



# Biodiversity Assessment Report

## The Bay Resort

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Name	Signature	Date
Rob Dwyer		April 2015

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## Summary

RPS has been engaged by Raphael Shin Enterprises Pty Ltd (the proponent) to undertake ecological investigations and reporting to inform a proposed integrated Tourist Resort facility (the Project) within Part Lot 2 DP 747399, hereafter referred to as the 'Project Site'. Such investigations will form a component of an Environmental Impact Statement (EIS) for this State Significant Development (SSD) under Section 78A (8A) of the *Environmental Planning & Assessment Act (1979)*. The EIS responds to Director-General's Environmental Assessment Requirements generated for the proposal.

A core component of the biodiversity assessment process is the application of the BioBank Assessment Methodology (BBAM) to assess development impact, and to enable a suitable biodiversity offset arrangement to be determined. To that end, as the project is a SSD (now termed 'Major Project'), and following discussions with both NSW OEH and NSW Planning, the assessment process herewith follows the recently introduced Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major Projects (FBA). This involves a three stage investigation and reporting process; including:

**Stage 1** – Biodiversity Assessment;

**Stage 2** – Impact Assessment (Biodiversity Values); and

**Stage 3** – Biodiversity Offset Strategy.

The Biodiversity Offset Strategy is centred around conversion of the large remaining residue portion of the site into a formal Biobank site. The area has been shown to contain numerous ecological features of note, including but not limited to estuarine areas, SEPP 14 wetland, EEC vegetation communities, and known habitat for various threatened species. The land is contiguous with the Tilligerry Nature Reserve, which may offer potential for integration with the conservation estate. Discussions have been initiated with OEH / NPWS in this regard.

The table overleaf provides a summary overview of the Credit Balance Ledger for the development and biodiversity offset proposal (Biobank site). Negative balances are presented in (brackets). This balance shows that all credit categories are met and exceeded, aside from Saltmarsh which is in deficit by 274 credits. Overall the proposed Biobank site delivers a collective positive credit balance of 758 credits. The proponent is committed to providing the necessary Saltmarsh Ecosystem Credits to offset the development, and has commenced investigating several possible solutions to meeting this requirement.

In addition, the presence within part of the Development Area of "Riparian Buffer of an estuarine area (50m)" is classed as an "impact that requires further consideration" by the Consent Authority. It is considered that there are sufficient ecological benefits associated with the project to result in improved outcomes for the tidal estuarine areas within the Project Site.

Species / Community	Development Area Impact	Biobank Land Generation	Balance
<b>Ecological Communities</b>			
Saltmarsh	361	87	(274)
Swamp Oak Forest	56	315	259
Swamp Mahogany Forest	0	48	48
Mangroves	0	7	7
<b>Ecological Community Balance = 40 credits</b>			
<b>Birds</b>			
Black Bittern	73	222	149
<b>Birds Balance = 149 credits</b>			
<b>Frogs</b>			
Wallum Froglet	13	87	74
<b>Frogs Balance = 74 credits</b>			
<b>Mammals</b>			
Koala	0	45	45
Eastern Cave Bat	13	222	209
Little Bentwing-bat	13	222	209
Grey-headed Flying-fox	0	32	32
<b>Mammals Balance = 495 credits</b>			
<b>Overall Balance = 758</b>			

## Stage I – Biodiversity Assessment

## 1.0 Introduction

RPS has been engaged by Raphael Shin Enterprises Pty Ltd (the proponent) to undertake ecological investigations and reporting to inform a proposed integrated Tourist Facility to be known as “The Bay Resort” (the Project) off Nelson Bay Road, Anna Bay. Such investigations will form a component of an Environmental Impact Statement (EIS) for this State Significant Development (SSD) under Section 78A(8A) of the *Environmental Planning & Assessment Act (1979)*. The EIS responds to Director-General’s Environmental Assessment Requirements generated for the proposal.

A core component of the biodiversity assessment process is the application of the BioBank Assessment Methodology (BBAM) to assess development impact, and to enable a suitable biodiversity offset arrangement to be determined. To that end, as the project is a SSD (now termed ‘Major Project’), the assessment process herewith follows the *Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major Projects*.

### 1.1 Description of Development

**Locality** – 4177 Nelson Bay Road, Anna Bay. See **Figure 1**.

**LGA** – Port Stephens.

**Area** – The Project Site is comprised of a proposed Development Area (approx 8.4ha) and remaining residue lands (approx 31.3ha) proposed to be converted into a Biobank site. See **Figure 2**.

**Current Land Use** – The development area supports existing dwelling and associated rural structures, cleared grazing land and some native vegetation. The Biobank area supports native vegetation.

**Topography** – The Project Site occurs on flat coastal depression lands, much of which is affected by tidal influence. Higher lands occur in the south within the proposed development zone, and in the north-east of the Biobank area where Eucalypt Forest occurs.

**Vegetation** – Vegetation mapping has been conducted across the entire Project Site by RPS. The following vegetation communities occur:

Development Area: Exotic Pastures; Swamp Oak Rushland Forest (Disturbed); Saltmarsh; and Saltmarsh (Disturbed).

Biobank Area: Swamp Mahogany – Paperbark Forest, Swamp Oak Rushland Forest, Swamp Oak Rushland Forest (Disturbed), Mangrove Estuarine Complex, Saltmarsh, Saltmarsh (Disturbed), Exotic Pastures.

**Proposed Development** – The proposed development includes construction of a five star hotel incorporating 150 hotel rooms, internal restaurant and cafe, internal retail space, multi-purpose theatre and associated car parking. It will also include construction of three tourist accommodation buildings incorporating a total of 219 units with undercover parking and extensive landscaping throughout the proposed development footprint. Entrance features, and water sensitive urban design structures will enhance the aesthetic appeal of the development. Similarly provision of “on site” environmental offsets will maintain and enhance the natural attributes of the site.

The total building floor area of the Bay Resort, including the international eco-hotel and tourist apartments is approximately 23,074m<sup>2</sup>, representing approximately 27% of the proposed development footprint of 8.4ha or 5.7% of the approx total 40ha site. The project budget is approximately \$230million, including commercial element/s eg theatre/function, restaurants, retail estimated at approximately \$15million.

A key component of the project as relates to biodiversity assessment is the provision of a suitable biodiversity offsets package. This package includes ecological offsets in the form of creation of a formal Biobank site over the residue of the Project Site (approx 31.3ha). The area has been shown to contain numerous ecological features of note, including but not limited to estuarine areas, SEPP 14 wetland, EEC vegetation communities, and known habitat for various threatened species. The area is also contiguous with Tilligerry Nature Reserve, and would offer a seamless funded addition to the Conservation Reserve system if so desired by NPWS.

## 1.2 Background Information

A review of relevant information was undertaken to provide an understanding of ecological values occurring or potentially occurring on the Project Site and in the wider region. Such included previous ecological reports, vegetation maps, topographic maps, aerial photography and general scientific literature reviews. Of particular relevance was the following ecological survey previously carried out on the Project Site:

- Cumberland Ecology (2007). *Flora and Fauna Impact Assessment: Anna Bay*. Draft Report prepared for Spacecon Pty Ltd, December 2007. See **Appendix B**.

The Cumberland Ecology (2007) document also incorporated relevant results from a previous ecological survey conducted across the Project Site, namely:

- HWR Ecological (2005). *Ecological Assessment - Anna Bay Nature Resort – Nelson Bay Road, Anna Bay*. Unpublished Report.

RPS has utilised the above information as a baseline, and undertaken a suite of ecological survey work across the Project Site in order to update the dataset, and to assess significant habitat features of the Project Site and their potential for supporting threatened species, populations and Endangered Ecological Communities (EECs) that are known to occur within the locality. Such works are included herewith as **Appendix A**.

Additional targeted fieldwork has also been undertaken utilising the Framework for Biodiversity Assessment (FBA) methodology to assess impacts and to inform biodiversity offsets considerations for the proposal.

**Legend**

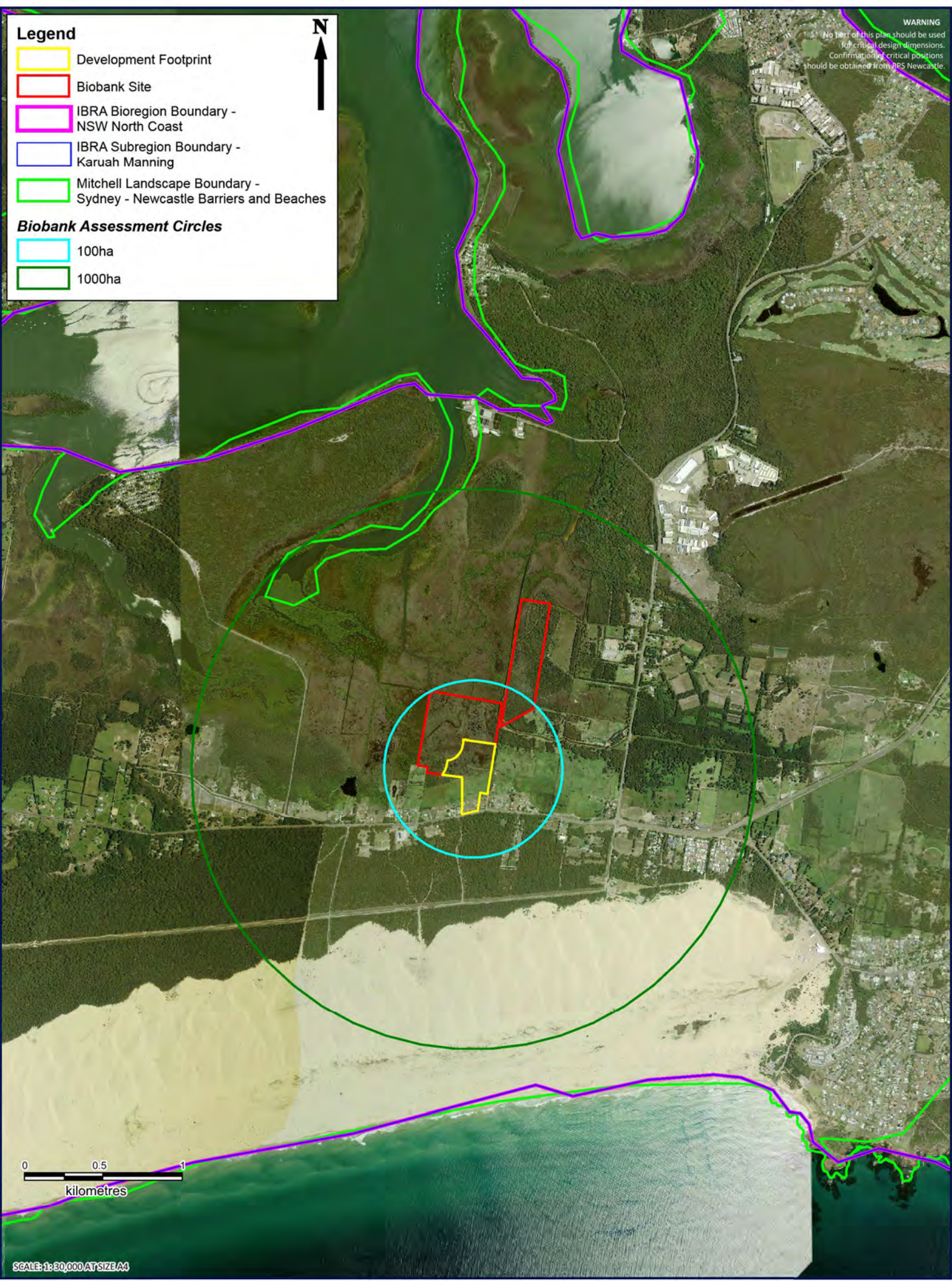
- Development Footprint
- Biobank Site
- IBRA Bioregion Boundary - NSW North Coast
- IBRA Subregion Boundary - Karuah Manning
- Mitchell Landscape Boundary - Sydney - Newcastle Barriers and Beaches

**Biobank Assessment Circles**

- 100ha
- 1000ha



**WARNING**  
 No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.



SCALE: 1:30,000 AT SIZE A4

Title: <b>FIGURE 1: SITE LOCATION</b>	LOCATION: ANNA BAY	DATUM: GDA 94 PROJECTION: MGA ZONE 56	DATE: 26/03/2015 PURPOSE: BIOBANKING	LAYOUT REF: \\UOB\119K\119462 Anna Bay 110 - Drafting\Mapinfo Workspaces VERSION (PLAN BY): A A4 (JS)
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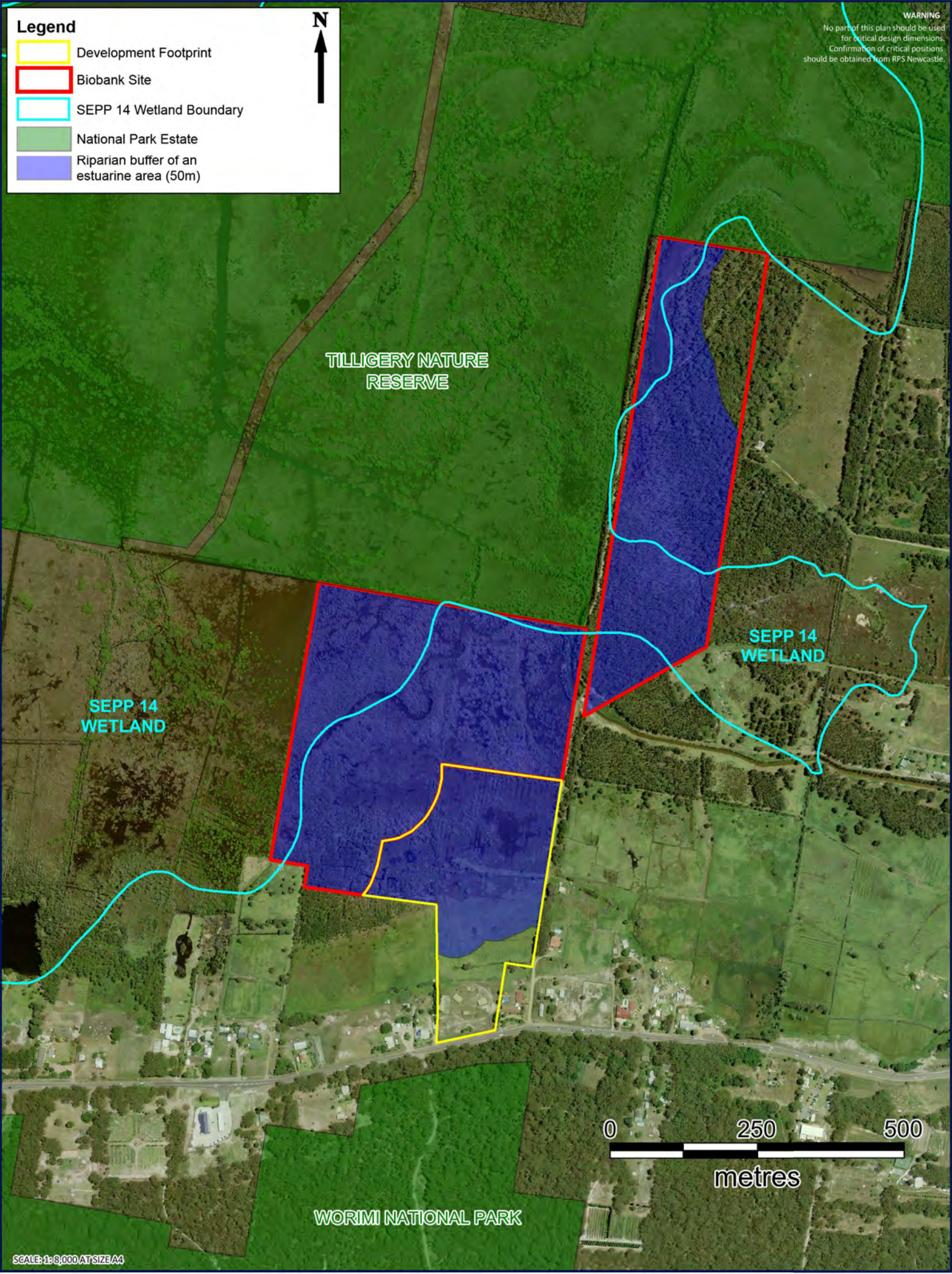


**Legend**

- Development Footprint
- Biobank Site
- SEPP 14 Wetland Boundary
- National Park Estate
- Riparian buffer of an estuarine area (50m)



**WARNING**  
 No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.



SCALE: 1:8,000 AT SIZE A4

## 2.0 Biodiversity Assessment – Development Area

### 2.1 Identified Landscape Features

The Project Site is situated within the Sydney Basin IBRA Bioregion and the Hunter IBRA Subregion.

The Project Site is located within the 'Sydney-Newcastle Barriers and Beaches' Mitchell Landscape.

Part of the western portion of the site contains SEPP 14 Wetland, which continues offsite into Tilligerry Nature Reserve.

Large parts of the site are subject to tidal influence, and would be considered as "Riparian buffer of an estuarine area (50m)".

Landscape features identified within the Project Site and surrounding assessment buffers are depicted in **Figure 1** and **Figure 2**.

### 2.2 Determining Landscape Value

The Project Site Landscape Value is scored based on several variables including:

- Percentage (%) Native Vegetation Cover;
- Connectivity Values; and
- Patch Size.

#### 2.2.1 Percentage (%) Native Vegetation Cover

Two landscape assessment circles, being 100 and 1000 hectares in area, were initially centred over the proposed Development Area using aerial imagery and GIS software. Percentage native vegetation cover within each assessment circle was visually estimated for 'Before' and 'After' development scenarios.

The 1000 hectare assessment circle was used to assess any loss (or negative impacts) of the proposed development on the percent native vegetation cover in the 'locality' and to identify threatened species that may occur on the Project Site. The smaller 100 hectare circle was used to assess the loss of surrounding vegetation cover at an even more local scale as a result of the proposed development.

The 100 hectare assessment circle was assessed as having a native vegetation cover class of 61-65% Before development, and 56-60% After development, resulting in a downward change or 'jump' of one native vegetation cover class.

The 1000 hectare circle was assessed as having a native vegetation cover of 81-85% for Before and After development scenarios.

The assessment circles and associated native vegetation visually assessed are shown in **Figure 1**.

#### 2.2.2 Connectivity Value

Step 1:

A desktop Connectivity Condition assessment was undertaken by assessing the average condition of native vegetation across the Project Site's 'Primary' linkages to adjoining vegetation. Primary linkages are defined as native vegetation that:

- Is in moderate to good condition;
- Has a patch size > 1 hectare in area;
- Is separated by a distance of <100 metres; and
- Is not separated by a dual carriageway or wider highway or similar hostile link.

It is clear that the Project Site is a part of a connecting link of native vegetation.

#### Step 2:

Given these links, it is necessary to assess whether the development will impact on a 'State Significant Biodiversity Link' and/or a 'Regionally Significant Biodiversity Link'. Examination of these factors reveals that the development site does contain a nominated category, being "Riparian buffer of an estuarine area (50m)".

As such, the Development Area is considered to qualify for the maximum connectivity score of 12, and no further steps of connectivity assessment was required.

### 2.2.3 Patch Size

To assess the Patch Size, the assessment must:

- Determine the percent native vegetation cleared in the Mitchell Landscape in which most of the development occurs. In this case the Mitchell Landscape is 'Sydney-Newcastle Barriers and Beaches' and this landscape is 50% cleared.
- Determine the Patch size class, which in this instance is 'extra large'.

Based on the above, the derived Patch Size Score is 12.

## 2.3 Derived Landscape Value

Data for Percentage Native Vegetation Cover, Connectivity and Patch Size is combined to give the proposed Development Area Landscape Score of 24.4.

## 2.4 Assessing Native Vegetation

### 2.4.1 Vegetation Zones

The proposed development involves the removal of 5.61ha of native vegetation. The directly affected vegetation zones were determined to consist of:

- Saltmarsh Estuarine Complex (HU960) – 0.45ha
- Saltmarsh Estuarine Complex (HU960) (Disturbed) – 4.14ha
- Swamp Oak – Sea Rush – Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast (HU941) – 1.02ha

Full descriptions of these communities are presented within **Appendix A**.

These vegetation types were classified based on the 'best fit' vegetation type listed in the Plant Communities Types Database (OEH 2009). Parameters used to choose the 'best fit' Vegetation Type included overstorey and understorey floristics, soil landscape, location and topographic position.

Final Scientific Committee Determinations under the TSC Act were reviewed to assess whether any of the Vegetation Zones were classified as Endangered or Critically Endangered Ecological Communities (EECs).

The Saltmarsh community is commensurate with 'Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions' Endangered Ecological Community under the TSC Act 1995.

The Swamp Oak community is commensurate with 'Swamp Oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions' Endangered Ecological Community under the TSC Act 1995.

The vegetation communities listed above correspond to three Biobank Vegetation Zones recorded for the Development Area and entered into the Credit Calculator, listed below in **Table 2** and shown in **Figure 3**.

**Table 1 Vegetation Zones – Development Area**

Veg Zone #	Vegetation Class (Keith 2004)	Biobank Vegetation Type	Area (ha)	Identification Method	Condition Class	EEC	Estimate percent cleared value	Site Value Score
1	Saltmarshes	HU960 – Saltmarsh Estuarine Complex	4.14	Detailed floristics for site and surrounds provided in Cumberland Ecology (2007), ground-truthed by RPS 2014/15.	Moderate / Good	<i>Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions</i>	50%	98.15
2	Saltmarshes	HU960 – Saltmarsh Estuarine Complex (Disturbed)	0.45	Detailed floristics for site and surrounds provided in Cumberland Ecology (2007), ground-truthed by RPS 2014/15.	Moderate / Good_Poor (Disturbed)	<i>Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions</i>	50%	83.33
3	Coastal Floodplain Wetlands	HU941 - Swamp Oak – Sea Rush – Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast	1.02	Detailed floristics for site and surrounds provided in Cumberland Ecology (2007), ground-truthed by RPS 2014/15.	Moderate / Good_Poor	<i>Swamp Oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions</i>	50%	64.67

**Legend**

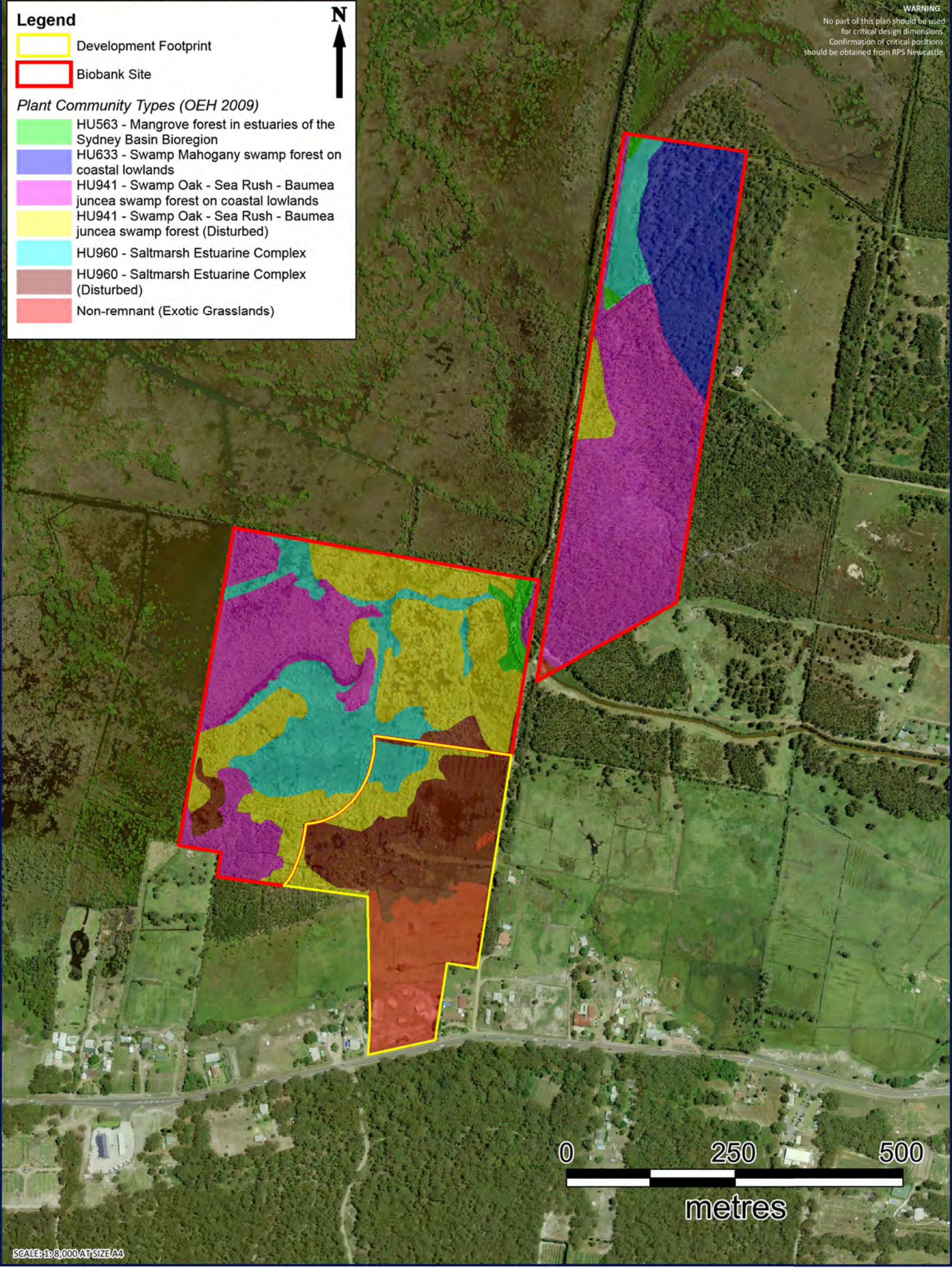
- Development Footprint
- Biobank Site

*Plant Community Types (OEH 2009)*

- HU563 - Mangrove forest in estuaries of the Sydney Basin Bioregion
- HU633 - Swamp Mahogany swamp forest on coastal lowlands
- HU941 - Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands
- HU941 - Swamp Oak - Sea Rush - Baumea juncea swamp forest (Disturbed)
- HU960 - Saltmarsh Estuarine Complex
- HU960 - Saltmarsh Estuarine Complex (Disturbed)
- Non-remnant (Exotic Grasslands)



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SCALE: 1:8,000 AT SIZE A4

Title: FIGURE 3: VEG ZONES MAP

LOCATION: ANNA BAY

DATUM: GDA 94  
PROJECTION: MGA ZONE 56

DATE: 26/03/2015  
PURPOSE: BIOBANKING

LAYOUT REF: \\JOB5\119K\119462 Anna Bay  
110 - Drafting\Mapinfo Workspaces  
VERSION (PLAN BY): A A4 (JS)

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### 2.4.2 Plot and Transect Surveys

A Biobank field survey of the Development Area was undertaken by an RPS field team overseen by Craig Anderson (Consultant Accredited Biobank Assessor No. 150).

A total of five Biobank biometric plots were carried out within the Development Area where native vegetation is present (5.61ha) which has been subsequently subjected to impact assessment calculations. Each survey site comprised the establishment of a 400m<sup>2</sup> quadrat (dimension = 20 metre x 20 metre) nested within a larger 0.1 hectare plot (dimension = 20 metre x 50 metre). Data collected within the nested plot comprised full floristics, elevation, slope, aspect, topographic position and soil type. Data collected within the larger plot comprised a census of hollow bearing trees and length of fallen logs. Structural vegetation data (vegetation cover for all strata) was collected along a 50 metre long transect (representing one of the 0.1 ha plot boundary lines). Plot data was recorded on Biobank specific field proformas prepared by OEH.

Survey methodologies for site variables recorded (e.g. how foliage cover is calculated for each strata) are detailed in OEH (2014).

Transect/plot data for the Development Area was entered into the 'Site Values' section of the Credit Calculator and is reproduced below in **Table 2**. The Credit Calculator requires that a minimum number of Biometric plots be carried out for each Vegetation Zone based on the Zone's extant area. The number of plots undertaken meets the Biobank assessment minimum survey effort requirements.


Biobank plot survey sites for the project are shown in **Figure 4**.

Table 2 Survey Plot/Transect Data – Development Area


Plot ID #	Plant Species Richness	Native Overstorey Cover	Native Mid Storey Cover	Native Ground Cover - grasses	Native Ground Cover - shrubs	Native Ground Cover - other	Exotic Plant Cover	# Tree Hollows	Overstorey Regeneration	Length Fallen Logs (m)	AMG Grid Refs WGS84
<b>Veg Zone: – HU960 – Saltmarsh Estuarine Complex - Moderate/Good_Poor Condition Class (Disturbed)</b> (3 plots completed; minimum 3 plots required)											
Plot 3	4	0	0	76	0	60	0	0	1	0	411649(E); 6374268(N)
Plot 16	4	0	0	66	0	70	0	0	1	0	411658(E); 6374341(N)
Plot 17	7	0	0	46	0	76	0	0	1	0	411523(E); 6374268(N)
<b>Veg Zone: – HU960 – Saltmarsh Estuarine Complex - Moderate/Good Condition Class</b> (1 plot completed; minimum 1 plot required)											
Plot 5	3	0	0	22	0	94	0	0	1	0	411511(E); 6374425(N)
<b>Veg Zone: – HU941 – Swamp Oak – Sea Rush – Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast - Moderate/Good_Poor Condition Class (Disturbed)</b> (1 plot completed; minimum 1 plot required)											
Plot 4	3	18.5	0	18	0	84	0	0	1	0	411497(E); 6374360(N)


**Legend**


 Development Footprint


 Biobank Site


*Plant Community Type (OEH 2009)*


 HU563 - Mangrove forest in estuaries of the Sydney Basin Bioregion


 HU633 - Swamp Mahogany swamp forest on coastal lowlands


 HU941 - Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands

 HU941 - Swamp Oak - Sea Rush - Baumea juncea swamp forest (Disturbed)

 HU960 - Saltmarsh Estuarine Complex

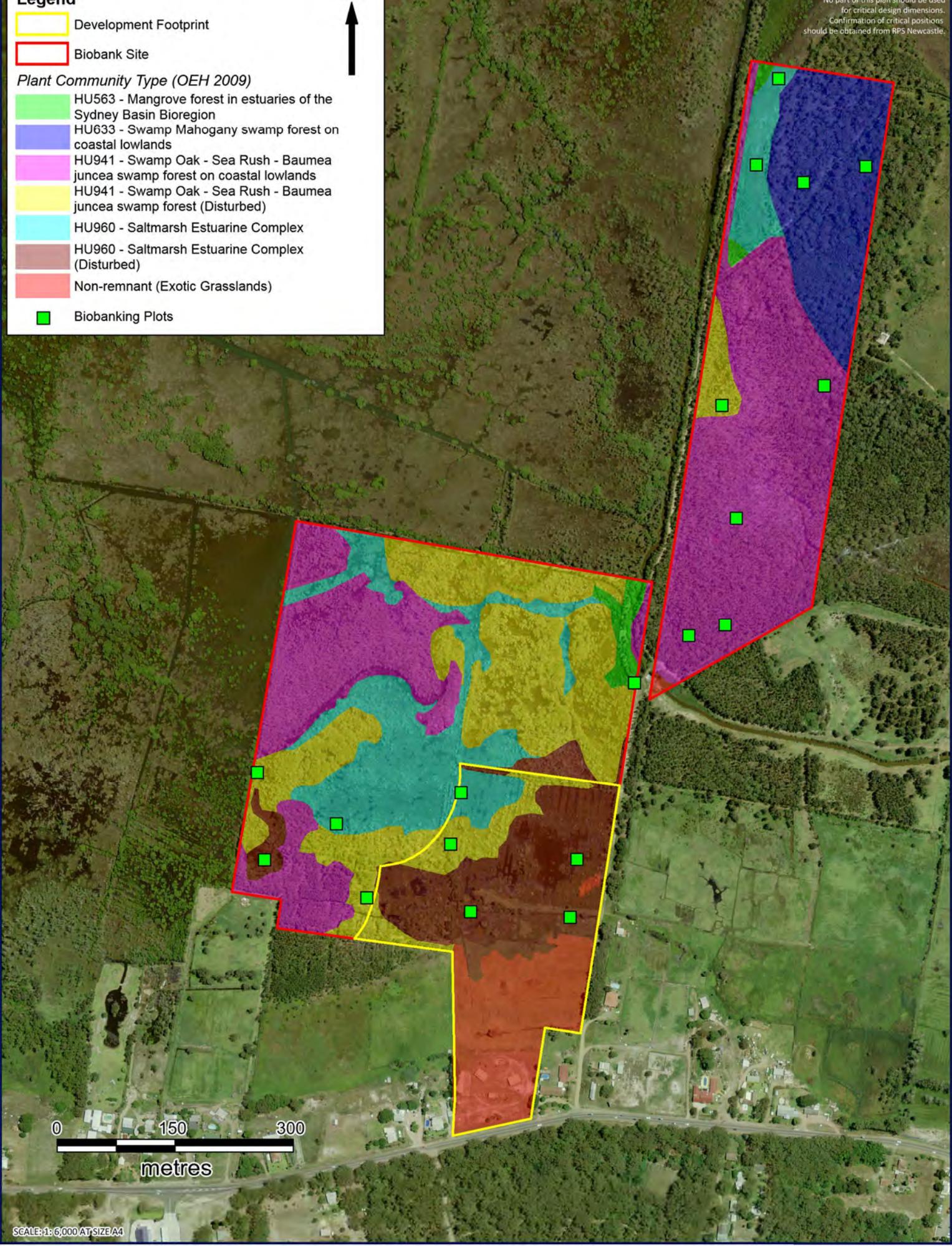
 HU960 - Saltmarsh Estuarine Complex (Disturbed)

 Non-remnant (Exotic Grasslands)

 Biobanking Plots



**WARNING**  
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.



SCALE: 1:6,000 AT SIZE A4

Title: **FIGURE 4: BIOBANKING PLOT LOCATION MAP**

LOCATION: ANNA BAY

DATUM: GDA 94  
PROJECTION: MGA ZONE 56

DATE: 24/03/2015  
PURPOSE: BIOBANKING

LAYOUT REF: \\J:\085\119\K\119462 Anna Bay\110 - Drafting\Wapinfo Workspaces  
VERSION (PLAN BY): A A4 (JS)

CLIENT: RAPHAEL SHIN ENTERPRISES PTY LTD  
JOB REF: 119462

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)  
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## 2.5 Geographic and Habitat Features

The Biobanking Credit Calculator has considered the habitat values inherent within the proposed Development Area and asks whether 13 listed Geographic and Habitat Features (GHFs) associated with specific threatened flora and fauna ecosystem credit-type species occur on the Development Area. The eight GHFs listed below in **Table 4** were chosen in the Credit Calculator as being relevant to the proposed Development Area (i.e. having broad features that match site habitats). The remaining GHFs listed in the Credit Calculator were considered as not having broad features that match the Development Area habitats and thus were not 'ticked' as relevant to the proposed Development Area (and were filtered out of the subsequent steps of the Biobank assessment).

**Table 3 Geographic and Habitat Features – Development Area (filtered)**

Geographic/Habitat Feature (GHF)	Relevant Threatened Species
Land within 40m of high water mark on beaches, sandbars, margins of estuaries or lagoons	Pied Oystercatcher ( <i>Haematopus longirostris</i> )
Land within 40m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation or emergent aquatic vegetation	Black Bittern ( <i>Ixobrychus flavicollis</i> )
Land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters	Eastern Osprey ( <i>Pandion cristatus</i> )
Land within 40 m of inshore coastal waters or shallow waters of estuaries, coastal lagoons and/or lakes	Little Tern ( <i>Sterna albifrons</i> )
Land within 40 m of freshwater or saline wetlands (eg saltmarsh, mangroves, mudflats, swamps, billabongs, floodplains, watercourse pools, wet heathland and/or farm dams)	Black-necked Stork ( <i>Ephippiorhynchus asiaticus</i> )
Sheltered areas in mangroves, estuaries or sand surrounded by short grass or scattered shrubs	Beach Stone-curlew ( <i>Esacus magirostris</i> )
Land within 100m of emergent aquatic or riparian vegetation	Green and Golden Bell Frog ( <i>Litoria aurea</i> )
Land east of Cessnock in Hunter CMA subregion	Australasian Bittern ( <i>Botaurus poiciloptilus</i> )

## 3.0 Threatened Species

Threatened species have been classified into two types; 'Ecosystem Credit' and 'Species Credit' type species, as detailed within the Threatened Species Profile Database (TSPD). Ecosystem Credit species are species with habitat needs that can be reliably predicted based on vegetation type and location. The Credit Calculator considers the impacts to these species based on the impact to the vegetation types or localities that they are predicted to occur within. Species Credit species are species with habitat needs that are not reliably predicted by the vegetation type or location. Only species that are considered to be Species Credit species require targeted surveys.

Some species are 'split' with species credits applying to, for example, breeding habitat whereas ecosystem credits applied to foraging habitat for a species. The 'Tg' value of both ecosystem and species type species weights the significance of habitat and in the case of ecosystem credit type species the species with the highest 'Tg' value is applied to the site. 'Tg' value is a representation of a species' life history characteristics, rarity, and the amount of information available on the species.

### 3.1 Ecosystem Credit Species

The 'Site Survey details' section of the Credit Calculator lists a total of 13 Ecosystem Credit type species that potentially occur on the Development Area, reproduced in **Table 4** below.

**Table 4 Predicted ecosystem type species – Development Area**

Common Name	Scientific Name	Recorded From Within 10km (NSW Wildlife Atlas 2015)	Recorded From the Project Site (all previous surveys)
		Y/N	Y/N
Australian Painted Snipe	<i>Rostratula australis</i>	N	N
Barking Owl	<i>Ninox connivens</i>	Y	N
Black-tailed Godwit	<i>Limosa limosa</i>	Y	N
Bush Stone-curlew	<i>Burhinus grallarius</i>	Y	N
Eastern Grass Owl	<i>Tyto longimembris</i>	N	N
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	N	N
Great Knot	<i>Calidris tenuirostris</i>	Y	N
Little Eagle	<i>Hieraaetus morphnoides</i>	N	N
Sanderling	<i>Calidris alba</i>	N	N
Spotted Harrier	<i>Circus assimilis</i>	N	N
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	Y	N
Varied Sittella	<i>Daphoenositta chrysoptera</i>	Y	N
White-fronted Chat	<i>Epthianura albifrons</i>	Y	N

### 3.2 Species Credit Species

'Site Survey details', of the Credit Calculator lists a total of 11 Species Credit type species that potentially occur on the Development Area, reproduced in **Table 5** below.

**Table 5 Species Credit Species within Development Area**

Species	BioBanking Survey Period	Site Surveyed During Recommended Period (HWR 2003/05, Cumberland Ecology 2007, RPS 2014/15) Y/N	Recorded From the Site Y/N	Assumed Presence Y/N
Australasian Bittern ( <i>Botaurus poiciloptilus</i> )	All year round	Y	N	N
Beach Stone-curlew ( <i>Esacus magnirostris</i> )	All year round	Y	N	N
Black Bittern ( <i>Ixobrychus flavicollis</i> )	All year round	Y	Y	Identified
Black-necked Stork ( <i>Ephippiorhynchus asiaticus</i> )	All year round	Y	N	N
Brush-tailed Phascogale ( <i>Phascogale tapoatafa</i> )	All year round	N	N	N
Eastern Osprey ( <i>Pandion cristatus</i> )	All year round	Y	N	N
Green and Golden Bell Frog ( <i>Litoria aurea</i> )	August - March	Y	N	N
Little Tern ( <i>Sterna albifrons</i> )	September - March	Y	N	N
Noah's False Chickweed ( <i>Lindernia alsinoides</i> )	November - February	Y	N	N
Pied Oystercatcher ( <i>Haematopus longirostris</i> )	All year round	Y	N	N
Tall Knotweed ( <i>Persicaria elatior</i> )	December - May	Y	N	N

The only 'Species Credit' Species recorded within the Project Site by the various surveys undertaken has been the Black Bittern, and no 'Ecosystem Credit' species have been recorded.

The location of Black Bittern records within the Project Site is shown in **Figure 5**.

### 3.2.2 Threatened Species Survey Methodologies

The recommended survey period for the eleven species credit type species is detailed in **Table 5**. By combining the detailed ecological survey works undertaken by RPS in 2014/15 (See **Appendix A**), with the previous works undertaken by HWR 2003 & 2005 and Cumberland Ecology (2007) (See **Appendix B**), a comprehensive understanding of the ecological attributes of the site has been obtained over several seasons, and required survey methodologies for species credit species have been met. Where any doubt remained, presence was assumed.

Additional threatened species have also been recorded on the Project site and have some potential habitat within the Development Area, including:

Eastern Freetail-bat

*Mormopterus norfolkensis*

---

Eastern Cave Bat	<i>Vespadelus troughtoni</i>
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>
Little Bentwing-bat	<i>Miniopterus australis</i>
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>
Wallum Froglet	<i>Crinia tinnula</i>

The location of records of these additional threatened species within the Project Site is shown in **Figure 5**.

For the purposes of impact assessment, where these species are “Species Credit Species” they have been added to the Threatened Species Survey results in the Calculator.

### 3.2.3 Species Polygons

A species polygon has been developed for each of the various threatened species considered to potentially utilise the Development Area.

#### 3.2.3.1 Black Bittern

This species is considered to have 5.61ha of suitable habitat within the Development Area. The extent of this polygon is shown in **Figure 6**. This equates to all of the Development Area aside from the areas containing Exotic Pastures.

#### 3.2.3.2 Micro-bats

The Eastern Freetail-bat, Eastern Cave Bat, Greater Broad-nosed Bat, Little Bentwing-bat and the Yellow-bellied Sheath-tail-bat are all considered to 1.02ha of suitable forested habitat (Swamp Oak Forest) within the Development Area. The extent of this polygon is shown in **Figure 6**. The remaining areas of the Development Area do not contain treed areas, and whilst these species may forage over open areas, the conversion to a development site with landscaping is not considered to change that potential to any notable limiting degree.

#### 3.2.3.3 Wallum Froglet

This species is considered to have 1.02ha of suitable habitat within the Development Area, being the area of Swamp Oak Forest. The extent of this polygon is shown in **Figure 6**. Other habitats are either cleared or too saline for this species. The Swamp Oak Forest, whilst being saline in tidal influence, offers vegetation structure that sits above direct tidal influence, and as such has been conservatively included as potential habitat.

## 3.3 Identified Populations

The Director General of OEHL may develop an ‘Identified Populations’ Database that identifies population(s) of Threatened species present in an area of land that require assessment under the BBAM (either for a Biobank or Development site).

To date, the BBAM has not determined any Identified Populations.

**Legend**

- Development Footprint
- Biobank Site

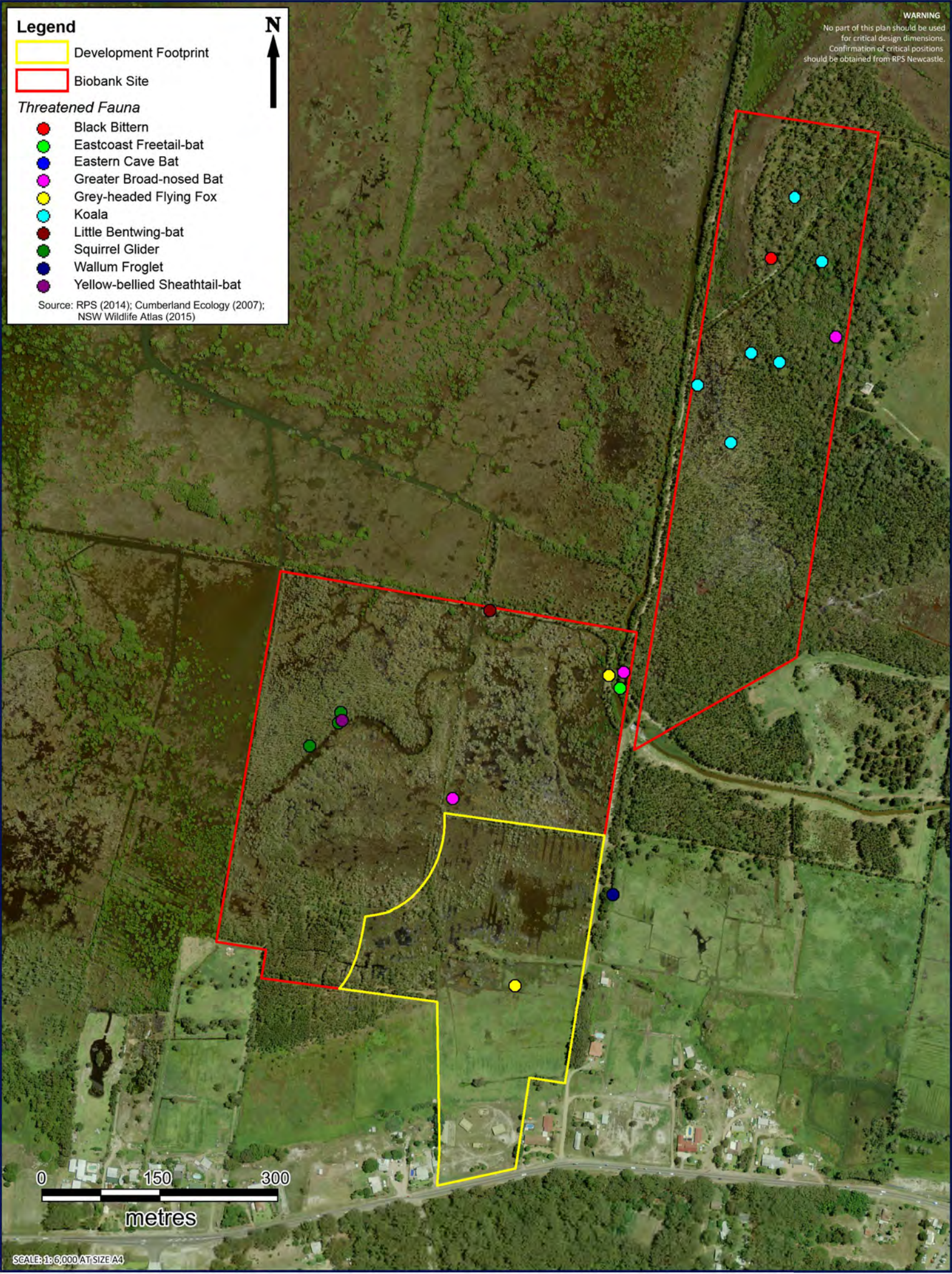
**Threatened Fauna**

- Black Bittern
- Eastcoast Freetail-bat
- Eastern Cave Bat
- Greater Broad-nosed Bat
- Grey-headed Flying Fox
- Koala
- Little Bentwing-bat
- Squirrel Glider
- Wallum Froglet
- Yellow-bellied Sheathtail-bat

Source: RPS (2014); Cumberland Ecology (2007); NSW Wildlife Atlas (2015)



**WARNING**  
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.



Title: FIGURE 5: THREATENED SPECIES RECORDS

LOCATION: ANNA BAY

DATUM: GDA 94  
PROJECTION: MGA ZONE 56

DATE: 24/03/2015  
PURPOSE: BIOBANKING

LAYOUT REF: \\J085\119K\119462 Anna Bay  
110 - Drafting\MapInfo Workspaces  
VERSION (PLAN BY): A A4 (JS)

CLIENT: RAPHAEL SHIN ENTERPRISES PTY LTD  
JOB REF: 119462



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T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au





**Legend**

 Development Footprint

 Biobank Site

*Species Polygons*

 Black Bittern

 Wallum Froglet / Microbats



**WARNING**  
No part of this plan should be used  
for critical design dimensions.  
Confirmation of critical positions  
should be obtained from RPS Newcastle.



SCALE: 1:2,000 AT SIZE A4

Title: FIGURE 6: THREATENED  
SPECIES POLYGONS -  
DEVELOPMENT FOOTPRINT

LOCATION: ANNA BAY

DATUM: GDA 94  
PROJECTION: MGA ZONE 56

DATE: 24/03/2015  
PURPOSE: BIOBANKING

LAYOUT REF: \\JOB5\119K\119462 Anna Bay  
110 - Drafting\Mapinfo Workspaces  
VERSION (PLAN BY): A A4 (JS)

CLIENT: RAPHAEL SHIN ENTERPRISES PTY LTD  
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## Stage 2 – Impact Assessment (Biodiversity Values)

## 4.0 Potential Impacts

### 4.1 Avoid and Minimise Impacts

Ecological Communities: The current development proposal has been scaled back significantly in spatial extent from previous designs, primarily as a result of consideration of ecological impacts. The Development Area has been sited to utilise all exotic pasture areas in the southern end of the site, and the remaining areas of native vegetation to be affected support disturbed examples of EEC vegetation (aside from 0.45ha of Saltmarsh in good condition). Given the need for a minimum footprint area to achieve a viable economic development, impacts on Ecological Communities have been minimised as far as possible. There is no other part of the Project Site where the development could be feasibly sited, and the proposed Development Area chosen achieves the minimum ecological impact possible for this site.

PCT's that contain threatened species habitat: By maximising the use of exotic pasture areas, and by reducing the area of impact on native vegetation communities (mostly disturbed examples thereof), the proposal has in turn reduced impacts on PCT's that contain threatened species habitat as far as feasibly possible for this proposal.

Threatened Species Habitat Areas: By maximising the use of exotic pasture areas, and by reducing the area of impact on native vegetation communities (mostly disturbed examples thereof), the proposal has in turn reduced impacts on threatened species habitat areas as far as feasibly possible for this proposal.

Critical Habitat: No part of the proposed Development Area contains or occurs in proximity to an area nominated as 'Critical Habitat'.

Riparian Areas / Wetlands / Estuaries: The Development Area has been shown to in part contain "Riparian buffer of an estuarine area (50m buffer)". Much of the Project Site is affected by tidal influence to varying degrees. Some fringe areas of tidal influence (primarily as evidenced by the presence of Saltmarsh) will be directly affected by the proposal. The retraction of the proposed development footprint back from previous more expansive proposals has reduced the level of impact on the identified riparian area and buffers and tidal areas as far as possible whilst maintaining an economically viable area.

The SEPP 14 wetland areas with a 100m minimum buffer in the north west of the site are not subject to any proposed direct development activity.

State Significant Biodiversity Links: The areas of the Project Site shown to contain "Riparian buffer of an estuarine area (50m buffer)" qualify as part a State Significant Biodiversity Link. Parts of this area are proposed to be developed in association with the proposal. To minimise the impact of such development, measures and strategies will be put in place to ensure that the development achieves an "improve or maintain" outcome, primarily via the creation of a managed Biobank site over the large land residue not subject to development. This is outlined further in Stage 3 of the BAR herewith.

Based on the impacts identified above, and the limitations also identified in regards to potentially re-siting the development, there is little scope to avoid direct impacts on identified biodiversity values. There is no other part of the Project Site where the development could be feasibly sited, and the proposed Development Area chosen achieves the minimum ecological impact possible for this site.

Taking into account inherent design, construction, and economic considerations, the proposed development clearing footprint has been minimised in size as far as possible. Given such, provision of offsets and/or other

supplementary measures is the only way that a suitable biodiversity outcome can be achieved in this instance.

Taking into account all relevant planning factors, including biodiversity impacts, the final site development footprint was chosen.

## 4.2 Direct Impacts

The proposed development will result in the following direct impacts:

- Loss of 4.14ha of Saltmarsh Estuarine Complex (Disturbed).
- Loss of 0.45ha of Saltmarsh Estuarine Complex.
- Loss of 1.02ha of Swamp Oak – Sea Rush – Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Disturbed).
- Loss of 5.61ha of suitable habitat for the Black Bittern, which has been recorded within the Project Site.
- Loss of 1.02ha of suitable habitat for various micro-bat species which have been recorded within the Project Site.
- Loss of 1.02ha of (marginally) suitable habitat for the Wallum Froglet, which has been recorded within the Project Site.
- Modification of 8.67ha of habitat for extant native flora and fauna species.

No Red Flags are triggered by the above losses.

## 4.3 Indirect Impacts

The proposed development will result in the following indirect impacts:

- General indirect impacts on surrounding retained areas resulting from a clearing edge interface and construction operations, and to a lesser degree ongoing site operation (noise, lighting etc).
- Downstream impacts on areas subject to tidal influence. The level of such impacts would be dependent on the design, operation and efficiency of proposed drainage control systems for the proposed development, and proximity to the development interface.

## 4.4 Impact Minimisation Measures

Aside from the primary biodiversity offsets proposed as part of the development (i.e. the formal creation of a Biobank site with resultant credit generation / retirement), the following mitigation measures have been recommended to minimise the potential flora and fauna impacts of the clearing, construction and operation of the proposed development:

- Clearance of native vegetation should be minimised as far as is practicable;
- The extent of vegetation clearing is to be clearly identified on construction plans;
- The development footprint will be appropriately demarcated to ensure machinery is limited to the designated disturbance area. Machinery will not be stored in areas of adjacent habitat;
- All contractors will be specifically advised of the designated work area. The following activities are not to occur outside of designated work areas to minimise impacts on native vegetation:
  - » Vehicle movements;
  - » Storage and mixing of materials;

- 
- » Vehicle parking;
  - » Liquid disposal;
  - » Machinery repairs and/or refueling;
  - » Construction within the Site office or shed;
  - » Combustion of any material;
  - » Inappropriate stockpiling of soil, rubble or debris; and/or
  - » Any filling or excavation including trenching, topsoil skimming and/or surface excavation.
- All construction and operational vehicles/machinery will use designated access tracks. Speeds will be limited to 20 kilometres per hour to reduce the potential of fauna strike and to reduce dust generation;
  - Plant and machinery will be cleaned of any foreign soil and propagative material prior to being transported to the site to prevent the spread of weeds and potential importation of *Phytophthora*;
  - If machinery is transported from an area of confirmed infection of *Phytophthora* or Chytrid fungus to the site, stringent wash down will be completed before leaving the area, removing all soil and vegetative material from cabins, trays, and under carriages;
  - To minimise potential impacts on adjacent conservation lands and wetland habitats all liquids (fuel, oil, cleaning agents, drilling liquids etc.) will be stored appropriately and disposed of at suitably licensed facilities. Spill management procedures will be implemented as required. Rubbish will be collected and removed from the Site;
  - Appropriate erosion and sediment control measures will be managed via the implementation of an erosion and sediment control plan, in accordance with best management practices. Such as the Best Practice Erosion and Sediment Control Guidelines (IECA, 2008) and *Managing Urban Stormwater: Soils and Construction* 4th Ed. 'The Blue Book' (Landcom 2004). It is imperative that the plan ensures that any offsite discharge of stormwater (freshwater) does not significantly impact upon the adjoining saline environments;
  - Implement actions identified within the Port Stephens CKPoM (e.g. appropriate fencing, domestic animal controls);
  - No domestic pets (including dogs or cats) will be allowed within the site;
  - Construction personnel will be trained adequately in pest management and hygiene procedures;
  - Weed management procedures will be implemented to prevent the spread of weeds both on and off-site. Ongoing weed monitoring to be implemented and potential weed infestations appropriately managed to minimise the spread of weeds on the site. Management of noxious weeds are to be undertaken in accordance with the *Noxious Weeds Act* 1993. Weed monitoring should occur throughout the construction and operation phase and weed removal will be carried out as necessary;
  - Microbat nest boxes should be installed within the conservation areas at a ratio of one nest box per dead stag removed to compensate for the removal of fissures and loose tree bark throughout the vegetation to be cleared. These nest boxes should be monitored and maintained for a period of at least three years;
  - Any clearing should be supervised by a qualified ecologist to ensure previously identified habitat trees are
-

'soft-felled'. Felled trees must be left for a short period of time on the ground to give any fauna trapped in the trees an opportunity to escape before further processing of the trees. The ecologist is to handle any injured or displaced fauna and relocate displaced fauna where necessary;

- Site inductions during construction are to include a briefing regarding the local fauna of the Site and identification of protocols to be undertaken if fauna are encountered;
- Appropriate landscaping of the Development Area should be carried out with native endemic species to enhance the retained vegetation, habitat corridors, and to provide seasonal foraging resources for local and migratory faunal species.

## 5.0 Thresholds Assessment

### 5.1 Development Impact Thresholds

Consideration was made against the specific impact threshold criteria spelled out in the FBA.

#### Impacts that require further consideration by consent authority

- The “Riparian buffer of an estuarine area (50m)” is an identified Landscape Feature that will be affected by the proposed development. See **Figure 2**.
- This is a matter that will require further consideration by the consent authority.

#### Impacts for which the assessor is required to determine an offset

- Landscape features – not applicable to FBA.
- As the proposed development involves the removal of 5.61ha of EEC native vegetation, an offset requirement has been determined via application of the FBA Biobank Calculator.
- As the proposed development will impact on several identified threatened species, an offset requirement has been determined via application of the FBA Biobank Calculator.

#### Impacts for which the assessor is not required to determine an offset

- All relevant considerations have been captured by above categories.

#### Impacts that do not require further assessment by the assessor

- All relevant considerations have been captured by above categories.

### 5.2 Impact on “Riparian buffer of an estuarine area (50m)”

The area in question is part of a larger area subject to tidal influence to the south of Tilligerry Creek, incorporating Bobs Farm Creek, Fenninghams Island Creek, and several other natural and man-made tributaries and drains. A large part of the area is designated as Tilligerry Nature Reserve, which is contiguous with the subject site to the north and west.

The present situation is that parts of the Project Site have historically been cleared, grazed, fenced, drained and subject to tidal water exclusion to varying degrees of success. These activities have resulted in varying levels of degradation to the native vegetation communities occurring therein. Ongoing permissible rural uses of the Project Site as per its zoning would be expected to continue with some or all of these impacting effects.

The proposed Development Area contains existing higher land not subject to tidal influence, which is cleared and supports an existing dwelling and associated rural structures and improvements. Lower lands in proximity to the higher lands in the southern end of the Project Site, and subject to the proposed development activity herewith, have been subject to the most obvious impacts of degradation via ongoing grazing activity. This is reflected in the vegetation zone designation which shows that most of this vegetation is in a disturbed state.

The area to be directly affected by the proposed development sits at the southern fringe of the area subject to tidal influence stretching north to Tilligerry Creek.

The proposed development will result in the following direct impacts on “Riparian buffer of an estuarine area (50m)”:

- Loss of 4.14ha of Saltmarsh Estuarine Complex (Disturbed).

- 
- Loss of 0.45ha of Saltmarsh Estuarine Complex.
  - Loss of 1.02ha of Swamp Oak – Sea Rush – *Baumea juncea* swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Disturbed).
  - Loss of an area of exotic pasture within the buffer from the tidal area extent.

Indirect impacts would include:

- General indirect impacts on surrounding retained areas resulting from a clearing edge interface and construction operations, and to a lesser degree ongoing site operation (noise, lighting etc).
- Downstream impacts on areas subject to tidal influence. The level of such impacts would be dependent on the design, operation and efficiency of proposed drainage control systems for the proposed development, and proximity to the development interface.

Direct impacts are proposed to be offset via biodiversity credit retirement associated with conversion of the residue of the Project Site into a formal Biobank site.

Indirect impacts will be mitigated via a suitably design and operated drainage system controlling run-off into the retained tidal area, and appropriate design and operation of the development in regards to other identified indirect impacts. Also management of the retained area in accordance with a suitable Plan of Management generated as part of the creation of the Biobank site would occur.

## 6.0 Offset Requirements

### 6.1 Credit Report

The FBA Credit Calculator was 'run' with the data input as described in **Section 2** and generated a Credit Profile for the Development Area. The Development Biobank Credit Report generated by the Credit Calculator is provided as **Appendix 3**.

The Development Area is proposed to be totally cleared.

**Table 6 Summary of Ecosystem Credits Required**

Plant Community Type	Area (ha)	Credits
HU941 – Swamp Oak – Sea Rush – Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast	1.02	56
HU960 – Saltmarsh Estuarine Complex	4.59	361

**Table 7 Summary of Species Credits Required**

Species	Extent of Impact (individuals or Ha)	Credits
Black Bittern	5.61	73
Eastern Cave Bat	1.02	13
Little Bentwing-bat	1.02	13
Wallum Froglet	1.02	13

## Stage 3 – Biodiversity Offset Strategy

## 7.0 Offset Site Identification

### 7.1 Offset site location and description

The proposed offset site (Biobank site) is the large residue of the Project Site (Lot 2 DP 747399) not subject to proposed development.

**LGA** – Port Stephens Council.

**Area** – The Biobank Site is approximately 31.3 hectares in total and comprises two areas separated by Crown Road running northwards from Nelson Bay Road. The northern area is approximately 14 hectares and the southern area is approximately 17.3 hectares.

**Zoning** – The Biobank site is zoned 1(a) Rural Agriculture under Port Stephens Local Environmental Plan (LEP) 2000.

**Boundaries** – The Biobank Site is situated to the north of Nelson Bay Road, and the proposed Development Area. Immediately south of Nelson Bay road is the Worimi National Park. The remainder of the southern boundary adjoins rural residencies and associated farm paddocks. The northern and western boundaries adjoin and contain areas mapped as SEPP 14 Wetland. The northern boundaries of the Biobank Site also adjoin the Tilligerry Nature Reserve. A majority of the eastern boundary adjoins the Sahara Trails Horse Riding and Farmstay Accommodation.

**Current Land Use** – Part of the southern area contains cleared grazing land and it is currently stocked with horses. The remainder of the southern area contains signs of disturbance – possibly as a result of a change in water regime and failed attempts at draining and farming the swampy land. The northern area consists of predominantly native vegetation with moderate levels of disturbance and weed invasion. A few unpaved tracks and manmade drainage lines occur.

**Topography** – The Biobank Site is relatively flat with a few higher areas of vegetation in the north of the northern area. The majority of the Biobank Site is influenced by tidal waterlogging with elevations ranging from approximately 30 metres Australian Height Datum (AHD) near residential developments in the south (within the proposed Development Area) down to approximately 5 metres AHD in the tidal Swampland. The general topography of the Biobank Site is a gentle south to north decline from rural residential developments in the south down to swampland in the northwest.

**Hydrology**- A shallow, sandy ephemeral drainage line runs from south to north along the Biobank Site's eastern border and into the area mapped as SEPP 14 Wetlands and Tilligerry Nature Reserve. Many small tidal man-made drainage lines run through the Biobank site predominantly in a south to north direction.

**Vegetation** – The Biobank Site is predominantly swampy native vegetation of varying levels of tidal inundation and associated salinity levels (see **Figure 3**), and includes Saltmarsh, Swamp Oak Forest, Swamp Mahogany Forest and Mangroves in varying condition levels.

**Legend**

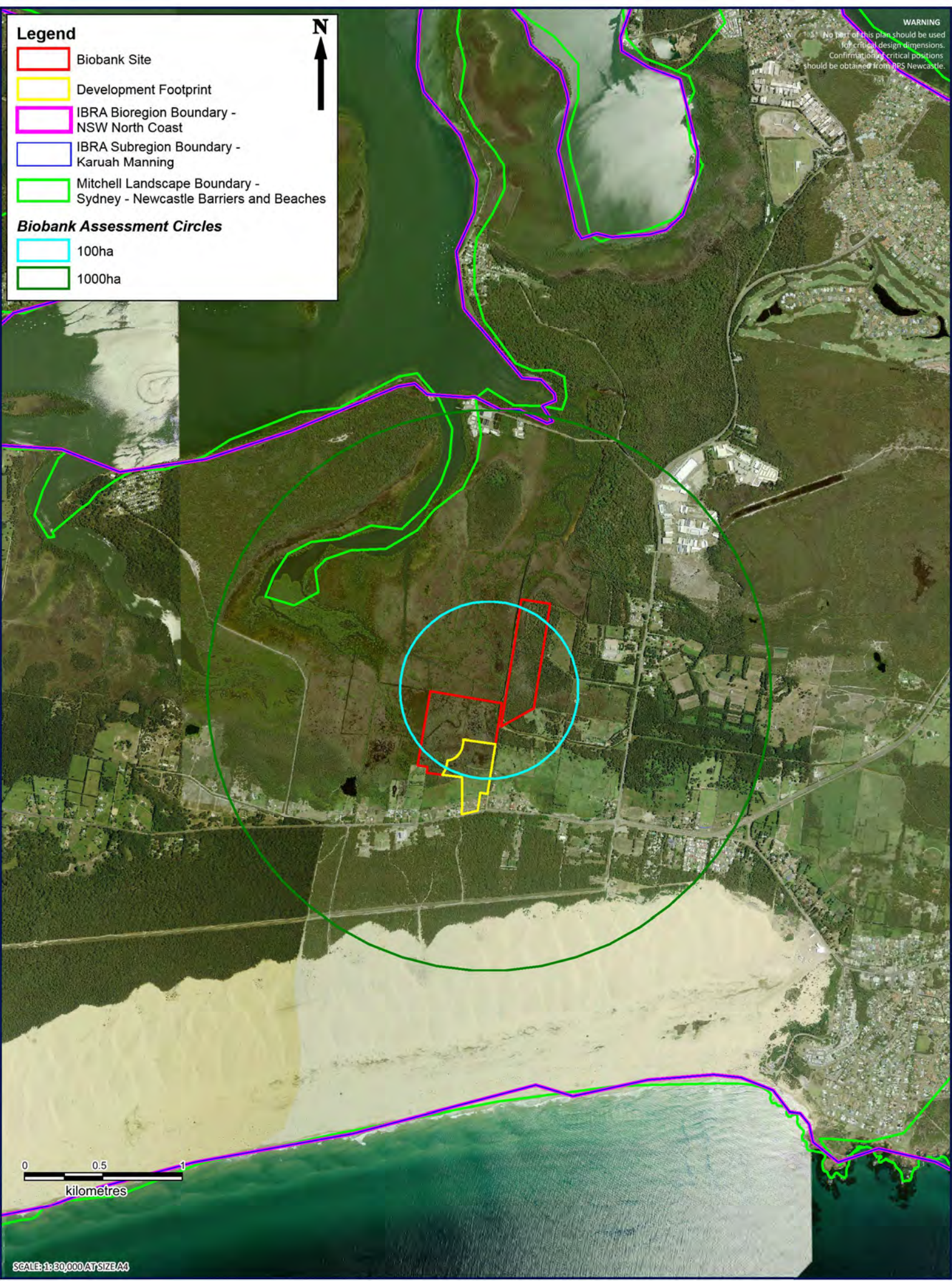
- Biobank Site
- Development Footprint
- IBRA Bioregion Boundary - NSW North Coast
- IBRA Subregion Boundary - Karuah Manning
- Mitchell Landscape Boundary - Sydney - Newcastle Barriers and Beaches

**Biobank Assessment Circles**

- 100ha
- 1000ha



**WARNING**  
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.



SCALE: 1:30,000 AT SIZE A4

Title: **FIGURE 7: PROPOSED OFFSET (BIOBANK) SITE MAP**

LOCATION: ANNA BAY

DATUM: GDA 94  
PROJECTION: MGA ZONE 56

DATE: 26/03/2015  
PURPOSE: BIOBANKING

LAYOUT REF: \\UOB5\119K\119462 Anna Bay  
110 - Drafting\Mapinfo Workspaces  
VERSION (PLAN BY): A A4 (JS)

CLIENT: RAPHAEL SHIN ENTERPRISES PTY LTD  
JOB REF: 119462



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## 8.0 Biodiversity Assessment – Offset Site

### 8.1 Identified Landscape Features

The Project Site is situated within the Sydney Basin IBRA Bioregion and the Hunter IBRA Subregion.

The Project Site is located within the 'Sydney-Newcastle Barriers and Beaches' Mitchell Landscape.

Part of the western portion of the Project Site contains SEPP 14 Wetland, which continues offsite into Tilligerry Nature Reserve.

Large parts of the site are subject to tidal influence, and would be considered as "Riparian buffer of an estuarine area (50m)".

Landscape features identified within the Project Site and surrounding assessment buffers are depicted in **Figure 1** and **Figure 2**.

### 8.2 Determining Landscape Value

The Project Site Landscape Value is scored based on several variables including:

- Percentage (%) Native Vegetation Cover;
- Connectivity Values; and
- Patch Size.

#### 8.2.1 Percentage (%) Native Vegetation Cover

Two landscape assessment circles, being 100 and 1000 hectares in area, were initially centred over the proposed Biobank Site using aerial imagery and GIS software. Percentage native vegetation cover within each assessment circle was visually estimated for 'Before' and 'After' biobank scenarios.

The 1000 hectare assessment circle was used to assess any gains (or positive impacts) of the proposed Biobank site on the percent native vegetation cover in the 'locality' and to identify threatened species that may occur. The smaller 100 hectare circle was used to assess the gain of surrounding vegetation cover at an even more local scale as a result of the proposed Biobank site.

The 100 hectare assessment circle was assessed as having a native vegetation cover class of 81-85% for Before and After biobank.

The 1000 hectare circle was assessed as having a native vegetation cover of 76-80% for Before and After biobank scenarios.

The assessment circles and associated native vegetation visually assessed are shown in **Figure 7**.

#### 8.2.2 Connectivity Value

##### Step 1:

A desktop Connectivity Condition assessment was undertaken by assessing the average condition of native vegetation across the Project Site's 'Primary' linkages to adjoining vegetation. Primary linkages are defined as native vegetation that:

- Is in moderate to good condition;
- Has a patch size > 1 hectare in area;
- Is separated by a distance of <100 metres; and
- Is not separated by a dual carriageway or wider highway or similar hostile link.

It is clear that the Project Site is a part of a connecting link of native vegetation.

#### Step 2:

Given these links, it is necessary to assess whether the biobank site contains a 'State Significant Biodiversity Link' and/or a 'Regionally Significant Biodiversity Link'. Examination of these factors reveals that the biobank site does contain a nominated category, being "Riparian buffer of an estuarine area (50m)".

As such, the Biobank site is considered to qualify for the maximum connectivity score of 12, and no further steps of connectivity assessment was required.

### **8.2.3 Patch Size**

To assess the Patch Size, the assessment must:

- Determine the percent native vegetation cleared in the Mitchell Landscape in which most of the development occurs. In this case the Mitchell Landscape is 'Sydney-Newcastle Barriers and Beaches' and this landscape is 50% cleared.
- Determine the Patch size class, which in this instance is 'extra large'.

Based on the above, the derived Patch Size Score is 12.

## **8.3 Derived Landscape Value**

Data for Percentage Native Vegetation Cover, Connectivity and Patch Size is combined to give the proposed Biobank Site Landscape Score of 30.0.

## **8.4 Assessing Native Vegetation**

### **8.4.1 Vegetation Zones**

The proposed Biobank site covers an area of 31.3ha and contains the following mapped vegetation zones:

- Saltmarsh Estuarine Complex (HU960) – 4.98ha
- Saltmarsh Estuarine Complex (HU960) (Disturbed) – 0.65ha
- Swamp Oak – Sea Rush – Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast (HU941) – 13.56ha
- Swamp Oak – Sea Rush – Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast (HU941) (Disturbed) – 7.6ha
- Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and norther Sydney Basin Bioregion (HU633) – 3.97ha
- Mangrove forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (HU563) – 0.54ha

Full descriptions of these communities are presented within **Appendix A**.

These vegetation types were classified based on the 'best fit' vegetation type listed in the Plant Communities Types Database (OEH 2009). Parameters used to choose the 'best fit' Vegetation Type included overstorey and understorey floristics, soil landscape, location and topographic position.

Final Scientific Committee Determinations under the TSC Act were reviewed to assess whether any of the Vegetation Zones were classified as Endangered or Critically Endangered Ecological Communities (EECs).

The Saltmarsh community is commensurate with '*Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions*' Endangered Ecological Community under the TSC Act 1995.

The Swamp Oak community is commensurate with '*Swamp Oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions*' Endangered Ecological Community under the TSC Act 1995.

The Swamp Mahogany community is commensurate with '*Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin Bioregion and South East Corner Bioregions*' Endangered Ecological Community under the TSC Act 1995.

The vegetation communities listed above correspond to six Biobank Vegetation Zones recorded for the Biobank site and entered into the Credit Calculator, listed below in **Table 8** and shown in **Figure 3**.

**Table 8 Vegetation Zones – Biobank site**

Veg Zone #	Vegetation Class (Keith 2004)	Biobank Vegetation Type	Area (ha)	Identification Method	Condition Class	EEC	Estimate percent cleared value	Site Value Score
1	Saltmarshes	HU960 – Saltmarsh Estuarine Complex	4.98	Detailed floristics for site and surrounds provided in Cumberland Ecology (2007), ground-truthed by RPS 2014/15.	Moderate / Good	<i>Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions</i>	50%	98.15
2	Coastal Swamp Forests	HU633 - Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	3.97	Detailed floristics for site and surrounds provided in Cumberland Ecology (2007), ground-truthed by RPS 2014/15.	Moderate / Good	<i>Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin Bioregion and South East Corner Bioregions</i>	60%	83.33
3	Coastal Floodplain Wetlands	HU941 - Swamp Oak – Sea Rush – Baumea juncea swamp forest on coastal	13.56	Detailed floristics for site and surrounds provided in Cumberland Ecology (2007),	Moderate / Good	<i>Swamp Oak floodplain forest of the NSW North Coast, Sydney Basin and South East</i>	50%	82.67

Veg Zone #	Vegetation Class (Keith 2004)	Biobank Vegetation Type	Area (ha)	Identification Method	Condition Class	EEC	Estimate percent cleared value	Site Value Score
		lowlands of the Central Coast and Lower North Coast		ground-truthed by RPS 2014/15.		<i>Corner Bioregions</i>		
4	Coastal Floodplain Wetlands	HU941 - Swamp Oak – Sea Rush – Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast	7.6	Detailed floristics for site and surrounds provided in Cumberland Ecology (2007), ground-truthed by RPS 2014/15.	Moderate / Good_Poor (Disturbed)	<i>Swamp Oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions</i>	50%	70.67
5	Mangrove Swamps	HU563 - Mangrove forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	0.54	Detailed floristics for site and surrounds provided in Cumberland Ecology (2007), ground-truthed by RPS 2014/15.	Moderate / Good		50%	100
6	Saltmarshes	HU960 – Saltmarsh Estuarine Complex (Disturbed)	0.65	Detailed floristics for site and surrounds provided in Cumberland Ecology (2007), ground-truthed by RPS 2014/15.	Moderate / Good_Poor (Disturbed)	<i>Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions</i>	50%	99.07

#### 8.4.2 Plot and Transect Surveys

A Biobank field survey of the Biobank site was undertaken by an RPS field team overseen by Craig Anderson (Consultant Accredited Biobank Assessor No. 150).

A total of fourteen Biobank biometric plots were carried out within the Biobank site which has been subsequently subjected to impact assessment calculations. Each survey site comprised the establishment of a 400m<sup>2</sup> quadrat (dimension = 20 metre x 20 metre) nested within a larger 0.1 hectare plot (dimension = 20 metre x 50 metre). Data collected within the nested plot comprised full floristics, elevation, slope, aspect, topographic position and soil type. Data collected within the larger plot comprised a census of hollow bearing trees and length of fallen logs. Structural vegetation data (vegetation cover for all strata) was collected along a 50 metre long transect (representing one of the 0.1 ha plot boundary lines). Plot data was recorded on Biobank specific field proformas prepared by OEH.

Survey methodologies for site variables recorded (e.g. how foliage cover is calculated for each strata) are detailed in OEH (2014).

Transect/plot data for the Biobank site was entered into the 'Site Values' section of the Credit Calculator and is reproduced below in **Table 9**. The Credit Calculator requires that a minimum number of Biometric plots be carried out for each Vegetation Zone based on the Zone's extant area. The number of plots undertaken more than meets the Biobank assessment minimum survey effort requirements.

Biobank plot survey sites for the Biobank site are shown in **Figure 4**.

Table 9 Survey Plot/Transect Data – Biobank site

Plot ID #	Plant Species Richness	Native Overstorey Cover	Native Mid Storey Cover	Native Ground Cover - grasses	Native Ground Cover - shrubs	Native Ground Cover - other	Exotic Plant Cover	# Tree Hollows	Overstorey Regeneration	Length Fallen Logs (m)	AMG Grid Refs WGS84
<b>Veg Zone: – HU960 – Saltmarsh Estuarine Complex - Moderate/Good Condition Class</b> (3 plots completed; minimum 3 plots required)											
Plot 7	4	0	0	4	0	100	0	0	1	0	411352(E); 6374386(N)
Plot 14	3	0	14	0	0	100	0	0	1	0	411915(E); 6375335(N)
Plot 15	5	6	12	2	0	100	0	0	1	0	411886(E); 6375224(N)
<b>Veg Zone: – HU633 - Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin</b> - Moderate/Good Condition Class (2 plots completed; minimum 2 plots required)											
Plot 12	31	42	25	48	4	98	30	1	1	6	412026(E); 6375222(N)
Plot 13	26	35	16	48	8	100	46	0	1	8	411946(E); 6375202(N)
<b>Veg Zone: – HU941 – Swamp Oak – Sea Rush – Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast</b> - Moderate/Good Condition Class (4 plots completed; minimum 3 plots required)											
Plot 8	13	33	0	28	52	76	70	0	1	5	411801(E); 6374625(N)
Plot 9	8	35	2.5	90	0	28	20	0	1	10	411846(E); 6374639(N)
Plot 10	9	25	0.5	84	0	36	0	0	1	5	411861(E); 6374775(N)
Plot 11	8	43	4.5	32	0	62	0	0	1	12	411973(E); 6374943(N)
<b>Veg Zone: – HU941 – Swamp Oak – Sea Rush – Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast</b> - Moderate/Good_Poor Condition Class (Disturbed) (3 plots completed; minimum 3 plots required)											

Plot 2	4	24.5	1.5	60	0	60	0	0	1	0	411252(E); 6374452(N)
Plot 6	8	22.5	5.5	4	2	30	10	0	1	0	411391(E); 6374293(N)
Plot 19	6	23.5	3.5	32	1	45	5	0	1	0	411842(E); 6374918(N)
<b>Veg Zone: – HU563 – Mangrove forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion - Moderate/Good Condition Class (1 plot completed; minimum 1 plot required)</b>											
Plot 1	3	29	25	0	24	54	0	0	1	0	411731(E); 6374565(N)
<b>Veg Zone: – HU960 – Saltmarsh Estuarine Complex - Moderate/Good_Poor Condition Class (Disturbed) (1 plot completed; minimum 1 plot required)</b>											
Plot 18	5	0	0	52	0	74	0	0	1	0	411260(E); 6374340(N)

## 8.5 Geographic and Habitat Features

The Biobanking Credit Calculator has considered the habitat values inherent within the proposed Biobank site and asks whether 26 listed Geographic and Habitat Features (GHFs) associated with specific threatened flora and fauna ecosystem credit-type species occur on the Biobank site. The 15 GHFs listed below in **Table 10** were chosen in the Credit Calculator as being relevant to the proposed Biobank site (i.e. having broad features that match site habitats). The remaining GHFs listed in the Credit Calculator were considered as not having broad features that match the Biobank site habitats and thus were not 'ticked' as relevant to the proposed Biobank site (and were filtered out of the subsequent steps of the Biobank assessment).

**Table 10 Geographic and Habitat Features – Biobank Site (filtered)**

Geographic/Habitat Feature (GHF)	Relevant Threatened Species
Mangroves and intertidal mudflats or sandflats within inlets, bays, harbours, estuaries, lagoons, ocean beaches and/or sandy spits	Terek Sandpiper ( <i>Xenus cinereus</i> )
Land within 40m of high water mark on beaches, sandbars, margins of estuaries or lagoons	Pied Oystercatcher ( <i>Haematopus longirostris</i> )
Land within 40m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation or emergent aquatic vegetation	Black Bittern ( <i>Ixobrychus flavicollis</i> )
Land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters	Eastern Osprey ( <i>Pandion cristatus</i> )
Land within 40 m of inshore coastal waters or shallow waters of estuaries, coastal lagoons and/or lakes	Little Tern ( <i>Sterna albifrons</i> )
Land within 40 m of freshwater or saline wetlands (eg saltmarsh, mangroves, mudflats, swamps, billabongs, floodplains, watercourse pools, wet heathland and/or farm dams)	Black-necked Stork ( <i>Ephippiorhynchus asiaticus</i> )
Sheltered areas in mangroves, estuaries or sand surrounded by short grass or scattered shrubs	Beach Stone-curlew ( <i>Esacus magnirostris</i> )
Land within 100m of emergent aquatic or riparian vegetation	Green and Golden Bell Frog ( <i>Litoria aurea</i> )
Land east of Cessnock in Hunter CMA subregion	Australasian Bittern ( <i>Botaurus poiciloptilus</i> )
Swamps, swamp margins or creek edges	Biconvex Paperbark ( <i>Melaleuca biconvexa</i> )
Land below 1000m in altitude and within 40 m of rainforest or eucalypt forest with deep leaf litter	Giant Barred Frog ( <i>Mixophyes iteratus</i> )
Land within 40m of swamps, wet or dry heaths or sedge grasslands	Wallum Froglet ( <i>Crinia tinnula</i> )
Land within 40m of watercourses, containing hollow-bearing trees, loose bark and/or fallen timber	Pale-headed Snake ( <i>Hoplocephalus bitorquatus</i> )
Rainforest, eucalypt forest, heathland, marshland, grassland or rocky areas	Common Planigale ( <i>Planigale maculata</i> )
Land within 100m of semi-permanent or ephemeral ponds or depressions containing leaf litter	Green-thighed Frog ( <i>Litoria brevipalmata</i> )

## 9.0 Threatened Species

Threatened species have been classified into two types; 'Ecosystem Credit' and 'Species Credit' type species, as detailed within the Threatened Species Profile Database (TSPD). Ecosystem Credit species are species with habitat needs that can be reliably predicted based on vegetation type and location. Species Credit species are species with habitat needs that are not reliably predicted by the vegetation type or location. Only species that are considered to be Species Credit species require targeted surveys.

Some species are 'split' with species credits applying to, for example, breeding habitat whereas ecosystem credits applied to foraging habitat for a species. The 'Tg' value of both ecosystem and species type species weights the significance of habitat and in the case of ecosystem credit type species the species with the highest 'Tg' value is applied to the site. 'Tg' value is a representation of a species' life history characteristics, rarity, and the amount of information available on the species.

### 9.1 Ecosystem Credit Species

The 'Site Survey details' section of the Credit Calculator lists a total of 28 Ecosystem Credit type species that potentially occur on the Biobank site, reproduced in **Table 11** below.

**Table 11 Predicted ecosystem type species – Biobank Site**

Common Name	Scientific Name	Recorded From Within 10km (NSW Wildlife Atlas 2015) Y/N	Recorded From the Project Site (all previous surveys) Y/N
Australian Painted Snipe	<i>Rostratula australis</i>	N	N
Barking Owl	<i>Ninox connivens</i>	Y	N
Black-tailed Godwit	<i>Limosa limosa</i>	Y	N
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus subsp. victoriae</i>	N	N
Bush Stone-curlew	<i>Burhinus grallarius</i>	Y	N
Common Blossom Bat	<i>Syconycteris australis</i>	N	N
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	F	N
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	Y	Y
Eastern Grass Owl	<i>Tyto longimembris</i>	N	N
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	N	N
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	Y	N
Great Knot	<i>Calidris tenuirostris</i>	Y	N
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	Y	Y
Little Eagle	<i>Hieraetus morphnoides</i>	N	N
Little Lorikeet	<i>Glossopsitta pusilla</i>	Y	N
Long-nosed Potoroo	<i>Potorous tridactylus</i>	N	N
Rose-crowned Fruit-dove	<i>Ptilinopus regina</i>	N	N
Sanderling	<i>Calidris alba</i>	N	N
Sooty Owl	<i>Tyto tenbricosa</i>	N	N
Spotted Harrier	<i>Circus assimilis</i>	N	N

Common Name	Scientific Name	Recorded From Within 10km (NSW Wildlife Atlas 2015)	Recorded From the Project Site (all previous surveys)
		Y/N	Y/N
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	Y	N
Squirrel Glider	<i>Petaurus norfolcensis</i>	Y	Y
Super Fruit-dove	<i>Ptilinopus superbis</i>	Y	N
Swift Parrot	<i>Lathamus discolor</i>	Y	N
Varied Sittella	<i>Daphoenositta chrysoptera</i>	Y	N
White-fronted Chat	<i>Epthianura albifrons</i>	Y	N
Yellow-bellied Glider	<i>Petaurus australis</i>	N	N
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	Y	Y

## 9.2 Species Credit Species

'Site Survey details', of the Credit Calculator lists a total of 31 Species Credit type species that potentially occur on the Biobank site, reproduced in **Table 12** below.

**Table 12 Species Credit Species within Biobank Site**

Species	BioBanking Survey Period	Site Surveyed During Recommended Period (HWR 2003/05, Cumberland Ecology 2007, RPS 2014/15) Y/N	Recorded From the Site Y/N	Assumed Presence Y/N
Australasian Bittern ( <i>Botaurus poiciloptilus</i> )	All year round	Y	N	N
Beach Stone-curlew ( <i>Esacus magnirostris</i> )	All year round	Y	N	N
Biconvex Paperbark ( <i>Melaleuca biconvexa</i> )	All year round	Y	N	N
Black Bittern ( <i>Ixobrychus flavicollis</i> )	All year round	Y	Y	Identified
Black-eyed Susan ( <i>Tetradlea juncea</i> )	July - December	Y	N	N
Black-necked Stork ( <i>Ephippiorhynchus asiaticus</i> )	All year round	Y	N	N
Brush-tailed Phascogale ( <i>Phascogale tapoatafa</i> )	All year round	Y	N	N
Common Planigale ( <i>Planigale maculata</i> )	All year round	Y	N	N
Eastern Chestnut Mouse ( <i>Pseudomys gracilicaudatus</i> )	All year round	Y	N	N
Eastern Osprey ( <i>Pandion cristatus</i> )	All year round	Y	N	N
Eastern Pygmy Possum	Undefined in BB		N	N

Species	BioBanking Survey Period	Site Surveyed During Recommended Period (HWR 2003/05, Cumberland Ecology 2007, RPS 2014/15) Y/N	Recorded From the Site Y/N	Assumed Presence Y/N
( <i>Cercartetus nanus</i> )	Calculator			
Emu population, NSW North Coast Bioregion and Port Stephens Local Government Area	All year round	Y	N	N
Giant Barred Frog ( <i>Mixophyes iteratus</i> )	October - April	Y	N	N
Green and Golden Bell Frog ( <i>Litoria aurea</i> )	August - March	Y	N	N
Green-thighed Frog ( <i>Litoria brevipalmata</i> )	October - March	Y	N	N
Koala ( <i>Phascolarctos cinereus</i> )	All year round	Y	Y	identified
Koala population, Hawks Nest and Tea Gardens	All year round	Y	N	N
Little Tern ( <i>Sterna albifrons</i> )	September - March	Y	N	N
Narrow-leaved Red Gum population, Greater Taree Local Government Area	All year round	Y	N	N
Noah's False Chickweed ( <i>Lindernia alsinoides</i> )	November - February	Y	N	N
Pale-headed Snake ( <i>Hoplocephalus bitorquatus</i> )	October - April	Y	N	N
Pied Oystercatcher ( <i>Haematopus longirostris</i> )	All year round	Y	N	N
Regent Honeyeater ( <i>Anthochaera Phrygia</i> )	All year round	Y	N	N
Rough Doubletail ( <i>Diuris praecox</i> )	July - August	Y	N	N
Small-flower Grevillea ( <i>Grevillea parviflora subsp. parviflora</i> )	All year round	Y	N	N
Stephen's Banded Snake ( <i>Hoplocephalus stephensii</i> )	Undefined in BB calculator		N	N
Tall Knotweed ( <i>Persicaria elatior</i> )	December - May	Y	N	N
Terek Sandpiper ( <i>Xenus cinereus</i> )	September - May	Y	N	N
Trailing Woodruff ( <i>Asperula asthenes</i> )	All year round	Y	N	N
Wallum Froglet	All year round	Y	Y	identified

Species	BioBanking Survey Period	Site Surveyed During Recommended Period (HWR 2003/05, Cumberland Ecology 2007, RPS 2014/15) Y/N	Recorded From the Site Y/N	Assumed Presence Y/N
<i>(Crinia tinnula)</i>				

'Species Credit' Species recorded within the Project Site by the various surveys undertaken has been Black Bittern, Eastern Cave Bat, Little Bentwing-bat, Grey-headed Flying-fox, Koala and Wallum Froglet.

'Ecosystem Credit' species recorded include Eastern Freetail-bat, Greater Broad-nosed Bat, Yellow-bellied Sheath-tail-bat and Squirrel Glider.

The location of the records of these species within the Project Site is shown in **Figure 5**.

### 9.2.2 Threatened Species Survey Methodologies

The recommended survey period for the species credit type species is detailed in **Table 12**. By combining the detailed ecological survey works undertaken by RPS in 2014/15 (See **Appendix A**), with the previous works undertaken by HWR 2003 & 2005 and Cumberland Ecology (2007) (See **Appendix B**), a comprehensive understanding of the ecological attributes of the site has been obtained over several seasons, and required survey methodologies for species credit species have been met.

### 9.2.3 Species Polygons

A species polygon has been developed for each of the various threatened species considered to utilise the Biobank Site.



#### 9.2.3.1 Black Bittern

This species is considered to have 31.30ha of suitable habitat within the Biobank Site. The extent of this polygon is shown in **Figure 8**. This equates to all of the Biobank Site.

#### 9.2.3.2 Micro-bats

The Eastern Freetail-bat, Eastern Cave Bat, Greater Broad-nosed Bat, Little Bentwing-bat and the Yellow-bellied Sheath-tail-bat are all considered to 31.30ha of suitable forested habitat (Swamp Oak Forest) within the Biobank Site. The extent of this polygon is shown in **Figure 8**. This equates to all of the Biobank Site.

**Legend**

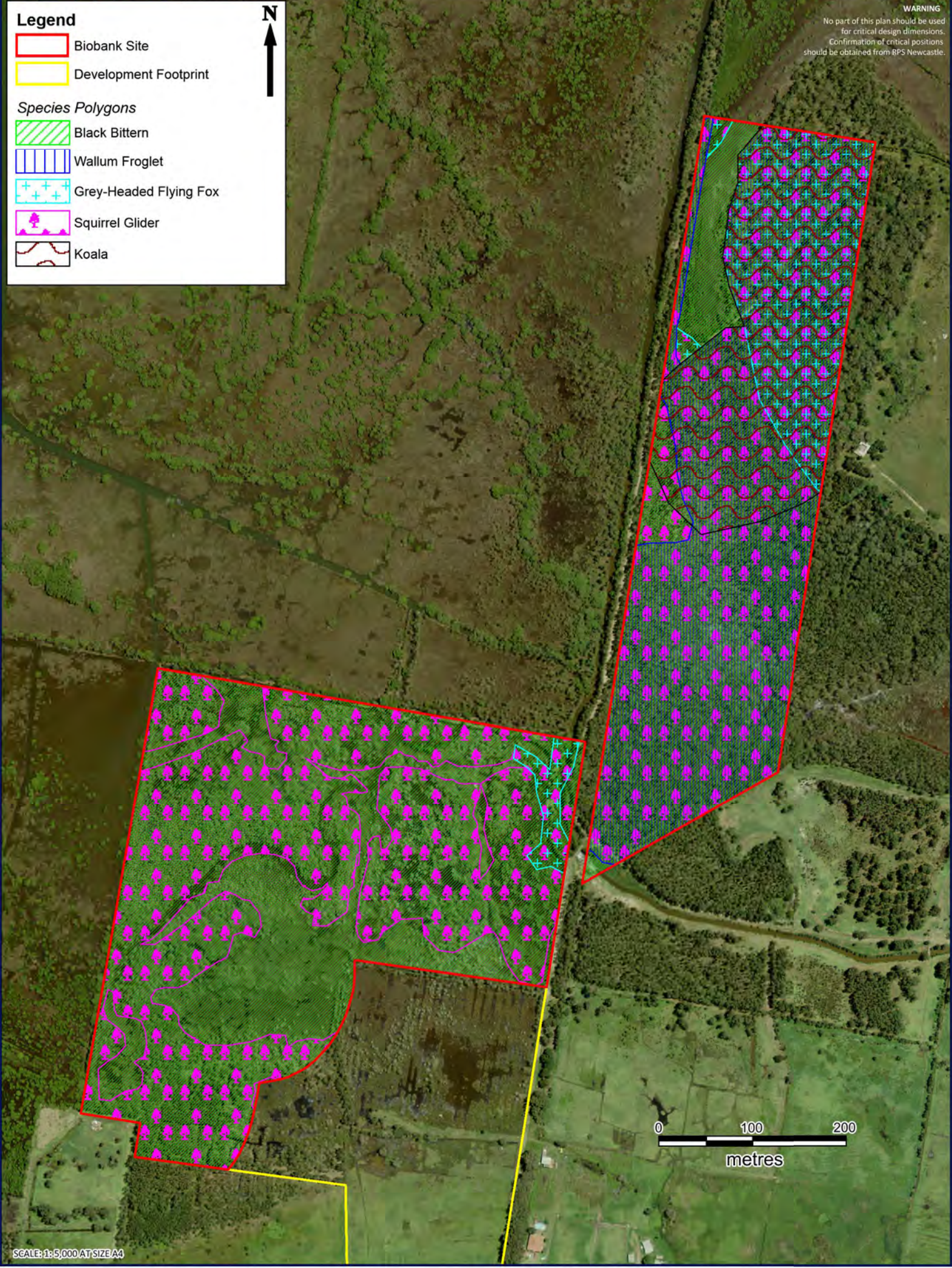
-  Biobank Site
-  Development Footprint

*Species Polygons*

-  Black Bittern
-  Wallum Froglet
-  Grey-Headed Flying Fox
-  Squirrel Glider
-  Koala



**WARNING**  
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.



SCALE: 1:5,000 AT SIZE A4

Title: **FIGURE 8: THREATENED SPECIES POLYGONS - BIOBANK SITE**

LOCATION: ANNA BAY

DATUM: GDA 94  
PROJECTION: MGA ZONE 56

DATE: 24/03/2015  
PURPOSE: BIOBANKING

LAYOUT REF: \\JOB5\119K\119462 Anna Bay  
110 - Drafting\Wapinfo Workspaces  
VERSION (PLAN BY): A A4 (JS)

CLIENT: RAPHAEL SHIN ENTERPRISES PTY LTD  
JOB REF: 119462



RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)  
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303  
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au



### 9.2.3.3 Grey-headed Flying-fox

This species is considered to have 4.51ha of suitable habitat within the Biobank Site. The extent of this polygon is shown in **Figure 8**. This equates to the extent of the Swamp Mahogany Forest and the Mangrove area, as these areas would provide seasonal nectar sources for this species.

### 9.2.3.4 Koala

This species is considered to have 36.35ha of suitable habitat within the Biobank Site. The extent of this polygon is shown in **Figure 8**. This equates to the extent of the Swamp Mahogany Forest, and a polygon extension into the adjacent Swamp Oak Forest to encapsulate the site records for this species.

### 9.2.3.5 Squirrel Glider

This species is considered to have 25.67 of suitable habitat within the Biobank Site. The extent of this polygon is shown in **Figure 8**. This equates to the extent of the treed habitats present.

### 9.2.3.6 Wallum Froglet

This species is considered to have 12.32ha of suitable habitat within the Biobank Site, being the areas of habitat Swamp Oak Forest. The extent of this polygon is shown in **Figure 8**. Other habitats are considered too saline for this species.

## 9.3 Identified Populations

The Director General of OEH may develop an 'Identified Populations' Database that identifies population(s) of Threatened species present in an area of land that require assessment under the BBAM (either for a Biobank or Development site).

To date, the BBAM has not determined any Identified Populations.

## 10.0 Improvement in Biodiversity Values at an Offset Site

### 10.1 Ecosystem and Species credits

The Biobank Credit Calculator was 'run' to generate a Credit Profile for the proposed Biobank site (see **Appendix 4**), which includes an assessment of the biodiversity values of the offset site, and calculates the number and type of biodiversity credits that may be created from management actions that are or are proposed to be carried out on the offset site in accordance with the BBAM.

**Table 13 Ecosystem credit values for Offset Biobank site**

Vegetation Zone Type	Area (ha)	Landscape Value Score	Current Site Value	Future Site Value	Gain in Site Value	Averted loss in Site Value	Credits created
Saltmarsh Estuarine Complex (HU960)	4.98	30	83.33	99.07	15.74	17.59	79
Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion (HU633)	3.97	30	83.33	88	4.67	14.00	48
Swamp Oak – Sea Rush – Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast (HU941)	13.56	30	82.67	100	17.33	16.67	217
Swamp Oak – Sea Rush – Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast (HU941) (Disturbed)	7.6	30	70.67	76	5.33	16	98
Mangrove forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (HU563)	0.54	30	100	100	0	19.19	7
Saltmarsh Estuarine Complex (HU960) (Disturbed)	0.65	30	99.07	100	0.93	19.9	8

**Table 14 Species credit values for Offset Biobank site**

Species	Species Credits created
Black Bittern	222
Eastern Cave Bat	222
Grey-headed Flying-fox	32
Koala	45
Little Bentwing-bat	222
Wallum Froglet	87

## 11.0 Summary

**Table 15** below is a summary of credit values of the proposed biodiversity offset sites, and how these relate to credit requirements created by the proposed development site.

**Table 15 The Bay Resort – Draft Credit Balance Ledger**

Species / Community	Development Area Impact	Biobank Land Generation	Balance
<b>Ecological Communities</b>			
Saltmarsh	361	87	(274)
Swamp Oak Forest	56	315	259
Swamp Mahogany Forest	0	48	48
Mangroves	0	7	7
<b>Ecological Community Balance = 40 credits</b>			
<b>Birds</b>			
Black Bittern	73	222	149
<b>Birds Balance = 149 credits</b>			
<b>Frogs</b>			
Wallum Froglet	13	87	74
<b>Frogs Balance = 74 credits</b>			
<b>Mammals</b>			
Koala	0	45	45
Eastern Cave Bat	13	222	209
Little Bentwing-bat	13	222	209
Grey-headed Flying-fox	0	32	32
<b>Mammals Balance = 495 credits</b>			
<b>Overall Balance = 758</b>			

Various management activities will be required to be instigated to achieve the biodiversity credits generation shown for the offset Biobank site. Such activities would be formalised within a formal Biobank site management plan required by a Statement of Commitment, and would include:

- Fox Control
- Control of feral pigs
- Exclude miscellaneous feral species
- Maintain or re-introduce natural flow regimes
- Slashing
- Feral and/or over-abundant native herbivore control

Other site specific management activities may also be considered in consultation with OEH / NPWS.

---

## 12.0 References

Cumberland Ecology (2007) *Flora and Fauna Impact Assessment: Anna Bay*. Draft Report prepared for Spacecon Pty Ltd, December 2007.

NSW Office of Environment and Heritage (2014) *Biobanking Assessment Methodology 2014*, September 2014.

NSW Office of Environment and Heritage (undated). *Draft Operational Manual for using the Biobanking Credit Calculator v2.0*.

NSW Office of Environment and Heritage (2012). *Assessors Guide to using the Biobanking Credit Calculator v2*, April 2012.

OEH Threatened Species, Populations and Ecological Communities website (<http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/>).

## Appendix I – RPS Flora and Fauna Assessment Works (2015)

## Flora Surveys

### Vegetation Mapping

Confirmation and refinement of the existing vegetation mapping produced by Cumberland Ecology (2007) for the Site was undertaken via baseline flora surveys. The baseline flora surveys were undertaken utilising 19 quadrats to inventory native flora across the Site. Within each 0.04 hectare quadrat (typical quadrat dimension = 20m X 20m), all vascular plant species present were recorded and given an abundance rating based on a modified Braun-Blanquet scale. Physical attributes of the Site within the quadrat (vegetation structure, soil type, elevation, slope, aspect, physiographical position) were also recorded, and photographs taken of the Site for later reference. Plant specimens of unknown or significant status are collected for later identification or lodgement with the National Herbarium in Sydney. All field data were recorded on RPS proformas.

Analysis of quadrat in conjunction with interpretation of digital aerial imagery resulted in a refinement of the vegetation mapping for the Site.

### BioBanking Plots Development Site

BioBank field surveys of the Site were undertaken on 25-27 March 2014 and 16-17 March 2015. Each BioBank survey site comprised the establishment of a 400m<sup>2</sup> (20m x 20m) quadrat nested within a larger 0.1 hectare plot (dimension = 20m x 50m). Data collected within the nested plot comprised full floristics, elevation and soil type. Data collected within the larger plot comprised a census of hollow bearing trees, length of fallen logs and structural vegetation information (foliage cover for all strata). Plot data was recorded on BioBank-specific field proformas.

Vegetation Zones were classified based on both the 'best fit' vegetation type listed in the BioBank Vegetation Types Database (OEH 2009) as well as Condition Class (Moderate/Good, Low). Parameters used to choose the 'best fit' Vegetation Type included overstorey and understorey floristics, soil landscape, location and topographic position. It is noted that the Cumberland Ecology (2007) mapping combined with aerial photography interpretation was chiefly relied upon in some inaccessible areas of the southern lot.

Final Scientific Committee Determinations listed under the TSC Act were reviewed to assess whether any of the three Vegetation Zones were classified as Endangered Ecological Communities (EECs) under this legislation.

Survey methodologies for site variables recorded (eg. how foliage cover is calculated for each strata) are detailed in the BioBank Assessment Methodology (BBAM, OEH 2009).

Vascular flora species recorded were identified as far as practicable to species and subspecies level. When a plant could not be identified accurately in the field, a voucher sample was collected, together with notes on habitat, form and height. Collected samples were later identified using a stereozoom microscope and botanical texts. Botanical nomenclature followed the Harden series of Flora of NSW Volumes 1-4 (including revised Volumes 1 and 2).

### Biobanking Plots Offset Site

BioBank field surveys of the Offset Site were undertaken on 25-27 March 2014 and 16-17 March 2015.

Each BioBank survey site comprised the establishment of a 400m<sup>2</sup> (20m x 20m) quadrat nested within a larger 0.1 hectare plot (dimension = 20m x 50m). Data collected within the nested plot comprised full floristics, elevation and soil type. Data collected within the larger plot comprised a census of hollow bearing trees, length of fallen logs and structural vegetation information (foliage cover for all strata). Plot data was recorded on BioBank-specific field proformas.

Vegetation Zones were classified based on both the 'best fit' vegetation type listed in the BioBank Vegetation Types Database (OEH 2009) as well as Condition Class (Moderate/Good, Low). Parameters used to choose the 'best fit' Vegetation Type included overstorey and understorey floristics, soil landscape, location and topographic position.

Final Scientific Committee Determinations listed under the TSC Act were reviewed to assess whether any of Vegetation Zones were classified as Endangered Ecological Communities (EECs) under this legislation.

### Threatened Flora Survey

A list of potentially occurring significant flora species from the locality (10 kilometre radius) was compiled, which included threatened species (Critically Endangered, Endangered or Vulnerable) and EECs listed under the TSC Act and/or the EPBC Act.

Targeted flora searches were conducted during all days of field surveys using the "Random Meander Technique" described by Cropper (1993).

### **Fauna Surveys**

A desktop assessment of the potential use of the Site by threatened fauna species (as listed under the TSC Act and EPBC Act) identified from the vicinity of the site was undertaken prior to the commencement of field surveys. A review was also undertaken of the previous fauna survey works conducted on the site by HWR (2003 & 2005) and Cumberland Ecology (2007).

The presence of fauna within the Site was determined through a variety of survey techniques including Elliot traps, hair tubes, camera traps, spotlighting, call playback, harp trapping, Anabat recordings and opportunistic sightings. These methodologies were conducted on the 10-14 March 2014 and are described in further detail below. Opportunistic sightings were also undertaken during surveys from 16-17 March 2015. Survey effort is provided in the table below.

**Table 1 Total Survey Effort**

Terrestrial Elliot A	Terrestrial Elliot B	Arboreal Elliot B	Camera Traps	Hair Tubes	Harp Trap	Anabat	Spot lighting	Flora Quadrats
Trap Nights						Hours		
200	200	48	8	160	8	40	12	19

### Avifauna

Birds were surveyed within a two hectare (ha) search plot for 20 minutes at each site. Surveys were restricted to mornings or late afternoons in order to record birds during peak activity periods.

All birds observed or heard within or flying over the two hectare area were recorded. Birds that were detected outside the search area were recorded separately as opportunistic during all days of fieldwork. Birds were identified by direct observation or by recognition of calls or distinctive features such as nests, feathers and owl regurgitation pellets.

A hand held Trimble differential global positioning system (D-GPS), accurate to less than one metre, was used to record the location of any threatened bird species.

Nocturnal surveys were undertaken to detect nocturnal bird species on-site.

### Arboreal Mammal Trapping

Arboreal trapping was undertaken using tree mounted Elliott B size traps. Traps were mounted on brackets set at approximately two metres in height on trees with a DBH greater than 30 centimetres. Traps were baited with a rolled oats, peanut butter and honey mixture and the tree trunks were sprayed liberally with a brown sugar and water mix every second day in the late afternoon. Traps were checked early each morning. Arboreal traps targeted arboreal mammals such as the threatened Squirrel Glider (*Petaurus norfolcensis*), which has been previously recorded within the southern site by Cumberland Ecology (2007).

A total of two trapping transects, containing six Elliott B size arboreal traps were installed. Trapping was undertaken over four nights, resulting in 48 arboreal trap nights within the Site.

### Terrestrial Mammal Trapping

Terrestrial trapping was undertaken using Elliott A, Elliott B and Camera traps. Elliott traps were baited with a mixture of rolled oats, peanut butter and honey. Camera traps were baited with commercial tinned Cat food. Traps were checked within two hours of sunrise each morning, with any captures identified and released at point of capture. Traps were re-baited where necessary. The selected locations of the trap lines focused on stratification units as well as areas consisting of understorey that would provide protection for terrestrial mammal species and areas which were not likely to be inundated at high tide resulting in potential mortality issues.

Terrestrial traps targeted small terrestrial mammals such as dasyurids (e.g. Antechinus and Dunnarts), and rodents (e.g. rats and mice). A total of two trapping transects were undertaken within the site containing 25 Elliott A, 25 Elliott B and one Camera trap per line. This resulted in 200 Elliott A trap nights, 200 Elliott B trap nights and eight Camera trap nights within the Site.

### Hair Tubes

Surveys were undertaken using Hair Tubes across the Site. These were baited with rolled oats, peanut butter and honey. Trees in which arboreal Hair Tubes were erected were sprayed every second day with a brown sugar and water mix. At each site, 10 arboreal and 10 terrestrial Hair Tubes were set.

Hair Tubes targeted small-medium mammals such as dasyurids (e.g. Antechinus and Dunnarts), rodents (e.g. rats and mice), gliders, and bandicoots. A total of two trapping transects were undertaken within the Site, resulting in 80 arboreal trap nights and 80 terrestrial trap nights.

Any hair samples retrieved during the survey were sent to Barbara Triggs at 'Dead Finish' for analysis.

### Herpetofauna

Herpetofauna (frog and reptile) searches were carried out across the Site, targeting areas of appropriate habitat. Some suitable reptile habitat was scattered throughout the site including areas of rock assemblages, logs and/or leaf litter.

The swamp areas and drainage lines were targeted for amphibians and call playback was used to elicit calls particularly for the Wallum Froglet (*Crinia tinnula*) and the Green and Golden Bell Frog (*Litoria aurea*).

### Micro-Chiropteran Bats

Microbat echolocation calls were recorded using Anabat II Detector and CF ZCAIM units set to remotely record for the entire night (6pm to 6am). Each survey site had two consecutive nights of sampling, with emphasis placed on those areas deemed likely to provide potential foraging and flyway sites for microbats.

Bat call analysis was undertaken by Echo Ecology. Each call sequence ('pass') was assigned to one of three categories, according to the confidence with which an identification could be made, being:

- Definite - Pass identified to species level and could not be confused with another species;
- Probable - Pass identified to species level and there is a low chance of confusion with another species; or
- Possible - Pass identified to species level but short duration or poor quality of the pass increases the chance of confusion with another species.

Harp Traps were also utilised at both trap line locations.

### Koala Surveys

Koala surveys and habitat assessments were undertaken in accordance with the Port Stephens Councils CKPoM. Ground truthing confirmed or refined areas of Preferred Koala Habitat as mapped by the Port Stephens Councils Koala Habitat Planning Map. The Koala Spot Assessment Technique (SAT) methodology as described by Phillips and Callaghan (2011) was conducted within the Site. 30 SATs were conducted within the area of Preferred Koala Habitat identified within the northern site. The Koala food trees that were surveyed were recorded with a Trimble D-GPS. The SATs were used to measure Koala activity levels and establish the extent of habitat utilisation within the local area.

### Spotlighting

Spotlighting was undertaken with the use of a 75-Watt hand-held spotlight and head torch whilst driving and walking over the Site. Areas of dense bush were targeted, however, tracks were also spotlighted whilst entering and exiting the Site. A total of 12 person hours of spotlighting was conducted over three nights.

### Nocturnal Call Playback

Pre-recorded calls of threatened Owl, Koala, Frog and Glider species with the potential to occur within the Site were broadcast during the surveys in an effort to elicit vocal responses or to attract the species to the playback site. The swamp areas and drainage lines were targeted for frogs. The calls were broadcast through an amplification system (loud hailer) designed to project the sound for at least one kilometre under still night conditions.

As described by Kavanagh and Peake (1993) and Debus (1995), the call of each species was broadcast for at least five minutes, followed by five minutes of listening, and stationary spotlighting. Following the final broadcast and listening, the area was spotlighted on foot. Species targeted included the Powerful Owl (*Ninox strenua*), Barking Owl (*N. connivens*), Masked Owl (*Tyto novaehollandiae*), Yellow-bellied Glider (*Petaurus australis*) Squirrel Glider (*Petaurus norfolcensis*), Koala (*Phascolarctos cinereus*), Wallum Froglet (*Crinia tinnula*), and the Green and Golden Bell Frog

(*Litoria aurea*). A total of three call playback sessions were undertaken within the Site. However, additional targeted call playback sessions for frogs were undertaken at potential habitat locations.

## Appendix 2 – Cumberland Ecology Flora and Fauna Assessment Report (2007)



**FLORA AND FAUNA IMPACT ASSESSMENT: ANNA  
BAY**

**Draft Report/Summary SIS**

For:

**SPACECON PTY LTD**

December 2007

Draft Report

Cumberland Ecology  
PO Box 2474, Carlingford Court 2118

**Report No. 6083RP4**

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology

Approved by: David Robertson

Position: Project Director

Signed: \_\_\_\_\_

Date: 10 December, 2007

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# Executive Summary

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## **PURPOSE**

Cumberland Ecology Pty Ltd has been commissioned by Spacecon Pty Ltd to prepare a Species Impact Statement (SIS) for a proposed development of a five star hotel complex with eco villas within Lot 2 DP 747399, Anna Bay. The purpose of this report is to provide a preliminary assessment of the impacts to threatened flora and fauna of the proposed Anna Bay Resort development and to present proposed off-sets and ameliorative measures to the Department of Environment and Climate Change (DECC) and the National Parks and Wildlife Service (NPWS) as a basis for further discussion.

## **BACKGROUND**

The property, within which the proposed development is to occur, is located on two parcels of land off Nelson Bay Road and is approximately 40 hectares in size. The development footprint encompasses approximately 10 hectares (including Asset Protection Zones) along the south-eastern edge of the property adjacent to Nelson Bay Road. The proposed resort consists of a 150 room hotel and associated infrastructure, a man-made lagoon and 100 eco-style lodges. The remaining 30 hectares within the site are being proposed for conservation offset. A number of endangered ecological communities and threatened species occur on the site.

## **THE STUDY AREA**

The study area for a SIS includes the subject site upon which the proposal is to be constructed and any additional areas which are likely to be affected by the proposal, either directly or indirectly. The subject site is the area that will be directly affected by the proposal, the development footprint.

Where native vegetation exists, plant communities include forest, woodland and saltmarsh communities associated with coastal floodplains. There are also cleared areas within the study area that have been cleared and altered by past agricultural activities. The subject land has had the original drainage patterns modified via the construction of a series of drainage channels and levies. The original swamp systems appear to have been at least partially drained and to have regenerated to reflect the artificial drainage conditions.

Nine main plant communities occur in the study area:

- Broad-leaved Paperbark Open Forest;
- Swamp Oak Open Forest, Woodland and Open Woodland;
- Disturbed Swamp Oak Open Forest, Woodland and Open Woodland;
- Grey Mangrove Woodland & Low Woodland;
- Estuarine Complex;
- Samphire-Sea Couch-Sea Rush Herbland and Sedgeland (Saltmarsh);
- Disturbed Samphire-Sea Couch-Sea Rush Herbland and Sedgeland (Saltmarsh);
- Buffalo Grass-Couch Closed Grassland; and
- Shivery Grass-Whisky Grass-Carpet Grass Open Grassland.

## SUBJECT SPECIES AND AFFECTED FLORA AND FAUNA

Within the SIS, “subject” flora and fauna include threatened species, populations or communities that are known to occur or potentially could occur within the study area. Species were determined as subject species based on their recorded occurrence in the locality, the suitability of habitat on the subject site and consideration of the Director-General’s Requirements. “Affected” flora and fauna are a subset of subject species that are considered likely to be impacted in some way by the proposal.

No threatened species or populations of plants were found to occur on the subject land in the surveys conducted for this SIS and based upon habitats present. Threatened species that are known to occur in the locality of the subject land include *Callistemon linearifolius*; *Eucalyptus parramattensis subsp. decadens*; *Diuris arenaria*; and other species.

Subject fauna species include: Square-tailed Kite, Glossy Black Cockatoo, Black-necked Stork, Regent Honeyeater, Black Bittern, Brown Treecreeper, Wompoo Fruit-dove, Hooded Robin, Grey-crowned Babbler, Swift Parrot, Turquoise Parrot, Barking Owl, Powerful Owl, Grass Owl, Masked Owl, Sooty Owl, Spotted-tailed Quoll, Brush-tailed Phascogale, Common Planigale, Yellow-bellied Sheathtail Bat, Eastern Freetail Bat, Eastern Chestnut Mouse, Yellow-bellied Glider, Squirrel Glider, Koala, Long-nosed Potoroo, Grey-headed Flying-fox, Common Blossom Bat, Golden-tipped Bat, Little Bentwing Bat, Eastern Bentwing Bat, Large-footed Myotis and Greater Broad-nosed Bat.

Subject ecological communities include: Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, Swamp Oak Floodplain forest of the NSW North Coast, Sydney Basin

and South East Corner bioregions, Coastal Saltmarsh of the NSW North Coast, Sydney Basin and South East Corner bioregions.

No endangered populations occur or are considered likely to occur in the study area and so none have been considered as subject species.

## FIELD SURVEY RESULTS

The vegetation of the subject land is currently in a varied condition. The age structure of the forest is such that there are very few remnant old growth trees that have escaped historical clearing for agricultural and forestry purposes. The vegetation shows a history of disturbance such as logging and fire. The subject land has also been subject to grazing, probably by cattle, as evidenced by the presence of two dams and old fences and aerial photographs of the site taken in 1952. Most large trees on the subject land have established after land clearance and are approximately 50-60 years old. The communities also contain younger trees, many of which have also established as canopy trees. Due to the relatively young age of most of the trees, the subject land contains very few hollow-bearing trees. Many hollow stages of dead trees have been destroyed by fire and no longer contain enclosed hollows.

The fauna habitats of the subject site vary considerably from grassland and saltmarsh, which are open treeless habitats, to Swamp Oak and Broad-leaved Paperbark forests. The forest communities support the highest diversity and abundance of vertebrates.

A variety of forest fauna was detected in the northern site, and the northern portion of the southern site during the field surveys and many species could occur on the subject site as they have been detected in past surveys of the locality (Appendix B). Species include a considerable variety of forest birds and bats but a relatively small number of mammal, reptile and amphibian species.

Two native frog species were detected during the 2007 surveys; the Wallum Froglet and the Common Eastern Froglet. The latter was also detected in the HWR Ecological surveys. Reptiles detected on site include Jacky Lizard, Bearded Dragon, Carpet Python, Common Tree Snake, Red-bellied Black Snake, Copper-tailed Skink, Eastern Water Skink, Dark-flecked Garden Sunskink and Lace Monitor.

Many forest bird species were detected in the Broad-leaved Paperbark Open Forest. These included typical small forest species such as Eastern Yellow Robin, White-throated Tree-creeper, Eastern Whipbird, Brown Thornbill, Lewin's Honeyeater, Grey Fantail, Red-browed Finch, Grey Shrike-thrush and Eastern Spinebill.

A variety of arboreal fauna was found within the forest communities including Brush-tailed Possum, Sugar Glider, Squirrel Glider and Koala. The Brush-tailed Possum, Sugar Glider and Koala were detected within the Paperbark forest. The Squirrel Glider was found within the Swamp Oak Forest. The presence of Brush-tailed Possum, which requires

medium sized tree hollows, is indicative of the presence of larger hollows within the northern site.

A Brown Antechinus was the only native ground dwelling mammal detected on the subject

## IMPACT ASSESSMENT

Indirect impacts are those impacts to flora and fauna that arise as an indirect consequence of the direct impacts. Examples of indirect impacts include the following:

- Alterations to downstream water quality or quantity;
- Alterations to microclimate;
- Weed invasion of adjacent areas;
- Feral animal colonisation of adjacent areas;
- Spreading of plant pathogens into adjacent flora and fauna habitat (for example Cinnamon Fungus, *Phytophthora cinnamomi*, that impacts some vascular plants);
- Spreading of animal pathogens (for example the Chytrid Fungus, that affects some frog species);
- Loss of hollow-bearing trees; and
- Alteration of wildlife corridor values.

Direct and indirect impacts of the development are discussed below:

### ***Direct Impacts***

The proposal entails a development element and a conservation element. The development element of the proposal has been subdivided into two components:

1. **Construction Zone** = the area of construction including roads, paths, buildings and artificially landscaped areas; and
2. **Asset Protection Zones (APZs)** = the area of modified native vegetation that is maintained in fuel reduced form in order to protect the proposed development from bushfire.

The development footprint is illustrated in Figure 5.1, while a summary of areas of native vegetation to be cleared or conserved is provided within Table 5.1.

The proposed development footprint is located within the most disturbed areas of the subject land. Vegetation within this area has either been cleared for agriculture or modified by past land uses including livestock grazing and turf farming. As such the vegetation within the proposed development footprint includes the majority of exotic grassland on the subject land. It also contains small areas of Swamp Oak Woodland, Saltmarsh Complex and Sedgeland Mosaic.

The APZ portion of the proposed development would be located within Swamp Oak Forest; and Saltmarsh Complex. However, of these, only the Swamp Oak vegetation would require thinning to provide vegetation that conforms to an APZ. The existing saltmarsh areas currently have low fuel loads and would not require further modification for the project.

**Table S.1 AREAS WITHIN PROPERTY TO BE CLEARED, MODIFIED AND CONSERVED**

<b>Community</b>	<b>Area within property boundary (ha)</b>	<b>Area to be developed (ha)</b>	<b>Area to be modified within APZ (ha) (treed areas only)</b>	<b>% of each community to be cleared</b>	<b>% of each community to be modified</b>	<b>area to be conserved</b>	<b>% of each community to be conserved</b>
Paperbark Open Forest	3.9	0.0	0.0	0.0	0.0	3.9	100.0
Swamp Oak Forest/Woodland	14.8	0.2	0.7	1.4	4.7	13.9	93.9
Disturbed Swamp Forest/Woodland	6.8	0.7	0.7	9.5	10.5	5.4	79.4
Grey Mangrove Low Woodland	0.4	0.0	0.0	0.0	0.0	0.4	100.0
Saltmarsh Complex	5.1	0.7	0.0	14.3	0.0	4.4	86.3
Disturbed Saltmarsh Complex	2.4	2.0	0.0	82.9	0.0	0.4	16.7
Sedgeland mosaic	0.9	0.9	0.0	99.8	0.0	0.0	0.0
Exotic grassland	5.6	3.5	0.0	63.9	0.0	2.1	37.5
<b>Total</b>	<b>39.9</b>	<b>8.0</b>	<b>1.4</b>	<b>n/a</b>	<b>n/a</b>	<b>30.5</b>	<b>n/a</b>

## MITIGATION MEASURES

Retention and conservation of the native vegetation on the balance of the property owned by the proponent (30.5 ha) is the foremost mitigation measure for the proposal. Such land will be protected in perpetuity by a mechanism yet to be determined. However, land could be donated to National Parks and Wildlife Service, or protected under the ownership of the current owner Section 88B covenant. The vegetation that is to be retained on the subject land will be allowed to continue to regenerate without further disturbance.

Effects of the proposal on the subject site will be mitigated through the implementation of a series of environmental management plans. A VMP will be drafted for the management of vegetation in and around the proposed development.

The primary objectives for this plan will be to:

- Outline the ecological values of the future Development Area and Conservation Area and identify potential impacts;
- Prescribe vegetation and fauna habitat management strategies and methods to ensure the long-term viability of native vegetation communities within the site;
- Prescribe vegetation restoration strategies and methods to prevent or mitigate impacts on native bushland and fauna habitats in degraded areas within the site;
- Prescribe management strategies and methods to prevent or mitigate impacts on native vegetation and fauna habitats that may occur as a result of the proposed road construction or bushfire protection measures;
- Prescribe an implementation schedule and monitoring schedule; and
- Indicate a number of performance criteria which will be reviewed annually.

Habitat for threatened flora and fauna exists and will be enhanced and maintained in the long-term through the implementation of the VMP as described above:

These mitigation measures are considered to be appropriate and adequate to deal with the perceived indirect impacts of the proposal.

## CONCLUSION

No significant impact is likely upon threatened flora and fauna species as a result of the proposed development.

After considering the material raised in the SIS, without regard to the ameliorative measures proposed, the construction of the proposal and ongoing use of the subject site

as a tourist facility is not considered to have a significant impact on any threatened species or communities that are known or considered likely to occur in the study area.

The SEPP 14 wetland that occurs within the subject land will be protected by a naturally vegetated buffer of conserved native vegetation and is not expected to be detrimentally impacted by the proposed development.

Some Saltmarsh, an EEC, will be cleared for the proposed development. However, the saltmarsh to be cleared has been altered by previous land uses. Higher quality Saltmarsh in greater quantity will be conserved across parts of the remainder of the property.

The majority of flora and fauna are likely to remain viable on the subject land and in the study area in the long term. This is for a variety of reasons, principally including:

- The majority of the site, including all the Paperbark Forest, all mangroves and the largest and most intact remnants of Swamp Oak Forest and Saltmarsh communities will be conserved in the long term;
- The threatened species detected (Koala, Squirrel Glider, Wallum Froglet, Australasian Bittern, microchiropteran bats and Grey-headed Flying Fox) have been found to occur predominantly within the forested northern portions of the subject land and/or within wetland areas, which under the proposal will be conserved in perpetuity.

Vegetation clearance that is required as part of the proposal will add to the cumulative impacts upon Saltmarsh and Swamp Oak Forest in the locality in the short term. However, the management of the remainder of the subject land for conservation will offset such impacts as the protected habitats are regenerated and managed and provide for a net gain in biodiversity in the long term.

# Introduction

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## 1.1 Purpose

The purpose of this report is to assess the impacts on flora and fauna of the proposed Anna Bay Resort development (within Lot 2 DP 747399, Anna Bay) by Spacecon Pty Ltd and to present proposed off-sets and ameliorative measures to the Department of Environment and Climate Change (DECC) and the National Parks and Wildlife Service (NPWS) as a basis for further discussion.

Following the receipt of Director General's Requirements (DGRs) from DECC earlier this year and discussions in September 2007 with DECC and the NPWS concerning the potential impacts of the development on threatened flora and fauna, this document has been prepared to serve as a summary report that pre-emptes the preparation of a full Species Impact Statement (SIS).

The report and associated research identifies the species and communities that occur or have the potential to occur within the study area and presents an assessment of the impacts and ameliorative measures of the proposed development based on the information that is currently available. The objective of the report is to enable useful discussions to take place between Spacecon Pty Ltd and the Departments concerning the details of the development and the provisions for conservation, prior to the completion of a detailed SIS.

## 1.2 Background

The property, within which the proposed development is to occur, is located on two parcels of land off Nelson Bay Road and is approximately 40 hectares in size. The development footprint encompasses approximately 10 hectares (including Asset Protection Zones) along the south-eastern edge of the property adjacent to Nelson Bay Road. The proposed resort consists of a 150 room hotel and associated infrastructure, a man-made lagoon and 100 eco-style lodges. The remaining 30 hectares within the site are being proposed for conservation offset. A number of endangered ecological communities and threatened species occur on the site.

## 1.3 Scope of Work

The report covers the following information:

- Database searches and a review of available documentation to identify threatened species or populations known or likely to occur in the locality;
- Detailed mapping and descriptions of the vegetation communities that occur on site;
- An assessment of the conservation significance and resilience of the vegetation communities on site;
- Targeted surveys for selected threatened flora species on site that are known to occur in the locality;
- An assessment of the extent and quality of habitat available for fauna species known to occur in the locality;
- Targeted surveys for selected threatened fauna species on site;
- An assessment of the direct and indirect impacts that may occur as a result of the development; and
- Consideration of the ameliorative measures that are being proposed as part of the development to provide a conservation outcome.

## Site Description

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### 2.1 Description of the Proposal

The proposal is for a \$50m, 5 star international resort located on a 40ha rural site at 229 Nelson Bay Road, Anna Bay. A development envelope of approximately 10ha (including Asset Protection Zones) has been identified on the site's south-eastern corner off Nelson Bay Road which will comprise a three storey 150 room hotel with guest accommodation, conference centre, shops and international "food street".

The remainder of the site (approximately 30ha) features a range of diverse ecological communities and habitats, including Swamp Oak Open Forest, Broad-leaved Paperbark Open Forest and Saltmarsh complex. These lands will remain undeveloped.

The proposed hotel will be located at the southern part of the envelope, off Nelson Bay Road. A large artificial (unfiltered) lagoon will separate the hotel from 100 eco-style lodges, located at the envelope's north and western extremities.

The resort is fully serviced and landscaped, with approx 1.5km sealed roads and a network of walking paths. It is estimated the total building footprint, including parking is 25,000m<sup>2</sup> or 25% of the envelope area.

Peak population including guests, staff and day visitors is 500-750 persons.

### 2.2 Land Tenure

Under the Port Stephens LEP 2000 (Port Stephens Council 2000), the subject site and surrounding areas are zoned 1(a) Rural Agriculture, with occasional areas zoned 6(a), General Recreation.

### 2.3 Description of the Study Area

The terrain throughout the study area comprises sandy or peaty ground of very low relief. The southern end is the most elevated, rising to sand dunes south of Nelson Bay Road. Most of the subject site contains very low elevation ground with rises and falls of less than

one metre. Local surface changes are often less than a 100 or 200 millimetres. Owing to the generally high water table of brackish or saline water, plant communities alter significantly according to slight elevation changes. The property is divided into two separate plots – one lying south-east and one lying north-west of a large drainage channel.

Much of the southern section of the property (hereafter referred to as the southern site) has been cleared in the past. Numerous shallow channels have been cut through the lot in order to drain subsurface water. The lowest areas to the north and west are too low-lying, wet and saline for useful pasture and have been left unaltered or have been partly cleared but have subsequently regenerated to more natural plant communities.

The part of the property that lies north-east of the large drainage channel (hereafter referred to as the northern site) largely comprises native vegetation. It is possible that some of this has been cleared many years previously but has regrown to mature but still developing forest.

### **2.3.1 Definition of SIS Study Area**

The **study area** for a SIS is the subject site upon which the project is to be constructed and any additional areas that are likely to be affected by the approved components of the project, either directly or indirectly. For the purposes of this SIS, the study area includes both sections of the subject site: the southern site being where impacts may potentially occur and the northern site being included as it is being offered as a conservation off-set and therefore its' conservation values require recording.

It is unlikely that impacts from the development will affect land north of the southern site, however it is included in the definition of the SIS study area because it forms habitat connectivity between the two separate plots of land owned by Spacecon. This area has not been surveyed in detail.

Finally, the area to the east of the southern site and directly south of the northern site is included in the definition of the SIS study area, as impacts from the development such as light and noise may occur in the immediate surrounding area.

This definition of study area has been adopted so as to include a wide area around the proposed development and so include all flora and fauna that could conceivably be indirectly impacted by the approved components of the project. For example it includes areas that could be used for local wildlife dispersal.

## **2.4 Description of Vegetation and Habitat Values**

Nine main plant communities occur in the study area (refer to Figure 2.1):

- Broad-leaved Paperbark Open Forest;

- Swamp Oak Open Forest, Woodland and Open Woodland;
- Disturbed Swamp Oak Open Forest, Woodland and Open Woodland;
- Grey Mangrove Woodland & Low Woodland;
- Estuarine Complex\*;
- Samphire-Sea Couch-Sea Rush Herbland and Sedgeland (Saltmarsh);
- Disturbed Samphire-Sea Couch-Sea Rush Herbland and Sedgeland (Saltmarsh);
- Buffalo Grass-Couch Closed Grassland; and
- Shivery Grass-Whisky Grass-Carpet Grass Open Grassland.

\*Estuarine Complex was identified in the northern section of the study area, outside the subject site. This was related to other communities described below and was not surveyed in detail.

Cleared vegetation occurs east of the northern section of the subject property.

Table 2.1 shows the area in hectares of each vegetation type within the property. Vegetation descriptions are provided below.

**Table 2.1 Areas within property of different community types**

Community	Hectares within property
Paperbark Open Forest	3.9
Swamp Oak Forest/Woodland	14.8
Disturbed Swamp Forest/Woodland	6.8
Grey Mangrove Low Woodland	0.4
Saltmarsh Complex	5.1
Disturbed Saltmarsh Complex	2.4
Sedgeland mosaic	0.9
Exotic grassland	5.6
<b>Total</b>	<b>39.9</b>

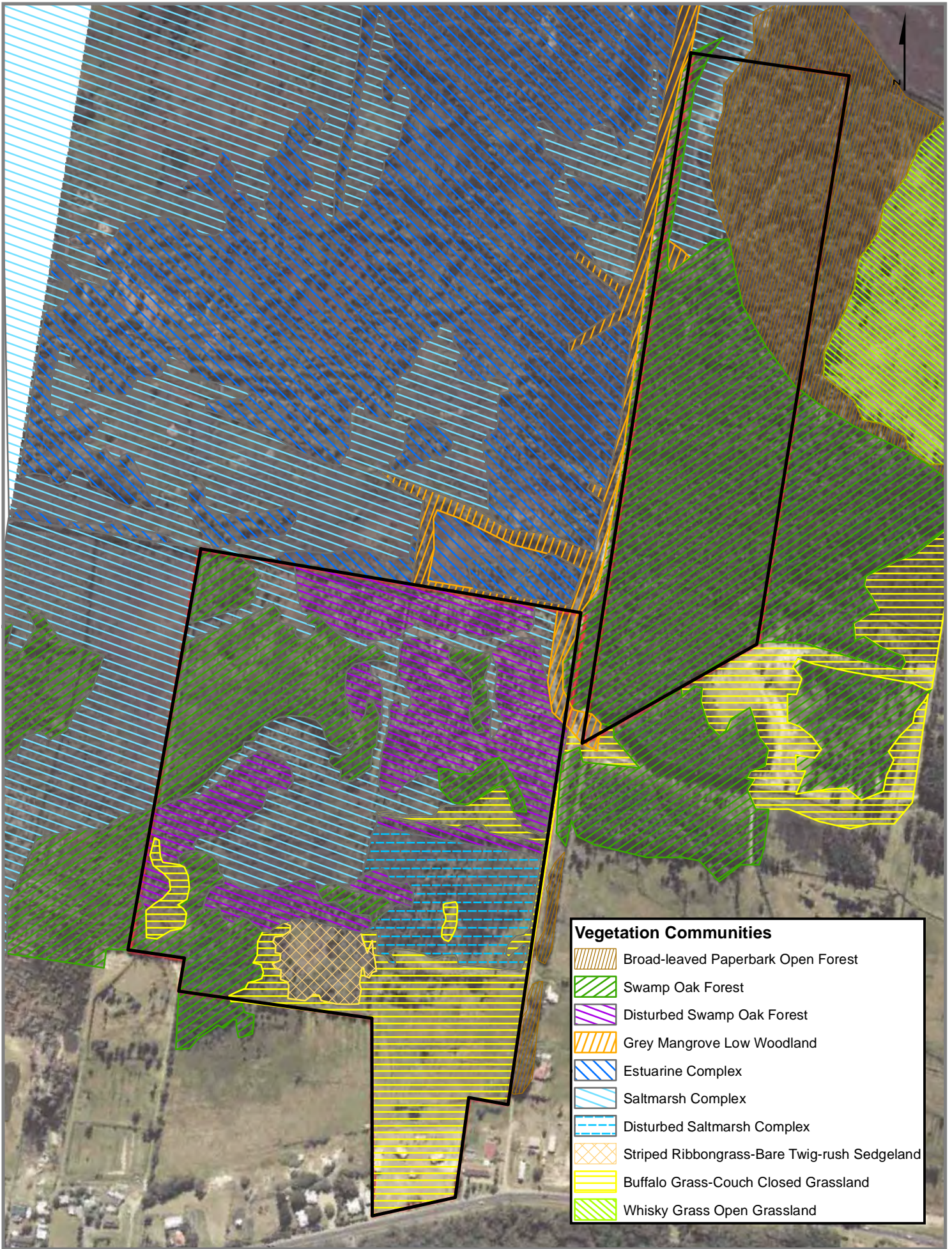
#### **2.4.1 Broad-leaved Paperbark Open Forest**

Broad-leaved Paperbark Open Forest occurs in somewhat more elevated locations that contain lower water table or fresh water rather than saline subsurface water.

The community occurs adjacent to the southern site, along the eastern side of the road reserve north of Nelson Bay Road, and in the northeastern section of the northern site. It also occurs discontinuously east of the northern site.

This community appears to have previously occupied much of the slightly elevated southern section of the southern site that has since been cleared for grazing and other landuse. This is indicated by the band of this community along the eastern road reserve and scattered *Melaleuca quinquenervia* (Broad-leaved Paperbark) further west in pasture within the subject site.

The community south of the channel is dominated by *Melaleuca quinquenervia*. *Casuarina glauca* (Swamp Oak) is generally a rare component but increases in proportion in the lower areas near the margin with Swamp Oak Open Forest. Small tree species are uncommon and limited to *Acacia irrorata*, *Rapanea howittiana* (Howitts Muttonwood), *Myoporum acuminatum* (Hard Corkwood) and the exotic *Cinnamomum camphora* (Camphor Laurel).



0 160 320 Meters

Figure 2.1

Vegetation communities

The understorey is largely dominated by ferns, especially, *Hypolepis muelleri* (Harsh Ground Fern), *Blechnum indicum* (Swamp Fern) and *Pteridium esculentum* (Bracken Fern).

In the northern site, this community has a more diverse and shrubby understorey. The canopy is also more variable, additionally containing *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus robusta* (Swamp Mahogany).

The understorey contains obvious small tree and shrub strata. *Glochidion ferdinandi* var *ferdinandi* (Cheese Tree) is the most common species. Others include: *Acacia irrorata*, *Myoporum acuminatum*, *Rapanea howittiana*, *Glochidion ferdinandi* var *pubens* (Hairy Cheese Tree) and juvenile *Banksia integrifolia* (Coast Banksia). Many of the small trees are hardy rainforest species. It appears that these have regenerated or re-sprouted following bushfire some years previously. Depending on the fire regime, it is possible that these will not establish a subcanopy but will be subject to a cycle of periodic burning and subsequent regrowth to young mature stages.



**Photograph 2.1 Broad-leaved Paperbark Open Forest in the northern site**

Typical shrubs include: *Breynia oblongifolia* (Dwarfs Apples), *Goodenia ovata*, *Melaleuca ericifolia* (Swamp Paperbark) and the introduced *Lantana camara* (Lantana) and *Chrysanthemoides monilifera* ssp *rotundata* (Bitou Bush).

*Pteridium esculentum*, *Gahnia clarkei* (a Saw-sedge) and *Themeda australis* (Kangaroo Grass) are the main ground cover species. The most common exotics are: *Hypochaeris radicata* (Flatweed) and *Senecio madagascariensis* (Fireweed).

Vines are common in this community, especially: *Parsonsia straminea* (Common Silkpod), *Pandorea pandorana* (Wonga Wonga Vine) and *Clematis aristata/glycinoides* (Toothed Clematis/Travellers Joy).

This community is in viable condition although in some locations high proportions of *Lantana camara* and *Chrysanthemoides monilifera* ssp *rotundata* occur in the shrub stratum. Exotic ground covers are generally sparse, except along track and forest margins.

Natural regeneration of native species occurs in many locations, however exotic species are also regenerating. This community contains the highest species richness of all in the study area.

#### **2.4.2 Swamp Oak Open Forest, woodland and open woodland**

The most widespread community in the study area is dominated by *Casuarina glauca* (Swamp Oak). In less saline locations it forms Open Forest with a small tree and shrub understorey of juvenile *Casuarina glauca*. The ground cover of this variant is typically leaf litter and scattered herbs such as: *Juncus kraussii* (Sea Rush) and *Gahnia clarkei* (a Saw-sedge). Saltmarsh species are occasionally present, mainly adjacent to saltmarsh or in other saline locations. Exotics such as *Ehrharta erecta* (Veldt Grass), *Cynodon dactylon*, *Lantana camara* and *Chrysanthemoides monilifera* spp *rotundata* are locally common to very common, especially in better-drained situations and along track or forest margins.



**Photograph 2.2 Swamp Oak Forest in the northern site**

In more saline areas this community has an open to scattered canopy. *Juncus kraussii* is generally dominant in these situations and other saltmarsh species are common. Owing to the higher salinity levels, weeds are rare to absent in this variant.

The only epiphyte recorded in the study area occurs in Swamp Oak Open Forest: *Dendrobium teretifolium* (Spider Orchid). This is restricted to mature open forest rather than woodland except for two occurrences. The orchid population is large in the northern lot, being estimated at over 2000 plants. The other two occurrences are small – two plants on a dead *Casuarina glauca* in the southern site and less than about 100 plants in one section north of the southern site.

#### **2.4.3 Disturbed Swamp Oak Open Forest, woodland and open woodland**

Areas of Disturbed Swamp Oak generally contain the same species as above but form a much more open canopy with many of the trees either being dead or showing evidence of die-back. The reason for this is not clear but could be due to changes in watertable levels or salinity.



**Photograph 2.3 Disturbed Swamp Oak in the southern site**

#### **2.4.4 Grey Mangrove woodland & low woodland**

Mangroves are dominant in a few locations but the only relatively large occurrence is north of the southern site, in a low zone adjacent to this. *Avicenna marina* (Grey Mangrove) is the dominant species and usually only species. *Casuarina glauca* is present in slightly elevated locations. *Aegiceras corniculatum* (River Mangrove) occurs along the main north-south drainage channel adjacent to the northern site. The understorey is sometimes devoid of other species, but frequently contains saltmarsh species, especially *Juncus kraussii*.



**Photograph 2.4 Grey Mangrove Woodland and Low Woodland**

#### **2.4.5 Estuarine Complex**

The Estuarine Complex largely comprises native vegetation that is a composite of Grey Mangrove Low Woodland, Swamp Oak Open Woodland, Saltmarsh and scattered mudflats. The eastern and southern margins of this community adjoin the subject site at the main north-south constructed channel and the east-west channel at its northern boundary.

As with the disturbed swamp oak, significant numbers of trees have died in this community however the date and reason for this is unknown. Owing to tree death it is difficult to determine whether this community was previously dominated by mangroves. The habitat

appears to be generally very low-lying and mangroves, especially *Avicenna marina*, are common along its eastern margin and internal drainage lines.

#### **2.4.6 Samphire-Sea Couch-Sea Rush Herbland and sedgeland (Saltmarsh)**

Areas of high saline water table or subject to tidal influence contain *Sarcocornia quinqueflora*–*Sporobolus virginicus*-*Juncus krausii* herbland or sedgeland. This community varies greatly from combinations of these species or one species alone. By nature it has very low species richness. Other species are rare to locally common and include: *Apium prostratum*, *Cotula coronopifolia* (Sea Buttons), *Samolus repens* (Creeping Brookweed), *Suaeda australis* (Seablite) and *Avicenna marina* seedlings.

This community merges with other adjoining communities: Swamp Oak Open Forest, Woodland and Open Woodland, and exotic pasture. Where it adjoins swamp oak community, *Sporobolus virginicus* tends to dominate at the swamp oak margin, and *Juncus krausii* occurs between this and the *Sarcocornia quinqueflora* saltmarsh.



**Photograph 2.5**      **Saltmarsh in the northern site**

#### **2.4.7 Disturbed Samphire-Sea Couch-Sea Rush Herbland and sedgeland (Saltmarsh)**

Areas of Disturbed Saltmarsh contain similar species to those outlined above but have a larger distribution of exotic grasses (see description in 2.4.9 below) dispersed throughout the area, particularly on areas of higher elevation.



**Photograph 2.6 Disturbed Saltmarsh in the southern site**

#### **2.4.8 Striped Ribbongrass-Bare Twig-rush Sedgeland**

In one sedgeland area, adjoining pasture the ground water is less saline than the saltmarsh community and favours other species, especially *Triglochin striata* (Striped Ribbongrass) and *Baumea juncea* (Bare Twig-rush). *Melaleuca ericifolia* (Swamp Paperbark) occurs in a couple of dense stands. The exotic *Hydrocotyle bonariensis* occurs in many parts of this community and is locally co-dominant in the southern section adjacent to the slightly raised east-west boundary track. Species that are more typical of saltmarsh, such as, *Juncus krausii* and *Sporobolus virginicus* are rare. This community has been mapped previously as Wet Meadow (HWR Ecological, 2005).



**Photograph 2.7**      **Striped Ribbongrass-Bare Twig-rush Sedgeland**

#### **2.4.9 Buffalo Grass-Couch closed grassland**

The largest area of this community extends from Nelson Bay Road to the Swamp Oak Woodland approximately 200-400m north. Most of this contains very few trees however scattered individuals and small groups of mature and young trees of *Melaleuca quinquenervia* and *Casuarina glauca* are present.

Smaller areas include: along slightly raised tracks extending west from the track in the road reserve and several nodes in nearby saltmarsh. Exotic grassland also occurs as a ground cover in Swamp Oak Forest in a few locations and adjacent to this community along channels, where it has presumably been used for access.

The vegetation in this zone mainly comprises the exotic grasses: *Stenotaphrum secundatum* (Buffalo Grass), *Cynodon dactylon* (Couch Grass) with scattered *Juncus kraussii*, *Hydrocotyle bonariensis*, *Cyperus* sp., *Paspalum dilatatum* (Paspalum) and *Aster subulatus* (Wild Aster). Native species form a very small proportion of the ground cover, mostly estimated to be less than 10%. Indigenous herbaceous species include: *Juncus kraussii*, *Apium prostratum* (Sea Celery) *Typha domingensis*, *Triglochin striatum*, *Agrostis* sp. and *Cotula coronopifolia*.

Despite containing small numbers of native species, this plant community cannot be considered bushland. The canopy has been removed except for a few individuals and the exotic ground cover is estimated to generally form more than 90% of the ground cover. It

is unlikely the community would regenerate to re-establish one that is representative of the original forest.

Most of this area probably contained Broad-leaved Paperbark Open Forest before clearing occurred. Although *Casuarina glauca* was probably one of the minor constituents, Swamp Oak Open Forest was probably restricted to the lower slope where saline soils occur. It is possible Blackbutt-Smooth-barked Apple extended north of Nelson Bay Road into the upper margin of the subject property.



**Photograph 2.8** Buffalo-Grass Couch Closed Grassland in the southern site

#### **2.4.10 Couch-Shivery Grass-Whisky Grass-Carpet Grass open grassland**

Outside the property boundary, east of the Broad-leaved Paperbark Open Forest in the northern site is a large cleared zone. This appears to have previously been Broad-leaved Paperbark Open Forest, probably similar to that described above.

Most of it is dominated by exotic grasses. Prolific indigenous tree and shrub regeneration occurs although in early stages. *Melaleuca quinquenervia* and *Melaleuca ericifolia* are the main species. Scattered juvenile *Eucalyptus tereticornis* and *Acacia irrorata* are also present. A few specimens of mature and regenerating *Eucalyptus robusta* occur along the

western margin. *Chysanthemoides monilifera* ssp *rotundata* is uncommon, occurring under established trees, from which it is likely birds dropped seeds.

The ground cover is generally exotic however indigenous species also occur, especially near the margin with intact paperbark forest in the subject property. Species include: *Selaginella uliginosa*, *Paspalidium* sp., *Pteridium esculentum* (Bracken Fern), *Pultenaea retusa*, *Glochidion ferdinandi*, *Kennedia rubicunda* (Dusky Coral Pea) and *Adiantum aethiopicum* (Maidenhair Fern).

## Initial Assessment

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### 3.1 Identifying Subject Species

This chapter includes a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action.

#### **3.1.1 Assessment of available information**

Database analyses and a review of the current literature for records of threatened species occurring within the locality were examined to assess the likelihood of threatened species occurring in the habitats present in the study area. The NSW Government's BioNet database {NSW Government 2007} the Atlas of NSW Wildlife {DEC (NSW) 2007}, the EPBC Protected Matters search tool {DEWR 2007} and the Birds Australia database{Bird Australia 2007} were used to identify threatened flora and fauna species that had been recorded in the Port Stephens LGA and within 5km of the subject site.. The BioNet database accesses collections and data from the Australian Museum, the Department of Environment and Conservation (National Parks and Wildlife Service and the Royal Botanical Gardens), and the Department of Primary Industries (NSW State Forests and NSW Fisheries). Consideration is also given to those threatened species listed in the DGRs but not recorded within the locality.

Figure 3.1 shows the location of threatened species occurring within a 5km radius of the site {DEC (NSW) 2007}. The following tables (Tables 3.1 - 3.3) provide analyses of all species recorded in the database searches and consider whether these should be included as subject species. Species have been included as subject species if they are known to occur within the study area or are considered likely or possible to occur in the locality based on known distribution and provision of suitable habitat. Note that the SIS approach to the list of subject species is precautionary, so that species that are considered to have some chance of occurrence within the study area are not discarded from consideration.

### 3.1.2 Endangered Populations

The following populations occur in either the Port Stephens LGA or Hunter Catchment, in which the study area lies, but are not considered as subject populations for the reasons given below:

- *Eucalyptus camaldulensis* in the Hunter Catchment. The most easterly record is at Hinton on the banks of the Hunter River and no suitable habitat occurs in the study area;
- *Cymbidium canaliculatum* R. Br. is listed in the Hunter Valley but the species most commonly occurs in White Box Woodlands but also woodlands dominated by *E. dawsoni*, *E. crebra*, *E. moluccana*, *Angophora floribunda* and *Acacia salicina*. Therefore the study area is not considered to provide suitable habitat for the population; and
- *Acacia pendula* in the Hunter Catchment but it has only been recorded in the LGAs of Mid-Western Regional, Muswellbrook, Singleton and Upper Hunter and only as far east as Warkworth.

The Emu population in the NSW North Coast bioregion and Port Stephens LGA is considered a subject population. Despite limited recent records in the locality, there is suitable habitat for the species in the study area.

### 3.1.3 Endangered Ecological Communities

A number of endangered ecological communities occur in the Sydney Basin bioregion (refer to Table 3.4). Characteristics of these communities such as distribution, composition and other distinguishing features listed in the final and preliminary determinations have been analysed to determine if any of the vegetation communities recorded on the subject land can be included in any endangered ecological community. Any listed ecological communities that were not recorded from the Hunter area were not considered in this assessment. Table 3.4 shows the characteristics of these communities that were used to determine the subject communities.

There are six communities that occur in the study area that conform to four endangered ecological communities. These are:

- Broad-leaved Paperbark Open Forest which conforms to Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;

- Swamp Oak Forest and Disturbed Swamp Oak Forest which conform to Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- Saltmarsh Complex and Disturbed Saltmarsh Complex which conform to Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions; and
- Striped Ribbongrass – Bare Twig-rush Sedgeland which conforms to Freshwater Wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

The Broad-leaved Paperbark Open Forest mapped in the study area is similar to River-flat Eucalypt Forest because it contains *Eucalyptus tereticornis* but does not conform to the EEC because of the dominance of *E. robusta* and *Melaleuca quinquenervia* in the community in the study area. Paragraph 6 of the final determination for River-flat Eucalypt Forest describes the EEC as being characterised by the relatively low abundance of *M. quinquenervia*, *Casuarina glauca* and *E. robusta* (NSW Scientific Committee 2004) therefore River-flat Eucalypt Forest is not considered to occur in the study area.

The species compositions of the communities present on site are not consistent with Littoral Rainforest, Lowland Rainforest, *Themeda australis* grassland on seacliffs and coastal headlands, Montane peatlands and swamps, or Hunter Lowland Redgum Forest, nor is the habitat present suitable for Littoral Rainforest, *Themeda australis* grassland on seacliffs and coastal headlands, or Montane peatlands and swamps. Hunter Valley Weeping Myall Woodland, Warkworth Sand Woodland and Kurri Sand Swamp Woodland each have restricted distributions outside the locality. Therefore none of these communities occurs in the study area.

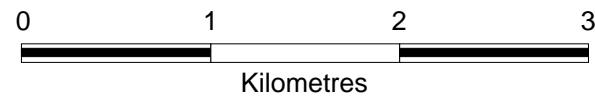
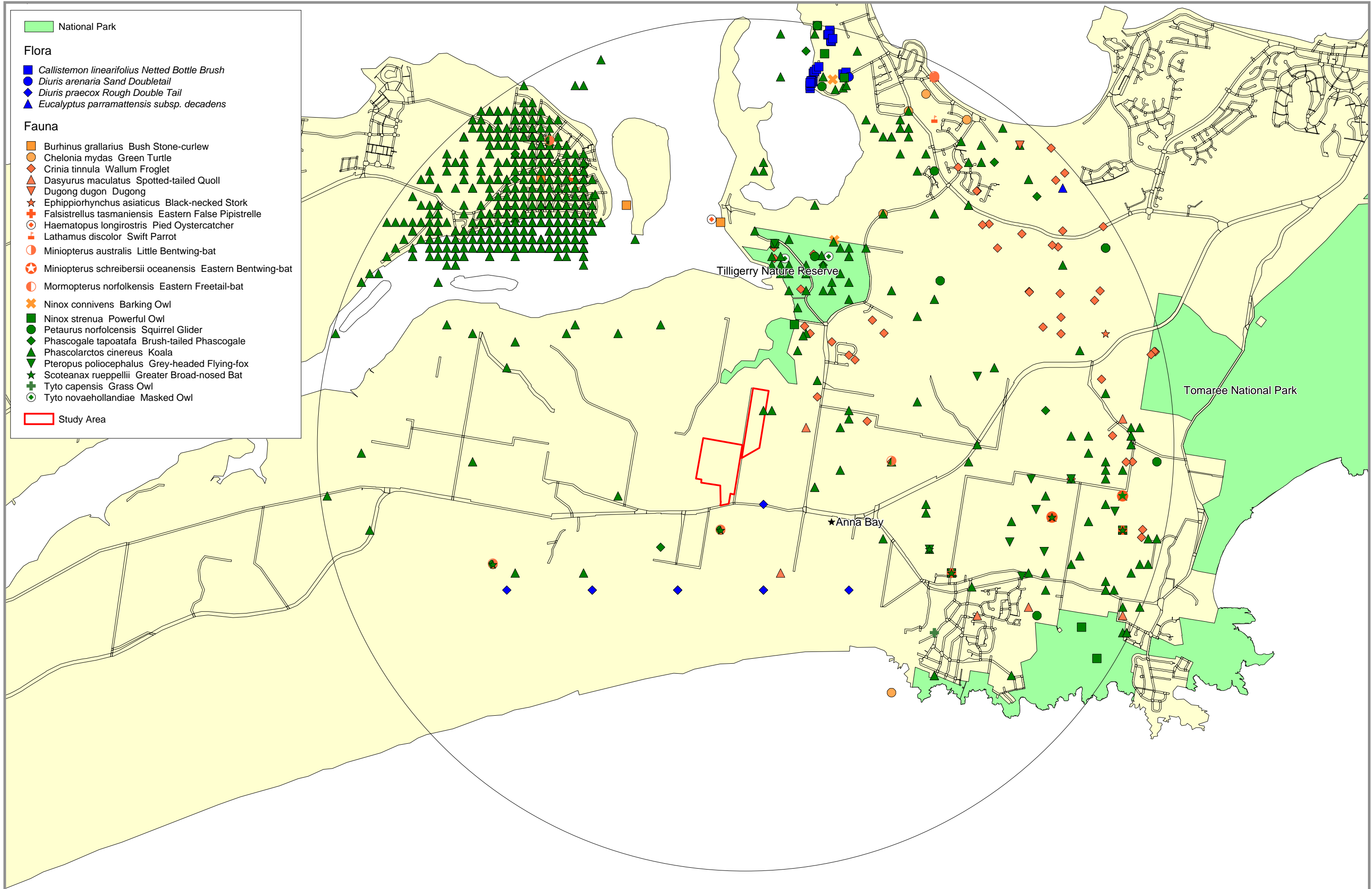


Figure 3.1 DEC threatened species records in the locality

**Table 3.1 ANALYSIS OF THREATENED FLORA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	RBG Count	Recorded within 5km?	Listed in DGRs?	Habitat Requirements	Likelihood of Occurrence	Subject Species?
Elaeocarpaceae	<i>Tetratheca juncea</i>	Black-eyed Susan	V	V	13	2	No	No	Occurs in sandy, occasionally swampy heath and dry sclerophyll forest.	No suitable habitat, not likely to occur	No
Euphorbiaceae	<i>Chamaesyce psammogeton</i>	Sand Spurge	E1		3		No	No	Occurs on foredunes and exposed sites on headlands.	No suitable habitat, not likely to occur	No
Juncaginaceae	<i>Maundia triglochinooides</i>	Small Water-ribbons	V			1	No	Yes	Occurs in swamps or shallow fresh water on clay.	Could potentially occur on subject land and in study area	Yes
Lamiaceae	<i>Prostanthera densa</i>	Villous Mint-bush	V	V	12	3	No	No	Generally found on sandstone in sclerophyll forest and shrubland on coastal headlands	No suitable habitat, not likely to occur	No
Myrtaceae	<i>Angophora inopina</i>	Charmhaven Apple	V	V	6		No	No	Open dry sclerophyll <i>Eucalyptus haemastoma</i> and <i>Corymbia gummifera</i> woodland with a dense shrub understorey.	No suitable habitat, not likely to occur	No

**Table 3.1 ANALYSIS OF THREATENED FLORA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	RBG Count	Recorded within 5km?	Listed in DGRs?	Habitat Requirements	Likelihood of Occurrence	Subject Species?
Elaeocarpaceae	<i>Tetratheca juncea</i>	Black-eyed Susan	V	V	13	2	No	No	Occurs in sandy, occasionally swampy heath and dry sclerophyll forest.	No suitable habitat, not likely to occur	No
Myrtaceae	<i>Callistemon linearifolius</i>	Netted Bottle Brush	V		50	1	Yes	Yes	Dry sclerophyll forest on the coast and adjacent ranges	No suitable habitat, not likely to occur	No
Myrtaceae	<i>Eucalyptus camfieldii</i>	Heart-leaved Stringybark	V	V	2	2	No	No	Occurs in shallow sandy soils overlying Hawkesbury sandstone in coastal heath or near the boundary of tall coastal heaths and low open woodland in more fertile areas.	No suitable habitat, not likely to occur	No
Myrtaceae	<i>Eucalyptus glaucina</i>	Slaty Red Gum	V	V	1	6	No	No	Dry eucalypt forest on deep, moderately fertile and well-watered soils	No suitable habitat, not likely to occur	No
Myrtaceae	<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>		V	V	27		Yes	Yes	Occurs in dry sclerophyll woodland on sandy soils in low, often wet sites.	No suitable habitat, not likely to occur	No

**Table 3.1 ANALYSIS OF THREATENED FLORA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	RBG Count	Recorded within 5km?	Listed in DGRs?	Habitat Requirements	Likelihood of Occurrence	Subject Species?
Elaeocarpaceae	<i>Tetratheca juncea</i>	Black-eyed Susan	V	V	13	2	No	No	Occurs in sandy, occasionally swampy heath and dry sclerophyll forest.	No suitable habitat, not likely to occur	No
Myrtaceae	<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V		1	No	Yes	Occurs in damp places, often near streams.	Could potentially occur on subject land and in study area	Yes
Myrtaceae	<i>Melaleuca groveana</i>	Grove's Paperbark	V		8		No	No	Occurs in heath, often in exposed sites, restricted to higher areas.	No suitable habitat, not likely to occur	No
Orchidaceae	<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	2		No	Yes	Occurs in a range of habitats from swamp heath to woodland.	Could potentially occur on subject land and in study area	Yes
Orchidaceae	<i>Diuris arenaria</i>	Sand Doubletail	E1		37		Yes	Yes	Coastal heath and dry grassy eucalypt forest on sandy flats or clay soil	No suitable habitat, not likely to occur	No
Orchidaceae	<i>Diuris praecox</i>	Rough Double Tail	V	V	13	1	Yes	Yes	Hills and slopes of near-coastal districts in Open	No suitable habitat, not likely	No

**Table 3.1 ANALYSIS OF THREATENED FLORA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	RBG Count	Recorded within 5km?	Listed in DGRs?	Habitat Requirements	Likelihood of Occurrence	Subject Species?
Elaeocarpaceae	<i>Tetratheca juncea</i>	Black-eyed Susan	V	V	13	2	No	No	Occurs in sandy, occasionally swampy heath and dry sclerophyll forest. Forests which have a grassy to fairly dense understorey	No suitable habitat, not likely to occur	No
Polygonaceae	<i>Persicaria elatior</i>	Tall Knot-weed	V	V		2	No	Yes	Grows in damp places besides streams and lakes. Occasionally occurs in swamp forest or associated with disturbance.	Could potentially occur on subject land and in study area	Yes
Proteaceae	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V		4		No	No	Range of vegetation types on sandy or light clay soils, often in open, slightly disturbed sites	Could potentially occur on subject land and in study area	Yes
Rubiaceae	<i>Asperula asthenes</i>	Trailing Woodruff	V	V			No	Yes	Occurs in damp sites, often along river banks.	Could potentially occur on subject land and in study area	Yes

**Table 3.1 ANALYSIS OF THREATENED FLORA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	RBG Count	Recorded within 5km?	Listed in DGRs?	Habitat Requirements	Likelihood of Occurrence	Subject Species?
Elaeocarpaceae	<i>Tetratheca juncea</i>	Black-eyed Susan	V	V	13	2	No	No	Occurs in sandy, occasionally swampy heath and dry sclerophyll forest.	No suitable habitat, not likely to occur	No
Scrophulariaceae	<i>Lindernia alsinoides</i>	Noah's False Chickweed	E1				No	Yes	Occurs on swampy sites in sclerophyll forest and coastal heath.	Could potentially occur on subject land and in study area	Yes
Sterculiaceae	<i>Rulingia prostrata</i>	Dwarf Kerrawang	E1	E	3	3	No	No	Occurs on sandy, sometimes peaty soils in a variety of habitats. Nearest known habitat is Scribbly Gum/Swamp Mahogany Ecotonal Forest at Tomago.	Potential habitat does occur but species is only known from very few sites	No

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
<b>Amphibia</b>											
Hylidae	<i>Litoria aurea</i>	Green and Golden Bell Frog	E1	V	0		No	Yes	Freshwater marshes, dams or stream sides containing vegetation such as bullrushes or spikerushes.	Majority of wetland areas are too saline. However, marginal habitat occurs in the study area	Yes
Myobatrachidae	<i>Crinia tinnula</i>	Wallum Froglet	V		31		Yes	Yes	Occurs in acid paperbark swamps.	Majority of wetland areas are too saline. However could potentially occur on the subject land and in the study area	Yes
<b>Aves*</b>											

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Acanthizidae	<i>Pyrrholaemus saggitatus</i>	Speckled Warbler	V		1		No	No	Occurs in timbered woodland with grassy understorey. Usually occurs west of Great Dividing Range and not near the coast.	No suitable habitat in study area	No
Accipitridae	<i>Heliaeetus leucogaster</i>	White-bellied Sea Eagle		M			Yes (BA)	No	Usually coastal, foreshores, mudflats, sand-pits, headlands, beaches, bays, mangroves, seasonally flooded inland swamps, lagoons and floodplains.	Marginal habitat occurs in the study area	Yes
Accipitridae	<i>Pandion haliaetus</i>	Osprey	V	M	6		Yes (BA)	Yes	Occurs along coast and offshore islands.	Could potentially nest in study area	Yes

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Anatidae	<i>Oxyura australis</i>	Blue-billed Duck	V		1		No	No	Occurs in deep, permanent, well-vegetated freshwater swamps with cumbungi.	No suitable habitat in study area	No
Anatidae	<i>Stictonetta naevosa</i>	Freckled Duck	V		1		No	No	Disperses from Bulloo and Lake Eyre basins and Murray-Darling System as far as coastal NSW in severe drought. Prefers permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree.	No suitable habitat in study area	No

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Anseranatidae	<i>Anseranas semipalmata</i>	Magpie Goose	V		14		No	Yes	Forages in and breeds near swamps generally within 80km of the coast.	Only a vagrant to region, nearest records from Hexham Swamp and Seaham, last recorded in 2000. Not likely to occurs.	No
Apodidae	<i>Hirundapus caudactus</i>	White-throated Needletail		M			Yes (BA)	No	Almost exclusively aerial. Could fly over site but unlikely to utilise habitat	No	No
Ardeidae	<i>Botaurus poiciloptilus</i>	Australasian Bittern	V		4		No	Yes	Occurs in temperate and subtropical swamps.	Could potentially occur on the subject land and in the study area	Yes
Ardeidae	<i>Egretta sacra</i>	Eastern Reef Egret		M			Yes (BA)	No	Occurs on foredunes and exposed sites on headlands.	No suitable habitat, not likely to occur	No

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Ardeidae	<i>Ixobrychus flavicollis</i>	Black Bittern	V		1		No	Yes	Occurs in short marshy vegetation and along creeks.	Could potentially occur on the subject land and in the study area	Yes
Burhinidae	<i>Burhinus grallarius</i>	Bush Stone-curlew	E1		5		Yes	No	Occurs in grassy woodland with sparse grassy groundlayer and fallen timber	Could potentially occur on the subject land and in the study area	Yes
Burhinidae	<i>Esacus neglectus</i>	Beach Stone-curlew	E1					Yes	Occurs on open, undisturbed beaches, islands, reefs, estuarine intertidal sandflats and mudflats, prefers beaches with estuaries or mangroves nearby.	Rare vagrant, study area contains marginal potential habitat	No

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Cacatuidae	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V		2		No	No	Occurs in tall mountain forests and woodlands, especially heavily timbered and mature wet sclerophyll forests. May come into drier forests in winter. Nests in tree hollows.	Only marginal habitat available, not likely to occur	No
Cacatuidae	<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V		19		Yes	Yes	Occurs in temperate rainforest, coastal woodland and open inland woodland where Casuarina species are common.	Could potentially occur on the subject land and in the study area	Yes

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Charadriidae	<i>Charadrius leschenaulti</i>	Greater Sand-plover	V				No	Yes	Occurs on sheltered sandy shelly or muddy beaches or estuaries with large intertidal mudflats or sand banks. Roosts during high tide on sandy beaches and rocky shores.	Could potentially occur in the study area	Yes
Charadriidae	<i>Charadrius mongolus</i>	Lesser Sand-plover	V		1		No	Yes	Occurs on tidal sand and mudflats in bays, inlets and estuaries.	Could potentially occur in the study area	Yes
Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E1		50		Yes	Yes	Occurs in lakes, swamps, fresh-water pools and mangroves.	Could potentially occur on the subject land and in the study area	Yes
Climacteridae	<i>Climacteris picumnus</i>	Brown Treecreeper	V		2		No	No	Occurs in open eucalypt woodland.	No suitable habitat in study area	No

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Columbidae	<i>Ptilinopus magnificus</i>	Wompoo Fruit-Dove	V		3		No	No	Occurs in lowland and adjacent highland rainforest.	Could potentially occur on the subject land and in the study area	Yes
Columbidae	<i>Ptilinopus regina</i>	Rose-crowned Fruit-dove	V				No	Yes	Occurs in subtropical and dry rainforest, occasionally in moist eucalypt or swamp forest where fruit is plentiful.	Could potentially occur on the subject land and in the study area	Yes
Columbidae	<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V		1		No	No	Occurs in rainforests and similar closed forests. May also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	Could potentially occur on the subject land and in the study area	Yes
Diomededidae	<i>Thalassarche melanophrys</i>	Black-browed Albatross	V				Yes (BA)		Inhabits marine waters spending most of its time at sea. Breeds in	No potential habitat occurs in the study area	No

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
									colonies on isolated islands.		
Haematopodidae	<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V		10		Yes	Yes	Found on rocky shores, beaches and estuaries.	No suitable habitat in study area	No
Haematopodidae	<i>Haematopus longirostris</i>	Pied Oystercatcher	V		9		Yes	Yes	Occurs on ocean beaches and estuaries.	No suitable habitat in study area	No
Jacaniidae	<i>Irediparra gallinacea</i>	Comb-crested Jacana	V		2		No	Yes	Occurs on the edges of freshwater pools.	No suitable habitat in study area	No
Laridae	<i>Stercorarius parasiticus</i>	Arctic Jaeger, Arctic Skua		M			Yes (BA)	No	Inshore waters, bays, harbours and inlets, singly or in small groups	No suitable habitat, not likely to occur	No

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Laridae	<i>Sterna albifrons</i>	Little Tern	E	M			Yes (BA)		Breeds in low dunes, sandy beaches, mouths of estuaries. Forages in shallow estuary waters or coastal lagoons	Potential foraging habitat exists in study area outside of subject site	Yes
Meliphagidae	<i>Xanthomyza phrygia</i>	Regent Honeyeater	E1	E	2		No	No	Occurs in forest and woodland.	Could potentially occur on the subject land and in the study area	Yes
Pomatostomidae	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V		11		No	No	Occurs in dry, open woodland.	No suitable habitat in study area	No
Procellariidae	<i>Puffinus pacificus</i>	Wedge-tailed Shearwater		M			Yes (BA)	No	Marine, pelagic, in tropical and sub-tropical waters	No suitable habitat, not likely to occur	No

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Procellariidae	<i>Puffinus tenuirostris</i>	Short-tailed Shearwater		M			Yes (BA)	No	Marine, pelagic, mainly over continental shelf waters, both inshore and offshore during the breeding season	No suitable habitat, not likely to occur	No
Psittacidae	<i>Lathamus discolor</i>	Swift Parrot	E1	E, OMA	22		Yes	Yes	Occurs in timbered country with flowering trees. Breeds in Tasmania.	Could potentially occur on the subject land and in the study area	Yes
Psittacidae	<i>Neophema pulchella</i>	Turquoise Parrot	V		3		No	Yes	Occurs in Open Forest and timbered grass lands.	No suitable habitat in study area	No
Rostratulidae	<i>Rostratula benghalensis</i>	Painted Snipe	E1	M, OMA			No	Yes	Occurs at fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	Only marginal habitat available, not likely to occur	No

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Scolopacidae	<i>Calidris alba</i>	Sanderling	V	M			No	Yes	Occurs in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open soil.	Could potentially occur in the study area	Yes
Scolopacidae	<i>Calidris tenuirostris</i>	Great Knot	V	M			No	Yes	Occurs within sheltered, coastal habitats with large intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons.	Could potentially occur in the study area	Yes
Scolopacidae	<i>Limicola falcinellus</i>	Broad-billed Sandpiper	V	M			No	Yes	Uses sheltered parts of the coast including estuarine sandflats, mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding	Could potentially occur in the study area	Yes

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
									and roosting habitat.		
Scolopacidae	<i>Limosa limosa</i>	Black-tailed Godwit	V				No	Yes	Occurs on coastal and bayside mudflats, estuaries and swamps, and inland swamps and lakes.	Could potentially occur in the study area	Yes
Scolopacidae	<i>Calidris canutus</i>	Red Knot		M			Yes (BA)	No	Forages in sheltered inlets of coastal estuaries, intertidal mudflats, sandflats.	No suitable habitat, not likely to occur	No

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Scolopacidae	<i>Gallinago hardwickii</i>	Latham's Snipe		M			Yes (BA)	No	Freshwater wetlands. Inland, upland and Coastal Plains. Soft moist ground or shallow flooded areas	suitable habitat present on site	Yes
Scolopacidae	<i>Limosa lapponica</i>	Bar-tailed Godwit		M			Yes (BA)	No	Mainly coastal, usually sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats.	No suitable habitat, not likely to occur	No
Scolopacidae	<i>Numenius madagascariensis</i>	Eastern Curlew		M			Yes (BA)	No	Estuaries, tidal mudflats, sandspits, saltmarshes, mangroves, open grasslands near water and occasionally fresh or brackish lakes, singly or in small flocks	Potential habitat occurs in the study area	Yes

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Scolopacidae	<i>Numenius phaeopus</i>	Whimbrel		M			Yes (BA)	No	Intertidal coastal mudflats, river deltas and mangroves, occasionally sandy beaches	Potential habitat occurs in the study area	Yes
Scolopacidae	<i>Xenus cinereus</i>	Terek Sandpiper	V	M			No	Yes	Occurs on muddy beaches, near mangroves, also rocky pools and coral reefs, occasionally up to 10km inland around brackish pools.	Could potentially occur in the study area	Yes
Strigidae	<i>Ninox connivens</i>	Barking Owl	V		4		Yes	Yes	Occurs in forest and woodland with hollows for breeding and cleared areas for hunting.	Potential foraging habitat exists in study area	Yes

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Strigidae	<i>Ninox strenua</i>	Powerful Owl	V		31		Yes	Yes	Occurs in dense forest, usually wet sclerophyll. Nests in hollows 15m above ground.	Potential foraging habitat exists in study area	Yes
Turnicidae	<i>Turnix maculosa</i>	Red-backed Button-quail	V				No	Yes	Occurs in grasslands, woodlands and cropped lands. Prefers sites near water including grasslands and sedgeland near creeks, swamps, springs and wetlands.	Could potentially occur on the subject land and in the study area	Yes
Tytonidae	<i>Tyto capensis</i>	Grass Owl	V		3		Yes	Yes	Occurs in tall tussock grass or sedges.	Could potentially occur on the subject land and in the study area	Yes

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Tytonidae	<i>Tyto novaehollandiae</i>	Masked Owl	V		18		Yes	Yes	Occurs in forest, savannah woodland or treeless areas with caves.	Potential foraging habitat exists in study area	Yes
<b>Mammalia</b>											
Burramyidae	<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V		1		No	Yes	Occurs in wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath.	Could potentially occur on the subject land and in the study area	Yes
Dasyuridae	<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	38	2	Yes	Yes	Occurs in dry sclerophyll forest and monsoonal forest and woodland. Dens in tree hollows, hollow logs or rock crevices.	Could potentially occur on the subject land and in the study area	Yes

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Dasyuridae	<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V		56	2	Yes	Yes	Occurs in rainforest, wet and dry sclerophyll forest, coastal heath and scrub.	Could potentially occur on the subject land and in the study area	Yes
Petauridae	<i>Petaurus australis</i>	Yellow-bellied Glider	V		1		No	No	Occurs in wet and damp sclerophyll forest.	Could potentially occur on the subject land and in the study area	Yes
Petauridae	<i>Petaurus norfolcensis</i>	Squirrel Glider	V		75	2	Yes	Yes	Occurs in damp coastal eucalypt banksia forest and woodland.	Could potentially occur on the subject land and in the study area	Yes
Phascolarctidae	<i>Phascolarctos cinereus</i>	Koala	V		4748	1	Yes	Yes	Occurs in sclerophyll forest and woodland.	Could potentially occur on the subject land and in the study area	Yes
Potoroidae	<i>Potorous tridactylus</i>	Long-nosed Potoroo	V	V	1		No	No	Occurs in rainforest, adjacent wet sclerophyll forest and coastal wallum.	Could potentially occur on the subject land and in the study area	Yes

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Pteropodidae	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	29		Yes	No	Roosts in camps usually in dense forest in gullies.	Potential foraging habitat exists in study area	Yes
Vespertilionidae	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	1		No	No	Roosts in caves, crevices in cliffs, old mines and disused Fairy Martin nests. Forages in dry Open Forest and woodland.	Potential foraging habitat exists in study area	Yes
Vespertilionidae	<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		6		Yes	Yes	Occurs in sclerophyll forests from coast to dividing range. Roosts in hollow eucalypt trunks but has been recorded in caves and old wooden buildings.	Could potentially occur on the subject land and in the study area	Yes

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Vespertilionidae	<i>Kerivoula papuensis</i>	Golden-tipped Bat	V		1		No		Occurs in dense vegetation, often close to creeklines. Roosts in abandoned nests of scrub wrens and warblers, tree hollows and dense vegetation.	Could potentially occur on the subject land and in the study area	Yes
Vespertilionidae	<i>Miniopterus australis</i>	Little Bentwing-bat	V		53	3	Yes	Yes	Occurs in lowland rainforest, wet and dry sclerophyll forest, paperbark swamps. Roosts in caves and mine tunnels.	Potential foraging habitat exists in study area	Yes
Vespertilionidae	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V		18		Yes	Yes	Roosts in caves, old mines, road culverts.	Potential foraging habitat exists in study area	Yes

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Vespertilionidae	<i>Myotis adversus</i>	Large-footed Myotis	V		7	1	No	Yes	Occurs close to water including creeks, lakes and estuaries. Roosts in caves, mine shafts, culverts, dense foliage and tree hollows.	Could potentially occur on the subject land and in the study area	Yes
Vespertilionidae	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V		34	1	Yes	Yes	Occurs in tall, wet forest, drier forest along gullies. Roosts in tree hollows.	Could potentially occur on the subject land and in the study area	Yes
Vespertilionidae	<i>Vespadelus trougtoni</i>	Eastern Cave Bat	V				No	No	Usually found in dry Open Forest and woodland, near cliffs or rocky overhangs.	Could potentially occur on the subject land and in the study area	Yes
Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V		1		No	Yes	Occurs in wet and dry sclerophyll forest, open woodland, <i>Acacia</i> shrubland, mallee, grasslands	Could potentially occur on the subject land and in the study area	Yes

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
									and desert.		
Molossidae	<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V		9		No	Yes	Occurs in dry and wet sclerophyll forest, coastal woodland. Roosts in tree hollows.	Could potentially occur on the subject land and in the study area	Yes
<b>Reptilia</b>											
Elapidae	<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake	V					Yes	Occurs in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest. Shelters in the day under loose bark or	Could potentially occur on the subject land and in the study area	Yes

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
									in tree hollows.		
Elapidae	<i>Hoplocephalus stephensii</i>	Stephens Banded Snake	V					Yes	Occurs in wet sclerophyll or rainforest.	Could potentially occur on the subject land and in the study area	Yes
<b>Fish</b>											
Odontaspidae	<i>Carcharias taurus</i>	Grey Nurse sharks	FE	CE	1				Occurs in subtropical to cool temperate waters from southern Queensland to southern NSW.	No suitable habitat in study area	No

**Table 3.2 ANALYSIS OF THREATENED FAUNA RECORDED FROM PORT STEPHENS LGA (ATLAS OF NSW WILDLIFE, BIONET) OR LISTED IN THE DGRS FOR SUBJECT SPECIES FOR LIKELIHOOD OF OCCURRENCE**

Family	Scientific Name	Common Name	TSC Status	EPBC Status	NPWS Count	AM Count	Recorded within 5km?	Listed in DGRS?	Habitat Requirements	Likelihood of Occurrence	Subject Species ?
Serranidae	<i>Epinephelus daemeli</i>	Black Cod	FV		1				Occurs in warm temperate and subtropical parts of the south-western Pacific.	No suitable habitat in study area	No

**Table 3.3 ANALYSIS OF ENDANGERED ECOLOGICAL COMMUNITIES FOR SUBJECT COMMUNITIES**

Name	TSC Status	Distribution	Elevation	Dominant species and Structure	Hydrology and Soil	Landforms	CRA/Forestry Commission equivalents	Recorded in Anna Bay area?	LHCCREMS equivalents	Mapped on subject land?	Listed in DGRs?	Subject community?
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and	Endangered	NSW North Coast, Sydney Basin and South East Corner bioregions	Generally below 50m but up to 250m above sea level	<i>Eucalyptus tereticornis</i> , <i>E. amplifolia</i> , <i>Angophora floribunda</i> , A.	Periodically inundated silts, clay-loams and sandy loams	Alluvial flats, drainage lines and river flats associated with coastal	47 Escarpment Red gums; 13 Central Hunter Riparian Forest; 14 Wollombi Red gum	No	Central Hunter Riparian Forest, Wollombi	No	No	No

**Table 3.3 ANALYSIS OF ENDANGERED ECOLOGICAL COMMUNITIES FOR SUBJECT COMMUNITIES**

Name	TSC Status	Distribution	Elevation	Dominant species and Structure	Hydrology and Soil	Landforms	CRA/Forestry Commission equivalents	Recorded in Anna Bay area?	LHCCREMS equivalents	Mapped on subject land?	Listed in DGRs?	Subject community?
South East Corner bioregions				<i>subvelutina</i> , <i>E. saligna</i> and <i>E. grandis</i> Tall <i>Open Forest</i> to woodlands		floodplains.	River oak Woodland; 38 Red gum Rough-barked Apple Swamp Forest		Redgum - River Oak Woodland, Redgum Roughbarked Apple Swamp Forest			
Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Endangered	Small floodplains or where larger floodplains adjoin lithic substrates or coastal sand plains in the NSW North Coast, Sydney Basin and South East Corner bioregions	Generally below 20m but up to 50m above sea level	<i>Eucalyptus robusta</i> , <i>Melaleuca quinquenervi</i> a Open Forest	Waterlogged or periodically inundated humic clay loams and sandy loams	Alluvial flats and drainage lines associated with coastal floodplains	112 Paperbark, 142 Swamp Mahogany	Yes	Swamp Mahogany - Paperbark Swamp Forest, Riparian Melaleuca Swamp Woodland, Melaleuca Scrub	Yes - Broad-leaved Paperbark Swamp Forest	Yes	Yes

**Table 3.3 ANALYSIS OF ENDANGERED ECOLOGICAL COMMUNITIES FOR SUBJECT COMMUNITIES**

Name	TSC Status	Distribution	Elevation	Dominant species and Structure	Hydrology and Soil	Landforms	CRA/Forestry Commission equivalents	Recorded in Anna Bay area?	LHCCREMS equivalents	Mapped on subject land?	Listed in DGRs?	Subject community?
Littoral rainforest in the NSW North Coast, Sydney Basin and South East corner bioregions	Endangered	Entire NSW Coast	Not specified.	Rainforest species. Scattered sclerophyll emergents may occur in some stands. Closed forest	Not specified. Sand dunes and soils derived from underlying rocks	Sand dunes, headlands, hind dunes or sites up to 2km inland or with a maritime influence.	25 Headland Brush Box	No	Not described	No	No	No
Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Endangered	NSW North Coast, Sydney Basin and South East Corner bioregions	Generally below 20m	Herbaceous amphibious and aquatic plants, few woody species. Sedgeland, reedlands to herb fields	Periodic or semi-permanent inundation by freshwater but there may be some minor saline influence. Silts, muds, humic loams	Depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains	Not described	Yes	Freshwater wetlands complex	Yes - Striped Ribbongrass - Bare Twig-rush Sedgeland	Yes	Yes
Swamp Oak	Endangered	NSW North	Generally	<i>Casuarina</i>	Water-logged	Flats, drainage	143 Swamp Oak	Yes	Swamp Oak -	Yes - Swamp	Yes	Yes

**Table 3.3 ANALYSIS OF ENDANGERED ECOLOGICAL COMMUNITIES FOR SUBJECT COMMUNITIES**

Name	TSC Status	Distribution	Elevation	Dominant species and Structure	Hydrology and Soil	Landforms	CRA/Forestry Commission equivalents	Recorded in Anna Bay area?	LHCCREMS equivalents	Mapped on subject land?	Listed in DGRs?	Subject community?
Floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions		Coast, Sydney Basin and South East Corner bioregions	below 20m (rarely above 10m) elevation	<i>glauca. Open Forests, low woodlands, scrubs or reedands with scattered trees</i>	or periodically inundated grey-black clay-loams and sandy loams where groundwater is saline or subsaline	lines, lake margins and estuarine fringes associated with coastal floodplains			Rushland Forest, Swamp Oak Sedge Forest	Oak Forest		
Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions	Preliminary listing as endangered	NSW North Coast and Sydney Basin bioregion	Up to 600m above sea level, limited to elevations below 350m in Sydney Basin	Subtropical rainforest and some dry rainforest species	Not specified. High-nutrient geological substrates, notably basalts and fine-grained sedimentary rocks	Coastal plains and plateau, footslopes and foothills	Not described but is included in Subtropical Rainforests class of Keith (2004) and <i>Argyrodendron trifoliolatum</i> and <i>Dendrocnide excelsa</i> - <i>Ficus</i> spp. Alliances of Floyd (1990)	No	Not described	No	No	No

**Table 3.3 ANALYSIS OF ENDANGERED ECOLOGICAL COMMUNITIES FOR SUBJECT COMMUNITIES**

Name	TSC Status	Distribution	Elevation	Dominant species and Structure	Hydrology and Soil	Landforms	CRA/Forestry Commission equivalents	Recorded in Anna Bay area?	LHCCEMS equivalents	Mapped on subject land?	Listed in DGRs?	Subject community?
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner bioregions	Endangered	Seacliffs and headlands of the NSW North Coast, Sydney Basin and South East Corner bioregions	Not specified.	<i>Themeda australis</i> . Closed tussock grassland, may be open shrubland or open heath	Not specified. Sand dunes, basalt headlands	Seacliffs and coastal headlands	Maritime Grasslands (Keith 2004)	No	Not described	No	No	No
Montane peatlands and swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	Endangered	Bioregions listed in determination	Above 400-500m	<i>Baeckea</i> , <i>Callistemon</i> and <i>Leptospermu</i> m species. Dense, open or sparse layer of shrubs with soft-leaved sedges,	Poorly drained flats at headwaters of streams. Accumulated peaty or organic sediments	Undulating tablelands and plateaus	Montane Bogs and Fens and Alpine Bogs and Fens (Keith 2004)	No	Not described	No	No	No

**Table 3.3 ANALYSIS OF ENDANGERED ECOLOGICAL COMMUNITIES FOR SUBJECT COMMUNITIES**

Name	TSC Status	Distribution	Elevation	Dominant species and Structure	Hydrology and Soil	Landforms	CRA/Forestry Commission equivalents	Recorded in Anna Bay area?	LHCCREMS equivalents	Mapped on subject land?	Listed in DGRs?	Subject community?
Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions	Endangered	NSW coast	Intertidal zone	grasses and forbs 10 species typically dominate according to latitude and period of inundation. Not specified	Intertidal. Not specified	Shores of estuaries and lagoons when intermittently closed	Not described	Yes	Not described	Yes - Saltmarsh complex	Yes	Yes
Hunter lowland redgum forest in the Sydney Basin and NSW North Coast bioregions	Endangered	Hunter Valley	Not specified.	<i>Eucalyptus tereticornis</i> , <i>E. punctata</i> . Open Forest	Not specified. Permian sediments	Gentle slopes arising from depressions and drainage flats	Not described	No	Hunter Lowland Redgum Forest	No	No	No
Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion	Endangered (+EPBC)	Hunter Valley (Muswellbrook and Singleton LGAs)	Valley floor	<i>Acacia pendula</i> , <i>Eucalyptus crebra</i> , <i>A. salicina</i>	Heavy clay soils on depositional landforms	Valley floor	Not described	No	Not recorded	No	No	No

**Table 3.3 ANALYSIS OF ENDANGERED ECOLOGICAL COMMUNITIES FOR SUBJECT COMMUNITIES**

Name	TSC Status	Distribution	Elevation	Dominant species and Structure	Hydrology and Soil	Landforms	CRA/Forestry Commission equivalents	Recorded in Anna Bay area?	LHCCREMS equivalents	Mapped on subject land?	Listed in DGRs?	Subject community?
Warkworth Sand woodland in the Sydney Basin Bioregion	Endangered	Singleton LGA, around Warkworth	Not specified.	Woodland <i>Angophora floribunda</i> and <i>Banksia integrifolia</i> woodland	Aeolian sand deposits	Sand dunes on a river terrace	Not described	No	Not described	No	No	No
Kurri Sand Swamp Woodland in the Sydney Basin Bioregion	Endangered	Cessnock LGA	Not specified.	<i>Eucalyptus parramattensis</i> ssp <i>decadens</i> , <i>Angophora bakeri</i> low woodland	Poorly-drained Tertiary sand deposits	Not specified	Not described	No	Kurri Sand Swamp Woodland	No	No	No

## Detailed Investigations

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### 4.1 Requirement to Survey

This chapter provides an outline of the surveys that have been conducted on the subject land and in the study area, as well as the results of these surveys.

Flora and fauna survey work was conducted in the study area for the purposes of the SIS during spring of 2007. This SIS also relies on data included in the Ecological Assessment by HWR Ecological collected during field survey work in February 2003 and February 2005{HWR Ecological 2005}.

Surveys were conducted by suitably qualified personnel, and specialist biologists took part in the investigations for plant species, endangered ecological communities, bats, birds, frogs, reptiles and mammals.

Surveys were undertaken at an appropriate time of the year to locate subject species and the weather conditions during the survey period were favourable for the detection of most species. Surveys were conducted across a range of habitat types, stratified to a level satisfactory with DECC Threatened Species Survey Assessment Guidelines. Methods are described in the following sections.

### 4.2 Description of survey techniques and survey sites

#### 4.2.1 *Flora Investigation*

##### *i. General Flora Field Surveys*

Flora field surveys for the SIS were conducted 12<sup>th</sup> of September and the 4<sup>th</sup>, 5<sup>th</sup>, 10<sup>th</sup>, and 15<sup>th</sup> of October, 2007 within the study area in order to identify flora species occurring in the study area, ground-truth vegetation community boundaries previously mapped by LHCCREMS and HWR Ecological and to determine the presence of threatened flora species on the subject site.

Initially the site was inspected briefly in order to obtain an overview of the nature, distribution and variation of plant communities in the study area. Subsequently, locations that were typical of each vegetation type, or showed variation within the broader community, were chosen for quadrat survey. A total of 22 20x20m quadrats were surveyed throughout the study area. Locations of quadrats are shown in Figure 4.1.

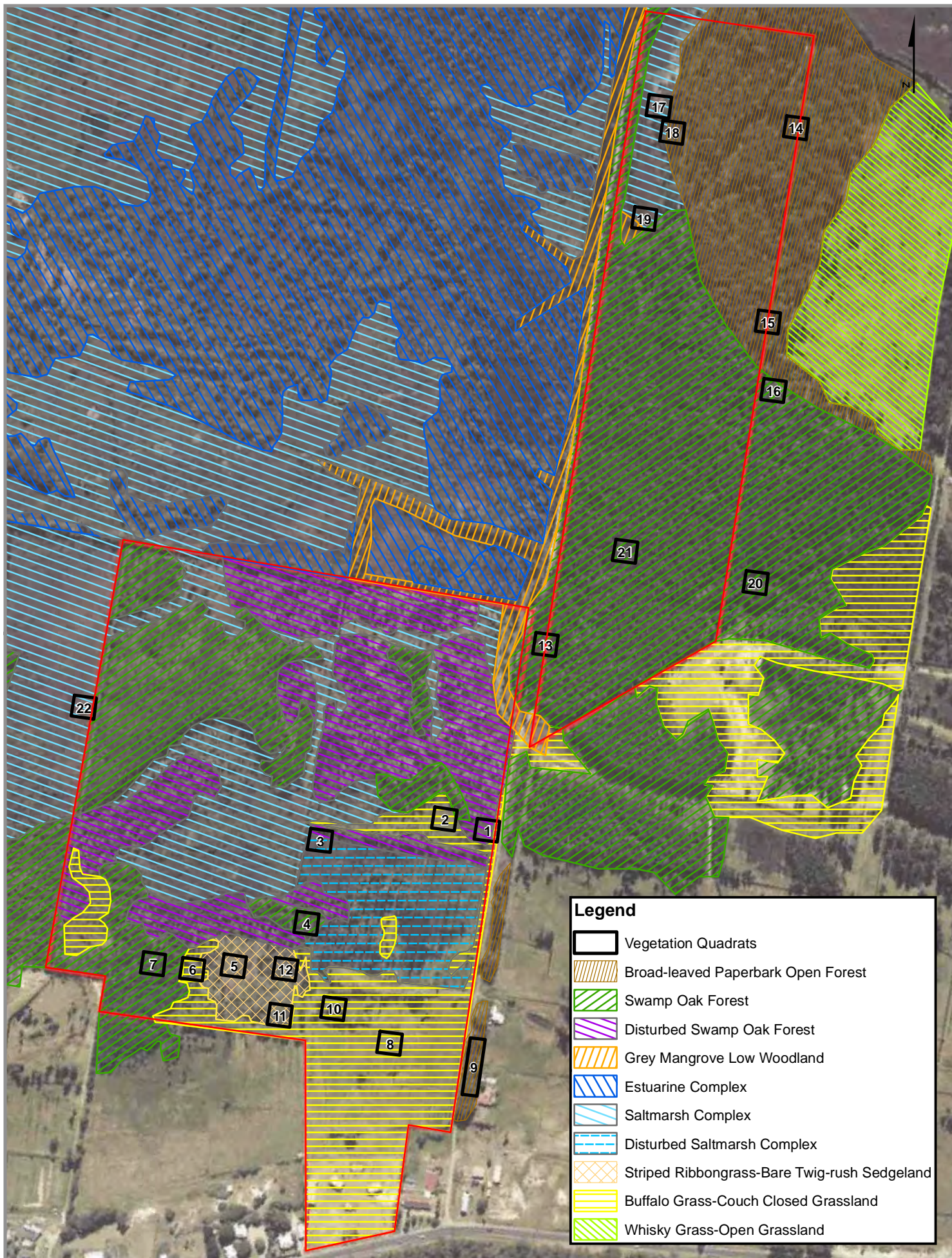
Within each quadrat all vascular plants present were recorded and estimations were made of the relative abundance of species. Plant specimens that were not easily identified in the field were collected and identified using Harden (Harden 1990-1993). A modified form of the Braun-Blanquet cover-abundance rating is used for estimating crown cover and projected foliage cover {Murray, Bell, et al. 2002}.

Three transects were surveyed in addition to the 22 quadrats. Transects were approximately 100 metres in length and meandered within each vegetation community around quadrats.

Besides cover-abundance data, information recorded in the quadrats and transects included notes regarding details of dominant species, vegetation structure, condition and viability of bushland, and miscellaneous details.

Plant communities were described based on the dominant canopy species and community structure, according to Specht {Specht 1970}. Plant species nomenclature conforms to Harden {Harden 1990 -1993}, except for the more recent revision of *Omalanthus populifolius* to *O. nutans*.

The potential conservation significance of communities and species is based on the schedules of the TSC Act and EPBC Act, Briggs & Leigh {Briggs & Leigh 1995} and NPWS {NSW NPWS 2000}. The potential significance is then considered according to other factors to obtain a value that more accurately reflected the likely contribution to conservation of the community or species generally.



**Legend**

- Vegetation Quadrats
- Broad-leaved Paperbark Open Forest
- Swamp Oak Forest
- Disturbed Swamp Oak Forest
- Grey Mangrove Low Woodland
- Estuarine Complex
- Saltmarsh Complex
- Disturbed Saltmarsh Complex
- Striped Ribbongrass-Bare Twig-rush Sedgeland
- Buffalo Grass-Couch Closed Grassland
- Whisky Grass-Open Grassland

Figure 4.1 Flora Survey Quadrat Locations

ii. *Threatened Flora Species Survey*

Targeted surveys were conducted on the 12<sup>th</sup> of September and the 4<sup>th</sup>, 5<sup>th</sup>, 10<sup>th</sup> and 15<sup>th</sup> of October, 2007 for a range of threatened plant species. Where possible, surveys occurred during anticipated flowering period of the different species. Targeted searches were conducted within potential habitat for individual plants or populations of the subject flora species listed in Table 3.1. Further surveys for threatened flora identified as potential subject species were conducted during the quadrat and transect surveys, as well as during other time spent in the study area.

Table 4.1 summarises the flora survey techniques and locations used by HWR Ecological and Cumberland Ecology.

**Table 4.1 FLORA SURVEY TECHNIQUES AND LOCATIONS**

Survey	Technique	Survey Sites
HWR Ecological (2003 and 2004)	Preliminary Haphazard Searches	5 transects – location not specified
HWR Ecological (2003 and 2004)	Descriptive Quadrats	8 quadrats – location not specified (although report indicates at least 2 in every vegetation community)
HWR Ecological (2003 and 2004)	Intensive quadrats	6 quadrats – location not specified (although report indicates at least 2 in every vegetation community)
HWR Ecological (2003 and 2004)	Targeted Transects	3 transects – location not specified (although report indicates at least 2 in every vegetation community)
HWR Ecological (2003 and 2004)	Transects – flora community edge definition	Edges of communities (not specified)
HWR Ecological (2003 and 2004)	Intensive targeted searches	Throughout subject site (not specified)
Cumberland Ecology (2007)	Quadrat survey	Assigned locations within each vegetation community on the subject land. See Figure 4.1.
Cumberland Ecology (2007)	Transect survey	Swamp Oak Open Forest, Broad-leaved Paperbark Open Forest.
Cumberland Ecology (2007)	Targeted threatened flora searches	Within all native vegetation including Swamp Oak Forest, Saltmarsh and Broad-leaved Paperbark Open Forest communities.
Cumberland Ecology (2007)	Vegetation Mapping	Throughout subject area, and part of the locality

## 4.2.2 Fauna Survey

### i. General Fauna Surveys

Refer to Figure 4.2 for fauna survey locations.

#### a. Trapping

A number of trapping grids were established in the study area by staff from Cumberland Ecology. Four trapping grids were set out within the three treed communities: Paperbark, Swamp Oak and Disturbed Swamp Oak Forest. Trapping was carried out from 15<sup>th</sup> to 19<sup>th</sup> October 2007.

One row of ten trap points were set out in each survey location (see Figure 4.2), with traps set approximately 10-15m apart depending on available habitat. Each trap point included an Elliott Type B trap placed on a platform at a height of approximately 1.5m in a tree and hair funnels as described below. Traps were baited alternately with a mixture of peanut butter, honey and rolled oats or a mixture of peanut butter, honey, rolled oats and sardines. Trees with traps were sprayed with a water and honey mixture.

Traps were set open for a period of four nights and a total effort of 40 trap nights was employed at each trap site or 160 trap nights in total. Traps were checked within 2 hours of dawn the following morning.

#### b. Hair Funnels

One Faunatech hair funnel was placed on the ground and one on a tree near each Elliott trap location during the trapping period. Hair funnels were baited alternately with a mixture of honey, oats and peanut butter or honey, oats, peanut butter and sardines. The hair funnels were set on 9<sup>th</sup> October 2007 and were retrieved after 9 nights. Twenty hair tubes were set in each of the 4 transect lines giving a survey effort of 180 trap nights at each trapping site or 720 trap nights over all the transects. Hair samples were analysed by Georgeanna Story of 'Scats About'.

#### c. Spotlighting

Spotlighting was conducted for nocturnal mammals, birds and reptiles using a hand held lamp with a 100 watt halogen globe on the 4<sup>th</sup>, 10<sup>th</sup>, 14<sup>th</sup>, and 18<sup>th</sup> October 2007. Walking transects were undertaken within all treed habitat areas on the development site to ensure that the majority of the study area was sampled during the survey period. The property was surveyed for 1 to 3.33 person hours on each of the nights of survey giving a total of 10 person hours. The area traversed was approximately 0.5-1km for each survey. Each survey traversed a different habitat or grid area.

#### d. General Bird Surveys

Visual observation and call identification of birds was carried out during visits to the site by Dr Anthony Saunders and John Whyte using the area search method and opportunistic sightings. Bird surveys were undertaken over five days on the 12<sup>th</sup> September, 4<sup>th</sup>, 15<sup>th</sup>, 17<sup>th</sup> and 18<sup>th</sup> October 2007 for a total of 28 hours using an area search method. Surveys were undertaken at dawn, late morning and late afternoon until sunset and after dusk. Surveys were rotated between the SW portion and the NE portion so that each portion was sampled during each of the diurnal survey periods. The nocturnal surveys were confined to the NE portion. The survey effort concentrated on woodland remnants and saltmarsh areas throughout the sites, but all habitat types were sampled and all bird species detected by sight or call were recorded with their abundance or a count for each habitat type. Breeding was also recorded if observed. GPS readings were taken for sightings of any threatened or protected bird species or the general location was noted. Habitat of such species was also noted.

e. Nocturnal Bird Surveys

Nocturnal bird surveys were undertaken on the 4<sup>th</sup>, 10<sup>th</sup>, 14<sup>th</sup>, 16<sup>th</sup>, 17<sup>th</sup> and 18<sup>th</sup> October. The presence of Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*) and Barking Owl (*Ninox connivens*) were targeted by broadcasting taped calls through a 15 watt Toa 'Faunatech' amplifier. Calls were played for 2-minute periods at 5-minute intervals. This was followed with quiet listening and spotlighting.

Searches for evidence of Owl roosts and potential Owl roosting/breeding hollows were made during surveys of the subject site. Any whitewash, or regurgitated pellets found were noted.

f. Ultrasonic Call Recordings

Anabat ZCAIM bat detector units were set on the nights of the 16<sup>th</sup> and 18<sup>th</sup> October 2007 to detect and record ultrasonic calls of microchiropteran bats. One unit was set in trap transect 1 for 1 night, one unit in trap transect 4 for 1 night, one in the horse paddock over a drain for 1 night and one in the Mangrove Open Woodland directed over the large drain for 1 night. ZCAIM units were set before dusk and switched off after dawn each night they were set.

g. Diurnal Reptile Surveys

Surveys primarily targeted the one species of reptile listed as vulnerable (Pale-headed Snake), although all reptile subject species were considered during these surveys. Nocturnal reptile surveys coincided with mammal spotlighting. General diurnal reptiles were located opportunistically and by brief searches of fallen timber, sheets of metal or other solid ground cover items. The reptile was only caught if it could not be immediately identified. Reptile surveys were carried out by John Whyte of Cumberland Ecology on the 12<sup>th</sup> September, 4<sup>th</sup> and 15<sup>th</sup> October 2007.

h. Frog Surveys

Frog surveys were conducted by John Whyte of Cumberland Ecology on 12<sup>th</sup> of September and the 4<sup>th</sup>, 10<sup>th</sup>, 15 and 16<sup>th</sup> of October, 2007. Areas of potential habitat for the Wallum Froglet (*Crinia tinnula*) were noted and revisited that night for nocturnal survey. Areas of open water were inspected for tadpoles. If tadpoles could be immediately identified, they were recorded and released, tadpoles that were too small to be identified were returned to the ponds. Nocturnal surveys consisted of walked transects around the edges of each of the identified ponds and connecting waterways. Calling frogs were noted, the position and number of calling frogs at each site was recorded on a site sheet. Non-calling frogs were detected using headlamps. These were caught, identified and immediately released.

Imitation calls of the Wallum Froglet (*Crinia tinnula*) and Green and Golden Bell Frog (*Litoria aurea*) were made at 4 locations at least once during the surveys. A listening period of about two minutes followed calling session.

i. Other fauna signs

Searches for other signs of fauna use such as scats and scratches were undertaken during mammal trapping surveys to determine the presence or absence of arboreal mammals within the subject site. Searches were made for scratches, pockmarks and scats on and below Swamp Mahogany and other gums within survey areas. A further description can be found below under the targeted survey methods for koalas. 'Scats About' analysed any scats or pellets located during this survey.

j. Incidental observations

Any incidental vertebrate fauna species that were observed, heard calling or otherwise detected on the basis of tracks or signs were recorded and listed in the total species list for the subject site.

ii. Targeted Habitat Searches

a. Koala Assessment

The study area was assessed for potential and actual activity by Koalas, using procedures set out by the Director General's Requirements and the Australian Koala Foundation. These included:

- A search of Atlas of NSW Wildlife database (DEC (NSW) 2007);
- An analysis of the composition of each woodland and Open Forest type was conducted in order to determine whether or not each vegetation type supported potential Koala habitat (by determining the percentage of feed trees listed in SEPP 44 – Koala Habitat Protection);
- Koala spot assessment technique; and

- Koalas were searched for during spotlighting and call playback surveys.

Spot assessment, undertaken on 4<sup>th</sup>, 15<sup>th</sup> and 18<sup>th</sup> October 2007, involved faecal pellet searches within an approximate 25m radius of the central tree, checking a radius of 1m from around the closest 19 trees to the central tree. The systematic search for faecal pellets undertaken around the base of each tree, lasted two person minutes per tree. Koala activity levels are reported as a percentage derived from dividing the number of trees with faecal pellets by the total number of trees assessed in the circle.

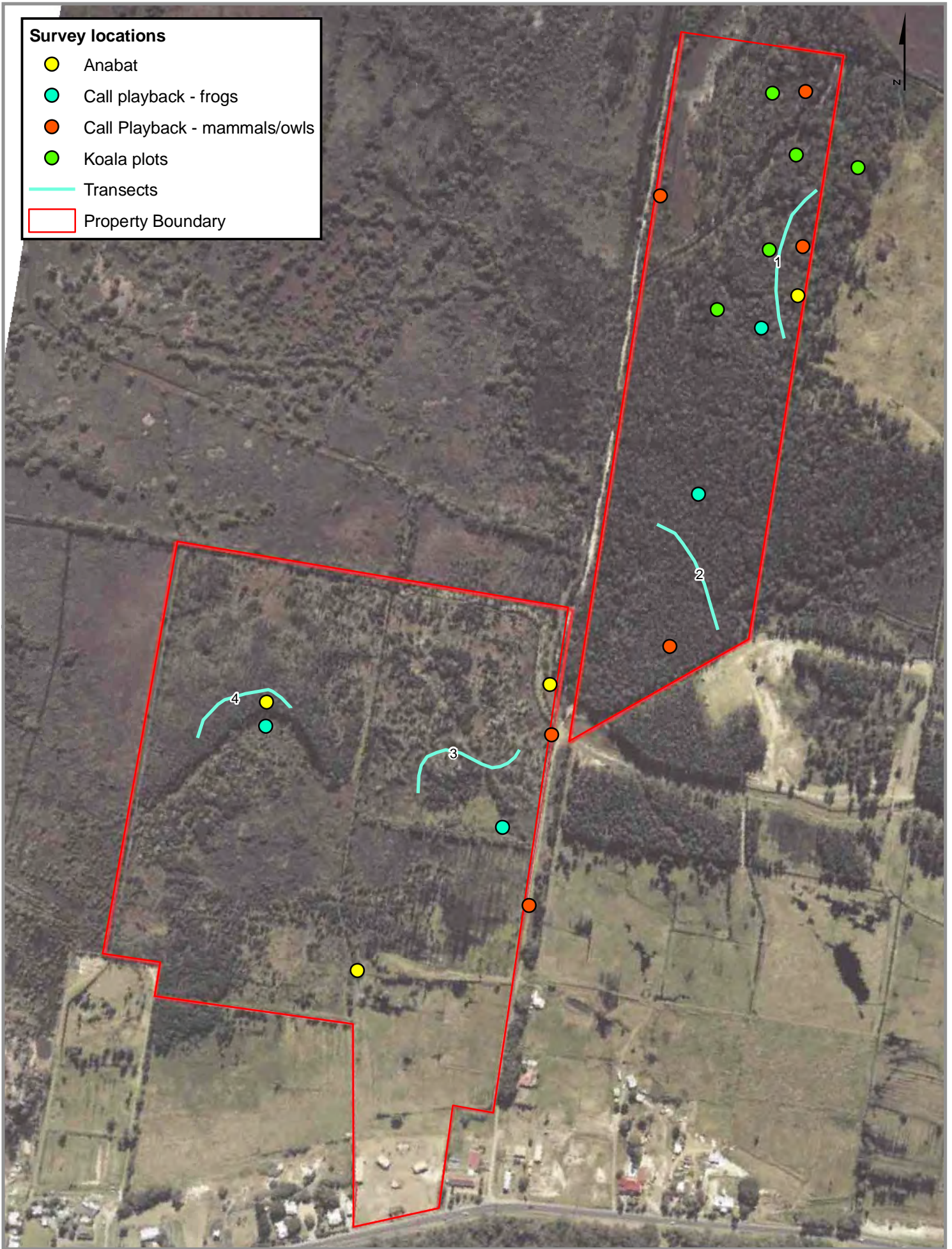
Table 4.2 summarises the fauna survey techniques and locations used by HWR Ecological and Cumberland Ecology.

**Table 4.2 FAUNA SURVEY TECHNIQUES AND LOCATIONS**

Survey	Technique	Survey Sites
HWR Ecological (2003)	Arboreal trapping	5 transects; 4 transects in NE portion, 1 in SW portion of subject site
	Ground trapping	5 transects; 4 transects in NE portion, 1 in SW portion of subject site
	Diurnal fauna searches	Haphazard sampling throughout subject site (not specified)
	Scat searches beneath trees	Not specified
	Spotlight searches	Haphazard sampling throughout subject site (not specified)
	Owl-call playback	Centre of the eastern boundary of NE portion of subject site
	Bat echolocation call recording	4 locations; 1 in centre of SW portion, 3 near western boundary or NE portion of the subject site
Cumberland Ecology (2007)	Trapping	Four trapping grids in 3 treed communities. See Figure 4.2
	Hair funnels	Four hair funnel transects in 3 treed communities. See Figure 4.2
	Spotlighting	Transects within all treed habitat areas on the subject site.
	General bird surveys	All habitat types were sampled
	Nocturnal bird surveys	The northern site and the eastern boundary of the southern site
	Ultrasonic call recordings	Transect 1, Transect 4, Mangrove Open Woodland and a horse paddock. See Figure 4.2
	Diurnal reptile surveys	Throughout subject site.

**Table 4.2 FAUNA SURVEY TECHNIQUES AND LOCATIONS**

Survey	Technique	Survey Sites
		Nocturnal surveys took place along mammal spotlighting transects
	Frog surveys	All potential frog habitats
	Other fauna signs	Throughout subject site.
	Incidental observations	Throughout subject site
	Koala assessment	See Figure 4.2



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Figure 4.2 Fauna Survey Locations

### **4.3 Documenting Survey Effort**

Approximately 37 person hours were spent conducting flora surveys that were used specifically for the preparation of this report. This includes time spent on general surveys, which have involved random meanders and quadrat surveys, targeted threatened species searches and vegetation mapping (Table 4.3). Approximately 78 hours have been spent on targeted fauna surveys and habitat assessments, and 880 trap nights of varying types of traps have been used to survey the fauna of the subject land (Table 4.4).

**Table 4.3 FLORA SURVEY EFFORT**

Survey	Technique	Dates	Total Survey Effort	Environmental Conditions
HWR Ecological (2003 and 2004)	Preliminary Haphazard Searches	May 2003, February 2004	5 hours, 5 haphazard transects	Not specified
HWR Ecological (2003 and 2004)	Descriptive Quadrats	May 2003, February 2004	3 hours, 8 descriptive quadrats	Not specified
HWR Ecological (2003 and 2004)	Intensive quadrats	May 2003, February 2004	3 hours, 6 intensive quadrats	Not specified
HWR Ecological (2003 and 2004)	Targeted Transects	May 2003, February 2004	3 hours, 3 targeted transects	Not specified
HWR Ecological (2003 and 2004)	Transects – flora community edge definition	May 2003, February 2004	3 hours	Not specified
HWR Ecological (2003 and 2004)	Intensive targeted searches	May 2003, February 2004	3 hours intensive ground searches	Not specified
Cumberland Ecology (2007)	Quadrat survey	12/09/07, 4-5/10/07, 10/10/07	22 20x20m quadrats	Mild to warm temperatures, no rain
Cumberland Ecology (2007)	Transect survey	12/09/07, 4-5/10/07	3 transects	Mild to warm temperatures, no rain
Cumberland Ecology (2007)	Targeted threatened flora searches	12/09/07, 4-5/10/07, 10/10/07, 15/10/07	13 hours	Mild to warm temperatures, no rain
Cumberland Ecology (2007)	Vegetation Mapping	12/09/07, 4-5/10/07	14 hours	Mild to warm temperatures, no rain

**Table 4.4 FAUNA SURVEY EFFORT**

Survey	Technique	Dates	Total Survey Effort	Environmental Conditions
HWR Ecological (2003)	Aboreal trapping	11-21/02/03	100 trap nights	Not specified
	Ground trapping	11-21/02/03	135 trap nights	Not specified
	Diurnal fauna searches	11-21/02/03	4 hours	Not specified
	Scat searches beneath trees	11-21/02/03	4 hours	Not specified
	Spotlight searches	11-21/02/03	4 hours	Not specified
	Owl-call playback	11-21/02/03	2 hours	Not specified
	Bat echolocation call recording	11-21/02/03	30 hours	Not specified
Cumberland Ecology (2007)	Trapping	15-19/10/07	4 transects, 160 trap nights	Fine, warm-hot
	Hair funnels	9-19/10/07	4 transects, 720 trap nights	Fine, warm-hot
	Spotlighting	4/10/07, 10/10/07, 14/10/07, 17-18/10/07	10 person hours	Mild, clear to partly cloudy, light wind, crescent moon
	General bird surveys	12/09/07, 4/10/07, 15/10/07, 17-18/10/07	28 person hours	Fine, warm-hot
	Call playbacks for owls and nocturnal mammals	4/10/07, 10/10/07, 14/10/07, 16-18/10/07	6 person hours	Mild, clear to partly cloudy, light wind, crescent moon
	Ultrasonic call recordings	16/10/07, 18/10/07	48 hours	Mild, clear to partly cloudy, light wind, crescent moon

**Table 4.4 FAUNA SURVEY EFFORT**

Survey	Technique	Dates	Total Survey Effort	Environmental Conditions
	Diurnal reptile surveys	12/9/07, 4/10/07, 15/10/07	10 person hours	Fine, warm-hot, no cloud cover
	Frog surveys	12/9/07, 4/10/07, 10/10/07, 15- 16/10/07	20.5 person hours	Fine, cool-warm
	Other fauna signs	12/9/07, 4/10/07, 10/10/07, 14- 19/10/07	Throughout survey period	Fine, warm-hot
	Incidental observations	10/10/07, 14- 19/10/07	Throughout survey period	Fine, warm-hot
	Koala assessment		5 spot assessments in study area, 3.5 person hours.	Fine, warm-hot

### 4.3.1 Weather Conditions

Weather conditions for the survey period were varying from mild to hot with the daily maximum temperature varying from 19°C to 33°C (Table 4.5). There was no rainfall during the survey period. The moon phase varied from new moon to last quarter.

**Table 4.5 WEATHER CONDITIONS DURING FIELD SURVEYS**

	10/10/2007	14/10/2007	15/10/2007	16/10/2007	17/10/2007	18/10/2007	19/10/2007
Wind	Light breeze	Light breeze	Still	Still	Light breeze	Moderate	Light breeze
Moon	New moon	Crescent	Crescent	Crescent	Crescent	Quarter moon	Quarter moon
Rain	0	0	0	0	0	0	0
Cloud	Minimal	Minimal	Partial	Partial	0	Partial	Partial
°C min	9.9	6.9	10.9	12.4	11.3	12.7	8.2
°C max	22.8	26	30.4	33.4	19.4	21.7	30.1

### 4.3.2 Survey Personnel Involved in Current Study

Table 4.6 lists the survey personnel who were involved in the current study or identified records collected from the current study.

**Table 4.6 MEMBERS OF THE PROJECT TEAM**

Team Member	Company	Role	Contact details
Dr David Robertson	Cumberland Ecology	Project Director and Ecologist	Ph: (02) 98681933
Samantha Holliday	Cumberland Ecology	Project Manager and Ecologist	Ph: (02) 98681933
Joanne Ironside	Cumberland Ecology	Ecologist	Ph: (02) 98681933
John Whyte	Cumberland Ecology	Ecologist	Ph: (02) 98681933
Katrina Wolf	Cumberland Ecology	Assistant Ecologist	Ph: (02) 98681933
Ariane Weiss		Ecologist	Ph: 0409325605
Gabor Vasarhelyi		GIS Consultant	Ph: (02) 93264084
David Thomas	Thomas Surveys	Botanist	Ph: (02) 98584360
Dr Tony Saunders	Merops Services	Ornithologist	Ph: (02) 48373141
Greg Ford		Anabat call analyst	Ph: 0427245211
Georgeanna Storey	Scats About	Hair and scat	Ph: (02) 66534190

**Table 4.6 MEMBERS OF THE PROJECT TEAM**

Team Member	Company	Role	Contact details
		sample analyst	

## 4.4 Survey Results

### *i. Subject species recorded*

Two ecological studies have been conducted in the subject site. The subject species\* that have been recorded in the study area in the most recent studies are shown in Figure 4.3. A list of the vegetation communities in which they were recorded in the study area is contained in Table 4.7. Records of the subject species that were recorded during surveys on the subject land are provided in Appendix B in a form consistent with NSW Wildlife Atlas and they are marked in Table 4.7 as having been recorded on the subject land.

\* *Subject species is defined here as being the threatened species that occur or have the potential occur in the study area as identified in Tables 3.1 and 3.2.*

**Table 4.7 SUBJECT SPECIES RECORDED IN THE STUDY AREA**

Species	Habitat	Recorded on subject land
Koala	Broad-leaved Paperbark Open Forest, Swamp Oak Forest	Yes
Squirrel Glider	Swamp Oak Forest	Yes
Wallum Froglet	Broad-leaved Paperbark Open Forest	Yes
Black Bittern	Saltmarsh Complex	Yes
Latham's Snipe	Saltmarsh Complex	Yes
Dollarbird	Broad-leaved Paperbark Open Forest	Yes
Yellow-bellied Sheathtail Bat (Possible)	Swamp Oak Forest	Yes
Eastern Freetail Bat (Possible, Probable)	Broad-leaved Paperbark Open Forest, Swamp Oak Forest	Yes
Little Bentwing Bat (Possible, Probable)	Broad-leaved Paperbark Open Forest, Swamp Oak Forest, Grey Mangrove Low Woodland	Yes
Greater Broad-nosed Bat	Broad-leaved Paperbark Open	Yes

**Table 4.7 SUBJECT SPECIES RECORDED IN THE STUDY AREA**

Species	Habitat	Recorded on subject land
(Possible)	Forest, Grey Mangrove Low Woodland	
Eastern Cave Bat (Possible)	Broad-leaved Paperbark Open Forest, Swamp Oak Forest, Grey Mangrove Low Woodland	Yes

*ii. Survey limitations*

Two major flora and fauna surveys have now been undertaken on the subject site: one by HWR Ecological (2005) and the current surveys by Cumberland Ecology for this report. Surveys have taken the form of:

- General flora and fauna surveys for all species of vertebrates and vascular plants;
- Targeted threatened flora surveys; and
- Targeted threatened fauna surveys.

A range of threatened flora and fauna are now known to occur within the study area, having been definitely and repeatedly confirmed by survey. There are also some species that remain considered likely to occur (based upon the habitats present in the study area) but which have not been detected by any surveys or surveyors to date. One of the purposes of this section is therefore to explain the limitations of the survey techniques employed in the various surveys that have been utilised in the preparation of this SIS.

Generally, due to the length of time over which flora and fauna studies have been conducted, the number of different people who have conducted studies and the methods used for detection of species, the database of information for threatened species is sizeable, and considered reliable. The following general points can be made and these are further explained below:

The surveys are limited in being “snapshot” investigations and so present a view of the fauna that were active during the time of the surveys. The data produced by the surveys is intended to be indicative of the types of species that could occur and not an absolute census of all vertebrate species of the site.

The SIS makes use of its own spring surveys and also draws upon surveys conducted from 2003 to the present date, including summer surveys – thus for the majority of species, surveys have been conducted during the correct seasons.

A technical malfunction resulted in one Anabat unit not recording any data on the night of 17/10/07.

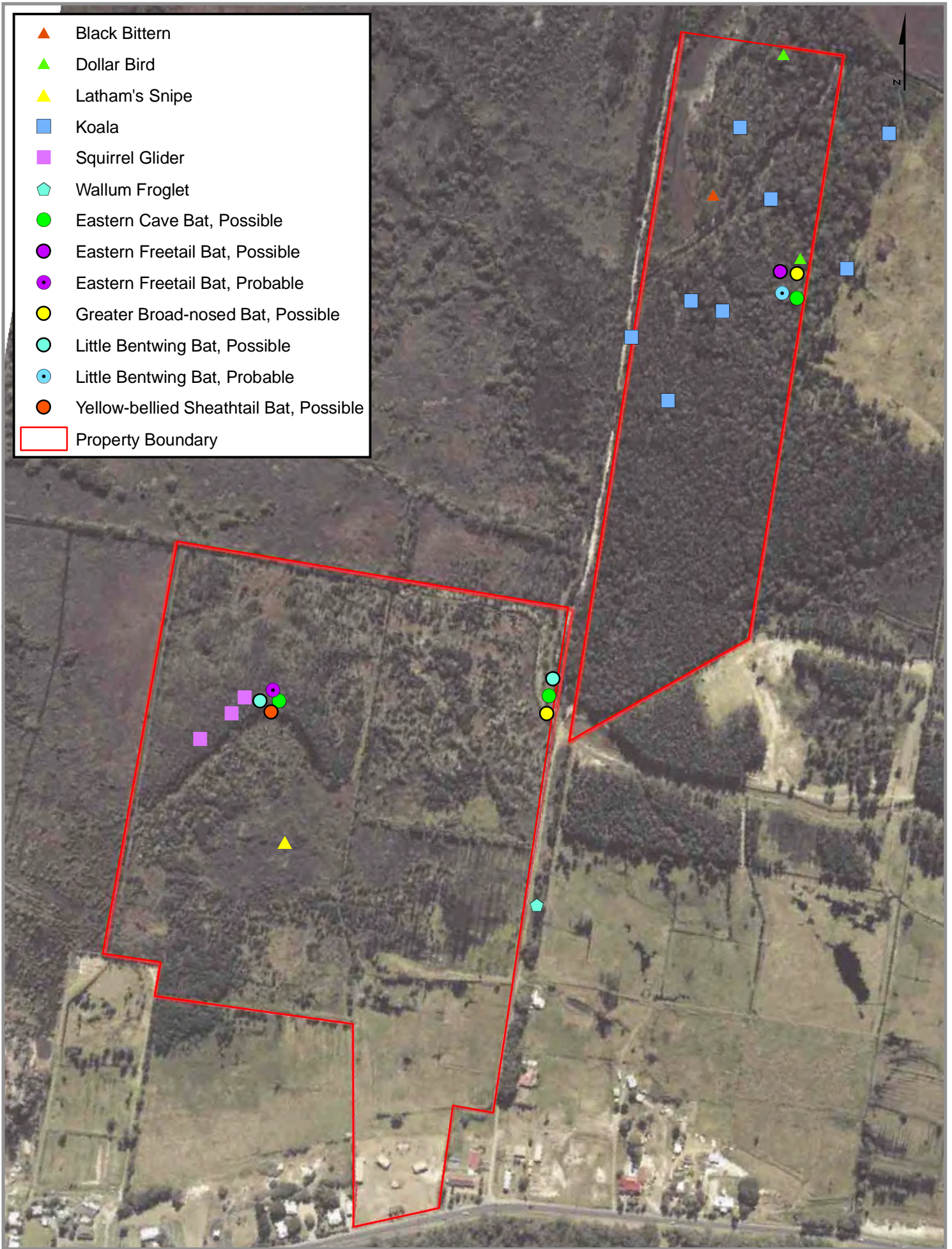
There were moderate winds on the evening of 18/10/07 while spotlighting and call playbacks were attempted, which could have affected the sound of the call playbacks or any responses.

Spotlighting surveys generally avoided the swampier, tidal areas of the site as a safety precaution for crossing canals in the dark.

Several species are cryptic and difficult to detect or migratory and not all surveys, if any were conducted at the appropriate time of year. These include:

- Swift Parrot which is migratory and needs to be surveyed in winter. No bird surveys were conducted during winter;
- Eastern Pygmy Possum is cryptic and should be targeted with intensive small Elliott traps or pitfall traps. No pitfall traps or small Elliott traps were set although hair tubes were set on the ground;
- Long-nosed Potoroo can require intensive cage trapping to detect. This survey relied on hair tubes to detect ground-dwelling fauna; and
- Pale-headed Snake and Stephens Banded Snake are cryptic and difficult to detect.

Any species that are known to occur in the study area but were not detected during surveys are also considered in the SIS as subject species if potential habitat for the species occurs on the subject land.



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0 150 300 Meters

Figure 4.3 Subject Species Recorded

#### 4.4.2 Vegetation communities

Based on aerial photographic interpretation, random meander surveys and quadrat surveys of this and previous studies, six main vegetation communities were found to occur on the subject land including:

- Broad-leaved Paperbark Open Forest
- Swamp Oak Open Forest;
- Grey Mangrove woodland and low woodland
- Samphire-Sea Couch-Sea Rush Herbland and sedgeland (Saltmarsh);
- Buffalo Grass-Couch closed grassland; and
- Shivery Grass-Whisky Grass-Carpet Grass open grassland.

Full descriptions of these communities are given in Chapter 2. Assessments of their conservation significance are provided in Section 3.1.1

#### 4.4.3 Exotic Species & Viability

The Broad-leaved Paperbark Open Forest community at the northern end of the property is in viable condition. In the two sample quadrats surveyed exotic species were confined to the shrub and ground cover strata where they comprised an estimated 5% of the projective foliage cover of the relevant strata. In some other areas the concentration of exotic shrubs is locally higher, probably to 40% of the stratum with locally high proportions of *Lantana camara* occurring.

Drier phases of Swamp Oak Forest appear to be in generally similar condition to the paperbark forest with a low percentage of exotics present. This variant of swamp oak community is in viable condition. Along the outer margins of these two communities in the northern section of the site, where a walking/horse riding track separates them from saltmarsh, locally high proportions of *Chrysanthemoides monilifera* (Bitou Bush) occur, which would benefit from some management.

Damper and more saline phases of Swamp Oak Forest are more difficult habitat for most species, including most introduced plant species, and are generally in weed-free condition or almost so. Localised patches of exotic grasses (*Ehrharta erecta* and *Cynodon dactylon*) occur on slightly elevated ground. The saline variant is in viable condition.

Grey Mangrove Woodland and Open Woodland and Saltmarsh communities are in viable condition and could be expected to remain so into the future, without management actions being required. Sedgeland is also relatively weed free and appears viable in its current condition. Localised patches of exotic grasses (*Ehrharta erecta* and *Cynodon dactylon*)

occur in the Sedgeland on slightly elevated ground but these do not comprise a high proportion of the community.

Some areas of Swamp Oak Woodland, Open Woodland and Saltmarsh are disturbed and may be showing the effects of being located in marginal habitat for the communities rather than indicating a regeneration progression from clearing to forest community.

The exotic grassland community is not bushland and is unlikely to revert to bushland naturally or be feasible to restore to that condition with active management.

#### **4.4.4 Flora species**

A diverse range of flora species has been recorded on the subject land. A list of these species which includes which quadrat each species was recorded in and the vegetation communities in which quadrats occurs can be found in Appendix A. The locations of quadrats are in shown in Figure 4.1.

No threatened species or populations of plants were found to occur on the subject land in the surveys conducted for this SIS and based upon habitats present. Threatened species that are known to occur in the locality of the subject land include but are not limited to:

- *Callistemon linearifolius*;
- *Eucalyptus parramattensis subsp. decadens*;
- *Diuris arenaria*; and
- *Diuris praecox*.

No threatened plants were detected during the field surveys and none of the aforementioned plants are considered likely to occur on the subject land based upon the habitat types that are present.

#### **4.4.5 Fauna species**

##### *i. General Fauna Species Detected*

The fauna habitats of the subject site vary considerably from grassland and saltmarsh, which are open treeless habitats, to Swamp Oak and Broad-leaved Paperbark forests. The forest communities support the highest diversity and abundance of vertebrates.

A variety of forest fauna were detected in the northern site, and the northern portion of the southern site during the field surveys and many species could occur on the subject site as they have been detected in past surveys of the locality (Appendix B). Species include a considerable variety of forest birds and bats but a relatively small number of mammal, reptile and amphibian species.

Two native frog species were detected during the 2007 surveys; the Wallum Froglet and the Common Eastern Froglet. The latter was also detected in the HWR Ecological surveys. Reptiles detected on site include Jacky Lizard, Bearded Dragon, Carpet Python, Common Tree Snake, Red-bellied Black Snake, Copper-tailed Skink, Eastern Water Skink, Dark-flecked Garden Sunskink and Lace Monitor.

Many forest bird species were detected in the Broad-leaved Paperbark Open Forest. These included typical small forest species such as Eastern Yellow Robin, White-throated Tree-creeper, Eastern Whipbird, Brown Thornbill, Lewin's Honeyeater, Grey Fantail, Red-browed Finch, Grey Shrike-thrush and Eastern Spinebill.

A variety of arboreal fauna were found within the forest communities including Brush-tailed Possum, Sugar Glider, Squirrel Glider and Koala. The Brush-tailed Possum, Sugar Glider and Koala were detected within the Paperbark forest. The Squirrel Glider was found within the Swamp Oak Forest. The presence of Brush-tailed Possum, which requires medium sized tree hollows, is indicative of the presence of larger hollows within the northern site.

A Brown Antechinus was the only native ground dwelling mammal detected on the subject site.

ii. *Fauna of Conservation Significance*

a. Frogs

Frog surveys were carried out in October 2007 by John Whyte. One threatened frog species, Wallum Froglet (*Crinia tinnula*) was heard calling from a drainage line adjacent to the site.

b. Reptiles

Reptile surveys were carried out in October 2007 by John Whyte. No threatened reptile species have been recorded in the locality of the subject site.

c. Birds

Targeted bird surveys were carried out in October 2007 by Dr Tony Saunders, and call playbacks targeting owls were carried out by Cumberland Ecology and Dr Tony Saunders in October 2007. The Broad-leaved Paperbark Open Forest contained suitable habitat as a potential foraging and roosting site for the Powerful Owl (*Ninox strenua*). A possible distant response to call playback was received from a Powerful Owl but this was on other forested land beyond the boundaries of the subject land.

A Black Bittern and a Latham's Snipe were detected in the Saltmarsh in the far north of the subject land and a Dollarbird was detected in several locations within the Broad-leaved Paperbark Open Forest.

d. Mammals

Along with the visual and aural identification of the Grey-headed Flying Fox, four microchiropteran bats were detected using Anabats on the subject land; Greater Broad-nosed Bat (possible), Little Bentwing-bat (probable), Eastern Cave Bat, Eastern Freetail-bat (probable) and Yellow-bellied Sheathtail-bat (possible). A range of native bat species are expected to forage for insects in the forest habitats.

Squirrel Gliders were caught three times during the survey and Squirrel Glider hair was detected in a hair tube in the Swamp Oak Forest in the northern site. Survey work carried out by HWR Ecological also detected a Squirrel Glider.

Koala scats were recovered from all 5 sites for spot assessments within the study area. Sites 1-5 returned activity levels of 100%, 40%, 60%, 30% and 40% respectively, which all correspond to Core Koala Habitat. These results suggest that the site supports a resident population.

e. Potential species

A range of other threatened bats have the potential to occur on the subject land. According to threatened species database records (NSW Government 2007 #3596) (DEC (NSW) 2007 #2479) the following species of threatened bats also have the potential to occur on the subject land:

- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Golden-tipped Bat (*Kerivoula papuensis*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*); and
- Large-footed Myotis (*Myotis adversus*).

Yellow-bellied Gliders have been recorded in the locality, but were not detected on the subject site. This species uses taller denser forests that occur on the subject site and they are not expected to occur. However, both Squirrel Gliders and Sugar Gliders have been found and suitable habitat is extensive for these species in the treed northern portions of the study area.

Potential habitat exists for the Spotted-tailed Quoll and the Brush-tailed Phascogale, although the small area of potential habitat for Spotted-tailed Quoll on the subject land would mean that it is not likely to support a large population of this species as this species shelters in tree hollows and hollow logs.

Stands of *Casuarina glauca* and the presence of Mangroves provides potential habitat for species that may utilise the areas as roosting or foraging sites. Potential species utilising these habitat types include:

- Striated Heron (*Butorides striatus*);
- Nankeen Night Heron (*Nycticorax caledonicus*); and
- Australasian Bittern (*Botaurus poiciloptilus*).

# Impact Assessment

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## 5.1 Potential Direct and Indirect Impacts

Proposed developments potentially have both direct and indirect impacts upon flora and fauna. For the purposes of this chapter, direct impacts are defined as removal of habitat arising from clearing and/or total changes to the environment (such as occurs when land is filled).

Indirect impacts are those impacts to flora and fauna that arise as an indirect consequence of the direct impacts. Examples of indirect impacts include the following:

- Alterations to downstream water quality or quantity;
- Alterations to microclimate;
- Weed invasion of adjacent areas;
- Feral animal colonisation of adjacent areas;
- Spreading of plant pathogens into adjacent flora and fauna habitat (for example Cinnamon Fungus, *Phytophthora cinnamomi*, that impacts some vascular plants);
- Spreading of animal pathogens (for example the Chytrid Fungus, that affects some frog species);
- Loss of hollow-bearing trees; and
- Alteration of wildlife corridor values.

Direct and indirect impacts of the development are discussed below:

## 5.2 Direct Impacts

### 5.2.1 Vegetation Communities

The proposal entails a development element and a conservation element. The development element of the proposal has been subdivided into two components:

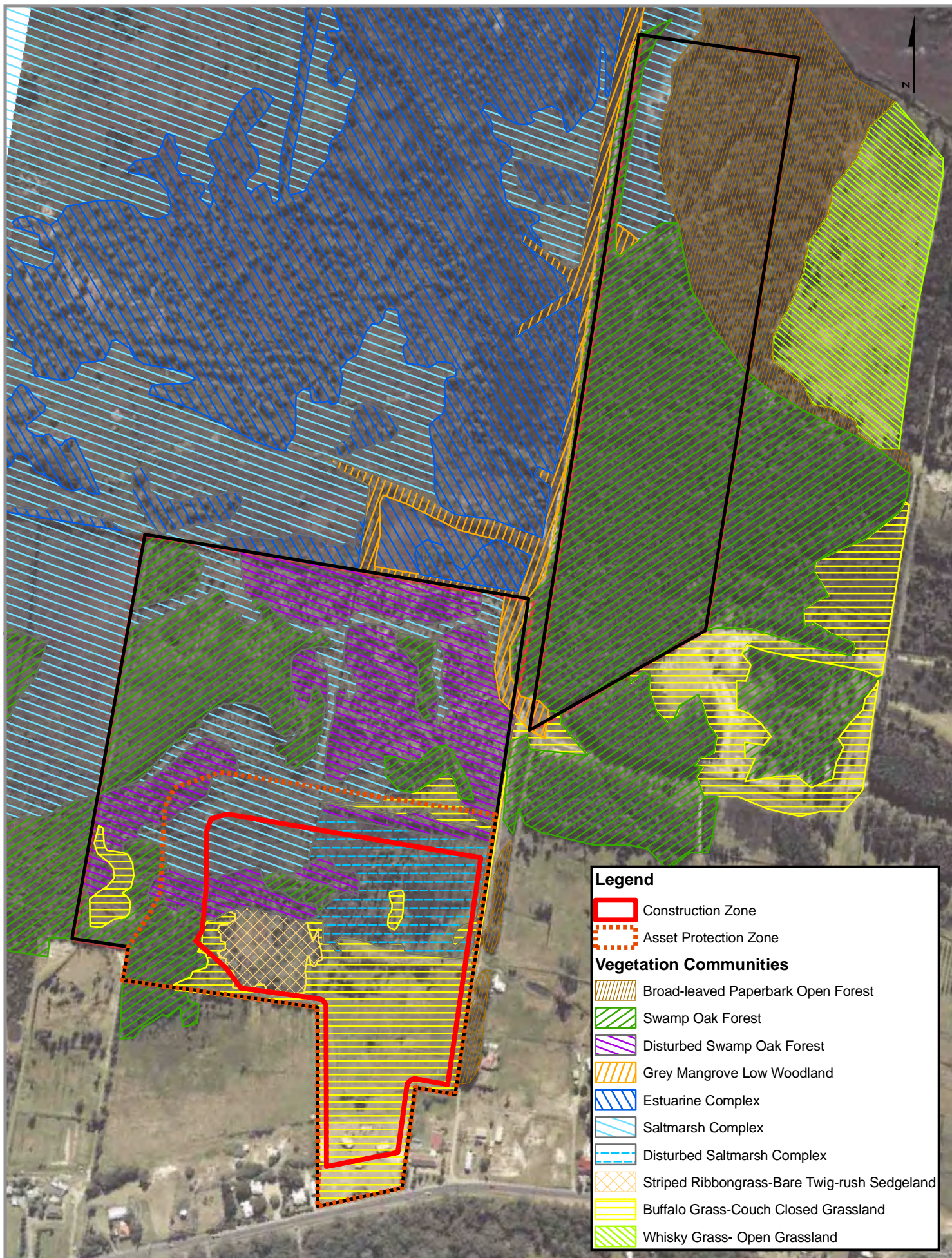
3. **Construction Zone** = the area of construction including roads, paths, buildings and artificially landscaped areas; and
4. **Asset Protection Zones (APZs)** = the area of modified native vegetation that is maintained in fuel reduced form in order to protect the proposed development from bushfire.

The development footprint is illustrated in Figure 5.1, while a summary of areas of native vegetation to be cleared or conserved is provided within Table 5.1.

The proposed development footprint is located within the most disturbed areas of the subject land. Vegetation within this area has either been cleared for agriculture or modified by past land uses including livestock grazing. As such the vegetation within the proposed development footprint includes the majority of exotic grassland on the subject land. It also contains small areas of Swamp Oak Woodland, Saltmarsh Complex and Sedgeland Mosaic.

The APZ portion of the proposed development would be located within Swamp Oak Forest; and Saltmarsh Complex. However, of these, only the Swamp Oak vegetation would require thinning to provide vegetation that conforms to an APZ. The existing saltmarsh areas currently have low fuels and would not require further modification for the project.

Within the proposed APZ, 2.7 ha of saltmarsh occur, including 0.73 ha of saltmarsh and 1.96 ha of disturbed saltmarsh.



0 160 320 Meters

Figure 5.1

Development Footprint showing impact on vegetation communities

**Table 5.1 AREAS WITHIN PROPERTY TO BE CLEARED, MODIFIED AND CONSERVED**

<b>Community</b>	<b>Area within property boundary (ha)</b>	<b>Area to be developed (ha)</b>	<b>Area to be modified within APZ (ha) (treed areas only)</b>	<b>% of each community to be cleared</b>	<b>% of each community to be modified</b>	<b>area to be conserved</b>	<b>% of each community to be conserved</b>
Paperbark Open Forest	3.9	0.0	0.0	0.0	0.0	3.9	100.0
Swamp Oak Forest/Woodland	14.8	0.2	0.7	1.4	4.7	13.9	93.9
Disturbed Swamp Forest/Woodland	6.8	0.7	0.7	9.5	10.5	5.4	79.4
Grey Mangrove Low Woodland	0.4	0.0	0.0	0.0	0.0	0.4	100.0
Saltmarsh Complex	5.1	0.7	0.0	14.3	0.0	4.4	86.3
Disturbed Saltmarsh Complex	2.4	2.0	0.0	82.9	0.0	0.4	16.7
Sedgeland mosaic	0.9	0.9	0.0	99.8	0.0	0.0	0.0
Exotic grassland	5.6	3.5	0.0	63.9	0.0	2.1	37.5
<b>Total</b>	<b>39.9</b>	<b>8.0</b>	<b>1.4</b>	<b>n/a</b>	<b>n/a</b>	<b>30.5</b>	<b>n/a</b>

### 5.2.2 Threatened Fauna

A range of threatened fauna occurs on the site including Koalas, Squirrel Gliders, wetland and migratory birds and bats. A Wallum Froglet was also detected in a drainage channel adjacent to the subject site and has the potential to occur on the site itself. Wide ranging species such as the Powerful Owl may also utilise the habitat within the property for foraging purposes. The development proposal includes conservation of the majority of the site (see Table 5.1 and Chapter 6) which would set-aside these areas for environmental protection in the long-term.

Individual species are considered in brief below:

#### *i. Koalas*

The Port Stephens Comprehensive Koala Plan of Management Habitat Planning Map {Port Stephens Council with the Australian Koala Foundation 2002} identifies “Preferred Koala Habitat” as occurring across the entire northern site as well as the northern portion of the southern site. The remainder of the southern site has been mapped as “Mainly Cleared” land. The Koala Habitat Planning Map is based on the work of Lunney *et al.* {Lunney 1998} that identifies koala habitat in the Port Stephens LGA. Under the Comprehensive Koala Plan of Management {Port Stephens Council with the Australian Koala Foundation 2002}, Preferred Koala Habitat is the most important category of koala habitat in the Port Stephens LGA and hence should be afforded the highest level of protection.

Habitat buffers contribute to the long-term survival of Preferred Koala Habitat by ensuring incompatible development or land use does not occur on land immediately adjacent to Preferred Koala Habitat. A minimum of 50m is considered to be reasonable for absorbing adverse edge effects. The Koala Plan of Management recommends that all habitat buffers should also be afforded the highest level of protection and considered for possible restoration where appropriate.

#### *a. Potential Impacts of the Development on Koala Habitat*

The development proposal will not have an impact on koalas or their habitat for the following reasons:

- Koalas were observed in the Paperbark Forest in the far northern section of the site, which is not located adjacent to or within 50m of the proposed development footprint;
- The development zone is not within any identified preferred, supplementary or marginal koala habitat;

- There will be at least the minimum buffer of 50m between the requisite Asset Protection Zone (APZ) and the areas mapped in the Koala Management Plan as being Preferred Koala Habitat;
- There are no preferred koala food trees in the development zone, namely *Eucalyptus teretecornis*, *E. parramattensis* and *E. robusta*, and hence no preferred koala food trees will be removed as a result of the development proposal.
- Under the current proposal, all land mapped as Preferred Koala Habitat along with the 50m habitat buffer would be preserved for long term conservation.

#### ii. *Squirrel Gliders*

Squirrel Gliders were detected in Swamp Oak Forest in the northern section of the property adjacent to the Paperbark Forest, as well as the northwest corner of the southern section of the property. A Sugar Glider was also detected in the Paperbark Forest in the far north and it is likely that Squirrel Gliders inhabit this area as well.

The area in the south eastern section of the property that is due to be developed contains minimal potential habitat for Squirrel Gliders (0.9ha Swamp Oak and Disturbed Swamp Oak within the construction zone and 1.4ha within the APZ) and it is not considered that the development would impact upon this species, particularly as the area that will be impacted occurs on the edge of the Swamp Oak community and is surrounded by low-growing vegetation. As with koalas above, under the current proposal the majority of good quality Squirrel Glider habitat would be conserved in perpetuity for conservation purposes.

#### iii. *Wetland and Migratory Birds*

A number of wetland birds were detected in the study area and it is likely that a range of wetland species utilise the SEPP 14 wetlands in Anna Bay which include part of the subject site. The proposal includes plans to conserve 4.4ha of saltmarsh (and 0.4ha of disturbed saltmarsh) in perpetuity as compensation for 0.7ha of saltmarsh and 2ha of disturbed saltmarsh being removed as part of the development. Extensive wetland habitat occurs to the west and north of the proposed development area and it is not considered that the small area to be removed would have an impact on wetland or migratory bird species particularly due to its location, occurring adjacent to exotic grassland.

#### iv. *Microchiropteran Bats*

A range of bat species are likely to forage in the area, particularly along drainage lines and on the edges of wooded communities near open water where insects tend to be more prolific. The majority of land in the construction zone forms exotic grassland and the small area of wooded and wet/edge habitat to be removed is not likely to impact on bat foraging or roosting activities as extensive habitat exists across the site and beyond.

v. *Grey-headed Flying-fox*

As with microchiropteran bats above, a minimal amount of potential foraging habitat would be cleared for the development and this would not impact on the foraging activities of Grey-headed Flying-foxes, particularly as ample foraging habitat occurs throughout the site and beyond and Grey-headed Flying-foxes are relatively wide-ranging.

vi. *Owls*

During call playback on the site, one potential Powerful Owl was heard in the distance to the north-east of the northern site. No potential roost sites were detected within the southern site however and it is unlikely that the small area of Swamp Oak and Disturbed Swamp Oak Forest that would be removed as part of the development would have any impact on the foraging activities of forest owls.

vii. *Wallum Froglet*

One Wallum Froglet was heard calling from a drainage channel adjacent to the development site within broad-leaved Paperbark Open Forest. This area is slightly elevated from much of the rest of the site and the drainage channel itself is likely to be more fresh water than those within the site, which are dominated by species more tolerant of saline water such as mangrove, swamp oak and saltmarsh species. There is marginal potential habitat within the sedgeland mosaic vegetation community for the Wallum Froglet as this area is slightly more freshwater than the rest of the site, but even within this vegetation community saltmarsh species occur, indicating that there is some salinity in the watertable. Therefore it is considered unlikely that the development would have an impact on the breeding or foraging activities of the Wallum Froglet, largely due to the salinity of the water on site.

## 5.3 Indirect Impacts

### 5.3.1 Potential Impacts on Wildlife Corridors

A potential wildlife corridor connects the north section of the property and the northern and western portions of the site. Species that were detected during the 2007 fauna surveys include the Koala, Squirrel Glider, various microchiropteran bats and the Grey-headed Flying Fox. These were located in the northern and western areas of the site and in the north section of the property; no threatened fauna were found in the southern portion of the site within in the development zone.

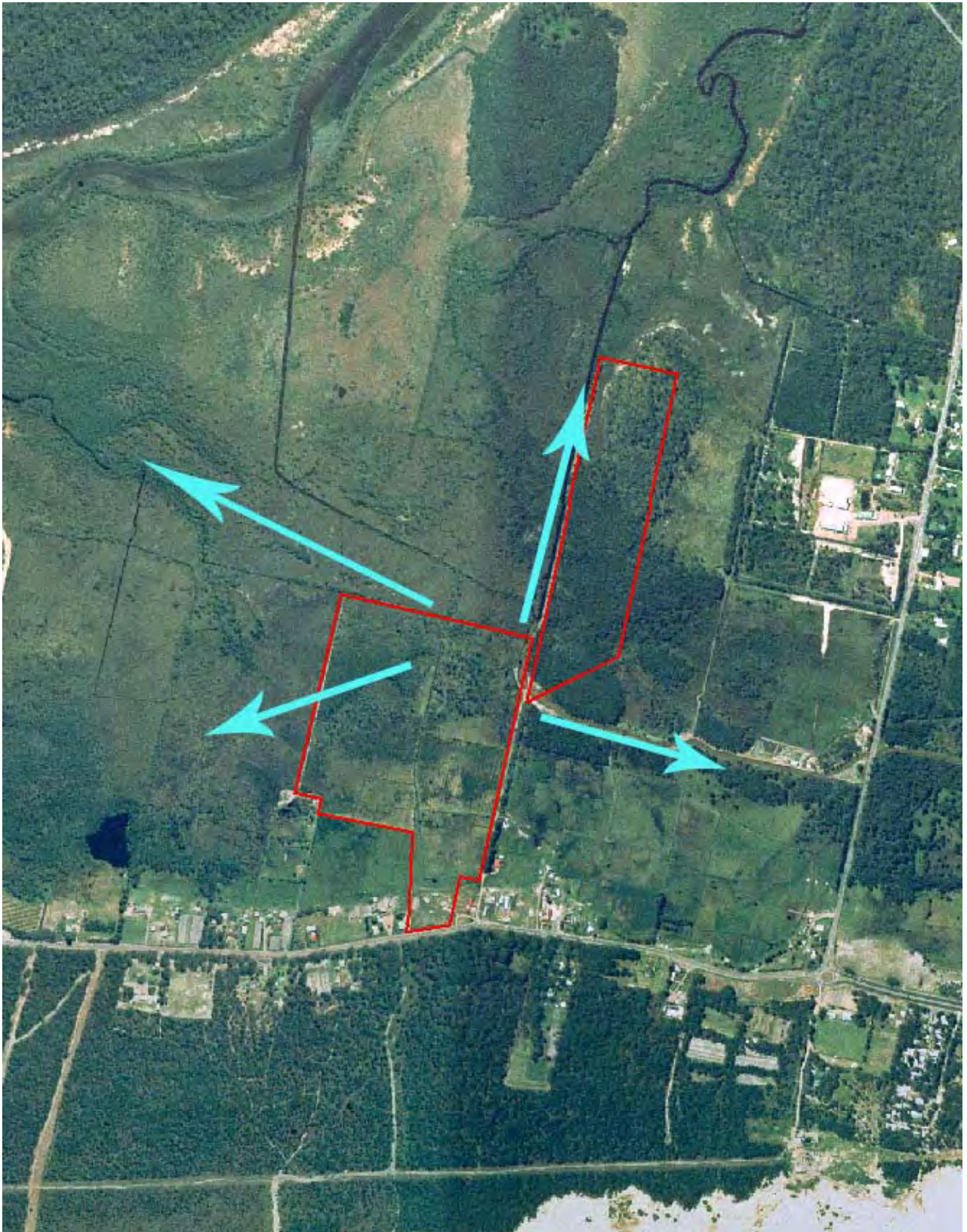


Figure 5.2 Potential Wildlife Corridors

The proposed development zone consists of open land that has been disturbed by past land uses. It does not form part of a habitat linkage of significance for the region or the locality. It is unlikely that the proposed development would have a significant detrimental impact upon any potential wildlife corridor. Any potential wildlife corridor would more likely extend north and north-west of the development footprint across contiguous vegetation.

### 5.3.2 Key Threatening Processes

The proposed development has potential for a suite of indirect impacts that will need to be managed. The NSW Scientific Committee has formally listed some such impacts as “Key Threatening Processes” under the requirements of the TSC Act. The list of Key Threatening Processes provides a starting point for consideration of the major types of indirect impacts. A list of the KTPs in NSW that are relevant to this proposal is provided in the table below. All of these are manageable in the context of the proposed development and mitigation measures and management plans will be prepared to ameliorate them as part of the development outcome. The implications of such indirect impacts will be examined in more detail within the final version of the SIS and are only mentioned briefly here.

**Table 5.2 KEY THREATENING PROCESSES THAT WILL NEED TO BE ADDRESSED AS PART OF THE PROPOSED DEVELOPMENT**

List of Key Threatening Processes	Relevance to Proposal
Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands - key threatening process listing	The proposed development has potential to have an impact upon the natural flow regimes of streams and floodplains
Clearing of native vegetation - key threatening process listing	The proposed development will clear native vegetation and this is why the SIS is being prepared.
Exotic vines and scramblers - key threatening process listing	The proposed development will entail landscaping of the development site. However, no noxious or environmental weeds will be planted within the proposed landscaping areas.
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis - key threatening process listing	There is the potential for spread of this pathogen as a result of the proposed development
Infection of native plants by Phytophthora cinnamomi - key threatening process listing	There is potential for spread of this pathogen as a result of the proposed development.
Invasion of native plant communities by bitou bush and boneseed - key threatening process	There is potential for the spread of these weeds as a result of the proposed

**Table 5.2 KEY THREATENING PROCESSES THAT WILL NEED TO BE ADDRESSED AS PART OF THE PROPOSED DEVELOPMENT**

List of Key Threatening Processes	Relevance to Proposal
listing	development.
Invasion of native plant communities by exotic perennial grasses - key threatening process listing	There is potential for the spread of these weeds as a result of the proposed development.
Lantana camara - key threatening process listing	There is potential for the spread of Lantana as a result of the proposed development.
Loss of Hollow-bearing Trees - key threatening process determination	There is some proposed modification of trees and tree hollows as a result of the proposed development. However, the majority of treed habitats will be conserved in the long term.
Predation by feral cats - key threatening process listing	There is potential for these feral animals to benefit from the proposed development.
Predation by the European red fox - key threatening process listing	There is potential for these feral animals to benefit from the proposed development.
Predation by the plague minnow ( <i>Gambusia holbrooki</i> ) - key threatening process listing	There is potential for these feral animals to benefit from the proposed development.
Removal of dead wood and dead trees - key threatening process listing	There is potential for removal of dead wood and trees as a result of the proposed development.

The relevant Key Threatening Processes outlined above will need to be addressed as part of the development activities. This would include such things as preparing a Soil and Water Management Plan and a Vegetation Management Plan for the site as well as following DECC guidelines such as the Frog Hygiene Protocol which will need to be followed during any development activities.

## Ameliorative Measures

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### 6.1 The Conservation Outcome

The proposal provides for more than three quarters of the subject land (30.5 ha) to be managed for conservation purposes (refer to Table 5.1 above). The developer proposes to hand this land over to National Parks to ensure the conservation of the set-aside land in-perpetuity. This entails sizeable areas of the following native vegetation communities:

- Paperbark Open Forest;
- Swamp Oak Forest;
- Grey Mangrove Low Woodland; and
- Saltmarsh Complex.

Of these plant communities three are endangered ecological communities (Paperbark, Swamp Oak and Saltmarsh) which are all gazetted as endangered communities at least in part because they are underrepresented in the conservation network. Additionally Grey Mangroves and Saltmarsh both contribute directly or indirectly to the provision of estuarine fish habitats.

A number of threatened fauna species were detected in the area that would be set-aside for conservation, including koalas, squirrel gliders, various microchiropteran bats and the Grey-headed Flying Fox. Core koala habitat is contained within much of the proposed set-aside land and these areas include habitat for squirrel gliders as well as forming part of a potential fauna habitat corridor. Conversely, the area to be developed contains largely exotic grassland and disturbed native vegetation communities that do not have such high conservation significance.

If adopted, the proposal will provide a substantial addition of over 30ha of native vegetation that can serve as an addition to the reserve system within the locality and within the region. It can provide a complementary area of habitat to those within Tiligery Nature Reserve and Tomaree National Park.

In conjunction with offering set-aside land for conservation, a number of environmental management plans (soil and water, bushfire, vegetation etc) would be prepared for the site to ensure that no impacts occur from the development in the area that would be set aside for conservation.

Considering the development impacts and conservation outcomes outlined above, it is considered that overall the development proposal would offer a good conservation outcome for flora and fauna

## **6.2 Management Plans**

The relevant Key Threatening Processes outlined will be addressed as part of the development activities. This would include such things as preparing a Soil and Water Management Plan and a Vegetation Management Plan for the site as well as following DECC guidelines such as the Frog Hygiene Protocol which will need to be followed during any development activities.

# Conclusion

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## 1.1 Significance of Impacts

After considering the material raised in the SIS, without regard to the ameliorative measures proposed, the construction of the proposal and ongoing use of the subject site as a tourist facility is not considered to have a significant impact on any threatened species or communities that are known or considered likely to occur in the study area.

The SEPP 14 wetland that occurs within the subject land will be protected by a naturally vegetated buffer of conserved native vegetation and is not expected to be detrimentally impacted by the proposed development.

Some saltmarsh, an EEC, will be cleared for the proposed development. However, the saltmarsh to be cleared has been altered by previous land uses. Higher quality saltmarsh in greater quantity will be conserved across parts of the northern section of the property.

The majority of flora and fauna are likely to remain viable on the subject land and in the study area in the long term. This is for a variety of reasons, principally including:

- The majority of the site, including the all Paperbark Forest, all mangroves and the largest and most intact remnants of Swamp Oak Forest and Saltmarsh communities will be conserved in the long term;
- Of the threatened species detected (Koala, Squirrel Glider, Wallum Froglet, Australasian Bittern, microchiropteran bats and Grey-headed Flying Fox) the majority of them have been found to occur predominantly within the forested portions of the subject land north of the development site and/or within wetland areas, which do not occur within the development footprint and much of which will be conserved in perpetuity.

Vegetation clearance that is required as part of the proposal will add to the cumulative impacts upon Saltmarsh and Swamp Oak Forest in the locality in the short term. However, the management of the remainder of the subject land for conservation will offset such impacts as the protected habitats are regenerated and managed and provide for a net gain in biodiversity in the long term.

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- Port Stephens Council with the Australian Koala Foundation 2002** *Port Stephens Comprehensive Koala Plan of Management*

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*Appendix A*

**Flora Species List**

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**Table A.1 FLORA SPECIES (QUADRATS 1-13)**

Family	Scientific Name	Common Name	2007 Quadrats												
			1	2	3	4	5	6	7	8	9	10	11	12	13
Trees															
Casuarinaceae	Casuarina glauca	Swamp Oak	1	2	adj	6		5	7	x	x	2		1	6
Euphorbiaceae	Glochidion ferdinandi var pubens	Hairy Cheese Tree													
Euphorbiaceae	Glochidion ferdinandi var ferdinandi	Cheese Tree													
Fabaceae	Acacia irrorata														
Fabaceae	Acacia irrorata ssp irrorata														
Lauraceae	*Cinnamomum camphora	Camphor Laurel										1			
Myrsinaceae	Avicennia marina	Grey Mangrove													
Myrtaceae	Eucalyptus robusta	Swamp Mahogany													
Myrtaceae	Eucalyptus tereticornis	Forest Red Gum													
Myrtaceae	Melaleuca quinquenervia	Broad-leaved Paperbark										6	5		
Proteaceae	Banksia integrifolia	Coast Banksia													
Santalaceae	Exocarpos cupressiformis	Cherry Ballart													
Shrubs															
Anacardiaceae	?*Pistacia sp.														1
Asteraceae	Ozothamnus diosmifolius	White Dogwood													

**Table A.1 FLORA SPECIES (QUADRATS 1-13)**

Family	Scientific Name	Common Name	2007 Quadrats												
			1	2	3	4	5	6	7	8	9	10	11	12	13
Asteraceae	*Chrysanthemoides monilifera ssp rotundata	Bitou Bush				2			1		2				
Casuarinaceae	Casuarina glauca	Swamp Oak sapling	x	x		x	1			x			2		
Epacridaceae	Leucopogon ?parviflora														
Epacridaceae	Monotoca elliptica	Coast Broom Heath													
Euphorbiaceae	Breynia oblongifolia	Dwarfs Apples													
Euphorbiaceae	Glochidion ferdinandi var pubens	Hairy Cheese Tree saplings													
Euphorbiaceae	Omalanthus nutans	Bleeding Heart											1		
Euphorbiaceae	Glochidion ferdinandi var ferdinandi	Cheese Tree saplings													
Fabaceae	Acacia longifolia	Sydney Golden Wattle													
Fabaceae	Acacia melanoxylon	Blackwood													
Goodeniaceae	Goodenia ovata														
Malaceae	*Raphiolepis indica	Indian Hawthorn											1		
Myoporaceae	Myoporum acuminatum	Corkwood													
Myrsinaceae	Avicenna marina	Grey Mangrove saplings													
Myrsinaceae	Rapanea howittiana	Howitts Muttonwood											3		
Myrtaceae	Melaleuca quinquenervia	Broad-leaved Paperbark saplings												1	
Myrtaceae	Melaleuca ericifolia	Swamp Paperbark					adj	adj	2		x		2		

**Table A.1 FLORA SPECIES (QUADRATS 1-13)**

Family	Scientific Name	Common Name	2007 Quadrats													
			1	2	3	4	5	6	7	8	9	10	11	12	13	
Pittosporaceae	Pittosporum revolutum	Yellow Pittosporum														
Proteaceae	Persoonia katerae															
Santalaceae	Exocarpos cupressiformis	Cherry Ballart														
Sapindaceae	Dodonaea triquetra	Common Hopbush													adj	
Verbenaceae	Aegiceras corniculata	River Mangrove														
Verbenaceae	*Lantana camara	Lantana														
Herbs - ferns																
Blechnaceae	Blechnum indicum	Swamp Fern													5	
Dennstaedtiaceae	Histiopteris incisa	Bats Wing Fern													2	
Dennstaedtiaceae	Hypolepis muelleri	Harsh Ground Fern													5	
Dennstaedtiaceae	Pteridium esculentum	Bracken Fern													5	
Sinopteridaceae	*Pellaea falcata cv	Sickle Fern														
Thelypteridaceae	Cyclosorus interruptus														adj	
Herbs - dicots																
Amaranthaceae	Alternanthera denticulata															1
Apiaceae	*Hydrocotyle bonariensis			3			2			4	1	4	4	5		
Apiaceae	Apium prostratum var filiforme	Sea Celery					3	7			3					
Apiaceae	Apium prostratum var prostratum	Sea Celery					3									2

**Table A.1 FLORA SPECIES (QUADRATS 1-13)**

Family	Scientific Name	Common Name	2007 Quadrats													
			1	2	3	4	5	6	7	8	9	10	11	12	13	
Apiaceae	Hydrocotyle pedunculata															
Asclepiadaceae	*Gomphocarpus fruticosus	Milkweed														
Asteraceae	*Ageratina adenophora	Crofton Weed														
Asteraceae	*Aster subulatus			x				3		2		3		2		
Asteraceae	*Conyza sp	a Fleabane					2									
Asteraceae	*Hypochaeris radicata	Flatweed														
Asteraceae	*Senecio madagascariensis	Fireweed														1
Asteraceae	*Sonchus oleraceus	Sow Thistle														2
Asteraceae	*Taraxacum officinale	Dandelion														
Asteraceae	Cotula australis													4		
Asteraceae	Cotula coronopifolia	Water Buttons					2	2		1		2				1
Asteraceae	Empodisma minor															
Asteraceae	Senecio hispidulus															1
Asteraceae	Vernonia cinerea															
Chenopodiaceae	Atriplex austalastica						3									
Chenopodiaceae	Einadia hastata															
Chenopodiaceae	Sarcornia quinqueflora	Samphire	7				1							3	6	
Chenopodiaceae	Suada australis	Seablite					1									
Convolvulaceae	Dichondra repens	Kidney Plant														
Fabaceae	*Melilotus indica	Hexham Scent											2			

**Table A.1 FLORA SPECIES (QUADRATS 1-13)**

Family	Scientific Name	Common Name	2007 Quadrats													
			1	2	3	4	5	6	7	8	9	10	11	12	13	
Fabaceae	*Trifolium repens	White Clover		x									2			
Fabaceae	Desmodium varians	Tick Trefoil														
Geraniaceae	Geranium homeanum	Trailing Storksbill											adj			
Lamiaceae	Plectranthus parviflorus	Cockspur Flower														
Lobeliaceae	Pratia purpurascens	Whiteroot														
Lythraceae	Lythrum hyssopifolium					2				1						
Malvaceae	*Sida rhombifolia	Paddys Lucerne														
Onagraceae	Epilobium sp															
Polygonaceae	Persicaria strigosa	Spotted Knotweed											3			
Primulaceae	Samolus repens	Creeping Brookweed														1
Ranunculaceae	Ranunculus inundata															2
Ranunculaceae	Ranunculus lappaceus															
Rubiaceae	Pomax umbellata															
Solanaceae	*Solanum nigrum	Blackberry Nightshade														
Violaceae	Viola hederacea	Native Violet														
Herbs - monocots																
Commelinaceae	Commelina cyanea	Blue Wandering Jew														
Cyperaceae	Baumea juncea															2
Cyperaceae	Carex appressa												1			

**Table A.1 FLORA SPECIES (QUADRATS 1-13)**

Family	Scientific Name	Common Name	2007 Quadrats													
			1	2	3	4	5	6	7	8	9	10	11	12	13	
Cyperaceae	<i>Cyperus polystachyos</i>										3		2			
Cyperaceae	<i>Gahnia clarkei</i>	a Saw Sedge											2			
Cyperaceae	<i>Isolepis</i> sp					3					adj					
Cyperaceae	<i>Schoenoplectus validus</i>	River Club Rush				x										
Juncaceae	<i>Juncus krausii</i>	Sea Rush	5	4	8	5	2	2	4	2	2			3	6	5
Juncaceae	<i>Juncus prismatocarpus</i>										2					
Juncaceae	<i>Juncus</i> sp										1					
Juncaceae	<i>Juncus</i> sp													2		
Juncaginaceae	<i>Triglochin striata</i>	Streaked Arrowgrass	3	x				6						2	7	3
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush														
Orchidaceae	<i>Caladenia carnea</i>															
Orchidaceae	<i>Cryptostylis</i> sp.	Tongue Orchid														
Orchidaceae	<i>Pterostylis ?collina</i>	a Greenhood														
Phormiaceae	<i>Dianella caerulea</i>	Flax Lily														
Phormiaceae	<i>Dianella longifolia</i>															
Poaceae	* <i>Bromus catharticus</i>	Prairie Grass											adj			
Poaceae	* <i>Cynodon dactylon</i>	Couch Grass		x		2					6	3	5			
Poaceae	* <i>Ehrharta erecta</i>	Veldt Grass														4
Poaceae	* <i>Lolium perenne</i>	Perennial Rye		x												
Poaceae	* <i>Paspalum dilatatum</i>	Paspalum										2				

**Table A.1 FLORA SPECIES (QUADRATS 1-13)**

Family	Scientific Name	Common Name	2007 Quadrats													
			1	2	3	4	5	6	7	8	9	10	11	12	13	
Poaceae	* <i>Pennisetum clandestinum</i>	Kikuyu										2				
Poaceae	* <i>Poa annua</i>	Winter Grass												2		
Poaceae	* <i>Setaria</i> sp.	a Pigeon Grass														
Poaceae	* <i>Stenotaphrum succedanea</i>	Buffalo grass		8					8	2	6			7		
Poaceae	<i>Agrostis avenacea</i>	Blown Grass												2		
Poaceae	<i>Echonopogon caespitosus</i>	Hedgehog Grass														
Poaceae	<i>Entolasia marginata</i>	Margined Panic														
Poaceae	<i>Entolasia stricta</i>	Wiry Panic														
Poaceae	<i>Imperata cylindrica</i> var major	Blady Grass		x					adj							
Poaceae	<i>Microlaena stipoides</i>	Weeping Meadow-grass														
Poaceae	<i>Oplismenus aemulus</i>	Basket Grass														
Poaceae	<i>P distichum</i>	Water Couch												1		
Poaceae	<i>Phragmites australis</i>	Common Reed		x								3				
Poaceae	<i>Sporobolus virginicus</i>	Sea Couch	3		4	3			2				2		5	3
Poaceae	<i>Themeda australis</i>	Kangaroo Grass														
Typhaceae	<i>Typha orientalis</i>	Cumbungi												adj		
Vines																
Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod												2		
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine														

**Table A.1 FLORA SPECIES (QUADRATS 1-13)**

Family	Scientific Name	Common Name	2007 Quadrats													
			1	2	3	4	5	6	7	8	9	10	11	12	13	
Fabaceae	<i>Glycine clandestina</i>	Love Creeper														
Fabaceae	<i>Kennedia rubicunda</i>	Dusky Coral Pea											2			
Lauraceae	<i>Cassytha pubescens</i>	Devils Twine														
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry														
Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily														
Menispermaceae	<i>Stephania japonica</i> var <i>discolor</i>	Tape Vine														
Ranunculaceae	<i>Clematis glycinoides</i>	Travellers Joy														
Rosaceae	* <i>Rubus fruticosus</i>	Blackberry											1			
Epiphytes																
Orchidaceae	<i>Dendrobium teretifolium</i>	Spider Orchid														

**KEY**

Cover abundance in 20 x 20 quadrats

1 = rare

2 = occasional

3 = common but less than 5%

4 = very common but less

**Table A.1 FLORA SPECIES (QUADRATS 1-13)**

Family	Scientific Name	Common Name	2007 Quadrats												
			1	2	3	4	5	6	7	8	9	10	11	12	13
than 5%															
5 = 5-25%															
6 = 26-50%															
7 = 51-75%															
8 = >75%															
* = introduced species															
adj = occurs adjacent to quadrat in similar community															
x = occurs in community indicated but not in quadrat or adjacent to it															

**Table A.2 FLORA SPECIES LIST (QUADRATS 14-22 AND TRANSECTS 1-3)**

Family	Scientific Name	Common Name	2007 Quadrats										2007 Transects		
			14	15	16	17	18	19	20	21	22	T1	T2	T3	
Trees															
Casuarinaceae	Casuarina glauca	Swamp Oak			6		5		6	6	6	x	x	x	
Euphorbiaceae	Glochidion ferdinandi var pubens	Hairy Cheese Tree	1												
Euphorbiaceae	Glochidion ferdinandi var ferdinandi	Cheese Tree	5	5											

**Table A.2 FLORA SPECIES LIST (QUADRATS 14-22 AND TRANSECTS 1-3)**

Family	Scientific Name	Common Name	2007 Quadrats										2007 Transects			
			14	15	16	17	18	19	20	21	22	T1	T2	T3		
Fabaceae	<i>Acacia irrorata</i>		3													
Fabaceae	<i>Acacia irrorata</i> ssp <i>irrorata</i>												x			
Lauraceae	* <i>Cinnamomum camphora</i>	Camphor Laurel														
Myrsinaceae	<i>Avicennia marina</i>	Grey Mangrove								1			adj		x	
Myrtaceae	<i>Eucalyptus robusta</i>	Swamp Mahogany	5	2											x	
Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Red Gum	5												x	
Myrtaceae	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	5	6			1						x	x		
Proteaceae	<i>Banksia integrifolia</i>	Coast Banksia	1												x	
Santalaceae	<i>Exocarpos cupressiformis</i>	Cherry Ballart	2													
Shrubs																
Anacardiaceae	?* <i>Pistacia</i> sp.										adj					
Asteraceae	<i>Ozothamnus diosmifolius</i>	White Dogwood											x			
Asteraceae	* <i>Chrysanthemoides monilifera</i> ssp <i>rotundata</i>	Bitou Bush	3	3	2		1						x	x		
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak sapling			2					4	5	5				
Epacridaceae	<i>Leucopogon</i> ? <i>parviflora</i>		3													
Epacridaceae	<i>Monotoca elliptica</i>	Coast Broom Heath	1												x	
Euphorbiaceae	<i>Breynia oblongifolia</i>	Dwarfs Apples	3										x	x		
Euphorbiaceae	<i>Glochidion ferdinandi</i> var <i>pubens</i>	Hairy Cheese Tree saplings		1												

**Table A.2 FLORA SPECIES LIST (QUADRATS 14-22 AND TRANSECTS 1-3)**

Family	Scientific Name	Common Name	2007 Quadrats										2007 Transects			
			14	15	16	17	18	19	20	21	22	T1	T2	T3		
Euphorbiaceae	Omalanthus nutans	Bleeding Heart		1												
Euphorbiaceae	Glochidion ferdinandi var ferdinandi	Cheese Tree saplings		5	2											x
Fabaceae	Acacia longifolia	Sydney Golden Wattle			2											
Fabaceae	Acacia melanoxylon	Blackwood											x			
Goodeniaceae	Goodenia ovata		3	3	4										x	x
Malaceae	*Raphiolepis indica	Indian Hawthorn														
Myoporaceae	Myoporum acuminatum	Corkwood			2		1						x			
Myrsinaceae	Avicenna marina	Grey Mangrove saplings					2			3						
Myrsinaceae	Rapanea howittiana	Howitts Muttonwood	3		2											x
Myrtaceae	Melaleuca quinquenervia	Broad-leaved Paperbark saplings														
Myrtaceae	Melaleuca ericifolia	Swamp Paperbark	1	2	2								x		x	
Pittosporaceae	Pittosporum revolutum	Yellow Pittosporum	2													
Proteaceae	Persoonia katerae															x
Santalaceae	Exocarpos cupressiformis	Cherry Ballart											x		x	
Sapindaceae	Dodonaea triquetra	Common Hopbush														
Verbenaceae	Aegiceras corniculata	River Mangrove														x
Verbenaceae	*Lantana camara	Lantana	3	3	5								x		x	

**Table A.2 FLORA SPECIES LIST (QUADRATS 14-22 AND TRANSECTS 1-3)**

Family	Scientific Name	Common Name	2007 Quadrats										2007 Transects		
			14	15	16	17	18	19	20	21	22	T1	T2	T3	
Herbs - ferns															
Blechnaceae	Blechnum indicum	Swamp Fern													
Dennstaedtiaceae	Histiopteris incisa	Bats Wing Fern													
Dennstaedtiaceae	Hypolepis muelleri	Harsh Ground Fern													
Dennstaedtiaceae	Pteridium esculentum	Bracken Fern	4	5								x			
Sinopteridaceae	*Pellaea falcata cv	Sickle Fern			2										
Thelypteridaceae	Cyclosorus interruptus														
Herbs - dicots															
Amaranthaceae	Alternanthera denticulata														
Apiaceae	*Hydrocotyle bonariensis														
Apiaceae	Apium prostratum var filiforme	Sea Celery													
Apiaceae	Apium prostratum var prostratum	Sea Celery													
Apiaceae	Hydrocotyle pedunculata			2											
Asclepiadaceae	*Gomphocarpus fruticosus	Milkweed		2											
Asteraceae	*Ageratina adenophora	Crofton Weed		2											
Asteraceae	*Aster subulatus													x	
Asteraceae	*Conyza sp	a Fleabane		3	1							x			
Asteraceae	*Hypochaeris radicata	Flatweed	3	3											
Asteraceae	*Senecio madagascariensis	Fireweed	1	2											

**Table A.2 FLORA SPECIES LIST (QUADRATS 14-22 AND TRANSECTS 1-3)**

Family	Scientific Name	Common Name	2007 Quadrats										2007 Transects		
			14	15	16	17	18	19	20	21	22	T1	T2	T3	
Asteraceae	* <i>Sonchus oleraceus</i>	Sow Thistle											x	x	
Asteraceae	* <i>Taraxacum officinale</i>	Dandelion												x	
Asteraceae	<i>Cotula australis</i>										adj		x		
Asteraceae	<i>Cotula coronopifolia</i>	Water Buttons											adj		
Asteraceae	<i>Empodisma minor</i>				1										
Asteraceae	<i>Senecio hispidulus</i>		2	2	1								x		
Asteraceae	<i>Vernonia cinerea</i>		1												
Chenopodiaceae	<i>Atriplex austalasia</i>														
Chenopodiaceae	<i>Einadia hastata</i>												x		x
Chenopodiaceae	<i>Sarcornia quinqueflora</i>	Samphire				8	2								
Chenopodiaceae	<i>Suada australis</i>	Seablite													x
Convolvulaceae	<i>Dichondra repens</i>	Kidney Plant	3										x	x	
Fabaceae	* <i>Melilotus indica</i>	Hexham Scent													
Fabaceae	* <i>Trifolium repens</i>	White Clover													
Fabaceae	<i>Desmodium varians</i>	Tick Trefoil											x		
Geraniaceae	<i>Geranium homeanum</i>	Trailing Storksbill													
Lamiaceae	<i>Plectranthus parviflorus</i>	Cockspur Flower			2								x		
Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot	2											x	
Lythraceae	<i>Lythrum hyssopifolium</i>														
Malvaceae	* <i>Sida rhombifolia</i>	Paddys Lucerne												x	

**Table A.2 FLORA SPECIES LIST (QUADRATS 14-22 AND TRANSECTS 1-3)**

Family	Scientific Name	Common Name	2007 Quadrats										2007 Transects			
			14	15	16	17	18	19	20	21	22	T1	T2	T3		
Onagraceae	Epilobium sp			1												
Polygonaceae	Persicaria strigosa	Spotted Knotweed														
Primulaceae	Samolus repens	Creeping Brookweed														
Ranunculaceae	Ranunculus inundata															
Ranunculaceae	Ranunculus lappaceus			1												
Rubiaceae	Pomax umbellata		2													
Solanaceae	*Solanum nigrum	Blackberry Nightshade											x			
Violaceae	Viola hederacea	Native Violet	3	3	1										x	
Herbs - monocots																
Commelinaceae	Commelina cyanea	Blue Wandering Jew			1											
Cyperaceae	Baumea juncea			2	2		4								x	x
Cyperaceae	Carex appressa		1													
Cyperaceae	Cyperus polystachyos															
Cyperaceae	Gahnia clarkei	a Saw Sedge	4	3	5					3	4		x	x		
Cyperaceae	Isolepis sp															
Cyperaceae	Schoenoplectus validus	River Club Rush														
Juncaceae	Juncus krausii	Sea Rush				1	5	3	5	4	3	x	x	x		
Juncaceae	Juncus prismatocarpus															
Juncaceae	Juncus sp															

**Table A.2 FLORA SPECIES LIST (QUADRATS 14-22 AND TRANSECTS 1-3)**

Family	Scientific Name	Common Name	2007 Quadrats										2007 Transects				
			14	15	16	17	18	19	20	21	22	T1	T2	T3			
Juncaceae	Juncus sp																
Juncaginaceae	Triglochin striata	Streaked Arrowgrass									3						
Lomandraceae	Lomandra longifolia	Spiny-headed Mat-rush	3										x				
Orchidaceae	Caladenia carnea															x	
Orchidaceae	Cryptostylis sp.	Tongue Orchid			2												
Orchidaceae	Pterostylis ?collina	a Greenhood	adj														
Phormiaceae	Dianella caerulea	Flax Lily	2	2	1								x				
Phormiaceae	Dianella longifolia															x	
Poaceae	*Bromus catharticus	Prairie Grass															
Poaceae	*Cynodon dactylon	Couch Grass						3		2						x	
Poaceae	*Ehrharta erecta	Veldt Grass			2												x
Poaceae	*Lolium perenne	Perennial Rye															
Poaceae	*Paspalum dilatatum	Paspalum															
Poaceae	*Pennisetum clandestinum	Kikuyu															
Poaceae	*Poa annua	Winter Grass															
Poaceae	*Setaria sp.	a Pigeon Grass			2												
Poaceae	*Stenotaphrum succedanea	Buffalo grass															x
Poaceae	Agrostis avenacea	Blown Grass															
Poaceae	EchNOPogon caespitosus	Hedgehog Grass			2												
Poaceae	Entolasia marginata	Margined Panic	1	2	2												

**Table A.2 FLORA SPECIES LIST (QUADRATS 14-22 AND TRANSECTS 1-3)**

Family	Scientific Name	Common Name	2007 Quadrats										2007 Transects		
			14	15	16	17	18	19	20	21	22	T1	T2	T3	
Poaceae	<i>Entolasia stricta</i>	Wiry Panic	3	2									x		
Poaceae	<i>Imperata cylindrica</i> var <i>major</i>	Blady Grass	1	3									x		x
Poaceae	<i>Microlaena stipoides</i>	Weeping Meadow-grass	2										x		
Poaceae	<i>Oplismenus aemulus</i>	Basket Grass	1	2	2										
Poaceae	<i>P distichum</i>	Water Couch													
Poaceae	<i>Phragmites australis</i>	Common Reed											x		x
Poaceae	<i>Sporobolus virginicus</i>	Sea Couch				1	6	7			6	adj	x		
Poaceae	<i>Themeda australis</i>	Kangaroo Grass	4	3											
Typhaceae	<i>Typha orientalis</i>	Cumbungi													x
Vines															
Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod	3		3								x	x	
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine	3											x	
Fabaceae	<i>Glycine clandestina</i>	Love Creeper	2	2										x	
Fabaceae	<i>Kennedia rubicunda</i>	Dusky Coral Pea	2	2									x		
Lauraceae	<i>Cassytha pubescens</i>	Devils Twine	1	1	2								x	x	
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry	2												
Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily	2												
Menispermaceae	<i>Stephania japonica</i> var <i>discolor</i>	Tape Vine	adj												
Ranunculaceae	<i>Clematis glycinoides</i>	Travellers Joy	3	1											x

**Table A.2 FLORA SPECIES LIST (QUADRATS 14-22 AND TRANSECTS 1-3)**

Family	Scientific Name	Common Name	2007 Quadrats									2007 Transects				
			14	15	16	17	18	19	20	21	22	T1	T2	T3		
Rosaceae	* <i>Rubus fruticosus</i>	Blackberry														
Epiphytes																
Orchidaceae	<i>Dendrobium teretifolium</i>	Spider Orchid			3						3	2				

**KEY**

Cover abundance in 20 x 20 quadrats

1 = rare

2 = occasional

3 = common but less than 5%

4 = very common but less than 5%

5 = 5-25%

6 = 26-50%

7 = 51-75%

8 = >75%

\* = introduced species

adj = occurs adjacent to quadrat in similar community

x = occurs in community indicated but not in quadrat or adjacent to it

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*Appendix B*

**Fauna Species List**

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**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Amphibia							
Hylidae	<i>Litoria aurea</i>	Green and Golden Bell Frog	V	E1	2		
	<i>Litoria caerulea</i>	Green Tree Frog		P	7		
	<i>Litoria dentata</i>	Bleating Tree Frog		P	5		
	<i>Litoria fallax</i>	Eastern Dwarf Tree Frog		P	54		
	<i>Litoria freycineti</i>	Freycinet's Frog		P	5		
	<i>Litoria gracilentata</i>	Dainty Green Tree Frog		P	1		
	<i>Litoria jervisiensis</i>	Jervis Bay Tree Frog		P	2		
	<i>Litoria latopalmata</i>	Broad-palmed Frog		P	33		
	<i>Litoria lesueuri</i>	Lesueur's Frog		P	3		
	<i>Litoria nasuta</i>	Rocket Frog		P	1		
	<i>Litoria peronii</i>	Peron's Tree Frog		P	33		
	<i>Litoria phyllochroa</i>	Leaf-green Tree Frog		P	2		
<i>Litoria tyleri</i>	Tyler's Tree Frog		P	8			

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Myobatrachidae	<i>Litoria verreauxii</i>	Verreaux's Frog		P	7		
	<i>Adelotus brevis</i>	Tusked Frog		P	11		
	<i>Crinia signifera</i>	Common Eastern Froglet		P	65	C	C, O, Ob
	<i>Crinia tinnula</i>	Wallum Froglet		V	31		C
	<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog		P	7		
	<i>Limnodynastes ornatus</i>	Ornate Burrowing Frog		P	10		
	<i>Limnodynastes peronii</i>	Brown-striped Frog		P	36		
	<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog		P	16		
	<i>Mixophyes fasciolatus</i>	Great Barred Frog		P	3		
	<i>Paracrinia haswelli</i>	Haswell's Froglet		P	5		
	<i>Pseudophryne bibronii</i>	Bibron's Toadlet		P	10		
	<i>Pseudophryne coriacea</i>	Red-backed Toadlet		P	21		
	<i>Pseudophryne sp.</i>			P	2		
	<i>Uperoleia fusca</i>	Dusky Toadlet		P	7		
	<i>Uperoleia laevigata</i>	Smooth Toadlet		P	13		

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Aves							
Acanthizidae	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill		P	8	R,C	O
	<i>Acanthiza lineata</i>	Striated Thornbill		P	21		TS
	<i>Acanthiza nana</i>	Yellow Thornbill		P	12		TS
	<i>Acanthiza pusilla</i>	Brown Thornbill		P	39	R	TS
	<i>Acanthiza reguloides</i>	Buff-rumped Thornbill		P	7		
	<i>Calamanthus pyrrhopygius</i>	Chestnut-rumped Heathwren		P	3		
	<i>Gerygone fusca</i>	Western Gerygone		P	1		
	<i>Gerygone mouki</i>	Brown Gerygone		P	8		TS
	<i>Gerygone olivacea</i>	White-throated Gerygone		P	24		TS
	<i>Pyrrholaemus sagittatus</i>	Speckled Warbler		V	2		
	<i>Sericornis frontalis</i>	White-browed Scrubwren		P	30		TS
	<i>Sericornis magnirostris</i>	Large-billed Scrubwren		P	0		TS
	<i>Smicronis brevirostris</i>	Weebill		P	2		
Accipitridae	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk		P	7		
	<i>Accipiter fasciatus</i>	Brown Goshawk		P	8		

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
	<i>Accipiter novaehollandiae</i>	Grey Goshawk		P	5		
	<i>Aquila audax</i>	Wedge-tailed Eagle		P	8		
	<i>Aviceda subcristata</i>	Pacific Baza		P	7		
	<i>Circus approximans</i>	Swamp Harrier		P	7		
	<i>Circus assimilis</i>	Spotted Harrier		P	2		
	<i>Elanus axillaris</i>	Black-shouldered Kite		P	14		
	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle		P	472		O
	<i>Haliastur sphenurus</i>	Whistling Kite		P	26	R, C	TS
	<i>Hieraaetus morphnoides</i>	Little Eagle		P	4		
	<i>Milvus migrans</i>	Black Kite		P	3		
	<i>Pandion haliaetus</i>	Osprey		V	7		
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar		P	14		
Alcedinidae	<i>Alcedo azurea</i>	Azure Kingfisher		P	2		
	<i>Dacelo novaeguineae</i>	Laughing Kookaburra		P	73	R, C	TS
	<i>Todiramphus sanctus</i>	Sacred Kingfisher		P	37	R, C	TS
Anatidae	<i>Anas castanea</i>	Chestnut Teal		P	17		TS

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
	<i>Anas gracilis</i>	Grey Teal		P	9		
	<i>Anas rhynchotis</i>	Australasian Shoveler		P	2		
	<i>Anas superciliosa</i>	Pacific Black Duck		P	34		TS
	<i>Aythya australis</i>	Hardhead		P	5		
	<i>Biziura lobata</i>	Musk Duck		P	3		
	<i>Chenonetta jubata</i>	Australian Wood Duck		P	24		O
	<i>Cygnus atratus</i>	Black Swan		P	15		
	<i>Dendrocygna arcuata</i>	Wandering Whistling-Duck		P	4		
	<i>Dendrocygna eytoni</i>	Plumed Whistling-Duck		P	2		
	<i>Malacorhynchus membranaceus</i>	Pink-eared Duck		P	2		
	<i>Oxyura australis</i>	Blue-billed Duck		V	1		
	<i>Stictonetta naevosa</i>	Freckled Duck		V	1		
	<i>Tadorna tadornoides</i>	Australian Shelduck		P	2		
Anhingidae	<i>Anhinga melanogaster</i>	Darter		P	5		
Anseranatidae	<i>Anseranas semipalmata</i>	Magpie Goose		V	15		

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Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Apodidae	Apus pacificus	Fork-tailed Swift		P	1		
	Hirundapus caudacutus	White-throated Needletail		P	8		
Ardeidae	Ardea alba	Great Egret		P	15		
	Ardea intermedia	Intermediate Egret		P	10		
	Ardea pacifica	White-necked Heron		P	11	R	O
	Botaurus poiciloptilus	Australasian Bittern		V	4		
	Bubulcus ibis	Cattle Egret		P	25		TS
	Butorides striatus	Striated Heron		P	1		
	Egretta garzetta	Little Egret		P	7		
	Egretta novaehollandiae	White-faced Heron		P	30		TS
	Egretta sacra	Eastern Reef Egret		P	1		
	Ixobrychus flavicollis	Black Bittern		V	2		O
	Nycticorax caledonicus	Nankeen Night Heron		P	6		
Artamidae	Artamus cyanopterus	Dusky Woodswallow		P	13		
	Artamus leucorhynchus	White-breasted Woodswallow		P	7	R	
	Artamus superciliosus	White-browed Woodswallow		P	2		TS

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
	<i>Cracticus nigrogularis</i>	Pied Butcherbird		P	24		TS
	<i>Cracticus torquatus</i>	Grey Butcherbird		P	43		TS
	<i>Gymnorhina tibicen</i>	Australian Magpie		P	66	R	TS
	<i>Strepera graculina</i>	Pied Currawong		P	45	R	TS
Burhinidae	<i>Burhinus grallarius</i>	Bush Stone-curlew		E1	5		
Cacatuidae	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo		P	17	R, C	TS
	<i>Cacatua sanguinea</i>	Little Corella		P	10		
	<i>Cacatua tenuirostris</i>	Long-billed Corella		P	2		
	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo		V	2		
	<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo		P	31		O
	<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo		V	20		
	<i>Eolophus roseicapillus</i>	Galah		P	34	R, C	TS
Campephagidae	<i>Coracina maxima</i>	Ground Cuckoo-shrike		P	2		
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		P	64	R	TS
	<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike		P	5		
	<i>Coracina tenuirostris</i>	Cicadabird		P	9		TS

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
	Lalage tricolor	White-winged Triller		P	4		
Caprimulgidae	Eurostopodus mystacalis	White-throated Nightjar		P	10		O
Casuariidae	Dromaius novaehollandiae	Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area		E2	9		
	Dromaius novaehollandiae	Emu		P	9		
Centropodidae	Centropus phasianinus	Pheasant Coucal		P	20		TS
Charadriidae	Charadrius bicinctus	Double-banded Plover		P	2		
	Charadrius mongolus	Lesser Sand-plover		V	1		
	Charadrius ruficapillus	Red-capped Plover		P	2		
	Euseyornis melanops	Black-fronted Dotterel		P	3		
	Pluvialis fulva	Pacific Golden Plover		P	2		
	Vanellus miles	Masked Lapwing		P	39	R, C	TS
	Vanellus tricolor	Banded Lapwing		P	2		
Ciconiidae	Ephippiorhynchus asiaticus	Black-necked Stork		E1	52		

**Table B.1 FAUNA SPECIES**

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					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Cisticolidae	Cisticola exilis	Golden-headed Cisticola		P	2		
Climacteridae	Climacteris picumnus	Brown Treecreeper		V	3		
	Cormobates leucophaea	White-throated Treecreeper		P	39		TS
Columbidae	Chalcophaps indica	Emerald Dove		P	2		
	Columba leucomela	White-headed Pigeon		P	1		
	Columba livia*	Rock Dove		U	5		
	Geopelia humeralis	Bar-shouldered Dove		P	18		TS
	Geopelia placida	Peaceful Dove		P	5		
	Leucosarcia melanoleuca	Wonga Pigeon		P	6		
	Macropygia amboinensis	Brown Cuckoo-Dove		P	3		
	Ocyphaps lophotes	Crested Pigeon		P	36		O
	Phaps chalcoptera	Common Bronzewing		P	1		O
	Phaps elegans	Brush Bronzewing		P	5		
	Ptilinopus magnificus	Wompoo Fruit-Dove		V	4		
	Ptilinopus superbus	Superb Fruit-Dove		V	2		
	Streptopelia chinensis*	Spotted Turtle-Dove		U	19	R	TS

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Coraciidae	Eurystomus orientalis	Dollarbird		P	23		TS
Corcoracidae	Corcorax melanorhamphos	White-winged Chough		P	15		
Corvidae	Corvus coronoides	Australian Raven		P	57	R	TS
	Corvus orru	Torresian Crow		P	5		TS
	Corvus tasmanicus	Forest Raven		P	1		
Cuculidae	Cacomantis flabelliformis	Fan-tailed Cuckoo		P	27		
	Cacomantis variolosus	Brush Cuckoo		P	4		O
	Chalcites basalis	Horsfield's Bronze-Cuckoo		P	4		TS
	Chalcites lucidus	Shining Bronze-Cuckoo		P	10		TS
	Cuculus pallidus	Pallid Cuckoo		P	8		TS
	Cuculus saturatus	Oriental Cuckoo		P	1		
	Eudynamys orientalis	Pacific Koel		P	29		
	Eudynamis scolopacea	Common Koel		n/a	0		TS
	Scythrops novaehollandiae	Channel-billed Cuckoo		P	25		TS
	Dicaeidae	Dicaeum hirundinaceum	Mistletoebird		P	16	
Dicruridae	Dicrurus bracteatus	Spangled Drongo		P	8		

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	Database Records of Fauna within the Port				
			EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
	<i>Grallina cyanoleuca</i>	Magpie-lark		P	34	R	TS
	<i>Monarcha melanopsis</i>	Black-faced Monarch		P	13		
	<i>Myiagra cyanoleuca</i>	Satin Flycatcher		P	4		TS
	<i>Myiagra inquieta</i>	Restless Flycatcher		P	3		
	<i>Myiagra rubecula</i>	Leaden Flycatcher		P	15		TS
	<i>Rhipidura albiscapa</i>	Grey Fantail		P	61	R, C	TS
	<i>Rhipidura leucophrys</i>	Willie Wagtail		P	35	R, C	TS
	<i>Rhipidura rufifrons</i>	Rufous Fantail		P	17		TS
Estrildidae	<i>Neochmia temporalis</i>	Red-browed Finch		P	37	R	TS
	<i>Taeniopygia bichenovii</i>	Double-barred Finch		P	1		
Eupetidae	<i>Cinclosoma punctatum</i>	Spotted Quail-thrush		P	2		
	<i>Psophodes olivaceus</i>	Eastern Whipbird		P	46		TS
Falconidae	<i>Falco berigora</i>	Brown Falcon		P	7		
	<i>Falco cenchroides</i>	Nankeen Kestrel		P	10		
	<i>Falco longipennis</i>	Australian Hobby		P	5		
	<i>Falco peregrinus</i>	Peregrine Falcon		P	7		TS

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
	<i>Falco subniger</i>	Black Falcon		P	1		
Fringillidae	<i>Carduelis carduelis*</i>	European Goldfinch		U	2		
Haematopodidae	<i>Haematopus fuliginosus</i>	Sooty Oystercatcher		V	10		
	<i>Haematopus longirostris</i>	Pied Oystercatcher		V	9		
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow		P	32		O
	<i>Petrochelidon ariel</i>	Fairy Martin		P	5		
	<i>Petrochelidon nigricans</i>	Tree Martin		P	3		
Jacanidae	<i>Irediparra gallinacea</i>	Comb-crested Jacana		V	2		
Laridae	<i>Chlidonias hybridus</i>	Whiskered Tern		P	1		
	<i>Chlidonias leucopterus</i>	White-winged Black Tern		P	2		
	<i>Larus novaehollandiae</i>	Silver Gull		P	13		
	<i>Sterna bergii</i>	Crested Tern		P	5		
	<i>Sterna caspia</i>	Caspian Tern		P	4		
Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren		P	56	R, C	TS
	<i>Malurus lamberti</i>	Variegated Fairy-wren		P	32		TS
	<i>Stipiturus malachurus</i>	Southern Emu-wren		P	7		TS

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Megapodiidae	<i>Alectura lathamii</i>	Australian Brush-turkey		P	2		
Meliphagidae	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill		P	43	R, C	TS
	<i>Anthochaera carunculata</i>	Red Wattlebird		P	37		TS
	<i>Anthochaera chrysoptera</i>	Little Wattlebird		P	28	R, C	TS
	<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater		P	10		
	<i>Epthianura albifrons</i>	White-fronted Chat		P	2		
	<i>Gliciphila melanops</i>	Tawny-crowned Honeyeater		P	1		
	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater		P	67		TS
	<i>Lichenostomus fuscus</i>	Fuscous Honeyeater		P	5		
	<i>Lichenostomus leucotis</i>	White-eared Honeyeater		P	3		
	<i>Lichenostomus melanops</i>	Yellow-tufted Honeyeater		P	6		
	<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater		P	4		
	<i>Lichmera indistincta</i>	Brown Honeyeater		P	3		
	<i>Manorina melanocephala</i>	Noisy Miner		P	53	R	O
	<i>Manorina melanophrys</i>	Bell Miner		P	2		
	<i>Meliphaga lewinii</i>	Lewin's Honeyeater		P	31	R, C	TS

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act	TCA Act	Database Records of Fauna within the Port Stephens LGA <sup>3</sup>		
			Legal Status <sup>1</sup>	Legal Status <sup>2</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>	
	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater		P		13	
	<i>Melithreptus lunatus</i>	White-naped Honeyeater		P		16	
	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater		P		19	
	<i>Philemon citreogularis</i>	Little Friarbird		P		2	
	<i>Philemon corniculatus</i>	Noisy Friarbird		P		45	
	<i>Phylidonyris niger</i>	White-cheeked Honeyeater		P		24	R O
	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater		P		2	
	<i>Plectorhyncha lanceolata</i>	Striped Honeyeater		P		2	TS
	<i>Xanthomyza phrygia</i>	Regent Honeyeater	E	E1		2	
Menuridae	<i>Menura novaehollandiae</i>	Superb Lyrebird		P		2	
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater		P		2	
Motacillidae	<i>Anthus australis</i>	Australian Pipit		P		3	
Muscicapidae	<i>Zoothera</i> sp.	unidentified ground thrush		P		1	
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella		P		10	
Numididae	<i>Numida meleagris</i> *	Helmeted Guineafowl		U		1	
Oriolidae	<i>Oriolus sagittatus</i>	Olive-backed Oriole		P		26	TS

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
	<i>Sphecotheres vieilloti</i>	Australasian Figbird		P	5		
	<i>Sphecotheres viridis</i>	Figbird		n/a	0		TS
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrike-thrush		P	29		TS
	<i>Falcunculus frontatus</i>	Eastern Shrike-tit		P	3		TS
	<i>Pachycephala pectoralis</i>	Golden Whistler		P	30		TS
	<i>Pachycephala rufiventris</i>	Rufous Whistler		P	31		TS
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote		P	36		TS
	<i>Pardalotus striatus</i>	Striated Pardalote		P	15		
Passeridae	<i>Passer domesticus</i> *	House Sparrow		U	7		
Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican		P	25		
Petroicidae	<i>Eopsaltria australis</i>	Eastern Yellow Robin		P	34	R, C	TS
	<i>Microeca fascinans</i>	Jacky Winter		P	7		
	<i>Petroica boodang</i>	Scarlet Robin		P	5		
	<i>Petroica goodenovii</i>	Red-capped Robin		P	1		
	<i>Petroica rosea</i>	Rose Robin		P	1		
Phalacrocoracidae	<i>Phalacrocorax carbo</i>	Great Cormorant		P	15		

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	Database Records of Fauna within the Port				
			EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
	<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant		P	24		
	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant		P	17		
	<i>Phalacrocorax varius</i>	Pied Cormorant		P	5		
Phasianidae	<i>Coturnix pectoralis</i>	Stubble Quail		P	3		
	<i>Coturnix ypsilophora</i>	Brown Quail		P	6		
Pittidae	<i>Pitta versicolor</i>	Noisy Pitta		P	1		
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth		P	40		
Podicipedidae	<i>Podiceps cristatus</i>	Great Crested Grebe		P	1		
	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe		P	10		
Pomatostomidae	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler (eastern subspecies)		V	13		
Psittacidae	<i>Alisterus scapularis</i>	Australian King-Parrot		P	13		
	<i>Aprosmictus erythropterus</i>	Red-winged Parrot		P	1		
	<i>Glossopsitta concinna</i>	Musk Lorikeet		P	11		
	<i>Glossopsitta pusilla</i>	Little Lorikeet		P	16		
	<i>Lathamus discolor</i>	Swift Parrot	E	E1	23		

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Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
	<i>Neophema pulchella</i>	Turquoise Parrot		V	3		
	<i>Platycercus adscitus eximius</i>	Eastern Rosella		P	59	R	TS
	<i>Platycercus elegans</i>	Crimson Rosella		P	5		
	<i>Psephotus haematonotus</i>	Red-rumped Parrot		P	10		
	<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet		P	19		
	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet		P	37		TS
Ptilonorhynchidae	<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird		P	11		
	<i>Sericulus chrysocephalus</i>	Regent Bowerbird		P	1		
Rallidae	<i>Fulica atra</i>	Eurasian Coot		P	9		
	<i>Gallinula tenebrosa</i>	Dusky Moorhen		P	19		
	<i>Gallirallus philippensis</i>	Buff-banded Rail		P	2		
	<i>Lewinia pectoralis</i>	Lewin's Rail		P	1		
	<i>Porphyrio porphyrio</i>	Purple Swamphen		P	19		
	<i>Porzana fluminea</i>	Australian Spotted Crake		P	2		
	<i>Porzana pusilla</i>	Baillon's Crake		P	5		
	<i>Porzana tabuensis</i>	Spotless Crake		P	3		

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Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Recurvirostridae	Himantopus himantopus	Black-winged Stilt		P	8		
	Recurvirostra novaehollandiae	Red-necked Avocet		P	1		
Rostratulidae	Rostratula benghalensis	Painted Snipe (Australian subspecies)		E1	1		
Scolopacidae	Calidris acuminata	Sharp-tailed Sandpiper		P	4		
	Calidris melanotos	Pectoral Sandpiper		P	1		
	Calidris ruficollis	Red-necked Stint		P	1		
	Gallinago hardwickii	Latham's Snipe		P	16		TS
	Heteroscelus brevipes	Grey-tailed Tattler		P	2		
	Limosa lapponica	Bar-tailed Godwit		P	3		
	Numenius madagascariensis	Eastern Curlew		P	4		
	Numenius phaeopus	Whimbrel		P	4		
Spheniscidae	Tringa nebularia	Common Greenshank		P	1		
	Eudyptula minor	Little Penguin		P	1		
Stercorariidae	Stercorarius parasiticus	Arctic Jaeger		P	3		
Strigidae	Ninox boobook	Southern Boobook		P	21		

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Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
	<i>Ninox connivens</i>	Barking Owl		V	5		
	<i>Ninox strenua</i>	Powerful Owl		V	31		
Sturnidae	<i>Acridotheres tristis</i> *	Common Myna		U	22	R	O
	<i>Sturnus vulgaris</i> *	Common Starling		U	16		O
Sulidae	<i>Morus serrator</i>	Australasian Gannet		P	2		
Sylviidae	<i>Acrocephalus australis</i>	Australian Reed-Warbler		P	5		
	<i>Cincloramphus cruralis</i>	Brown Songlark		P	1		
	<i>Cincloramphus mathewsi</i>	Rufous Songlark		P	4		
	<i>Megalurus gramineus</i>	Little Grassbird		P	7		
	<i>Megalurus timoriensis</i>	Tawny Grassbird		P	2		
Threskiornithidae	<i>Platalea flavipes</i>	Yellow-billed Spoonbill		P	7		
	<i>Platalea regia</i>	Royal Spoonbill		P	20		O
	<i>Plegadis falcinellus</i>	Glossy Ibis		P	6		
	<i>Threskiornis molucca</i>	Australian White Ibis		P	19		TS
	<i>Threskiornis spinicollis</i>	Straw-necked Ibis		P	15		
Turnicidae	<i>Turnix pyrrhorostrax</i>	Red-chested Button-quail		P	1		

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Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Tytonidae	<i>Turnix varia</i>	Painted Button-quail		P	2		
	<i>Tyto alba</i>	Barn Owl		P	3		
	<i>Tyto capensis</i>	Grass Owl		V	3		
	<i>Tyto novaehollandiae</i>	Masked Owl		V	19		
Zosteropidae	<i>Zosterops lateralis</i>	Silvereeye		P	39		TS
Insecta							
Nymphalidae	<i>Heteronympha merope</i>	Common Brown		U	1		
Papilionidae	<i>Papilio aegaeus</i>	Large Citrus Butterfly		U	1		
Mammalia							
Acrobatidae	<i>Acrobates pygmaeus</i>	Feathertail Glider		P	15		
Balaenidae	<i>Eubalaena australis</i>	Southern Right Whale	E	V	1		
Balaenopteridae	<i>Megaptera novaeangliae</i>	Humpback Whale	V	V	1		
Bovidae	<i>Bos taurus</i> *	European cattle		U	5		
	<i>Capra hircus</i> *	Goat		U	1		Sc

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Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Burramyidae	<i>Cercartetus nanus</i>	Eastern Pygmy-possum		V	1		
Canidae	<i>Canis lupus familiaris</i> *	Dog		U	1		
	<i>Canis lupus</i> *	Dingo, domestic dog		U	32		
	<i>Vulpes vulpes</i> *	Fox		U	45		H, Sc
Dasyuridae	<i>Antechinus flavipes</i>	Yellow-footed Antechinus		P	35		
	<i>Antechinus</i> sp.	Unidentified Antechinus		P	5		Sc
	<i>Antechinus stuartii</i>	Brown Antechinus		P	132		T, S
	<i>Dasyuridae</i> sp.	unidentified dasyurid		P	1		
	<i>Dasyurus maculatus</i>	Spotted-tailed Quoll		V	46		
	<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale		V	62		
	<i>Sminthopsis murina</i>	Common Dunnart		P	8		
Delphinidae	<i>Delphinus delphis</i>	Common Dolphin		P	1		
	<i>Dolphin</i> sp.	Unidentified Dolphin		P	1		
	<i>Tursiops aduncus</i>	Long-beaked Bottle-nosed Dolphin		P	294		
	<i>Tursiops truncatus</i>	Bottlenose Dolphin		P	5		

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act	TCA Act	Database	2003/2004	2007
			Legal Status <sup>1</sup>	Legal Status <sup>2</sup>	Records of Fauna within the Port Stephens LGA <sup>3</sup>		
					Stephens	Surveys <sup>4</sup>	Surveys <sup>4,5</sup>
Dugongidae	Dugong dugon	Dugong		E1	9		
Emballonuridae	Saccolaimus flaviventris	Yellow-bellied Sheath-tail-bat		V	1		Poss
Equidae	Equus caballus*	Horse		U	8		
Felidae	Felis catus*	Cat		U	17		
Kogiidae	Kogia breviceps	Pygmy Sperm Whale		P	1		
Leporidae	Lepus capensis*	Brown Hare		U	16	R	
	Oryctolagus cuniculus*	Rabbit		U	30		H, S, Sc
Macropodidae	Macropod sp.	unidentified macropod		P	1		
	Macropus giganteus	Eastern Grey Kangaroo		P	38		
	Macropus robustus	Common Wallaroo		P	4		
	Macropus rufogriseus	Red-necked Wallaby		P	41		
	Macropus sp.	kangaroo		P	32		
	Wallabia bicolor	Swamp Wallaby		P	36		
Molossidae	Mormopterus loriae	Little Northern Freetail-bat		P	2		
	Mormopterus norfolkensis	Eastern Freetail-bat		V	9		Prob
	Tadarida australis	White-striped Freetail-bat		P	24	E	Def

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the		
					Port Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Muridae	Hydromys chrysogaster	Water-rat		P	2		
	Mus musculus*	House Mouse		U	27		
	Pseudomys novaehollandiae	New Holland Mouse		P	37		
	Rattus fuscipes	Bush Rat		P	69		
	Rattus lutreolus	Swamp Rat		P	51		
	Rattus norvegicus*	Brown Rat		U	1		
	Rattus rattus*	Black Rat		U	87		
	Rattus sp.	rat		P	4		
Ornithorhynchidae	Ornithorhynchus anatinus	Platypus		P	6		
Otariidae	Arctocephalus forsteri	New Zealand Fur-seal		V	1		
	Arctocephalus sp.	Unidentified Fur-seal		P	2		
Peramelidae	Isoodon macrourus	Northern Brown Bandicoot		P	30		
	Isoodon/Perameles sp.	unidentified Bandicoot		P	1		
	Perameles nasuta	Long-nosed Bandicoot		P	19		
Petauridae	Petaurus australis	Yellow-bellied Glider		V	1		
	Petaurus breviceps	Sugar Glider		P	42		T

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	Database Records of Fauna within the Port				
			EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Phalangeridae	<i>Petaurus norfolcensis</i>	Squirrel Glider		V	76	T, R	T, C
	<i>Petaurus</i> sp.	glider		P	2		
	<i>Trichosurus</i> sp.	brushtail possum		P	9		H
	<i>Trichosurus vulpecula</i>	Common Brushtail Possum		P	124	R	S
	<i>Trichosurus vulpecula arnhemensis</i>	Northern Brushtail Possum		P	1		
Phascolarctidae	<i>Phascolarctos cinereus</i>	Koala		V	5489		S, C, O
Potoroidae	<i>Potorous tridactylus</i>	Long-nosed Potoroo	V	V	1		
Pseudocheiridae	<i>Petauroides volans</i>	Greater Glider		P	1		
	<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum		P	83	R	
Pteropodidae	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	30	R, C	S, C
	<i>Pteropus scapulatus</i>	Little Red Flying-fox		P	3		
	<i>Pteropus</i> sp.	Flying-fox		P	374		
Rhinolophidae	<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe-bat		P	3		
Suidae	<i>Sus scrofa</i> *	Pig		U	3		
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna		P	54		

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Vespertilionidae	Chalinolobus dwyeri	Large-eared Pied Bat	V	V	1		
	Chalinolobus gouldii	Gould's Wattled Bat		P	41	E	C, Def
	Chalinolobus morio	Chocolate Wattled Bat		P	16		Prob
	Falsistrellus tasmaniensis	Eastern False Pipistrelle		V	6		
	Kerivoula papuensis	Golden-tipped Bat		V	1		
	Miniopterus australis	Little Bentwing-bat		V	53		Prob
	Miniopterus schreibersii oceanensis	Eastern Bentwing-bat		V	19		
	Myotis adversus	Large-footed Myotis			V	7	
	Nyctophilus geoffroyi	Lesser Long-eared Bat			P	25	
	Nyctophilus gouldi	Gould's Long-eared Bat			P	15	
	Nyctophilus sp.	long-eared bat			P	2	Prob
	Scoteanax rueppellii	Greater Broad-nosed Bat			V	34	Poss
	Scotorepens orion	Eastern Broad-nosed Bat			P	20	Poss
	Vespadelus darlingtoni	Large Forest Bat			P	3	E
	Vespadelus pumilus	Eastern Forest Bat			P	3	Prob

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
	Vespadelus regulus	Southern Forest Bat		P	2		
	Vespadelus sp.	Unidentified Eptesicus		P	4		
	Vespadelus troughtoni	Eastern Cave Bat		V	0		Poss
	Vespadelus vulturnus	Little Forest Bat		P	136		Poss
Vombatidae	Vombatus ursinus	Common Wombat		P	54		
Reptilia							
Agamidae	Amphibolurus muricatus	Jacky Lizard		P	18		Ob
	Physignathus lesueurii	Eastern Water Dragon		P	7		
	Pogona barbata	Bearded Dragon		P	18		Ob
Boidae	Morelia spilota	Carpet & Diamond Pythons		P	5		Ob
	Morelia spilota spilota	Diamond Python		P	4		
Chelidae	Chelodina longicollis	Eastern Snake-necked Turtle		P	7		
Cheloniidae	Caretta caretta	Loggerhead Turtle	E	E1	3		
	Chelonia mydas	Green Turtle	V	V	38		
	Cheloniidae sp.	unidentified sea turtle		P	2		

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Colubridae	Dendrelaphis punctulatus	Common Tree Snake		P	3		Ob
Elapidae	Cryptophis nigrescens	Eastern Small-eyed Snake		P	1		
	Demansia psammophis	Yellow-faced Whip Snake		P	3		
	Furina diadema	Red-naped Snake		P	5		
	Hemiaspis signata	Black-bellied Swamp Snake		P	6		
	Notechis scutatus	Tiger Snake		P	1		
	Pelamis platurus	Yellow-bellied Seasnake		P	1		
	Pseudechis porphyriacus	Red-bellied Black Snake		P	23	R	O, Ob
	Pseudonaja textilis	Eastern Brown Snake		P	9		
	Vermicella annulata	Bandy-bandy		P	2		
Gekkonidae	Oedura robusta	Robust Velvet Gecko		P	2		
Pygopodidae	Lialis burtonis	Burton's Snake-lizard		P	3		
	Pygopus lepidopus	Common Scaly-foot		P	3		
Scincidae	Carlia tetradactyla	Southern Rainbow-skink		P	4		
	Cryptoblepharus virgatus	Cream-striped Shinning-skink		P	3		
	Ctenotus robustus	Robust Ctenotus		P	16		

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act	TCA Act	Database Records of Fauna within the Port Stephens LGA <sup>3</sup>		
			Legal Status <sup>1</sup>	Legal Status <sup>2</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>	
	<i>Ctenotus taeniolatus</i>	Copper-tailed Skink		P	6		Ob
	<i>Cyclodomorphus gerrardii</i>	Pink-tongued Lizard		P	2		
	<i>Cyclodomorphus michaeli</i>	Mainland She-oak Skink		P	1		
	<i>Egernia major</i>	Land Mullet		P	41		
	<i>Egernia mcphreei</i>	Eastern Crevice Skink		P	2		
	<i>Eulamprus heatwolei</i>	Yellow-bellied Water-skink		P	1		
	<i>Eulamprus quoyii</i>	Eastern Water-skink		P	13	R	Ob
	<i>Eulamprus tenuis</i>	Barred-sided Skink		P	1		
	<i>Lampropholis amicula</i>	Friendly Sunskink		P	4		
	<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink		P	55	R	Ob
	<i>Lampropholis guichenoti</i>	Pale-flecked Garden Sunskink		P	10		
	<i>Lampropholis sp.</i>	unidentified grass skink		P	1		
	<i>Lygisaurus foliorum</i>	Tree-base Litter-skink		P	1		
	<i>Saiphos equalis</i>	Three-toed Skink		P	1		
	<i>Saproscincus mustelinus</i>	Weasel Skink		P	1		
	<i>Tiliqua rugosa</i>	Shingle-back		P	1		

**Table B.1 FAUNA SPECIES**

Family	Scientific Name	Common Name	EPBC Act Legal Status <sup>1</sup>	TCA Act Legal Status <sup>2</sup>	Database Records of Fauna within the Port		
					Stephens LGA <sup>3</sup>	2003/2004 Surveys <sup>4</sup>	2007 Surveys <sup>4,5</sup>
Typhlopidae	Tiliqua scincoides	Eastern Blue-tongue		P	12		
	Ramphotyphlops nigrescens	Blackish Blind Snake		P	4		
	Ramphotyphlops proximus	Proximus Blind Snake		P	1		
	Ramphotyphlops sp.	blind snake		P	1		
Varanidae	Varanus varius	Lace Monitor		P	50		Ob, Sc

## Appendix 3 – Development Area Biobank Credit Report

# Biodiversity credit report



This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 22/04/2015

Time: 2:31:43PM

Calculator version: v4.0

## Major Project details

**Proposal ID:** 0150/2015/1726MP

**Proposal name:** The Bay Resort Development

**Proposal address:** 4177 Nelson Bay Road Anna Bay NSW 2316

**Proponent name:** Raphael Shin Enterprises Pty Ltd

**Proponent address:** Suite 2, Level 1 570 Blaxland Road Eastwood NSW

**Proponent phone:** 0417 272 989

**Assessor name:** Craig Anderson

**Assessor address:** Anderson St Newcastle NSW 2300

**Assessor phone:** 0418681581

**Assessor accreditation:** 0150

## Summary of ecosystem credits required

<b>Plant Community type</b>	<b>Area (ha)</b>	<b>Credits created</b>
Saltmarsh Estuarine Complex	4.59	360.88
Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast	1.02	55.69
<b>Total</b>	<b>5.61</b>	<b>417</b>

## Credit profiles

**1. Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast, (HU941)**

Number of ecosystem credits created

56

IBRA sub-region

Karuah Manning

Offset options - Plant Community types	Offset options - IBRA sub-regions
<p>Coastal floodplain sedgeland, rushland, and forbland of the North Coast, (HU532)</p> <p>Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion, (HU635)</p> <p>Parramatta red gum - Fern-leaved banksia - Melaleuca sieberi swamp woodland of the Tomaree Peninsula, (HU865)</p> <p>Cabbage Gum - Forest Red Gum - Flax-leaved Paperbark Floodplain Forest of the Central Coast, (HU934)</p> <p>Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast, (HU941)</p> <p>Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast, (HU942)</p>	<p>Karuah Manning and any IBRA subregion that adjoins the IBRA subregion in which the development occurs</p>

## 2. Saltmarsh Estuarine Complex, (HU960)

Number of ecosystem credits created

361

IBRA sub-region

Karuah Manning

<b>Offset options - Plant Community types</b>	<b>Offset options - IBRA sub-regions</b>
Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion, (HU606) Saltmarsh Estuarine Complex, (HU960)	Karuah Manning and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

## Summary of species credits required

<b>Common name</b>	<b>Scientific name</b>	<b>Extent of impact Ha or individuals</b>	<b>Number of species credits created</b>
Black Bittern	<i>Ixobrychus flavicollis</i>	5.61	73
Wallum Froglet	<i>Crinia tinnula</i>	1.02	13
Little Bentwing-bat	<i>Miniopterus australis</i>	1.02	13
Eastern Cave Bat	<i>Vespadelus troughtoni</i>	1.02	13

## Appendix 4– Biobank Site Biobank Credit Report

This report identifies the number and type of credits required at a BIOBANK SITE

Date of report: 22/04/2015

Time: 2:33:04PM

Calculator version: v4.0

## Biobank details

**Proposal ID:** 0150/2015/1731B  
**Proposal name:** The Bay Resort Biobank Site  
**Proposal address:** 4177 Nelson Bay Road Anna Bay NSW 2316  
  
**Proponent name:** Raphael Shin Enterprises Pty Ltd  
**Proponent address:** Suite 2, Level 1 570 Blaxland Road Eastwood NSW  
**Proponent phone:** 0417 272 989  
  
**Assessor name:** Craig Anderson  
**Assessor address:** Anderson St Newcastle NSW 2300  
**Assessor phone:** 0418681581  
**Assessor accreditation:** 0150

### Additional information required for approval:

- Use of local benchmark
- Expert report...
- Request for additional gain in site value

## Ecosystem credits summary

Plant Community type	Area (ha)	Credits created
Mangrove forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	0.54	7.00
Saltmarsh Estuarine Complex	5.63	87.00
Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	3.97	48.00
Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast	21.16	315.00
<b>Total</b>	<b>31.30</b>	<b>457</b>

## Credit profiles

### 1. Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion, (HU633)

Number of ecosystem credits created	48
IBRA sub-region	Karuah Manning

### 2. Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast, (HU941)

Number of ecosystem credits created	315
IBRA sub-region	Karuah Manning

### 3. Mangrove forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion, (HU563)

Number of ecosystem credits created	7
IBRA sub-region	Karuah Manning

### 4. Saltmarsh Estuarine Complex, (HU960)

Number of ecosystem credits created	87
IBRA sub-region	Karuah Manning

## Species credits summary

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Black Bittern	<i>Ixobrychus flavicollis</i>	31.30	222
Koala	<i>Phascolarctos cinereus</i>	6.35	45
Wallum Froglet	<i>Crinia tinnula</i>	12.32	87
Little Bentwing-bat	<i>Miniopterus australis</i>	31.30	222
Eastern Cave Bat	<i>Vespadelus troungtoni</i>	31.30	222
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	4.51	32

## Additional management actions

Additional management actions are required for:

Vegetation type or threatened species	Management action details
Black Bittern	Control exotic pest fish species (within dams)
Black Bittern	Control of feral pigs
Black Bittern	Fox control
Black Bittern	Maintain or re-introduce natural flow regimes
Eastern Cave Bat	Feral and/or over-abundant native herbivore control
Grey-headed Flying-fox	Slashing
Koala	Exclude miscellaneous feral species
Koala	Slashing
Little Bentwing-bat	Exclude miscellaneous feral species
Little Bentwing-bat	Feral and/or over-abundant native herbivore control
Little Bentwing-bat	Fox control
Little Bentwing-bat	Slashing
Mangrove forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Control exotic pest fish species (within dams)
Mangrove forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Control of feral pigs
Mangrove forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Exclude miscellaneous feral species
Mangrove forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Feral and/or over-abundant native herbivore control
Mangrove forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Fox control
Mangrove forest in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Maintain or re-introduce natural flow regimes

Saltmarsh Estuarine Complex	Control exotic pest fish species (within dams)
Saltmarsh Estuarine Complex	Control of feral pigs
Saltmarsh Estuarine Complex	Exclude miscellaneous feral species
Saltmarsh Estuarine Complex	Feral and/or over-abundant native herbivore control
Saltmarsh Estuarine Complex	Fox control
Saltmarsh Estuarine Complex	Maintain or re-introduce natural flow regimes
Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Exclude commercial apiaries
Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Exclude miscellaneous feral species
Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Feral and/or over-abundant native herbivore control
Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Fox control
Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Slashing
Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast	Exclude miscellaneous feral species
Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast	Feral and/or over-abundant native herbivore control
Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast	Fox control
Wallum Froglet	Control exotic pest fish species (within dams)
Wallum Froglet	Maintain or re-introduce natural flow regimes
Wallum Froglet	Slashing