinia species, it is unlikely that Wallum Froglets can successfully maintain their presence on the subject land. It is more likely that Wallum Froglets periodically are able to invade the subject land but that they ultimately cannot remain on site permanently and are forced to retreat to core habitat areas. The most feasible access route for Wallum Froglets onto the subject land is via the downstream section of the Southern Drain, below the overflow of the dam (i.e from Lot 7). The areas below the dam contains potential breeding habitat as well as potential refuge habitat. This area was surveyed on the night of the 26th of July and no Wallum Froglets were detected there.

Based on the field surveys, its appears that the southern part of the subject land, around the Southern Drain is more suitable for the other two Crinia species than for Wallum Froglets. This is because the area around the drain contains ephemeral sites that lack an organic layer and have scant ground cover. These characteristics would suit *C. signifera* the best, but also Beeping Froglets during conditions of regular rainfall. For Wallum Froglets to utilise this area, the other two Crinia species would need to be displaced this could happens, for example, when Moonee Creek backs up and brackish water enters the Southern Drain. While the saline influence is present, Wallum Froglets would be better able to enter the drain and use some of the surrounding areas. As freshwater conditions return, the balance would slowly favour the other two species of Crinia at the expense of Wallum Froglets. It appears that the last time that these circumstances occurred was in November 1996 (K. Maguire pers comm..).

5.2 Extent of Wallum Froglet Habitat

In Figure 3 I have indicated the probable extent of Wallum Froglet foraging and dispersal activity. Under favourable conditions, Wallum Froglets could move up the Southern Drain and venture out onto the low-lying areas on either side of the drain. It is unlikely that they would venture far up the drain as the further west they travelled, the more they would experience the discharge water from the grazing properties on the western side of the Pacific Highway. Dispersal of Wallum Froglets is easier in the area immediately north of the dam (Figure 3).

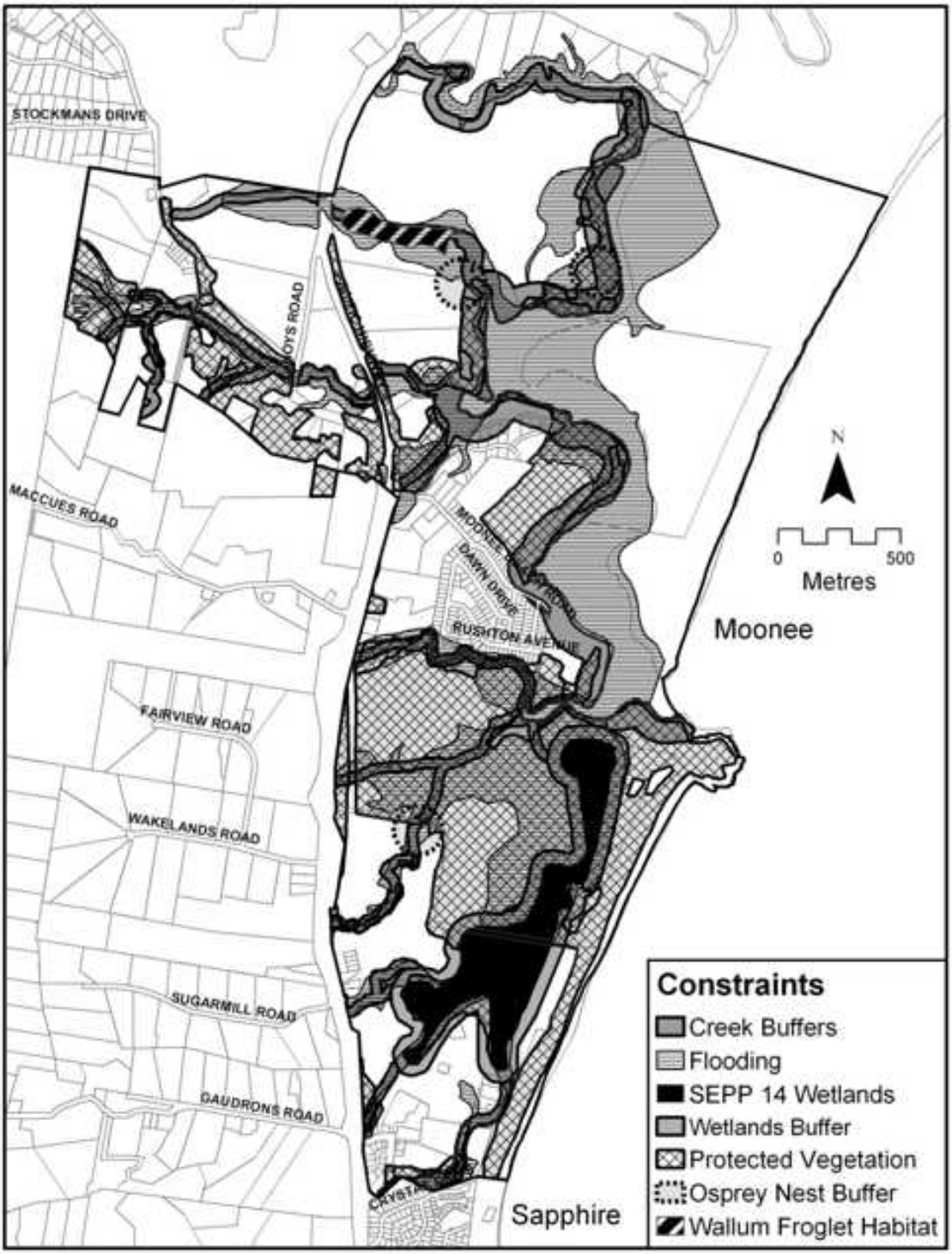
The Moonee DCP (2004) presents figures that depict areas of habitat (Figure 4 DCP) and potential habitat (Figure 5 DCP) for the Wallum Froglet. Figure 4 depicts the entire length of the Southern Drain and immediate surrounds as habitat. I generally concur with this interpretation, but differ in that I would also extend the area of habitat below the dam and across Lot 7. (Figure 3 this report) as well as discounting the area at the western end of the Southern Drain. The area indicated as potential habitat in the DCP is more difficult to support. In particular, a large area along the eastern part of the site is indicated as potential habitat; I think that this area is unlikely to be used at all as it is predominately grassland with no refuge areas on either side. Access to this area is also difficult and there are no obvious movement corridors to allow Wallum Froglets to reach this area.

Areas on either side of the Southern Drain may be reached by Wallum Froglets under very favourable circumstances but it is hard to believe that these areas prove any lasting benefit to Wallum Froglets in the area. I would support a potential habitat area extending up to about 50 metres on the northern side of the drain, and about 30 metres on the southern side of the drain (Figure 3).

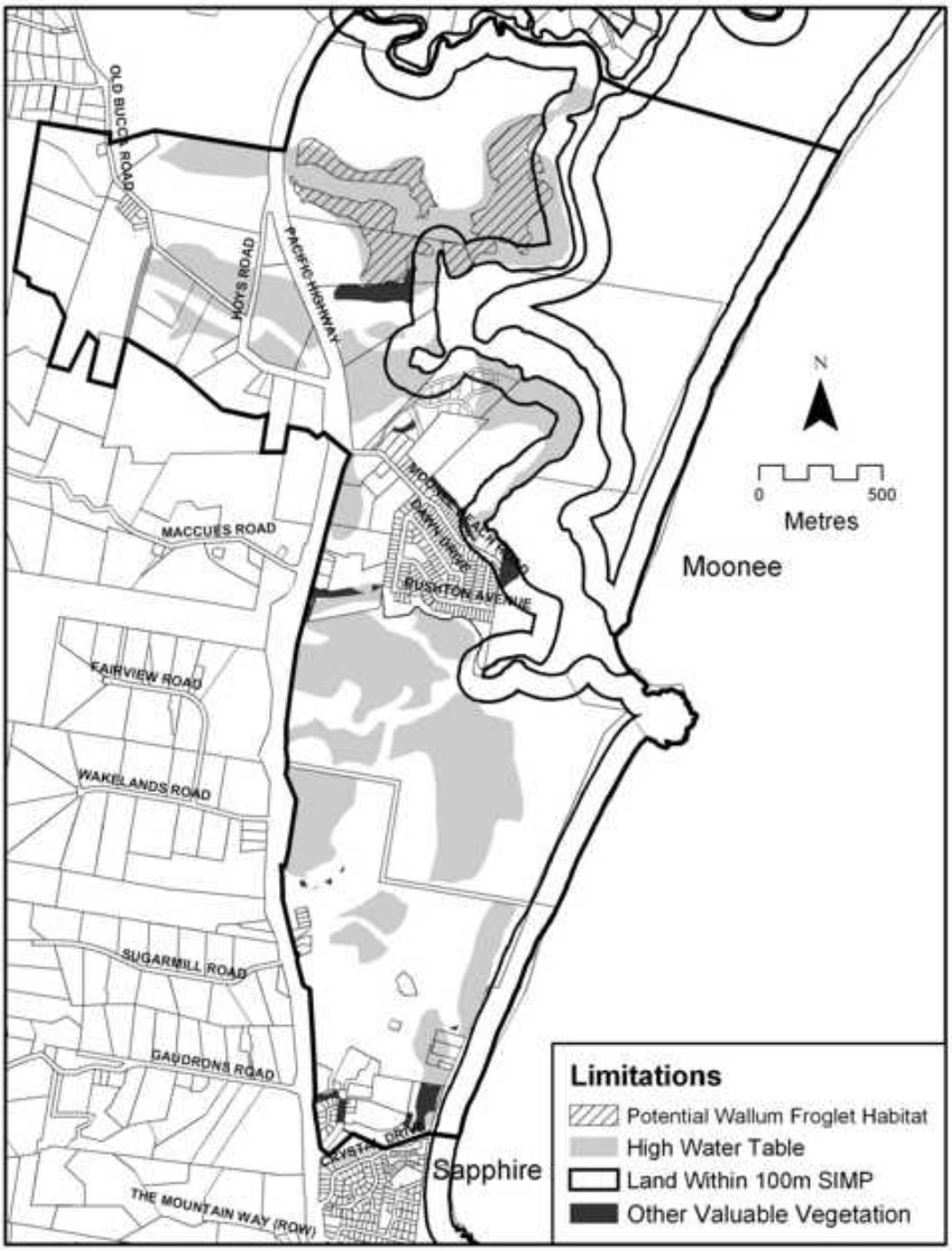
5.3 Conservation Issues

It is important to note that habitat for Wallum Froglets extends off-site into Lot 7. There is little value in conserving land on the subject site if access to these areas is cut off or becomes more difficult to cross as a result of changes to the land use in Lot 7. Efforts should be made to create a continuous habitat corridor that includes the section of the Southern Drain below the dam to Moonee Creek

The other issue relates to water quality. Under periods of low water flow, the water that enters the Southern Drain emanates from properties on the western side of the Pacific Highway. The quality of this water will changes under conditions of low flow and may render the Southern Drain unusable by Wallum Froglets. An assessment of the water quality in the Southern Drain should be carried out, and a water treatment scheme adopted if required.



MAP 4
CONSTRAINTS



MAP 5
LIMITATIONS

The proposed re-development of the subject land may also influence run-off water that reaches the Southern Drain. Urban run-off may contain petro-chemicals, detergents and other household chemicals that are lethal or injurious to frogs. The development proposal includes measures to divert runoff from the residential areas and use in-ground filtration to treat the water before it reaches the southern drain. It is recommended that a bund be created on either side and parallel to the Southern Drain; the bund should be installed when earthworks are due to commence on site, The bund may also be the location for silt fences that will later be erected when works are due to begin. A permanent bio-retention swale is proposed to be created to divert surface run-off when the residential lots are being developed (Gilbert and Sutherland 2005). This system should be sufficient to deal with site run-off both during and after site works.

6.0 Conclusion

The present surveys did not detect Wallum Froglets on the subject site. This survey and previous surveys have indicated that Wallum Froglets are not permanent residents on the site, but inhabit the site only after particular events (e.g. flooding by Moonee Creek). Wallum Froglets were detected in the nearby Moonee Beach Nature Reserve and other off-site areas. Habitat for the Wallum Froglet is present on the subject land and is associated with the low-lying land on either side of the Southern Drain. In order to conserve Wallum Froglets in the Moonee Beach Area, the land on either side of the Southern Drain should be protected and maintained as Wallum Froglet habitat. Land elsewhere on the site does not appear to be useful Wallum Froglet habitat.

Measures to conserve the Wallum Froglets include the protection of the land on either side of the Southern Drain by creating run-off diversion bunds between the habitat area and the development area (as advised by Gilbert and Sutherland 2005). Silt fences and other site protection measures must be employed before any earthworks occur on the site. An assessment of the water quality entering the Southern Drain from the western side of the Pacific Highway is required and a water treatment system may be required if the water is found to fluctuate too greatly in quality. The habitat area will need to be managed in the long-term to prevent it from becoming overgrown or otherwise unusable as Wallum Froglet habitat. This will involve the periodic thinning and removal of trees and taller shrubs, such as wattles and paperbarks. In addition, the ground surface can be enhanced by the creation of shallow scrapes that would act as temporary pooling sites for surface water following rain. This variation to the ground surface should also promote the growth of sedges and some ferns so that they become more dominant ground cover plants. A long-term management and maintenance plan for the frog habitat area should be developed and this should be a consent condition of the development of the site.

References Cited

Anstis, M. (2002). Tadpoles of South-eastern Australia. Reed New Holland, Frenchs Forest.

Coffs Harbour City Council (2004). Moonee Development Control Plan.

Gilbert and Sutherland (2005). Amended stormwater assessment of the proposed residential development. The Glades Moonee Beach at Moonee Beach, Coffs Harbour. Prepared for the Winten Group Pty Ltd.

Hines, H., Mahony, M.J., and K.McDonald. (1999). An assessment of frog declines in wet subtropical Australia. In "Declines and Disappearances of Australian Frogs; ed. A. Campbell. Environment Australia. Pp 44-63.

Lewis, B. (1996). The distribution and habitat of three threatened frog species *Litoria aurea, Litoria olongburensis* and *Crinia tinnula* in northern NSW. Intergrated project, Southern Cross University, Lismore.

Pyke, G.H. and A.W.White (2006). Patterns of use of breeding habitat for two closely related Australian frogs, *Crinia tinnula* and *C. signifera.* Manuscript submitted to Journal of Herpetology (London).

Warren, James and Associates (JWA) (2004). Flora and Fauna assessment. Lot 1 and 2 Moonee Beach.

Dr Arthur White
4 August 2006.

APPENDIX 4

FAUNA ASSEMBLAGES IN THE STUDY AREA

SPECIES LIST FOR MOIST ESCARPMENT FOOTHILLS UNC ASSEMBLAGE

A widespread assemblage occupying moist open forests of the escarpment and foothills. The assemblage consists of 13 priority species, including several renowned for their sensitivity to loss of habitat and disturbance (e.g. Greater Glider, Yellow-bellied Glider, Rufous Bettong, Powerful and Masked Owls). Key habitats are reasonably widespread, and commonly occur within public lands. Potential corridors link the rather widespread assemblage, and its key habitats, across all tenures. Four broad bands of potential corridors provide important altitudinal links from the escarpment forests to the foothills and tablelands.

COMMON NAME:	**SCIENTIFIC NAME:**
Powerful Owl	*Ninox strenua*
Masked Owl	*Tyto novaehollandiae*
Greater Glider	*Petauroides volans*
Rufous Bettong	*Aepyprymnus rufescens*
Grey-headed Flying Fox	*Pteropus poliocephalus*
White-striped Freetail-bat	*Tadarida australis*
Little Bentwing-bat	*Miniopterus australis*
Common Bentwing-bat	*Miniopterus schreibersii*
Eastern Forest Bat	*Vespadelus pumilus*
Glossy Black-cockatoo	*Calyptorhynchus lathami*
Spotted-tail Quoll	*Dasyurus maculatus*
Koala	*Phascolarctos cinereus*
Yellow-bellied Glider	*Petaurus australis*

SPECIES LIST FOR THE WET ESCARPMENT UNC ASSEMBLAGE

Consists of 11 species, again characteristic of the wet escarpment forests, but demonstrating more widespread distributions than species of the Northern Escarpment and Wet Eastern Tablelands assemblages.

COMMON NAME:	SCIENTIFIC NAME:
Giant Barred Frog	*Mixophyes iteratus*
Murray's Skink	*Eulamprus murrayi*
Barred-sided Skink	*Eulamprus tenuis*
Sooty Owl	*Tyto tenebricosa*
Paradise Riflebird	*Ptiloris paradiseus*
Eastern Pygmy-possum	*Cercartetus nanus*
Long-nosed Potoroo	*Potorous tridactylus*
Eastern Horseshoe-bat	*Rhinolophus megaphyllus*
Eastern Freetail-bat	*Mormopterus norfolkensis*
Large-eared Pied bat	*Chalinolobus dwyeri*
Greater Broad-nosed Bat	*Scoteanax rueppellii*

SPECIES LIST FOR THE DRY COASTAL FOOTHILLS UNC ASSEMBLAGE

A large assemblage of 21 species that occupies the drier productive forests of the coastal plains and foothills. This assemblage includes many high-priority species that have undergone substantial reductions in range. The habitat features mapped for this assemblage are under-represented in the reserve system. Key habitats for this assemblage are mapped within the Bungawalbyn and Lower Clarence Valleys.

COMMON NAME:	SCIENTIFIC NAME:
Green-thighed Frog	*Litoria brevipalmata*
White Crowned Snake	*Cacophis harriettae*
Pale-headed Snake	*Hoplocephalus bitorquatus*
Black-necked Stork	*Ephippiorhynchus asiaticus*
Musk Lorikeet	*Glossopsitta concinna*
Little Bronze-Cuckoo	*Chrysococcyx minutillus*
Forest Kingfisher	*Todiramphus macleayii*
Hooded Robin	*Melanodryas cucullata*
Grey-crowned Babbler	*Pomatostomus temporalis*
Yellow-tufted Honeyeater	*Lichenostomus melanops*
Common Planigale	*Planigale maculata*
Hoary Wattled Bat	*Chalinolobus nigrogriseus*
Broad-nosed Bat	*Scotorepens sp.1*
Eastern Chestnut Mouse	*Pseudomys gracilicaudatus*
New Holland Mouse	*Pseudomys novaehollandiae*
Pale Field-rat	*Rattus tunneyi*
Red Goshawk	*Erythrotriorchis radiatus*
Bush Stone-curlew	*Burrhinus grallarius*
Turquoise Parrot	*Neophema pulchella*
Brush-tailed Phascogale	*Phascogale tapoatafa*
Squirrel Glider	*Petaurus norfolcensis*

SPECIES LIST FOR THE COASTAL COMPLEX UNC ASSEMBLAGE

Comprises 11 species, including frogs, birds and bats, characteristic of forests and associated environments of the coastal fringe, and the floodplains of the Tweed, Richmond and Clarence Rivers. Many areas mapped as assemblage hubs and hot spots are within reserves, but many potential corridors linking these reserves cross freehold tenures.

COMMON NAME:	**SCIENTIFIC NAME:**
Wallum Froglet	*Crinia tinnula*
Wallum Sedge Frog	*Litoria olongburensis*
Coastal Shade Skink	*Saproscincus oriarus*
Osprey	*Pandion haliaetus*
Brush Bronzewing	*Phaps elegans*
Mangrove Honeyeater	*Lichenostomus fasciogularis*
Common Blossom-bat	*Syconycteris australis*
Black Flying-fox	*Pteropus alecto*
Eastern Long-eared Bat	*Nyctophilus bifax*
Black Bittern	*Lxobrychus flavicollis*
Grassland Melomys	*Melomys burtoni*

APPENDIX 5
FAUNA DISTRIBUTION TABLES

Name	**Barred cuckoo shrike** (*Coracina lineata*)	
Status	Vulnerable – Schedule 2 TSC Act 1995.	
Geographical Distribution	This species occurs from Cape York Peninsula in Queensland to the Manning River district in NSW (Schodde and Tidemann 1986).	
Description	Medium sized (26-28cm) songbird, face is dark with black lores and yellow eyes. It is dark grey above with darker wings, breast to abdomen is white, strongly barred with black (Simpson and Day 1996).	
Habitat	Blakers et al (1984) note that this species inhabits rainforests and eucalypt forests including margins and regrowth, where it feeds on fruits and insects. A major habitat component is the presence of fruiting trees, particularly figs (*Ficus* sp.).	
Life Cycle Requirements	Forage	The Barred cuckoo shrike flies freely from one feeding tree to another but once settled the birds tend to be quiet and undemonstrative. Aside from rainforest fruits, this species has been reported also to feed on beetles, insect larvae and dragonflies (Shields 1993). Roosting is communal.
	Nesting	Nesting is between October and January, with a small nest of dry twigs and foliage usually built high in a tree (Shields 1993).
	Movements	The bird is often encountered alone or in pairs, but it also congregates in flocks at temporarily abundant food sources.
Conservation Reserves	Border Ranges, Mt. Warning, Nightcap National Parks. Iluka, Limeburners, Sea Acres Nature Reserves.	
Threatening Processes	This is mainly a tropical and subtropical species of lowland rainforest. This habitat has been subject to extensive clearing for residential and agricultural purposes.	
References	Blakers, M.; Davies, S.J.J.F.; and Reilly, P.N. (1984). The Atlas of Australian birds. RAOU and Melbourne University Press: Melbourne. Schodde, R. and Tidemann, S. (Eds) (1986) Readers Digest Complete Book of Australian Birds. Second Edition. Readers Digest Services, Sydney. Shields, J.M. (1993) Yellow-eyed cuckoo shrike *Coracina lineata*. In: Strahan, R (Ed). Cuckoos, Kingfisher and Nightbirds of Australia. Angus and Robertson, Sydney. Simpson, K. & Day, N (1996). Field Guide to the Birds of Australia. Viking: Penguin Books, Sydney.	

Name	**Black-necked stork** (*Xenorhynchus asiaticus)*	
Status	Endangered –Schedule 1 TSC Act (1995)	
Geographical Distribution	This species occurs sparsely throughout much of its northern and north-east Australian range. It is more common in the Coastal northern Territory and along northern and south eastern Queensland coast and plains. Breeding populations are found mainly in these zones.	
Description	An impressive very tall (1.29-1.37m) black and white bird with pipestem red legs: They have a heavy black bill, glossy green-black head and neck. The eye in males is black and in females yellow (Pizzey 1993).	
Habitat	The Black-necked stork inhabits riverine swamps, large permanent pools and coastal wetlands and estuaries. Fresh, brackish or saline water is used (SFNSW 1995). An abundant supply of frogs and fish is required, together with suitable roost and nest trees, usually overhanging rivers and swamps. Foraging occurs singly or in pairs. Critical habitat components for this species include their aquatic food base, water quality and availability of suitable nest and roost trees. The Black necked stork will therefore be sensitive to disturbance of these habitat components.	
Life Cycle Requirements	Foraging	This species forages in shallow water for small invertebrates, fish, amphibians, reptiles and possibly small mammals (Marchant and Higgins 1990). Once settled in specific localities, individual birds may become established for several years (Salmon 1965).
	Breeding	Breeding occurs from March to June with nests forming large stick platforms built in live or dead trees in secluded swamps.
	Movements	The Black-necked stork is an occasional breeding vagrant or transient in the locality. Elsewhere in Australia this species is widespread and moderately abundant as a breeding resident across the north of the continent. Many, if not all of the birds present in the study area may be transients overflowing from populations from the north, although there is no proof of this.
Conservation Reserves	Bundjalung, Broadwater and Yuraygir National Parks. Limeburners Creek Nature Reserve.	
Threatening Processes	The Black-necked stork is primarily threatened by the loss of suitable swamp habitats through draining of wetlands for agricultural and urban development; disturbance of feeding habitat by livestock grazing; contamination of water and food supplies by urban and agricultural nutrients and chemicals and the loss of roost and nest trees.	
References	Pizzey, G and Doyle (1993). A Field Guide to the Birds of Australia. Angus and Robertson. Salmon (1965). Distribution of the Jabiru in central and northern coastal NSW. *Emu*, **65:** 149-151. State Forests of NSW. (1995). Coffs Harbour Urunga Management Area - Environmental Impact Statement. Vol C, Proposed forestry operations - Schedule 12 Fauna. SFNSW, Northern Region.	

Name	**Brolga** (*Grus rubicundus*)	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	This species occurs throughout coastal and subcoastal tropical Australia, ranging to the eastern interior. There are small local populations through the Murray Darling basin to western Victoria (Reader's Digest 1997).	
Description	An impressive very tall (0.95 to 1.15m) pale grey bird with a bright red or orange strip on the head. The eye is yellow and the bill long, straight and green-grey (Reader's Digest 1997).	
Habitat	The Brolga is usually found around open swamplands. It disperses widely out of breeding season, with family groups often combining to form large flocks.	
Life Cycle Requirements	Foraging	Brolgas forage in swampland habitats, feeding mainly on the tubers of sedges. They also take grain, molluscs and insects.
	Breeding	Breeding occurs from September to December in the south and February to June in the north. Its nest is a platform of dry grasses or sedge, 1.5m in diameter, in or beside swampy grasslands.
	Movements	The Brolga wanders widely around coastal Northern Australia in search of food out of breeding season.
Conservation Reserves	The Brolga occurs in Broadwater, Bundjalung, Yuraygir National Parks and Mother of Ducks Lagoon NR.	
Threatening Processes	The Brolga is primarily threatened by the loss of suitable swamp habitats through draining of wetlands for agricultural and urban development; disturbance of feeding habitat by livestock grazing; contamination of water and food supplies by urban and agricultural nutrients and chemicals and the loss of suitable nesting areas.	
References	Reader's Digest (1997) Complete book of Australian Birds. Reader's Digest, Sydney.	

Name	**Brush-tailed phascogale** (*Phascogale tapoatafa*)	
Status	Endangered– Schedule 1 TSC Act (1995)	
Geographical Distribution	The species prefers open forest with sparse ground cover. The species was formerly distributed throughout the dry sclerophyll forest and woodlands of temperate and tropical Australia.	
Description	Head and body length is 181mm (approximately) for males. Uniform grizzled grey above, cream to white below. Large naked ears. Conspicuous black bottle-brush tail with hairs up to 55mm long.	
Habitat	The preferred habitat of this species is reported to be dry open forest and woodland containing box, stringybark and ironbark trees (Cuttle 1982, Trail and Coates 1993) but it has also been recorded from coastal forest in NE NSW containing Blackbutt and red bloodwood (Quin, cited in AMBS 1995).	
Life Cycle Requirements	Breeding	The requirement for hollow-bearing trees for nesting sites indicates that this species will require some component of old-growth within its habitat and therefore is likely to be sensitive to removal of this habitat component. This species occurs patchily and in low densities throughout its entire range.
	Foraging	This species is known to forage over the trunks and major limbs of trees, taking arthropods from the bark surface and in shallow bark crevices, and it is thought that they may also forage on logs (Trail and Coates 1993). Foraging takes place throughout the home range of this species rather than at particular sites (Soderquist 1995). The Phascogale forages as it travels, and all parts of the home range therefore represent forage habitat.
	Dispersal	Recent studies by Soderquist (1995) in Victoria have shown that both females and males occupy large home ranges (41ha and 106ha respectively). The home range of males was found to expand during the breeding season to an average length of 2.7km.
Conservation Reserves	Barrington Tops NP, Bundjalung NP, Dorrigo NP, Limeburners Ck. NR, Mt. Warning NP, New England NP, Washpool NP, Werrikimbe NP, Yuraygir NP.	
Threatening Processes	*P. tapoatafa* is sensitive to the loss of critical nest, shelter and feeding habitat such as tree hollows and suitable foraging substrate (especially fallen logs), and predation by feral carnivores such as foxes and cats (CHUMA - Supporting Document 4, 1995). Little is known about this species ecology but an overly frequent fire regime in drier forests is likely to be detrimental to the species through reduction in cover and increased exposure to predation (Smith *et al.*, 1994).	
References	Australian Museum Business Services (1995). Urbenville Management Area - Fauna Impact Statement Vol. D. State Forests of N.S.W., Pennant Hills. Cuttle, P (1982) Life history of the dasyurid marsupial *Phascogale tapoatafa* pp13-22. In Carnivorous Marsupials Ed by M. Archer, Royal Zoological Society of NSW, Sydney. Soderquist, T.R. (1995) Spatial organisation of the arboreal carnivorous marsupial *Phascogale tapoatafa*. Journal of Zoology, 237 pp 385-398. Traill, B.J. and Coates, T.D. (1993). Field Observations on the Brush-tailed Phascogale (Phascogale tapoatafa) Marsupalia: Dasyuridae. *Australian Mammalogy*, 16: 61-65.	

Name	**Collared Kingfisher** (*Todiramphus chloris*)	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	Coastal and Islands of northern Australia from Carnarvon, WA to north-eastern NSW (Tweed River). Occasional to Ballina and possibly further south (Pizzey 1993).	
Description	Head Blue to brown-olive. White spot in front of eye; broad black band from base of bill through eyes and ear coverts and around nape, bordered by white collar below. Back, shoulders, rump and upper tail coverts blue to brown-olive.	
Habitat	This species is confined to mangroves around the northern coast of Australia and offshore islands. More specifically, the seaward fringe of mangroves and bigger tidal creeks are utilised and individuals are spaced out singly or loosely in pairs in territories of several hundred metres or more of waterfront (Readers Digest 1988).	
Life Cycle Requirements	Foraging	Prey (crustaceans, worms, fish, insects, reptiles and other small tidal animals) are picked up from the surface of muds and small tidal pools exposed at low tide.
	Nesting	Nests are constructed in burrowed arboreal termite mounds, tree hollows or earthen banks 4 – 15m above the ground usually in mangroves or adjacent tall trees. Nesting occurs in south-eastern Queensland and north-eastern NSW.
	Movements	In south-eastern regions of their range (i.e. North-eastern NSW) the Collared kingfisher appears to be nomadic or migratory with most birds arriving in September to breed and leaving for Torres Straight and New Guinea in March
Conservation Reserves	Brunswick Heads Nature Reserve.	
Threatening Processes	Threatening processes include loss of preferred Mangrove habitats and suitable nest sites.	
References	Readers Digest (1988). Complete Book of Australasian Birds 2nd ed, Readers Digest Association, Far East Limited: Sydney	

Name	**Comb-crested jacana** (*Irediparra gallinacea*)	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	This species occurs in coastal and sub-coastal northern and eastern Australia. It is occasionally recorded well inland at Mount Isa, for example. Its core breeding populations occur near Darwin, north and south-east Queensland coastlines, and north-east NSW. Within NSW, it is mainly confined to the north-east coast, although individuals have historically been recorded breeding on the Hawkesbury River and at Bilpin (Hindwood 1940; Hindwood and Hoskins 1954).	
Description	The Comb-crested jacana has a black crown, nape and hindneck, with a purplish-blue gloss in some lights. The face, sides of the head and the rest of the neck is golden yellow, grading into white on the chin and throat. The upper body is mainly brown. Wing coverts, tail, underwing and breast are black. A fleshy yellow to pink to red wattle covers the feathers of the forehead and crown (Marchant and Higgins 1993).	
Habitat	This species utilises freshwater wetlands such as lagoons, billabongs, swamps, lakes, rivers and reservoirs. These water bodies generally have abundant aquatic vegetation that forms dense mats or rafts on the surface of the water (Marchant and Higgins 1993). It prefers water-lily and water hyacinth choked, deep, permanent wetlands on fertile soils.	
Life Cycle Requirements	Foraging	This species forages alone or in pairs, along the edges of pools and among floating leaves, feeding on aquatic plants, seeds and insects (Marchant and Higgins 1993)
	Nesting	Nesting is from September to January usually 15 to 30m from the shore on a platform of aquatic weeds. Usually three to four eggs are laid and are incubated by the male. Fledging is at about 8 weeks.
	Movements	The species is mainly sedentary but moves locally in response to changing water levels. It is strongly territorial when breeding but gregarious in non-breeding times. There is no evidence of large-scale seasonal movement and the species' use of vegetated corridors is not known.
Conservation Reserves	Not recorded.	
Threatening Processes	The main pressures on the survival of this species and its habitat are the drainage of coastal wetlands for agricultural or urban development; disturbance of core breeding habitat by livestock and humans; and changes in wetland water levels in response to drought and other events.	
References	Hindwood, K.A. (1940) Notes on the distribution and habits of the Jacana or Lotus-bird. *Emu*, **39**: 261-267. Hindwood, K.A. and Hoskin, E.S. (1954). The Waders of Sydney (County of Cumberland), New South Wales. *Emu*, **54:** 217-255. Marchant, S. and Higgins, P.J. (eds) (1993) Handbook of Australian, New Zealand and Antarctic birds. Vol. 2 Raptors to Lapwings. Oxford University Press, Melbourne.	

Name	**Common blossom bat** (*Syconycteris australis*)	
Status	Vulnerable –Schedule 2 TSC Act (1995).	
Geographical Distribution	This species occurs in eastern Queensland from Cape York south, with disjunct populations occurring south to the mid north coast of NSW around Taree. The southern limit distribution of the Common blossom bat in NSW is latitude 32°19'S at Booti Booti National Park, and may be a determent of climatic factors (Law 1994a).	
Description	The Common blossom bat is one of the smallest pteropids, about the size of a mouse. It has fawn to reddish fur that is very soft. The nostrils are raised above the surface of the muzzle and it has a long brush-like tongue (Strahan 1995).	
Habitat	The Queensland blossom bat is a nectarivore and takes nectar from species such as Banksia and Melaleuca in autumn and winter and from coastal Eucalypts in summer. The Bat prefers to roost in coastal Rainforest or other communities containing broad-leaved species where the canopy provides good protection from rain and wind (B Law, pers. comm).	
Life Cycle Requirements	Foraging	Foraging resources for the Common blossom bat species are produced in a number of habitats throughout coastal NSW and include heaths, paperbark swamps, coastal Eucalypt forest and sub-tropical rainforest. An essential requirement for the occurrence of the Queensland Blossom Bat is a diversity of habitats proximate to rainforest roost sites, so as to ensure a year round supply of nectar and pollen through sequential flowering of different species.
	Roosting	Individuals tend to roost solitarily, shifting roost sites within rainforest habitat depending on prevailing weather conditions.
	Movements	Commuting distances from these roosts to foraging areas are greater in spring and autumn (mean 1.4km) than in winter (mean 0.8km). Adults often change roosts each day, moving approximately 100m, while juveniles re-use roosts over longer periods (Law 1993).
Conservation Reserves	Broadwater, Broken Head, Bundjalung, Mt. Warning, Yuraygir National Parks. Iluka, Limeburners Creek Nature Reserves.	
Threatening Processes	The dominant threat to the critical habitat of this species in NSW is the extensive development of the coastal zone which disrupts the proximity of food supplies and roost sites.	
References	Law, B.S. (1993) "Roosting and Foraging Ecology of the Queensland Blossom Bat (*Syconycteris australis*) in north-eastern New South Wales: Flexibility in response to seasonal variation". Wildlife Research, 20: 419-431. Law, B.S. (1994a) "Climatic limitations of the southern distribution of the Common blossom bat (*Syconycteris australis*) in New South Wales." Aust. J. Ecology 19:366-374. Strahan R. (1995) "The Mammals of Australia". Reed Books, Chatswood.	

Name	**Glossy black cockatoo** (*Calyptorhynchus lathami)*	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	This species occurs from about the Clarke Range in Queensland to Gippsland and the Central Highlands of Victoria along the eastern seaboard. It occurs as far west as the Riverina and Pilliga Scrub (Blakers *et al* 1984).	
Description	This is the smallest of the Black cockatoos with a body length of about 48cm. Plumage I brownish black, with two panels in the tail: these panels are bright red in males, barred and shot with yellow in females. The bill is more bulbous than that of the Red-tailed black cockatoo (Simpson and Day 1996).	
Habitat	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: *Allocasuarina littoralis, Allocasuarina torulosa* and *A. verticillata* (Forshaw, 1981) and suitable large hollow bearing trees for nesting.	
Life Cycle Requirements	Foraging	It is noticeable that birds appear to favour a certain tree, perhaps when seeds are at correct maturity and sweeter, or perhaps the tree is easily accessible (Clout 1989).
	Breeding	The cockatoos require large hollows in tall mature Eucalyptus for nesting (Forshaw 1981). Successful breeding of this species is dependent on cones having high seed-fill rates (% of viable seed per cone). Higher seed fill rate, often in excess of 80% appears to be influenced by geology, soil and moisture (Garnett 1997 *in press*).
	Movements	This cockatoo is mainly sedentary with pairs isolating themselves from groups to breed and then rejoin the main group with their young (Joseph, 1989). This species live in loose groups of 2 to 20 birds (Blakers *et al* 1984). Groups may disperse over wider areas during times of reduced she-oak seed occurrence within their normal range. There are no known barriers to the movement of this species.
Conservation Reserves	Barrington Tops, Border Ranges, Bundjalung, Dorrigo, Gibraltar Range, Guy Fawkes River, Hat Head, New England, Nymboida, Washpool, Werrikimbe, Woko and Yuraygir National Parks.	
Threatening Processes	The Glossy black cockatoo is threatened by any action that significantly reduces the quantity, quality or availability of the seed crop of the preferred *Allocasuarina* species, and/or results in the removal or destruction of potential nest sites.	
References	Blakers, M. Davies, S.J.J.F.; and Reilly, P.N. (1984). The Atlas of Australian birds. RAOU and Melbourne University Press: Melbourne. Clout, M.N. (1989). Foraging behaviour of Glossy Black Cockatoos. Aust Wild. Res. 16, 467-473. Forshaw, J.M (1981). Australian Parrots. Second (revised) Edition. Lansdowne Press, Melbourne. Joseph, L. (1989). The Glossy Black-Cockatoo in the South Mount Lofty Ranges. South Australian Ornithologists, 30: 202-204. Simpson, K. & Day, N (1996). Field Guide to the Birds of Australia. Viking: Penguin Books, Sydney.	

Name	**Greater broad-nosed bat** (*Scoteanax rueppellii*)	
Status	Vulnerable –Schedule 2 TSC Act (1995).	
Geographical Distribution	This species is widely distributed but sparse and localised throughout its range from south-eastern Queensland to southern NSW, It occurs at a range of altitudes in the study region and has been recorded from a number of State Forests and conservation reserves.	
Description	This is the largest member of the family in the state. It has dark reddish-brown to dark brown fur above and is slightly paler below. Externally similar to *Falseistrellus tasmaniensis*. Head and body length is 80-95mm. Weight is 25-35g (Hoye and Richards 1995).	
Habitat	The Greater Broad-nosed bat forages over a range of habitats, including rainforest and moist forests, but prefers ecotones between woodland and cleared land and riparian forest (SFNSW 1995). This species is a specialist which may prefer unlogged forest on high fertility soils (Parnaby 1984).	
Life Cycle Requirements	Foraging	The diet of this species has not been adequately investigated, but studies of the stomach contents of several individuals by Vestjens and Hall 1977 found moth and beetle remains. Slow flying and large beetles are known to form a part of the diet of this species (Dwyer 1965), while this species has been recorded eating other bat species in capture and captivity situations (Woodside and Long 1984).
	Roosting	The Greater broad-nosed bat requires hollows for roosting. This species has also been reported from roof spaces of old buildings. Little is known of the reproductive biology of this species other than a single young is born in January.
	Movements	Creeks and small rivers are favoured corridors, where is hawks backwards and forwards for its prey (Hoye and Richards 1995).
Conservation Reserves	Border Ranges, Broadwater, Gibraltar Range, Nymboida, Washpool National Parks. Tyagarah Nature Reserve.	
Threatening Processes	Environmental pressures within the study area cannot be precisely defined for this species beyond potential threats likely to arise from habitat modification. This includes alterations to forest canopy structure and tree species composition, the age structure of trees particularly destruction of hollow bearing trees that are likely to be more than 150 years of age, and structural and floristic changes to understorey vegetation.	
References	Hoye, G.A. and Richards, G.C. (1995). Greater Broad-nosed bat *Scoteanax rueppellii* (Peters 1866) In: Strahan, R (Ed). The Mammals of Australia. The Australian Museum and Reed Books, Sydney. State Forests of NSW. (1995). Coffs Harbour Urunga Management Area - Environmental Impact Statement. Vol C, Proposed forestry operations - Schedule 12 Fauna. SFNSW, Northern Region. Parnaby, H.E (1984.) A Survey of the Bats of the Rainforests of North East NSW. A report to the Australiana NPWS. Vestjens, W.J.M. & Hall, L.S (1977). Stomach contents of forty two species of bat from the Australasian region. *Australian Wildlife Research*, 4: 25-35. Dwyer, P.D. (1965). Flight patterns of some eastern Australian bats. *Victorian Naturalist*, 82: 36-41. Woodside, D.P. and Long, A. (1984) Observations on the feeding habits of the Greater broad-nosed bat, *Nycticeius rueppellii* (Chiroptera:Vespertilionidae). *Australian Mammalogy* 7:121-29.	

Name	**Grey-headed Flying Fox** (*Pteropus poliocephalus)*	
Status	Vulnerable (Schedule 2 TSC Act (1995); Tidemann *et al.*, 1999	
Recovery Plan	Under the *Threatened Species Conservation Act* 1995, a Recovery Plan for the Grey-headed Flying Fox is required to be prepared by 2006.	
Geographical Distribution	Occurs along the east coast from Bundaberg in Queensland to Melbourne in Victoria (Eby, 2000a). The distribution of this species has contracted south, formerly ranging north to Rockhampton (Eby, 2000a). This species may range to the western slopes of the Great Dividing Range in northern NSW (Eby, 1991). At any one time the majority of animals only occupy a small proportion of this entire range.	
Description	The Grey-headed Flying Fox has dark grey fur on the body, lighter grey fur on the head and a russet collar encircling the neck. This species can be distinguished from other flying-fox species by leg fur which extends to the ankle. Wing membranes are black and the wingspan can be up to one metre with a head and body length 23-30cm and weight of 600-1000g. (Tidemann, 1995 and Eby, 1995)	
Habitat	The Grey-headed Flying Fox inhabits "sub – tropical and temperate rainforests, tall sclerophyll forest and woodlands, heaths and swamps" (Eby, 1995). Urban gardens and cultivated fruit crops also provide habitat for this species.	
Life Cycle Requirements	Breeding/ nesting	Mating occurs annually with mating commencing in January, the majority to a single young.
	Foraging	The nectar and pollen of native trees, in particular *Eucalyptus, Melaleuca* and *Banksia* (Eby, 2000a), and fruits of rainforest trees and vines. This species is an important pollinator and seed-disperser of native trees.
	Movements	The Grey-headed Flying Fox migrate in response to food availability, sometimes travelling hundreds of kilometres. In addition, during periods when native food is limited, during periods when native food is limited, they disperse from colonial roosts, often foraging in cultivated gardens and fruit crops. This species occasionally inflicts severe crop damage during periods of native food shortage. (Ratcliffe, 1932; Eby, 1991; Parry-Jones & Augee, 1992). This results in large fluctuations of the numbers of this species in NSW from as few as 20% of the total population in winter up to around 75% of the total population in summer (Eby, 2000a).
Conservation Reserves	In NSW, Grey-headed Flying Fox have been recorded in numerous conservation reserves along the east coast, and the tablelands and eastern slopes of the Great Dividing Range.	
Threatening Processes	Destruction and fragmentation of roosting and foraging habitat pose significant threats to this species in NSW. Unregulated shooting, electrocution on power lines, persecution due to poor understanding of diseases they may carry and competition and hybridisation with the Black Flying-fox (*Pteropus alecto*).	

References	Eby, P. 1991. Seasonal movements of Grey-headed Flying-foxes, *Pteropus poliocephalus* (Chiroptera: Pteropodidae). From two maternity camps in northern New South Wales. *Wildlife Research* 18:547-559. Eby, P. 1995. The biology and management of flying-foxes in NSW; Species management report number 18 Llewellyn, L. (ed). NPWS, Hurstville. Eby, P. 2000a. The results of four synchronous assessments of relative distribution and abundance of Grey-headed Flying-fox *Pteropus poliocephalus*. In *Proceedings of a Workshop to Assess the Status of the Grey-headed Flying-fox in New South Wales*. Richards, G. (ed). http://batcall.csu.edu.au/abs/ghff/ghffproceedings.pdf Eby, P. 2000b. A case for listing Grey-headed Flying-fox *Pteropus poliocephalus* as threatened in NSW under IUCN creiterion A2. In *Proceedings of a Workshop to Assess the Status of the Grey-headed Flying-fox in New South Wales*. Richards, G. (ed). http://batcall.csu.edu.au/abs/ghff/ghffproceedings.pdf Parry-Jones, K.A. and Augee, ML. 1992. Movements of Grey-headed Flying Foxes (*Pteropus poliocephalus*) to and from a colony site on the central coast of New South Wales. *Wildlife Research* 19:331-340. Ratcliffe, F.N. 1932. Notes on the fruit bats (*Pteropus spp.*) of Australia. *Journal of Animal Ecology* 1:32-57. Tidemann, C.R., Eby P., Parry-Jones, K.A. and Vardon, M. 1999. Grey-headed Flying-fox. In *The Action Plan for Australian Bats*. Duncan, A., Baker, G.B. and Montgomery, N. (eds.). Environment Australia, Canberra.

Name	**Koala** (*Phascolarctos cinereus*)	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	The Koala has a broad distribution in eastern Australia, extending from South Australia through to north Queensland (Lee and Martin 1988). Reed *et al* (1990) noted that the distribution of the Koala in NSW was sparse on the south coast but there was a concentration of sightings on the north coast, northern tablelands and western slopes.	
Description	The Koala is an arboreal marsupial with woolly, pale to dark grey fur on the back, lighter on the underside. The tail is vestigial. Animals from the northern part of the range are smaller than those from the south (Martin and Handasyde 1995)	
Habitat	Koalas primarily inhabit Eucalypt woodlands and open forest and occasionally grazing lands and residential developments, although the later obviously do not constitute optimal habitat. Home ranges can vary from 1ha to 67ha depending on the resource availability (MKES 1994).	
Life Cycle Requirements	Breeding	Breeding occurs in summer. Females become sexually active at two years and produce one young each year after a gestation period of about 35 days. Weaning occurs at 12 months and at 18 months dispersal may occur. Females breed to more than 14 years of age (Martin and Handasyde 1995)
	Foraging	Schedule 2 of State Environmental Planning Policy No. 44 (SEPP 44) - Koala Habitat Protection, supplies a list of ten (10) Koala Feed Tree Species, noting that "almost all occurrences of Koalas in NSW have been associated with the presence of one or more of these species." The nominated species are; Forest red gum (*Eucalyptus tereticornis*), Tallowwood (*E. microcorys*), Grey gum (*E. punctata*), Ribbon gum (*E. viminalis*), River red gum (*E. camaldulensis*), Broad - leaved scribbly gum (*E. haemastoma*), Scribbly gum (*E. signata*), White box (*E. albens*), Bimple box (*E. populnea*) and Swamp mahogany (*E. robusta*). Department of Planning: 1995).
	Movements	The Koala is solitary. Home range size is related to the density of occurrence of large trees, preferred feed trees and population density. Homer range can vary from several hectares to 15ha in area (Mitchell 1990).
Conservation Reserves	Billinudgel NR, Bongil Bongil NP, Border Ranges NP, Broadwater NP, Broken Head NR, Brunswick Heads NR, Bundjalung NP, Chaelundi NR, Cudgen NR, Dorrigo NP, Iluka NR, Koreelah NP, Mallanganee NP, Mebbin NP, Mt. Warning NP, Nightcap NP, Richmond Range NP, Stotts Island NR, Toloom NP, Toonumbar NP, Ukerebagh NR and Wilson NR. In NSW, Koalas have been recorded in numerous conservation reserves along the east coast and the slopes and tablelands of the Great Dividing Range (NPWS 1999).	
Threatening Processes	The most serious threat to the koala is the removal of food trees (Braithwaite 1993). The optimal habitat of this species has been mainly cleared for agriculture and forestry activities.	

References	Lee A.K. and Martin R.W. 1988. The Koala a Natural History. New South Wales University Press, Kensington. Reed P.C., Lunney D. and Walker P. 1990. A 1986-1987 survey of the koala *Phascolarctos cinereus* (Goldfuss) in New South Wales and an ecological interpretation of its distribution, in A.K. Lee, K.A. Handasyde and G.D. Sanson (Eds). Biology of the Koala. pp 55-74. Surrey Beatty and Sons, Sydney. Martin R.W. and Handasyde K.A. 1995. Koala *Phascolarctos cinereus* (Goldfuss, 1817), in R. Strahan (Ed). The Mammals of Australia. pp 195-198. Reed Books, Chatswood. Mitchell P. 1990. The home ranges and social activity of koalas – a quantitative analysis, in A.K. Lee, K.A. Handasyde and G.D. Sanson (Eds). Biology of the Koala. pp 171-187. Surrey Beatty & Sons, Sydney.

Name	**Little bent-wing bat** (*Miniopterus australis*)	
Status	Vulnerable –Schedule 2 TSC Act (1995).	
Geographical Distribution	Regionally, this species is widely distributed with records from coastal districts to the Great dividing range. This species becomes increasingly coastal in the southern part of its range in eastern Australia. In north eastern NSW it occurs from the Macleay River watershed to the Hunter River. Nationally this species occurs along the coastal plains and adjacent ranges from Cape York to north east NSW and around the Hunter Valley (Strahan 1992).	
Description	This bat is chocolate brown on the upper surface, with paler fur on the underside. It is similar to M. schreibersii but tends to have lighter and more subtle shades of colour and can be distinguished by smaller size and lighter weight (Dwyer 1995b).	
Habitat	The Little bentwing bat is generally found in forested areas, particularly well timbered habitats, where it forages below and above the tree canopy (Dwyer 1995b).	
Life Cycle Requirements	Foraging	Dwyer (1991) identifies this species as a sub-canopy forager, however Strahan (1992) notes that the Little Bent-wing Bat feeds above the forest canopy in wet and dry open forest, catching insects on the wing.
	Roosting	This species roosts in caves, old mines, stormwater channels and buildings. Roost sites tend to be located adjacent to large areas of dense vegetation.
	Movements	It is known to migrate over large distances to maternity sites, apparently using different roosts for different seasonal needs (Dwyer 1991).
Conservation Reserves	Border Ranges, Broadwater, Broken Head, Bundjalung, New England, Mt. Warning, Yuraygir National Parks, Iluka and Tyagarah Nature Reserves.	
Threatening Processes	State wide threats to this species include disturbance of maternity and winter roost sites from human visitation, destruction of roost sites in caves and mine tunnels, toxic accumulation of agricultural chemicals (such as pesticides and herbicides) in body fat used during winter torpor (Dunsmore *et al* 1974), predation at roost sties from foxes (Dwyer 1964), and destruction and modification of foraging habitat, which is assumed to be forested areas and wetlands.	
References	Dunsmore, J.D., Hall, L.S. & Kottek, K.H. (1974). DDT in the Bent-winged Bat in Australia. Search 5: 110-111. Dwyer, P.D. (1995b) Little bent-wing bat (Miniopterus australis). In The Australian Museum Complete book of Australian Mammals. R. Strahan (ed). Surrey Beatty and Sons, Sydney. Dwyer, P.D (1991b) Little bent-wing bat (Miniopterus australis). In The Australian Museum Complete book of Australian Mammals. R. Strahan (ed). Angus and Robertson, Sydney. Pp. 338-339. Dwyer, P.D. (1964). Fox Predation on Cave Bats. Australian Journal of Science 26: 397-98. Strahan R. (1992) Encyclopedia of Australian Animals: Mammals. Angus and Robertson Publishers, Sydney.	

Name	**Masked Owl** (*Tyto novaehollandiae*)	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	Closely resembles the Barn owl from which it is not easily distinguished visually. Distinguishing characteristics are fully feathered legs as opposed to the sparsely feathered legs of the Barn owl.	
Description	The Masked owl occurs along all of coastal and sub coastal Australia except for a small section of the Western Australian coastline.	
Habitat	The southern subspecies novaehollandiae occurs from Cooktown in north-eastern Queensland, around the southern coast of Australia to the Pilbara in Western Australia (Schodde and Mason 1980). Although it occurs mainly on the coast, records also occur from the Nullabor Plain and up to 1000km inland along watercourses (Garnett 1992).	
Life Cycle Requirements	Forage	The preferred foraging areas of this species appear to be in open forests with a very sparse or grassy ground cover near creeks or small drainage lines, and near the ecotones between forest and natural or man made clearings (Kavanagh and Murray 1996). The diet of the Masked owl in disturbed environments has been observed to consist mainly of introduced species of small terrestrial mammals, particularly *Rattus rattus*, although birds have also been taken (Kavanagh and Murray 1996). In more intact forest, this species has been observed to feed most frequently on the Bush rat (*Rattus fuscipes*), Brown antechinus (*Antechinus stuartii*) and Dusky antechinus (*Antechinus swainsonii*) (Kavanagh 1996).
	Nesting	Nesting occurs at any time of the year with nests in deep vertical tree hollows (tall Eucalypts are favoured) or ledges in caves. Nests are prepared by the male and used for successive years. Masked owls roost during the day inside large Eucalypt hollows or among dense foliage and in caves (Debus 1993).
	Movements	This owl can range over an area of at least 200-300 hectares (and may range up to 3 km from any detection point). Recent studies by Kavanagh and Murray (1996) suggest that the Masked Owl may forage over a much larger area (over 1000ha) that may contain a mosaic of relatively undisturbed and disturbed environments.
Conservation Reserves	Barrington Tops, Border Ranges, Bundjalung, Dorrigo, Gibraltar, Guy Fawkes, Nightcap, Werrikimbe and Yuraygir National Parks. Limeburners Creek Nature Reserve.	
Threatening Processes	Threats to this species include loss of habitat and vehicle strike.	
References	Debus, S.J.S. (1993). The mainland Masked Owl *Tyto novaehollandiae* A Review. *Aust. Bird Watcher,* 15, 168-191. Garnett, S (1992). Threatened and Extinct Birds of Australia. RAOU Report 82. Kavanagh, R.P. (1996). The Breeding biology and Diet of the Masked owl *Tyto novaehollandiae* Near Eden, New South Wales. EMU, 96, pp 158-165 Kavanagh, R.P. and Murray, M. (1996). Home range, Habitat and Behaviour of the Masked Owl *Tyto novaehllandiae* near Newcastle, New South Wales. Emu, 96. Pp250-257 Schodde, R and Mason, I.J. (1980) Nocturnal Birds. Lansdowne Editions, Melbourne.	

Name	**Osprey** (*Pandion haliaetus*)	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	Most of the Australian coastline in suitable but limited habitat (Marchant and Higgins 1993).	
Description	Dark brown above with a mainly white head, neck and underside. A distinctive bold black stripe passes through the eye. A variable dusky breast band may be present. Length is 50 to 60cm, wingspan 145-170cm (Marchant and Higgins 1993).	
Habitat	Ospreys require adequate supplies of fish, expanses of open water, tall trees for use as feeding bases, nest sites and vantage points. The preferred habitats are coastal lakes, rivers, estuaries, oceans and beaches. Offshore islands are utilised, and this species may range inland along large rivers, particularly in the northern part of the country. Extensive sheets of clear open water, fresh, brackish or saline are needed for fishing.	
Life Cycle Requirements	Breeding/ nesting	This species breeds mainly on coasts and islands; nesting near the ocean or other large waterbodies for fishing, in open position for access and visibility, and in site protected from predators be height or surrounding water; often in a prominent position on rocky headlands, stacks, cliffs, palm trees, or in tall dead trees or on artificial platforms (Marchant and Higgins 1993).
	Foraging	Ospreys are specialist predators of live fish, taking prey often by submergence to a depth of one metre.
	Movements	The Osprey is mainly a sedentary species but forages over a wide area during the non breeding season. It remains faithful to nest sites and nest-site territories over successive years (Marchant and Higgins 1993).
Conservation Reserves	Broadwater, Broken Head, Bundjalung, Hat Head, Yuraygir National Parks, Limeburners and Iluka Nature Reserves.	
Threatening Processes	The main threats to the survival of this species are the loss of suitable feeding, nesting and roosting habitat and disturbance of nest sites by humans.	
References	Marchant, S. and Higgins, P.J. (eds) (1993) Handbook of Australian, New Zealand and Antarctic birds. Vol. 2 Raptors to Lapwings. Oxford University Press, Melbourne.	

Name	**Pied oystercatcher** (*Haematopus longirostris*)	
Status	Vulnerable –Schedule 2 TSC Act (1995).	
Geographical Distribution	This species is common on beaches and in estuaries in Tasmania, and otherwise thinly scattered around the Australian coastline ranging to New Guinea.	
Description	Head and body length about 48-52 cm. Upper parts including wings and tail mostly black. Head to upper breast black, rest of underparts white. Bill bright orange-red. Legs and feet pink.	
Habitat	Entirely coastal in NSW, favouring ocean beaches and estuarine sand and mudflats. It has been recorded inland on rare occasions elsewhere in Australia (Smith 1990).	
Life Cycle Requirements	Foraging	The chief prey appears to be molluscs, both bivalves and gastropods. Also takes small crustaceans, marine worms and insects (Smith 1990). Oystercatchers work alone or in pairs along wet sandy bars and flats at low tide, probing and pecking deeply with the bill. Prey is dug out and opened by hammering or stabbing (Reader's Digest 1997).
	Breeding	The nest is a scrape in sand or shingle on coastal or estuarine beaches, typically near the high tide mark. Occasionally nests in saltmarsh or grassy areas (Smith 1990).
	Movements	Indications are that adults are sedentary but immature's are more nomadic and may range back and forth over a distance of at least 35km (Smith 1990).
Conservation Reserves	Billinudgel, Broadwater, Bundjalung, Limeburners Creek, Yuraygir.	
Threatening Processes	Threatening processes include coastal development, disturbance of nesting sites, destruction of eggs by four-wheel drive vehicles and other forms of beach recreation and predation of eggs by feral animals.	
References	Reader's Digest (1997) Complete Book of Australian Birds. Reader's Digest, Sydney. Smith, P. (1990) The Biology and Management of Waders (Suborder Charadrii) in NSW. NPWS.	

Name	**Powerful Owl** (*Ninox strenua*)	
Status	Vulnerable– Schedule 2 TSC Act (1995)	
Geographical Distribution	This owl is extensively distributed in the forests of the south-east of mainland Australia, from Portland in western Victoria to the Clarke Range in Queensland, mainly from the Great Dividing Range to the coast (Garnett 1992).	
Description	This is the largest (60-66cm) of Australia' owls. It is readily located from it's call, and identified by it's larger size and bold chevrons on the underparts. Males are somewhat larger than females (Schodde and Tidemann 1986).	
Habitat	The Powerful owl inhabits open eucalypt forests and may forage along the forest edge. It prefers the gullies of coastal forests below 1500m where prey densities are often highest and preferred roost trees are common (Debus & Chafer 1994).	
Life Cycle Requirements	Breeding	This species roosts during the day on a branch among the foliage of a tall understorey or sub-canopy tree in tall moist forest, rainforest or open forest (Debus & Chafer 1994). Nesting occurs in large, deep hollows high in large eucalypts and often at the head of a minor drainage line or up-slope of streams. Preferred nest hollows are about 30 to 50cm internal diameter and one to three metres deep. Nests may occur in vertical hollows, spouts of horizontal branches (Debus & Chafer 1994).
	Foraging	Powerful owls are nocturnal carnivores, specialising in the predation of moderate to large arboreal mammals such as possums and gliders. Birds and Flying foxes are also taken. In mountain northern NSW, predation appears to focus on Greater Gliders and the owls appearance is often governed by the occurrence of sizeable populations of this mammal (Kavanagh 1988). In coastal lowlands, the Common ringtail possum is known to provide the most substantial prey base for the Powerful Owl (Debus and Chafer 1994).
	Movements	Estimates of territory vary from 400ha to 1450ha (Davey 1993), 600ha (Garnett 1993), 800 to 1000ha (Fleay 1968) or more than 1000ha (Seebeck 1976).
Conservation Reserves	Barrington Tops NP, Border Ranges NP, Bundjalung NP, Dorrigo NP Gibraltar Range NP, Guy Fawkes River NP, Iluka NR, Limeburners Ck. NR, Mt. Warning NP, New England NP, Nymboida NP, Oxley Wild River NP, Washpool NP, Werrikimbe NP, Woko NP.	
Threatening Processes	Sensitive components of this species habitat include large hollow-bearing trees, roost trees in or near gullies, arboreal mammal populations that form the preferred prey base of this species, and riparian and forest edge habitat (McNab 1996). This species was not recorded from the study area.	
References	Davey, S.M (1993) Notes on the habitat of four Australian owl species. In: Olsen P. (ed.) Australian Raptor Studies. Australasian Raptor Association, Royal Australasian Ornithologists Union, Moonee Ponds, Melbourne, pp. 126-142. Debus, S.J.S and Chafer, C.J. (1994) The Powerful Owl *Ninox strenua* in New South Wales Aust. Birds (suppl.) :S22-S38. Fleay, D (1968) Night Watchmen of Bush and Plain. Jacaranda Press, Brisbane. Garnett, S (1992). Threatened and Extinct Birds of Australia. RAOU Report 82. Mc Nab, E.G. (1996). Observations on the Biology of the Powerful Owl *Ninox strenua* in Southern Victoria. Australian Bird watcher 16 (7) pp 267-295. Schodde, R. and Tidemann, S. (Eds) (1986) Readers Digest Complete Book of Australian Birds. Second Edition. Readers Digest Services, Sydney Seebeck, J.H. (1976) The diet of the Powerful Owl *Ninox strenua* in western Victoria. Emu, 76, 167-170.	

Name	**Regent honeyeater** (*Xanthomyza phrygia*)	
Status	Endangered– Schedule 1 TSC Act (1995)	
Geographical Distribution	In NSW small, isolated populations occur along the Northern Tablelands and North-west slopes, Hunter Valley, Central coast, Blue Mountains and the far south coast. Breeding occurs in the northern Tablelands, ACT, upper hunter valley and far south coast regions (Webster and Menkhorst 1992).	
Description	Size 200-220mm. Head and upper and lower neck black, bare warty skin around eyes. Back, scapulars and rump black scalloped cream-yellow. Tail black, outer feathers bright yellow. Lower breast and belly cream scalloped black. Bill black. Feet dusky grey. (Readers Digest 1988).	
Habitat	This species inhabits temperate eucalypt woodland and open forest, including forest edges, woodland remnants on farmland and urban areas with mature eucalypts. In NSW it utilises gallery forests of *Casuarina cunninghamiana*. Areas providing reliable and ample supplies of nectar often support semi-resident groups of this species which revisit the area annually.	
Life Cycle Requirements	Breeding	This species roosts in tall eucalypts and breeds, sometimes in small colonies, in open forest/woodland and occasionally more disturbed woodland near housing and farmland. The breeding season is determined by the availability of nectar flows but generally extends from August to January.
	Foraging	Favoured sources of nectar are *Eucalyptus sideroxylon*, *E. albens, E. melliodora, E. leucoxylon*, heavy infestations of Mistletoe and *C. cunninghamiana* (Webster and Menkhorst 1992). In coastal areas this species is known to prefer the blossoms of Swamp mahogany *(Eucalyptus robusta*), and probably utilises several species of coastal ironbarks (*eg. E. siderophloia*).
	Dispersal	Movements of this species appear to be nomadic although individuals or groups will regularly frequent districts each year when Banksias and Eucalypts are in flower (Keast 1968).
Conservation Reserves	Broadwater NP Bundjalung NP, Hat Head NP, Yuraygir NP.	
Threatening Processes	Disturbance of critical feeding and breeding habitat, particularly during periods of peak nectar flow, may force individuals to emigrate to other more suitable habitat (Franklin and Menkhorst 1988).	
References	Franklin, D.C. and Menkhorst, P.W (1988) A history of the Regent Honeyeater in South Australia. South Australian Ornithologist, 30, 141-145. Keast (1968) Seasonal movements of the Australian Honeyeaters (Meliphagidae), and there ecological significance. *EMU* **89**: 140-154. Readers Digest (1988). Complete Book of Australasian Birds 2nd ed, Readers Digest Association, Far East Limited: Sydney Webster, R. and Menkhorst, P. (1992) The Regent Honeyeater (*Xanthomyza phrygia*): population status and ecology in Victoria and New South Wales. Arthur Rylah Institute for Environmental Research, Technical Report Series, No. 126.	

Name	**Large-footed myotis** (*Myotis macropus*)	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	This species is widely but sparsely distributed in eastern and northern Australia in coastal and sub-coastal regions. This species has been redefined in a recent taxonomic revision to include two similar species in eastern Australia. *Myotis macropus* is relatively common in riparian habitat in the study region.	
Description	The species is normally grey-brown above, paler below, but the fur gets more ginger as the bats get older. The feet are exceptionally large. Head and body length is 52-56mm (Richards 1995b).	
Habitat	This species roosts in tunnels and caves, and prefers riparian habitat over 500m in length Hall and Richards (1979). It generally requires forested waterways with nearby roosting opportunities. The most significant foraging habitats for this species are streams, creeks, rivers, lagoons, lakes and other waterbodies and their banks.	
Life Cycle Requirements	Breeding/ Roosting	The Large-footed myotis has been recorded roosting in caves, mines, tunnels, bridges, buildings and dense foliage in tropical areas. Males establish territories within the colony and monopolise a cluster of females during the breeding season (Strahan 1995). This species goes into torpor during winter and utilises caves during this period which are separate from maternity caves (SFNSW 1995).
	Foraging	This species forages by making feeding passes over the surface of water bodies for small aquatic insects, including water boatmen and mayflies Vestjens and Hall (1977). It seldom occurs far from waterbodies which range from rainforest streams to large reservoirs and even brackish water (Richards 1991c).
	Movements	This species is now known to travel significant distances from roost sites in caves to forage areas. Bats from a colony at Samford near Brisbane have been observed to fly each night to feed on a Lake 10km away (Richards *pers. comm*. 1998).
Conservation Reserves	Border Ranges, Bundjalung, Nightcap, Nymboida National Parks.	
Threatening Processes	State wide threats to this species include toxic accumulation of agricultural chemicals (such as pesticides and herbicides) in body fat used during winter torpor (Dunsmore *et al* 1974), predation at roost sites from foxes (Dwyer 1964), and destruction and modification of foraging habitat.	

References	Richards, G.C. (1995). Large-footed myotis *Myotis macropus* (Morsfield 1824). In: Strahan, R. (Ed). Mammals of Australia. The Australian Museum and Reed Books Sydney Richards (1991) Yellow bellied sheath-tail bat In: Strahan, R. (Ed). Mammals of Australia. The Australian Museum and Reed Books Sydney, p.315 Hall, L.S. and Richards, G.C (1979) "Bats of Eastern Australia" Booklet No. 12. Queensland Museum, Brisbane. Strahan R. (1995) "The Mammals of Australia". Reed Books, Chatswood. Dunsmore, J.D., Hall, L.S. & Kottek, K.H. (1974). "DDT in the Bent-winged Bat in Australia". Search 5: 110-111. State Forests of NSW. (1995) "Coffs Harbour Urunga Management Area – Environmental Impact Statement. Vol C, Proposed forestry operations - Schedule 12 Fauna." SFNSW, Northern Region. Dwyer, P.D. (1964). "Fox Predation on Cave Bats". Australian Journal of Science 26: 397-98. Vestjens, W.J.M. and Hall, L.S (1977). Stomach contents of forty two species of bat from the Australasian region. Australian Wildlife Research, 4: 25-35.

Name	**Square-tailed kite** (*Lophoictinia isura)*	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	This species is widespread in its distribution throughout Australia but is uncommon in the arid shrublands and grasslands of central Australia (Debus and Czechura 1989).	
Description	The Square-tailed kite closely resembles several other hawks in appearance. The tail is long and broad with angular corners and shadowy grey and black bars below. At rest the wingtips extend past the tail. Other features include: pale, dark streaked head, slight crest, rufous dark-streaked body, blackish back, fawn mark on shoulder.	
Habitat	Habitat utilised is open forests and woodlands, particularly those on fertile soils and with abundant passerines. This species may range into open habitats nearby but not extensive treeless regions (Marchant and Higgins 1993).	
Life Cycle Requirements	Forage	The Square-tailed kite predates mainly on the fledglings and nestlings of passerines, lizards and insects. Kites usually forage singly among forests and woodlands at or just above the canopy.
	Nesting	Breeding occurs in Spring. Nests are built high in trees, typically on a large horizontal bough of a Eucalypt and 12 to 26m from the ground. Two or three eggs are laid, these hatch in 37 to 42 days and fledging takes 8 to 10 weeks (Marchant and Higgins 1993).
	Movements	The species is migratory through much of it's range and it is a spring/summer breeding migrant in the south-east, east and south-west of Australia (Marchant and Higgins 1993).
Conservation Reserves	Bundjalung and Gibraltar Range National Parks.	
Threatening Processes	Habitat destruction is the main threat to the survival of the Square-tailed kite, as at least half of the area of open dry eucalypt forest and woodland in southern and eastern Australia has been cleared for settlement or agriculture.	
References	Debus, S.J.S and Czechura, G.V. (1988). The Square-tailed Kite *Lophoictinia isura*: a review. Australian Birdwatcher, 13, 81-97. Marchant, S. and Higgins, P.J. (eds) (1993) Handbook of Australian, New Zealand and Antarctic birds. Vol. 2 Raptors to Lapwings. Oxford University Press, Melbourne.	

Name	**Squirrel glider** (*Petaurus norfolcensis*)	
Status	Vulnerable –Schedule 2 TSC Act (1995).	
Geographical Distribution	The range of the Squirrel glider has, in the past, been considered to lie to west of the Great Dividing Range and extend from western Victoria to northern Queensland (Strahan 1995). However recent records would tend to suggest that the Squirrel glider is also present in suitable habitat on the coastal lowlands of NSW and Queensland.	
Description	The Squirrel glider is similar to the Sugar glider but has a longer and more pointed face, longer and narrower ears and bushier tail and the facial markings often more distinct (Suckling 1995)..	
Habitat	The Squirrel glider occupies wet and dry sclerophyll forests (Smith & Winter 1984) with open dry sclerophyll forests regarded as optimum habitat (Tyndale-Biscoe & Calaby 1975). Although Davey (1984) has found Squirrel gliders in rainforest, it is unlikely that they occur extensively in this habitat type.	
Life Cycle Requirements	Foraging	Critical habitat consists of mixed stands of Eucalypts which invariably include gum barked species and high proportion of winter nectar producing trees. Mixed species Eucalypt forests may provide a more reliable year round food resource than do less diverse forests. This may attribute to the greater availability of microhabitats for invertebrates and to the availability of nectar for a greater part of the year.
	Nesting	Dens or hollows in trees are another critical habitat component and Squirrel gliders require several hollow trees within a home range. Dens are communal and are occupied by 2-9 adults (Quin 1993).
	Movements	In Victoria (Traill & Coates 1993) have estimated the home range of the Squirrel glider to be 13 hectares with an average density of 0.4 individuals/hectare. The Squirrel glider generally has a higher density than the Sugar glider and as a result where the two occur together the Squirrel glider is usually the more common (Suckling 1984).
Conservation Reserves	Border Ranges, Bundjalung, Mt. Warning, new England, Washpool, Werrikimbe, Yuraygir National Parks. Limeburners Creek Nature Reserve.	
Threatening Processes	Threats to Squirrel glider populations are likely to include: clearing of habitat *which* provides critical habitat components, particularly older Eucalypt stands which provide a large number of hollow bearing trees. Domestic animals, particularly cats are a major threat. Squirrel glider kills have been observed where motor vehicles pass through or near habitat (based on AKF 1995).	
References	Davey, S.M. (1984). Habitat preferences of arboreal marsupials within coastal forests in Southern NSW. In: Smith, A.P. and Hume, I.D. (Eds.) *Possums and Gliders*. Surrey Beatty and Sons, Chipping Norton, Sydney, pp. 509-516 Tyndale-Biscoe, C,H and Calaby, J.H. (1975) Eucalypt forests as refuges for wildlife. Australian Forestry 38, 117-133. Quin, D.G. (1993). Socio-ecology of the Squirrel Glider and the Sugar Glider. PhD Thesis, University of New England, Armidale. Strahan R. (1995). The Mammals of Australia. Reed Books, Chatswood. Suckling, G.C. (1984). Population ecology of the sugar glider, *Petaurus breviceps*, in a system of fragmented habitats. *Aust. Wild. Res.* 11: 49-75.Traill, B.J. and Coates, T.D. (1993). Field Observations on the Brush-tailed Phascogale (*Phascogale tapoatafa*) Marsupalia: Dasyuridae. *Australian Mammalogy*, 16: 61-65.	

Name	**Stephens' banded snake** (*Hoplocephalus stephensii*)	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	On the coast and Great Dividing Range from Gosford in NSW to Kroombit Tops is southern Queensland (Wilson and Knowles 1988).	
Description	A medium sized (65cm) nocturnal semi-arboreal snake. The dorsal surface is usually brownish to yellowish and can have the colour pattern of broad dark cross bands, but is may lack this pattern entirely. The head is black with a brown or creamy patch either side of the nape. The lips are barred with black and cream (Cogger 1994).	
Habitat	Stephens' banded snake inhabits dry and moist hardwood forest and rainforest in coastal and near coastal areas (Cogger 1992; Wilson and Knowles 1988). It also occurs in rocky outcrops, particularly those comprising exfoliated granite (Wilson and Knowles 1988; Ehmann 1992) and occasionally sandstone in the southern parts of its range (Wells *et al* 1988). The key elements of the preferred habitat for Stephens' banded snake are a dense understorey and canopy structure which are required for foraging and movement.	
Life Cycle Requirements	Forage	Hollows, tree scars and loose bark in mature or senescent trees, and to a lesser extent large hollow logs, are required for foraging. It feeds in the canopy as well as on the ground. Prey is lizards and small mammals, including bats, that occur in the tree canopy or in its roost site in trees (Ehmann 1992).
	Breeding	Breeding habitat is analogous with sheltering habitat. Females appear to reproduce every two years, producing a litter of 3 to 8 young in December to February.
	Shelter	Hollows, tree scars and loose bark in mature or senescent trees, and to a lesser extent large hollow logs, are required for sheltering sites.
	Dispersal	Not known.
Conservation Reserves	Mt. Warning, Dorrigo, Nymboida, Gibraltar Range and Border Ranges National Parks	
Threatening Processes	Stephens' banded snake is threatened by habitat loss brought about by logging and Clearing Rainforest, Dry hardwood forest and Moist hardwood forest.	
References	Cogger, H. (1992). Reptiles and Amphibians of Australia. Reed International Books. Cogger, H. (1994) Reptiles and Amphibians of Australia. Reed International Books. Ehmann H., (1992). Encyclopaedia of Australian Animals. Reptiles. Angus and Robertson 495pp. Wells, R.W., Wellington, C.R. & Williams D.J (1988) Notes on Stephens' Banded Snake *Hoplocephalus stephensii* Krefft, 1869. The Australian Herpetologist No. 512. Wilson, S.K. and Knowles, D.G. (1988) Australia's reptiles: A photographic Guide to the terrestrial Reptiles of Australia. Collins, Sydney.	

Name	**Swift Parrot** (*Lathamus discolor)*	
Status	Endangered– Schedule 1 TSC Act (1995)	
Geographical Distribution	The breeding population is based in Tasmania. This species occurs along the eastern seaboard into south- eastern Queensland.	
Description	The swift parrot is a small (24cm) lorikeet like parrot. Colour is bright green, with red around the bill base, throat and forehead. Edges of the throat patch yellow, crown bluish purple. The shoulders are bright red and wing coverts blue. The red underwing and tail coverts are obvious when in flight (Simpson and Day 1996).	
Habitat	Mainland populations of this species favour winter-flowering eucalypt forest and woodland, usually where abundant supplies of Eucalypt nectar exist.	
Life Cycle Requirements	Breeding	This species breeds only in eastern and northern Tasmania. It overwinters on the mainland seeking winter-flowering eucalypts to feed on and store energy to sustain its return to Tasmania in the Spring.
	Foraging	Preferred feed trees are the Tasmanian blue gum (*Eucalyptus globulus*), Red ironbark (*E. sideroxylon*), Yellow gum (*E. leucoxylon*), White box (*E. albens*) and Swamp gum (*E.ovata*). In the study region, Spotted gum (*E. maculata*), Coast banksia (*Banksia integrifolia*) and Saw banksia (*B. serrata*) are utilised.
	Dispersal	The breeding population occurs in Tasmania, and in late March almost the entire population migrates to mainland Australia (Schodde and Tidemann 1986). Most bird overwinter in Victoria and central and eastern NSW, but a few are recorded from south-east Queensland. Migrants return to Tasmania in September (Brown 1989)
Conservation Reserves	Border Ranges NP, Yuraygir NP.	
Threatening Processes	Threatening processes acting on this species on the mainland include the clearing of stands of winter flowering Eucalypts such as Red Ironbark (*Eucalyptus sideroxylon*), Yellow gum (*Eucalyptus leucoxylon*), White box (*Eucalyptus albens*) and Swamp gum (*Eucalyptus ovata*) (Brown 1989).	
References	Brown, P. (1989) The Swift Parrot *Lathamus discolor*: a report on its ecology, distribution and status, including management considerations. Technical report. Department of Lands, Parks and Wildlife, Hobart. Schodde, R. & Tidemann, S.C (eds) (1986). Readers Digest Complete Book of Aust. Birds (2nd Edition). Reader's Digest Services Pty Ltd, Surry Hills. Simpson, K. & Day, N (1996). Field Guide to the Birds of Australia. Viking: Penguin Books, Sydney.	

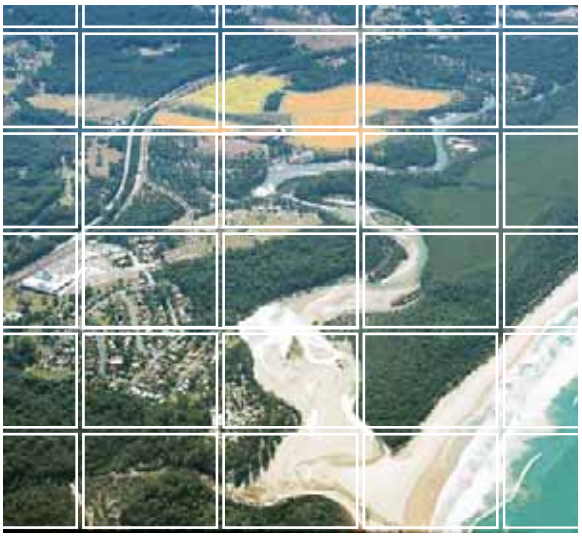
Name	**Wallum froglet** (*Crinia tinnula*)	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Geographical Distribution	Strictly coastal from Tin Can Bay in Queensland to Wyong in NSW. Distribution along this strip is not continuous.	
Description	Similar in most respects to the Common Eastern froglet (*Crinia signifera*) from which it differs in having a median line of white dots on the throat, a more pointed snout and a distinctive call.	
Habitat	In NSW this species is most often recorded from coastal heath sites and Paperbark swamps. In Queensland this species is associated with Paperbark swamps on coastal alluvial sands (Straughan and Main 1966)	
Life Cycle Requirements	Breeding	Breeding occurs in ephemeral sites such as larger puddles in heath or puddles in watercourses and creek-lines (White 1995). Breeding also occurs on the periphery of permanent wetlands and drains (J. Richard pers. obs.)
	Foraging	The Wallum froglet appears to feed on small arthropods in sedges and grasses around the fringes of wetland or wet heathland sites (AMBS 1995).
	Dispersal	The Wallum froglet will disperse into highly disturbed habitats such as grasslands during flood events (J. Richard pers. obs).
Conservation Reserves	Broadwater NP, Bundjalung NP, Yuraygir NP, Myall Lakes NP, Tyagarah NR, Broken Head NR.	
Threatening Processes	The Wallum froglet is threatened by the loss of coastal wetland and wet heath habitats, and declines in the quality of water entering such habitats.	
References	Australian Museum Business Services (1995**).** Urbenville Management Area - Fauna Impact Statement Vol. D. State Forests of N.S.W., Pennant Hills. Straughan, I.R. and Main, A.R. (1966). Speciation and polymorphism in the genus Crinia (*Anura Leptodactylidae*) in Queensland. Proceedings of the Royal Society of Queensland, 78, 11-28. White (1995) *Crinia tinnula* distribution extension. Frogcall. Newsletter of the NSW Frog and Tadpole Study Group.	

Name	**Yellow-bellied glider** (*Petaurus australis)*	
Status	Vulnerable – Schedule 2 TSC Act (1995)	
Recover Plan	NSW National Parks and Wildlife Service (2003). Recovery Plan for the Yellow-bellioed Glider (*Petaurus australis*). NSW National Parks and Wildlife Service, Hurstville.	
Geographical Distribution	The Yellow-bellied glider has a patchy distribution along the east coast and adjacent ranges of Australia from south-eastern South Australia to North Queensland. The southern subspecies *P. australis australis* occurs along the east coast of Australia to central Queensland and the northern subspecies *P.a. reginae* occurs in two small populations in North Queensland (Russell 1995).	
Description	Grey fur above, whitish to orange fur underneath and large bare ears. Individuals have a gliding membrane that extends from the wrists to the ankles. The head and body is much longer than that of the Sugar or Squirrel glider but shorter than in the Greater glider. Tail is fluffy and about one and a half times the length of its body and relatively much longer than in other gliders. Males and females are similar in appearance.	
Habitat	Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows and yearround food resources are available from a mixture of eucalypt species (Goldingay & Kavanagh 1991; Tanton 1994; Craig 1985).	
Life Cycle Requirements	Breeding	A single young is born between May and September, with the variation likely to reflect the abundance of food resources (Goldingay & Kavanagh 1991). The yound remains in the pouch for up to 100 days after which time it is left in the nest while the mother forages. After leaving the pouch, the young is suckled for up to 60 days (Russell 1995).
	Foraging	Primarily made up of eucalypt nectar, eucalypt sap, honeydew, manna and invertebrates found under decorticating bark and pollen (Goldingay & Kavanagh 1991). Incises the bark of eucalypts to obtain sugar-rich sap.
	Dispersal	Homerange between 30 and 65 ha (Goldingay & Kavanagh 1991) usually occurs in densities of 0.05-0.14 individuals per ha (Russell 1995). This is a gregarious species and lives in family groups of between 3 (in southern parts of its range) and 6 (in the north).
Conservation Reserves	Yellow-bellied glider occurs in various conservation reserves along the east coast and adjacent inland areas in NSW (NPWS 1999).	
Threatening Processes	The loss and fragmentation of habitat through clearing and the activities associated with clearing is a threat as the logging of oldgrowth elements removes the number of hollow bearing trees available for nesting. Inappropriate fires regimes reduces the availability of food resources and isolates populations making them vulnerable. Predation by feral carnivores such as foxes and cats is also a threat.	
References	Craig, S.A. 1985. Social organization, reproduction and feeding behaviour of a population of Yellow-bellied Glider *Petaurus australis* (Marsupalia: Petauridae). *Australian Wildlife Research* 12:1-18. Goldingay, R.L. and Kavanagh, R.P. 1991. The Yellow-bellied Glider: a review	

	of its ecology, and management considerations, in D. Lunney (Ed.) Conservation of Australia's Forest Fauna. Royal Zoological Society of NSW, Mosman. Russell, R. 1995. Yellow-bellied Glider *Petaurus australis* Shaw 1791, in R. Strahan (Ed.) The Mammals of Australia. Reed Books, Chatswood. Tanton, M.T.T. 1994. Fauna Impact Statement. Proposed Forestry operations in the Eden Management Area. Environmental Impact Statement. Vol. B: Appendix 1. State Forests of NSW, Sydney.

ERM has over 100 offices across the following countries worldwide

Australia
Argentina
Belgium
Brazil
China
France
Germany
Hong Kong
Hungary
India
Indonesia
Ireland
Italy
Japan
Korea
Malaysia
Mexico
Netherlands
New Zealand
Peru
Poland
Portugal
Puerto Rico
Singapore
Spain
Sri Lanka
Sweden
Taiwan
Thailand
UK
USA
Venezuela
Vietnam



Environmental Resources Management

53 Bonville Ave
Thornton NSW 2322
PO Box 71,
Thornton NSW 2322

T: 61 2 4964 2150
F: 61 2 4964 2152
www.erm.com

ERM